SYLX 1: Symposium Laser Driven X-Rays: Generation and Application

Time: Friday 14:30–16:30 Location: RW 1

Invited Talk SYLX 1.1 Fri 14:30 RW 1

Laserstrahlquellen als Treiber für Sekundärstrahlquellen — •Torsten Mans[1], Dominik Bauer[1], Thomas Metzger[2], Dominik Ertel[2], Claus Schnitzler[3] und Tino Eidam[4] — [1]Trumpf Laser SE, Schramberg, Deutschland — [2]Trumpf Scientific Laser, München, Deutschland — [3]Amphos GmbH, Herzogenrath, Deutschland — [4]AFS GmbH, Jena, Deutschland

Ultrakurzpulslasern, die als Treiber nichtlinearer Prozesse zur Erzeugung von Sekundärstrahlung geeignet sind, werden vorgestellt. Wir präsentieren einen umfassenden Überblick über unsere neuesten Ergebnisse im Bereich gepulste Laser, basierend auf verschiedenen Laser-Bausteinen wie Seed-Lasern und Laserverstärkern, wie Faser- Slab-, Disk- und Plattenverstärkern und Kombinationen davon. Neben den technischen Einblicken geben wir einen Ausblick auf die nächsten Entwicklungsschritte zur weiteren Skalierung dieser Parameter.

Invited Talk SYLX 1.2 Fri 15:00 RW 1

Development and Integration of Novel LPP Radiation Sources for Enhanced Characterization and Industrial Application — Lion Günster[1], Luka Petersen[1], Philip Mosel[1], Peer Biesterfeld[1], Sven Fröhlich[1,2], Jose Mapa[1], Greta Paruschke[1], Pia Koopmann[1], Bianca Iwan[1,2], Uwe Morgner[1,2], and •Milutin Kovacev[1,2] — [1]Institut für Quantenoptik, Leibniz Universität Hannover, Hannover 30167, Germany — [2]Cluster of Excellence PhoenixD (Photonics, Optics and Engineering, Innovation Across Disciplines), Hannover 30167, Germany

The development of LPP sources for generating hard X-rays has long been the subject of research and development [1]. Within the XProLas project we investigate novel concepts for LPP radiation sources. The aim is to improve the achievable brilliance and their scalability, as well as to optimize the emission geometry. For this purpose, our sources are integrated into the measurement chamber and can be directly compared with electron beam-based technology. Novel secondary sources will become increasingly important due to the high average power of ultrashort pulse lasers [2]. The presentation provides an overview of the latest developments in laser plasma sources and highlights potential risks associated with the interaction of intense laser pulses with matter [4,5].

[1] Kördel, M. et al. , Optica, 7(6), 658 (2020) [2] Saraceno, C.J. et al., J. Eur. Opt. Soc., 15(1), 15 (2019) [3] Legall, H.,et al., Appl. Phys. A 124, 407 (2018). [4] Mosel, Philip, et al., Materials, 14 (16) 4397 (2021) [5] Mosel, P. et al., Optics Express, 30(20), 37038 (2022)

Invited Talk SYLX 1.3 Fri 15:30 RW 1

Near-relativistic ytterbium fiberlaser plasma source for high-flux hard X-ray generation from a liquid-metal jet — •Robert Klas[1,2], Maximilian Benner[2], Mohammed Almassarani[2], Maximilian Karst[2,3], Lucas Eisenbach[1,2,3], Philipp Gierschke[1,2], Warunya Röder[1,2], Arno Klenke[1,2,3], Jan Rothhardt[1,2,3], and Jens Limpert[1,2,3] — [1]Fraunhofer, Germany — [2]Friedrich Schiller University Jena, Germany — [3]Helmholtz-Institute Jena, Germany

We demonstrate a compact, high-flux hard-X-ray source driven by a Ytterbium fiber laser tightly focused onto a flowing liquid-metal jet target composed of In- and Bi-based alloys, operating in the near-relativistic regime. Using ultrashort pulses from a high-average-power fiber system, we reach intensities corresponding to a 3E17 to 1.5E18 W/cm^2 at 1030 nm wavelelength, enabling sub-cycle electron acceleration and re-injection into the dense liquid to generate high-flux In Kα (~24.2 keV) and Bi Lα (~10.8 keV) emission superimposed on a broadband bremsstrahlung continuum. The fiber-laser platform provides a high stability, excellent beam quality, and multi-kHz repetition rates, while the liquid jet offers a continuously refreshed interaction surface with manageable debris operation. We report (i) X-ray spectrum with element-specific Kα/Lα peaks with tunability through the jet composition, (ii) absolute flux scaling with repetition rate and intensity, and (iii) the emission spot size. These results are enabling practical, laboratory-scale ultrafast X-ray spectroscopy and diffraction.

Invited Talk SYLX 1.4 Fri 16:00 RW 1

Laser-driven X-ray generation for industrial applications — •Johannes Maximilian Ebert, Klaus Bergmann, Sarah Klein, Martin Traub, Jochen Vieker, Stephan Herman Wissenberg, and Hans-Dieter Hoffmann — Fraunhofer Institute for Laser Technology ILT, Steinbachstr. 15, 52074 Aachen, Germany

Novel applications demand X-ray sources with high photon flux at higher brilliance than conventional electron-beam-driven X-ray sources can provide. Laser-driven sources are regarded as the next step, offering high spectral brilliance through narrowband Kα-line emission and highly energetic Bremsstrahlung.
The talk will focus on results from consortia projects regarding optics layout and system architecture of laser-driven hard X-ray sources and applications. In these projects, several interrelated topics are being considered, such as:

- Light-matter interaction, X-ray generation
- Beam delivery, high-NA focusing to intensities $> 10^{18}\ W/cm^2$
- Regenerative target technology
- Debris mitigation for protection of optics
- Radiation safety, particularly for the high energetic tail of Bremsstrahlung