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# ***X-ray Lasers and Coherent X-ray Sources: Development and Applications***

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

**24–26 April 2017**  
**Prague, Czech Republic**

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SPIE

**Volume 10243**

Proceedings of SPIE 0277-786X, V. 10243

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

X-ray Lasers and Coherent X-ray Sources: Development and Applications, edited by Annie Klisnick,  
Carmen S. Menoni, Proc. of SPIE Vol. 10243, 1024301 · © 2017 SPIE  
CCC code: 0277-786X/17/\$18 · doi: 10.1117/12.2282016

Proc. of SPIE Vol. 10243 1024301-1

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Please use the following format to cite material from these proceedings:

Author(s), "Title of Paper," in *X-ray Lasers and Coherent X-ray Sources: Development and Applications*, edited by Annie Klisnick, Carmen S. Menoni, Proceedings of SPIE Vol. 10243 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510609877

ISBN: 9781510609884 (electronic)

Published by

**SPIE**

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445

[SPIE.org](http://SPIE.org)

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# Contents

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

---

## **SESSION 1    LABORATORY-SCALE SOFT X-RAY LASERS AND COHERENT X-RAY SOURCES**

---

- 10243 03    **DAGON: a 3D Maxwell-Bloch code** [10243-2]

---

## **SESSION 2    SOFT X-RAY APPLICATIONS I**

---

- 10243 07    **Thomson scattering laser-electron x-ray source for reduction of patient radiation dose in interventional coronary angiography** [10243-6]
- 10243 08    **Optimizing soft x-ray NEXAFS spectroscopy in the laboratory** [10243-7]
- 10243 09    **Soft x-ray nanoscale imaging using highly brilliant laboratory sources and new detector concepts (Invited Paper)** [10243-8]

---

## **SESSION 3    NEW CONCEPTS FOR HIGH-BRIGHTNESS X-RAY SOURCES**

---

- 10243 0C    **Using the XFEL to drive gain in L-shell systems using photoionization processes** [10243-11]
- 10243 0D    **Amplified spontaneous and stimulated Mg L emissions from MgO pumped by FEL pulses** [10243-12]

---

## **SESSION 4    LABORATORY-SCALE SOFT X-RAY LASERS AND APPLICATIONS**

---

- 10243 0F    **Progress in high repetition rate soft x-ray laser development and pump lasers at Colorado State University (Invited Paper)** [10243-14]
- 10243 0G    **Soft x-ray ablation mass spectrometry: high sensitivity elemental trace analysis** [10243-15]
- 10243 0I    **Table-top two-color soft x-ray laser from Ni-like Mo plasma (Invited Paper)** [10243-17]

**SCIENTIFIC APPLICATIONS OF LASER- AND ACCELERATOR-BASED X-RAY SOURCES:  
JOINT SESSION WITH CONFERENCES 10237 AND 10243**

---

10243 0K **Time-resolved x-ray spectroscopy for x-ray-induced phenomena** [10243-19]

10243 0L **The EIS beamline at the seeded free-electron laser FERMI** [10243-20]

**SESSION 5 SOFT X-RAY APPLICATIONS II**

---

10243 0O **Soft x-ray imaging with incoherent sources (Invited Paper)** [10243-23]

10243 0P **X-ray absorption spectroscopy probing hydrogen in metals** [10243-24]

10243 0Q **Laser plasma soft x-ray source based on cryogenic target (Invited Paper)** [10243-25]

10243 0S **Soft x-ray laser ablation of metals and dielectrics (Invited Paper)** [10243-27]

**SESSION 6 HIGH-ORDER HARMONICS AND APPLICATIONS**

---

10243 0V **Tunable orbital angular momentum beams in the extreme ultraviolet/soft x-ray regimes**  
[10243-30]

**POSTER SESSION**

---

10243 0X **Resolution of x-ray parabolic compound refractive diamond lens defined at the home  
laboratory** [10243-32]

10243 0Y **Evaluation of laser-electron x-ray source and related optics for x-ray diffractometry and  
topography** [10243-33]

10243 15 **XUV generation from the interaction of pico- and nanosecond laser pulses with  
nanostructured targets** [10243-41]

# Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five 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.

