EUROPHOTON 2016

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<td>The papers included in this digest comprise the short summaries of the 7th EPS-QEOD Euro photon Conference held in Vienna, Austria from 21 to 26 August 2016. The extended version of the papers (1-page summaries in pdf format) will be made available online during a time period of 2 months beginning from the conference. A link with login and password is provided on a separate sheet.</td>
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<tr>
<td>All web browsers (Firefox, Internet Explorer, Safari or similar) will allow you to download the digest.</td>
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<td>A .pdf viewer (tested with Adobe Acrobat) will be necessary to view the papers. This software can be downloaded from <a href="http://www.adobe.com">http://www.adobe.com</a></td>
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Europhysics Conference Abstracts Volume 40 B, ISBN 979-10-96389-00-1
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Europhoton 2016 is organized by

European Physical Society
Quantum Electronics and Optics Division

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### List of Exhibitors

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<th>Company</th>
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<tr>
<td><strong>CRYSTALLINE MIRROR SOLUTION</strong></td>
<td>represent a ground-breaking optics technology, enabling radically new applications and products for the laser-based precision-metrology market. Without requiring modifications to existing measurement systems, our products provide an immediate 10- to 100-fold improvement in the limiting performance of optically-enabled time and frequency measurement schemes. In addition, the crystalline coating process also enables unprecedented optical performance of mid-IR mirrors and thermal performance for high power/ultrafast laser systems. <a href="http://www.crystallinemirrors.com/">http://www.crystallinemirrors.com/</a></td>
</tr>
<tr>
<td><strong>EKSMA Optics</strong></td>
<td>is a manufacturer of precision components for high power laser applications. Product range includes laser optics, opto-mechanics and nonlinear crystals for 193-20,000nm range, Pockels cells, HV drivers and ultrafast pulse picking systems. Company owns IBS coating facility, optics and crystals polishing facilities, spherical and aspherical lenses production facilities. <a href="http://www.eksmaoptics.com">www.eksmaoptics.com</a></td>
</tr>
<tr>
<td><strong>EKSPLA</strong></td>
<td>is an innovative manufacturer of lasers, systems and components from custom system for basic research to small OEM series. In-house R&amp;D team enables to tailor products for specific applications and/or according to specific requirements. Main products are femtosecond, picosecond and nanosecond lasers, tunable-wavelength systems, ultrafast fiber lasers, spectroscopy systems and laser electronics. <a href="http://www.ekspla.com">www.ekspla.com</a></td>
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<tr>
<td><strong>Laser Quantum</strong></td>
<td>is a world-class manufacturer of revolutionary solid-state and ultrafast lasers. Our products lead the industry in performance specifications, reliability, compactness and operational lifetime. You will find Laser Quantum lasers used in laboratories and integrated in systems and machines worldwide. Our lasers are helping scientists to break new ground in many applications ranging from attosecond physics to forensics and genomics. <a href="http://www.laserquantum.com/">http://www.laserquantum.com/</a></td>
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<tr>
<td><strong>Light Conversion</strong></td>
<td>is the world-leader for tunable ultrafast OPA systems with the worldwide recognized TOPAS series products. Light conversion is also an established manufacturer of Yb-based laser PHAROS (180 fs, up to 20w, 2mJ, 1MHz), harmonics generators, parametric amplifier “ORPHEUS” and time-resolved spectrometers. Together the portfolio forms a 'best-in-class' set of devices for femtosecond applications in industry, medicine, and fundamental research. <a href="http://www.lightcon.com">www.lightcon.com</a></td>
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http://www.nufern.com

Excitement is not measurable. Light is.
Menlo Systems, a leading developer and global supplier of instrumentation for high-precision metrology, was founded in 2001 as a spin-off of the Max Planck Institute for Quantum Optics, with the foremost aim to commercialize measurement technologies and make it available to emerging application fields. Menlo Systems maintains a strong bond to co-founder Theodor W. Hänsch, who pioneered precision laser techniques. Known for the Nobel Prize-winning optical frequency comb technology, the Munich-based company offers complete solutions based on lasers and synchronization electronics. Applications for our products and solutions span from research laboratories to truly industrial tasks. The patented technology is recognized by global laser manufacturers to whom we deliver solutions for integration into cutting-edge products.
http://www.menlosystems.com/

http://www.picoquant.com

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As the first laser company, Spectra-Physics is singularly focused on helping customers use precision laser technologies to advance science and propel industries forward. The company does so by offering groundbreaking technologies, deep applications expertise, disruptive cost-performance, and a commitment to world-class customer experience. Our product portfolio spans CW to nanoseconds to femtosecond, UV to mid-infrared, and fiber to DPSS lasers. We enable applications in industrial and microelectronics manufacturing, medical and life sciences, and scientific research. http://www.newport.com/

Standa Ltd. was founded in Vilnius, Lithuania in 1987 and now has more than 150 employees working at the company. Standa has its own industrial base that includes CNC turning, milling, grinding machines. Standa’s design department, while developing standard products presented in Standa’s catalogue (such as motorized and manual translation and rotation stages, motion controllers, optical tables, vibration isolation systems, optical mounts and holders, optics, dpps lasers and etc.) also develops the equipment for OEM customers. Some examples of it, after the agreement with OEM customers, are shown on this website. Standa currently has several laser product development laboratories. http://www.standa.lt/

TRUMPF Scientific Lasers GmbH + Co. KG

TRUMPF Scientific Lasers is a Joint Venture between TRUMPF and Professor Dr. Ferenc Krausz, Director Max-Planck-Institute for Quantum Optics Garching, Munich. We are a high-tech company focusing on high-power femtosecond laser technology especially on optic parametric amplifiers and high energy picosecond lasers. Base technology is the TRUMPF disk laser technology. www.trumpf-scientific-lasers.com
Introduction

The Europhoton conference features the latest breakthroughs in the field of Solid-State, Fibre, and Waveguided Light Sources. The conference will be held in the TU Vienna, Austria (Campus Gusshaus - Gusshausstrasse 27) close to the city centre with many attractions easily accessible by foot or by excellent public transportation. World-renowned researchers discuss the latest developments in the scientific community accompanied by Summer School sessions at the PhD student and postdoctoral level, and by informal breakout sessions for discussion and company display. This conference will also feature a half-day special Symposium on “Novel Laser-matter Interaction regimes” where prominent Keynote and Invited Speakers will discuss state of the art and future visions for this fascinating field. The seventh in a row, the Europhoton conference series has shown to be very popular among the scientists and engineers who have continued to place it on their calendars.

The conference is organised by the European Physical Society and the TU Vienna in cooperation with the Quantum Electronics and Optics Division (QEOD) of EPS.

The Conference Programme includes:

- The Summer School on Frontiers of Solid State Light Sources from Sunday 21 August (afternoon) to Monday 22 August 2016 (all day)
- The main Conference on Solid-State, Fibre, and Coherent Light Sources from Tuesday 22 August (morning) to Friday 26 August 2016 (evening)
- A half-day special Symposium on “Novel Laser-matter Interaction Regimes” on Tuesday 23rd and Wednesday 24th August 2016 (morning).

The 7th EPS-QEOD Europhoton Conference 2016 technical programme includes keynote, invited and selected contributed papers completely encompassing the field of lasers and photonics. All aspects of the technologies will be covered, including fundamentals, device development, systems, and applications.

Short abstracts of the papers to be presented at the EPS-QEOD Europhoton Conference 2016 appear in this programme. 240 presentations (6 Summer School lectures, 2 keynotes, 12 invited speakers including 2 speakers for the Special Symposium, 89 orals, and 131 poster presentations from Europe and overseas) have been selected for presentation at the Conference.

Tabletop Exhibit

A tabletop exhibit will be organised from Tuesday 23 August (morning) to Thursday, 25 August (afternoon). It will take place on the ground floor near the Lecture Hall. It will be co-located with coffee breaks. This exhibition will allow laser and photonics related companies to present and promote their new products among attendees.
EUROPHOTON 2016

Summer School
The Europhoton Conference includes a Summer School on "Frontiers of Solid-State Light Sources". The Summer School will be held from Sunday 21 August (afternoon) to Monday 22 August (all day), 2016. PhD Students and Postdocs who have paid the conference fee are especially invited to attend the Summer School. They will receive free entrance to the School. The same rule will be applied for the full paying conference participants. Lecturers who are internationally renowned in their research subjects will present the lecture programme. The Summer School will give students a chance to get introduced into various laser related subjects, covering the basics up to the latest research results.

Poster Sessions
Poster sessions for contributed papers have been a major attraction at recent conferences. Poster presentations provide a direct interaction between the presenter and the viewer. To allow participants to see as many posters as possible, 3 sessions are organised from Tuesday 23 to Thursday 25 August 2016 in the afternoon. All posters will be displayed in the rooms located next to the main lecture hall. There will be no oral presentations during this time.

Each author is provided with one bulletin board. Poster size should be portrait format A0 (120 cm high x 80 cm wide). The boards will be marked with the paper session code (ex. PO-1.x; PO-2.xy; PO-3.yy)

All authors are requested to display posters on their allocated boards in the morning of the day of their presentation. Fixing material (tape) will be provided. Posters still in their places in the evening will be removed and discarded by the conference organization. In order to present their work and answer questions, authors are requested to be present in the vicinity of their poster during the poster session. The schedule of the poster sessions is presented on the respective pages of this programme.

Speakers' Information
Speakers are asked to check-in with the session presider in the conference room ten minutes before the session begins. Speakers will have also the opportunity to check their presentation at the registration counter.

Total length of the talks:
Keynote presentations: 45 minutes presentation including 10 minutes for discussion
Invited presentations: 30 minutes presentation including 10 minutes for discussion.
Oral presentations: 15 minutes including 5 minutes for discussion.

A laptop with Windows 7 or Windows 10, PowerPoint (for ppt and pptx format files) and Adobe Reader (for pdf format file) will be available. Authors will transfer their oral presentation files by USB memory stick.

All oral sessions take place in the main auditorium so called Lecture Hall E17 of Campus Gusshaus.

Abbreviations for the sessions:
SSL: Solid-State Lasers
FWG: Fibre and Waveguide Devices
SS: Special Symposium on Novel Laser-Matter Interaction Regimes

Conference Language
English will be the official conference language.

Technical Digest
The registration fee includes an online technical digest including the one-page summaries.
General Information

Social Programme
Each registered participant is cordially invited to attend the social programme as detailed below.

Welcome Reception: Monday 22 August 2016, 18:45 – 21:00.

The welcome reception will take place in the Kuppelsaal of the main building of TU Vienna. (Karlsplatz 13, 1040 Wien).


The conference dinner will take place at the Wiener Rathauskeller, Rathausplatz 1, 1010 Wien in the basement of the Viennese City Hall. The location is easy to reach by underground U2 (station Karlsplatz – station Rathaus) or by tram No 1 from the conference site (stop Paulanergasse – stop Rathausplatz/Burgtheater). Tradition and culinary delights meet in the traditional halls and parlours of the Wiener Rathauskeller have been known as the “centre of good taste” since their opening in 1899. An extra fee of 10€ has been asked during the registration on-line. Accompanying guests will pay an extra fee of 30€. No reservation can be done on site.
EUROPHOTON 2016

General Information

Conference & Social Programme Locations

The conference will take place at the TU Vienna, Campus Gusshaus.

Address: Gusshausstrasse 27-29, 1040 Vienna, Austria.
Phone: +43 1 58801-0
All oral sessions take place in the Lecture Hall EI7.

All poster sessions take place in rooms located next to the main lecture.

Exhibition and coffee breaks also take place in rooms next to the lecture hall.
EUROPHOTON 2016

General Information

On-Site Facilities
Wireless Internet is available inside the building of the conference centre with free access. A message board around the registration area will be installed.

Lunches
Lunches are not included in the registration fees. No lunch (in any form) is possible inside the conference room. Several restaurants are located at a short walking distance from the conference venue.

Coffee Breaks
Coffee breaks take place directly next to the lecture room. The exhibition will take place at the same time.

Registration Information
The registration fees for the meeting include:
- Admission to all technical sessions of the main conference on "Solid-State, Fibre, and Waveguide Coherent Light Sources", as well as to the Special Symposium on "Novel Laser-Matter Interaction Regimes" which will take place on Tuesday, 23rd and Wednesday morning 24th August 2016.
- Admission to the Summer School on "Frontiers of Solid-State Light Sources": PhD Students and Postdocs who have paid the conference fee are especially invited to attend the Summer School. They will receive free entrance to the School. The same rule will be applied for the full paying conference participants.
- Online digest including the one-page summaries.
- Welcome Reception as mentioned in the Social Programme (Conference Dinner is only included provided an additional extra cost of 10€ per participant was paid)
- Entrance to the exhibition.
- Coffee breaks as mentioned in the programme.

Lunches are not included. Tickets for public transports are not included.

As a rule, due to space limitations and necessary advance reservation, on site registrants may not be able to attend the social programme. No fee reduction will be applied. Also, no guest tickets can be obtained on site.
General Information

EUROPHOTON 2016

Conference Registration Hours:

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<tr>
<th>Day</th>
<th>Morning</th>
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Conference Hours:

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Coffee Breaks:

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Lunch Breaks:

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Social Programme:

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<tr>
<td>Wednesday 24 August</td>
<td>19:30 – 22:00</td>
<td>Wiener Rathauskeller</td>
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Special Event:

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<tr>
<td>Thursday 25 August</td>
<td>17:00 – 18:00</td>
<td>Lecture Hall EI7</td>
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(*) Summer School
(**) including Special Student Training Session
(*** including Post deadline session

(**) held in conjunction with the poster session

18:00 – 18:30
Conference Committees

General Chair: Andrius Baltuska, TU Vienna, Austria
Programme Chair: F. Ömer Ilday, Bilkent University, Ankara, Turkey
Local Chairs: Audrius Pugzlys and Markus Kitzler, TU Vienna, Austria

Programme Sub-Committee “Solid-State Lasers”
Chair: Majid Ebrahim-Zadeh, The Institute of Photonic Sciences (ICFO), Barcelona, Spain
Antonioangelo Agnesi, Università di Pavia, Pavia, Italy
Eric Cormier, University of Bordeaux, Bordeaux, France
Shekhar Guha, Air Force Research Laboratory, Materials and Manufacturing Directorate, Wright Patterson Air Force Base, Ohio, USA
Christian Kränkel, University of Hamburg, Hamburg, Germany
Vaslav Kubecek, Czech Technical University, Prague, Czech Republic
Marco Marangoni, Politecnico di Milano, Milan, Italy
Uwe Morgner, University of Hannover, Laser Zentrum Hannover, Hannover, Germany
Fabian Rotermund, Ajou University, Suwon, South Korea
Alphan Sennaroğlu, Koç University, Istanbul, Turkey

Programme Sub-Committee “Fibre and Waveguide Devices”
Chair: Johan Nilsson, University of Southampton, ORC, Southampton, United Kingdom
Rodrigo Amezcua Correa, CREOL, Orlando, USA
Mark Dubrinskii, US Army Research Laboratory, Adelphi, USA
Phillipe Grelu, Université de Bourgogne, Dijon, France
Xavier Mateos, Max Born Institute, Berlin, Germany
Markus Pollnau, Kungliga Tekniska Högskolan, Kista, Sweden
Thomas Schreiber, Fraunhofer Institute for Applied Optics, Jena, Germany
John Travers, Max Planck Institute for the Science of Light, Erlangen, Germany
Yoann Zaouter, Amplitude Systèmes, Evry, France

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Andrius Baltuska, Technical University of Vienna, Austria (ex officio)
Andrew Clarkson, University of Southampton, ORC, Southampton, United Kingdom (QEDC representative)
Patrick Georges, Institut d’Optique, Palaiseau, France
Ingmar Hartl, DESY, Hamburg, Hamburg, Germany
Ömer Ilday, Bilkent University, Ankara, Turkey (ex officio)
Thomas Südmeyer, University of Neuchâtel, Neuchâtel, Switzerland

Conference Management
The European Physical Society provides the Conference Management, 6 rue des Frères Lumière, 68200 Mulhouse, France.

This programme is edited by O. Fornari and A. Wobst.
Vienna

Vienna is the capital and the largest city of Austria with a population of about 1.8 million (2.6 million within the metropolitan area) and it is the second-largest German-speaking city. Vienna is host to many major international organizations, including the United Nations and OPEC. In 2001, the city centre was designated a UNESCO World Heritage Site. The city is quite rich in culture.

Many sights are located in or around the present city center, as this was the entire city for many centuries, strictly confined by a fortification. Only few romanesque and gothic buildings remain, which are typically churches. The most famous one is certainly St. Stephen's Cathedral, which marks the very center of Vienna and features both medieval architectural styles. The imperial Hofburg. Palace also has a medieval core, but was extended and modified many times in various kinds of styles, such that the original look is well concealed today.

The baroque style is much more prominent in Vienna (and Austria). Many churches were built in that period, among them St. Charles's Church, which is located in close proximity to the conference venue. But there are also important secular buildings from the baroque era, most prominently Schönbrunn and Belvedere palaces.

The predominant historic style, however, dates back to the latter half of the 19th century, and is generally known as historicism. It means that previous styles were copied and often combined. As in many other cities, the fortification was eventually torn down, making room for a circular boulevard around the city center with many important buildings, such as the City Hall, the State Opera, the Parliament and several others. The architectural style was often chosen according to the function of the building.

Around 1900, the Jugendstil (Art nouveau) emerged, and there are still several remnants of that era, most notably the Vienna Secession building, which is not far from the conference venue. The first metropolitan railways, built by Otto Wagner, also date back to that era, and you can still see the historic Karlsplatz station building close to the venue. Soon thereafter, modernism emerged, which was widely applied in an unparalleled municipal tenement building program. One of the most prominent architectural evidence of that era is the Karl-Marx-Hof with more than 1300 apartments. It is more than a kilometer long and remains the longest residential building in the world to date.

Museums

Vienna has a long tradition of arts, and consequently a large number of museums. The collections on display range from traditional paintings to very specialized topics such as globes, schnapps or undertakers.

During their long reign, the Habsburg dynasty collected numerous works by artists such as Raphael, Caravaggio, Tizian, Rubens, Bruegel, Arcimboldo and many others. Those paintings, as well as artefacts from ancient civilizations, are on display in the Kunsthistorisches Museum. Speaking of Habsburg: The crown jewels of the Holy Roman Empire and the Austrian Empire as well as many other valuables can be seen in the Secular and Ecclesiastical Treasury.

Paintings of the 19th and early 20th centuries, most notably Klimt, Schiele and Kokoschka, are hosted in the Upper Belvedere. Similarly, the Leopold Museum is focused on paintings of the early 20th century. It is located in the so called Museumsquartier, a complex which houses several museums, but also bars and restaurants. An impressive collection of drawings (e.g. by Düer) and prints can be found in the Albertina.

The history of Vienna is well represented in the Wien Museum, next to St. Charles's Church not far from the conference venue. MAK, the museum of applied arts, has a large collection of handicrafts from medieval to contemporary periods. The Sigmund Freud Museum is located in the former place where the inventor of psychoanalysis lived and worked. The rich Jewish history of Vienna is revealed in the Jewish Museum Vienna.

This is only a short list of the most prominent museums.

Music

What would Vienna be without music? The Wiener Klassik (First Viennese School) features the most famous composers of the late 18th century: Haydn, Mozart and Beethoven. None of them was born in Vienna, but they all moved to the city, worked and died here. Needless to say that there are many opportunities to listen to their works.
But also in the 19th century, especially the second half, several famous musicians emerged in Vienna, e.g. Brahms, Mahler or the Strauss family. The An der schönen blauen Donau (Blue Danube) waltz by Johann Strauss the younger is probably the best known musical score of the time and has been used in many movies such as Kubrick's 2001.

Based on that long tradition, there are many places in Vienna where one can listen to classical music (in a wider sense, including the 19th and early 20th centuries as well). First of all, the well-known Vienna State Opera is certainly worth a visit, but be aware that it is not always easy to obtain tickets. There are two more opera houses in the city: one is the so called Theater an der Wien, quite close to the conference venue and the other one is the Volksoper (People's Opera), which also features operettas and musicals.

Get Around
Public transportation in Vienna is very good. Luckily, all means of public transportation within the city limits can be used with the same ticket (one exception is the yellow trams circulating around the city center). Tickets are sold at tobacconists, at vending machines in underground and S-Bahn stations.

From Vienna airport to the conference venue
Railjet and IC
Railjets (RJ) and intercity trains (IC) depart from the airport at 03 and 33 min past the hour and bring you to the main railway station (Wien Hauptbahnhof) within 15 minutes. The cost of a one-way ticket is 8.60€. From Wien Hauptbahnhof take subway U1: one stop to Taubstummengasse or two stops to Karlsplatz.

Currency
The official currency in Vienna is the Euro.

