The papers included in this digest comprise the short summaries of the 6th EPS-QEOD EUROPHOTON Conference held in Neuchâtel, Switzerland from 24 to 29 August 2014. The extended version of the papers (1-page summaries in pdf format) will be made available on line during a time period of 2 months beginning from the conference. A link with login and password is provided on a separate sheet.

All web browsers (Firefox, Internet Explorer, Safari or similar) will allow you to download the digest.

A .pdf viewer (tested with Adobe Acrobat) will be necessary to view the papers. This software can be downloaded from http://www.adobe.com

The papers reflect the authors’ opinion and are published as presented and without any change in the interest of timely dissemination. Their inclusion in these publications does not necessarily constitute endorsement by the editors, the European Physical Society.

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[Logos of EPS, QEOD, and UNINE]

http://qeod.epsdivisions.org/
http://www.unine.ch/

Europhoton 2014 is organized in cooperation with:

[Logos of activefiber systems, BASF, Roche, Novartis, Syngenta, and MUST]

http://www.afs-jena.de/
http://www.kgf.ch/
http://www.nccr-must.ch/home.html

[Logos of ne.ch and SATW]

http://www.ne.ch/Pages/accueil.aspx
http://www.satw.ch/index_EN

[Logos of SSOM and Swiss Photonics]

http://ssom.ch/
http://www.swissphotonics.net/home.html
http://www.swissphotonics.net/swiss_national_photonics_labs/snop.html
The Active Fiber Systems GmbH is located in Jena, known as ‘city of photonics’ in Germany. As a spin-off from the Fraunhofer IOF Jena and the Institute of Applied, Physics at the University of Jena the Active Fiber Systems GmbH represents the expertise of innovative solid-state laser development.

The mission of Active Fiber Systems GmbH is to transfer experimental results to reliable laser systems suitable for scientific and industrial applications. Among the extra-ordinary features of pulsed fiber lasers from AFS are compact dimensions, considerably reduced production costs as well as flexible and outstanding laser parameters, which can be customized.

AFS’s product portfolio includes:

- femtosecond fiber lasers with up to 1mJ of pulse energy and up to 200W of average power
- customized pre- and main amplifiers
- fs and ps modelocked fiber lasers
- turn-key and maintenance-free dual-wavelength ps systems e.g. for CARS microscopy
- high repetition energetic few-cycle lasers
- high repetition rate OPA systems

More information: www.afs-jena.de | contact@afs-jena.de
Technological center for “Route des Lasers” competitiveness cluster, ALPhANOV accompanies innovation. 7 areas of excellence: Laser micromachining; Laser sources; Fiber components; Laser and optical systems; Imaging and vision; Light/Living tissues interaction; Technological support.

http://www.alphanov.com/

A-P-E Angewandte Physik & Elektronik GmbH develops and manufactures measurement devices and other accessories for ultrafast laser systems. The company is one of the international market leaders in ultrafast laser technology from autocorrelators to wavelength measurement, from acoustooptics to synchronously pumped optical parametric oscillators (OPOs).

http://www.ape-berlin.de/

Coherent, Inc. is a Standard & Poor’s SmallCap 600 and a Russell 2000 Index company and a world leader in providing laser-based solutions to commercial and scientific research markets. Headquartered in Santa Clara, CA USA it employs more than 2,300 employees at 10 manufacturing sites in North America, Europe and Asia.

http://www.coherent.com/

EKSPLA features more than 20 years experience and focuses on manufacturing of advanced solid-state pulsed lasers, laser systems, ultrafast fiber lasers, optoelectronics and power supplies for researchers and OEM manufacturers.

http://www.ekspla.com/

NUFERN is a leading U.S. manufacturer of specialty optical fibers, precision wound optical fiber coils, fiber lasers and amplifiers. Our integrated team has the experience, resources, and facilities required to design, manufacture, test and qualify highly-engineered optical fibers and fiber-based products for diverse applications and industries.

http://www.nufern.com
**List of Exhibitors**

**NKT photonics** A/S is the result of a merger in 2009 between Crystal Fibre A/S – the largest commercial supplier of micro-structured specialty fiber and Koheras A/S – the leading company within ultra precise fiber lasers and SuperK Supercontinuum White Light Lasers.

http://www.nkt photonics.com/

**Onefive GmbH** is a leading supplier of industrial-grade, low-noise femtosecond and picosecond laser modules. The company’s strong expertise allows it to provide sub-100 fs ultra-low noise mode-locked lasers from pulse-on-demand up to 1.25 GHz repetition rate. A unique packaging technology offers compact, air-cooled and maintenance-free lasers for a wide range of applications.

http://www.onefive.com

**TOPTICA** is a privately held technology driven company, which develops, produces and sells diode and ultrafast fiber lasers for scientific and industrial applications.

http://www.toptica.com/

**TRUMPF Scientific Lasers GmbH + Co. KG** 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 femto-second laser technology especially on optic parametric amplifiers and high energy picosecond lasers. Base technology is the TRUMPF disk laser technology.


**VENTEON Laser Technologies GmbH** is a leading-edge manufacturer of high-end femto-second Ti:Sapphire laser systems and equipment. The products range from femtosecond oscillators with sub-6-fs pulse duration to high energy laser systems and OPCPA solutions with dedicated seed laser systems. The product line is completed by pulse characterization tools, ultrafast optics and accessories.

http://www.venteon.com
General Information

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 University of Neuchâtel - Faculty of Humanities (Faculté des Lettres et Sciences Humaines), Espace Louis-Agassiz, 1, Neuchâtel, Switzerland close to the city centre with all 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 postdoc level, and by informal breakout sessions for discussion and company display. This conference will also feature a half-day special Symposium on “Lasers for Biomedical Imaging and Sensing” where prominent keynote and Invited Speakers will discuss state of the art and future visions for this fascinating field. The sixth 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 University of Neuchâtel 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 24 August (afternoon) to Monday 25 August 2014 (all day)

- The main Conference on Solid-State, Fibre, and Coherent Light Sources from Tuesday 26 August (morning) to Friday 29 August 2014 (noon)

- A half-day special Symposium on “Lasers for Biomedical Imaging and Sensing” on Wednesday 27 August 2014 (morning).

The 6th EPS-QEOD Europhoton Conference 2014 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 2014 appear in this programme. 205 presentations (6 Summer School lectures, 3 keynotes, 12 invited including 1 upgrade, 73 orals, and 111 poster presentations from Europe and overseas) have been selected for presentation at the Conference.

Tabletop Exhibit

A tabletop exhibit will be organised from Tuesday 26 August (morning) to Thursday, 28 August (afternoon). It will take place at the University of Neuchâtel, Faculty of Humanities (Faculté des Lettres et Sciences Humaines) in the Cafeteria. 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.

Summer School

The Europhoton Conference includes a Summer School on “Frontiers of Solid-State Light Sources”. The Summer School will be held from Sunday 24 August (afternoon) to Monday 25 August (all day), 2014. 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 26 to Thursday 28 August 2014 in the afternoon. All posters will be displayed in rooms located next to the main lecture hall when crossing the outdoor courtyard. There will be no presentations during this time.

Each author is provided with one bulletin board. Poster size should be portrait format A0 (120 cm high × 80 cm wide). The boards will be marked with the paper session code. All authors are requested to display posters on their allocated boards in the morning of the day of their presentation. Fixing material (tape or pins) will be provided. Posters still in their places in the evening will be removed and discarded by the conference organisation. 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.

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 presentation including 5 minutes for discussion.

A computer with Windows 7, Microsoft Pack Office (for ppt format files) and Adobe Reader (for pdf format file) will be available. Authors will transfer their presentation files by USB memory stick or CD-Rom.

All oral sessions take place in the main auditorium so called Aula des jeunes-rives of the Faculty of Humanities (Faculté des Lettres et Sciences Humaines - FLSH).

Conference Language

English will be the official conference language.

Technical Digest

The registration fee includes an on line technical digest including the one-page summaries.

Social Programme

Each registered participant is cordially invited to attend the social programme as detailed on page 07. Tickets will be included in the registration package. Conference participants will need to go to each site on their own (no shuttle organised).
A map on page 08 shows the location of the different events.

