

International Workshop on EUV and Soft X-Ray Sources (2016 Source Workshop)

November 7-9, 2016
Amsterdam ■ The Netherlands

Workshop Agenda



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**2016 International Workshop
on EUV and Soft X-ray Sources
(2016 Source Workshop)**

Workshop Co-Organizers



Welcome

Dear Colleagues;

I will like to invite you to join me and our colleagues at the International Workshop on EUV and Soft X-Ray Sources (2016 Source Workshop) in Amsterdam, The Netherlands from November 7-9, 2016.

The workshop, in its 7th year, is being organized by EUV Litho Inc. in the Netherlands in collaboration with ARCNL. This change of location this year is allowing us to interact with many new researchers in this geographical area, who are actively working on EUV and XUV sources and applications. As in the previous years, the workshop's agenda will provide a forum for researchers in the EUV/XUV source area to present their work and discuss potential applications of their technology. I expect that researchers as well as the end-users of these sources will find this workshop valuable. As always, the workshop proceedings will be published online at our website.

This workshop has been made possible by the support of workshop sponsors, technical working group (TWG) members, workshop support staff at ARCNL, session chairs and presenters and attendees. I would like to specially thank Oscar Versolato, Joost Frenken, Marjan Fretz and Romy Metz from ARCNL, for their contributions in making this workshop a success.

I look forward to your participation and a successful workshop.

Best Regards

Vivek Bakshi
Organizing Chair, International Workshop on EUV and Soft X-Ray Sources
(2016 Source Workshop)

Source Technical Working Group (TWG)

Reza Abhari (ETH Zurich)
Jinho Ahn (Hanyang University)
Peter Anastasi (Silson)
Sasa Bajt (DESY)
Vadim Banine (ASML)
Klaus Bergmann (ILT-Fraunhofer)
Davide Bleiner (University of Bern)
Vladimir Borisov (Trinity)
John Costello (DCU)
Padraig Dunne (UCD)
Samir Ellwi (ALSphotonics)
Akira Endo (HiLase)
Henryk Fiedorowicz (Military University of Technology, Poland)
Torsten Feigl (OptiXfab)
Francesco Flora (ENEA)
Debbie Gustafson (Energetiq)
Ahmed Hassanein (Purdue)
Takeshi Higashiguchi (Utsunomia University)
Larissa Juschkin (Aachen University)
Hiroo Kinoshita (Hyogo University)
Chiew-seng Koay (IBM)
Konstantin Koshelev (ISAN)
Rainer Lebert (Bruker)
Peter Loosen (ILT-Fraunhofer)
Eric Louis (University of Twente)
James Lunney (Trinity College, Dublin)
John Madey (University of Hawaii)
Shunko Magoshi (EIDEC)
Hakaru Mizoguchi (Gigaphoton)
Udo Dinger (Carl Zeiss)
Katsuhiko Murakami (Nikon)
Patrick Naulleau (LBNL)
Fergal O'Reilly (UCD)
Gerry O'Sullivan (UCD)
Luca Ottaviano (University of L'Aquila)
Yuriy Platonov (RIT)
Martin Richardson (UCF)
Valentino Rigato (INFN-LNL)
Jorge Rocca (University of Colorado)
David Ruzic (University of Illinois)
Akira Sasaki (JAEA)
Leonid Shmaenok (PhysTex)
Emma Sokell (UCD)
Seichi Tagawa (Osaka University)
Hironari Yamada (PPL)
Mikhail Yurkov (DESY)
Sergey Zakharov (NAEXTSTREAM)
Vivek Bakshi (EUV Litho, Inc.) - Organizing Chair
Oscar Versolato (ARCNL) – Co-Chair

Workshop Agenda

2016 International Workshop on EUV and Soft X-Ray Sources (2016 Source Workshop)

Agenda Outline

Monday, November 7, 2016

Location: Hotel Casa 400, Eerste Ringdijkstraat 4, 1097 BC, Amsterdam, The Netherlands

6:00 - 8:00 PM Reception and Speaker Prep at Hotel Casa 400

Tuesday, November 8, 2016

Location: Amsterdam Science Park Congress Centre, Science Park 123, 1098 XG, Amsterdam, The Netherlands

