PhotonDiag2015 - Workshop on FEL Photon Diagnostics, Instrumentation, and Beamlines Design - ICTP, Leonardo Building, Budinich Lecture Hall - 8 - 10 June 2015

Abstracts book

ORAL CONTRIBUTIONS

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Abstract ID : 0

Photon Diagnostics at SwissFEL: an Overview

Content :

The upcoming SwissFEL facility will feature a photon diagnostic suite to fulfill the needs of both the machine operators and the experimenters. This contribution presents the devices and methods that will be used as on-line diagnostics at SwissFEL, measuring the intensity, position, spectrum, pulse length, and arrival (relative to a pump laser) of the FEL beam. The presentation also discusses the plans for the commissioning and use of the devices, along with choices, methods, and techniques used to ensure their reliability and endurance over longer periods of time. New devices developed at PSI for some of these types of measurements, like the Photon Arrival and Length Monitor (PALM) and the Photon Single-Shot Spectrometer (PSSS) will be discussed in detail, with recent results from their tests presented.

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Abstract ID : 1

Coherence properties of free-electron lasers

Content :

The coherence of free-electron laser beams plays a major role for many applications of these facilities. For instance, diffractive imaging techniques require a high degree of spatial coherence in order to reconstruct the investigated object successfully. Thus, detailed knowledge of this fundamental beam property is of great importance, possibly leading to a better understanding of the control parameters that influence the coherence of FELs.

Experimentally, some basic coherence information can be gained by Young's well-known interference experiment. However, in order to entirely describe the spatial coherence distribution in the beam it is convenient to employ the formalism of the Wigner distribution function, also denoted as "generalized radiance". In a tomographic reconstruction, it can be computed from a number of beam profiles measured at different positions along the propagation direction. Subsequently, a Fourier transform yields the mutual coherence function which completely describes the spatial coherence.

Here, we present results from our measurements at the free-electron laser FLASH at DESY. From the reconstructed four-dimensional Wigner distribution function we derive the coherence lengths and the global degree of coherence. Additionally, we provide an estimation of the fluctuations of those properties.

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Abstract ID : 2

Design of the X-ray Optics for SwissFEL

Content :

We present the design of the x-ray optics for SwissFEL, the new hard X-ray free electron laser currently under construction at the Paul Scherrer Institut in Villigen, Switzerland. During the initial phase till 2017 the ARAMIS undulator with two beamlines and experimental stations will be built. The total length of the beam transport system is approximately 130 m and covers the photon energy range from about 2 to 12 keV. The beamlines are horizontally separated. Switching is done by a retractable system of two flat mirrors in sequence. The optics offers various operation modes: with- and without double crystal monochromator, higher order rejection mirrors, focusing with compound refractive lenses or KB mirrors. Design considerations, the chosen solutions and status of the main optics components will be discussed in detail.

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Abstract ID : 4

The impact of pulse duration on multiphoton ionization in the soft X-ray regime

Content :

At the soft X-ray free electron laser FLASH, multiphoton ionization of free atoms has been studied by ion time-of-flight spectroscopy. Depending on the multiphoton mechanism, the ionization processes were influenced in different ways by the FEL pulse duration. In particular, the time-dependent multiphoton ionization of xenon atoms was studied with femtosecond pulses in the excitation range of the 4d giant resonance at the photon energy of 93 eV [1]. The different multiphoton mechanisms behind could be disentangled up to a charge state of 10+benefiting from a special operation mode of FLASH with varying pulse durations. The results up to 8+ are well explained by sequences of single photon, multiphoton, and Auger processes, but higher charge state generation suggests the need for collective electron multiphoton excitations.

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Abstract ID : 9

Commissioning of mirrors metrology at European XFEL

Content :

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The European XFEL is a Free Electron Laser facility currently under construction in the Hamburg area that will deliver SASE pulses with the peak power of up to 20 GW. The facility will generate extremely short and intense X-ray laser pulses of high coherence and nearly diffraction limited
divergence. Guiding these X-rays beams over a distance of more than 1 km to the experiments requires an extreme precision in pointing stability of beamline components like mirrors and gratings.
Due to the very short wavelength and very high pulse energy, the mirrors need to have high quality surface and 1 m length. To match this challenging specification and check our mirrors we need to perform high precision optical measurements.

In order to measure our mirrors and characterize the corresponding mechanical mounts, we equipped a metrology lab with a 12 inches Fizeau interferometer. It is then possible to inspect an area of 300 mm directly or the entire mirror with a grazing incidence setup.
We commissioned the instrument and evaluated its performance. We will show the installation and characteristics of the instrument and some preliminary results, as well as a major update of the next steps to be foreseen for the x-ray mirrors measurements.
Our final goal will be the characterization of 1 meter long mirrors inside its mechanics with nanometer accuracy.

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Abstract ID : 10

FEL-based transient grating experiments at FERMI

Content :

The aim of the EIS-TIMER beamline at FERMI is to extend four wave mixing (FWM) applications, in particular those based on the transient grating (TG) approach [1], into the extreme ultraviolet (EUV) and soft x-ray (SXR) regime. EUV/SXR FWM experiments can provide major breakthroughs into different fields of research [2]. In particular the combination of the TG approach with multi-color and tunable FEL sources (as FERMI) could open the way for more complex EUV/SXR FWM experiments, potentially able to provide information, e.g., on charge transfers from a selected atom to another.
A special setup (mini-TIMER, hosted by the DiProI beamline) has been recently used to demonstrate FWM experiments stimulated by EUV TG [3], while a dedicated beamline (EIS-TIMER) is presently under construction at FERMI. In this contribution we will present the results obtained with mini-TIMER and we will discuss on the further steps that could be achieved in a near future at EIS-TIMER, also through the exploitation of the multi-color seeded FEL emission of FERMI.

