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# ***X-Ray Lasers and Coherent X-Ray Sources: Development and Applications XI***

**Annie Klisnick  
Carmen S. Menoni**  
*Editors*

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# Contents

- v *Authors*
- vii *Conference Committee*
- ix *Introduction*

---

## **SESSION 1 X-RAY INTERACTION WITH SOLIDS**

---

- 9589 02 **Observation of dynamics and modification of solid surface using a picosecond soft x-ray laser (Invited Paper) [9589-1]**
- 9589 03 **The application of extreme ultra-violet lasers in plasma heating and diagnosis [9589-2]**
- 9589 04 **Low electron temperature in ablating materials formed by picosecond soft x-ray laser pulses [9589-3]**
- 9589 05 **Soft x-ray laser ablation mass spectrometry for materials study and nanoscale chemical imaging [9589-4]**

---

## **SESSION 2 OPTICS FOR COHERENT SOURCES: JOINT SESSION WITH CONFERENCES 9588 AND 9589**

---

- 9589 07 **Multilayer optics for coherent EUV/x-ray laser sources (Invited Paper) [9589-6]**

---

## **SESSION 3 X-RAY INTERACTION WITH SOLIDS AND CLUSTERS**

---

- 9589 0A **The observation of a transient surface morphology in the femtosecond laser ablation process by using the soft x-ray laser probe [9589-9]**
- 9589 0C **Generation of strongly coupled plasma using Argon-based capillary discharge lasers [9589-11]**

---

## **SESSION 4 SEEDED X-RAY LASERS**

---

- 9589 0E **Modeling of dense injection-seeded Ni-like Krypton plasma amplifiers [9589-13]**
- 9589 0G **Chirped pulse amplification in x-ray free-electron lasers [9589-15]**

---

## **SESSION 5 HIGH-REPETITION-RATE X-RAY LASERS AND APPLICATIONS**

---

- 9589 0K **X-ray characterization of short-pulse laser illuminated hydrogen storage alloys having very high performance [9589-19]**

9589 OL **Employing partially coherent, compact gas-discharge sources for coherent diffractive imaging with extreme ultraviolet light** [9589-20]

9589 OM **3D nanoscale imaging of biological samples with laboratory-based soft x-ray sources** [9589-21]

---

**SESSION 6 BEAM PROPERTIES AND DIAGNOSTICS**

---

9589 ON **Output beam polarisation of x-ray lasers with transient inversion (Invited Paper)** [9589-22]

9589 OR **Cross-correlation measurement of femtosecond hard x-ray pulses from a laser plasma source: approaching 100 fs benchmark** [9589-26]

---

**SESSION 7 HIGH-HARMONICS AND APPLICATIONS**

---

9589 OT **The MEL-X project at the Lawrence Livermore National Laboratory: a mirror-based delay line for x-rays** [9589-28]

---

**SESSION 8 NEW X-RAY SOURCES**

---

9589 OW **Attosecond pulse formation via switching of resonant interaction by tunnel ionization (Invited Paper)** [9589-31]

9589 OX **Using the XFEL to drive the gain of inner-shell x-ray lasers using photo-ionization and photo-excitation processes** [9589-32]

---

**POSTER SESSION**

---

9589 10 **Time-dependent simulation of the gas attenuator for the LCLS-II X-ray FEL's under high beam power operations** [9589-35]

9589 11 **Soft x-ray source based on the high-current capillary-discharge system** [9589-36]

9589 12 **Ultra-broadband ptychography with self-consistent coherence estimation from a high harmonic source** [9589-37]