Weather
The climate in Austria is typically temperate. The temperatures are mild in summer. End of August may be nice but occasional showers may happen.
Programme at a Glance

### Sunday 21 August 2016 (Summer School)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
</table>
| 13:45 - 15:45 | Summer School Lecture 1  
Giulio Cerullo, Politecnico di Milano, Italy  
"Micro/nanostructuring with Ultrashort Laser Pulses » |
| 15:45 - 16:15 | Coffee Break |
| 16:15 - 18:15 | Summer School Lecture 2  
See Lang Chin, Center for Optics, Photonics and Laser (COPL) Laval University, Quebec City, Canada  
"Femtosecond Laser Filamentation and Some Applications » |

### Monday 22 August 2016 (Summer School)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
</table>
| 08:00 - 10:00 | Summer School Lecture 3  
Ursula Keller, Department of Physics, Institute for Quantum Electronics ETH Zürich, Zürich, Switzerland  
"Semiconductor Saturable Absorber Mirror (SESAM) » |
| 10:00 - 10:30 | Coffee Break |
| 10:30 - 12:30 | Summer School Lecture 4  
Almantas Galvanauskas, Electrical Engineering and Computer Science Department University of Michigan, Ann Arbor, Michigan, USA  
"High Brightness Fiber Laser Technologies" |
| 12:30 - 13:45 | Lunch Break |
| 13:45 - 15:45 | Summer School Lecture 5  
Paul B. Corkum, Joint Attosecond Science Laboratory University of Ottawa, Ottawa, Canada  
"From Femtosecond to Attoseconds" |
| 15:45 - 16:15 | Coffee Break |
| 16:15 - 18:15 | Summer School Lecture 6  
Christopher Barty, Lawrence Livermore National Laboratory, Livermore, USA  
Megajoule-class Lasers for Fusion and Beyond |
| 18:45 – 21:00 | Welcome Reception and Welcome Speech |

### Tuesday 23 August 2016 (Conference)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00 - 08:15</td>
<td>Welcome presented by Andrius Baltuska and Ömer Ilday</td>
</tr>
</tbody>
</table>
| SS-1 08:15 - 10:00 | Special Symposium – Novel Laser-matter Interaction Regimes (I)  
(oral session and Special Symposium) |
| 10:00 - 10:30 | Coffee Break |
| SSL-1 10:30 - 12:30 | Frequency Combs and CEP-Stabilised Sources (oral session) |
| 12:30 - 13:45 | Lunch Break |
| FWG-1 13:45 - 15:45 | Beam Combination (oral session) |
| PO.1 15:45 - 17:00 | Poster Session 1 with Coffee Break |
| FWG-2 17:00 - 19:00 | Fiber Lasers and Amplifiers (oral session) |
**EUROPHOTON 2016 Programme at a Glance**

**Wednesday 24 August 2016** (Conference)

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>08:00 - 10:00</td>
<td>Special Symposium – Novel Laser-matter Interaction Regimes (II) (oral session - Special symposium)</td>
</tr>
<tr>
<td>10:00 - 10:30</td>
<td>Coffee Break</td>
</tr>
<tr>
<td>10:30 - 12:30</td>
<td>Frequency Conversion and OPOs (oral session)</td>
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<tr>
<td>12:30 - 13:45</td>
<td>Lunch Break</td>
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<tr>
<td>13:45 - 15:45</td>
<td>New Sources and Concepts for Imaging and Spectroscopy (oral session)</td>
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<tr>
<td>15:45 - 17:00</td>
<td>Poster Session 2 with Coffee Break</td>
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<tr>
<td>17:00 - 19:00</td>
<td>OPAs/OCPAs (oral session)</td>
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<tr>
<td>19:30 – 22:00</td>
<td>Conference Dinner</td>
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</tbody>
</table>

**Thursday 25 August 2016** (Conference)

<table>
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<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>08:00 - 10:00</td>
<td>Materials and Waveguide Lasers (oral session)</td>
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<td>10:00 - 10:30</td>
<td>Coffee Break</td>
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<tr>
<td>10:30 - 12:30</td>
<td>Crystalline Lasers (oral session)</td>
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<tr>
<td>12:30 - 13:45</td>
<td>Lunch Break</td>
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<tr>
<td>13:45 - 15:45</td>
<td>High-Power Lasers (oral session)</td>
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<tr>
<td>15:45 - 17:00</td>
<td>Poster Session 3 with Coffee Break</td>
</tr>
<tr>
<td>17:00 - 18:00</td>
<td>EPS Prize for Research in Laser Science and Applications</td>
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<tr>
<td>18:00 - 18:30</td>
<td>Refreshments</td>
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<tr>
<td>18:30 - 19:15</td>
<td>Post deadline Session</td>
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</tbody>
</table>

**Friday 26 August 2016** (Conference)

<table>
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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>08:00 - 10:00</td>
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<tr>
<td>10:00 - 10:30</td>
<td>Coffee Break</td>
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<tr>
<td>10:30 - 12:30</td>
<td>Lasers and Applications (I) (oral session)</td>
</tr>
<tr>
<td>12:30 - 13:45</td>
<td>Lunch Break</td>
</tr>
<tr>
<td>13:45 - 16:00</td>
<td>Hollow-Core, Ultrashort, and High-Energy Fiber Sources (oral session)</td>
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<tr>
<td>16:00 - 16:30</td>
<td>Coffee Break</td>
</tr>
<tr>
<td>16:30 - 18:15</td>
<td>Lasers and Applications (II) (oral session)</td>
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<tr>
<td>18:15 - 18:30</td>
<td>Closing Remarks</td>
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</tbody>
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Summer School – Technical Programme  
EUROPHOTON 2016

Sunday 21 August 2016

Summer School Lecture 1 – 13:45 – 15:45
13:45-14:30 Summer School Lecture 1
14:30-14:45 Break
14:45-15:30 Summer School Lecture 1, continued
15:30-15:45 Discussion 1

Giulio Cerullo
Politecnico di Milano, Milano, Italy

Topic: Micro/nanostructuring with ultrashort laser pulses

Due to their unique nonlinear light-matter interaction regime, femtosecond lasers have recently emerged as a powerful micro/nanostructuring tool for transparent dielectrics. On the one hand, they enable to induce a permanent refractive index increase in a (sub-)micrometer-sized volume in the bulk of the material, allowing single-step, mask-free writing of optical waveguides and photonic circuits. On the other hand, glass irradiation followed by selective chemical etching enables the manufacturing of directly buried microfluidic channels. Finally, two photon polymerization of photosensitized resists results in cross-linking of the monomers/oligomers and true three-dimensional nanofabrication with subdiffraction limited lateral and axial resolution. This lecture will review the physical foundations of laser microstructuring techniques and present examples of their applications to manipulation and sensing of biomolecules as well as stem cell growth.

15:45 - 16:15 Coffee Break (Foyer)

Summer School Lecture 2 - 16:15 - 18:15
16:15-17:00 Summer School Lecture 2
17:00-17:15 Break
17:15-18:00 Summer School Lecture 2, continued
18:00-18:15 Discussion 2

See Leang Chin
Center for Optics, Photonics and Laser (COPL), Laval University, Quebec City, Canada

Topic: Femtosecond laser filamentation and some applications.

After a quick historical review of the impact of laser technology on high laser field physics, the physics of femtosecond laser filamentation will be discussed in detail. Intensity clamping leads to the so-called filamentation nonlinear optics inside the filament zone where homogeneous high field interactions are possible. A few examples of application will be given, such as high field chemical reaction, remote sensing and lasing in air. The talk will end with the observation of filament induced snow/rain inside a cloud chamber.
EUROPHOTON 2016 — Summer School – Technical Programme

Monday 22 August 2016

Summer School Lecture 3 - 08:00 - 10:00

08:00-08:45 Summer School Lecture 3
08:45-09:00 Break
09:00-09:45 Summer School Lecture 3, continued
09:45-10:00 Discussion 3

Ursula Keller
Department of Physics, Institute for Quantum Electronics ETH Zurich, Switzerland

Topic: Semiconductor saturable absorber mirror (SESAM)

Ultrafast lasers have become the key enabling technology for many new applications. This tutorial reviews the design and characterization of SESAMs, SESAM-mode locked diode-pumped solid-state and semiconductor thin disk lasers, frequency comb generation and noise characterization.

10:00 - 10:30 Coffee Break (Foyer)

Summer School Lecture 4 - 10:30 - 12:30

10:30-11:15 Summer School Lecture 4
11:15-11:30 Break
11:30-12:15 Summer School Lecture 4, continued
12:15-12:30 Discussion 4

Almantas Galvanauskas
Electrical Engineering and Computer Science
Department, University of Michigan, Ann Arbor USA

Topic: High Brightness Fiber Laser Technologies

This tutorial will survey scientific and technological foundations, state of the art, and emerging new applications of high peak power and high energy pulsed fiber lasers, with a strong emphasis on ultrashort pulse systems. Due to their suitability for high average power and high wall plug efficiency fiber lasers are very attractive as pulsed sources for multitude of applications, but limitations inherent in fiber geometry make it very challenging to achieve high short-pulse energies. It will be discussed how numerous innovations ranging from large core fiber design, to novel system architectures, such as coherent spatial-domain and time-domain combining, are pushing this technology towards significantly higher energies, and entirely new applications.

12:30 - 13:45 Lunch Break
Summer School – Technical Programme

Summer School Lecture 5 - 13:45 - 15:45
13:45-14:30 Summer School Lecture 5
14:30-14:45 Break
14:45-15:30 Summer School Lecture 5, continued
15:30-15:45 Discussion 5

Paul B. Corkum
Joint Attosecond Science Laboratory, University of Ottawa, Ottawa, Canada

Topic: From Femtoseconds to Attoseconds

The tutorial will cover short pulse generation and characterization in both the femtosecond and attosecond domain. Similarities and differences will be emphasized as well as the unique experiments opened by attosecond science.

15:45 - 16:15 Coffee Break (Foyer)

Summer School Lecture 6 - 16:15 - 18:15
16:15-17:00 Summer School Lecture 6
17:00-17:15 Break
17:15-18:00 Summer School Lecture 6, continued
18:00-18:15 Discussion 6

Christopher Barty
Lawrence Livermore National Lab, Livermore, USA

Topic: Megajoule-class Lasers for Fusion and Beyond

This tutorial will review megajoule-class laser technology, the pursuit of inertial confinement fusion and the implications and extensions of these technologies for clean energy and extreme field science.
Tuesday 23 August 2016

SS-1: Special Symposium - Novel Laser-matter Interaction Regimes (I)
08:15 – 10:15

08:15 – 08:45
(Invited Speaker Special Symposium)
**THz Linear Acceleration and Compact X-ray Sources**, Franz X. Kärntner, Center for Free-Electron Laser Science, DESY, Hamburg, and The Hamburg Center for Ultrafast Imaging Hamburg, Germany
A compact attosecond X-ray source based on novel laser-matter interactions is discussed. It includes a THz based electron gun and accelerator with a nanostructured photocathode and optical undulator to froma Free-Electron Laser like coherent X-ray source. The source is driven by a 1J, 1kHz repetition rate picosecond Yb:YAG laser.

09:00 – 09:30
(Invited Speaker Special Symposium)
**Energy partition and dynamics of absorption and ablation in burstmode (>100 MHz) ultra-fast pulsed laser ablation in biotissues**, Robin Marjoribanks, Zuoming Qian, Z., Andrés Covarrubias1, Margarete Akens Lothar Lilge—1Department of Physics, University of Toronto, Canada—2Princess Margaret Cancer Centre, and Department of Medical Biophysics, University of Toronto, Toronto, Canada
100+ MHz burst-mode ultrafast-laser ablation of biological tissues depends on how each pulse interacts with the sample, thus ultimately on the state left over from the previous pulse. Measured dynamics of absorption show the impact of persistence of ionization, dissipation of plasma plume, and the driven oscillation of cavitation features.

SSL-1: Frequency Combs and CEP-Stabilised Sources
10:30 – 12:30

10:30 (Keynote) - **Advances in optical frequency combs and their applications**
Scott Diddams — NIST, Gaithersburg, USA
Recent advances in the development of optical frequency combs based on both mode-locked lasers and micro-resonator devices will be reviewed. Precision frequency synthesis with these laser-based tools is enabling a range of applications in mid-infrared spectroscopy and trace gas sensing, optical clocks, waveform synthesis and astronomy.

FWG-1: Beam Combination
13:45 – 15:45

13:45 (Invited) - **Beam combining of fiber amplifiers**
Tso Yee Fan, MIT Lincoln Laboratory, Lexington, MA, USA
Beam combining of arrays of lasers is becoming an increasing attractive approach to generate high-power and high-brightness sources. Coherent beam combining can scale the brightness by large amounts, in principle by as much as the number of elements.

14:15 (Invited) - **Multi-kW-level near-diffraction-limited coherent polarization beam combining of fiber laser sources**
Pu Zhou1,2, Pengfei Ma1,2, Jiangming Xu1,2, Rumao Tao1,2, Hailing Yu1,2, Xiaolin Wang1,2—1College of Optoelectronic Science and Engineering, National University of Defense Technology, Changsha, 410073, China — 2Hunan Provincial Collaborative Innovation Center of High Power Fiber Laser, Changsha 410073, China
We will show the recent progress in developing the coherently combinable high power linearly-polarized fiber amplifiers and their combining. Four linearly-polarized fiber amplifiers are coherently polarized beam combined (CPBC) into a 3-kW single aperture beam with near-diffraction-limited beam quality. CPBC of two high-average-power femtosecond fiber amplifiers will also be presented
Keynote and Invited Talks

FWG-2 : Fiber lasers and Amplifiers
17 :00 – 19 :00
17 :00 (Invited) Active and passive solid-core microstructured fibers for laser applications
Olivier Vanvincq1, Jean-Paul Yehouessi1, Pierre Gourtou2 3, Florent Sco2 4, Andy Cassez2, Hicham El Hanazaou2, Mohamed Bouazzaou2, Emmanuel Hugonn2, Constance Valentin1, Yves Quiperpoid1, Gérard Bouwman1, Laurent Bigot1
1University of Lille, Lille, France - 2Commissariat à lEnergie Atomique et aux Energies Alternatives, Centre dEtudes Scientifiques et Techniques dAquitanie, Le Barp, France
We will describe our strategies to achieve large mode area while keeping a singlemode behavior in solid-core photonic bandgap fibers by using cladding heterostructured or pixelated Bragg fibers. Experimental and numerical results on microstructured singlemode fibers that deliver a flat top intensity profile will be also reported.

STS : Student Training Session
19 :00 – 21 :00
19 :00 Physical Modeling in Passive and Active Fiber Optics
R. Paschotta, R.P. Photronics GmbH, Bad Dürheim, Germany
This course gives an overview on modeling in fiber optics, covering the calculation of fiber modes, numerical beam propagation, light absorption and amplification in active fibers, amplified spontaneous emission, self-consistent steady-state solutions for fiber amplifiers and lasers, and ultrashort pulse propagation in mode-locked fiber lasers and ultrafast amplifiers.

Wednesday 24 August 2016

SSL-2 Frequency Conversion and OPOs
10:30 – 12:30
10:30 (Invited) Highly nonlinear crystals for ultrafast mid-IR frequency conversion
Peter Schunemann - BAE Systems, Inc., Nashua, NH, USA
ZnGeP2 and CdSIP2, as well as the orientation-patterned semiconductors GaAs (OP-GaAs) and GaP (OP-GaP), exhibit the highest nonlinear optical coefficients among phase-matchable crystals with practical absorption losses and transparency ranges. Advances in growth and processing of these materials have extended ultrafast laser output deep into the mid-infrared.

FWG-3 : New Sources and Concepts for Imaging and Spectroscopy
13 :45 – 15 :45
13:45 (Invited) - All-fiber optical parametric oscillator for bio-medical imaging
Thomas Gottschaal1, Tobias Meyer2, Michael Schmitt2, Jürgen Popp2 3, Jens Limpert4, Andreas Tümnermann4, 5 - 1Friedrich-Schiller-Universität Jena, Abbe Center of Photonics, Albert-Einstein-Str. 6, 07745 Jena, Germany - 2Friedrich-Schiller-Universität Jena, Institute of Physical Chemistry, Abbe Center of Photonics, Helmholtzweg 4, 07745 Jena, Germany - 3Leibniz-Institut für Photonische Technologien Jena (IPHT) e.V., Albert-Einstein-Str. 9, 07745 Jena, Germany - 4Fraunhofer Institute for Applied Optics and Precision Engineering, Albert-Einstein-Str. 7, 07745 Jena, Germany
The first broadly tunable all-fiber optical parametric oscillator system is presented. This laser concept could very well be the missing key to establish nonlinear imaging as a diagnostic tool in bio-medical domains.

14:45 (Keynote) - Intermodal nonlinear fiber optics: a new pathway to power scalable sources
Siddharth Ramachandran —ECE Department & Photonics Center, Boston, University, Boston, MA, USA
Fibers stably guiding a multitude of Bessel-beam-like spatial modes help decouple the dispersion-versus-mode-area trade-off that often restricts achievable power levels via nonlinear-optical interactions in single-moded fibers and waveguides. We will discuss this design space and potential applications in fields as disparate as quantum-optics, nanoscale and deep-tissue imaging, and highpower lasers.
EUROPHOTON 2016

Thursday 25 August 2016

FWG-4: Materials and Waveguide Lasers
08:00 – 10:00

08:30 (Invited) - Rare-earth-doped active device on glass: from telecom to sensors
Jean-Emmanuel Broquin1,2, Lionel Bastard1,2, Elise Chibaudo1,2, Davide Bucci1,2 - Univ. Grenoble Alpes, IMEP-LAHC, F-38000 Grenoble, France — 2 CNRS, IMEP-LAHC, F-38000 Grenoble, France
This paper reviews the activities carried out on rare-earth-doped active devices made by ion exchange on glass at the IMEP-LaHC over the last decade. First the technology is presented, then results on Erbium lasers for airborne Lidar, Neodymium pulsed lasers for supercontinuum generation and recent developments on hybrid devices are shown.

SSL-4 : Crystalline Lasers
10:30 – 12:30

10:30 (Invited) - High-power single-crystal fiber amplifiers
Xavier Délen - Institute of Optics, France
We present a study of the specificity of the pump guiding in the single crystal fiber (SCF) and give an overview of the results obtained using SCF gain modules in laser amplifiers including high power experiments and the last results obtained with picosecond multi-stages Yb:YAG SCF amplifiers.

Friday 26 August 2016

SSL-6: Mode-Locked Lasers
08:00 – 10:00

08:00 (Invited) - Progress in development of gain and saturable absorber mirrors for semiconductor disc lasers
Guina Mircea - Tampere University, Tampere, Finland
Recent progress in the development of gain and saturable absorber mirrors used in semiconductor disc lasers is reviewed. Emphasis is put on linking technological advances to laser performance, in particular concerning power scaling and wavelength coverage. An overview of emerging applications in spectroscopy and medicine is provided.

SSL-7 : Lasers and Applications (I)
10:30 – 12:30

10:30 (Invited) - High-power single-mode cw lasers for gravitational wave detection
Dietmar Kracht - Lazercentrum Hannover, Germany
The development of high-power solid-state lasers for gravitational wave detectors is presented, in particular with respect to the state-of-the-art lasers utilized in the current generation of these detectors. Furthermore, results on high-power fiber amplifiers regarding

SSL-8: Lasers and Applications (II)
16:30 – 18:15

16:30 (Invited) - Structured laser beams and novel applications
G.K. Samanta - Photonic Sciences Lab., Physical Research Laboratory, Navrangpura, Ahmedabad 380009, Gujarat, India
Structured laser beams are of great importance due to their wide range of scientific and technological applications. In this talk, we will discuss our recent results on generation of various structured laser beams including optical vortices, perfect vortices, Airy beam, and hollow Gaussian beam and some of their applications.
SS: Special Symposium “Novel Laser-matter interaction regimes”

The Europhoton Conference includes a half day Special Symposium entitled "Novel laser-matter interaction regimes". We are experiencing truly exciting times for laser-matter interactions, as two broad fields have accelerated in recent years simultaneously. On the scientific side, interaction of intense laser radiation with matter enabled by novel laser sources now provide convenient access to extreme parameter ranges, which were only recently unthinkable, with impact from high-field physics to generation of x-rays. On the applications side, ultrafast lasers are finally fulfilling their long-held promise of transforming laser-material and in particular laser-tissue interactions, from glass processing to recently developed femtosecond cataract surgeries, with significant impact already materializing in the multi-billion dollar industries associated with them. Ranging from large-scale facilities to portable laser boxes, the common driving force behind these developments is the capability to access extreme parameter ranges enabled by recent developments in laser technology. The goal of this Special Symposium is to bring together a diverse group of users and developers of applications of novel interaction regimes together with the community behind the development of the laser technology, such that common interests as well as laser needs, which are not addressed by existing technologies can be identified.

SSL : Solid State Lasers


FWD : Fibre and Waveguide Devices

The EPS-QEOD Prize for Research in Laser Science and Applications is a major prize awarded on behalf of the European Physical Society through its Quantum Electronics & Optics Division (QEOD). The prize is awarded every 2 years in recognition of recent work by one or more individuals (no more than three) for scientific excellence in the area of laser science and applications in its broadest sense. Relevant topics include laser source development, power-scaling concepts, pump source development, nonlinear optics, ultrafast sources, material science, spectroscopic and characterisation techniques, and applications both in optics and photonics as well as in other fields.

The work for which the individual(s) is/are nominated must be such that a significant component of it was performed during the period 5 years prior to the award. In addition, the award will recognise research for which a significant portion of the work was carried out in Europe or in cooperation with European researchers, and may be given for either pure or applied research. The award is accompanied by an engraved glass medal, a certificate, and a monetary sum of 2000 euros.
**Main Conference – Tuesday Sessions**

**EUROPHOTON 2016**

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**Welcome Reception**

**Time:** Monday, 18:45–21:00  
**Location:** Kuppelsaal

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**Chair’s Welcome**

Chair: Andrius Baltuska, Technical University of Vienna, Austria and Ömer Ilday, Bilkent University, Turkey  
**Time:** Tuesday, 8:00–8:15  
**Location:** Lecture Hall E17

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**SS-1: Special Symposium - Novel Laser-Matter Interaction Regimes (1)**

**Chair:** Giulio Cerullo, Politecnico di Milano, Milano, Italy  
**Time:** Tuesday, 8:15–10:00  
**Location:** Lecture Hall E17

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**Invited**

**SS-1.1 Tue, 8:15**

**THz Linear Acceleration and Compact X-ray Sources**

Franz X. Kärtna → Center for Free-Electron Laser Science, DESY, Hamburg, and The Hamburg Center for Ultrafast Imaging Hamburg, Germany  
A compact attosecond X-ray source based on novel laser-matter interactions is discussed. It includes a THz based electron gun and accelerator with a nanostructured photocathode and optical undulator to from a Free-Electron Laser like coherent X-ray source. The source is driven by a 1J, 1kHz repetition rate picosecond Yb:YAG laser.

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**SS-1.2 Tue, 8:45**

**Thulium-doped Fiber Lasers for Dielectric Laser Accelerators**

2. Department of Physics, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Staudtstrasse 1, 91058 Erlangen, Germany  
3. Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Albert-Einstein-Str. 15, 07743 Jena, Germany  

Dielectric laser acceleration has the potential to achieve GV/m acceleration gradients and to shrink the size of an electron accelerator to a microchip. We show that 2µm Ti:sapphire drive laser in combination with silicon accelerating structures have a significant advantage over previously used Ti:sapphire laser and fused silica gratings.

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**Invited**

**SS-1.3 Tue, 9:00**

**Energy partition and dynamics of absorption and ablation in burst-mode (≥100 MHz) ultra-fast pulsed laser ablation in biotissues**

Robin Marderbaum, Zouming Qian, Andrés Covarrubias, Margarete Arndt, and Lothar Ligele → 1. Department of Physics, University of Toronto, Toronto, Canada  
2. Princess Margaret Cancer Centre, and Department of Medical Biophysics, University of Toronto, Toronto, Canada

10:00–10:30 Coffee Break

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**SSL-1: Frequency Combs and CEP-Stabilised Sources**

**Chair:** Majid Ebrahim-Zadeh, The Institute of Photonic Sciences, Barcelona, Spain  
**Time:** Tuesday, 10:30–12:30  
**Location:** Lecture Hall E17

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**Keynote**

**SSL-1.1 Tue, 10:30**

**Advances in optical frequency combs and their applications**

Scott Diddams → NSG, Göttingen, USA

Recent advances in the development of optical frequency combs based on both mode-locked lasers and micro-resonator devices will be reviewed. Precision frequency synthesis with these laser-based...
tools is enabling a range of applications in mid-infrared spectroscopy and trace gas sensing, optical clocks, waveform synthesis and astronomy.

SSL-1.2 Tue, 11:15
Gigahertz Offset-Free Mid-Infrared Frequency Comb — 
Aline S. M. Gersch, Jürgen Gebhardt, Martin Rinder, U. Keller, and Miquel M. Sorel — 1Department of Physics, Institute of Quantum Electronics, ETH Zurich, 8093 Zurich, Switzerland — 2School of Electrical and Computer Engineering, Cornell University, Ithaca, NY 14853, USA — 3Department of Electrical Engineering, Columbia University, New York, NY 10027, USA.

We present two alternative approaches for the compression of few-cycle MIR pulses and application of such pulses for HHG in bulk solids.

SSL-1.4 Tue, 11:45
Multi-mJ CEP-Stable Mid-IR OPA pumped by a femtosecond 120 mJ Yb:CaF2 amplifier — 
Tadas Baltuška, Guangyu Fan, Tsuneto Kanai, Gediminas Andriukaitis, Edgar Karik, and András Baltuška — Institute of Photonics, TU Wien, Gusshausstraße 27/387, Vienna, Austria.