[1] F. Bencivenga and C. Masciovecchio, MINA 606, 785 (2009)
[2] F. Bencivenga et al., New J. Phys. 15, 123023 (2013)
[3] F. Bencivenga et al., Nature (accepted)

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The high-resolution single-shot spectrometer used at the SwissFEL

Content :

Once the FEL undulator segments could be matched, the actual lasing-process starts and the generated radiation needs to be inspected. The resulting spectrum will most probably vary from shot to shot. In order to cover these variations, X-ray optical elements and an apparatus are required that are capable to deliver/result a spectrum which contains the information with a sufficient energy resolution. At the same time the entire spectrometric system needs to work at very high temporal resolution, meaning that it should result the spectral information from each single shot. The task is, to obtain this information right during performing experiments as an online-device. It should be able to deliver most of the XFEL-generated radiation towards the experiment while getting its spectral information, simultaneously. We will present the apparatus developed at Paul-Scherrer-Institute, consisting of a transmission grating and a bent crystal analyzer, which will be able to measure the spectrum from shot to shot.

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Abstract ID : 12

The VUV Raman Spectroment at FLASH

Content :

The aim of this talk is to introduce you to the unique high-resolution VUV Raman Spectrometer which is installed as a permanent end-station at the PG1 branch of the plane grating monochromator beamline at the free-electron laser FLASH in Hamburg.
This double-stage spectrometer has been designed and developed at University Hamburg in collaboration with DESY for inelastic (Raman) scattering experiments in the VUV wavelength range from 20 to 200 eV.
Taking advantage of the ultra-high brilliance of FLASH as well as the microfocusing Kirkpatrick-Baez (KB) optics of the PG1 beamline, the spectrometer will provide unprecedented spectral, spatial and temporal resolution with efficient elastic light suppression. This will allow to study, for example, low energy excitations in strongly correlated materials.
Within the talk the main properties and the current status of the instrument, its near and far perspectives as well as the scientific potential will be shown.

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Abstract ID : 13

Gratings for Synchrotron and FEL-beamlines – a project for manufacture of ultra-precise gratings at Helmholtz Zentrum Berlin

Content :
Optical elements like laminar and blazed diffraction gratings have become key components in today's synchrotron and FEL optics to serve experiments with photons in the IR, UV and VUV range up to soft X-rays. The requirements for such diffraction gratings are challenging. These optical components feature nanometre accuracy on a macroscopic length scale. In addition to the challenges posed by perfect substrate quality in terms of slope error and micro-roughness, it requires special attention to guaranty a precise positioning of the grooves along the full aperture length. A positioning accuracy of about 20 nm for the carriage system of a ruling engine is mandatory to meet the required tolerance for the groove spacing along full aperture of a grating.
Blazed gratings are of dedicated interest if a high flux of photons is required like for RIXS-experiments or if use of laminar gratings is excluded due to too high flux at e.g. at FEL beamlines. Their availability became a bottleneck since the decommissioning of the grating manufacture at Carl Zeiss in Oberkochen. To overcome this situation a new technological laboratory was established at the Helmholtz Zentrum Berlin (HZB), including instrumentation from Carl Zeiss. Besides the upgraded ZEISS equipment, an advanced grating production line has been developed, including a new ultra-precise ruling machine, ion etching technology as well as laser holography. While the old ZEISS-ruling machine GTM-6 allows for a grating length up to 170 mm, the new GTM-24 is designed to a capability for 600 mm long gratings with line densities between 50 l/mm and 5000 l/mm. A new ion etching machine with a scanning HF-source allows for etching the holographic or mechanically ruled grating into the substrate as well as to provide very shallow blaze-angles of >0.1° for large aperture dimension up to 500 mm in length. This paper reports on the status of the grating fabrication, the measured quality of fabricated items, and further development goals.

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Abstract ID : 16

The Online Photoionization Spectrometer OPIS at FLASH

Content :

For SASE FEL light sources, photon wavelength determination is essential for machine tuning and radiation property monitoring during user operation. As an alternative to grating spectrometers a device based on photoionization of noble gas targets has been tested at FLASH in that respect recently. Photo-electrons and photo-ions are detected with time-of-flight spectrometers and the wavelength is determined my means of well-known binding energies and cross-section data of the target species. Due to the absence of any optical elements and a low target as pressure the device is completely non-invasive regarding the beam path and basically transparent for user experiments. Ion and electron time-of-flight spectrometers in combination with fast digitizers technically allow for single bunch resolved online wavelength monitoring. Results of the latest studies and cross-calibration measurements will be presented.

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Submitted by : Dr. BRAUNE, Markus

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Abstract ID : 17

A novel approach in the free-electron laser (FEL) diagnosis based on Pixeled Phosphor Detector (PPD)

Content :

The diagnosis of the free-electron laser (FEL) focused beam quality is still an open issue for the improvement of pulsed high-power vacuum ultraviolet (VUV) and soft X-ray (SXR) sources. Various techniques have been adopted such as: direct imaging at focus, employing YAG or phosphors screens [1] and ablative imprint over PMMA or silicon [2], or wavefront reconstruction by means of a wavefront sensor in the far field [3]. All these techniques present some limitations, in fact screens occour into saturation, indentation is an ex-situ technique and its analysis is time consuming while the wavefront sensor works in a limited wavelength range and is generally expensive. Here we present a new method of beam diagnosis with improved performance developed at FERMI in collaboration with IOM-CNR in Trieste, Italy. In detail, the novel Pixeleted Phosphor Detector (PPD) consists of micrometric pixels produced by simple lithographic techniques, proximity UV-lithography and dry etching, fabricated on a silicon substrate, arranged in a hexagonal geometry and filled with phosphors. Silicon allows to reduce the cross-talking between the pixels so to increase the overall resolution of the system [4]. With this solution, the focused beam size is traced through the simple detection of the illuminated phosphors pixels in each cavity given by the pixel size (4 μm diameter) and the pitch between the pixels (6 μm). This results in a highly precision detector able to measure the actual spot size shot-to-shot with unprecedent resolution. Various types of PPD have been tested at FERMI demostrating that this detector could become the reference technique in the FEL diagnosis field. One of the possible variations consist of a coating of indium tin oxide (ITO) in order to avoid the damage of the PPD. High reliability and low cost are further advantages of the proposed detector.