8:00 AM	Bus leaves Hotel Casa 400 for Amsterdam Science Park (Board at 7:50 AM)
8:00 AM – 8:40 AM	Coffee and Pastries (Workshop Hall Foyer)
8:40 AM – 11:55 AM	Workshop Presentations
11:55 AM – 12:55 PM	Lunch
12:44 PM – 4:30 PM	Workshop Presentations
4:45 PM	Poster Session
6:15 PM	Depart for off-site dinner

7:00 – 9:00 PM Dinner Location: Restaurant “In de Waag”

(Buses will be made available to take attendees to the restaurant for dinner, from the workshop location. Buses will drop the attendees off at Hotel Casa 400 after dinner.)

Wednesday, November 8, 2016

Location: Amsterdam Science Park Congress Centre, Science Park 123, 1098 XG, Amsterdam, The Netherlands

8:00 AM Bus leaves Hotel Casa for Amsterdam Science Park (Please arrive by 7:50 AM for boarding)

8:40 AM – 12:45 AM Workshop Presentations

12:45 AM – 2:15 PM Lunch
(A tour of ARCNL will be offered from 1:15 PM to 2:15PM.)

2:00 PM – 6:00 PM Workshop Presentations

(Buses will be available to take workshop attendees to Casa 400 at the end of the workshop.)

WORKSHOP AGENDA

2016 International Workshop on EUV and Soft X-Ray Sources

November 7-9, 2016, Amsterdam, The Netherlands

Monday, November 7, 2016 (Hotel Casa 400)

6:00 - 8:00 PM Reception and Speaker Prep at Hotel Casa 400

Tuesday, November 8, 2016 (Amsterdam Science Park Congress Centre)

8:40 AM Announcements and Introductions

Welcome, Announcements and Introductions (Intro-1)

Vivek Bakshi
EUV Litho, Inc., USA

9:00 AM Session 1: Keynote Session -1

Session Chair:

2016 EUVL Update (*Tentative Title*) (S1)

Wim J. van der Zande
ASML Netherlands B.V., De Run 6501, 5504 DR Veldhoven, The Netherlands

X-ray Microscopy with Laboratory Sources (S2)

Hans M Hertz
Biomedical and X-Ray Physics, Dept. of Applied Physics, KTH/Albanova, Stockholm, Sweden

Break 10:20 AM (15 Minutes)

10:35 AM Session 2: HVM EUV Sources - 1

Session Chairs:

Development of 250 W LPP EUV Light Source for HVM Lithography (S11) (Invited)

T. Yanagida, S. Nagai, G. Soumagne, K. M Nowak, Y. Kawasuji, H. Tanaka, H. Hayashi, Y. Watanabe, T. Hori, Y. Shiraishi, T. Yamada, T. Abe, T. Okamoto, T. Kodama, H. Nakarai, T. Yamazaki, T. Saitou and H. Mizoguchi

Gigaphoton Inc., 3-25-1 Shinomiya, Hiratsuka-shi, Kanagawa 254-8555, Japan

Correlation of Fundamental Plasma Parameters with EUV Emission Profiles of Laser-produced Sn Plasmas for EUV Lithography Light Sources (S12) (Invited)

Kentaro Tomita¹, Yuta Sato¹, Syoichi Tsukiyama¹, Toshiaki Eguchi¹, Kiichiro Uchino¹, Kouichiro Kouge², Tatsuya Yanagida², Hiroaki Tomuro², Yasunori Wada², Masahito Kunishima², Takeshi Kodama², Hakaru Mizoguchi²

¹ *Interdisciplinary Graduate School of Engineering and Sciences, Kyushu University, 6-1, Kasugakoen, Kasuga, Fukuoka 816-8580, JAPAN*

² *Gigaphoton Inc., 400 Yokokurashinden Oyama, Tochigi, 323-8558, JAPAN*

Power Scaling of Pico-second Thin Disc Laser for LPP and FEL EUV Sources (S13) (Invited)

Akira Endo

HiLASE Centre, Dolni Brezany, Czech Republic

Dynamics of a Metallic Micro-droplet upon Interaction with Nanosecond Laser Pulse (S14) (Invited)

