# T 125: Beschleunigerphysik XII (Kurze Pulse)

Zeit: Donnerstag 14:00–16:15 Raum: WIL-C205

T 125.1 Do 14:00 WIL-C205

**Novel Drift compensation for a femtosecond laser system at a quasi-cw electron accelerator** — •Bertram Green, Michael Kuntzsch, Sergei Kovalev, and Michael Gensch — Helmholtz-Zentrum Dresden-Rossendorf

A method for electron beam/THz to femtosecond (fs) - laser synchronization drift correction at the quasi-cw linear electron accelerator ELBE is presented, which is utilizing THz radiation generated by a CDR/CTR screen and an undulator respectively. Measurements of these pulses will allow for compensation of slow drifts in the arrival time on millisecond timescales between the THz and the fs-laser pulses. The method requires two electro-optic detection setups which allow for the sampling of a single THz pulse, at two different working points. Given a consistent pulse shape these two data points can provide information on the sign of the arrival time drift relative to the laser. This information can be used both for providing feedback on fs laser arrival time in a potential THz time domain experiment as well as the electron bunch arrival time in the accelerator.

T 125.2 Do 14:15 WIL-C205

**Optical Synchronization and Electron Bunch Diagnostic at the quasi-cw accelerator ELBE** — •Michael Kuntzsch[1,2], Ulf Lehnert[1], Fabian Röser[1], Marie Kristin Czwalinna[3], Sebastian Schulz[3], Holger Schlarb[3], and Silke Vilcins[3] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Technische Universität Dresden, Dresden, Germany — [3]Deutsches Elektronen-Synchrotron, Hamburg, Germany

The continuous wave electron accelerator ELBE is upgraded to generate short and highly charged electron bunches (~200fs duration, up to 1 nC) with an energy of up to 40 MeV. In the last years a prototype of an optical synchronization system using a mode locked fiber laser has been build up which is now in commissioning phase. The stabilized pulse train can be used for new methods of electron bunch diagnostics like bunch arrival time measurement with the resolution down to a few femtoseconds. At ELBE a bunch arrival time monitor (BAM) has been designed and tested at the accelerator. The contribution will show the concept of the femtosecond synchronization system, the design of the BAM and first measurement results.

T 125.3 Do 14:30 WIL-C205

**Detection of ultrashort VUV radiation pulses using photoelectron spectroscopy at DELTA** — •Maryam Zeinalzadeh[1], Stefan Cramm[2], Sven Döring[3], Markus Höner[1], Holger Huck[1], Shaukat Khan[1], Robert Molo[1], Lukasz Plucinski[1], Andreas Schick[1], and Peter Ungelenk[1] — [1]Zentrum für Synchrotronstrahlung (DELTA), TU Dortmund — [2]Forschungszentrum Jülich — [3]Universität Duisburg-Essen

At the 1.5-GeV electron storage ring DELTA operated by the TU-Dortmund University, coherent VUV radiation is generated in a short-pulse facility based on the Coherent Harmonic Generation (CHG) scheme. In this scheme, a femtosecond laser pulse is used to induce a periodic modulation of the electron energy in an undulator. The energy modulation is converted to a density modulation in a dispersive section. The resulting electron microbunches radiate coherently at higher harmonics of the laser wavelength in a second undulator. The VUV beamline operated by the Forschungszentrum Jülich will be employed for pump-probe experiments. It comprises a plane-grating monochromator and a photoelectron spectrometer optimized for angle-resolved photoemission spectroscopy. While a dedicated setup was initially used during commissioning of the short-pulse facility, the CHG-generated pulses can now be characterized directly in the VUV beamline.

T 125.4 Do 14:45 WIL-C205

**Sub-Femtosecond X-Ray Pulse from Electron Bunches with Very Low Charge at LCLS** — •Violetta Wacker[1], Juliane Rönsch-Schulenburg[1], Yuantao Ding[2], Zhirong Huang[2], and Feng Zhou[2] — [1]University Of Hamburg, Hamburg, Germany — [2]SLAC, CA 94025, USA

The Linac Coherent Light Source (LCLS) is an x-ray free-electron laser (FEL) at SLAC National Accelerator Laboratory, supporting a wide range of scientific research with an x-ray pulse length varying from a few to several hundred femtoseconds. There is also a large interest in even shorter x-ray pulses consisting of a single spike only, which will allow the investigation of matter at the atomic length (Å) and time scale (fs). For the hard x-ray operation at 13.6 GeV of LCLS, we investigate the FEL performance using 1 pC and 3 pC electron bunches, based on start-to-end simulations. With an optimization of the machine set up, simulations show that single spike, sub-fs, hard x-ray pulses are achievable at such a low charge. Additionally single spike pulse studies for the soft x-ray operation at 4.3 GeV of LCLS using a 5 pC electron bunch are in progress.