Amano, Sho, 0Q  
André, Jean-Michel, 0D  
Arbelo Pena, Yunieski, 0P  
Artyukov, I. A., 07, 0Y  
Ayele, M., 0O  
Barbato, Francesco, 0P  
Barte, Ellie Floyd, 15  
Bartnik, A., 0O  
Baumgarten, Cory, 0F  
Bencivenga, F., 0L  
Berrill, Mark, 0F  
Blank, V. D., 0X, 0Y  
Bleiner, Davide, 0I, 0P  
Borgschulte, Andreas, 0P  
Braenzel, J., 09  
Calvi, A., 0L  
Chao, W., 0G  
Cirelli, Claudio, 0P  
Cotelo, Manuel, 03  
Czwartos, J., 0O  
Dal Zilio, S., 0L  
Dehlinger, A., 09  
Delmelle, Renaud, 0P  
Denisov, V. N., 0X  
Duffin, A. M., 0G  
Dunne, Pádraig, 15  
Dyachkov, N. V., 07  
Escudero, Juan Carlos, 03  
Faenov, A., 0S  
Fava, C., 0L  
Feshchenko, R. M., 07, 0Y  
Fiedorowicz, H., 0O  
Foglia, L., 0L  
Fok, T., 0O  
Gasilov, S. V., 0X  
Gerusina, S., 0L  
Gessini, Alessandro, 0D  
Gobessi, R., 0L  
González-Fernández, Agustín, 03  
Green, T., 0G  
Hasegawa, N., 0S  
Hernández-García, Carlos, 0V  
Inogamov, N., 0S  
Ishino, M., 0S  
Jonas, A., 08  
Jonnard, Philippe, 0D  
Jung, R., 08, 09  
Kando, M., 0S  
Kanngießer, B., 08  
Kawachi, T., 0S  
Kodama, R., 0S  
Kos, Domagoj, 15  
Kurdi, G., 0L  
Kuznetsov, I., 0G  
Kyaw, C. N., 0F  
Le Guen, Karine, 0D  
Limpouch, Jiri, 15  
Lokasani, Ragava, 15  
Luebcke, A., 09  
Maguire, Oisin, 15  
Mahne, N., 0L  
Manfreda, M., 0L  
Mantouvalou, I., 08  
Marconi, Mario C., 0F  
Martyushov, S. Yu., 0X  
Masciotti, V., 0L  
Masciovecchio, Claudio, 0D, 0L  
Matruglio, A., 0L  
McCormack, Tom, 15  
Menoni, Carmen S., 0F, 0G  
Mincigrucci, Riccardo, 0D, 0L  
Nielsen, Joseph, 0C  
Nishikino, M., 0S  
O'Reilly, Fergal, 15  
O'Sullivan, Gerry, 15  
Odstrcil, M., 0O  
Oliva, Eduardo, 03  
Parkman, T., 0O  
Patterson, Bruce, 0P  
Pedicone, Michael, 0F  
Peyrusse, Olivier, 0D  
Picón, Antonio, 0K, 0V  
Pikuz, T., 0S  
Plaja, Luis, 0V  
Polunina, A. V., 07  
Polyakov, S. N., 0X, 0Y  
Popov, N. L., 07, 0Y  
Principi, Emiliano, 0D, 0L  
Proska, Jan, 15  
Raimondi, L., 0L  
Reagan, Brendan A., 0F  
Regehly, M., 09  
Rego, Laura, 0V  
Ritter, S., 09  
Rocca, Jorge J., 0F, 0G  
Sambalova, Olga, 0P  
Sanchís, Alberto, 03  
San Román, Julio, 0V