We present a passively CEP-stabilized parametric source tunable in the 3 to 4 μm spectral range producing 6 mJ 82 fs pulses at 3.2 μm. A diode-pumped Yb:CaF2 120 mJ 200 fs multi-pass amplifier is used as a pump source.

EUROPHOTON 2016
Main Conference — Tuesday Sessions

12:30–13:45 Lunch Break

FWG-1: Beam Combination

Chair: Mark Dubinskij, US Army Research Laboratory, Adelphi, USA

Time: Tuesday, 13:45–15:45
Location: Lecture Hall EI7

Invited FWG-1.1 Tue, 13:45
Beam combining of fiber amplifiers — 
Yue Yee Fan — MIT Lincoln Laboratory, USA

Beam combining of arrays of lasers is becoming an increasing attractive approach to generate high-power and high-brightness sources. Coherent beam combining can scale the brightness by large amounts, in principle by as much as the number of elements.

Invited FWG-1.2 Tue, 14:15
Multi-kW-level near-diffraction-limited coherent polarization beam combining of fiber laser sources — 
Wei Zhao, Pengfei Ma, Jiacheng Xu, Hailong Yu, and Xiaolin Wang — 1College of Optoelectronic Science and Engineering, National University of Defense Technology, Changsha 410073, China — 2Hunan Provincial Collaborative Innovation Center of High Power Fiber Laser, Changsha 410073, China

We will show the recent progress in developing the coherently combinable high power linearly-polarized fiber amplifiers and their combining. Four linearly-polarized fiber amplifiers are coherently polarized beam combined (CBPC) into a 3-kW single aperture beam with near-diffraction-limited beam quality. CBPC of two high-average-power femtosecond fiber amplifiers will also be presented.

FWG-1.3 Tue, 14:45
Coherent beam combining of 19 fibers in the femtosecond regime — 
We report on the coherent beam combining of a record number of 19 fibers in the femtosecond regime, actively phase-locked with an interferometric measurement method. The residual phase-shift error is measured below 1/60 rms and the combined pulses are transform-limited with 305 fs duration.

FWG-1.4 Tue, 15:00
11.7 mJ pulse energy kW-class average power 8-channel ultrafast fibre laser — Michael Müller1, Marco Kiefer2, Arno Klenke1, Thomas Gottschall1, Evgeny SHESTAEV1, Jens Limpert1,3,5, and Andreas Tünnemann1,2,3,5 — 1Friedrich-Schiller-University Jena, Institute of Applied Physics, Albert-Einstein-Straße 15, 07743 Jena, Germany; 2Fraunhofer Institute for Applied Optics and Precision Engineering, Albert-Einstein-Straße 7, 07743 Jena, Germany

We demonstrate an ultrafast fibre laser featuring 8 amplifier channels delivering 1 kW average power at 1 mJ pulse energy and a pulse duration of ~260 fs. Using divided-pulse amplification, 11.7 mJ of pulse energy are extracted using 4 pulses at 690 W average power.

FWG-1.5 Tue, 15:15
Extraction of enhanced, ultrashort laser pulses from a passive 10-MHz stack-and-dump cavity — Svend Breitkopf1, Steffen Wunderlich1, Tino Eidam1, Evgeny Shestakov1, Thomas Gottschall1, Heinrich Carstens1, Simon Hohberger1, Andreas Tünnemann1,3,5, Joachim Puzella1, and Jens Limpert1,2,3,5 — 1Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität, Jena, Germany; 2Active Fiber Systems GmbH, Jena, Germany; 3Max-Planck-Institute of Quantum Optics, Garching, Germany; 4Ludwig-Maximilians-Universität München, Garching, Germany; 5Helmholtz-Institut Jena, Germany

Periodic dumping of ultrashort laser-pulses from a passive enhancement-cavity, is a promising route towards multi-kHz-repetition-rate pulses with Joule-level energies at unparalleled average powers. We extract 0.16 mJ pulses (65 stacked pulses) at 30 kHz repetition-rate from a 10-MHz cavity, representing an energy improvement of three orders of magnitude over previous results.

PO-1.1 Tue, 15:45
Amplification of a radially-polarised beam in an Yb:YAG thin slab — Callum Smith1, Stephen Bexcher1, Jacob Mackenzie1, and Andy Clarkson1 — Optoelectronics Research Centre, University of Southampton, Southampton, UK

Amplification of an axially-symmetric, doughnut-shaped radially-polarised beam at 1030nm in a diode-bar-pumped double-pass thin Yb:YAG slab amplifier architecture without degradation in polarisation purity is demonstrated. Preliminary experiments yielded a small signal gain of 9dB for 50W of incident pump power while maintaining the polarisation purity of the seed beam.

PO-1.2 Tue, 15:45
Energy scaling of pre-chip managed nonlinear amplification using circular polarization — Yizhou Lu1, Wei Liu2, Damian Schirripa2,3, Tino Eidam2, Jens Limpert1,3,5, and Guoping Chang3,5 — 1Center for Free-Electron Laser Science — 2Physics Department, University of Hamburg, 2The Hamburg Center for Ultrafast Imaging — 3Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena — 4Helmholtz Institute Jena

We investigated energy scaling of pre-chip managed amplification (PCMA) using circularly polarized seeding pulses. Using circularly polarized seed can scale up the pulse energy by 1.5 times than linearly polarized seed without changing the spectral bandwidth of the amplified pulse. We finally obtained 24-MHz, 55 fs, 1.4 µJ amplified pulses.

PO-1.3 Tue, 15:45
Simulation and experimental investigation of higher order beam distortions in end-pumped bulk laser amplifiers — Philipp Albrecht1, Xavier Pérez1, Moneisha Besbes2, Julien Foulgueras2, Frédéric Drouet1, and Patrick Georges1 — 1Laboratoire d’Optique Appliquée, ENSTA ParisTech, Ecole Polytechnique, CNRS, Université Paris-Saclay, 828 bd des Maréchaux, 91762 Palaiseau cedex, France; 2Thales Optonique SA, Laser Solutions Unit, 2 Avenue Guy-Lussac, 78995 Elancourt, France; 3ELI Attosecond Light Pulse Source, ELI-Hu Non-Profit Ltd, Dunaföldvár 13, Szeged, H-6720, Hungary

We demonstrate passive four-fold coherent combining of 10-fs pulses from a hollow-fibre compressor with 92% efficiency using birefringent plates for pulse division and combination and show how dispersion and nonlinear cross-talk between replicas can be carefully managed in order to preserve the high temporal fidelity of the compressed recombined pulses.

PO-1.4 Tue, 15:45
Diode-pumped Er3(Yb:GdAl3(BO3)4)3 laser passively Q-switched with a SWCNT saturable absorber — Konstantin Gorbatcheva1, Viktor Kisel1, Anatol Yasynivych1, Sergey Kurbiel1,4,5, Viktor Maltsev2, Nikolay Leonov2, Sunyoung Cho1, Fabian Rottwund1, and Nikolai Koleshov1 — 1Center for Optical Materials and Technologies, Belarusian National Technical University, Minsk, Belarus; 2Department of Crystallography and Crystal Chemistry, Moscow State University, Moscow, Russia; 3Department of Energy Systems Research & Department of Physics, Ajou University, Suwon, Republic of Korea; 4–5Kazan Federal University, Kazan, Russia

Diode-pumped Er3(Yb:GdAl3(BO3)4)3 laser emitting near 1.5 µm passively Q-switched by using single-walled carbon nanotube (SWCNT) based saturable absorber was demonstrated. Q-switched laser pulses with energy of 0.8 µJ and duration of 130 ns at a maximum repetition rate of 500 kHz were obtained at 1550 nm.

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PO-1: Poster Session 1 with Coffee Break
Time: Tuesday, 15:45–17:00
Location: Foyer
Fast-tunable femtosecond visible radiation via intracavity sum-frequency generation in a NIR NOPA — Yuliya Khimukhova, Toni Lang, Athan Tallal, José R. C. Andrade, Thomas Binhammer, and Uwe Morgenstern 1

Institut für Quantenoptik, Leibniz Universität Hannover, Welfengarten 1, D-30167 Hannover, Germany — 2Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, D-22607 Hamburg, Germany — 3VTEON Laser Technologies GmbH, Hertstr. 1B, D-30827 Garbsen, Germany — 4Laser Zentrum Hannover e.V., Hollerithalle 8, D-30419 Hannover, Germany

We present an ultrabroadband femtosecond non-collinear OPO simultaneously delivering NIR pulses from 650–950 nm and VIS pulses from 412 to 500 nm generated via intracavity sum-frequency generation. Fast tunability over the whole range is demonstrated by varying the resonator length only.

Thermal lensing in cubic sesquioxides Tim:Lu2O3, Tim:Y2O3 and Tim:Sc2O3 — Petia Lobo, Josef Maria Sierks, Xavier Mateos, Konstantin Yumashev, Valentin Petrov, Uwe Griebner, Magdalena Aguilo, Francis Diaz, and Christian Kranz 1, 2

ICFMA-FICNA, Universitat Rovira i Virgili (URV), Tarragona, Spain — Center for Optical Materials and Technologies (COMT), Belarusian National Technical University, Minsk, Belarus — Max-Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany — Universität Hamburg, Institut für Laser-Physik, Hamburg, Germany — 1Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Hamburg, Germany

Thermal lensing is studied for cubic sesquioxides, Tim:Lu2O3, Tim:Y2O3 and Tim:Sc2O3. For 1.8 at. % Tim:Sc2O3, sensitivity factor of the thermal lens is 3.7 m-1/W and the fractional heat load is 0.34±0.05. Tim:Lu2O3 microchip laser generated an output power of 3.3 W at 803 nm with a slope efficiency of 50%.

Fabrication of a multicore coupler for phase locking of fiber lasers — Ziv Alperovich, Gabriel Biadalenski, Zev Montz, and Amir A. Ishay 1, 2

Department of Electrical and Computer Engineering, Ben-Gurion University of the Negev, Beer Sheva 84105, Israel — Electro-Optics Unit, Ben-Gurion University of the Negev, Beer Sheva 84105, Israel — 1 Nuclear Research Center Negev, 84190 Beer-Sheva, Israel

We present a multicore fiber coupler design for passive phase locking six fiber lasers. The LMA core diameter is 20 μm and the pitch is 50 μm. Preliminary fabrication trials using tapered HF-etched LMA fibers and a Quartz tube are shown.

Generation and parametric amplification of broadband chirped pulses centered at 2 μm — Agne Marcinekvičienė and Rytis Butkus 1

Vilnius University, Faculty of Physics, Laser Research Center, Saulište Ave. 10, LT-10223 Vilnius, Lithuania

We demonstrate generation and parametric amplification of broadband chirped pulses at 2 μm. Two stages for parametric amplification were employed and 0.35 μJ pulses at 1 kHz have been achieved. Two-beam pumping was applied in the last stage for broadening and shaping of the amplified pulse spectrum.

Er:TmLiNbO3 ridge waveguides amplifiers by optical grade dicing and three side Er/Ti in-diffusion — Sergey Shunto, Christian Ritter, and Ditlev Kip 1

Helmut Schmidt University, Hamburg, Germany

The fabrication of erbium-doped ridge waveguide optical amplifiers in lithium niobate by optical-grade diamond blade dicing is reported. The method of erbium/titanium in-diffusion from all three sides of the ridges allows for the better overlap of guided modes with the dopant concentration profiles thus leading to improved small-signal amplification.

Bending Loss Characterization in Nodeless Hollow-core Anti-Resonant Fiber — Shuaiwei Gao, Yingsong Wang, Xiaole Liu, Wei Ding, and Pu Wang 1

1Institute of Laser Engineering, Beijing University of Technology, Beijing, China — 2Laboratory of Optical Physics, Institute of Physics, Chinese Academy of Sciences, Beijing, China

State-of-the-art nodeless hollow-core anti-resonant fibers are demonstrated with outstanding optical performance on the aspects of transmission bandwidth and bending loss. In-depth investigation show the flexibility of tailoring the transmission band in a tightly bent fiber, paving the way for plenty of interdisciplinary applications including pulse compression and laser-matter interaction.

New developments in high power, all-fiberized and polarization-maintained amplifiers with narrow linewidth and near-diffraction-limited beam quality — Pengwei Ma, 1, 2, 3 Pu Zhou, 1, 2, 3 Jiangming Xu, 1, 2, 3 Wei Lu, 1, 2, 3 and Ruxiao Tao 1, 2, 3

1 College of Optoelectronic Science and Engineering, National University of Defense Technology, Changsha, 410073, China — 2 Hunan Provincial Key Laboratory of High Energy Laser Technology, Changsha, 410073, China — 3 Hunan Provincial Collaborative Innovation Center of High Power Fiber Laser, Changsha, 410073, China

The brightness scaling potentials of all-fiberized, narrow linewidth and polarization-maintained amplifiers are investigated. The SBS effect is suppressed by two types of narrow linewidth seeds, respectively. The MI effect is suppressed by using selective mode loss mechanism. Near 2 kW output is achieved without SBS, SBS and MI effects.

Measurement of active fiber longitudinal temperature distribution using radiofrequency impedance spectroscopy — Vladimir Arkhipov 1, Renat Sharullin 1, and Oleg Ryzhikshen 1, 2

1Moscow Institute of Physics and Technology, Institutskiy per. 9, Dolgoprudny Moscow region, 141700, Russia — 2Kotelnikov Institute of Radio-engineering and Electronics of RAS, Vvedensky Sq. 1, Fryazino Moscow region, 141190, Russia

Method, based on radio-frequency impedance spectroscopy, for measuring longitudinal temperature distribution of protective polymer coating of active fiber in condition of generation and amplification of laser radiation is introduced. Temperature distribution measurement results for high-power optical amplifier, assembled using Yb3+/Er3+-doped silica fiber, are presented.

Periodic laminar structured quartz for intense-laser pumped wavelength conversion — Hideki Ishizuki and Takeshi Taoka 1

Institute for Molecular Science, Okazaki, Japan

Crystal quartz was used in the first wavelength conversion, and has excellent optical properties as short absorption edge and high laser damage threshold, which is suitable for intense pulse-laser pumped wavelength conversion. We present on initial evaluation of quasi-phase matched wavelength conversion using periodic laminar structured quartz.

A comparative study on cryogenically cooled Yb:YAG ceramic diode laser pumped at 940 nm and zero-phonon-line — Venkatesan Jambunathan, Petr Navratil, Tatsuke Mura, Akira Endo, Antonio Lucianetti, and Tomas Mocek 1

1HILASE Centre, Institute of Physics CAS, Dolní Břežany, Czech Republic

We present continuous-wave laser operation of cryogenically cooled Yb:YAG ceramic diode laser pumped using two different pump
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PO-1.15 Tue, 15:45
Generation of ultra-broadband dissipative solitons from a simple Ti-doped all-fiber laser — \( \text{Zuzana Sobot}, \text{Jaroslav Sobot}, \text{and Kryzysztof Rambo} \) — Laser & Fiber Electronics Group, Wroclaw University of Technology, Wroclaw, Poland

We demonstrate the generation of ultra-broadband dissipative solitons from a simple, fully-fiberized mode-locked Ti-doped fiber laser. The oscillator is mode-locked via nonlinear polarization evolution in the net normal dispersion regime. Depending on the net dispersion, the laser was capable of generating 60 nm or 100 nm broadband dissipative solitons.

PO-1.16 Tue, 15:45
Building block of picosecond pump laser for large femtosecond OPCPA infrastructure projects — \( \text{Jonas Adamowicz}, \text{Aleks Aleksievicius}, \text{Kirill Mikhailovas}, \text{Stanislav Balickas}, \text{and Andrejus Mikhailovas} \) — \( \text{Klaipeda University, Lithuania} \)

We present an amplifier layout, which could be used as a building block of an efficient pump source for a TW class high repetition rate OPCPA system, providing output power of ~150W at 1 kHz repetition rate with pulse duration of ~100 ps.

PO-1.17 Tue, 15:45
High-power, room temperature, continuous-wave optical parametric oscillator across 0.7 - 2.1 \( \mu \)m based on fan-out grating MgO:PPLT — \( \text{Kavita Divy} \text{ and Mahmood Raza} \) — \( \text{ICFO-Institut de Ciencies Fotoniques, Barcelona Institute of Science and Technology, 08860 Castelldefels (Barcelona), Spain} \)

We report a high-power single-frequency continuous-wave optical parametric oscillator at room temperature, tunable across 0.7 - 2.1 \( \mu \)m, using fan-out grating MgO:PPLT. The watt-level idler output exhibits passive power-stability better than 1\%rms (30mins.), and the sign inversion output exhibits a frequency stability of 518 MHz (2mins.) and a linewidth of 6.9 MHz in good beam-quality.

PO-1.18 Tue, 15:45
Modelling the influence of the Third Energy Level in the Gain Dynamics of Fiber Amplifiers — \( \text{Omar de Varona}, \text{Michael Stizen} \), Dietmar Kracht \text{,} Jorg Neumann \text{,} and Peter Wessel \text{,} — \( \text{Laser Zentrum Hannover, Hannover, Germany} \)

We report an analytical model to describe the gain dynamics of 3-level system fiber amplifiers and its experimental validation by fitting it to the pump-to-power-to-output power transfer functions and studying the induced phase-shift in an EDFA. The results show good agreement with the common values in literature.

PO-1.19 Tue, 15:45
Polarization-controlled wavelength switching in fiber ring laser using inline switching filter based on polarization-diversity loop — \( \text{Youngsang Paik}, \text{ysunwoo Choi}, \text{Koongsuk Jo}, \text{Phoo Ki}, \text{Seulell Lee}, \text{Youngho Jung}, \text{Sohnjung Jung}, \text{and Yong wook Lee} \) — \( \text{Interdisciplinary Program of Biomedical Mechanical & Electrical Engineering, Pukyong National University, 45 Yongso-ro, Nam-gu, Busan 48513, Korea} \)

By composing a polarization-diversity loop, we have demonstrated the inline switching optical fiber ring laser of reflection spectra of one of two short-period grating with different resonance wavelengths, which is dependent of input polarization. The output lasing is generated at 1554.92 nm and 1549.98 nm.

PO-1.20 Tue, 15:45
Characterization of optical pulses generated by fiber pulse generators based on self-phase modulation and alternating spectral filtering — \( \text{Juliana Zelinska Kleiner}, \text{Maria Niecik}, \text{and Kaisutus Rigelius} \) — \( \text{Center for Physical Sciences and Technology, Vilnius, Lithuania} \)

In this work we investigate fiber pulse generator based on self-phase modulation and alternating spectral filtering in the case when material dispersion effect is negligible. Influence of generator setup configuration for pulse characteristics is estimated by numerical calculations and experimental trials.

PO-1.21 Tue, 15:45
Bragg fibers for delivery of 1.9 \( \mu \)m radiation — \( \text{Milan Frank}, \text{Michal Jesek}, \text{Yagil Kibberek}, \text{Ondrej Podrazek}, \text{Ivan Kasar}, \text{and Vladimir Mafier} \) — \( \text{Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering, Břehtmír 7, 115 19 Prague 1, Czech Republic} \)

In this paper we deal with the 194um laser-radiation delivery using several Bragg fibers with the air core diameters in a range of 5-73um. The lowest attenuation coefficient of 1.2786/km was determined for the Bragg fiber with a core diameter of 66um. In addition, fundamental optical characteristics will be presented.

PO-1.22 Tue, 15:45
OPCPA Pump Source Based on Chirped Second Harmonic Pulse Compression — \( \text{Laszlo Fekete}, \text{Rokas Danilevicius}, \text{Andrejus Zurbickevicius}, \text{and Nerijus Rusteika} \) — \( \text{Ekspla Ltd, Savanoriu Ave. 237, LT-02300, Vilnius, Lithuania} \)

In this work a novel variation of a CPA technique was demonstrated. Second harmonic generation was performed and corresponding pulses were compressed in Treacy pulse compressor yielding shorter pulse durations compared to first harmonic.

PO-1.23 Tue, 15:45
The characteristics of PW level OPCPA near 800nm with different injected signal energies — \( \text{Lianghong Yu}, \text{Xiao Yan}, \text{Wenqi Li}, \text{Yuxin Li}, \text{Ruxin Li}, \text{and Zhejian Xu} \) — \( \text{State Key Laboratory of High Field Laser Physics, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai 201800, China} \)

In this letter, we investigate the main output characteristics of PW-level optical parametric chirped-pulse amplification (OPCPA) near 800 nm with different injected signal energies. After optimization, the peak power of amplified laser pulse reached 1.02 PW with a compressed duration of 32 fs.

PO-1.24 Tue, 15:45
Tunable diode pumped 2.1 \( \mu \)m Tm,Ho:GGAG laser — \( \text{Ian Sule}, \text{Pavel Bohacek}, \text{Michael Nemec}, \text{Martin Fibrich}, \text{Helena Jirikova}, \text{Bohumil Trunda}, \text{Lubomir Haylak}, \text{Karel Jurek}, \text{Martin Nebi}, \text{and Karel Niedzialek} \) — \( \text{Czech Technical University in Prague, Czech Republic} \)

In this paper, we present a non-stoichiometric tertiary garnet Tm,Ho:GGAG as a laser material for mid-infrared laser, tunable using birefringent filter. The laser tuning range extended from 2006 nm up to 2122 nm. The output energy of 3.2 mJ at 2099 nm was obtained for the absorbed energy 50 mJ.
PO-1.25 Tue, 15:45
Passive harmonic mode-locking in all-polarization maintaining fiber laser based on antimony telluride saturable absorber — Jacek Bogusławski, Grzegorz Sobon, Maciej Komaszewski, Rafał Zbierała, Jan Zarka, Krzysztof Abramski, and Jarosław Sotier — Wrocław University of Technology, Wroclaw, Poland — Warsaw University of Technology, Warszaw, Poland We report 5 GHz passive harmonic mode-locking in all-polarization-maintaining Er-doped fiber laser. The laser was mode-locked by antimony telluride (Sb2Te3) thin film saturable absorber, deposited directly on the fiber connector, which provides 2% modulation depth at low saturation fluence. Picosecond, scalar soliton pulses were generated with 19 mW average power.

PO-1.26 Tue, 15:45
192.3J output energy using Ti:Sapphire CPA laser system — Zhebiao Gan, Yuntao Chu, Xiaoyan Liang, Liang Song, Yuxin Li, Ruxin Li, and Zhizhuan Xu — Shanghai Institute of Optics and Fine Mechanics, Shanghai, China We compare the output ability of the lightly doped and heavily doped large aperture Ti:Sapphire. Our research results indicated that lightly doped Ti:S is more favorable to overcome the PL and TASE, near 200J pulse energy can be achieved using a 150mm diameter lightly doped Ti:S with PL suppression technology.

PO-1.27 Tue, 15:45
 Laser performance of non-aqueous tape casting fabricated composite YAG/Yb:YAG ceramics — Guo Wang, Wenzhu Li, Chao Yang, Dongqi Bai, Jiang Li, Lin Gu, Yibai Pan, and Heping Zeng — East China Normal University, Shanghai, China — Chinese Academy of Sciences, Shanghai, China Two and three layers of different compositions (YAG/Yb:YAG and YAG/Yb:YAG/YAG) were designed to reduce the thermal effects and thermally induced mechanical stress, constructing better continuous-wave and mode-locked lasers.