D. Kurilovich^{1,2}, A. Klein³, F. Torretti^{1,2}, M. Noordam¹, J. Scheers^{1,2}, W. Ubachs^{1,2}, R.A. Hoekstra^{1,4}, H. Gelderblom³, O.O. Versolato¹

¹*Advanced Research Center for Nanolithography (ARCNL), Science Park 110, 1098 XG Amsterdam, The Netherlands*

²*Department of Physics and Astronomy, and LaserLaB, Vrije Universiteit, De Boelelaan 1081, 1081 HV Amsterdam, The Netherlands*

³*Physics of Fluids Group, Faculty of Science and Technology, MESA+Institute, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands*

⁴*Zernike Institute for Advanced Materials, University of Groningen, Nijenborgh 4, 9747 AG Groningen, The Netherlands*

Lunch 11:55 AM (60 Minutes)

12:55 PM Session 3: HVM EUV Sources – 2

Session Chairs:

High-radiance LDP Source: Clean, Reliable and Stable EUV Source for Mask Inspection (S15) (Invited)

Yusuke Teramoto, Bárbara Santos, Guido Mertens, Ralf Kops, Margarete Kops, Hironobu Yabuta, Akihisa Nagano, Noritaka Ashizawa, Yuta Taniguchi, Daiki Yamatani, Takahiro Shirai, Kunihiro Kasama, Alexander von Wezyk¹ and Klaus Bergmann¹
Ushio Inc.

¹*Fraunhofer ILT*

Droplet-based High Brightness LPP Light Sources for High Volume Metrology and Inspection Applications (S16) (Invited)

Reza S. Abhari, Markus Brandstaetter, Duane Hudgins, Alexander Sanders, Marco Weber, Daniel Boehringer¹
Laboratory for Energy Conversion, Swiss Federal Institute of Technology Zurich (ETHZ), Switzerland

¹*Adlyte AG, Zug, Switzerland*

Scaling of Discharge based XUV Sources for Metrology Applications (S17) (Invited)

Klaus Bergmann, Alexander von Wezyk, Jochen Vieker
Fraunhofer Institute for Laser Technology – ILT, Steinbachstr. 15, 52074 Aachen, Germany

A High-Brightness LPP EUV Source based on Liquid Lithium Jet for Actinic Mask Inspection (S18) (Invited)

Konstantin Koshelev, Alexander Vinokhodov, Mikhail Krivokoritov, Oleg Yakushev, Denis Glushkov, Pavel Seroglazov, Samir Ellwi
RnD-Isan, Moscow, Russia
ISTEQ B.V., Eindhoven, the Netherlands

Progress Towards Actinic Patterned Mask Inspection (S19) (Invited)

Oleg Khodykin
RAPID, KLA-Tencor Inc.

14:35 PM Break (15 Minutes)

14:50 PM Session 4: Plasma Dynamics

Session Chairs:

Conversion Efficiency of Laser-produced Plasmas at 13.5 nm and Colliding Plasmas as EUV Sources (S21) (Invited)

Gerry O'Sullivan, Thomas Cummins, Tony Donnelly, Pdraig Dunne, Paddy Hayden, Domagoj Kos, Oisín Maguire, Fergal O'Reilly and Emma Sokell
School of Physics, University College Dublin, Belfield, Dublin 4, Ireland

Physics of Laser Ablation and the Quest for Maximum CE (S22) (Invited)

M. M. Basko
Keldysh Institute of Applied Mathematics (KIAM), Moscow, Russia
RnD-ISAN/EUV Labs, Moscow, Troitsk, Russia

Cross-sections for Electron-impact Ionization of Tin ions from a Crossed-beams Experiment (S23) (Invited)

Stefan Schippers
Atom und Molekülphysik, I. Physikalisches Institut, Justus-Liebig-Universität Gießen
Leihgesterner Weg 217, 35392 Gießen, Germany

Charge-state Resolving Analysis of EUV Spectra using Electron-beam Ion Traps (S24) (Invited)

José R. Crespo López-Urrutia
Max-Planck-Institut für Kernphysik, D-69117 Heidelberg, Germany

Electron and Ion Dynamics in EUV-induced Plasmas (S25) (Invited)