[1] K Tiedtke et al. New J. Phys. 11 (2009) 023029.
[2] J. Chalupský et al. Optics Express, Vol. 15, Issue 10, pp. 6036-6043 (2007).
[3] Hidekazu Mimura et al. Nature Physics 6, 122 - 125 (2010).
[4] B. K. Cha et al. J Korean Phys Soc. Vol. 59, No. 6, pp. 3670_3673 (2011).

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Abstract ID : 19

At-wavelength wavefront metrology at XFELs using grating interferometry

Content :

We will present a transportable X-ray grating interferometer setup dedicated to quantitative in-situ, at-wavelength metrology measurements of X-ray optics at the Optics beamline [1] of the Swiss Light Source and perspectively at the SwissFEL, the Swiss X-ray free electron laser (XFEL) under construction at the Paul Scherrer Institut. It was demonstrated in the past that X-ray grating interferometry is a valuable tool for at-wavelength measurements of X-ray optical elements under operational conditions at synchrotrons [2,3] and also at XFELs [4,5]. Moreover, at XFELs the photon source position and its jitter in the undulator section can be monitored on a shot-to-shot basis by means of X-ray grating interferometry [4]. The principle of this technique is based on the measurement of an interference pattern downstream of a diffraction grating inserted in the X-ray beam. From the fringe pattern distortions in the wavefront can be reconstructed through Fourier analysis with an accuracy of the order of 10 nrad, allowing to investigate distortions induced by optical elements for example. The single-shot capabilites of the device enable it also to be operated as a diagnostic tool to monitor the wavefront properties and photon source position over time by using only an outcoupled fraction of the photon pulse without interfering with experiments conducted further downstream.

References

[1] U. Flechsig et al., Nucl. Instrum. Meth. A 609, 281-285 (2009).
[2] T. Weitkamp et al., Appl. Phys. Lett. 86, 054101 (2005).
[3] S. Rutishauser et al., J. Synchrotron Radiat. 20, 300-305 (2013).
[4] S. Rutishauser et al., Nature Communications 3, 947 (2012).
[5] Y. Kayser et al., Opt. Express. 22, 9004-9015 (2014).

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Abstract ID : 20

Real Time Analysis of FEL Radiation Spectra for the Estimation of Photon Puse Duration

Content :

Due to its importance for many experiments, the measurement of the photon pulse duration is an important task at free electron lasers. However, this is challenging [1]: Most methods require extensive experimental setup, data acquisition and evaluation time. In contrast to those, one of the indirect methods for average pulse length determination exploits the analysis of the statistical properties of SASE FEL spectra. At FLASH such spectra are routinely obtained employing the high-resolution monochromatorbeamline PG2 in spectrometer mode [2].
Basing on these data, a real-time diagnostics tool has been developed which allows the calculation of the average pulse durations from a set of measured spectra with only seconds of delay and without the need for any additional setup. The tool makes use of second order spectral correlation analysis and has been implemented into the Data Acquisition system of FLASH. Here the analysis method will be presented and the correlation of first results with other machine parameters (e.g. electron bunch charge) as well as a comparison to complementary measurement methods of photon pulse duration at FLASH will be shown.

[1] Düsterer et al, Phys.Rev. STAccel. Beams 17, 120702 (2014)
[2] Martins et al, Rev. Sci. Instrum.77, 115108 (2006)

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Abstract ID : 22

Detector Developments at DESY

Content :

With the increased brilliance of state-of-the-art Synchrotron radiation sources and the advent of Free Electron Lasers enabling revolutionary science with EUV to X-ray photons comes an urgent need for suitable photon imaging detectors. Requirements include high frame rates, very large dynamic range, single-photon sensitivity with low probability of false positives, and (multi)-megapixels.
At DESY, one ongoing development project - in a collaboration with RAL/STFC, Elettra, Diamond, and Pohang Accelerator Laboratory - is the CMOS-based soft X-ray imager Percival. PERCIVAL is a monolithic active pixel sensor (MAPS) that will be back-thinned to access its primary energy range of 250 eV to 1 keV with target efficiencies above 90%. According to its preliminary specifications, the roughly 10 x 10cm2, 3.5k x 3.7k monolithic sensor will operate at frame rates up to 120 Hz (commensurate with most FELs) and use multiple gains within its 27 micron pixels to measure 1 to ~ 100,000 (500 eV) simultaneously-arriving photons.
DESY is also leading the development of AGIPD, a high speed detector based on hybrid pixel technology intended for use at the European XFEL. It allows single pulse imaging at 4.5 MHz frame rate into a 352-frame buffer, with a dynamic range allowing single photon detection and detection of more than 10,000 12.4 keV photons in the same image.
The talk will focus on the AGIPD and Percival concepts and systems, and include an overview of recent results and status.

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please add "for the DESY Photon Science Detector Group and collaborators".