PO-1.28 Tue, 15:45
Generation of laser beam in variable sized “perfect” vortex spatial structure and its interaction with nonlinear crystal — M.V. Jabbar, N. Aprur Chitanta, A. Azabdi, and G. K. Samanta — Physical Research Laboratory, Ahmedabad, India — Indian Institute of Technology-Gandhinagar, India We report a novel scheme to generate a new class of laser beams in vortex structure having beam radius and vortex order as mutually independent parameters. Interaction of such beams with nonlinear crystal through spontaneous-parametric down-conversion (SPDC) shows that the angular-spectrum of SPDC photons are independent of orbital-angular-momentum of pump laser.

PO-1.29 Tue, 15:45
10 W multipass Ti:S amplifier for 80 MHz repetition rate — Attila Andráski, Péter Jósiárt, Szabolcs Toth, Roland Sandor Nagymihályi, Á. Borzsónt, and Károly Osvay — Department of Optics and Quantum Electronics, University of Szeged, P.O. Box 406, H-6701 Szeged, Hungary — ELI-HU Nonprofit Kft, Dunaiics tár 13, Szeged, Hungary We present a design of a novel multipass Ti:S amplifier for the amplification of few cycle laser pulses at 80MHz repetition rate. Ray-tracing modeling of the geometry, and beam size measurements based on knife-edge mode are included.

PO-1.30 Tue, 15:45
Towards continuous wave operation of ring cavity quantum cascade lasers — Martin Holzhaber, Rolf Szirmai, Benedikt Schwarz, Donald MacFarlane, Tobias Zedebskau, Hermann Detz, Aaron M. Andrews, Werner Scheck, Mykolas P. Samuolis, Ted W. Masseilen, and Gottfried Strasser — Institute of Solid State Electronics and Center for Micro- and Nanostructures TU Wien, Vienna, Austria — Austrian Academy of Sciences, Vienna, Austria — Physics Department Humboldt University Berlin, Berlin, Germany We present strategies to achieve continuous wave operation of mid-IR ring cavity quantum cascade lasers. In FEM simulations the heat dissipation and thermal bottlenecks are investigated and compared to experimental results from fabricated lasers. Device configurations optimized for surface and substrate emission are discussed.

PO-1.31 Tue, 15:45
Characterization of ultranarrow-linewidth distributed-feedback resonators below laser threshold — Christine Calle, Korens, Dmitriy Gershen, Nor Imaia, Meinke Dierkka, Edward Bernards and Markus Poli, — 1 Department of Materials and Nano Physics, School of Information and Communication Technology, KTH — Royal Institute of Technology, Electrum 229, Isafjords-gatan 22-24, 16440 Kista, Sweden — 2 Optical Sciences, MESA+ Institute, University of Twente, P.O. Box 217, 7590 AE Enschede, The Netherlands The resonance linewidth near 1029 nm of distributed-feedback resonators in Yb-doped aluminum oxide channel waveguides versus pump power below laser threshold is measured by a narrow-linewidth laser and calculated from gain measurements, providing good agreement between measurement and theory. The gain elongates the photon decay time and narrows the linewidth.

PO-1.32 Tue, 15:45
Simulation on thermal load gradient mitigation with auxiliary multi-seeds amplification in fiber amplifier — Yuting Feng, Harish Acharya Vasan, Yujuun Peng, Nan Zhao, and Johan Nilsen — Optoelectronics Research Centre, University of Southampton, Southampton, UK A technique that employs auxiliary multi-seeds for mitigating the inhomogeneous of thermal load in Yb-doped double cladding amplifier is presented and verified in simulation. The results shows this technique can reduce the thermal load gradient by a significant ratio, thus has potential application in high power amplifiers.

PO-1.33 Tue, 15:45
Picosecond high-average power parametric mid-IR source — Omkar D. V. Novak, Michael Vyvlička, Martin Smíšek, Taisuke Miura, Akira Enoki, and Tomáš Mocker — 1 HLASE Centre, Institute of Physics A5 CR, Zà Radium 828, 252 41 Dolní Břežany, Czech Republic — 2 Faculty of Mathematics and Physics, Charles University in Prague, Ke Karlovu 5, 121 16 Praga 2, Czech Republic The 100 kHz, 100-W, Yb:YAG thin-disk regenerative amplifier of 1030 nm wavelength pumps the parametric mid-IR source. The OPG stage with PPLN crystal is continuous-wave seeded at 1.94 μm. Signal is amplified in KTP crystals. The generated mid-IR idler wave of 2.2 μm wavelength is taken from the final amplifier.

PO-1.34 Tue, 15:45
Compact, high power, continuous-wave, single frequency, 10 μm core Yb-doped fiber amplifier and single pass, frequency doubling to 532 nm — Enkelida Balliu, Magnus Engdahl, Peter Janes, Gunnar Elgkrona, and Hakan Karlsson — 1 Mid Sweden University, Sundsvall, Sweden — 2 Cobold AB, A HUBNER group company), Solna, Sweden We report on a high power, single frequency, continuous wave, polarization maintaining, single stage fiber amplifier operating at 1064nm by using a custom made, ultra low noise seed laser and an overall fiber core/cladding diameter of 10/125μm. A custom made, highly Yb-doped active fiber is used to suppress non-linear effects.

PO-1.35 Tue, 15:45
Single shot laser writing with sub-nanosecond bursts of femtosecond pulses — Andrej Orskihchuk, Ivan Glebov, Vladimir Sigaev, and Peter Kazansky — D. Mendeleev University of Chemical Technology of Russia
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A method of efficient laser micromachining of fused silica and sapphire with a burst of femtosecond pulses separated by 10 – 100 ps is proposed and demonstrated. It exploits strongly localized absorption by transient electronic excitations prepared by the first pulse in the burst.

**PO-1.36** Tue, 15:45
Molecular pathway control in sequential double ionization of CO₂ using two-pulse sequences — **Sonia Erattupuzha**, Netea Rezea, and Markus Kutter — Photonics Institute, Vienna University of Technology, Vienna, Austria

We visualize and control molecular dynamics taking place on intermediate populated states during different sequential double ionization pathways of CO₂ using a sequence of two pulses with different peak intensities. Exchanging the pulse-sequence can almost completely switch the pathway, pointing towards opportunities for strong-field fragmentation control on extended time scales.

**PO-1.37** Tue, 15:45
Ultra-narrow linewidth 1.6 μm continuous-wave singly resonant optical parametric oscillator — **Alex Livits**, Christophe Sower, and Fabien Brütenkämper — Laboratoire Aimé Cotton, CNRS-Université Paris Sud 11-ENS Cachan, 91405 Orsay Cedex, France

We present a 1-Watt, low noise single frequency continuous wave singly resonant optical parametric oscillator. When locked on a Fabry-Perot cavity by a recently demonstrated technique, the 1.65 μm non-resonant OPO idler is narrowed down to a sub-kHz linewidth over 2K.

**PO-1.38** Tue, 15:45
Ultrafast All-In-Fiber Soliton Oscillator Optimized for Fiber-Chirped Pulse Amplification System — **Tadas Bartuševičius** 1,2,3, Boris Danilevicius 1,2, and Nerijus Rutkaitė 1,2 — Fikspa, Ltd., Vilnius, Lithuania — 4Center for Physical Sciences and Technology, Vilnius University, Vilnius, Lithuania

In this work the generation of ultrashort pulses from all-fiber oscillator using a low anomalous group delay dispersion chirped fiber Bragg gratings were investigated. Femtosecond pulses directly from an all-soliton-pulse-oscillator were achieved. Spectral filtering technique was demonstrated in all-in-fiber resonator for pulse spectrum quality management both numerically and experimentally.

**PO-1.39** has been withdrawn.

**PO-1.40** Tue, 15:45
Use of mismatched grating pairs with a cylindrical Offner stretcher working at the Littrow condition — **Shuai Li** 1, Cheng Wang 1, Yanqi Liu 1, Zhengzhong Liu 2, Yixin Leng 1, and Buxin Li 2, 3 — State Key Laboratory of High Field Laser Physics, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai 201800, China — 4University of Chinese Academy of Science, Beijing 100049, China

A stretcher-compressor system based on the cylindrical stretcher and a standard transmission with mismatched grating pairs is presented. Experiment shows that the output beam of the stretcher has little chromatic aberration. With this type design, the production of high-contrast pulses with pulse widths less than 30fs becomes possible.

**PO-1.41** Tue, 15:45
Multistep, odd-harmonics enhanced supercontinuum from plasma-dominated filamentation in solid state medium — **Nail Garazov** 1, Vytautas Jukas 2, Gintaras Tamulis 2,3, Milda Velžiene 1, Romualdas Šuminskas 1, Arnaud Coutard 4, and Andrius Dzhibitis 1 — 1Department of Quantum Electronics, Vilnius University, Vilnius, Lithuania — 2Laboratoire d’Optique Appliquée, ENSTA ParisTech, Ecole Polytechnique, Université Paris Saclay, Palaiseau, France — 3Centre de Physique Théorique, CNRS, Ecole Polytechnique, Palaiseau, France

We demonstrate that plasma-dominated filamentation regime in a solid state medium (CaF₂ crystal), which is accessed for millimeter-range propagation lengths and few TW/cm² input pulse intensities, produces ultraviolet-to-mid-infrared supercontinuum, whose short wavelength side is strongly enhanced by cascaded generation and spectral broadening of third, fifth and seventh harmonics.

**PO-1.42** Tue, 15:45
Influence of cooperative upconversion on optical gain in Yb3⁺-doped waveguide amplifiers — **Pavel Liska** 1, Lada Aagazi 2, Cristiane Caill Kokke 1, Meinert Dekstra 1, Dimitri Gersem 1, and Markus Pollmaier 1 — 1Department of Materials and Nano Physics, School of Information and Communication Technology, KTH – Royal Institute of Technology, Kista, Sweden — 2Visiting scientist — 3Optical Sciences, MESA Institute, University of Twente, Enschede, The Netherlands

We show that the process responsible for fast quenching of Yb ions in amorphous aluminum oxide waveguide amplifiers is cooperative upconversion (CU). The macroscopic CU parameter is derived from pump-transmission and green/infrared-luminescence versus pump-power dependencies. The effect of CU on the optical gain is quantified by considering distinct ion classes.

**PO-1.43** Tue, 15:45
Application of Ablation Cooling Technique to Cataract Surgery Using All-Fibre Burst-Mode Laser — **Denizhan Koral Kemis** 1,2, Hamit Kalaycıoğlu 1,3, M. Can Kılıç 1,2, Nurullah Çağrı 1,2, Mehmet D. Ay 1,2, and F. Ömer İlnar 1,2 — Department of Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey — 3Department of Physics, Bilkent University, Ankara, Turkey — 4School of Medicine, Hidayet Beyant University, Ankara, Turkey — 5Department of Nanotechnology and Nanomedicine, Hacettepe University, Ankara, Turkey

We present an all-fibre femtosecond laser system integrated with OCT that can operate in burst mode. Ablation cooled regime is exploited via closely spaced pulses inside bursts. This enables us to reduce pulse energies for surgery which would decrease the thermal loading on tissue. Several preliminary experiments were conducted and presented.

**PO-1.44** Tue, 15:45
Elasto-optic effects on quasi-phase-matching wavelengths of a periodically-inverted AlGaaS waveguide — **Atushi Otsuka** 1, Kimi Aizutsumi 2, Tomonori Matsubara 2,3, and Takashi Komine 2,3 — 1Department of Materials Engineering, The University of Tokyo, Tokyo, Japan — 2Research Center for Advanced Science and Technology, The University of Tokyo, Tokyo, Japan

We have succeeded in determining elasto-optic coefficients of AlxGa1-xAs films at two wavelengths by utilizing phase-matching wavelengths of second harmonic generation in periodically-inverted AlGaaS waveguide grown on an intentionally misoriented GaAs substrate. The obtained p11-p13 are 0.03 and 0.07 at 0.775 μm and 1.55 μm, respectively.
FWG-2.1 Tue, 17:00

Invited
Active and passive solid-core microstructured fibers for laser applications — Olivier Vanv之心, Jean-Paul Yousef, Pierre Gourrou, Florent Scoil, Andy Casiez, Hicham El Hamzaoui, Mohamed Bouazzaoui, Emmanuel Hugonnot, Constance Valentin, Yves Quemener, Gerard Bouwhijs and Laurent Bigot — University of Lille 1, CNRS, UMR5823, Ph.LAM, Lille, France
We will describe our strategies to achieve large mode area while keeping a single-mode behavior in solid-core photonic bandgap fibers by using cladding hetero-structured or pixelated Bragg fibers. Experimental and numerical results on microstructured single-mode fibers that deliver a flat top intensity profile will also be reported.

FWG-2.2 Tue, 17:30
Single-mode 4.3 kW average power fiber amplifier — Franz Bauer, Christian Hupke, Sybren Kuhn, Sigrun Heinz, Nicoletta Haakamiberg, Thomas Schreiber, Ramona Eberhard, and Andreas Tunnermann — Friedrich Schiller University Jena, Institute of Applied Physics, Albert-Einstein-Str. 15, 07745 Jena, Germany — Fraunhofer Institute for Applied Optics and Precision Engineering, Albert-Einstein-Str. 7, 07745 Jena, Germany
We report on a ytterbium-doped high power fiber amplifier system based on ‘in-house’ designed and fabricated large mode area fibers with ultra-low NA. A maximum output power of 4.3 kW was demonstrated with excellent beam quality and a high slope efficiency of 90%. No indications for mode instabilities or nonlinear effects were observed.

FWG-2.3 Tue, 17:45
High power all-fiber thulium oscillator with >550 W output power — Till Walch, Matthias Heinzel, Thomas Schreiber, Ramona Eberhard, and Andreas Tunnermann — Fraunhofer Institute for Applied Optics and Precision Engineering, Albert-Einstein-Str. 15, 07745 Jena, Germany — Abbe Center of Photonics, Friedrich Schiller-University Jena, Jena, Germany
We present an all-fiber thulium oscillator at 1970 nm wavelength with over 550 W output power, over three times the previous record below 2 micron. Splice characterization and optimization is shown to be crucial. Dual mode operation could be identified from fiber analysis and spectral measurement.

FWG-2.4 Tue, 18:00
Tunable Yb-doped fiber laser based on a fiber Bragg grating array and a modified resonator design enabling a constant repetition rate — Tobias Tiess, Philipp Kellner, Martin Becker, Max- fried Rothkamm, Hartmut Bartelt, and Matthias Jager — Leibniz Institute of Photonic Technology, Jena, Germany — Abbe Center of Photonics, Friedrich Schiller-University Jena, Jena, Germany
This work presents an enhanced tuning method for pulsed fiber-integrated lasers using FBG arrays as tailored spectral filters. Based on a novel resonator design, the distributed feedback of the filter is compensated ensuring a constant repetition rate for each wavelength. The concept is experimentally investigated based on an Ytterbium-doped laser.

FWG-2.5 Tue, 18:15
Direct control of mode-locking states of a fiber laser — Roman Jagaev and V. Omel’Ilyan — Department of Physics, Bilkent University, 06800 Ankara, Turkey — Department of Electrical and Electronics Engineering, Bilkent University, Ankara, 06800, Turkey
Mode-locked lasers have diverse applications, in addition to being of fundamental interest for investigating nonlinear dynamics of non-equilibrium steady states. We show that we can halt/restart mode-locking, suppress instabilities, reversibly steer mode-locking from one state to another and shape the spectrum using a spatial light modulator placed inside the cavity.

Time: Wednesday, 08:00–10:00
Location: Lecture Hall E17

SS-2.1 Wed, 08:00
Laser-sub-cycle fragmentation dynamics of Argon dimers — Sonia Ertattufzha, Vimal Kunnumpurath, Seydaa Larman, VACLAV Hanus, Markus Koch, Markus Schöffler, Xinshua Xie, Andreas Baltuška, Gerhard G. Paulus, Christoph Lemell, Joachim Burgdörfer, and Markus Kitzler — Photonics Institute, Vienna University of Technology, Vienna, Austria — Institute of Experimental Physics,
Graz University of Technology, Austria — 1 Institut für Kernphysik, Goethe-Universität Frankfurt, Germany — 1–Friedrich-Schiller-Universität Jena, Germany — 2 Helmholtz Institute Jena, Germany — 3 Institute for Theoretical Physics, Vienna University of Technology, Austria

Single and double electron recapture processes into Rydberg states driven by few-cycle laser pulses are studied for argon dimers as a function of the pulses' carrier-envelope phase (CEP). The CEP dependence of the dimers' center-of-mass momenta shows that the recaptured electrons are born around the maxima of the laser field oscillations.

SS–2.2 Wed, 8:15

Laser-sub-cycle control of sequential double ionization dynamics of Helium — Markus S. Schiffer1, Xinhua Xie2, Philipp Wüstelt3, Max Möller4, Stefan Rothke1, Ondrej Hrot1, Daniel Kartashov5, Andreas Baltuska1, Gerard G. Paulus2,3, and Markus Kitzler1 — Photonics Institute, Vienna University of Technology, Vienna, Austria — 1 Institute of Optics and Quantum Electronics, Friedrich-Schiller-University Jena, Germany — 2 Helmholtz Institute Jena, Germany

The dynamics of sequential double ionization from helium in near-circularly polarized laser pulses with a known carrier-envelope phase is extracted from measured ion momentum distributions. Two-electron emission in between the field-maxima and on sub-laser-cycle times is identified. Corresponding structures in the distributions cannot be reproduced by an established semi-classical model.

SS–2.3 Wed, 8:30

High photon flux 70 eV high harmonic source for coherent nanoscale imaging — Gertjet K Tadesse1,2, Robert Klaas1,2, Stefan Dettmer1,2, Steffen Hadeck1,2, Jasmin Warututa1,2, Michael Zürch1,2, Michael Steiner1,2, Christian Spielmann1,2, Andreas Tünnermann1,2,3, Jens Limpert1,2,3, and Jan Rothhardt1,2 — Helmholtz Institute Jena, Jena, Germany — 1 Institute of Applied Physics, Friedrich-Schiller-University Jena, Albert-Einstein-Straße 15, 07743 Jena, Germany — 2 Institute of Optics and Quantum Electronics, Friedrich-Schiller-University Jena, Max-Wien-Platz 1, 07743 Jena, Germany — 3 University of California, Department of Chemistry, CA 94720, Berkeley, USA — 4 Fraunhofer Institute for Applied Optics and Precision Engineering, Albert-Einstein-Str 7, 07745 Jena, Germany

We present an XUV source with record-high photon flux at 68.6 eV ideally suited for coherent diffraction imaging experiments that achieved a record 1nm resolution. Pulses from a two channel fiber CPA are post-compressed and focused at a gas jet to generate XUV beam with flux of 610^8 photons/sec.

SS–2.4 Wed, 8:45

Interferometric spatial characterization of high harmonic generation from two successive sources — Kyojin O’Keefe2, Matthias Mang1, David Lloyd1, Simon Hooke2, and Jan Walske2 — 1 Department of Physics, College of Science, Swansea University, Singleton Park, Swansea, SA2 8PP, UK — 2 Department of Physics, University of Oxford, Clarendon Laboratory, Parks Road, Oxford, OX2 8NP, UK

High harmonic generation from two longitudinally separated gas cells is observed to yield strong modulations in the intensity of both the long and short trajectories as the separation between cells is varied. Transverse spatial interferometry is performed to characterize the evolution of the harmonic wavefronts.

SS–2.5 Wed, 9:00

Mid-IR filaments: higher order Kerr nonlinearities vs. plasma formation — Sreekanta Aliasekar1, Valentina Shumakova2, Daniel Kartashov2, Andrius Prizulis3, and Andrius Baltuska1,4 — 1 TU Wien, Vienna, Austria — 2 Friedrich-Schiller University Jena, Jena, Germany — 3 Center for Physical Sciences & Technology, Vilnius, Lithuania.

We examine the role of plasma and higher-order Kerr nonlinearities in filamentation of sub-100 fs multi-m) mid-IR pulses. Two different regimes of filamentation are discovered in the case of moderate and loose focusing. Clear features of filamentation at negligibly low plasma densities point towards dominance of higher-order Kerr nonlinearities.

SS–2.6 Wed, 9:15

Control of mid-IR two color filamentation in solid with stabilized carrier-envelope phase — Tsuneto Kanai3, Pavlo Malychiv1, Sarayoo Kangpaykam2,1, Kakuca Ishida2, Makoto Mizut1, Kazuyuki Yamanouchi2, Heping Hoogland2, Ronald Holzwarth1, Andrius Prizulis3, and Andrius Baltuska1 — 1 Photonics Institute, Vienna University of Technology, Gußhausstraße 27-37, A-1040 Vienna, Austria — 2 Department of Chemistry, School of Science, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan — 3 Menlo Systems GmbH, Am Klopferpark 19a, 81252 Martinsried, Germany — 4 Center for Physical Sciences & Technology, Savanoriu Ave. 251 LT–02300 Vilnius, Lithuania

We generated mid-IR two color filamentation in YAG, whose spectra depend on the carrier envelope phase of the input beam.

SS–2.7 Wed, 9:30

High-energy pico-second Yb:YAG amplifier for the European XFEL laser heater — Francesca Moglia1, Peter Kroetz2, Sebastian Koehler1, Lutz Winkelmann1, and Jürgen Hartl1 — 1 Deutsches Elektronen-Synchrotron, Hamburg, Germany — 2 Center for Electron-Laser Science, Hamburg, Germany — 3 Max-Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany

A compact single-pass, single-sided end-pumped Yb:YAG amplifier for the laser electron heater of the European X-ray free-electron-laser was developed, which amplifies 600µs bursts of 222ns spaced 9µs pulses and delivers up to 200 µJ per pulse. Energy improvements by 38% and 70% for double-pass and double-sided pump configuration, respectively, were obtained.

SS–2.8 Wed, 9:45

Extreme Ultraviolet High Harmonic Generation in Dielectrics: Waveform Control and Spectroscopy — Stanislav Kruchinin1, Tran Trung Luu2, Manish Garg3, and Eleftherios Goulielmakis1 — 1 Max Planck Institute of Quantum Optics, Hans-Kopfermann-Str. 1, D-85748 Garching, Germany

We present the first observation of extreme ultraviolet high harmonic generation from thin films of polycrystalline quartz exposed to few-cycle and sub-cycle pulses. Carrier-envelope phase control of radiation spectrum was demonstrated. Theoretical analysis has shown that high harmonics can be used for characterization of band structure and lattice potential.
EUROPHOTON 2016  
Main Conference – Wednesday Sessions

SSL-2: Frequency Conversion and OPOs
Chair: Vaclav Kubec, Czech Technical University, Prague, Czech Republic

Time: Wednesday, 10:30–12:30  
Location: Lecture Hall EI7

Invited

SSL-2.1 Wed, 10:30
Highly nonlinear crystals for ultrafast mid-IR frequency conversion  
— Peter Schunemann — BAE Systems, Inc., Nashua, NH, USA
ZnSeP2 and CdSiP2, as well as the orientation-patterned semiconductors GaAs (OP-GaAs) and GaP (OP-GaP), exhibit the highest nonlinear optical coefficients among phase-matchable crystals with practical absorption losses and transparency ranges. Advances in growth and processing of these materials have extended ultrafast laser output deep into the mid-infrared.