WELCOME RECEPTION
Monday 25 August 2014, 18:30 - 20:45
The event will begin in the “Salle du Grand Conseil” where Gisela Eckhardt, Hughes Research Labs, Malibu, USA, will present an invited talk on “History of the Discovery of the Stimulated Raman Effect at the Hughes Research Laboratories”.

The event will be hosted at the Neuchâtel Castle. Address: Château de Neuchâtel, Château 1, 2000 Neuchâtel. The castle is at walking distance from the conference venue. We thank the Canton of Neuchâtel for their kind sponsoring of the event.

BOAT TRIP
Tuesday 26 August 2014, 18:30 - 20:15
The boat will depart at exactly 18:30. Be there on time with your badge!
Address: “Port de la Ville” - Harbour of Neuchâtel
You find the harbour when you follow the lake boarder on the direction of the City centre.

CONFERENCE DINNER
The conference dinner will take place at the Hotel DuPeyrou (http://www.dupeyrou.ch/).

Conference & Social Programme Locations
The conference will take place at the University of Neuchâtel, in the Faculty of Humanities (Faculté des Lettres et Sciences Humaines - FLSH).

Address: Espace Louis-Agassiz, 1, CH-2000 Neuchâtel, Switzerland
Phone: +41 32 718 10 9

All oral sessions take place in the Aula des Jeunes-Rives room.
All poster sessions take place in rooms located next to the main lecture hall when crossing the outdoor courtyard.
Exhibition and coffee breaks take place in the Cafeteria.
Europhoton 2014 all different locations
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.

The restaurant Le Romarin will be open (see location on pages 07-08). A commercial centre “La Maladière” (http://www.maladierecentre.ch/maladiere/accueil/index.aspx) located by the “stade de la Maladière” offers several possibilities to have lunch there (COOP restaurant, Piazza restaurant, Mezzo di Pasta). The restaurant “Cité Universitaire” is also open (see location on page 08). Several additional restaurants are also located at a short walking distance from the conference venue.

Coffee Breaks

Coffee breaks take place in the Cafeteria located opposite of the lecture room when crossing the outdoor courtyard. The exhibition will take place at the same time.

ATTENTION!!
It is completely forbidden to eat or drink in the conference room.

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 half-day special symposium on “Lasers for Biomedical Imaging and Sensing” which will take place on Wednesday morning 27 August 2014.
• 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.
  • On line digest including the one-page summaries.
  • Welcome Reception, Boat Trip and Conference Dinner as mentioned in the Social Programme.
  • 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.
Conference Registration Hours:
Sunday 24  12:00–17:00
Monday 25  07:30–12:00 // 13:00–17:00
Tuesday 26  07:30–12:00 // 13:15–16:30
Wednesday 27  07:45–11:45 // 13:00–16:30
Thursday 28  07:45–11:45 // 13:00–16:30
Friday 29  closed

Conference Hours
Sunday 24  14:00–18:30*
Monday 25  08:00–12:30* // 13:30–18:00*
Tuesday 26  08:00–12:45 // 13:45–18:15
Wednesday 27  08:00–12:15 // 13:15–18:45
Thursday 28  08:00–12:15 // 13:15–20:00
Friday 29  08:00–12:45
* Summer School

Coffee Breaks
Sunday 24  16:00–16:30
Monday 25  10:00–10:30 // 15:30–16:00
Tuesday 26  10:15–10:45 // 14:45–16:15*
Wednesday 27  10:00–10:30 // 15:30–17:00*
Thursday 28  10:00–10:30 // 15:15–16:45*
Friday 29  10:00–10:30
* held in conjunction with the poster session

Lunch Breaks
Monday 25  12:30 – 13:30
Tuesday 26  12:45 – 13:45
Wednesday 27  12:15 – 13:15
Thursday 28  12:15 – 13:15

Social Programme
WELCOME RECEPTION
AND INVITED TALK
Monday 25 August 2014
18:30 – 20:45 // Château de Neuchâtel

BOAT TRIP
Tuesday 26 August 2014
18:30 – 20:15 // Port de la Ville

CONFERENCE DINNER
Wednesday 27 August 2014
19:15 – 21:30 // Hotel DuPeyrou

Special Event
PRIZE FOR RESEARCH IN LASER SCIENCE AND APPLICATIONS
CEREMONY AND LECTURE
Tuesday 26 August 2014
13:45 – 14:45 // Aula des Jeunes-Rives

Conference Committees

GENERAL CHAIR:
Thomas Südmeyer,
University of Neuchâtel,
Neuchâtel, Switzerland

PROGRAMME CHAIR:
Ingmar Hartl,
DESY Hamburg, Hamburg, Germany

LOCAL CHAIRS:
Sandra Gouinguené,
Maxim Gaponenko and
Stéphane Schilt,
University of Neuchâtel,
Neuchâtel, Switzerland

Programme Sub-Committee
“Solid-State Lasers”

CHAIR: Andrius Baltuska,
Vienna University of Technology,
Vienna, Austria

Benoit Boulanger,
Institut NÉEL, Grenoble, France

Eric Cormier,
University of Bordeaux, Bordeaux, France

Martin Dawson,
University of Strathclyde, Glasgow, UK

Majid Ebrahim-Zadeh,
The Institute of Photonic Sciences,
Barcelona, Spain

Shekhar Guha,
Air Force Research Laboratory, Materials and Manufacturing Directorate, Wright Patterson Air Force Base, Ohio, USA

Christian Kränkel,
University of Hamburg, Hamburg, Germany

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: F. Ömer Ilday,
Bilkent University, Ankara, Turkey

Igor Bufetov,
General Physics Institute, Moscow, Russia

Francesc Diaz,
University Rovira i Virgili, Tarragona, Spain

Phillipe Grelu,
Université de Bourgogne, Dijon, France

John Minelly,
Coherent, USA

Johan Nilsson,
University of Southampton, ORC, UK

Oleg Okhotnikov,
Tampere University of Technology, Finland

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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CHAIR: Valdas Pasiskevicius,
Royal Institute of Technology, KTH, Stockholm, Sweden

Andrew Clarkson,
University of Southampton, ORC, UK

Patrick Georges,
Institut d’Optique, Palaiseau, France

Ingmar Hartl,
DESY, Hamburg, Germany (ex officio)

Paolo Laporta,
Politecnico di Milano, Italy (QEOD representative)

Richard Moncorgé,
University of Caen, France

Thomas Südmeyer,
University of Neuchâtel, Switzerland (ex officio)
Conference Management

The Conference management is provided by the European Physical Society, 6 rue des Frères Lumière, 68200 Mulhouse, France. This programme is edited by P. Helfenstein, A. Ouarab and X. de Araujo.

Neuchâtel

Neuchâtel has slightly over 32,800 inhabitants (60,000 including the surrounding area), and lies on the North Western shores of the largest Swiss inland lake at an altitude of 430 metres, located between the Jura Mountains and the Alps. It is one of the main towns in the French-speaking region of Switzerland, also called Suisse Romande. The other national languages are German (70%), Italian and Romansh. The town is ideally located halfway between Zürich and Geneva. Renowned for its watch industry, Neuchâtel has been able to position itself as the heart of micro-technology and high-tech industry. During the last 20 years, the region of Neuchâtel has attracted many leading companies in the high-tech sectors such as medical technology, micro-technology, biotechnology, machines and equipment, IT and clean technologies.

Neuchâtel is an ideal place for full-time study or high-level research work, in an idyllic setting at the heart of Europe. The city hosts around 4,000 students. As a result, you’ll find a young and cosmopolitan atmosphere, with plenty of things to see and do. Neuchâtel is home to the French speaking University of Neuchâtel. The University has five faculties (schools) and more than a dozen institutes, including arts and human sciences, natural sciences, law, economics and technology. The Faculty of Arts and Human Sciences is the largest school of those that comprise the University of Neuchâtel with 1,500 students. With beautiful historic architecture, numerous coffee shops, restaurants and bars, Neuchâtel is also close to many forests, some of which offer attractive lakeside walks. There are 32 sites in Neuchâtel that are listed as Swiss heritage site of National Significance. The entire old city is part of the Inventory of Swiss Heritage Sites.