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Track judgments :

Abstract ID : 25

Forthcoming beamlines at the FERMI Free Electron Laser: MagneDyn and TeraFermi

Content :

In order to provide new powerful tools the FERMI Free Electron Laser beamlines devoted to user experiments will be increased up to six. In this contribution we will show the optical scheme of the future TeraFERMI and MagneDyn beamlines discussing in detail their components and scientific case.
MagneDyn will employ the transform limit, bright and tuneable FERMI radiation in order to study the electronic states and the local magnetic properties of excited and transient states of complex systems. A dedicated on-line photon energy spectrometer will allow to measure accurately the spectral content while the active KB mirrors will give full control of the focusing performance allowing to move the focal spot from the cryomagnet to the Resonant Inelastic X-ray Scattering (RIXS) endstation.
On the other hand TeraFERMI will take advantage of the THz radiation emitted by the interaction between the electrons and a target exploiting the Coherent Transition Radiation (CTR) process. This short, high power pulses will be used for pump and probe experiments in order to modulate structural properties of the matter inducing phase transitions or to control and manipulate the magnetic states of matter covering a wide range of fields from solid-state physics to biochemistry.

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Abstract ID : 26

The P04 Online Diagnostic Unit in Action at FEL Facilities

Content :

The Online Diagnostic Unit which has been developed for the Variable Polarization XUV Beamline P04 at PETRA III relies on gas phase angle resolved electron time-of-flight spectrometry which enables its use in particular also for free-electron laser facilities. A set of 16 electron time-of-flight spectrometers allows characterizing the polarization, the relative intensity, the beam position as well as the photon spectrum of the free-electron laser radiation simultaneously. For most of these parameters the characterization can be done on a shot-by-shot basis up to MHz frequencies.
I will report on various diagnostics campaigns at different free-electron lasers and highlight the specific benefits of the device for real-time beamline commissioning and characterization as well as the boundary conditions of the applied measurement method.
The successful development and operation of the device was only made possible by a large collaboration of many colleagues from the free-electron laser facilities at DESY, Sincrotrone Trieste, SLAC as well as the European XFEL. We gratefully acknowledge their support.

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Presenter : Dr. VIEFHAUS, Jens (DESY, FS-PE)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. VIEFHAUS, Jens

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Comments :

Oral contribution.

Status : SUBMITTED

Track judgments :

Abstract ID : 28

High precision multilayer mirror for nanofocusing of X-ray free electron laser

Content :

X-ray free-electron laser (XFEL) sources have a peak brilliance 109 greater than that of the most powerful third-generation synchrotron radiation sources and can emit high-intensity femtosecond pules with full spatial coherence To enhance the characteristics, focusing XFEL is a critical and urgent requirement. We have already established 1um and sub-50nm focusing of XFEL at SPring-8 angstrom compact free-electron laser (SACLA). Now, we are trying to achieve smaller spot size less than 10nm. At the workshop, multilayer mirror optics for single nanometer focusing of XFEL will be discussed in terms of optical design, radiation damage, mirror fabrication, and a wavefront diagnosis with the latest status the project.

Primary authors : Prof. YAMAUCHI, Kazuto (Osaka University)

Co-authors :

Presenter : Prof. YAMAUCHI, Kazuto (Osaka University)

Track classification :

Contribution type : --not specified--

Submitted by : Prof. YAMAUCHI, Kazuto

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Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 29

X-ray optics and diagnostics at SACLA

Content :

We have designed, constructed, and operated a number of X-ray optics and diagnostics for advanced utilization of XFEL light at SACLA [1]. I will present recent status of our optical systems based on our experiences on 3-year operation for users.
Integration of X-ray diagnostics to accelerator operation is very important for achieving robust and reliable user operation of XFEL light sources [2].
Furthermore, X-ray optics and diagnostics play key role in advanced scientific applications of XFEL. In particular, creation and evaluation of an intense X-ray spot [3] are critically required for conducting experiments in quantum/nonlinear x-ray optics. We have achieved quantitative characterization of an X-ray intensity through measuring the beam size, the absolute intensity [4], and the pulse duration [5] for this purpose.
To improve a time resolution in pump-probe experiments with synchronized optical lasers, we have developed a timing tool that combines a one-dimensional X-ray focusing optics with a spatial decoding technique. We efficiently measured the arrival timing with a pulse energy less than 10 μJ for a wavelength shorter than 1 Å [6]. Although the original test was performed in a destructive way, we have constructed a system that enables a parasitic operation of the timing diagnostics being compatible with a user experiment [7].
Characterization of coherence properties is a key issue for fully exploitation of a unique property of XFEL light. I will present our new technique for achieving shot-to-shot diagnostics of transverse coherence even for a nanometer-sized beam based on a “diffraction-before-destruction” scheme [8].

[1] T. Ishikawa et al. Nature Photon. 6, 540 (2012).
[2] K. Tono et al., New. J. Phys. 12, 083035 (2013).
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[4] M. Kato et al., App. Phys. Lett., 101, 023503 (2012).
[5] Y. Inubushi et al. Phys. Rev. Lett. 109, 144801 (2012).
[6] T. Sato et al., Appl. Phys. Exp. 8, 012702 (2015).
[7] T. Katayama et al., in preparation
[8]. I. Inoue et al., submitted.