SSL-2.2 Wed, 11:00
High-average-power, high-repetition-rate, Yb-fiber-based pico-second parametric source at 2.1 μm  
— Chaitanya Kumar Sudarapalli1 and Mario Ebrahim-Zadeh1,2 — ICFO-Institut de Ciencies Fotòniques, Barcelona Institute of Science and Technology, 08860 Castelldefels (Barcelona), Spain — 1 Instituto Catalán de Recerca i Estudis Avancers (ICREA), Passeig Lluis Companys 23, Barcelona 08010, Spain
We report an Yb-fiber-pumped, high-power, linearly-polarized, pico-second source at 2.1 μm, providing >7% of average power at 39.4% conversion efficiency in 20 ps pulses at ~79 MHz repetition-rate, with excellent power stability of <1% rms over 15 h and beam-pointing stability <40 μrad over 1 h, in good beam-quality.

SSL-2.3 Wed, 11:15
First Ultrafast Optical Parametric Oscillator (OPO) Pumped by a Vertical External Cavity Surface Emitting Laser (VECSEL)  
— Nakya Jornion1, Valentin J. Wettwer1, Maxim Gaponenko1, Martin Hoffmann1, Nilu Hemple2, Graeme P. Malcolm2, Garett T. Mark2, and Thomas Stößmeier2 — 1 Laboratoire Temps-Fréquence, Université de Neuchâtel, Neuchâtel, Switzerland — 2 Mi Squared Lasers Ltd, Glasgow, Scotland
We present the first OPO synchronously pumped by an ultrafast VECSEL. The generated signal and idler waves cover the 1.35-1.80 μm and 2.10-3.57 μm range. The signal pulses have 2-4 ps duration and an output power up to 80 mW.

SSL-2.4 Wed, 11:30
Ultrafast Wavelength Tuning and Scanning Properties of a Non-collinear Optical Parametric Oscillator (NOP)  
— Alexander Pape1, Thomas Bahnhammer1, Yuliya Khvanukava1, Andreas Wiesen1, Tino Lange1, Jan Ahrens1, Oliver Prochowni2, and Uwe Morong2 — 1 Laser Quantum, Hannover, Germany — 2 Institut für Quantenoptik, Hannover, Germany — 3 DESY, Hamburg, Germany
We present an ultrafast tunable non-collinear parametric oscillator (NOP) which covers almost one optical octave from 650-1100 nm. The absence of intrinsic inversion life time allows a switching speed of more than 500 nm/ms. The scalability of the system and tuning behavior for two different non-collinear geometries will be investigated.

SSL-2.5 Wed, 11:45
Broadly tunable, femtosecond deep-infrared optical parametric oscillator based on CdSiP2  
— Chaitanya Kumar Sudarapalli1, A. Ebrahim-Zadeh1,2 — ICFO-Institut de Ciencies Fotòniques, Barcelona Institute of Science and Technology, 08860 Castelldefels (Barcelona), Spain — 2 Radiantis, Poligon Camí Ral, 08850 Gavà, Barcelona, Spain — 3 BAE Systems, Incorporated, Mer15-1813, P.O. Box 868, Nashua, New Hampshire 03061-0868, USA — 4 Instituto Catalán de Recerca i Estudis Avancers (ICREA), Passeig Lluis Companys 23, Barcelona 08010, Spain
We report the first pump-tuned cascaded deep-IR femtosecond OPO based on CdSiP2, providing rapid and hands-free tuning in 6-7 μm wavelength range, with up to 32 mW (6808 nm) of average idler power at 80 MHz and near-transform-limited signal pulse duration of ~10 fs with a bandwidth-product of Δλt~0.36.

SSL-2.6 Wed, 12:00
Broad tuning of a pico-second OPO based on aperiodically poled lithium niobate using an intracavity chirped volume Bragg grating  
— Delphine Descloux1,2, Guillaume Walter1,2, Jean-Baptiste Dherbecourt1,2, Guillaume Gobin1,2, Jean-Michel Melkonian1,2, Myriam Raynaut1,2, Cyril Dragi1,2, and Antoine Godard1,2 — 1 ONERA-The French Aerospace Lab, F-91129 Palaiseau cedex, France — 2 Laboratoire Aimé-Cotton, CNRS, Univ. Paris Sud, ENS Cachan, Université Paris-Saclay, F-91405 Orsay cedex, France
We report on a narrow-line-width synchronously-pumped picosecond OPO combining an aperiodically poled nonlinear crystal and an axially chirped volume Bragg grating. Translation of the grating along the beam axis enables wavelength tuning within 215 nm around 3.82 μm. Fast tuning over 170 nm in 100 ms is demonstrated.

SSL-2.7 Wed, 12:15
CEO Phase Noise Suppression in Synchronously Pumped Degenerate OPOs  
— Chenchen Wan1,2, Peng Li1,3, Axel Rehle1, and Ingoa Hart1 — 1 Deutsches Elektronen-Synchrotron (DESY), Notkestrasse 85, 22607 Hamburg, Germany — 2 Electro-optics Program, University of Dayton, 300 College Park, Dayton, OH, 45469-0245, USA — 3 Current affiliation: IMRA America Inc., 1844 Woodridge Ave, Ann Arbor, MI 48105, USA
The CEO frequency phase noise transfer from pump to a degenerate femtosecond doubly resonant OPO is measured. We observe, that the self-locked OPO has 6dB CEO phase noise suppression compared to pump indicating that it acts as an ideal frequency divider without any excess noise.

12:30–13:45  
Lunch Break

FWG-3: New Sources and Concepts for Imaging and Spectroscopy
Chair: Tso Yee Fan, MIT Lincoln Laboratory, Lexington, MA, USA

Time: Wednesday, 13:45–15:45  
Location: Lecture Hall EI7

Invited

FWG-3.1 Wed, 13:45
All-fiber optical parametric oscillator for bio-medical imaging  
— Thomas Gottschall1, Tobias Meyer1, Michael Schmitt1, Jürgen Popp2,3, Jens Limpert4,5, and Andreas Tönnessmann1,6 — 1 Friedrich-Schiller-Universität Jena, Abbe Center of Photonics, Albert-Einstein-Str. 6, 07745 Jena, Germany — 2 Friedrich-Schiller-
Main Conference – Wednesday Sessions

**EUROPHOTON 2016**

Universitats Jena, Institute of Physical Chemistry, Abbe Center of Photonics, Helmholtzweg 4, 07743 Jena, Germany — 1Leibniz-Institut für Photophysikalische Technologien Jena (IPHT) e.V., Albert-Einstein-Str. 9, 07745 Jena, Germany — 2Fraunhofer Institute for Applied Optics and Precision Engineering, Albert-Einstein-Str. 7, 07745 Jena, Germany

The first broadly tunable all-fiber optical parametric oscillator system is presented. This laser concept could very well be the missing key to establish non-linear imaging as a diagnostic tool in bio-medical domains.

**FWG-3.2 Wed, 14:15**

Ultrafast fiber laser source tunable in 825-1210 nm for multiphoton microscopy — Wei Li,1,2, Chen Li1, Hailing-Yu Chu1,2, Shih-Huei Chia1,2, Zhihong Zhang1,3, Bernd Jung1,2, and Yingying Jiang1,2 — 1Center for Free-Electron Laser Science, DESY, Notkestrasse 85, Hamburg, Germany — 2Physics Department, University of Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — 3State Key Laboratory of Advanced Optical Communication Systems and Networks School of Electronics Engineering and Computer Science, Peking University, Beijing 100871, China — 4The Hamburg Centre for Ultrafast Imaging, Luruper Chaussee 149, 22761 Hamburg, Germany

We propose and demonstrate a new approach to generate a wavelength-tunable ultrafast fiber laser source suitable for multiphoton microscopy. We employ fiber-optic nonlinearities to broaden a narrowband optical spectrum generated by an Yb-fiber laser system and then select the leftmost or rightmost spectral lobes from the broadened spectrum.

**FWG-3.3 Wed, 14:30**

In-vivo nonlinear optical microscopy with a novel all-polarization maintaining femtosecond Yb-fiber laser — Maartje Vereijken1,2, Lingxiao Zhu1,2, Marco Andrea1, Martin Distel1, Stone Møller Jakobsen1, Kariert Rottwitt1, Wolfgang Kattke1, Andreas Baltuska1, Angelika Unterhuller1, Wolfgang Dreckler1, and Alma Fernández1,2 — 1Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Vienna, Austria — 2Institut für Fotonic, Technische Universität Wien, Vienna, Austria — 3Universität Wien, Institut für Physikalische Chemie, Vienna, Austria — 4Children’s cancer research institute, Vienna, Austria — 5Technical University of Denmark, Department of Photonics Engineering, Kgs. Lyngby, Denmark

We present a novel all-polarization maintaining femtosecond Yb-fiber laser and its application to nonlinear optical microscopy. All-polarization maintaining Yb-fiber systems offer robust environmental stable turn-key operation, with a very compact footprint.

**PO-2: Poster Session 2 with Coffee Break**

*Location: Foyer*

**Time: Wednesday, 15:45–17:00**

**PO-2.1 Wed, 15:45**

Edge-pumped Nd:YAG/YAG-lens composite laser — Oana Valeria Gregorie1, Gabriela Ciortan1, Iulian Dascălu1, Miha Dincă1, and Nicolae Paevă1 — 1National Institute for Laser, Plasma and Radiation Physics, Laboratory of Solid-State Quantum Electronics, Bucharest, Romania — 2University of Bucharest, Faculty of Physics, Bucharest, Romania

We describe a laser configuration that consists of a Nd:YAG core surrounded by a circular-unpumped YAG, this composite structure having a lens-like shape. Under diode-laser edge-pumping in a three-fold scheme, the device yielded 1.06-micron laser pulses with 131.8-mJ energy at a repetition rate of 1064-laser pulses with 31.8-mJ energy at a repetition rate of 1064-Hz power. The device was used to demonstrate the concept of a laser with a compact design.

**PO-2.2 Wed, 15:45**

Blue-light induced infrared absorption in KTOPO4 isomorphs — Stenfjörn Olafsson1, Valerio Maestroni1, Andrey Zulkouskas1, Gaëtan Canalit1, Fredrik Laurent1, and Valdas Badzinski2 — 1National Institute of Technology, Stockholm, Sweden — 2Politecnico di Milano, Milano, Italy

We compared the dynamics of blue-light induced infrared absorption in periodically poled KTOPO4, Rb-KTOPO4, and KTOPO4. The results led us to attribute the largest portion of the induced absorption to photo-generated electrons and holes self trapped in the proximity to TiO4 and O2 ions, respectively, forming polaron color centers.

**PO-2.3 Wed, 14:45**

Optimal pumping of an OPO with a pulsedwidth-tunable MOPA source — Guillaume Aoust1, Caroline Couvent1, Xavier Delèze1, Myriam Ratba2, Jean-Baptiste Dherbecourt3, Jean-Michel Melkonian1, Guillaume Goux1, François Balembois1, Patrick Georges1, and Antoine Godard1 — 1ONERA-The French Aerospace Lab, F-91123 Palaiseau cedex, France — 2Laboratoire Charles Fabry, Institut d’Optique Graduate School, CNRS, Université Paris-Saclay, F-91127 Palaiseau cedex, France

A singly resonant OPO is pumped by a hybrid MOPA whose pulse duration is varied from 4 to 4 μs. For each pump energy, there is an optimal duration to maximize efficiency and avoid beam profile degradation. Numerical modelling enables to analyse the results and determine optimal pumping parameters.

**PO-2.4 Wed, 15:45**

Sub-nanosecond Yb:KLuW/Cr:YAG microchip laser — Paul Loido1,2, José Maria Sebre1, Xavier Matte2,3, Konstantin Yumashev1, Anatoly Yakushev1, Valentin Petrov1, Uwe Griebner1, Magdalena Aguiol1, and Francesc Diaz1 — 1Center for Optical Materials and Technologies (COMT), Belarussian National Technical University, Minsk, Belarus — 2Piscial And Crystallography of Materials and Nanomaterials (PICM-FCNA), University of Valencia, Valencia, Spain — 3Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany

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"europhoton7_book_print" — 2016/7/20 — 5:46 — page 38 — #38
A diode-pumped Yb:KLuW microchip laser passively Q-switched by a C+4:YAG saturable absorber generated a maximum average output power of 590 mW at 1031 nm with a slope efficiency of 53%. The pulse characteristics were 690 ps (47 s/6 ns). The output beam had a high circular profile with M2 < 1.05.

**PO-2.5** Wed, 15:45

**Compact terahertz-wave source based on silicon waveguides** — Qibing Sun, Zhaolu Wang, Hongjun Liu, and Nan Huang — Xi’an Institute of Optics and Precision Mechanics, Chinese Academy of Science, Xi’an, China

Compact terahertz-wave source based on four-wave mixing (FWM) in silicon waveguides is proposed and investigated. The pump wavelength located in the normal group-velocity dispersion region is required to realize collinear phase matching for the THz-wave generation via FWM. Broadband THz waves can be obtained with high conversion efficiency exceeding 1%.

**PO-2.6** Wed, 15:45

**2 m ring cavity diode-pumped Tm:YAP regenerative amplifier** — Pavel Malevich1,2, Clemens Livache1, Yutaka Nomura3, Andreas Baltuska1, and Takao Fujiy1 — Laser Research Center for Molecular Science, Institute for Molecular Science, 502-5203, Tochigi, Japan

We experimentally investigate multiple regimes obtained within a passive mode-locked fiber including a Mach-Zehnder interferometer. By adjusting the time delay imbalance, ultrashort pulse trains at multi-GHz repetition rates are generated, but display an inherent instability, which has been overlooked. By using a recirculation loop, we demonstrate a significant stability improvement.

**PO-2.7** Wed, 15:45

**Er:YLF laser with intracavity Mach-Zehnder interferometer for high-repetition short-pulse generation** — Racheh St Forni1,2,3, Foued Akmami1,4, Abdelhamid Kellou2, and Philippe Grell1 — 1 Lab ICR UMR 6303 CNRS, Univ. Bourgogne Franche-Comté, BP 47870, Dijon F-21000, France — 2 Laboratoire d’Électronique Quantique, USIBHR, BP52 El Alia, Bab Ezzouar, Algiers, Algeria

We experimentally investigated multiple regimes obtained within a passive mode-locked fiber including a Mach-Zehnder interferometer. By adjusting the time delay imbalance, ultrashort pulse trains at multi-GHz repetition rates are generated, but display an inherent instability, which has been overlooked. By using a recirculation loop, we demonstrate a significant stability improvement.

**PO-2.8** Wed, 15:45

An efficient single frequency Ho:YLF laser for IPDA lidar applications — Jiecong Wu, Yingxin Bai, Zhenhua Weng, Kaili Zhong, and Zhimin Jia — NASA Langley Research Center, Hampton, Virginia, 23681, USA — Science System & Applications, Inc. One Enterprise Parkway, Hampton, Virginia, USA

An efficient, single frequency, high repetition rate, diode-pumped Ho:YLF laser prototype has been developed for CO2 IPDA lidar applications. The output pulse energies have been 42 mJ at 100 Hz and 30 mL at 200 Hz. The characteristics of this laser meet the stringent requirements of CO2 IPDA lidar.

**PO-2.9** Wed, 15:45

**Rogue Waves Generated by Soliton Explosions in a Mode-Locked Laser** — Ziyi Cao1,2,3, Mings Li1,2,3, and Xin Chen1 — 1Guangdong Provincial Key Laboratory of Nanophotonic Functional Materials and Devices, School of Information and Optoelectronic Science and Engineering, South China Normal University, Guangzhou, Guangdong 510006, China — 2Guangdong Provincial Engineering Technology Research Center for Microstructured Functional Fibers and Devices, South China Normal University, Guangzhou, Guangdong 510006, China

We reported on the observation of rogue waves (RWs) generated by the soliton explosions in an ultrafast fibre laser. The observed results provide the first experimental evidence for the connection between the soliton explosions and rogue wave generation.

**PO-2.10** Wed, 15:45

**Progress in Q-switched diode-pumped Alexandrite lasers** — Michael Damzen1, Gabrielle Thomas1, and Arit Babamiri1, and Xi Shen2,3 — Imperial College, London, UK — 1Unilase Ltd, London, UK

We present latest results for Q-switched CW and QCW diode-pumped Alexandrite lasers with pulse energy as high as 3 mJ (70 ns) at 500 Hz; and high peak power pulses produced by cavity-dumped Q-switching (0.13 mJ at 10 kHz and 0.4 mJ at 4 kHz) with short 3 ns pulse duration independent of pulse repetition rate.

**PO-2.11** Wed, 15:45

**GaN nonlinear waveguides** — Maxim Grozovoy1, Fabrice Skomed1, Julien Brulet1, Admeric Courville1, Pascal Baldo2, Jean-Yves Duboz1, and Marc P. de Micheli1 — 1CNRS-UMR 7588, 60560 Valbonne, France — 2LPSC, University of Nice Sophia Antipolis, 06100 Nice France

Combining MBE and MOVPE we have been able to fabricate GaN epitaxial planar waveguides exhibiting ultra low loss in the visible (≤1 dB/cm at 640 nm) and allowing efficient NIR to visible nonlinear conversion.

**PO-2.12** Wed, 15:45

**Accurate measurements of second-order nonlinear-optical coefficients of LaBGeO5** — Yutaka Honda, Shinta Kawasaka, and Ichiro Suto — Chuo University, Tokyo, Japan

We accurately measure the second-order nonlinear-optical coefficients d33 and d22 of LaBGeO5 at the fundamental wavelength of 1064 nm using the wedge technique. The values are determined to be d33 = 0.96 pm/V and d22 = 0.86 pm/V, which are 2.7 and 3.6 times larger than previously reported values, respectively.

**PO-2.13** Wed, 15:45

**Tunable dual-bandwidth 100 GHz high-repetition-rate ultrafast fiber laser** — Xiao-Mei Tan1, Quan-Kai Zhao2, Tao-Ken Li3,4, Ai-Ping Liao1, Zhi-Chao Liu1, and Wei-Cheng Xu5 — 1South China Normal University, Guangzhou, China — 2South China Normal University, Guangzhou, China — 3South China Normal University, Guangzhou, China — South China Normal University, Guangzhou, China — 5South China Normal University, Guangzhou, China

We report a tunable dual-bandwidth 100 GHz high-repetition-rate (HRR) ultrafast fiber laser using a F-P fiber and a piece of highly nonlinear fiber (HNLF). The spacing between these two wavebands could be tuned from 12.7 nm to 16.9 nm. This kind of fiber laser may provide some potential applications.

**PO-2.14** Wed, 15:45

**Attosecond transient XUV absorption spectroscopy of laser dressed krypton** — Enzo De Sere1, Joszef Seres2, Karles Seker1, and Shiuchi Aiba1 — 1Ainoshima Institute for Advanced Science, Fukuoka University, 1-1 Kagamihara, Higashi-Hiroshima, Hiroshima 739-8527, Japan

Experimental results of time-resolved X-ray absorption spectroscopy in Krypton gas are presented. The laser dressed transition of 3d-5p with attosecond resolution and the quantum beat between 6p and 7p levels was measured using the high-order harmonics generated in Ne gas by a Ti:sapphire laser.
PO-2.15 Wed, 15:45
Powerful linearly-polarized high-order random fiber laser — Jiangming Xu1,2, Pu Zhou1,2, Pengfei Ma1,2, Jian Wu1,2, and Hanwei Zhang1,2 — College of Optoelectronic Science and Engineering, National University of Defense Technology, Changsha 410073, China. — 1 Hunan Provincial Collaborative Innovation Center of High Power Fiber Laser, Changsha 410073, PR China

We demonstrate a linearly-polarized narrowband high order random fiber laser operating at 1178 nm pumped by broadband amplified spontaneous emission (ASE) with maximal output power of 25.8 W. The dynamics of spectral-temporal evolutions is also investigated.

PO-2.16 Wed, 15:45
The generation of optical vortex beams using fused two-mode coupler based passively mode-locked fiber laser — Feng Wang, Fan Shi, Yang He, and Xianglong Zeng — The Key Lab of Specialty Fiber Optics and Optical Access Network, Shanghai University, Shanghai, China

We demonstrate a new method for the generation of optical vortex beams using single mode fiber–two mode fiber (SMF–TMF) coupler acting as power splitting ratio and mode conversion. It is inserted into passively fiber laser cavity to obtain the mode-locked pulse based nonlinear polarization evolution.

PO-2.17 Wed, 15:45
Magnetic field sensor based on hollow optical fiber and magnetic fluid — Fan Shi, Xuexun Bai, Feng Wang, Yang He, Shengli Pu, and Xianglong Zeng — The Key Lab of Specialty Fiber Optics and Optical Access Network, Shanghai University; 200872 Shanghai, China

A compact all fiber magnetic field sensor is achieved using Mach-Zehnder interferometer (MZI) based on hollow optical fiber (HOF) and magnetic fluid (MF). The high sensitivity of >170 pm/Oe is obtained when measuring using the external magnetic field from 0 Oe to 79.4 Oe.

PO-2.18 Wed, 15:45
Spatial, temporal and spectral-resolved measurement of small signal gain coefficient in a cryogenically cooled Yb:YAG slab — Paweł Skoczkowski1, Zbigniew M. Różański1, and Helena Jelinková1, Jana Hronková1, and Tomas Mocke2 — 1HILAS Centre, Institute of Physics ASCR, v.v.i., Dolní Břežany, Czech Republic. — 2 Czech Technical University in Prague, Prague, Czech Republic.

Temperature and pumping intensity dependence of small signal gain coefficient and gain-bandwidth of cryogenically-cooled Yb:YAG slab crystal utilizing spectral and time-resolved probe beam technique is presented. This method provides precise 2D gain profiles, is insensitive against the mode mismatching and makes it possible to analyse temporal gain dynamics of laser medium.

PO-2.19 Wed, 15:45
Polarization-Multiplexed, Mode-Locked Fiber Laser — Michael Kolano1,2, Benjamin Graß1,2, Daniel Molter1,2, Frank Elschner1,2, and Georg von Freymann1,2 — 1 Fraunhofer Institute for Physical Measurement Techniques IPM, Fraunhofer-Platz 1, 67663 Kaiserlautern, Germany. — 2 Department of Physics and Research Center OPTIMAS, University of Kaiserlautern, 67663 Kaiserlautern, Germany.

Two orthogonal-polarized pulse trains are simultaneously emitted from a single, all-polarization-maintaining fiber laser using two saturable absorber mirrors and a fiber-coupled polarization beam splitter. To our opinion this design shows great potential to reduce the complexity of current time-resolved measurement systems without sacrificing performance.