The city is home to several museums, including a Museum of natural history (English information), an art and history Museum (English information) and a Museum of ethnography (English information). As well, one can take a stroll along the shoreline paths of “Lac Neuchâtel”. The three-lake region can be visited during a cruise (Navigation SA). The lake is also suitable for swimming, although it can be quite chilly. There is a succession of beaches around Neuchâtel. The nearest from downtown are Serrières (Quai Max Petit-Pierre - Tram stop Champ-Bugin) and Jeunes Rives (close to the conference hall). Other places, such as the Botanical Garden (bus no. 109 from town centre (Ermitage stop), then 10 minutes on foot, Free entry) or the Jaquet-Droz Automates (located at the art and history museum) are worth a visit.

Get Around

Public transportation in Neuchâtel is fairly good. The city has reliable bus, tram and train schedule running throughout the city itself as well as the many outlying communities, as well as other towns in the area. All bus lines converge at the main square of the city, Place Pury. Neuchatel’s network, time and schedules can be seen via www.transn.ch/fr/reseau-horaires/litt.html (site only available in French). You can buy a ticket from any of the bus stations and there is a 24 hours pass for CHF 7.00 that allows you to use any transport in the Neuchâtel area for 24 hours from the time of issue.

Currency

The Swiss Currency is the Swiss Franc.

Weather

The climate in Switzerland 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 24 August 2014  (Summer School)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Speaker(s)</th>
<th>Institution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:00</td>
<td>SS1</td>
<td>Summer School Lecture 1</td>
<td>Jörg Rossbach, Hamburg University and DESY, Hamburg, Germany</td>
<td>“Introduction to the Physics of XUV and X-ray Free-Electron Lasers”</td>
</tr>
<tr>
<td>16:00</td>
<td></td>
<td>Coffee Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:30</td>
<td>SS2</td>
<td>Summer School Lecture 2</td>
<td>Tobias Kippenberg, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland</td>
<td>“Microresonator Based Optical Frequency Combs”</td>
</tr>
</tbody>
</table>

### Monday 25 August 2014  (Summer School)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Speaker(s)</th>
<th>Institution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00</td>
<td>SS3</td>
<td>Summer School Lecture 3</td>
<td>Markus Pollnau, University of Twente, MESA+ Institute for Nanotechnology, Enschede, The Netherlands</td>
<td>“Continuous-wave Lasers: Theory and Implementation in Rare-earth-doped Waveguides”</td>
</tr>
<tr>
<td>10:00</td>
<td></td>
<td>Coffee Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:30</td>
<td>SS4</td>
<td>Summer School Lecture 4</td>
<td>Alan Kemp, Fraunhofer UK, University of Strathclyde, Institute of Photonics, Glasgow, United Kingdom</td>
<td>“Applications of Diamond to Solid-state Laser Engineering”</td>
</tr>
<tr>
<td>12:30</td>
<td></td>
<td>Lunch Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13:30</td>
<td>SS5</td>
<td>Summer School Lecture 5</td>
<td>Siddharth Ramachandran, Boston University, ECE Department, Photonics Center, Boston, MA, USA</td>
<td>“Physics of Guided-wave Light Propagation: Applications to Fiber Lasers and Nonlinear Optics”</td>
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<tr>
<td>15:30</td>
<td></td>
<td>Coffee Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td>SS6</td>
<td>Summer School Lecture 6</td>
<td>Miles Padgett, School of Physics and Astronomy, Optics group, University of Glasgow, United Kingdom</td>
<td>“An Introduction to Structured Light and its Applications”</td>
</tr>
<tr>
<td>18:15</td>
<td></td>
<td>Walk to Castle</td>
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</tbody>
</table>

### Tuesday 26 August 2014  (Conference)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Speaker(s)</th>
<th>Institution(s)</th>
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</thead>
<tbody>
<tr>
<td>08:00</td>
<td></td>
<td>Welcome presented by Thomas Südmeyer and Ingmar Hartl</td>
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</tr>
<tr>
<td>08:15</td>
<td>TuA</td>
<td>OPCPA and Pump Systems (Oral Session)</td>
<td></td>
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<tr>
<td>10:45</td>
<td>TuB</td>
<td>Novel Pulsed Fiber Sources (Oral Session)</td>
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<tr>
<td>12:45</td>
<td>TuPr</td>
<td>Prize for Research in Laser Science and Applications - Ceremony and Lecture (Oral Session)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:45</td>
<td>TuC</td>
<td>High-Power Yb-doped Amplifiers (Oral Session)</td>
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</tbody>
</table>

### Wednesday 27 August 2014  (Conference)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Speaker(s)</th>
<th>Institution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00</td>
<td>WeA</td>
<td>Lasers for Spectroscopy, Sensing and Imaging (Oral Session - Special symposium)</td>
<td></td>
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<tr>
<td>10:00</td>
<td></td>
<td>Coffee Break</td>
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</tr>
<tr>
<td>10:30</td>
<td>WeB</td>
<td>Brain and Infrared Lasers (Oral Session - Special symposium)</td>
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<tr>
<td>12:15</td>
<td></td>
<td>Lunch Break</td>
<td></td>
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</tr>
<tr>
<td>13:15</td>
<td>WeC</td>
<td>Power-Scaling of Thin-Disk Lasers (Oral Session)</td>
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<tr>
<td>15:30</td>
<td></td>
<td>Coffee Break</td>
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<td></td>
</tr>
<tr>
<td>15:30</td>
<td>WeP</td>
<td>Poster Session 2 with Coffee Break</td>
<td></td>
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<tr>
<td>17:00</td>
<td>WeD</td>
<td>Waveguide- and Microresonator-based Sources (Oral Session)</td>
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<tr>
<td>18:45</td>
<td></td>
<td>Break and Walk to Dinner</td>
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<td></td>
</tr>
<tr>
<td>19:15</td>
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<td>Conference Dinner</td>
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Thursday 28 August 2014  (Conference)

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<tr>
<th>Time</th>
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<tr>
<td>08:00</td>
<td>Novel Fiber Amplifiers (Oral Session)</td>
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<td>10:00</td>
<td>Coffee Break</td>
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<td>10:30</td>
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<td>12:15</td>
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<tr>
<td>13:15</td>
<td>Low-noise Fiber Lasers and Spectroscopy (Oral Session)</td>
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<tr>
<td>15:15</td>
<td>Poster Session 3 with Coffee Break</td>
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<tr>
<td>16:45</td>
<td>Poster Session 3 with Coffee Break</td>
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<td>18:45</td>
<td>Coffee Break</td>
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<tr>
<td>19:15</td>
<td>Postdeadline Session (Oral Session)</td>
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<td>Closing Remarks</td>
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Wednesday 27 August 2014

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<td>Looking Inside the Brain: A fiber-optic Platform for Neurophotronics – Aleksei Zheltikov</td>
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Keynote and Invited Talks at a Glance

Monday 25 August 2014

18:30 Invited Talk held during the Welcome Reception
History of the Discovery of the Stimulated Raman Effect at the Hughes Research Laboratories – Gisela Eckhardt

Tuesday 26 August 2014

08:15 Frequency Domain Optical Parametric Amplification of nJ Laser Pulses – Francois Légaré
10:45 Recent Advances in Mid-Infrared Fiber Lasers – Martin Bernier
13:45 Femtosecond Frequency Combs and Applications – Thomas Udem
**Summer School – Technical Programme**

**Sunday 24 August 2014**

**Summer School Lecture 1** 14:00 - 16:00

<table>
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<th>Time</th>
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<tr>
<td>14:00-14:45</td>
<td>Summer School Lecture 1</td>
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<tr>
<td>14:45-15:00</td>
<td>Break</td>
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<tr>
<td>15:00-15:45</td>
<td>Summer School Lecture 1, continued</td>
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<tr>
<td>15:45-16:00</td>
<td>Discussion 1</td>
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**Jörg Rossbach**

_Hamburg University and DESY, Hamburg, Germany_

**Topic: Introduction to the Physics of XUV and X-ray Free-Electron Lasers**

State-of-the-art electron accelerators can drive free-electron lasers (FELs) in a wide range of wavelength from the far infrared down to the X-ray regime. This lecture will cover the physics of FELs, with emphasis on the single-pass high-gain FEL principle. In addition to the basic physics, technology requirements will be discussed, as well as typical performance values of existing facilities. Statistical properties of the photon pulse in SASE FEL mode will be covered as well as progress and plans for advanced schemes improving the pulse properties, such as various FEL seedings or single-mode operation.