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Track classification :

Contribution type : --not specified--

Submitted by : Dr. YABASHI, Makina

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Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 31

Damage processes of optics under irradiations with the intense XUV and x-ray FEL pulses – characteristic time scales and intensity regimes

Content :

Properties of the intense FEL beam create, apart new scientific and technological opportunities, extreme demands to optics. The radiation load imposed on optical elements served for beam diagnostics, controlling and shaping can lead to their damage. It has been shown that optical coatings are destroyed by single FEL pulses if the beam's intensity/fluence exceeds a critical level – single shot damage threshold. At such a fluence the temperature of the material reaches phase transition point. Secondly, for a high repetition sources, like in the lithographic applications, the heat load on optics may reach kW level. This will lead to the optics heating and its destruction, e.g. due to the enhanced atomic diffusivity in multilayer reflecting coating. Furthermore repeatable irradiations of optics may cause multi shot damage, e.g. related to thermal stresses. Moreover a rapid deposition of EUV pulse energy at the optics surface causes its hydrodynamical deformations what results in wavefront distortions for the proceeding pulses. Last but not least, combination of high photons' flux with high photons energy, may cause surface contamination with hydro-carbonates, similarly to the one observed at synchrotron radiation sources.

Primary authors : Dr. SOBIERAJSKI, Ryszard (Institute of Physics Polish Academy of Sciences)

Co-authors :

Presenter : Dr. SOBIERAJSKI, Ryszard (Institute of Physics Polish Academy of Sciences)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. SOBIERAJSKI, Ryszard

Submitted on Tuesday 31 March 2015

Last modified on : Tuesday 31 March 2015

Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 32

Measurement of the Modulation Transfer Function from speckle field

Content :

We present here a speckle method for measuring the Modulation Transfer Function of an optical system. The method is both conceptually and practically simple. It consists of feeding the test system with a random intensity distribution (speckles), which is generated via scattering from a random medium illuminated with narrow-band radiation. The MTF is then obtained by means of statistical analysis in the Fourier domain. Thanks to the huge statistical wealth of speckle field, it is possible to push the measure of the MTF up to an unprecedented limit, in two-dimension and without the introduction of a-priory models. The method is general, and requires just fairly spatially coherent radiation. By proper choice of the scattering medium, it can be virtually applied to any wavelength and to a wide variety of optical elements, such as visible optics lenses, direct-conversion detectors (e.g. CCDs), and indirect-conversion detectors (e.g. scintillators [1,2,3]). Here, we will presents the measurement of the MTF of a high-resolution scintillator used for X-ray tomography, characterized by synchrotron radiation source (ESRF, Grenoble) at the wavelength λ=0.1nm .

1 Ceribino et Al, Nat. Phys. 2008
2 M.D. Alaimo et al, Phys Rev. Lett. 103 (2009).
3 M. Manfredda et Al., in preparation

Primary authors : Dr. MANFREDDA, Michele (Elettra - Sincrotrone Trieste s.c.p.a) ; Dr. POTENZA, Marco Alberto Carlo (Università degli studi di Milano) ; Dr. ALAIMO, Matteo David (Politecnico di Milano) ; Dr. GIGLIO, Marzio (Università degli Studi di Milano)

Co-authors :

Presenter : Dr. MANFREDDA, Michele (Elettra - Sincrotrone Trieste s.c.p.a)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. MANFREDDA, Michele

Submitted on Tuesday 31 March 2015

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Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 33

Preparation and characterization of boron carbide coatings for advanced research light sources

Content :

X-ray optical elements are required for beam transport at the current and upcoming free-electron lasers and synchrotron sources. An x-ray mirror is a combination of a substrate and a coating. The demand for large mirrors with single layers consisting of light or heavy elements has increased during the last decades, since surface finishing technology is able to process longer mirror lengths up to 1 m on the sub-nanometer level according to microroughness. Thin-film fabrication is able to deposit some tens of nanometers of a suitable single layer material. After deposition, the mirror should provide excellent x-ray optical properties with respect to thickness error, roughness value and slope error, then, the mirror will transport the x-ray beam with high reflectivity, high beam flux and perfect wavefront to the experimental station. At the European XFEL, the technical specifications of the future mirrors are extraordinary, since the shape error should be below 2 nm over the whole length of 1 meter.

Amorphous layers of boron carbide (B4C) with a thickness in the range of 30 nm to 60 nm were manufactured using the HZG sputtering facility, which is able to cover areas up to 1500 mm by 120 mm in one step using rectangular B4C sputtering targets. These coatings were investigated by means of x-ray reflectometry (XRR), stylus profilometry and interference microscopy. The achieved results will be discussed according to thickness uniformity, density, roughness, thermal stability and elemental composition of the B4C layers.

Primary authors : Dr. STöRMER, Michael (Helmholtz-Zentrum Geesthacht)

Co-authors : Dr. SIEWERT, Frank (Helmholtz-Zentrum Berlin) ; Dr. SINN, Harald (European XFEL GmbH)

Presenter : Dr. STöRMER, Michael (Helmholtz-Zentrum Geesthacht)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. STöRMER, Michael

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Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 34

Influence of partial temporal coherence on autocorrelation measurements with plasma-based ASE XUV lasers

Content :

Over the last few years we have carried out a comprehensive set of measurements of the temporal coherence of plasma-based XUV lasers, pumped with different (laser or electrical-discharge) techniques. The main motivation was to investigate the related spectral properties of these sources, since they play an essential role in controlling the temporal behaviour of the pulse, especially in the seeded mode.
We use a wavefront-division interferometer with variable path-difference specifically designed for that purpose. The coherence time is determined by measuring the visibility of each interferogram as a function of the delay, which yields the autocorrelation function of the XUV laser electric field. This technique has been used at FLASH by other groups to measure the temporal coherence of the XUV free-electron laser pulse, with wavefront-division interferometers having a different design.
Depending on the pumping technique used, the XUV lasers that we have characterized differ by their pulse duration, spanning over 3 orders of magnitude from τ ~ 1 ns to ~ 1 ps. The measured coherence times, on the other hand, all lie within a smaller range (~0.6-5 ps). Thus our measurements were made with pulses that have markedly different degrees of temporal coherence, represented by the ratio τ/τc.
Distinct features in the autocorrelation signals were actually observed in each case, as will be summarized in this talk. Our results are remarkably well described by the model of partial coherence recently developed by Pfeifer et al. (Opt. Lett. 35, 3441–3443 (2010)) in the context of SASE free-electron lasers, thus illustrating similarities with ASE pulses from plasmas.