J. Beckers¹, R.M. van der Horst², T.H.M. van de Ven¹, C.A. de Meijere², G.M.W. Kroesen¹
and V.Y. Banine^{1,2}
¹ *Eindhoven University of Technology, Den Dolech 2, 5612 AZ Eindhoven, The Netherlands*
² *ASML, De Run 6501, 5504 DR Veldhoven, The Netherlands*

16:30 PM Break (15 Minutes)

16:45 PM Session 5: Poster Session

Transmission Grating Spectrometer for Broadband Characterization of EUV Sources (S81)

Muharrem Bayraktar¹, Bert Bastiaens², Caspar Bruineman³, Boris Vratzov⁴ and Fred Bijkerk¹

¹ *Industrial Focus Group XUV Optics, MESA + Institute for Nanotechnology, University of Twente, The Netherlands*

² *Laser Physics and Nonlinear Optics, MESA + Institute for Nanotechnology, University of Twente, The Netherlands*

³ *Scientec Engineering, The Netherlands*

⁴ *NT&D – Nanotechnology and Devices, Germany*

Femtosecond Laser Ablation of a Solid Tin Target (S82)

M.J. Deuzeman*, †, E. Leerssen*, A. Stodolna*, N. Spook*, ‡, S. Witte*, §, P.C.M.

Planken*, ‡, K.S.E. Eikema*, §, W. Ubachs*, §, R. Hoekstra*, †, O.O. Versolato*

* *Advanced Research Center for Nanolithography (ARCNL), Science Park 110, 1098 XG Amsterdam, The Netherlands*

† *Zernike Institute for Advanced Materials, University of Groningen, Nijenborgh 4, 9747 AG Groningen, The Netherlands*

§ *Department of Physics and Astronomy, Vrije Universiteit, De Boelelaan 1081, 1081 HV Amsterdam, The Netherlands*

‡ *Van der Waals-Zeeman Instituut, University of Amsterdam, Science Park 904, 1098 XH, Amsterdam, The Netherlands*

Compact Discharge based EUV Source with High-power and Long Maintenance Interval (S83)

Jochen Vieker and Klaus Bergmann

Fraunhofer Institute for Laser Technology – ILT, Steinbachstr. 15, 52074 Aachen, Germany

Development of a Collective Thomson Scattering System for High-Z Plasmas for Soft X-ray Sources (S84)

Yuta Sato, Kentaro Tomita, Toshiaki Euchar, Syoichi Tsukuyomi, Kiichiro Uchino

Interdisciplinary Graduate School of Engineering and Sciences, Kyushu University, 6-1, Kasugakoen, Kasuga, Fukuoka 816-8580, JAPAN

Optimization of Extreme Ultraviolet Emission and the Time of Flight Spectra with Dual-pulse Laser Irradiating Tin-droplet Target (S85)

Lan Hui¹, Wang Xinbing², Zuo Duluo², Zheng Guang¹

¹ *School of Physics and information engineering, Jiangnan University, Wuhan 430056, China*

² *Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, Wuhan 430074, China*

Advanced Laser Development for Plasma-based EUV Generation (S86)

Tiago Pinto, Randy Meijer, Aneta Stodolna, Stefan Witte, Kjeld Eikema
Advanced Research Center for Nanolithography

In-line EUV beam Monitoring using Microwaves (S87)

F.M.J.H. van de Wetering¹, O.J. Luiten¹, G.J.H. Brussaard², V.Y. Banine^{1,2} & J. Beckers¹
¹ *Eindhoven University of Technology, Department of Applied Physics, P.O. Box 513, 5600 MB Eindhoven, The Netherlands*
² *ASML The Netherlands B.V., PO Box 324, 5500 AH Veldhoven, The Netherlands*

Enhancement of X-ray Emission by Double-pulse Target Ablation in a Laser-produced Plasma (S26)

Pranitha Sankar, Reji Philip
Ultrafast and Nonlinear Optics Lab, Light and Matter Physics Group
Raman Research Institute, Bangalore 560080, India

Analysis of the Fine Structure of the EUV Emitting Ions Sn^{7+...14+} (S27)