T 125.5 Do 15:00 WIL-C205

**Status and latest improvements of the short-pulse facility at the DELTA storage ring*** — •Andreas Schick, Markus Höner, Holger Huck, Shaukat Khan, Robert Molo, Peter Ungelenk, and Maryam Zeinalzadeh — Center for Synchrotron Radiation (DELTA), TU Dortmund University, 44227 Dortmund, Germany

The new short-pulse facility at the synchrotron light source DELTA utilizes the interaction of the electrons with an ultrashort laser pulse in an undulator (Coherent Harmonic Generation principle). Subsequent microbunching leads to coherent radiation of sub-ps pulses in the VUV regime, which will be used for time-resolved photoelectron-spectroscopy experiments. In addition, coherent, ultrashort THz pulses are generated. Improvements regarding the stability, availability and reliability are presented. Furthermore, the progress towards the emission of shorter wavelengths and towards pump-probe experiments at an existing user beamline are shown.

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T 125.6 Do 15:15 WIL-C205

**FLASH II - a Multi Beamline FEL facility.** — •Sven Ackermann — DESY, Hamburg — Universität Hamburg

The Free-Electron Laser (FLASH) in Hamburg generates coherent XUV radiation used in various research projects. In order to provide more beam time for the growing community of photon users, DESY in collaboration with HZB started the FLASH II project in 2010. FLASH II is an extension of the existing FLASH facility consisting of a new undulator section in a separate tunnel and a new experimental hall. The two Free-Electron Lasers share the same super conducting linac. Due to the fixed gap undulators used in the present FLASH setup the radiation wavelength can be changed only by changing the electron energy. FLASH II, in contrast, will benefit from variable gap undulators which will allow to have largely independent radiation wavelength. For the generation of different electron bunch trains two different injector lasers will use the same photocathode RF gun. The linac will then accelerate the different bunch trains. This means that for the independent operation the gradients and phases of the superconducting acceleration modules have to be changed within the RF pulse. A first demonstration has been performed in 2012. In addition to the SASE operating mode, a HHG direct seeding option between 10 nm and 40 nm with a final repitition rate up to 100 kHz is foreseen. Other seeding schemes like HGHG, EEHG and Hybrid schemes are currently under investigation.

T 125.7 Do 15:30 WIL-C205

**Dynamics of ion heating and ionization in high power ultra-short laser pulses interacting with solid density plasmas** — •Lingen Huang[1,2], Thomas Kluge[1], Christian Gutt[3], Michael Bussmann[1], and Thomas E. Cowan[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf , Dresden 01328 , Germany — [2]Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai 201800, China — [3]Deutsches Elektronen-Synchrotron, Hamburg 22603, Germany

Plasma heating and ionization are important processes during the interaction of high power ultra-short laser pulses with solid density targets. In order to understand the relevant physics, particle-in-cell simulations including collisions and ionization were run to study ion heating dynamics in buried layer targets illuminated by high-intensity, ultra-short laser pulses. Our results show that bulk ions can be heated to above 1keV temperature. When studying the ionization dynamics strong filaments have been observed which depend on preplasma on the target front side, laser pulse duration and intensity. In order to study the evolution of ionization and ion bulk heating in experiment, ultrabright X-ray free electron lasers - such as the European XFEL - are a very promising and strong tool to resolve the spatial and temporal scales of these processes inside the solid target.

T 125.8 Do 15:45 WIL-C205

**Does electron dynamics in Travelling-wave Thomson-scattering allow for an optical FEL?** — •Klaus Steiniger, Alexander Debus, Michael Bussmann, and Roland Sauerbrey — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

In the Travelling-wave Thomson-scattering (TWTS) scheme ultrashort and narrow-band light pulses in the X-Ray region of the spectrum are created by scattering high intensity laser pulses from relativistic electron bunches. TWTS uses lasers with a pulse front tilt in a side-scattering geometry to scale the interaction length into the centimeter to meter range. This is crucial for allowing the scattered radiation to act back on the electrons which eventually can lead to coherent amplification of the radiation as in a free electron laser (FEL). We study the electron dynamics in the laser field including back reaction effects and discuss the applicability of TWTS as a SASE-FEL.

T 125.9 Do 16:00 WIL-C205

**Status of the short bunch operation project at FLASH** — Eugen Hass[1], Alexander Kuhl[1], •Marie Rehders[1,2], Juliane Rönsch-Schulenburg[1,2], Jörg Rossbach[1], Holger Schlarb[3], and Siegfried Schreiber[3] — [1]University of Hamburg — [2]CFEL, Hamburg — [3]DESY, Hamburg

The FEL FLASH (Free-Electron Laser in Hamburg) operates between 4.12 and 45nm. Typically photon pulses between 50 and 200fs are generated. Many users at FLASH work on pump-probe experiments, where time resolution is determined by the pulse duration. Therefore they have expressed a keen interest in being provided with shorter XUV pulses. The shortest possible SASE pulse is a single longitudinal optical mode of the FEL radiation. The most direct way to realize this at FLASH would be to reduce the electron bunch length to only a few $\mu$m at the entrance of the undulator section. In the ideal case a bunch charge of only 20pC is suited for the generation of such short bunches. Thus a shorter initial bunch length at the photo-cathode can be chosen, which in turn reduces the bunch compression required to reach single mode conditions. A new photo-injector laser with adjustable pulse duration is used to optimize the initial electron bunch length. Beam dynamic studies are being performed to optimize the injection and compression of small charge electron bunches, starting with the pulse parameters of the injector laser. Improvements of important diagnostics are under way to adapt for charges and bunch lengths that are very small compared to standard FLASH operation. An overview and current status of the project is given in this contribution.