Primary authors : Dr. KLISNICK, Annie (CNRS-ISMO)

Co-authors : Ms. LE MAREC, Andréa (CNRS-ISMO) ; Dr. GUILBAUD, Olivier (LPGP-Université Paris-Sud) ; Dr. LARROCHE, Olivier (CEA-B3) ; Dr. CHAVEL, Pierre (LCF-IOGS)

Presenter : Dr. KLISNICK, Annie (CNRS-ISMO)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. KLISNICK, Annie

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Last modified on : Tuesday 31 March 2015

Comments :

oral preferred

Status : SUBMITTED

Track judgments :

Abstract ID : 36

LCLS variable energy hard X-ray single-shot spectrometer

Content :

This proposed presentation will review the engineering design and operational performance for a recently designed and commissioned variable energy hard X-ray single-shot spectrometer installed in the LCLS front-end-enclosure.
Recent advances using a bent crystal have demonstrated the utility of this technique as a non-invasive diagnostic, and it will be the basis for the design of a complete system, including a dispersive element (a cylindrically bent ultra-thin Si single crystal) and a spatially resolved detector system (a YAG:Ce X-ray scintillator screen and an optical imaging system with a zoom lens and a pixelated CCD/CMOS camera). The project provides single-shot spectra for users whose experiments depend critically on the knowledge of the SASE FEL spectrum. It will also provide single-shot spectra to accelerator physicists for their continuing studies of self-seeding, iSASE testing.
The X-ray energy will range from 4 to 10 keV, the spectral bandwidth will be on the order of 1%, or smaller if higher resolution is required and the spectral resolution on the order of 5x10-5. The spectrometer will have the ability to be configured for both low and high resolution (wide and narrow range) mode of operation.
X-ray free-electron lasers such as the LCLS, when operated in the SASE mode exhibits shot-to-shot fluctuations in all beam properties including the energy spectrum. As such single-shot spectral characterization is imperative to allow users to obtain quantitative interpretation of experimental data, X-ray photon correlation spectroscopy and many other spectrum-sensitive measurements. It can be used by accelerator physicists to tune up the FEL to provide users with the desired X-ray bandwidth characteristics. In addition, hard X-ray spectral measurements are critical in evaluating and optimizing the performance of hard X-ray self-seeded FEL operation.

Some routinely collected data's will be presented to give an idea of the usefulness of the system and its resolving power.

Primary authors : RICH, David (SLAC)

Co-authors :

Presenter : RICH, David (SLAC)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. ZANGRANDO, Marco

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Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 38

Active shape correction of a thin glass mirror for X-ray astronomy

Content :

Adjustable mirrors equipped with piezo actuators are commonly used at FEL beamlines, in order to optimize their focusing properties and possibly to shape the intensity distribution of the focal spot with the desired profile. Unlike them, X-ray mirrors for astronomy are much thinner in order to enable the nesting and reduce the areal mass, and the application of piezo actuators appears much more difficult. There remains the possibility to correct the deformations using thin patches that exert a tangential strain on the rear side of the mirror: several groups are at work on this approach. Our technique relies on actively integrating thin glass foils with commercial piezoceramic patches, fed by voltages driven by the feedback provided by X-rays, while the tension signals are carried by a printed circuit obtained by photolithography. Finally, the shape detection and the consequent voltage signal to be provided to the piezoelectric array are determined in X-rays, in intra-focal setup at the XACT facility at INAF/OAPA. In this work, we describe the manufacturing steps to obtain a first active mirror prototype and the first test performed in X-rays.

Primary authors : Dr. SPIGA, Daniele (INAF/Brera Astronomical Observatory) ; Prof. BARBERA, Marco (Università degli Studi di Palermo) ; Prof. COLLURA, Alfonso (INAF - Osservatorio Astronomico di Palermo)

Co-authors :

Presenter : Dr. SPIGA, Daniele (INAF/Brera Astronomical Observatory)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. SPIGA, Daniele

Submitted on Wednesday 15 April 2015

Last modified on : Wednesday 15 April 2015

Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 39

Design challenges to diagnostics and components for high repetition rate X-ray FELs

Content :
Future high repetition rate X-ray FEL's such as the European XFEL and LCLS-II presents new challenges to photon diagnostics as well as essential beamline components. In addition to these devices having to sustain the high peak power of a single-pulse FEL radiation, they must also be capable of handling the enormous power density of tens to hundreds of watts over a small area as small as 0.1 mm2. In this talk, I will discuss the potential impact of high power FEL operation on performance of a gas attenuator and the design challenges to beam intercepting components such as a collimator or stopper.