CVD graphene/PMMMA saturable absorber for power scaling of erbium doped fiber lasers — Jan Tarna1, Jakub Boguslawski1, Alexey Kuznetsov2, Oleg Kalashnikov2, and Alexander Przewoski1, Wlodzimierz Sikorski1, and Jaroslaw Soto1 — 1 Laser & Fiber Electronics Group, Wrocław University of Technology, Wyb. Wyspiańskiego 27, 50-370 Wrocław, Poland. 2 Institute of Electronic Materials Technology, Wolczynska 133, 01-919 Warszawa, Poland

We present the study on power scaling of all-polarization maintaining (PM) fiber mode-locked laser using the multilayer CVD graphene/PMMMA composite as a saturable absorber. Pulses with the duration of 148 fs were generated are the shortest pulses obtained from mode-locked erbium doped fiber laser working in anomalous dispersion regime.

A novel stochastic model for the energy transfer process in Er3+:Yb3+ codoped phosphosilicate fibers — Michael Steinke1,2, Joerg Neumann2,3, Dietmar Kracht2,3, and Peter Wessels2,3 — 1 Laser Zentrum Hannover e.V., Hollerithalle 8, D-30419 Hannover, Germany. — 2 Centre for Quantum-Engineering and Space-Time Research. — 3 QUEST, Welfengarten 1, D-30167 Hannover, Germany.

A novel stochastic model for the energy transfer process in Er3+:Yb3+ codoped fibers is presented and corresponding results will be discussed. The stochastic model overcomes some inconsistencies of the common fixed rate modelling, in particular since it properly models the underlying dipole–dipole interaction with a 1/r6 characteristic.

Towards 20 nJ sub 10 fs UV pulses with MHz repetition rate — Sven Kleinschmidt1,2, Attila Taglia1,2, Bernd Kühn1,2, Alexander Khanukov1,2, Tamás Nagy1,2, and Uwe Möhwald1,3,4,5 — 1 Institut für Quantenoptik, Leibniz Universität Hannover, Woltersweg 1, 30167 Hannover, Germany. — 2 Laser Zentrum Hannover e.V., Hollerithalle 8, D-30419 Hannover, Germany. — 3 Hannoversches Zentrum für Optische Technologien, Leibniz Universität Hannover, Niemegker Straße 17, D-30167 Hannover, Germany.

We present a compact optical parametric amplification system for the visible range pumped by a chirped pulse amplification system at 1 MHz repetition rate. Those pulses will be used for generation of UV radiation via second harmonic generation resulting in 20 nJ sub-10 fs pulses.

RB-exchanged ridge waveguides in KTiOPo4 (KTP) — Joﬂin F. Volč1, Christian E. Ruter1, Christof Eigler2, Harald Herrmann3, Christine Silberhorn4, and Dietzel KP5 — 1 Faculty of Electrical Engineering, Helmut Schmidt University, 22033 Hamburg, Germany. — 2 Department of Physics, University of Paderborn, 33098 Paderborn, Germany.

We report on fabrication of KTP ridge waveguides by RB-ion-exchange and optical-grade doping, and their characterization. Waveguides were fabricated by ion-exchange through the top surface of z-cut substrates, followed by ridge definition. Additionally ridges were prepared in y-cut substrates and subsequently ion-exchanged through the side-walls.

Evaluation of True Temperature Tuning Curves of PPLN Crystal in Process of SHG — Andrey Baranov1,2, Oleg Kalashnikov2, and Alexander Konyashkin1,2 — 1 Moscow Institute of Physics and Technology, Dolgoprudny, Russia. — 2 Kotel'nikov Institute of Radioengineering and Electronics of RAS, Frunze, Russia.

Effect of temperature distribution of nonlinear-optical crystal on engineering and Electronicsof RAS, Fryazino, Russia.

Evaluation of True Temperature Tuning Curves of PPLN Crystal in Process of SHG — Andrey Baranov1,2, Oleg Kalashnikov2, and Alexander Konyashkin1,2 — 1 Moscow Institute of Physics and Technology, Dolgoprudny, Russia. — 2 Kotel’nikov Institute of Radioengineering and Electronics of RAS, Frunze, Russia.
Tunable 2.03–2.12 μm Ho:CaF2 laser pumped by Tm:fiber laser — 4.

Y. Kovalenko1, A. Gerasimenko1, and V. Puzikov2
1. Czech Technical University in Prague, Zbrasov, 1,1519 Prague 1, Czech Republic. 2. Institute for single crystals, NAN Ukraine, Kharkov, Ukraine

Fe:ZnS(x):Mn(x) solid solution (x=0.1 and 0.2) spectroscopic and laser properties were investigated in the temperature range 80–290K. Laser radiation generation was demonstrated at the central wavelength in the range 4.2 – 4.8 μm at T–80 K and in the range 4.8 – 5 μm at T–290 K.

Powerscaling off-laserooscillatorsindifferentoperationmodes

Powerscaling of ultrafast oscillators in a modular multi-crystal configuration is investigated with respect to the number of modules, pump splitting, output coupling ratio, gain materials, and different operation regimes, i.e. cw, mode-locked, hybrid and cavity-dumped.

Powerscaling of ultrafast oscillators in different operation modes using a modular 4-crystal resonator — 5.

Y. Kovalenko1, A. Gerasimenko1, and V. Puzikov2
1. Institute for single crystals, NAN Ukraine, Kharkov, Ukraine. 2. Institute of Quantum Optics, Leibniz Universität Hannover, Welfengarten 1, 30177 Hannover, Germany. 3. Max-Planck-Institut für Quantenoptik, Hans-Kopfermann-Str. 1, D–85748 Garching, Germany.
San 5 Wonchun-dong, 443-749 Sowon, Republic of Korea — 1NEST Istituto Nanoscienze—CNR and Dipartimento di Fisica dell’Università di Pisa, Largo B. Pontecorvo 3, 56127 Pisa, Italy

We report on diode-pumped, passively Q-switched Tm:YLF lasers with graphene as SA. We achieved 720 mW at 1884 nm with conversion efficiency as high as ~70%. The shortest pulse duration was 130 fs. The bi-layer graphene with increased modulation depth was advantageous for the pulse characteristics.

PO-2.34 Wed, 15:45
Noise reduction in high power Yb-doped fiber laser systems — 1Michael Müller, 2Cesar Jauregui, 3Marco Kielen, 1Florian Emadi, 2Clara Saraceno, 2Jens Limperis, 2,3,4, and Andreas Tünnemann, 2
1Institute of Applied Physics, Friedrich-Schiller University Jena — 2Institute for Quantum Electronics, ETH Zurich — 3Helmholtz-Institute Jena — 4Fraunhofer Institute for Applied Optics and Precision Engineering

The amplitude noise of a fiber laser system is tracked throughout the amplification chain. We observe a significant damping of the amplitude noise, reaching an rms value of ~0.06% at the maximum output power. This noise damping is also theoretically studied and explained as a consequence of saturation effects.

PO-2.35 Wed, 15:45
Thermal behavior of composite Yb:YAG/YAG active element in high average power pulsed amplifier — 1Vlad Kurzin, 2Michael Volkov, 2Olga Vasinova, 2Evgeny Perelyeyev, and 1Olga Palashov — 1Institute of Applied Physics of the Russian Academy of Science, Nizhny Novgorod, Russia

High energy and high average power multipass amplifier with the composite Yb:YAG/YAG active element is under development. It is shown that composite geometry helps not only to increase the gain but also to decrease thermal effects when optimal parameters are chosen. CW lasering with 440W average power is achieved.

PO-2.36 Wed, 15:45
Optimising Alexandrite laser performance — Experiment and Theory — 1William R. Kerber, 2Johns, 2Emma A. Abbazia, and 2Michael J. Dames — Imperial College, London, UK

We demonstrate highest-ever laser slope efficiency (54%) and widest wavelength tuning range (713 – 817nm) from a diode-pumped Alexandrite laser. New analytical modelling, incorporating pump and laser excited and ground-state absorption in the end-pumping geometry, is developed and used to aid optimisation of diode-pumped Alexandrite laser performance.

PO-2.37 Wed, 15:45
Strong Laser Field Induced High-Lying Rydberg States — 1Sete-Dreza Laikam, 2Sonja Erkutyanova, 2Rafaelo Macier, 2Christina Lemli, 2Steavan Nagle, 2Shinpei Yoshida, 2Joachim Burgdörfer, 2András András Baltés, 2Markus Kitzler, 2, and 3Xinxia Xie — 1Photonics Institute, Vienna University of Technology, Austria — 2Institute for Theoretical Physics, Vienna University of Technology, Austria — 3A-1040 Vienna, Austria

We report on the measurement of electron emission from high-lying Rydberg states after the interaction of strong laser pulses with atoms and molecules. Simulations show that both tunneling ionization by a weak dc field and photoionization by the black-body radiation contribute to delayed electron emission.

PO-2.38 Wed, 15:45

Optical parametric generation in OP-GaAs is demonstrated for the first time with single-source 2 μm pumping, reaching a record output energy of 2 μJ, 25 times more than previously reported.

PO-2.39 Wed, 15:45
Generation of tunable mid-infrared ultrashort pulses in suspended-core tellurite fibers — 1Masumi Koyama, 2Elena Anashirina, 2Alexey Andrianov, 2Vitaly Dobroserov, 2Alexey Kosolapov, 2Sergey Muravyev, 2, and Arkady Kim — 1Institute of Applied Physics of the Russian Academy of Science, 46 Ulyanov Street, Nizhny Novgorod, 603950, Russia — 2Institute of High Purity Substances of the Russian Academy of Sciences, 49 Tropinin Street, Nizhny Novgorod, 603950, Russia — 3Fiber Optics Research Center of the Russian Academy of Sciences, 28 Vavilov Street, Moscow, 119333, Russia

Widely tunable in 1.6–2.6 μm range Raman solitons are demonstrated in microstructured tellurite fiber pumped by femtosecond Er/Tm fiber laser. We also demonstrate numerically the possibility to obtain solitons in the range 4 μm and red-shifted dispersive waves up to 5 μm in such fibers with optimized parameters.

PO-2.40 Wed, 15:45
Dispersion managed mode-locked Holmium fibre oscillator operating beyond 2.1 μm — 1Jowan Bogar, 2Nikolai Toftelid, 2Eugene Sorokin, 3, and Irina T. Sorokina — 1Photonics Institute, TU Wien - Vienna University of Technology, Vienna, Austria — 2Department of Physics, NTNU - Norwegian University of Science and Technology, Trondheim, Norway

We present a simple solution for mode-locked Ho-doped fibre linear oscillator composed of only commercially available components. Precise compensation of the intracavity anomalous dispersion resulted in stable operation supporting sub-ps pulse duration according to the registered spectrum. The system has the longest wavelength of all reported mode-locked holmium fibre lasers.

PO-2.41 Wed, 15:45
Towards an intrinsically stable all fiber low-power broadband source at 1 μm — 1Philippe Riban, 2Valerio Romano, 3, Thomas Feurer, 4, and Manuel Ryser — 1Institute of Applied Physics, University of Bern, Bern, Switzerland — 2Bern University of Applied Sciences, Burgdorf, Switzerland

We present an intrinsically stable low power fiber-optic source in the 1μm wavelength range. It is based on the generation of strong population inversion in a few millimeter long piece of Yb-doped fiber by applying high pump power. Careful optimization of the setup leads to an ultra-stable broadband spontaneous emission source.

PO-2.42 Wed, 15:45
Absorption measurement effects in fibres with multimode cores — 1Betty Meng Zhang, 2Yutong Feng, 3Jonathan H. V. Price, 2Roderick Paschotta, 2, and Johan Nilsson — 2Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom — 3School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore, Singapore — 3RP Photonics Consulting, Bad Dürrenberg, Germany

We use simulations to investigate measurement error effects in the absorption of Yb-doped fibers. We find that both re-emission into the investigated absorption band and modal cutoff effects can lead to unacceptable errors and discuss under what circumstances this may occur in practice.

PO-2.43 Wed, 15:45
Noise Induced Creation and Annihilation of Dispersion Managed Solitons in Fiber Oscillators — 1Tatian Traimer, 2Parvez Elahi, and F. Omar Ilday — 1Department of Electrical and Electronics Engineering, Bilkent University, Ankara, 06800, Turkey — 2Department of Electrical and Electronics Engineering, Bilkent University, Ankara, 06800, Turkey

Relative intensity noise of fiber oscillator is characterized in dispersion managed soliton regime. With scanning of pump power the sys-
Stochastic spatiotemporal dynamics of transition states of bound solitons in a fiber oscillator — Thierry Treussart, Parvez Iqbal, Ghiath Makri, and F. Ober Ildma — Department of Physics, Bilkent University, Ankara, 06800, Turkey — Department of Electrical and Electronics Engineering, Bilkent University, Ankara, 06800, Turkey

Critical transition phenomena of a soliton bound state is experimentally observed as a pump is scanned inside fiber oscillator. This far from thermodynamic equilibrium point is characterized by energy exchange between solitons, vibrating temporal separation and other effects associated with soliton perturbation.

PO-2.44 Wed, 15:45

Femtosecond-pumped mid-infrared few-cycle optical parametric chirped pulse amplifier source — Philippe Rigaud, Atmeric Van de Valle, Mark Hanna, Alexandre Traî, Nicolas Forget, Florent Guchard, Yoann Zaoiture, and Patrick Georges — Laboratoire Charles Fabry, Institut d’Optique Graduate School, CNRS, Université Paris-Saclay, 91127 Palaiseau Cedex, France — Faulette, 1900 route des Côtes 06560 Valbonne, Sophia Antipolis, France — Amplitude Systemes, 11 avenue de Cantanne, Cité de la Photonique, 38600, Pesca, France

An OPCPA scheme based on a femtosecond pump is investigated to produce mid-infrared passively CEP stable few cycle pulses at high repetition rate. Femtosecond pumping advantages are highlighted in terms of optical synchronization, signal and idler generation, and stretching/compression solutions.

SSL-3: OPAs/OPCPAs

SSL-3.1 Wed, 17:00

Femtosecond-pumped mid-infrared few-cycle optical parametric amplifier source — Philippe Rigaud, Atmeric Van de Valle, Mark Hanna, Alexandre Traî, Nicolas Forget, Florent Guchard, Yoann Zaoiture, and Patrick Georges — Laboratoire Charles Fabry, Institut d’Optique Graduate School, CNRS, Université Paris-Saclay, 91127 Palaiseau Cedex, France — Faulette, 1900 route des Côtes 06560 Valbonne, Sophia Antipolis, France — Amplitude Systemes, 11 avenue de Cantanne, Cité de la Photonique, 38600, Pesca, France

An OPCPA scheme based on a femtosecond pump is investigated to produce mid-infrared passively CEP stable few cycle pulses at high repetition rate. Femtosecond pumping advantages are highlighted in terms of optical synchronization, signal and idler generation, and stretching/compression solutions.

SSL-3.2 Wed, 17:15

Multifiber OPCPA system at 100 kHz with sequential pump depletion — Jan Ahrens1,2, Olivier Prochon1, Alexandre Papi, Thomas Reinhammer1, Stefan Radsch1, Bastian Schulz1, Mark Freed1, and Uwe Morgner1,2 — Laser Quantum VENTON, D-30419 Hannover, Germany — Institute of Quantum Optics, Leibniz Universität Hannover, D-30167 Hannover, Germany — HeolASE GmbH, D-30419 Hannover, Germany

We present a 100 kHz OPCPA system seeded by an ultra-broadband Ti:sapphire oscillator and pumped by a frequency doubled CPA-free Nd:YVO4 based amplifier. Parametric amplification in two double-pass NOPA stages leads to 18 µJ of pulse energy at 87 fs pulse duration with low OPG background.

SSL-3.3 Wed, 17:30

High contrast few-cycle OPCPA system with adaptable repetition rate from 0.2 – 2 MHz — Alexandre Papi1, Jan Ahrens1, Olivier Prochon1, Hauck Rensch1, Andreas Wienke1, Stefan Rauch1, Uwe Morgner1, and Thomas Reinhammer1 — Laser Quantum, Hölterthalerstrasse 17, 30419, Germany — Institute of Quantum Optics, Leibniz Universität Hannover, Welfengarten 1, 30167, Hannover, Germany

We present a compact high contrast few-cycle Ti:sapphire oscillator seeded OPCPA system with a pulse push adjustable repetition rate between 200 kHz and 2 MHz. Using a simple and efficient method the 80 MHz background can be suppressed by more than three orders of magnitude down to 70dB.

SSL-3.4 Wed, 17:45

High-energy optical parametric amplifiers in the mid-infrared with large-aperture periodically poled RbKTiOPO4 — Riaan Coetzee, Andrius Zukauskas Zukauskas, and Valdas Paskelis, — Royal Institute of Technology (KTH), Stockholm, Sweden

Parametric down-conversion and amplification schemes are often utilized to obtain high energy, nanosecond pulses deep within the mid-infrared. We present a high-energy, 2 µm master oscillator power amplifier (MOPA) based on large-aperture periodically poled Rb-KTP. A maximum output energy of 52 mJ was obtained with a conversion efficiency of 40 %.

SSL-3.5 Wed, 18:00

Temporal Characterization of a Cascaded Optical Parametric Amplifier for Efficient THz Wave Generation — Giovanni Cerni1,4, Kouzubear Ray1, Fabian Reichert1, Michael Hemmer1, Huseyn Cankaya1,2, Anne-Laure Caubel2,3,5, Frederik Amr1, Nicholas Mayli6, Luis Zapata1, Oliver Mucker1,2, and Franz Kaertner2,3,4 — Center for Free-Electron Laser Science, DESY, Hamburg, Germany — The Hamburg Center for Ultrafast Imaging Hamburg, Germany — Physics Department, University of Hamburg Hamburg, Germany — Department of ECEs and RLE, MIT Cambridge, USA

We perform spectro-temporal characterization of the optical output of a cascaded optical parametric amplifier, as a novel source promising to generate multi-cycle THz radiation with several percent efficiency, necessary for table-top free electron lasers. FROG retrieval shows gradual modulation of the optical pulses into pulse trains spaced by the terahertz-wave period.

SSL-3.6 Wed, 18:15

Terahertz parametric generation from KTIOPO4 in comparison with LBO3 and LiTaO3 — Meng-Huang Wu2,1, Yu-Chung Chu1,2, Dong-Dong Wang3, Gang Zhao1, Andrius Zukauskas1, Frederik Laurell1, and Yan-Chieh Huang3,4,5 — National Tsing Hua University, Hsinchu, Taiwan — Chung-San Institute of Science and Technology, Taoyuan, Taiwan — Peking University, Beijing, China — Royal Institute of Technology, Sweden

We show superior terahertz parametric generation from potassium titanyl phosphate over lithium niobate and lithium tantalate, and demonstrate seeded terahertz parametric amplification in KTP at 5.7 THz.

SSL-3.7 Wed, 18:30

Proof-of-principle experiment on a Thin Disk Ti:Sapphire amplifier with Extraction During Pumping (EDP-TD) — Roland Sandor Nagymihalyi2,1, Haobin Cao1, Michael Kalashnikov1,2, Nikita Khodakovskiy1,2, Lutz Ehrentraut1, Karoly Osvay1, and Vladimir Chvykov1,2 — ELI-HU Non-Profit Ltd, Szeged, Hungary — Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany

Proof-of-principle experiment on a Thin Disk (TD) Ti:Sapphire amplifier with Extraction During Pumping (EDP) method was performed with room temperature cooling. Highly efficient energy extraction was reached only with 3 passes of the seed and an output energy of 2.6 J. Temperature profile in the crystal was measured and numerically simulated.

SSL-3.8 Wed, 18:45

Few-cycle pulse characterization via XPW d-scan — Riaan Coetzee, Andrius Zukauskas, and Valdas Paskelis — Royal Institute of Technology (KTH), Stockholm, Sweden

We present high-energy, 2 µm master oscillator power amplifier (MOPA) based on large-aperture periodically poled Rb-KTP. A maximum output energy of 52 mJ was obtained with a conversion efficiency of 40 %.
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Main Conference — Thursday Sessions

**FWG-4.1 Thu, 8:00**

Bi/Er co-doped silica-based fiber with gain bandwidth over 200 nm — Sergey V. Firstov, Sergey V. Auyshhev, Konstantin E. Rumensin, and Tamas Nagy — 1Institute of Quantum Optics, Leibniz Universität Hannover, Welfengarten 1, D-30167 Hannover, Germany — 2Laser Zentrum Hannover e.V., Hollenthalle 8, 30419 Hannover, Germany — 3Laser-Laboratorium Göttingen e.V., Hans-Adolf-Krebs-Weg 1, 37077 Göttingen, Germany — 4Current address: Max-Born-Institut für Nichtlineare Optik und Zeitkonzentrationspektroskopie, Max-Bloom-Strasse 2a, 12489 Berlin, Germany

We demonstrate a dispersion scan (d-scan) pulse characterization scheme employing cross-polarized wave (XPW) generation as non-linearity that has no phase-matching limitations. The scheme is an ideal choice for characterizing few-cycle pulses in various spectral regions. We characterize 5–10 fs near-IR pulses and compare them with the established SHG d-scan method.

**FWG-4.2 Thu, 8:15**

‘Crystalline-core/crystalline-clad’ versus ‘crystalline-core/glass-clad’ fibers — Mark Dubinskii, Jun Zhang, Youming Chen, George A. Newburton, Tigran Sanamyan, Stuart Yin, and Claire Loo — 1US Army Research Laboratory, Adelphi, MD, USA — 2General Opto Solutions, LLC, State College, PA, USA

Presented are comparison results of the ‘crystalline-core/crystalline-clad’ fiber (CCCFC = C4F) versus ‘crystalline-core/glass-clad’ fiber concepts for major further fiber laser power scaling out of single fiber aperture. Reported are C4F fabrication results based on liquid phase epitaxial growth of YAG clad around the 100 μm LHGP grown single-crystalline Yb-YAG-core.

**Invited**

**FWG-4.3 Thu, 8:30**

Rare-earth-doped active glass : from telecom to sensors — Jean-Emmanuel Brouqin, Lionel Bastardo, Elise Cheraud, and Davide Bucci — 1Univ Grenoble Alpes, IMEP-LAHC, F-38000 Grenoble, France — 2CNRS, IMEP-LAHC, F-38000 Grenoble, France

This paper reviews the activities carried out on rare-earth-doped active devices made by ion exchange on glass at the IMEP-LAHC over the last decade. First the technology is presented, then results on Erbium lasers for airborne Lidar, Neodymium pulsed lasers for supercontinuum generation and recent developments on hybrid devices are shown.

**FWG-4.4 Thu, 9:00**


We investigate optical gain around 1.53 μm in erbium-doped potassium double tungstate channel waveguides. A maximum gain per unit length of 13 dB/cm is measured. Parasitic excited-state absorption and energy-transfer upconversion are investigated spectroscopically, the corresponding parameters quantified, and their influence on gain is analyzed and compared with experimental results.

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**Time: Thursday, 8:00–10:00**

**Location: Lecture Hall E17**

**FWG-4.4 Thu, 8:30**


We investigate optical gain around 1.53 μm in erbium-doped potassium double tungstate channel waveguides. A maximum gain per unit length of 13 dB/cm is measured. Parasitic excited-state absorption and energy-transfer upconversion are investigated spectroscopically, the corresponding parameters quantified, and their influence on gain is analyzed and compared with experimental results.