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**Monday 25 August 2014**

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

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<tr>
<td>08:00-08:45</td>
<td>Summer School Lecture 3</td>
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<td>08:45-09:00</td>
<td>Break</td>
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<tr>
<td>09:00-09:45</td>
<td>Summer School Lecture 3, continued</td>
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<tr>
<td>09:45-10:00</td>
<td>Discussion 3</td>
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**Markus Pollnau**

_University of Twente, MESA+ Institute for Nanotechnology, Enschede, The Netherlands_

**Topic: Continuous-wave Lasers: Theory and Implementation in Rare-earth-doped Waveguides**

During the first half of this lecture I will extend the theory of continuous-wave (cw) lasers by systematically considering spontaneous emission as a result of vacuum fluctuations. Its inherent consequence that in a cw laser the gain is smaller than the losses necessitates that any coherent state inside a cw laser decays with one-half the coherence time of the emitted laser light and straightforwardly leads us to the definition of the finite Q-factor of a cw lasing resonator and the derivation of the laser linewidth. I will introduce the laser eigenvalue which relates the parameters of a cw lasing resonator to the corresponding...
parameters of the underlying passive resonator, thereby unifying resonator and laser theory, and show that the Schawlow-Townes linewidth is a three-fold approximation and does not represent a lower limit to the fundamental laser linewidth. During the second half I will discuss recent results on highly efficient rare-earth-doped waveguide lasers, with particular emphasis on ultranarrow-linewidth lasers on a silicon chip and applications to intra-laser-cavity optical sensing.

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

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

Alan Kemp
Fraunhofer UK, University of Strathclyde, Institute of Photonics, Glasgow, United Kingdom

Topic: Applications of Diamond to Solid-state Laser Engineering
The lecture will feature:
1. An overview of the opportunities and challenges of using diamond in solid-state laser engineering.
2. Characterisation of diamond for laser applications (birefringence, loss, damage, Raman gain).
3. The use of diamond to cool conventional laser materials (heat spreaders and the like).
4. The means to exploit diamond directly as a laser material, particularly diamond Raman lasers.

12:30 - 13:30  Lunch Time

Summer School Lecture 5  13:30 - 15:30

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

Siddharth Ramachandran
Boston University, ECE Department, Photonics Center, Boston, MA, USA

Topic: Physics of Guided-wave Light Propagation: Applications to Fiber Lasers and Nonlinear Optics
A fiber may be characterised by the number of discrete spatial modes it carries, their effective modal areas, and the phase accumulated when they propagate, all of which control interactions between different modes or colours, due to linear (via interference) or nonlinear (via, primarily, the $\chi(3)$ nonlinearity in silica) coupling. These interactions are not unlike those encountered in bulk optical media, but with a fundamental distinction – owing to the revolutionarily low loss of optical fibers, interaction lengths can be several orders of magnitude greater than that feasible with bulk media, and hence no other medium facilitates, with such ease, remote delivery of light. Here, we describe the physics of light propagation in optical fibers, which may guide light due to total internal reflection (as is the case with a majority of fibers, including most photonic crystal fibers) or due to band-gap effects (such as hollow-core bandgap fibers). We will elucidate the key design parameters that allow achieving desired mode areas, nonlinear coefficients, phase and dispersion matching, and show how these can be connected with simple ray-optic and wave-optic theories. Then, we will explore the regimes in which single-mode, mono-mode, few-mode, and vastly multimode fibers, including their vector effects, are applied and exploited. We will end with illustrative examples of applications in which specially designed fibers have been used, focusing on recent advances in nonlinear fiber optics, high-power lasers and imaging applications.

15:30 - 16:00  Coffee Break (Cafeteria)

Summer School Lecture 6  16:00 - 18:00

16:00-16:45  Summer School Lecture 6
16:45-17:00  Break
17:00-17:45  Summer School Lecture 6, continued
17:45-18:00  Discussion 6

Miles Padgett
School of Physics and Astronomy, Optics group, University of Glasgow, United Kingdom

Topic: An Introduction to Structured Light and its Applications
Monday 25 August 2014

Welcome Reception at the Castle, 18:30 - 20:45
18:30 - 19:00  (Invited)
“History of the Discovery of the Stimulated Raman Effect at the Hughes Research Laboratories”
Gisela Eckhardt, Hughes Research Labs, Malibu, USA
Gisela Eckhardt will present a talk on “History of the Discovery of the Stimulated Raman Effect at the Hughes Research Laboratories”

Tuesday 26 August 2014

OPCPA and Pump Systems - 08:15 - 10:15
08:15 - 08:45  (Invited)
“Frequency domain Optical Parametric Amplification of nJ Laser pulses”
Francois Legare, INRS, Varennes, Canada
Using Frequency domain Optical Parametric Amplification, 800nm nJ level pulses are amplified 2,000 to 12,000 times in a single 2mm BBO crystal, pumped by picosecond 400nm pulses. Blocking the seed input yielded a 1400 times weaker superfluorescence level.

Novel Pulsed Fiber Sources - 10:45 - 12:45
10:45 - 11:15  (Invited)
“Recent Advances in Mid-Infrared Fiber Lasers”
Martin Bernier, COPL, Laval University, Quebec, Canada
Recent advances in the development of fiber lasers operating in the mid-infrared will be reviewed. A 30W-level erbium-doped fluoride glass fiber laser emitting in the vicinity of 3μm will be detailed. The conversion of such laser in the 3-4μm window by stimulated Raman scattering in chalcogenide fibers will be demonstrated.

Prize for Research in Laser Science and Applications, Ceremony and Lecture - 13:45 - 14:45
14:00 - 14:45  (Invited)
Femtosecond Frequency Combs and Applications
Thomas Udem, Max-Planck-Institut für Quantenoptik, Garching, Germany
A femtosecond frequency comb is a simple and compact tool that allows the phase coherent connection of the radio frequency domain (below 10 GHz) with the optical domain (above 200 THz). It greatly simplified high precision optical frequency measurements and provides the long awaited clockwork mechanism for an all-optical atomic clock. In addition it allows to shape the electric field transients of femtosecond pulses including the phase between the carrier wave and the pulse envelope. I will try to give an overview of the technical aspects of frequency combs and their applications.

High-Power-Yb-doped Amplifiers - 16:15 - 18:15
16:15 - 16:45  (Invited)
Max Lederer, European X-Ray Free-Electron Laser Facility GmbH, Hamburg, Germany
We present the concept and development status of our pump-probe laser to be installed at experimental stations of the European XFEL. To date, features such as burst-mode operation with intra-burst frequencies up to 4.5MHz and arbitrary pulse selection are demonstrated at single pulse energies up to 180μJ and 15fs pulsewidth.

Wednesday 27 August 2014

Lasers for Spectroscopy, Sensing and Imaging - 08:00 - 10:00
08:00-08:45  (Keynote)
“Frequency Comb Measurements Outside the Laboratory”
Nathan Newbury, NIST, Boulder, United States
Frequency combs have been exploited in an expanding range of precision measurements, but so far primarily within the metrology laboratory. I will discuss development of a fieldable frequency comb, and experiments that send comb light across outdoor air paths to explore both accurate atmospheric gas measurements and optical time-frequency transfer.

09:00 - 09:30  (Invited)
“Fourier Domain Mode Locking (FDML) for Multi-Megahertz Optical Coherence Tomography (OCT) and Hyperspectral Stimulated Raman Imaging”

Robert Huber, Institut für Biomedizinische Optik, Universität zu Lübeck, Lübeck, Germany
Fourier Domain Mode Locked lasers use a kilometer long fiber cavity to generate very rapid, narrow linewidth wavelength sweeps over a wide spectral range. These lasers enable optical coherence tomography at Megahertz line rate (MHz-OCT) and time encoded molecular stimulated Raman (Ti-Co-Raman) microscopy.