Primary authors : Dr. FENG, Yiping (SLAC)

Co-authors :

Presenter :

Track classification :

Contribution type : --not specified--

Submitted by : Dr. ZANGRANDO, Marco

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Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 40

Detection challenges with FELs: experience on the combination of a stochastic source with prototype detectors

Content :

The high coherence, high peak power and short pulses duration of X-ray Free-Electron Lasers (XFELs) are particularly well suited for time-resolved pump-probe and coherent diffraction studies. In many pump-probe experiments small differences in signal produced by ground and excited states have to be detected and resolved. This requires detector systems with tremendous dynamic resolution and sources capable to provide either pulses with high intensity and moderate repetition rate or very high repetition rate with moderate intensity. To achieve sufficient intensity resolution, the typical approach is to average many frames. However source, pump-laser and sample instability make blind averages not really useful. It is therefore critical to preserve the information of each single pulse: comprising beamline and accelerator diagnostics, laser to FEL timing, and detector. Deep understanding of the detection system and careful calibration are necessary for good quality high yield data. Dynamic range, stability and homogeneity are equally important for other type of experiments and have made detectors requirements particularly challenging. This talk will provide an overview of the challenges experienced at LCLS.

Primary authors : Dr. CARINI, Gabriella (SLAC)

Co-authors :

Presenter : Dr. CARINI, Gabriella (SLAC)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. ZANGRANDO, Marco

Submitted on Wednesday 15 April 2015

Last modified on : Tuesday 28 April 2015

Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 41

areaDetector: the swiss-knife-tool for Swiss-Light-Source on-line wavefront analysis

Content :
The Swiss Light Source (SLS) at the Paul Scherrer Institute (PSI), the first 3rd generation synchrotron light source designed to operate in top-up regime, started user operation end of 2001 with four beam lines [1]. In this contribution we focus on optics metrology for which the EPICS toolkit is providing flexible control system architecture. The experimental setup, rigorously based on the SynApps "Positioner Trigger Detector" anatomy [2, 3], understands experimental needs in optics metrology [4]. On the "Detector" side an increased effort was made to standardize the control within the EPICS areaDetector (AD) software framework [5]. A specialized AD plugin was developed to stream data between GigE CCD [6] data-acquisition server and data processing clients, which implement the wavefront analysis in a Python AD-plugin [7]. The HDF5 compliant and lossless high-performance transfer of detector data between server and client is based on the ØMQ embeddable networking library [8]. The ØMQ data-stream includes metadata used for on-line wavefront analysis [8] inside client applications. The concept opens the doors towards high performance scientific data services and feedbacks based on shot-to-shot series of 2D detector images in SwissFEL experiments.

[1] Krempaský et al., "The SLS Beamlines Data Acquisition and Control System", Proceedings of ICALEPCS 2001, San Jose, USA [2] Krempaský et al., "10 years of experiment control at SLS beam lines: an outlook to SwissFEL", Proceedings of ICALEPCS 2013, San Francisco, USA
[3] http://www.aps.anl.gov/bcda/synApps/index.php
[4] U. Flechsig et al, "LTP-V with EPICS controls system for efficient quality assessment of KB-bender systems", Nuclear Instruments and Methods in Physics Research Section A, Volume 635, Issue 1, p. S64-S68
[5] M. Rivers, AIP Conference Proceedings; Journal Volume: 1234; Journal Issue: 1; 10. International conference on radiation instrumentation, Melbourne (Australia), 27 Sep - 2 Oct 2009
[6] http://www.alliedvisiontec.com/us/products/cameras/gigabit-ethernet/prosilica-ge.html
[7] http://controls.diamond.ac.uk/downloads/support/adPython/0-2/documentation/doxygen/index.html
[8] Y. Kayser et al. "Wavefront metrology measurements at SACLA by means of X-ray grating interferometry", OPTICS EXPRESS, Vol. 22, No. 8, (2014)

Primary authors : Dr. KREMPASKY, Juraj (PSI)

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Presenter : Dr. KREMPASKY, Juraj (PSI)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. ZANGRANDO, Marco

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Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 42

Ultrahigh performance mirrors for the European XFEL

Content :

The European XFEL will be the first facility that can produce coherent X-ray laser pulses in the range of 10-200 Watts averaged power. The short-time power load during pulse trains ranges even up to many kW on a mm-sized spot. At the same time, profile errors of X-ray mirrors should not exceed a few nanometers, otherwise distortions of wavefronts would occur. With long photon drift distances as present at the European XFEL, these profile distortions become even more critical as compared to shorter facilities. In this presentation specifications, concepts and first test results concerning these mirrors will be discussed.

Primary authors : Dr. SINN, Harald (European XFEL)

Co-authors :

Presenter : Dr. SINN, Harald (European XFEL)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. SINN, Harald

Submitted on Wednesday 15 April 2015

Last modified on : Wednesday 15 April 2015

Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 46

Progress on Photon Beam Diagnostics for the European XFEL facility

Content :

The European XFEL facility requires numerous devices for X-ray beam diagnostics [1] which were mostly developed already over the last years. The current status of final assemblies, laboratory tests and installations is reviewed for the baseline diagnostics devices of the SASE1 beamline which is installed first. This comprises several imagers, an undulator commissioning monochromator and filter chamber, and the X-ray gas monitor (XGM) for online intensity and position monitoring. Additionally, the conceptual phase of the hard X-ray diagnostic online spectrometer HiREX was completed [2], and the first photoelectron spectrometer (PES) device of European XFEL was commissioned with an FEL beam at the AMO station of LCLS.