Schnuerer, M., 09  
Seim, C., 09  
Sheridan, Paul, 15  
Shlyaptsev, Vyacheslav N., 0F  
Shvedunov, V. I., 07  
Simoncig, Alberto, 0D, 0L  
Skobelev, I., 0S  
Sokell, Emma, 15  
Stiel, H., 08, 09  
Stolcova, Lucie, 15  
Terentiev, S. A., 0X  
Torrìsi, A., 0O  
Tuemmler, J., 09  
Turnová, J., 0O  
Turpin, Alex, 0V  
Velarde, Pedro, 03  
Vera, Javier, 03  
Vicéns, Sergio, 03  
Vinogradov, A. V., 07, 0Y  
Vondrová, Š., 0O  
Wachulak, P., 0O  
Wang, Hanchen, 0F  
Wang, Shoujun, 0F  
Wang, Yong, 0F  
Węgrzyński, Ł., 0O  
Witte, K., 08  
Wu, Meiyi, 0D  
Yaroslavtsev, A. A., 0Y  
Yin, Liang, 0F  
Zangrando, M., 0L  
Zhakhovsky, V., 0S  
Zholudev, S. I., 0X, 0Y

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Scientific Applications of Laser- and Accelerator- based X-ray  
Sources: Joint Session with Conferences 10237 and 10243  
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Temporal, Spatial and Coherence Diagnostics of  
Ultrashort X-ray Pulses: Joint Session with Conferences 10237 and  
10243  
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## Introduction

The X-ray Lasers and Coherent X-ray Sources: Development and Applications conference was held in Prague, Czech Republic on April 24-27, 2017. The conference was part of the SPIE Optics and Optoelectronics Conference that attracts 16 other topical conferences, some of which complement the topics covered by X-ray Lasers and Coherent X-ray Sources: Development and Applications. The conference gathered an international group of participants that through invited and contributed talks described the most recent developments in the generation and applications of intense X-rays from plasma-based x-ray lasers, 4<sup>th</sup> generation accelerator-based sources and high-order harmonic (HOH) generation. Three joint sessions on accelerator based sources, metrology and applications were co-organized with SPIE conference 10237 "X-Ray Free Electron Lasers: Advances in Source Development and Applications". There were also several sessions that described the state-of-the art in optics and applications of these sources in imaging and spectroscopies.

Work presented at the conference showed significant advances of *plasma based x-ray lasers*. Seeding of x-ray laser amplifiers with high order harmonics (HOH) is providing opportunities to control polarization, realize full spatial coherence and potentially achieve femtosecond pulse duration. Besides already demonstrated high average power, plasma based x-ray lasers have reached output wavelengths down to 6.89 nm with micro-joule pulse energies suited for applications. Some high energy laser facilities already established and others that are projected to come into operation in the next few years are paving the way to further the development of plasma based x-ray lasers as well as other coherent high brightness x-ray sources.

The conference held three joint sessions on "Scientific Applications of Laser- and Accelerator-based X-ray Sources," "Temporal, Spatial and Coherence Diagnostics of Ultrashort X-ray Pulses," and "High Brightness and Ultrashort X-ray and EUV Sources," with SPIE Conference 10237 that were very well attended. Seeding of Free Electron Lasers to control coherence, reaching attosecond pulse durations and generating high quality electron beams to improve FEL output were discussed. Diagnostics of the temporal, spatial and coherence properties of the x-ray sources' output incentivized interest from the whole community as precise diagnostics of the output of coherent x-ray sources is critical for applications.

The sessions in applications highlighted important advances in imaging, and spectroscopy that are impacting materials science and biology. Access to excitation of inner shell electrons in atoms and molecules with the energetic X-ray photons has enabled the implementation of absorption, near edge and photoelectron emission spectroscopies some of which are exploiting the short

pulse duration of the x-ray emission to track ultrafast dynamics, such as in bond breaking. Advances in high resolution x-ray imaging using different geometries that include lensless, phase contrast imaging, holography and aerial geometries using table-top x-ray lasers, HOH and incoherent sources were presented. The control of polarization in HOH and plasma and accelerator based soft x-ray lasers, the ability to generate phase vortices with advanced optics or by tailoring the driving laser output as in HOH as presented at the conference will have a significant impact in broadening the application's landscape.

We gratefully acknowledge the continued support of SPIE for the field of x-ray lasers. The outstanding organization of the conference at all stages as well as the efforts of the staff towards the publication of the proceedings volume is also acknowledged. We would like to thank the Program 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 2017 meeting.

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