Brain and Infrared Lasers - 10:30 - 12:15
10:30 - 11:00  (Invited)
“Fiber-based Sources for Brain Imaging”
Chris Xu, School of Applied and Engineering Physics, Cornell University, Ithaca, NY USA
Deep tissue multiphoton microscopy (MPM) using solitons generated from optical fibers are reviewed. The main characteristics of the excitation source for deep tissue MPM, such as wavelength, pulse energy, and repetition rate, are discussed.

11:00 - 11:30  (Invited)
“Looking Inside the Brain: A fiber-optic Platform for Neurophotonics”
Aleksii Zheltikov, Moscow State University, Kurchatov Institute National Research Center, Moscow, Russia & Texas A&M University, College Station, TX, United States
New fiber-optic neurointerfaces are shown to offer a unique tool for continuous online quantitative monitoring of transcription factor dynamics in the brain of freely behaving mice, suggesting new ways toward understanding neuron plasticity, learning, and memory.

Power Scaling of Thin Disk Lasers - 13:15 - 15:30
13:15 - 14:00  (Keynote)
“Innovative Opportunities for combined High Average and High Peak Power Lasers”
John Collier, Central Laser Facility STFC Rutherford Appleton Laboratory, Oxfordshire, United Kingdom
In this presentation I will briefly report on the development of a new diode pumped high energy laser concept at the Rutherford Appleton Laboratory (RAL). Known as “DIPOLE”, it has been developed to be an intrinsically scalable system, providing a high average power basis for energetic pulse production from Joules to kiloJoules.
14:00 - 14:30 (Invited)

“Power-scaling of Kerr-lens mode-locked Yb:YAG thin-disk oscillators”
Jonathan Brons, Max-Planck-Institute of Quantum Optics, Garching, Germany

A geometrical energy scaling concept for Kerr-lens mode-locked thin-disk oscillators is presented. With an Yb:YAG thin-disk 14.4 µJ, 330 fs pulses at 18.8 MHz repetition-rate are measured. These 270 W average power and 38 MW peak power are the highest of any mode-locked thin-disk oscillator, operated in air.

Thursday 28 August 2014

Novel Fiber Amplifiers - 08:00 - 10:00

08:00 - 08:45 (Keynote)

“Performance Scaling of Ultrafast Fiber Laser Systems”
Jens Limpert, Friedrich-Schiller-Universität Jena, Jena, Germany

The presentation will review challenges and achievements of ultrashort pulse amplification in rare-earth-doped fibers as well as the basics of the concept “coherent addition of pulsed laser radiation” and its use for performance scaling. Finally, a design is presented which targets Joule-class femtosecond pulses at repetition rates beyond 10kHz.

08:45 - 09:15 (Invited)

“Ultrashort-pulse Enhancement Cavities and Applications”
Ioachim Pupeza, Max-Planck-Institut für Quantenoptik, Garching and Ludwig-Maximilians-Universität München, München, Germany

We review the challenges and the newest developments in scaling the performance of ultrashort-pulse enhancement cavities. Using state-of-the-art Yb:fiber lasers, custom mirrors and cavity designs, we demonstrate at 78-MHz repetition rate 1.9-kW average-power 40-fs pulses and, at 250 MHz, 400 kW with 250-fs pulses and 670 kW with 10-ps pulses.

Crystalline-host Lasers - 16:45 - 18:45

16:45 - 17:15 (Invited)

“Micro Domain-controlled Laser Materials Toward Giant Micro-phononics”
Takunori Taira, Laser Research Center for Molecular Science, Institute for Molecular Science, Okazaki, Japan

The past decade has witnessed a veritable revolution in the types and performance levels of solid-state lasers, largely due to development of micro-domain engineered new optical materials: micro-domain structured transparent laser ceramics and ferroelectrics for quasi-phase matched nonlinear optics. We’d like to discuss the capabilities of Giant Micro-phononics for energy.

Friday 29 August 2014

Fiber Sources for High-field Experiments - 08:00 - 10:00

08:00 - 08:30 (Invited)

“Extreme Nonlinear Optics with Kagome Hollow-core PCF”
Fetah Benabid, University of Limoges, Xlim Research Institute, CNRS UMR 7252, GPPMM Group, Limoges, France

We review the recent progress on hypocycloid-shaped core-contour (i.e. negative curvature) hollow-core photonic-crystal-fibre and its implementation for the first time in the fields of micro-wave plasma, whereby a highly stable fibre-confined argon plasma column is generated, and of high optical-fields, where a femtosecond pulse was self-compressed to the sub-cycle cycle regime.
**Sunday, Monday & Tuesday sessions**

**SUNDAY SESSIONS**

**Aula des Jeunes-Rives**

SS1 - Summer School "Introduction to the Physics of XUV and X-ray Free-Electron Lasers" - 14:00 - 16:00
Jörg Rossbach, Hamburg University and DESY, Hamburg, Germany

**Cafeteria**

Coffee Break - 15:30 - 16:00

**Aula des Jeunes-Rives**

SS6 - Summer School "An Introduction to Structured Light and its Applications" - 16:00 - 18:00
Miles Padgett, School of Physics and Astronomy, Optics group, University of Glasgow, United Kingdom

**Walk**

Walk to Castle - 18:15 - 18:30

**Castle**

Welcome Reception and Invited Talk - 18:30 - 20:45 Solid-State Lasers

MoA-T1-I-01 (Invited) 18:30

History of the Discovery of the Stimulated Raman Effect at the Hughes Research Laboratories

Gisela Eckhardt, Hughes Research Labs, Malibu, United Kingdom

Prof. Gisela Eckhardt will present a talk on "History of the Discovery of the Stimulated Raman Effect at the Hughes Research Laboratories"

**TUESDAY SESSIONS**

**Aula des Jeunes-Rives**

OPCPA and Pump Systems - 08:15 - 10:15 Solid-State Lasers
Chair by: Eric Cormier, University of Bordeaux, Bordeaux, France

TuA-T1-I-01 (Invited) 08:15

Frequency domain Optical Parametric Amplification of nJ laser pulses
Francois Legare1, Philippe Lassonde1, Maxime Boivin1, Ladan Arissian4, Bruno Schmidt1, 5

1 INRS, Varennes, Canada
2 University of New Mexico, Albuquerque, United States
3 few-cycle Inc., Montreal, Canada
4 Department of Physics and Astronomy, University of St. Andrews, St. Andrews, United Kingdom
5 BAE Systems Inc., Nashua, United States

We describe the operation of a long wavelength singly resonant optical parametric chirped-pulse amplifier (OPCPA) delivering 21.8µJ, 44.2-fs pulses at a center wavelength of 3.4 µm. The average power corresponds to 1.09 W at 50 kHz repetition-rate. The technique of achromatic quasi-phase-matching is demonstrated in the context of non-collinear OPCPA for the first time.

TuA-T1-O-02 08:45

Few-Cycle Mid-Infrared Pulses From Achromatic QPM OPCPA

Benedikt W. Mayer1, Christopher R. Phillips4, Lukas Gallmann2, Ursula Keller1

1 Department of Physics, Institute for Quantum Electronics, ETH Zurich, Zurich, Switzerland
2 Institute of Applied Physics, University of Bern, Bern, Switzerland

We present a quasi-phase matched optical parametric chirped-pulse amplifier (OPCPA) delivering 21.8-µJ, 44.2-fs pulses at a center wavelength of 3.4 µm. The average power corresponds to 1.09 W at 50 kHz repetition-rate. The technique of achromatic quasi-phase-matching is demonstrated in the context of non-collinear OPCPA for the first time.

TuA-T1-O-03 09:00

Tm:YAP Pumped Intracavity Pulsed OPO Based on Orientation-Patterned Gallium Arsenide (OP-GaAs)

Daniel Kane1, 2, John-Mark Hopkins1, Malcolm Dunn1, Peter Schunemann1, David Stothard1

1 Institute of Photonics, University of Strathclyde, Glasgow, United Kingdom
2 Fraunhofer Centre for Applied Photonics, Glasgow, United Kingdom
3 J. F. Allen Physics Research Laboratories, School of Physics & Astronomy, University of St. Andrews, St. Andrews, United Kingdom
4 BAE Systems Inc., Nashua, United States

We describe the operation of a long wavelength singly resonant optical parametric oscillator (OPO) based upon the nonlinear material orientation-patterned gallium arsenide (OP-GaAs) pumped internal to a high repetition rate, Q-switched Tm:YAP laser. This device is a low cost, compact and efficient, broadly tunable mid-IR spectroscopic platform.