## Authors

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Abe, Hiroshi, 0K  
Akhmedzhanov, T. R., 0W  
Alameda, Jennifer, 0T  
Anderson, E. H., 05  
Antonov, V. A., 0W  
Aquila, Andy, 0T  
Aslanyan, Valentin, 03, 0C  
Baba, Motoyoshi, 0A  
Baksh, P., 12  
Bernstein, Elliot R., 05  
Blechschiadt, Anne, 0M  
Boden, S. A., 12  
Bourassin-Bouchet, Ch., 07  
Boutet, Sébastien, 0T  
Bresenitz, R., 0L  
Brocklesby, W. S., 0L, 12  
Burian, Tomas, 05  
Bußmann, J., 0L  
Carlton, D., 05  
Chao, W., 05  
Choukourov, Andrei, 11  
Crick, Dean C., 05  
Dacasa, Hugo, 0G  
Daido, Hiroyuki, 0K  
Decker, Todd, 0T  
Dehlinger, Aurélie, 0M  
Dehlinger, M., 07  
Delmotte, F., 07  
Depresseux, Adrien, 0E  
de Rossi, S., 07  
Eyama, Takashi, 0A  
Faenov, Anatoly Y., 02, 04, 0A  
Fajardo, Marta, 0G  
Feng, Yiping, 10  
Filevich, Jorge, 05  
Frey, J. G., 12  
Frolov, Oleksandr, 11  
Furuyama, Takehiro, 0K  
Gautier, Julien, 0E  
Grötzsch, Daniel, 0M  
Grützmacher, D., 0L  
Guillet, Serge, 0T  
Hasegawa, Noboru, 02, 04, 0A, 0N  
Hau-Riege, Stefan P., 0T  
Hill, Randy, 0T  
Idutsu, Rui, 0A  
Ijaz, M., 0R  
Inogamov, Nail A., 02, 04, 0A  
Iqbal, Mazhar, 0R  
Ishino, Masahiko, 02, 04  
Ito, Atsushi M., 02, 0A  
Janulewicz, K. A., 0N, 0R  
Jerome, A., 07  
Juha, Libor, 05  
Jung, Robert, 0M  
Juschkin, L., 0L  
Kakimoto, Naoya, 0A  
Kanngießer, Birgit, 0M  
Kawachi, Tetsuya, 02, 04, 0A, 0N  
Kim, C. M., 0N  
Kim, H., 12  
Kocharovskaya, Olga, 0W  
Kolacek, Karel, 11  
Krzywinski, Jacek, 10  
Kuznetsov, Ilya, 05  
Le, Thuy T. T., 0G  
Li, Lu, 0G  
Mahieu, Benoît, 0G  
Maynard, Gilles, 0E  
Meltchakov, E., 07  
Menoni, Carmen S., 05  
Miao, Jianwei, 0L  
Minami, Yasuo, 02, 0A  
Nielsen, Joseph, 0X  
Nishikino, Masaharu, 02, 04, 0A, 0N  
Nishimura, Akihiko, 0K  
Noh, D. Y., 0R  
Odstřčil, M., 0L, 12  
Ohnishi, Naofumi, 02, 0A  
Ohshima, Takeshi, 0K  
Oliva, Eduardo, 0E, 0G  
Ortiz, Eliazar, 10  
Pardini, Tom, 0T  
Pikuz, Tatiana, 04  
Radeonychev, Y. V., 0W  
Raubenheimer, Tor O., 10  
Rocca, Jorge J., 05  
Rossall, Andrew K., 03, 0C  
Rowen, Michael, 10  
Rudolf, D., 0L  
Sato, K., 02  
Schafer, Donald W., 10  
Schmidt, Jiri, 11  
Sebban, Stéphane, 0E  
Seim, Christian, 0M  
Shahzad, Mohammed, 03  
Shimomura, Takuya, 0K  
Shobu, Takahisa, 0K

Skobelev, Igor, 04  
Soufli, Regina, 05, 0T  
Stiel, Holger, 0M, 0N, 0R  
Straus, Jaroslav, 11  
Suemoto, Tohru, 02, 0A  
Takenaka, Yusuke, 0K  
Tallents, Gregory J., 03, 0C  
Tissandier, Fabien, 0E  
Tokuhira, Shinnosuke, 0K  
Tomita, Takuro, 0A  
Uchida, Hirohisa, 0K  
Varnière, F., 07  
Wilson, Sarah, 03, 0C  
Woolston, M., 05  
Yamagiwa, Mitsuru, 02, 04, 0A  
Zeitoun, Philippe, 0G