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**FWG-4.5 Thu, 9:15**

Ultrafast laser inscribed single longitudinal mode Yb:YAG waveguide laser with high output power and high efficiency — Thomas Calzoni, Martin Ans, Peter Dekker, Michael J. Withford, and Christian Krauzel — 1Institut für Laser-Physik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — 2The Hamburg Centre for Ultrafast Imaging, Luruper Chaussee 149, 22761 Hamburg, Germany — 3Centre for Ultra-high Bandwidth Devices for Optical Systems (CLUDOS), MQ Photonics Research Centre, Department of Physics & Astronomy, Macquarie University, New South Wales 2109, Australia

We present highly efficient single longitudinal mode waveguide lasers with output powers of 1.59 W and optical-to-to-optical efficiencies of 65%. Single longitudinal mode operation was achieved by combining fs-laser written Yb:YAG waveguide lasers with external fs-laser written alumina-borosilicate glass waveguide Bragg gratings.

**FWG-4.6 Thu, 9:30**

Optical gain of 13 dB/cm at 1.53 μm in Kgd, LuEr4+, (WO4)2 channel waveguides and the influence of parasitic spectroscopic processes — Sergio Andrade Vázquez Córdova, Shamugam Arawazhi, Christos Gavriel, Alexander M. Heuer, Christian Krauzel, Yan-Sheng Yong, Sonia M. García Blanco, Jennifer L. Herbst, and Markus Pollehn — 1Optical Sciences, MESA+ Institute, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands — 2Integrated Optical Microsystems, MESA+ Institute, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands — 3School of Physics and Astronomy, University of Southampton, Southampton SO17 1BJ, United Kingdom — 4Institut für Laser-Physik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — 5Department of Materials and Nano Physics, KTH — Royal Institute of Technology, Isafjordsgatan 22-24, 16440 Kista, Sweden


We investigate optical gain around 1.53 μm in erbium-doped potassium double tungstate channel waveguides. A maximum gain per unit length of 13 dB/cm is measured. Parasitic excited-state absorption and energy-transfer upconversion are investigated spectroscopically, the corresponding parameters quantified, and their influence on gain is analyzed and compared with experimental results.

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**Time: Thursday, 8:00–10:00**

**Location: Lecture Hall E17**
Low-loss orientation-patterned GaAs buried waveguides for frequency conversion in the mid-infrared — Sophie Roux1, Axel Eversen2, Michel Lecomte1, Gábor Lehotay1, Christo Parlabane2, Bruno Gérard2, Arnaud Ghidoni1, and Eric Lallier1 1Thales Research & Technology, 1 avenue Augustin Fresnel, 91767 Palaiseau Cedex, France — 2III-V Lab, 1 avenue Augustin Fresnel, 91767 Palaiseau Cedex, France

We report on Ti:sapphire-pumped laser operation of a HEM-grown fiber delivering 20 W at 946 nm with a gain of 2 and a M2 better than 1.7. In order to limit the thermal effects, as a first result, single pass amplifiers delivering 20 W at 946 nm with a gain of 2 and a M2 better than 1.7.

We report the first realization of orientation-patterned GaAs buried waveguides for frequency conversion in the mid-infrared. Propagation losses down to 0.8 dB/cm at 3.9 µm have been measured in 0.5-µm waveguides, demonstrating the high quality of the regrowth on a corrugated template substrate. Nonlinear characterization will be reported at the conference.

00–10:30 Coffee Break

SSL-4: Crystalline Lasers

Chair: Eric Cormier, Université de Bordeaux, Bordeaux, France

Time: Thursday, 10:30–12:30

Invited

SSL-4.1 Thu, 10:30
High-power single-crystal fiber amplifiers — Xavier Delén — Institute of Optics, France

We present a study of the specificity of the pump guiding in the single crystal fiber (SCF) and give an overview of the results obtained using SCF gain modules in laser amplifiers including high power experiments and the last results obtained with picosecond multi-stages Yb:YAG SCF amplifiers.

SSL-4.2 Thu, 11:00
Ne/YVO4 laser LED-pumped with a luminescent concentrator — Adrien Barret1, Amanda Pace1, Thomas Gallienelli2, François Balembois3, Sébastien Forger1, Sébastien Chénais2, Frédéric Ducou2, and Patrick Georges3 1Laboratoire Charles Fabry, Institut d’Optique Graduate School, Palaiseau, France — 2Élixium, Les Ulis, France — 3Laboratoire de Physique des Lasers, Villeurbanne, France

We demonstrate that an LED-pumped Ge:YAG luminescent concentrator (LC) can increase the irradiance of blue LEDs by a factor of 10 with an optical efficiency of 25%. This LC was used to pump a Nd:YVO4 laser opening the way to new low cost LED pumped lasers.

SSL-4.3 Thu, 11:15
Development of an amplifier at 946 nm based on Nd:YAG single crystal fiber pumped at 805 nm — Romain Badoin1, Jean-Thomas Gomes1, Xavier Delén2, Igor Martíal2, François Balembois3, and Patrick Georges3 1Institut d’Optique Graduate School, CNRS, Université Paris-Saclay, 91127 Palaiseau Cedex, France — 2Élixium, Les Ulis, France — 3Laboratoire de Physique des Lasers, Villeurbanne, France

We present an amplifier at 946 nm based on Nd:YAG single crystal fibers operating in continuous wave. Pumping is performed at 885 nm in order to limit the thermal effects. As first result, single pass amplifier deliver 20 W at 946 nm with a gain of 2 and a M2 better than 1.7.

SSL-4.4 Thu, 11:30
Efficient laser operation of Nd3+ :Lu2O3 at 8 different laser wavelengths between 917 nm and 1463 nm — Patrick von Brechen1, Alexander M. Hueck1, and Christian Kranz1,2 1Institut für Laser-Fysik, Hamburg, Germany — 2The Hamburg Centre of Ultrafast Imaging, Hamburg, Germany

We report on Ti:sapphire pumped laser operation of a HEM-grown Nd3+ :Lu2O3 bulk crystal at different transitions. An excellent optical quality allowed for low laser thresholds and slope efficiencies as high as 70%. 917 nm and 1463 nm represent the shortest and longest wavelength, respectively, ever realized in this material.

SSL-4.5 Thu, 11:45
Tunable green laser operation of Tb3+:LiLuF4 — Philip Metz1, Günter Hueck1, and Christian Kranz1,2 1Institut für Laser-Fysik, Hamburg, Germany

We report the first realization of orientation-patterned GaAs buried waveguides for frequency conversion in the mid-infrared. Propagation losses down to 0.8 dB/cm at 3.9 µm have been measured in 0.5-µm waveguides, demonstrating the high quality of the regrowth on a corrugated template substrate. Nonlinear characterization will be reported at the conference.

00–10:30 Coffee Break
SSL-5: High-Power Lasers

SSL-5.1 Thu, 13:45
SESAM mode-locked Yb:CaF2 thin disk laser delivering 285 fs pulses with peak power of 5.5 MW — **Benjamin Dannecker**, Marwan Adouc, Ahmed, and Thomas Graef — Institut für Strahlenelektronik (IFW), University of Stuttgart, Pfaffenwaldring 43, 70569 Stuttgart, Germany

We report on a SESAM-mode-locked Yb:CaF2 thin disk laser delivering an average output power of 17.8 W at 10 MHz repetition rate with 285 fs pulse duration i.e. pulse energy of 1.78 micro J and peak power of 5.5 MW. Furthermore, we show results on chirped pulse amplification using Single Crystal Fiber.

SSL-5.2 Thu, 14:00
10-MW sub-500 fs high power SESAM-mode-locked Yb:La2O3 thin disk laser — **Vasa J. Grauman**1, Andreas Diebold2, Florian Emaury1, Bastian Deppe1,3, Christian Krankel1, Clara J. Saraceno1, and Ursula Keller1 — Institute for Quantum Electronics, ETH Zurich, 8093 Zurich, Switzerland — **Institut für Laser-Physik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany** — The Hamburg Center for Ultrafast Imaging, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — Center for Free-Electron Laser Science, DESY, Hamburg, Notkestraße 83, 22761 Hamburg, Germany

We present peak power scaling to 10 MW of a sub-500 fs mode-locked Yb:La2O3 thin disk laser. Our laser resonator is operated in a pressure-controlled environment, allowing for high pulse energies of 6.5 J. Future pulse shortening will make this oscillator an excellent source for driving HHG experiments.

SSL-5.3 Thu, 14:15
Watt-class femtosecond mid-infrared sources in the wavelength range from 4.1 μm to 8.5 μm — **Marcus Seidler**1, Gunnar Adouc2, Xiaojun Xiao1, Alexander Hartung2, Vladimir Pervev3, Oleks Pronin4, and Ferenc Krausz5,6,7 — Max-Planck-Institut für Quantenoptik, Hans-Kopfermann-Str. 1, D-85748 Garching, Germany

— **VFI (Norwegian Defence Research Establishment, P. O. Box 25, NO-2077 Kjeller, Norway)** — Leibniz-Institute of Photonic Technology (IPHT), Albert-Einstein-Straße 9, D-07745 Jena, Germany — Ludwig-Maximilians-Universität München, Am Coulombwall 1, D-85748 Garching, Germany

3.8 W average power at 4.1 μm wavelength and 1.3 W average power at 8.5 μm wavelength are generated through optical parametric amplification in periodically poled lithium niobate and LiGaS2, resp. The crystals are directly pumped by a mode-locked thin disk oscillator and seeded with continuos from normal dispersion fibres.

SSL-5.4 Thu, 14:30
500 W - 10 mJ — Picosecond Thin Disk Regenerative Amplifier — **Marcel Schütte**, Sandro Klinger, ChristoPH Vand, Katharine Y. Tissier, Robert Bessing, Matthias Hänser, Stephan Frei, Knut Michel, and Thomas Metzger — TRUMPF Scientific Lasers GmbH & Co. KG, Ferringstr.10a, 85774 Unterfröhling

We report on a thin disk regenerative amplifier delivering more than 500 W of compressed output power and a pulse duration of less than 1.2 ps at a repetition rate of 90 kHz.
Chirped pulse regenerative amplifier based on Yb:CaYAlO4 crystal: different orientation study — ALEXANDER RUDENSKY1, VIKTOR KUZEL1, ANATOLIUS DAШKEVICH2, KARINE HAYRAKANIAN3, ASHOT PETROSYAN4, and NIKOLAI KULESHOV1 — Center for Optical Materials and Technologies, Belarusian National Technical University, Minsk, Belarus — 1Institute of Physics, National Academy of Sciences of Belarus, Minsk, Belarus — 2Institute of Laser Physics, Siberian Branch of Russian Academy of Sciences, Novosibirsk, Russia — 3IFICMA-FICNA group, Universitat Rovira i Virgili (URV), Tarragona, Spain — 4V. Nikolaev Institute of Inorganic Chemistry, Siberian Branch of Russian Academy of Sciences, Novosibirsk, Russia

We report on growth and spectroscopy of monolithic Eu:KLuW crystals. The maximum stimulated-emission cross-section for the 5D0→7F4 transition is 1.78x10^-20 cm^2 and the lifetime of the 5D0 state is 8.45 ms. Quasi-CW Eu:KLuW laser operating at ~706 nm and pumped at 553.6 nm by a green Nd:GdW/KTP laser is demonstrated.

A high-power, tunable, dual wavelength and polarization Yb-fiber laser — FREDERIK LAURELL, VALDAS PASIEKVIČUS, and PETER ZEIL — KTH, Stockholm, Sweden

A high-power, dual polarization and dual wavelength Yb-fiber oscillator is demonstrated. The wavelength separation could be tuned from 0.03 to 2 THz, with output powers exceeding 78 W over the entire tuning range, maintaining a high beam-quality (M2<1.2) and a peak-to-top power-power stability of ±1%.

Femtosecond fiber laser pumped parametric amplification of broadband phase stabilized few cycle pulses at 2.9 μm — GREGORE MARINI ARCHIPPOULT, STÉPHANE PEYRAT, JEAN-CHRISTOPHE DELAGNES, and ERIC COMBREY — CELIA, Toulouse, France

We experimentally demonstrate ultra-low power all-optical wavelength conversion based on four-wave mixing in a silicon racetrack-shape microring resonator. When the input pump and signal are located at the resonance wavelengths of the microring, the maximum conversion efficiency of ~21 dB is obtained for a relatively lower pump power.

Red Eu3⁺:KLu(WO4)2 laser at ~706 nm — PAUL LOKO1, ELENA VLIEŠKOVÁ1, VLADIMÍR DÁŠKOVICH1, VÁCLAV ORLOVSKÝ1, ANATOLIUS RUSAK1, KONSTANTIN YUMASHKEV1, NIKOLAI KULESHOV1, SERGEI RAGIN2, SERGEI VAPN1, RAVIER MATOŠ2, and ANATOLY PAVLYUK2 — Center for Optical Materials and Technologies, Belarusian National Technical University, Minsk, Belarus — 1Institute of Physics, National Academy of Sciences of Belarus, Minsk, Belarus — 2Institute of Laser Physics, Siberian Branch of Russian Academy of Sciences, Novosibirsk, Russia — 3IFICMA-FICNA group, Universitat Rovira i Virgili (URV), Tarragona, Spain — 4V. Nikolaev Institute of Inorganic Chemistry, Siberian Branch of Russian Academy of Sciences, Novosibirsk, Russia

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A high-power, tunable, dual wavelength and polarization Yb-fiber laser — FREDERIK LAURELL, VALDAS PASIEKVIČUS, and PETER ZEIL — KTH, Stockholm, Sweden

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A high-power, tunable, dual wavelength and polarization Yb-fiber laser — FREDERIK LAURELL, VALDAS PASIEKVIČUS, and PETER ZEIL — KTH, Stockholm, Sweden

A high-power, dual polarization and dual wavelength Yb-fiber oscillator is demonstrated. The wavelength separation could be tuned from 0.03 to 2 THz, with output powers exceeding 78 W over the entire tuning range, maintaining a high beam-quality (M2<1.2) and a peak-to-top power-power stability of ±1%.

Femtosecond fiber laser pumped parametric amplification of broadband phase stabilized few cycle pulses at 2.9 μm — GREGORE MARINI ARCHIPPOULT, STÉPHANE PEYRAT, JEAN-CHRISTOPHE DELAGNES, and ERIC COMBREY — CELIA, Toulouse, France

We experimentally demonstrate ultra-low power all-optical wavelength conversion based on four-wave mixing in a silicon racetrack-shape microring resonator. When the input pump and signal are located at the resonance wavelengths of the microring, the maximum conversion efficiency of ~21 dB is obtained for a relatively lower pump power.
China Normal University, Guangzhou, China — 5South China Nor-
mal University, Guangzhou, China

We report on the synchronous generation of 4666 harmonic soliton
molecule and rectangular noise-like pulse (NLP) at the fundamental
repetition rate in a figure-eight fiber laser based on nonlinear ampli-
fiying loop mirror (NALM). The experimental results are helpful to
enrich the pulse operation regimes in fiber lasers.

PO-3.11 Thu, 15:45

Glass-Ceramics with Co2+/ZnO Nanocrystals: Novel Sat-
urable Absorber for Erbium Lasers — Nikolaï Smotrov³, Olga
Dymshtes², Vladimir Vitkin², Pavel Loko³, Alexander
Zhelev¹, Daria Shemchuk¹, Marina TSIKTERIS², Kirill
Beloborodov³, Evgenija Malarchuk², Ilia Glaesunov², Xavière
Matese¹, and Konstantin Yumashiev¹ — ¹Center for
Optical Materials and Technologies, Belarusian National Technical
University, Minsk, Belarus — ²NITOM S.J. Vasvold State Optical
Institute, St. Petersburg, Russia — ³ITMO University, St. Petersburg,
Russia — ²Fisica i Cristallografia de Materiais i Nanomaterials,
Tarragona, Spain

Novel saturable absorbers based on transparent glass-ceramics with
Co2+/ZnO nanocrystals are developed. They demonstrate broad
4A(24)/(6)-4T(14)/(6) absorption band of Co2+ ions, low saturation flu-
eness (0.8 J/cm2) and fast recovery time of initial absorption (895 ns).
Glass-ceramics can be used for passive Q-switching of crystalline er-
biaum lasers at 1.6-1.7 μm.

PO-3.12 Thu, 15:45

Single-frequency Ho:YAG laser resonantly pumped by 1.9 μm
laser diode — Quanxin Na, Chunjing Gao, Xueyan Zhang, Qiang
Wang, and Yan Li — Beijing Institute Of Technology, Beijing,
China

A single-frequency Ho:YAG laser resonantly pumped by a 1.9 μm laser
diode is demonstrated. The single-frequency output energy is 15.15 mJ at a pulse repetition rate of 20 Hz, with a pulse width of
109 ns and M²<1.22.

PO-3.13 Thu, 15:45

Sellmeier equations for CaGdAlO4 and CaYAlO4 laser host
crystals — Petra Becker¹, Larslay Rossat², Christoph Leibl¹, Mark
Peltz², Sophie Verma², Daniel Rytz², Pavel Loko², Josep Maria
Skerk³, Xaviere Matese¹, Konstantin Yumashiev¹, Yitian Wang³,
Valentin Pton³, and Uwe Griebner¹ — ¹Institute of Geology and Mining,
Section Crystallography, University of Cologne, Köln, Germany — ²FEE
GmbH, Ðder-Obereinst, Germany — ³Center for Optical Materials and
Technologies (COMIT), Belarusian National Technical University,
Minsk, Belarus — ²Fisica i Cristallografia de Materiais i Nanomater-
ials (PCMA-FGNA), Universitat Rovira i Virgili (URV), Tarragona,
Spain — ²Max-Born-Institute for Nonlinear Optics and Short Pulse
Spectroscopy, Berlin, Germany

Dispersion of the principal refractive indices, n and nε, is studied for
the uniaxial CaGdAlO4 and CaYAlO4 laser host crystals, and Sell-
meier equations are derived for the broad spectral range of 0.37-2.1
μm. Group velocity dispersion (GVD) is calculated. For CAGLO at 2
μm, GVD is negative — 40 fs/μm.

PO-3.14 Thu, 15:45

Cross relaxation and laser quantum efficiency in amorphous
Al2O3/Tin3 waveguides on silicon — Pavel Loko², Dimitri
Griskus, and Markus Pollini — Department of Materials and
Nano Physics, School of Information and Communication Technol-
ogy, KTH — Royal Institute of Technology, Kista, Sweden

Cross relaxation is studied for Tin-doped amorphous aluminum ox-
ide waveguides on silicon. The impact of spectroscopically distinct
ion classes, namely single ions and ions with neighbors, for the ac-
curate description of cross relaxation is demonstrated. For the highest
doping concentration investigated, the laser quantum efficiency of 2-
μm emission reaches 1.73.

PO-3.15 Thu, 15:45

High Power THz Quantum Cascade Lasers — Martin
Brandstetter², Christoph Deutsch², Michael Kraul¹, Sebas-
tian Schoenhof³, Martin A. Kaisu², Hermann Dettl², Donald
C. MacFarlane², Aaron M. Andrews³, Werner Schiebel³, Got-
teried Strasser³, and Karl Unterrainer³ — ¹Photonic Institute,
TU Wien, Austria — ²Institute of Solid State Electronics, TU Wien,
Austria — ³Austrian Academy of Sciences, Austria

We present high power emission from terahertz (THz) quantum cas-
cade lasers (QCLs) by making use of a direct water bending technique
to increase the active region thickness. In this way, optical output
powers of almost 1 W have been achieved at an emission frequency of
about 3.9 THz.

PO-3.16 Thu, 15:45

Rogue waves from spectral dynamics of phase-evolving
bound solitons in a fibre laser — Junsong Pem², Sriranth
Suganamalan³, Nikita Takasov³, and Dmitriy Churkin³, S. —
³Astro University, Birmingham, United Kingdom — ²Novosibirsk
State University, Novosibirsk, Russia — ³Institute of Computational
Technologies SB RAS, Novosibirsk, Russia

By utilizing dispersive Fourier transform technique and spatio-
temporal measurements, the real-time spectral dynamics of bound
solitons were measured in a passively mode-locked fibre laser. It was
found that though the phase-evolving bound solitons were static in
time domain, their optical spectrum evolves and exhibits rogue
waves.

PO-3.17 Thu, 15:45

Synchronized pulsed fiber laser source for single-photon fre-
quency upconversion detection — Jianhui Ma, Huqin Hu,
Haisong Fan, F. Wu, and Herczog Zeng — State Key Labora-
tory of Precision Spectroscopy, East China Normal University, Shanghai
200062, P. R. China

We experimentally demonstrate a compact synchronized fiber laser
system that enables fast and efficient coincidence infrared single-
photon frequency upconversion detection.

PO-3.18 Thu, 15:45

Sub-60 fs Yb:KGW oscillator pumped by single-mode laser
diode — Maciej Kowalczyk, Krestytor M. Abramski, and Jakub
Sotor — Laser & Fiber Electronics Group, Wrocław University of
Technologies Wybrzeże Wyspiańskiego 27, 50-370 Wrocław, Poland

We present a passively mode-locked Yb:KGW laser pumped by a
dow power single-mode laser diode. The laser operating in hybrid
SESAAM-assisted Kerr-lens mode-locked regime emits 59 fs pulses ap-
proaching the limit of the crystal performance.

PO-3.19 Thu, 15:45

Enhanced tissue ablation by manipulated pressure transients —
Amir Herzog, ¸yiAlperovich, and Amin Steinberg, A. — ¹Achi-
cal Institute of Technology, Haifa, Israel — ²Department of Medi-
cal Technologies, Technion-Israel Institute of Technology, Haifa,
Israel

We manipulate the pressure transients initiated during tissue abla-
tion with fiber-delivered 355 nm nanosecond pulses, by efectively
enlarging the fiber’s cladding diameter. We conducted numerical sim-
ulations, ultrasound pressure measurements, high-speed photography
and ex vivo studies, and show improvement of the ablation efficiency
for given laser parameters.

PO-3.20 Thu, 15:45

Combining and temporal multiplexing of four pulsed beams in
LBO crystal by means of non-collinear frequency conversion —
Julianas Zaleiudžienė, Marcin Miczuk, and Kęstutis Regel-
skis — Center for Physical Sciences & Technology, Vilnius, Lithuania

We report experimental results of combining and temporal mul-
tiplexing of four pulsed beams in LBO crystal by means of non-
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Main Conference – Thursday Sessions

collinear frequency conversion. Pulses with 400 ps duration amplified in four separate fiber amplifiers up to 100 J energy were successfully combined achieving maximum conversion efficiency of 56%.

PO-3.21 Thu, 15:45 Multi-pulse behavior of a high-power sub-100 fs SESAM-mode-locked VECSEL with Co:AgCl BRS saturable absorber. To the best of our knowledge, this is the first time that a doped silver halide crystal was operated as a saturable absorber Q-switch.

PO-3.27 Thu, 15:45 Dual-frequency VECSEL source at 1.5 μm for the generation of optically-carried RF signals — 1La Giauca, 2Guy Auren, 3Kamel Mergeneu, 4Jean-Louis Oudra, and 5Sophie Bouchoule — 1FSTTAR, Marne-la-Vallée, France — 2LPN-CNRS, Marcoussis, France

We demonstrate a dual-frequency VECSEL source emitting two cross-polarized laser beams at 1500 nm with a frequency difference close to 18 GHz, for fiber optic sensors. We report on the VECSEL performances and we discuss the influence of the intra-cavity elements on the laser output power and beat note stability.