TuA-T1-O-04 09:15

CPA-free solid-state amplifier for sequential pump depletion in a 10 µJ multi-pass OPCPA system at 100 kHz

Jan Matyschok1, 2, Oliver Prochnow1, Thomas Binhammer1, Tina Long1, 3, Stefan Rausch1, Bastian Schulz6, Maik Frede1, Uwe Morgen1, 3, 5

1 Institute for Nanotechnology, University of Twente, MESA+, Enschede, The Netherlands
2 Institute of Quantum Optics and Quantum Information, University of Innsbruck, Innsbruck, Austria
3 BAE Systems Inc., Nashua, United States
4 BAE Systems Inc., Nashua, United States
5 United States
6 Department of Physics, Institute for Quantum Electronics, ETH Zurich, Zurich, Switzerland

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TuA-T1-O-05 09:45

Frequency domain Optical Parametric Amplification of nJ laser pulses
Francois Legare1, Philippe Lassonde1, Maxime Boivin1, Ladan Arissian4, Bruno Schmidt1, 5

1 INRS, Varennes, Canada
2 University of New Mexico, Albuquerque, United States
3 few-cycle Inc., Montreal, Canada
4 Department of Physics and Astronomy, University of St. Andrews, St. Andrews, United Kingdom
5 BAE Systems Inc., Nashua, United States

We describe the operation of a long wavelength singly resonant optical parametric oscillator (OPO) based upon the nonlinear material orientation-patterned gallium arsenide (OP-GaAs) pumped internal to a high repetition rate, Q-switched Tm:YAP laser. This device is a low cost, compact and efficient, broadly tunable mid-IR spectroscopic platform.
We report the recent results obtained from the DiPOLE amplifier for 10 Hz operation. This includes the first demonstration of 10 J output corresponding to an optical-to-optical conversion efficiency of 21%. We demonstrate 48 Hr operation at 7 J output and second harmonic generation (SHG) at 10 Hz utilising DKDP, YCOB and LBO crystals.

**TuA-T1-O-07  10:00**

Neodymium Glass Laser with a Phase Conjugate Mirror Generating Several Hundred Joules Pulses in 1 Shot per 1 Minute Regime

Alexey Kuzmin, Efim Khazanov, Andrey Shaykin
Institute of Applied Physics of the Russian Academy of Sciences, 46 Ulyanov Street, 603950, Nizhny Novgorod, Russia

For pumping multipetawatt Ti:sapphire laser facility we developed a compact Nd:glass laser generating 220 J, 30 ns FWHM pulses with repetition rate of 0.02 Hz. The beam fill factor was 0.8. Phase distortions of laser radiation were compensated by optical phase conjugation. The depolarization was reduced to 0.4%. The beam divergence was 150 µrad.

**TuB-T2-O-03  11:30**

Seeded amplification of the Stokes wave in an ultrafast fiber amplifier

Uğur Teğin1, Parviz Elothi1, Sinem Yılmaz2, Fatih Ömer İlday1,2
1 Department of Physics Bilkent University, Ankara, Turkey
2 Department of Electrical and Electronics Engineering, Ankara, Turkey

We report Seeded amplification of the Stokes wave in an ultrafast fiber amplifier. Our setup consists of master oscillator and amplifier. Stokes wave generated during amplification is filtered and feedbacked to amplifier. With this design we achieve to increase the intensity of Stokes waves and generate 2.9 ps pulses at 1080 nm.

**TuA-T1-O-06  09:45**

DIOPE: A 10 J, 10 Hz multi-slab cryogenic gas cooled Yb:YAG amplifier

Saumyabrata Banerjee, Klaus Ertel, Paul Mason, Jonathan Phillips, Jodie M. Smith, Maria Stefania De Vido, Thomas Butcher, David Richards, Justin Greenhalgh, Cristina Hernandez - Gomez, John Collier
Central Laser Facility, STFC Rutherford Appleton Laboratory, Chilton, Didcot OX11 0QX, UK, Didcot, United Kingdom

We report the recent results obtained from the DiPOLE amplifier for 10 Hz operation, this includes the first demonstration of 10 J output corresponding to an optical-to-optical conversion efficiency of 21%. We demonstrate 48 Hr operation at 7 J output and second harmonic generation (SHG) at 10 Hz utilising DKDP, YCOB and LBO crystals.

**TuB-T2-O-04  11:45**

Self-starting all-polarization maintaining Yb-fiber laser with a polarization maintaining anomalous dispersion higher-order-mode fiber

Zhu Lingsiao1, Aart Verhoef2, Lars Gruner-Nielsen3, Stine Møller Israelsen4, Andrius Baltuska1, Alma Fernández1
1 Photonics Institute, TU Wien, Wien, Austria
2 University of Vienna, Vienna, Austria
3 OFS Denmark, Brøndby, Denmark
4 Technical University of Denmark, Department of Photonics Engineering, Kgs. Lyngby, Denmark

An Yb-fiber oscillator with an all-polarization maintaining anomalous dispersion higher order-mode fiber will be demonstrated. The setup is composed of 10 pairs of counter-propagating fibers in a ring cavity, and each pair is composed of 500 meters of 1 µm core diameter, 200 µm cladding diameter, 10 µm polarization maintaining fiber. A diode-pumped laser is used to pump the fiber cavity. The output of the fiber cavity is directed to a set of fiber delay lines and then to a fiber polarizer which is used to select the polarization state of the output light. The output of the polarizer is then directed to an optical fiber coupler which is used to couple the output light to an optical spectrum analyzer. The optical spectrum analyzer is used to measure the frequency of the output light. The output of the optical spectrum analyzer is then directed to a computer which is used to control the pump laser and the fiber delay lines. The output of the computer is then used to control the pump laser and the fiber delay lines. The output of the computer is then used to control the fiber polarizer. The output of the fiber polarizer is then directed to an optical fiber coupler which is used to couple the output light to an optical spectrum analyzer. The optical spectrum analyzer is used to measure the frequency of the output light. The output of the optical spectrum analyzer is then directed to a computer which is used to control the pump laser and the fiber delay lines. The output of the computer is then used to control the pump laser and the fiber delay lines. The output of the computer is then used to control the fiber polarizer.
The first Prize for Research in Laser Science and Applications is awarded to Thomas Udem, research associate at Max-Planck-Institut für Quantenoptik, Garching, Germany for “significant contributions to the development of optical frequency combs and their extension into the vacuum-ultra-violet region, as well as the realization of applications in astronomy, metrology and ultra-precise fast sensitive spectroscopy”.

TuP-T2-P-01
813-nm narrow linewidth light source for Sr optical lattice clock based on Tm-doped fluoride fiber amplifier

Yu-ichi Takeuchi1, Eiji Kajikawa1, Kenta Kohno1, Ken’ichi Niakagawa2, Mitsuru Musha1,2
1 Institute for Laser Science, University of Electro-Communications, Tokyo, Japan
2 Innovative Space-time Project, ERATO, JST, Tokyo, Japan

We have developed the stable and high power fiber MOPA system at 813 nm for the Sr optical lattice clock. By using the Tm-doped fluoride fiber amplifier, Maximum output power of 1.6 W is obtained whose linewidth is less 200 kHz.

TuP-T2-P-02
Laser Emission in Diode-Pumped Nd:YAG Cladding Waveguides Fabricated by Direct Writing with a Helical Movement Technique

Nicolaie Pavel1, Gabriela Salam1, Florin Jipa1, Marian Zamfirescu2, Flavius Voicu1, Traian Dascalu1
1 Laboratory of Solid-State Quantum Electronics, National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania
2 Solid-State Laser Laboratory, Laser Department, National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania

Cladding waveguides were inscribed in Nd:YAG ceramic by a novel technique in which the laser medium is moved on a helical trajectory along its axis and parallel to the writing direction. Efficient laser emission at 1.06 µm and 1.3 µm is obtained under quasi-continuous-wave pumping with a fiber-coupled diode laser.