F. Torretti^{1,2}, A. Windberger^{1,3}, A. Borschevsky⁴, A. Ryabtsev^{5,6}, S. Dobrodey³, H. Bekker³, W. Ubachs^{1,2}, R. Hoekstra^{1,7}, J. R. Crespo López-Urrutia³ and O. O. Versolato¹
¹ *Advanced Research Center for Nanolithography, Science Park 110, 1098 XG Amsterdam, The Netherlands*
² *Department of Physics and Astronomy, Vrije Universiteit, de Boelelaan 1081, 1081 HV Amsterdam, The Netherlands*
³ *Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, Heidelberg, Germany*
⁴ *The Van Swinderen Institute for Particle Physics and Gravity, University of Groningen, Nijenborgh 4, 9747 AG Groningen, The Netherlands*
⁵ *Institute of Spectroscopy, Russian Academy of Sciences, Troitsk, Moscow, Russia*
⁶ *EUV Labs, Ltd., Troitsk, Moscow, 108840 Russia*
⁷ *Zernike Institute for Advanced Materials, University of Groningen, Nijenborgh 4, 9747 AG Groningen, The Netherlands*

EBL2: Versatile EUV Exposure and Analysis facility (S54)

E. (Edwin) te Sligte, N. B. Koster, F. T. (Freek) Molkenboer, P. (Peter) van der Walle, P. M. (Pim) Muilwijk, W. F. W. (Wouter) Mulckhuyse, B.W. (Bastiaan) Oostdijck, C.L. (Christiaan) Hollemans, J. (Jeroen) Westerhout, B. A. H. (Bjorn) Nijland, P.J. (Peter) Kerkhof, M. (Michel) van Putten, A. M. (André) Hoogstrate, A. F. (Alex) Deutz, TNO; *Stieltjesweg 1, 2628 CK Delft -The Netherlands*

Study of Plasma Dynamics and Spectral Tunability in Hollow -cathode Triggered Gas-discharge Sources (S45)

Florian Melsheimer^{1,2,4}, Malte Ranis^{1,2,4}, Daniel Wilson^{1,2,3}, Sophia Schröder^{1, 2, 4} and Larissa Juschkin^{1,2,4}

¹ Forschungszentrum Jülich, Peter Grünberg Institut (PGI-9), Germany

² RWTH Aachen University, Experimental Physics of EUV, Aachen, Germany

³ Forschungszentrum Jülich, Peter Grünberg Institut (PGI-6), Germany

⁴ Jülich-Aachen Research Alliance (JARA), Fundamentals of Future Information Technology, Germany

Alternative Emitters for LPP sources around 6.x nm (S47)

Alexander von Wezyk, Klaus Bergmann

Fraunhofer Institute for Laser Technology, Steinbachstr. 15, 52074 Aachen, Germany

Picosecond Laser Krypton Plasma Emission in Water-Window Spectral Range (S48)

P. Vrba¹, M. Vrbova²

¹Institute of Plasma Physics, Czech Academy of Sciences, 182 00 Prague 8, CR

²Czech Technical University, Faculty of Biomedical Engineering, 272 01 Kladno, CR

18:15 PM Leave for Off-site Dinner

19:00 PM Dinner (2 Hours)

**Wednesday, November 9, 2016
(Amsterdam Science Park Congress Centre)**

8:40 AM Announcements and Introductions

Welcome, Announcements and Introduction (Intro-1)

Vivek Bakshi, *EUV Litho, Inc., USA*

8:50 AM Session 6: Keynote Session -6

Session Chair:

Interferometry, Spectroscopy and Lensless Imaging with Extreme-ultraviolet Radiation(S3)

Stefan Witte
ARCNL and VU University Amsterdam

9:30 AM Session 7: XUV Applications

Session Chairs:

Coherent Diffraction Imaging with Partially-coherent Discharge Plasma based EUV Sources (S71) (Invited)

Larissa Juschkin^{1,2}, Jan Bußmann^{1,2}, Michal Odstrcil^{1,3}, Raoul Bresenitz¹, Yusuke Teramoto⁴, Marco Perske⁵, Torsten Feigl⁵, William S. Brocklesby³

¹ *Chair for Experimental Physics of EUV, JARA-FIT, RWTH Aachen University, Steinbachstrasse 15, 52074 Aachen, Germany*

² *Peter Grünberg Institute 9, JARA-FIT, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany*

³ *Optoelectronics Research Center, University of Southampton, SO17 1BJ, United Kingdom*