PO-3.28 Thu, 15:45 MOPA laser for a compact, cost-effective underwater range-gated imaging system — 1Ettore Dell’Acqua, 2Edoardo Cacetti, 3Giuliano Piccinno, 4Giancarlo Reali, 5Paolo Fiorello, and 6Antoninozino Agnello — 1Bright Solutions, srl, Via degli Artigiani 27, 27010 Cutr Carpaneto (PV), Italy — 2Coulombwall1, 85748 Garching, Germany — 3Institute for Nano-Optics and Department for Physics and Astronomy, Georgia State University, Atlanta, GA 30303, USA

We theoretically predict that a semiconductor (GaAs) resonantly excited by a ultrashort resonant laser pulse exhibits a novel phenomena: kicked anharmonic Rabi oscillations (KARO). In this case, interband transitions are strongly coupled to intraband motion and mainly occur during short times when electron-hole pairs pass near the Brillouin zone center.
High average power ultra-short pulse Yb-doped fiber amplifier: experimental realization and accurate theoretical modeling — Robert Lindberg and Valmik Panekrtovics — Royal Institute of Technology, Stockholm, Sweden

A high repetition rate high average power ultra-short pulse Yb-fiber amplifier was experimentally characterized and extensively theoretically modeled by including commonly neglected effects. It was found that among other effects, the dependence of the index dispersion on the population inversion is key for accurate modeling of the output spectrum.

Modelling the excited state absorption effects in Alexandrite lasers — William R. Kerridge-Johns and Michael J. Daman — Imperial College, London, UK

The effects of pump excited state absorption are explored, both experimentally and theoretically, using a quasi-three level theory with end-pumped geometry. An experimental Alexandrite laser is shown to be well described by the modelling, the theory is then used to aid in optimising pumping parameters for laser performance.

Single-mode 1.1 kW monolithic Yb-doped fiber oscillator at 1030 nm — Andreas Liem, Niolitta Haarlammers, Thomas Schreiber, Ramona Ehrhardt, and Andreas Tünnemann — Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

In this paper we demonstrate a Yb-doped, monolithic fiber oscillator with an output power of 1.1 kW, an emission wavelength of 1030 nm, diffraction limited beam quality and a slope efficiency of 75%. This laser can be used as high brightness source for tandem pumping.

Performance and new developments of the seed laser system of the FERMI FEL — Mitroch B. Danalov — Elettra-Sincrotrone Trieste, SS 14, Km 163.5, Trieste 34149, Italy

The work describes the performance and new developments of the ultrafast laser system generating tunable UV pulses for external seeding of the FERMI Free Electron Laser. A new feature of the system is the tunable third harmonic generation option allowing to cover the range 260-270 nm without use of OPA.

Mid-IR filament guided conductivity and high-voltage discharge in air — Denis Mousin1, Valentina Shumakova2, Sreemantha AliSaisakas2, Aubrus Pužiūnas1,2, Egle Schuberti1, Jérôme Kasparian1, Jean-Pierre Wolff4, and Andreas Baltuška2,3 — 1GAP University of Geneva, Switzerland; 2Photonic Institute, TU Wien, Austria; 3Center for Physical Sciences & Technology, Vilnius, Lithuania

Filaments at 3.9 μm produce lower electron densities and lower pressure depression than in the mid-IR. Mid-IR filaments therefore require significantly higher energy/power levels for applications related to lightning control and for fully taking advantage of their unique propagation properties (single, large diameter filaments over long distances).

scaling supercontinuum generation in gas-filled hollow-core fibers — Andreas Hofmann1, Michael Götz1,2, Radu-Karant Sollap1, Daniil Kartashov1, Teodora Grigorova1, Gregor Sauer1, Alexander Hartung1, Markus Schmidt1, and Christian Spelmann1,2 — Institute of Optics and Quantum Electronics, Abbe Center of Photonics, Friedrich Schiller University, Max Wien Platz 1, 07743 Jena, Germany; 2University of California, Chemistry Department, D39 Hilbade Hall, CA 94720, Berkeley, USA

We report on two novel approaches for improved scaling supercontinuum generation in gas-filled hollow-core fibers. Switching either from atomic to molecular gases or from capillaries to novel anti-resonant hollow-core fibers allows increase of the parameter range and substantial performance, resulting in efficient UV generation or enhanced pulse shaping capabilities.

A selective transverse mode method for generating high-order Bessel-Gauss beams — Seyyed Mehdiz Mousavi1, Mohamad Sabaee1, Hamed Nadgaran1, and Azadhid Ebrahimiзад2 — 1Physics Department, College of Science, University of Shiraz, Shiraz, Iran; 2 Physics Department, Faculty of Science, Shahid Chamran University of Ahvaz, Iran

The zero-, first-, and second-order Bessel-Gauss beams were generated through the use of an axicon external to a plane-plate resonator supporting three lowest modes of Hermite-Gauss. Hermite-Gauss beams were extracted, and opened up a circular aperture in the cavity and after laser crystal with a predetermined aperture using the theory of diffraction.

107 W femtosecond all-fiber chirped pulse amplification system with a chirped-volume Bragg grating compressor — Ryoji Suenaga, Dongchenn Jin, Fangzhou Tan, Shishui Wei, and Pu Wang — Beijing University of Technology, Beijing, China

A femtosecond 1064nm Yb-doped all-fiber chirped pulse amplification system was report with an average output power of 107 W. The seed was based on an Er-doped mode locked fiber laser which gets frequency shifted to the 1μm. The pulse width is 566fs with 10.9WM peak power compressed by a chirped-volume Bragg grating.

Wavelength and temperature dependence of the refractive index of GAP — Jean Wi1, Joel Murray2, Jacob Baker1, Donnoglas Kirk1, Peter Schummann2, and Shekharra Guha3 — 1Air Force Research Laboratory, WPAFB, Ohio, USA; 2BAE Systems, Nashua, New Hampshire, USA

Refractive indices of gallium phosphate in the wavelength range of 0.6 to 12.5 micrometer at temperatures from 78 K to 473 K were determined from fringes in FTIR transmission spectra and from temperature dependent phase matching curves of second harmonic generation of a CO2 laser beam.

Enhanced pump absorption in double-clad fibres using localised laser-machined mode scramblers — Antonius Bollanct, Peter Smithson1, Kieron Boyd1, Nikita Simakov1, Alexander Hemming2, and W. Andrew Clarkson1 — 1Optoelectronics Research Centre, University of Southampton, SO17 1BJ, UK; 2Laser Technologies Group, Defence Science and Technology Group, Edinburgh, Australia 5111

A novel method for improving pump absorption efficiency in circular double-clad fibres by laser machining localised pump scramblers at strategic positions along the fibre is reported. Preliminary results for
a thulium-doped double-clad fibre indicate that the pump absorption coefficient attainable via this approach is comparable to an equivalent octagonal fibre.

PO-3.42 Thu, 15:45
Self-starting all-fibre, all-polarization maintaining Ti:Ho-codoped fibre oscillator — Andreas Curtze1, Jerome Lehmert2, and Eric Corriou3 — 1ILL-ALPS, Szeged, Hungary — 2Centre Lasers Intenses et Applications, Université de Bordeaux-CNRS-CEA, Talence, France We report a SESAM mode-locked all-fibre, all-polarization maintaining Ti:Ho-codoped fiber oscillator intra-cavity dispersion compensated with a chirped FBG. The laser operates in the dispersion managed soliton regime and delivers 0.46 nJ pulses with 2 nm spectral bandwidth centered at 2050 nm. The radiofrequency spectrum shows stable single pulse operation.

**EPS Prize**

Time: Thursday, 17:00–18:00
18:00–18:30 Refreshments

**PD-1: Postdeadline Session**

Time: Thursday, 18:30–19:15

**Post-deadline PD-1.1 Thu, 18:30**
Stabilized dual-comb modelocked semiconductor disk laser — Sandro M. Linge, Dominik Wallburger, Cees A. G. E. Meerholz, Matthias Golling, and Uteola Keller — ETH Zürich, Zurich, Switzerland
We present a stabilized dual-comb semiconductor disk laser generating simultaneously two gigahertz modelocked beams from a single cavity. The resulting down-converted microwave frequency comb is fully stabilized by applying two feedback-loops directly to the microwave spectrum. A first proof-of-principle spectroscopy demonstration is shown and the absolute optical stability is measured.

**Post-deadline PD-1.2 Thu, 18:45**
Efficient High-Power Pulse Compression in Self-Defocusing Bulk Media — Marcus Stiller1, Jonathan Brons2, Gunnar Arendt3, Kilian Fritsche4, Vladimir Pervakov5, and Oleg Brons6 — 1Max-Planck-Institut für Quantenoptik, Garching, Germany — 2UltraFast Innovations GmbH, Am Coulombwall 1, D-85748 Garching, Germany — 3FFI (Norwegian Defence Research Establishment), P.O. Box 25, NO-2027 Kjeller, Norway — 4Ludwig-Maximilians-Universität München, Am Coulombwall 1, D-85748 Garching, Germany
The compression of 90-W average power, 190-fs pulses to 70-W, 30-fs is realized by three sequential pulse compression stages utilizing cascaded χ(2)-nonlinearities in BBO. Balancing self-defocusing and Gaussian beam convergence results in an efficient, power-scalable spectral broadening mechanism. An increase in peak power from 18 to 60-MW is achieved.

**Post-deadline PD-1.3 Thu, 19:00**
Single frequency Yb:YAG DFB waveguide laser with 2 W output power — Thomas Calman1,2, Martin Ams1,2, Benjamin F. Johnston1, Peter Dekker3, Michael J. Withford4, and Christian Kränkel1,2 — 1Institut für Laser-Physik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — 2The Hamburg Centre for Ultrafast Imaging, Luruper Chaussee 149, 22761 Hamburg, Germany — 3Centre for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS), MQ Photonics Research Centre, Department of Physics & Astronomy, Macquarie University, New South Wales 2109, Australia
The first monolithic DFB Yb:YAG waveguide laser is presented. An output power of 2 W and a slope efficiency of 61% were achieved in single longitudinal mode operation. The DFB structures were inscribed as waveguide Bragg gratings by ultrafast laser writing into the Yb:YAG crystal.

**SSL-6: Mode-Locked Lasers**

Chair: Antoniangelo Agnesi, Università di Pavia, Pavia, Italy

**SSL-6.1 Fri, 8:00**
Recent progress in the development of gain and saturable absorber mirrors used in semiconductor disc lasers is reviewed. Emphasis is put on linking technological advances to laser performance, in particular concerning power scaling and wavelength coverage. An overview of emerging applications in spectroscopy and medicine is provided.
Record-short pulses from semiconductor disk lasers — Saurabh M. Linke, Dominik Waldhuber, Cesare G. E. Alferi, Matthias Gollogly, Emilio Giusi, and Ursula Keller

Institute for Quantum Electronics ETH Zürich, Zurich, Switzerland — FIRST Center for Micro- and Nanoscience ETH Zürich, Zurich, Switzerland

We present the shortest pulses ever achieved from any fundamentally mode-locked optically pumped semiconductor disk laser demonstrated with both a SESAM-mode-locked VECSEL generating pulses as short as 96 fs and a high peak power of 0.56 kW, and a MIXSEL with 184 fs and 130 W.

SESAs for short-pulse, high-power thin-disk lasers — Cesare G. E. Alferi, Andreas Diener, Michael Kopf, Florian Emaus, Clara J. Saraceno, Emilio Giusi, and Ursula Keller

Department of Physics, Institute for Quantum Electronics, ETH Zurich, Switzerland — FIRST Center for Micro- and Nanoscience, ETH Zurich, Switzerland

We present novel high-power MOVPE grown SESAM designs based on multiple strain compensated quantum wells. The structures show significant improvements in terms of recovery dynamics, damage threshold, and non-saturable losses compared to standard MBE grown samples. These ideal parameters will enable thin-disk lasers combining short pulses and high power.

90-fs Yb:LuLiF, Single-Mode Diode-Pumped SESAM Mode-Locked Laser — Hsing Lin†, Federico Pirro, Azzurra Volpi, Alberto Di Lieto, Marco Tonelli, and Antonio Acero

Fujian Institute of Research on the Structure of Matter, 155 Yangqiao Road West, Fujian 350002 China — University of Pavia — Laser Source Lab, Via Ferrata 5, 27100 Pavia, Italy — NEST Institut de Nanoscienze-CNR and Dipartimento di Fisica, Università di Pisa, Largo B. Pontecorvo 3, IT-56127 Pisa, Italy

We present, for the first time, to the best of our knowledge, a SESAM mode-locked Yb:LuLiF laser. Pumping with low-power single mode fiber-coupled laser diodes at 976 nm (350 mW maximum absorbed pump power), we obtained almost Fourier transform limited, 90-fs pulses at 1054 nm, with 32 mW average power.

Diode-pumped Ti:KYW laser passively mode-locked with a GaSb-SESAM — Maxim Gaponenko, Avtti Harkonen

10:00–10:30 Coffee Break

10:30–11:00 Invited

11:00–11:30 Discussion

11:30–12:00 Invited
We present a concept of remote atmospheric sensing based on

\[ \text{pumped by an InGaAs semiconductor disk laser} \]

of the detection plays an important role.

an interplay between the scattering efficiency and spectral resolution
timing tunable-wavelength femtosecond high-energy pulses where

-ing/scattering objects.

We present a concept of remote atmospheric sensing based on

\[ \text{pumped by an ~1180nm semiconductor disk laser.} \]

We measured a

\[ \text{emitting diamond Raman laser intracavity-} \]

search Centre, Tampere University of Technology, Korkeakoulunkatu 3, FIN-33301 Tampere, Finland.

We present a ~1400nm-emitting diamond Raman laser intracavity-pumped by an ~1180nm semiconductor disk laser. We measured a maximum output power of 2.3 W at ~1400nm with an output coupling of 3.5%. The Raman laser was tunable from 1273 to 1415nm using a 4-mm-thick birefringent filter.

We present a ~1400nm-emitting diamond Raman laser intracavity-pumped by an ~1180nm semiconductor disk laser. We measured a maximum output power of 2.3 W at ~1400nm with an output coupling of 3.5%. The Raman laser was tunable from 1273 to 1415nm using a 4-mm-thick birefringent filter.

High-power continuous wave Yb:CaF\(_2\) thin-disk laser

We present a table-top narrowband XUV source based on high-

harmonic-generation of a high average power femtosecond fiber laser, which has a record-high average power of 832 µJ at 21.7 eV. Furthermore, a resonantly-enhanced harmonic at 26.6 eV with a relative energy bandwidth of ~10⁻³ has been generated in argon.

Multi-shot TG-XFROG for the characterisation of deep-UV ultrashort pulses from dispersive-wave generation in gas-filled HC-PCF — 

Alexey Ermoslov, Heli Valtina-Luukse, John C. Travers, and Philip St.J. Russell — 1 Max Planck Institute for the Science of Light, G"unther-Scharowkt-str. 1, 91058 Erlangen, Germany — 2 Institute of Physics, University of Tartu, Ravila 14c, 50411 Tartu, Estonia

A multi-shot transient-grating cross-correlation FROG is implemented for characterization of nanosecond-scale, broadband, deep-UV pulses generated in a gas-filled kagomé-PCF through dispersive-wave emission. It is shown that the 210 THz broad dispersive-wave has a temporal duration of 5 fs. Modelling agrees with the experimental results.
Nonlinear pulse compression and high-harmonic generation driven by a high repetition rate Tm-based fiber CPA system — Fabian Stütsch, Christian Gaida, Martin Gehmacher, Robert Klais, Stefan Demmler, Steffen Habrich, Jan Rothhardt, César Jaquegui, Jens Limpert, and Andreas Tünnermann — Institute of Applied Physics, Abbe Center of Photonics, Jena, Germany — Helmholtz-Institute Jena, Jena, Germany — Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany.

We present a Tm-based fiber CPA system delivering a peak power of 2 GW and an average power of 28.5 W. These pulses are nonlinearly compressed in a hollow capillary fiber to less than 50 fs pulse duration. Finally, first experimental results on high-harmonic generation driven by this system are discussed.

Generation of Mid-IR Radiation by Four-Wave Mixing in Gas-filled Metal Coated Waveguides — T. Florey, P. Malévicius, A. Pożoga, A. Voronov, A. M. Zhitkovich, and A. Baltuska — Photonic Institute Vienna University of Technology, Gussmannstraβe 27-387, A-1040 Vienna, Austria — “Physics Department, International Laser Centre, M.V. Lomonosov Moscow State University, 119992 Moscow, Russia — Department of Physics and Astronomy, Texas A&M University, College Station TX, 77843–4242, USA.

Four-wave mixing-based optical parametric amplification of ultrashort pulses in gas-filled metal coated hollow waveguides enables the generation of tunable mid-IR radiation. We present experimental data and numerical simulation that reveal the influence of self- and cross-phase modulation and show the limitations of this approach.

Hollow-Core-Waveguide Compression of Multi-mJ CEP-Stable X-Na Pulses — Takuya Okamura, Takayuki Hasegawa, Tatsunari Kanai, Gerhard Andriukaitis, Bruno Schmidt, François Legare, and Andrius Baltuska — Institute of Photonics, TU Wien, Gussmannstraβe 27/387, Vienna, Austria — Centre d’Énergie Matériaux et Télécommunications, Institut National de la Recherche Scientifique, 1650 Boulevard Lionel-Boulet, Varennes, Quebec J3X 1S2, Canada — 5-cycle, Inc., 2890 Rue de Beaurivage, Montreal, Quebec H1L 5W5, Canada.

CEP stable, 6 ns, 80 fs, 3 μm pulse via spectral broadening in 3 m long, 1 mm diameter hollow core capillary with ~90% transmission, were compressed in 2 mm CaF2 plate down to 23 fs and FT duration is below sub-two cycle pulse. The work is underway to improve towards single cycle regime.

Development of chirped pulse amplifier based on Thulium-doped ZBLAN fibers — Yutaka Nomura and Takao Fuji — Institute for Molecular Science, Okazaki, Japan.

A chirped-pulse amplifier system based on thulium-doped ZBLAN fibers has been demonstrated. The gain medium is a 3.8 m-long, large-mode area double-clad ZBLAN fiber. The maximum output power is ~4.5 W, and the output pulse is compressed down to 150 fs.

Generation of 36 fs 23 MW peak power pulses from a third order dispersion managed fiber amplifier — Yang Liu, Wenxue Li, Dapeng Liu, Chao Wang, Donghe Bai, and Heping Zeng — State Key Laboratory of Precision Spectroscopy, East China Normal University, Shanghai, China.

We report on the generation of 36-fs, 23 MW pulses from a third order dispersion managed fiber amplifier operating at 110 MHz. Detailed experiments show that tuning the grism results in the production of ultrashort pulses with minimal temporal pedestal.

Using fiber lasers to obtain 220 W average power energetic sub-2 cycle pulses — Steffen Habrich, Marco Kienle, Michael Müller, Arno Klenke, Jan Rothhardt, Robert Klais, Thomas Gottschall, Tino Edsam, Andreas Drozdz, Peter Jürgt, Zoltan Várallyay, Eric Cormier, Karoly Onvay, Andreas Tünnermann, and Jens Limpert — Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Jena, Germany — Active Fiber Systems, Jena, Germany — ELI-ALPS, ELI-HU Non-Profit Ltd., Székesfehérvár, Hungary — Université Bordeaux–CNRS-CEA-UMR 5107, Talence, France — Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany.

A state-of-the-art fiber-chirped-pulse-amplifier system based on coherent combination delivers 680 W of average power 300 fs pulses. Two-stage nonlinear compression in gas-filled capillaries yields 400 W, 38 fs, 300 μJ pulses and 220 W, sub-7 fs, 170 μJ pulses, respectively. In high energy operation 100 W, 1 μJ, sub-10 fs are demonstrated.
Nonlinear generation of perfect vortex laser beams — Apurv Chattantya Nellikeri1,2, Jan M. V.1, and Goutam Kumar Samanta1 — 1Physical Research Laboratory, Ahmedabad, India — 2Indian Institute of Technology, Gandhinagar, India

We demonstrate efficient nonlinear generation of high power, ultrafast “perfect” vortices (PV) in green. By single-pass three wave mixing in chirped MgO:ppCLN we generated PV at 530 nm with output power of 1.2 W and vortex order up to 12 at a single-pass conversion efficiency of 27%, independent of the order.

Coherent pulse stacking of solid-state laser pulses — Jonas Astrauskas1, Edgar Kaskel1, Tobias Flor1, Giedrius Andriukaitis1, Audrius Puzžytė1, Andrius Baltuška1, John Ruppe2, Situn Chen3, Almantas Galvanauskas2, and Tadas Račiūnas4 — 1Photonic Institute, TU Wien, Vienna, Austria — 2Center for Ultrafast Optical Science, University of Michigan, Ann Arbor, USA

We present a coherent pulse stacking approach for up-scaling energy of a solid-state femtosecond chirped pulse amplifier. We demonstrate pulse splitting into four replicas, amplification of non-overlapping pulse train in a specially designed regenerative amplifier cavity, and phase-locked stacking into one dominant pulse.

Avalanche effect and gain saturation in high harmonic generation — Carles Serrat1, David Roca1, Josep M. Budesca1, Joséjéf Séré2, Enikő Séré2, Bastian Alzamé1, Andreas Hofmann3, Shinichi Namba4, Thomas Kühnel5,6, and Christian Spielmann3 — 1Universitat Politècnica de Catalunya, Departament de Física, Colom 11, 08222 Terrassa, Spain — 2Institute of Atomic and Subatomic Physics, Vienna University of Technology, Stadionallee 2, 1020 Vienna, Austria — 3Institut für Laser- und Plasmaphysik, Universität Düsseldorf, Universitätsstr. 1, 40225 Düsseldorf, Germany — 4Institute of Optics and Quantum Electronics, Friedrich Schiller University, Max Wien Platz 1, 07743 Jena, Germany — 5Graduate School of Engineering, Hiroshima University, 1-4-1 Kagamiyama, Higashi-Hiroshima, Hiroshima 739-8527, Japan — 6GSI Helmholtz Centre for Heavy Ion Research, Planckstrasse 1, 64291 Darmstadt, Germany — 7Helmholtz Institute Jena, Fritjof Nansenstr. 3, 07743 Jena, Germany

We show that the strong-field theory of high-harmonic generation fully describes the avalanche-like behavior of the amplification of XUV attosecond pulse trains in strong-field driven gas media. Furthermore, it excludes pressure induced phase matching as a possible explanation. The results of the simulations fully agree with the measurements.

Self-pulsing by Excited-state Absorption in Visible Sm3+ Lasers — Daniel-Tomo Marzahn1, Markus Pollnau2, and Christian Kränzel1,3 — 1Institut für Laser-Physik, Universität Hamburg, Hamburg, Germany — 2Department of Materials and Nano Physics, School of Information and Communication Technology, KTH – Royal Institute of Technology, Kista, Sweden — 3The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Hamburg, Germany

We present numerical simulations of visible Sm3+ lasers considering an ESA starting level populated by fluorescence and located above the lower laser level, at realistic ESA cross sections the simulations yield stable pulse operation being in good agreement with the experimental data.
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