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- 1 X-Ray Interaction with Solids  
**Annie Klisnick**, CNRS, Université Paris-Sud 11 (France)  
**Joseph Nilsen**, Lawrence Livermore National Laboratory  
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- 2 Optics for Coherent Sources: Joint Session with Conferences 9588 and 9589  
**Carmen S. Menoni**, Colorado State University (United States)  
**Ali M. Khounsary**, X-ray Optics, Inc. (United States) and Illinois Institute of Technology (United States)
- 3 X-Ray Interaction with Solids and Clusters  
**Regina Soufli**, Lawrence Livermore National Laboratory  
(United States)  
**Hiroyuki Daido**, Japan Atomic Energy Agency (Japan)
- 4 Seeded X-Ray Lasers  
**Jorge J. Rocca**, Colorado State University (United States)  
**Olga Kocharovskaya**, Texas A&M University (United States)
- 5 High-Repetition-Rate X-Ray Lasers and Applications  
**Chang Hee Nam**, Gwangju Institute of Science and Technology  
(Korea, Republic of)  
**Sylvie Jacquemot**, Laboratoire pour l'Utilisation des Lasers Intenses  
(France)
- 6 Beam Properties and Diagnostics  
**Larissa Juschkin**, RWTH Aachen Universität (Germany)  
**Cristian Svetina**, Elettra-Sincrotrone Trieste S.C.p.A. (Italy)
- 7 High-Harmonics and Applications  
**Gregory J. Tallents**, The University of York (United Kingdom)  
**Eduardo Oliva**, Universidad Politécnica de Madrid (Spain)
- 8 New X-Ray Sources  
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## Introduction

The *X-ray Lasers and Coherent X-ray Sources: Development and Applications XI* conference held in San Diego, California, 12–13 August 2015, attracted an international group of participants. Through invited and contributed talks they described the most recent developments in the generation and application of intense x-rays from plasma-based x-ray lasers, 4th generation accelerator-based sources and high-order harmonic (HOH) generation. The unique and complimentary characteristics of these sources, in combination with novel optics and instrumentation, make possible new fundamental studies of x-ray laser/materials interactions and innovative applications in spectroscopies and imaging.

Work presented at the conference in plasma based x-ray lasers showed these table-top sources continue on their path to realize an average power nearing a milliwatt at sub-20 nm wavelengths and to extend emission down to 7.3 nm with substantially lower pump energies. Seeding of x-ray laser amplifiers with HOH was extensively discussed. Experiments and modeling showed prospects for achieving femtosecond pulse duration and extremely high peak brightness. Work on Free Electron Laser (FEL) sources reported fully coherent x-ray emission in the 20-100 eV range at Fermi@Elettra FEL, with the first implementation of a double-cascade seeding technique. HOH source development and their applications in the probing of molecular structure and ultrafast dynamics were also extensively covered. The conference program included a section on new x-ray sources where concepts that involve resonant XUV excitation of an atomic gas simultaneously irradiated by an IR laser field to generate attosecond pulses, the prospects of inner-shell x-ray lasers to achieve gain at higher photon energies than those demonstrated, and new scaling of high order harmonics from relativistic electron cusps were discussed. Essential to effectively use these x-ray sources in applications is complete diagnostics of the output beam. Novel concepts for the polarization of x-ray lasers, for the characterization of spatial coherence with Wigner distributions, and the understanding of the impact of partial temporal coherence on their spectral properties were presented.

The conference held a joint session on "Optics for Coherence Sources" with SPIE Conference 9588 *Advances in X-Ray/EUV Optics and Components* that was very well attended. The trends in multilayer optics are in developing broad band coatings capable to sustain ultrashort pulses. New processing methods enable the fabrication of high aspect ratio diffractive optics, which are needed in the x-ray regime.

Applications of coherent x-ray sources are now impacting more and newer scientific and technological areas. High resolution imaging techniques were discussed including ptychography, structural 3D imaging and composition imaging

of biological samples. Recent progress in fundamental studies of interaction of intense x-ray pulses with solid materials were presented, including ablation of solid surfaces or generation of warm dense matter. Applications of ultrashort pulses to novel spectroscopies and ultrafast dynamics in gas phase and solids were also reported.

We gratefully acknowledge the continued support of SPIE for the field of x-ray lasers. We thank SPIE for the outstanding organization of the conference at all stages as well as the considerable efforts of the staff towards the publication of the Proceedings volume. We would like to thank the Programme Committee for their support and guidance and to the session chairs for their help in the running of the conference. Finally, we thank the many participants for their high quality scientific contributions to the 2015 meeting.

**Annie Klisnick**  
**Carmen S. Menoni**