PROCEEDINGS OF SPIE

X-Ray Free-Electron Lasers: Beam Diagnostics, Beamline Instrumentation, and Applications

Stefan P. Moeller
Makina Yabashi
Stefan P. Hau-Riege
Editors

13–16 August 2012
San Diego, California, United States

Sponsored and Published by
SPIE

Volume 8504

Proceedings of SPIE 0277-786X, V. 8504

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

X-Ray Free-Electron Lasers: Beam Diagnostics, Beamline Instrumentation, and Applications,
edited by Stefan P. Moeller, Makina Yabashi, Stefan P. Hau-Riege, Proc. of SPIE Vol. 8504, 850401
 · doi: 10.1117/12.2012088

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:
Author(s), "Title of Paper," in *X-Ray Free-Electron Lasers: Beam Diagnostics, Beamline Instrumentation, and Applications*, edited by Stefan P. Moeller, Makina Yabashi, Stefan P. Hau-Riege, Proceedings of SPIE Vol. 8504 (SPIE, Bellingham, WA, 2012) Article CID Number.

ISSN: 0277-786X
ISBN: 9780819492210

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

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

SPIE Digital Library

SPIEDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B … 0Z, followed by 10-1Z, 20-2Z, etc.

The CID Number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID Number.

Contents

OPTICS I

DETECTORS

APPLICATIONS

LASERS

DIAGNOSTICS II

POSTER SESSION

Conference Committee

Program Track Chair

Carolyn A. MacDonald, University at Albany (United States)

Conference Chairs

Stefan P. Moeller, SLAC National Accelerator Laboratory (United States)
Makina Yabashi, SPring-8/RIKEN (Japan)
Stefan P. Hau-Riege, Lawrence Livermore National Laboratory (United States)

Conference Program Committee

Henry N. Chapman, Deutsches Elektronen-Synchrotron (Germany)
Christian David, Paul Scherrer Institut (Switzerland)
Alan R. Fry, SLAC National Accelerator Laboratory (United States)
Gerhard Grübel, Deutsches Elektronen-Synchrotron (Germany)
Nina Rohringer, Max-Planck-Arbeitsgruppen für strukturelle Molekularbiologie (Germany)
Harald Sinn, European XFEL GmbH (Germany)
Kai Tiedtke, Deutsches Elektronen-Synchrotron (Germany)
Niels van Bakel, Nationaal instituut voor subatomaire fysica (Netherlands)

Session Chairs

1 Diagnostics I
Stefan P. Moeller, SLAC National Accelerator Laboratory (United States)

2 Optics I
Christian David, Paul Scherrer Institut (Switzerland)

3 Detectors
Lothar Strueder, Max-Planck-Gesellschaft (Germany)

4 Applications
Adrian L. Cavalieri, Max Planck Research Department for Structural Dynamics (Germany)

Introduction

The conference *X-Ray Free-Electron Lasers: Beam Diagnostics, Beamline Instrumentation, and Applications* was held for the first time in San Diego, California from August 13–16, 2012.

With the successful start–up and operation of the first hard X-ray free-electron laser (FEL), the Linac Coherent Light Source (LCLS) at Stanford in April of 2009, and, more recently, Japan's SPring-8 Angstrom Compact FEL, SACLA, in June of 2011, novel x-ray sources with unprecedented beam properties have become operational, offering great promise for exploring new scientific possibilities in ultrafast science with hard X-rays. These 4th generation light sources operate in the Self Amplified Stimulated Emission (SASE) mode and provide radiation with wavelengths typically as short as about 1Å and pulses of unrivaled brightness, brevity, peak power density, and transverse coherence, exceeding the values of the same parameters as 3rd Generation synchrotron radiation sources by up to ten orders of magnitude. The implementation of this class of sources using superconducting linac technology, for example in the European XFEL in Germany (planned operation in ca. 2015) and the FLASH VUV FEL, successfully operating since 2005, is also expected to match or exceed the time-averaged power density generated by most present day sources by several orders of magnitude. Besides the aforementioned facilities, there are nearly a dozen other FELs currently being proposed or under construction. All are scheduled to become operational before 2020.

The rapidly growing user community utilizes these sources for experiments in areas ranging from atomic physics, material science, x-ray diffraction, and x-ray coherent imaging to high-energy-density physics. The experimental techniques are becoming increasingly complex posing great challenges for beam transport and beam shaping optics, diagnostics, and detectors as well as synchronization techniques with optical lasers for pump probe experiments. Interpretation of scientific results necessitates the development and refinement of beam pulse diagnostic techniques. New developments are already underway to advance specialized schemes to generate ultra-short pulses of a few femtoseconds, and various seeding techniques promising improved bandwidth and coherence properties that will involve novel directions in scientific applications.

This conference captured recent developments in this exciting field, spanning topics from new facilities, optical components, instrumentation, beam diagnostics to optical lasers, novel detectors, applications, and simulations.

We gratefully acknowledge the support of SPIE in adding this conference to their program, and thank them for their outstanding organization of the conference as well as to the editorial staff for their efforts in publishing the proceedings' volume.

We would also like to thank the Program Committee for their support in many aspects of the program's organization, and the session chairs for their help in running the conference. Without the participants and their high-quality, scientific, and meaningful contributions, the success of 2012 meeting would not have been possible. Thank you.

Stefan Moeller
Makina Yabashi
Stefan Hau-Riege