⁴ *BLV Licht- und Vakuumtechnik GmbH, Steinbachstraße 15, Aachen, Germany*

⁵ *OptiXfab. GmbH, Hans-Knoell-Str. 6, 07745 Jena, Germany*

Transient XUV and X-ray lasers pumped by Free-Electron Laser Sources (S72) (Invited)

N. Rohringer
Max Planck Institute for the Structure and Dynamics of Matter Hamburg, 22761, GERMANY

**Water-Window X-Ray Pulses from a Laser-Plasma Driven Undulator (S73)
(Invited)**

Andreas R. Maier

Center for Free-Electron Laser Science & Department of Physics, Hamburg University

Optimization of Laser-produced Plasma towards the Generation of High-order Harmonics (S74)

N. Smijesh*, Kavya H. Rao, D. Chetty, R. T. Sang and I. Litvinyuk

*Australian Attosecond Science Facility, Centre for Quantum Dynamics, Griffith University
Nathan Campus, QLD-4111, Australia.*

10:50 Break (15 Minutes)

11:05 PM Session 8: XUV Sources (Including HHG)

Session Chairs:

Fiber Laser - driven High Harmonic Generation as Powerful Source for Applications (S41) (Invited)

Steffen Hädrich¹, Jan Rothhardt^{2,3}, Jens Limpert^{2,3,4}

¹*Active Fiber Systems GmbH, Wildenbruchstraße 15, 07745 Jena, Germany*

²*Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena,
Albert-Einstein-Straße 15, 07745 Jena, Germany*

³*Helmholtz Institute Jena, Fröbelstieg 3, 07743 Jena, Germany*

⁴*Fraunhofer Institute for Applied Optics and Precision Engineering, Albert-Einstein-Straße 7,
07745 Jena, Germany*

Enhancement of Extreme-Ultraviolet Fluorescence and Localized High Harmonic Generation using Structured Solids (S42) (Invited)

Murat Sivis

*4th Physical Institute - Solis and Nanostructures, Georg-August University, Göttingen,
Germany*

Applications of a Table-top Laser Driven EUV/Soft X-ray Source and Wavefront Optimization at Short Wavelengths (S43) (Invited)

K. Mann, J.O. Dette, M. Lübbecke, T. Mey, M. Müller, B. Schäfer

Laser-Laboratorium Göttingen e.V., D-37077 Göttingen, Germany

Unresolved Transition Array (UTA) Emission from Highly -charged Ions in Heavy-element Plasmas by a Dual-laser Pulse Irradiation (S44) (Invited)

Takeshi Higashiguchi

Department of Electrical and Electronic Engineering, Faculty of Engineering and CORE, Utsunomiya University, Yoto 7-1-2, Utsunomiya, Tochigi 321-8585, Japan

Laser-produced Highly-ionized Aluminum Plasma for High Harmonic Generation (S46)

N. Smijesh¹, Kavya H. Rao¹, N. Klemke¹, R. Philip², I. Litvinyuk¹ and R. T. Sang¹

¹*Australian Attosecond Science Facility, Centre for Quantum Dynamics, Griffith University Nathan, QLD-4111, Australia*

²*Ultrafast and Nonlinear Optics Lab, Light and Matter Physics Group, Raman Research Institute, Bangalore 560080, India*

**12:45 Lunch and Break (90 Minutes)
(Tour of ARCNL from 1:15 PM to 2:15 PM)**

2:15 PM Session 9: Optics for EUV and BEUV

Session Chairs:

Multilayer and Thin Film Coatings for EUVL and Beyond (S51) (Invited)

I.A. Makhotkin, D.S. Kuznetsov, R.A.J.M. van den Bos, R. Coloma Ribera, S.P. Hendrikx, A. Zameshin, J. M. Sturm, C.J. Lee, R.W.E. van de Kruijs, A. Yakshin, E. Louis and F. Bijkerk
MESA+ Institute for Nanotechnology, University of Twente, Netherlands

Leading Edge EUV /XUV Optics – Recent Highlights (Tentative Title) (S52) (Invited)

Torsten Feigal
optiXfab, Germany

A Study of EUV/SXR Grazing Incidence Collectors for Metrology Sources (S52) (Invited)