TuP-T2-P-03
Synchronization of Er- and Tm-doped fiber mode-locked lasers by a common graphene saturable absorber

Jan Tarka1, J. Sotó1, Grzegorz Sobon1, J. Bogusławski1, K. Krzempek1, I. Pasternak1, A. Krajewski1,2, W. Strupinski1, K.M. Abramski1
1 Laser & Fiber Electronics Group, Wrocław University of Technology, Wyspiańska 27, 50-307 Wrocław, Poland, Wrocław, Poland
2 Institute of Electronic Materials Technology, Wolczynska 133, 01-919 Warsaw, Poland, Warsaw, Poland

We report synchronized ultra-short pulse generation in 1.5 µm and 2 µm spectral ranges using common graphene based saturable absorber. The 915 fs and 1.57 ps soliton pulses were produced in Er-doped and Tm-doped fiber lasers, respectively. Synchronization holding range of reported system were also investigate.

TuP-T2-P-04
High-power actively mode-locked Tm3+-doped silica fiber laser

Christian Kneis1, Antoine Berrou1, Inka Manek-Hönninger1, Marc Eichhorn1, Christelle Kieleck1
1 French-German Research Institute of Saint-Louis, ISL, 5 rue du Général Cassignou, 68301 Saint Louis, FR, Saint Louis, France
2 Laboratoire Ondes et Matière d’Aquitaine, Université Bordeaux 1, 351 cours de la Libération, 33405 Talence, FR, Talence, France

A diode-pumped actively mode-locked Tm3+-doped double-clad silica fiber laser providing up to 30 W of average output power and 300 ps pulse width in mode-locked operation is reported. The fiber laser is harmonically mode-locked at a repetition rate of 66 MHz and produces a pulse energy of 454 nJ.

TuP-T2-P-05
Graphene Q-switched Yb:Phosphate Glass Channel Waveguide Laser

Amol Choudhary1, Shanoli Dhingra2, Brian D’Urso1, Pradeesh Kannan1, David Shepherd1
1 Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom
2 Physical Sciences & Technology, Vilnius, Lithuania

We present a passively CEO phase-stable femtosecond laser source providing multiple phase coherent outputs for OPCPA applications. Via difference frequency generation between the dispersive and the soliton part of the all-fiber generated super-continuum a broadband spectrum centered at 1560 nm is obtained. The resulting CEO phase-stable signal enables generating multiple phase stable outputs.
TuP-T2-P-06
The Impact of Core Displacement on Optical Properties of PCFs
Vladimir Demidov, Victor Shevandin
S.I. Vavilov State Optical Institute, St. Petersburg, Russia

We analyze both theoretically and experimentally the modal and leakage properties of large mode area photonic crystal fibers with the core displaced from the center of the lattice. The core displacement factor has the great impact on the fiber mode area scaling potential and spectral operation range expansion.

TuP-T2-P-07
Fabrication of long-period fiber-gratings by exposure to low-pressure mercury lamp - Effect of hydrogen loading
Toru Mizunami, Yoshihisa Tashiro
Graduate School of Engineering, Kyushu Institute of Technology, Kitakyushu, Japan

Low-cost fabrication of long-period gratings using exposure to a low-pressure mercury lamp was studied. By increasing the gas pressure in hydrogen loading from 120 to 135 atm, shortening of the exposure time to 2/3 was achieved. Further shortening was achieved for a longer loading time. Temperature and strain sensitivities were measured.

TuP-T2-P-08
High Peak Power Femtosecond Dissipative Dispersion-managed Soliton Generation in Mode-locked Thulium Doped Fiber Laser
Fangzhou Tan, Jiang Liu, Kun Liu, Shoufei Gao, Pu Wang
Institute of Laser Engineering, Beijing University of Technology, Beijing, China

We report an dispersion managed mode-locked thulium doped fiber laser. The laser delivered up chirped pulses with 0.19 nJ pulse energy. The pulse can be compressed to 285 fs after one-stage single-mode thulium doped fiber amplifier. The output power is 150 mW corresponding to a peak power of 40 kW.

TuP-T2-P-09
Dissipative soliton resonance by reverse saturable absorption in graphene oxide mode-locked All-normal-dispersion Yb-doped fiber laser
Zhaochen Cheng, Huihui Li, Hongxing Shi, Pu Wang
Institute of Laser Engineering, Beijing University of Technology, Beijing, China

We have observed dissipative soliton resonance phenomenon in our mode-locked Yb-doped fiber laser with graphene oxide as saturable absorber. Reverse saturable absorption, which comes from the etalon effect by a pair of non-touch fiber connectors in normal dispersion, plays a big role in generating square shaped pulses.

TuP-T1-P-10
Fiber mode-locked lasers based on topological insulator saturable absorbers
Jaroslav Sotor, Grzegorz Sobon, Jakub Boguslawski, Jan Tarka, Karol Krezmepk, Krzysztof Abramski
Laser & Fiber Electronics Group, Wrocław University of Technology, Wrocław, Poland

We present the fiber mode-locked lasers based on topological insulator saturable absorbers. The laser constructional cladding thickness ranges from 60 μm to 90 μm. Investigated samples passed proof-test with 1%-elongation.

TuP-T1-P-11
High-power, kHz-repetition rate femtosecond Fiber-CPA system at 1.55 μm
Grzegorz Sobon, Jaroslav Sotor, Dorota Sliwnska, Aleksander Gluszek, Karol Krezmepk, Pawel Kaczmarek, Krzysztof Abramski
Wrocław University of Technology, Wrocław, Poland

In this work, we demonstrate a high-power fiber-based CPA setup utilizing Er- and Er/ Yb-doped fibers, operating at the 1554 nm wavelength. The integrated pulse-picker allows to reduce the repetition frequency up to the kHz-range, which enables generation of 900 fs pulses with energies at the level of 0.75 μJ.

TuP-T1-P-12
LD-seeded thulium-doped fibre amplifier for CO₂ measurements at 2 μm
Yutong Feng¹, Johan Nilsson¹, Saurabh Jain¹, Timothy May-Smith¹, Jayanta Sahu¹, Fuqiang Jia¹, David Wilson¹, Michael Lengden¹, Walter Johnstone²
¹ Optronics Research Centre, University of Southampton, Southampton, United Kingdom
² Centre for Microsystems and Photonics, Dept. Electronic and Electrical Engineering, University of Strathclyde, Glasgow, United Kingdom

A simple single-stage thulium-doped fibre amplifier reaches 2.5 W of output power while simultaneously suppressing unwanted power modulation when seeded by a DFB laser-diode, wavelength-modulated around 1997 nm. The system meets the requirements for chemical species tomography of CO₂ in aero-engine exhaust plumes with desired spatial and temporal resolution.

TuP-T1-P-13
Metal-Coated Large-Core Single-Mode Microstructured Fiber
Aleksandra Pasishnik, Victor Shevandin
S.I. Vavilov Federal Optical Institute, St. Petersburg, Russia

We have fabricated and investigated metal-coated large-core single-mode microstructured fibers. It was found from the theoretical analysis that the better uniformity of coating could be obtained if the constructional cladding thickness ranges from 60 μm to 90 μm. Investigated samples passed proof-test with 1%-elongation.

TuP-T1-P-14
10 cm length Efficient Rod-Type Photonic Crystal Fiber Laser
Boris Rosenstein¹, Avery Shirakov², Daniel Belker¹, Amiel A. Ishaya¹
¹ Department of Electrical and Computer Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel
² Department of Physics, Ben-Gurion University of the Negev, Beer-Sheva, Israel

We experimentally demonstrate and investigate extremely short cavity photonic crystal fiber laser. With our special pump design, we succeeded to demonstrate doubled pump absorption, and corresponding improvement of lasing performance, compared with standard pumping schemes.
TuP-T1-P-15
Single transverse mode and high-average-power operation in tapered double-clad Yb-doped multimode fiber.
Hidetsugu Yoshida, Koji Tsukabimato, Hisanori Fujita, Noriaki Miyangara
Institute of Laser Engineering, Osaka University, Suita, Osaka, Japan
We have achieved high-average-power and single transverse mode operation from tapered double-clad Yb-doped multimode fiber (TDC-YDF) amplifier. The near-field pattern of the TDC-YDF amplified pulse had good Gaussian profile. The beam quality M2 was 1.2-1.3 at 10 W output power and 1.6-1.8 at 36 W output level.