References
[1] J.Grünert, XFEL.EU technical report TR-2012-003, April 2012, doi:10.3204/XFEL.EU/TR-2012-003
[2] J. Rehanek, N.Kujala, J. Grünert, Design Report Hard X-ray High-Resolution Single-Shot Spectrometer, XFEL.EU technical report, publication in progress

Primary authors : Dr. GRüNERT, Jan (XFEL)

Co-authors : MARC PLANAS, FLORIAN DIETRICH, JENS BUCK, WOLFGANG FREUND, JIA LIU, BERNARD BARANASIC, NARESH KUJALA (XFEL)

Presenter : Dr. GRüNERT, Jan (XFEL)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. ZANGRANDO, Marco

Submitted on Friday 17 April 2015

Last modified on : Friday 17 April 2015

Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 47

FEL-induced damage to various materials and structures: unwanted and wanted phenomena

Content :

During the last decade, an interaction of intense short-wavelength radiation with matter became extensively studied from several reasons. (1) Estimating and minimizing damages to surfaces of highly irradiated XUV/x-ray optical elements developed and used for the guiding and focusing of beams of short-wavelength lasers and related sources. (2) Durability assessments of materials suggested for the first walls of fusion reactors and optical elements exposed to intense XUV/X-ray radiation in a laser-plasma interaction chamber. (3) Diffraction-limited micro/nano-patterning of solid surfaces for fabrication of microelectronic and micromechanical elements and devices. (4) Understanding and reducing radiation damage to a sample during its structural investigation with intense x-rays. (5) Determination of radiation field characteristics, i.e., imaging of spatial energy distribution in a focused beam ablatively imprinted on the irradiated material and determination of pulse energy content. (6) Production of very dense plasmas with a low electron temperature, ~ 10 eV, called warm dense matter – WDM. In this contribution, we will summarize results of experiments and calculations conducted in streams (1) and (5). Ad (1) - High-performance optics is needed to concentrate an energy of XUV/x-ray laser pulses on chosen targets to carry out various application experiments. Of course, an optical element itself is heavily exposed to the short-wavelength laser radiation. Any element of the beam guiding and focusing system should be constructed, manufactured and operated under conditions avoiding damage induced by XUV/x-ray laser pulses. We are systematically studying responses of a wide variety of XUV/x-ray optical materials and structures to intense short-wavelength radiation. Ad (5) - In the physics of extreme states of matter, it is important not only to approach an appropriate high-energy-density level but also to diagnose and characterize the system investigated under the unsteady conditions. Therefore systematic experimental and theoretical works dealing with an accurate and reliable characterization of focused laser beams should be conducted to carry out the short-wavelength laser-matter interaction research properly. The detailed knowledge of transverse energy distribution within the beam profile turns out to be essential for interpretation of the quite nontrivial experimental results obtained at an enormous irradiance. Non-Gaussian beams, which are typical of XUV/x-ray lasers, require a rigorous study as well as the interactions induced by them. In this contribution, our recent work is reported devoted to a detailed characterization of focused general laser beams extending the ablative imprint technique published earlier. Acknowledgement: The author's research is in above-mentioned areas currently funded by the Czech Science Foundation (Grant # 14-29772S).

Primary authors : Dr. JUHA, Libor (Institute of Physics ASCR, v.v.i.)

Co-authors :

Presenter : Dr. JUHA, Libor (Institute of Physics ASCR, v.v.i.)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. JUHA, Libor

Submitted on Monday 20 April 2015

Last modified on : Monday 20 April 2015

Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 92

Development and current status of temporal diagnostics at LCLS

Content :

Time domain diagnostics have seen significant progress over the past years for X-ray free electron lasers, evolving from concepts, to proof of principle demonstrations, and finally universal deployments at the LCLS. It is playing an increasingly important role in the day-to-day operation of the X-ray FEL, both for finer tuning of the machine as well as improving the resolution and sensitivity of the experiments. In this talk, I would review the current status from an x-ray experimenter's view point, discuss how our temporal diagnostics, including the x-ray pulse duration monitors, arrival time monitors, and timing drift monitors, come into play and positively impact the results of the measurements and data analysis. Prospects of further resolution improvement in x-ray pump probe experiments will also be discussed.

Primary authors : Dr. ZHU, Diling (SLAC)

Co-authors :

Presenter : Dr. ZHU, Diling (SLAC)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. ZANGRANDO, Marco

Submitted on Saturday 25 April 2015

Last modified on : Saturday 25 April 2015

Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 94

Recent developments of photon beam diagnostics at LCLS

Content :

We will present an overview of recent developments in photon diagnostics at LCLS. The focus will be on the soft x-ray diagnostics particularly the latest results in producing and detecting different states of polarized FEL pulses using the recently commissioned Delta undulator. Various methods of producing polarized light along with the polarization measurements are presented.

Primary authors : Dr. MOELLER, Stefan (SLAC)

Co-authors :

Presenter : Dr. MOELLER, Stefan (SLAC)

Track classification :

Contribution type : --not specified--

Submitted by : Dr. ZANGRANDO, Marco

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Comments :

Status : SUBMITTED

Track judgments :

Abstract ID : 95

Seed laser based diagnostics at the FERMI FEL: current status and prospectives

Content :

Seeded Free Electron Lasers (FELs) represent an important step ahead in obtaining EUV and soft X-ray pulses with quality approaching the one of solid-state ultrafast optical lasers. For realizing its full potential, however, the design and operation of a seeded FEL poses a number of technical challenges on all the critical sub-systems. In particular, the requirements on the seed laser system pulse synchronization and quality needed to obtain stable HGHG FEL operation are rather stringent. This paper will first briefly describe the overall layout of the seed laser system and its diagnostics, with emphasis on the pulse timing detection and stabilization, as well as the pulse duration measurement. The second part of the talk will concentrate on the use of the optically transported seed laser pulse for diagnostics of the laser-to-electron bunch timing and FEL duration. Results of currently measured performance as well as the foreseen ways of improvement will be presented.

Primary authors : CINQUEGRANA, Paolo (Elettra - Sincrotrone Trieste)

Co-authors :

Presenter : CINQUEGRANA, Paolo (Elettra - Sincrotrone Trieste)

Track classification :

Contribution type : --not specified--

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