Ladislav Pina¹ and Andrzej Bartnik²

¹*Czech Technical University, Prague*

²*Institute of Optoelectronics, Military University of Technology, Warsaw*

3:15 PM Session 10: FEL based Sources for EUV

Session Chairs:

Recent Activities at FLASH and European XFEL (S61) (Invited)

M. V. Yurkov
DESY, Hamburg

**Strategy to Realize the EUV-FEL High-power Light Source:
Present Status on the EUV-FEL R&D Activities (S62) (Invited)**

Hiroshi Kawata
High Energy Accelerator Research Organization (KEK), Tsukuba, Ibaraki 305-0801, Japan

**Linear and Non-linear Interaction of X-ray Free Electron Laser Radiation
with Materials (S63) (Invited)**

Hermann A. Dürr
*SLAC National Accelerator Laboratory, Menlo Park CA 94025, USA and Van der Waals
– Zeeman Institute, University of Amsterdam, Science Park 904 C4 23, 1098XH
Amsterdam, The Netherlands*

4:15 PM Break (15 Minutes)

4:30 PM Session 11: Modeling

**Multiphysics Model of Plasma Interaction with Gas flow in EUV Source chamber
(S31) (Invited)**

D. Astakhov¹, V. Konovalov^{1,2}, I. Vichev^{1,2}, M. Kraposhin³, Yu. Mankelevich^{1,4}, V. Ivanov^{1,5},
I. Popov⁶, A. Ziganshin¹, D. Labetsky⁷, V. Medvedev^{1,2}, A. Yakunin⁷, K. Feenstra⁷

¹ *RnD-ISAN, Moscow, Troitsk, Russia*

² *KIAM RAS, Moscow, Russia*

³ *Institute for System Programming RAS, Moscow, Russia*

⁴ *SINP MSU, Moscow, Russia*

⁵ *Institute for Spectroscopy RAS, Moscow, Troitsk, Russia*

⁶ *ISTEQ, Eindhoven, The Netherlands*

⁷ *ASML Netherlands B.V., De Run 6501, 5504 DR Veldhoven, The Netherlands*

How a Laser Impact Propels, Deforms and Fragments a Liquid Drop: The Liquid Dynamics of the Pre-pulse (S32) (Invited)

Hanneke Gelderblom¹, Alexander L. Klein¹, Henri Lhuissier², Emmanuel Villermaux³, Dmitry Kurilovich⁴, Oscar Versolato⁴, Jacco H. Snoeijer^{1,5} and Detlef Lohse¹

¹ *Physics of Fluids, Faculty of Science & Technology, University of Twente, The Netherlands,*

² *IUSTI - Aix-Marseille Universit e, France,*

³ *IRPHE - Aix-Marseille Universit e, France,*

⁴ *Advanced Research Centre for Nanolithography, The Netherlands,*

⁵ *Mesoscopic Transport Phenomena, Department of Applied Physics, Eindhoven University of Technology, The Netherlands*

Simulating EUV Generation in Laser-Produced Plasma (S33) (Invited)

Howard Scott¹ and Frank McQuillan²

¹ *Lawrence Livermore National Laboratory, Livermore, CA, USA*

² *School of Physics, University College Dublin, Belfield, Dublin, Ireland*

Application of Plasma Formation Modeling for LPP EUV Sources (S34) (Invited)

Michael Purvis^a, Alexander Schafgans^a, Daniel Brown^a, Igor Fomenkov^a, Rob Rafac^a, Josh Brown^a, David Brandt^a, Harry Kreuwel^b, Andrei Yakunin^b, Aaron Fisher^c, Howard Scott^c, , Dave Eder^c, Scott Wilks^c, Anthony Link^c, Jave Kane^c, Fred Hartemann^c, Alice Koniges^d, Kevin Gott^d, Steve Langer^c

^a *Cymer LLC, 17075 Thormint Ct, San Diego, USA*

^b *ASML Netherlands B.V., De Run 6501, 5504 DR Veldhoven, The Netherlands*

^c *Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, CA 94550, USA*

^d *Lawrence Berkeley National Laboratory, 1 Cyclotron Rd., Berkeley, CA 94720, USA*

5:50 PM Workshop Summary and Announcements

2016 Source Workshop Summary

Vivek Bakshi

EUV Litho, Inc.

Workshop Adjourned