TuP-T1-P-16
Measurement of the Polarization Mode Dispersion in a HC-800 Photonic Crystal Fiber
Timea Grósz1, Katalin Csonti2, Róbert Szipács2, Attila Pál Kovács1
1 Department of Optics and Quantum Electronics, University of Szeged, Dóm tér 9, H-6720 Szeged, Hungary, Szeged, Hungary
The dispersion properties of a HC-800 photonic crystal fiber in different placements were investigated. It was demonstrated that the fiber had birefringence despite its hollow-core and symmetrical geometry. Furthermore, it was proven that the dispersion is mainly independent on the placement and that it is additive.

TuP-T1-P-17
Compression of Chirp Pulses from a Femtosecond Fiber Based Amplifier
Rumi Ito1, Kazuyoko Tai1, Shigeru Yamaguchi1, Jun Enokidani1, Shin Sumida1
1 Tokai University, Hiratsuka, Japan
2 OPT-i Co.,Ltd, Kawasaki, Japan
We demonstrate the chirp pulse generation with an all fiber master oscillator power amplifier. We use a passive modelocked Yb doped fiber laser with a 180 fs pulse width at a 42 MHz repetition rate for the master oscillator. The spectral width of amplified pulses was 18 nm.

TuP-T1-P-18
χ(2)-lens mode-locking of a Nd:YVO4 laser with high average power and repetition rate up to 600 MHz
Veselin Aleksandrov1, Teodora Grigorova1, Hristo Iliev1, Ivan Buchvarov1
1 Physics Department, Sofia University, Sofia, Bulgaria
2 Innovations Ltd., Sofia, Bulgaria
χ(2)-lens mode-locking is applied to a diode-pumped Nd:YVO4 laser for generation of 6.1 ps pulses with 6.1 W average power at repetition rate up to 600 MHz. The χ(2)-linear process introduces negative intracavity self-phase modulation corresponding to soliton pulse formation.

TuP-T1-P-19
Nested Cavity Optical Parametric Oscillator Emitting at 8 µm Pumped by a Pulsed Single-Frequency 2 µm Fiber Laser
Quentin Clément1, Erik Lucas1, Jean-Michel Melkonian2, Jean-Baptiste Dherbecourt2, Myriam Raybaud1, Guillaume Canat1, Antoine Godard1
1 ONERA the French Aerospace Lab, Palaiseau, France
2 Keopsys, Lannion, France
We report an optical parametric oscillator in a nested cavity configuration (NeSCOPO) with a ZnGeP2 crystal, pumped by a pulsed 2 µm fiber laser and emitting around 8 µm. Since the first characterizations of the NeSCOPO have been made, the main objective is to obtain a single-frequency tunable radiation.

TuP-T1-P-20
Yb:CaF2; thermal effects in diode pumped high power multipass amplifiers
Dimitris N. Papadopoulos1, Patrice Camy1, Jean-Louis Doualan2, Richard Moncorge1, Patrick Georges1, Frédéric Druon3, Florence Friebel4
1 Laboratoire Charles Fabry, Institut d’Optique, CNRS, Univ Paris Sud 11, 2 Av. A. Fresnel, 91127 Palaiseau Cedex, France, Palaiseau, France
2 Laboratoire d’Utilisation des Lasers Intenses,CNRS, Ecole Polytechnique,CEA,Univ P. et M. Curie,Palaiseau,France, Palaiseau, France
3 Centre de Recherche sur les Ions,les Matériaux et la Photonique,CNRS,CEA,ENS1 Caen,Université de Caen,France, Caen, France
4 Université de Caen,France, Caen, France
The dynamic thermal issues of the Yb:CaF2 crystals within a multi-mJ-energy multipass amplifier operating around 20-100 Hz, pumped in quasi-cw regime have been studied at different time scales. This complete analysis is used to demonstrate operating the amplifier at 20 Hz with 57 mJ and 100 Hz with 39-mJ stable regime.

TuP-T1-P-21
Deep ultraviolet vortex generation based on nonlinear frequency conversion by periodically-bonded β-BaB2O4 device
Yuta Sasaki1, Katsuhiko Miyamoto1, Ichiro Shoji1, Takashige Omasu4,5
1 Chiba University, 1-33 Yayoi-cho, Inage-ku, Chiba, Japan
2 Chuo University, 1-13-27 Kasuga, Bunkyo-ku, Tokyo, Japan
3 CREST Japan Science and Technology Agency, Sanbancho, Chiyoda-ku, Tokyo, Japan
We demonstrate a DUV (266nm) vortex generation by utilizing a periodically-bonded β-BaB2O4 (BBO) device formed of four 0.5mm BBO crystals with alternating orientations, so as to cancel out the walk-out effect. Experimental DUV nanosecond vortex pulse energy of 1.24 mJ, was obtained, corresponding to a conversion efficiency of 13.7%.

TuP-T1-P-22
Efficient Sub-Nanosecond Pulse Generation at 1180 nm and 559 nm with a SrWO4 Raman Crystal Pumped by a Multi-kHz MOPA Laser System
Paolo Farinello1, Federico Pizio1, Yuanpeng Zhang2,3, Antonio Agnesi1, Valentin Petrov1
1 Dipartimento di Ingegneria Industriale e dell’Informazione, Università di Pavia, via Ferrata 5, IT-27100 Pavia, Italy, Pavia, Italy
2 School of Information Science and Engineering and Shandong Provincial Key Laboratory of Laser Technology and Application, Shandong University, 250100 Jinan, China, Jinan, China
3 Max-Born-Institute for Nonlinear Optics and Ultrafast Spectroscopy, 2A Max-Born-Str., D-12489 Berlin, Germany, Berlin, Germany
We investigated stimulated Raman scattering in near-infrared and visible employing a SrWO4 crystal pumped by ~150-μJ, 500-ps pulses at multi-kHz repetition rate. Conversion slope efficiencies exceeded 40% (25 and 56-μJ maximum pulse energies at 1190 and 559-nm respectively). Pulse compression and good beam quality (M2<1.5) were demonstrated.

TuP-T1-P-23
Passive linewidth reduction of the carrier-envelope-offset frequency through high-brightness pumping
Sandro Link1, Alexander Klenner1, Mario Mangold1, Christian Zaugg2, Aline Mayer2, Emilio Gini2, Bauke Tilma2, Ursula Keller1
TuP-T1-P-24
Spectrally-tailored thulium-doped fibre amplified spontaneous emission source at two-microns
Antonin Billaud, Peter Shardlow, Joe Daniel, Andy Clarkson
Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom
A thulium-doped fibre source with a novel resonator architecture that produces amplified spontaneous emission output with spectral shape that be tailored in an arbitrary manner is reported. The source yielded 6W of single-mode output in the two-micron band for 18W of pump power at 1565nm with spectral resolution of 0.5nm.

TuP-T1-P-25
Noise Analysis of Ho:YLF and Ho:YAG Regenerative Amplifiers
Peter Kroetz1, R.J. Dwayne Miller1, Axel Ruehl1, Ingrid Hartl1
1 Max-Plank Institute for the Structure and Dynamics of Matter, Hamburg, Germany
2 Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany
We present a numerical noise analysis of high-energy, high-gain regenerative amplifiers based on Ho:YLF and Ho:YAG crystals. The systems were modelled including pump and seed noise. For similar performance in a comparable setup, we demonstrate that Ho:YLF exhibits more than five times lower output noise.

TuP-T1-P-26
Pulse-To-Pulse Spectra of a Picosecond Optical Parametric Oscillator Based on Chirped Quasi-Phase Matching
Delphine Descloux1, Cédric Laporte1, Jean-Baptiste Dherbecourt1, Jean-Michel Melkonian1, Myriam Raybaut1, Cyril Drag1, Antoine Godard1
1 Institut für Laser-Physik, Universität Hamburg, Hamburg, Germany
2 The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Hamburg, Germany
We report on spectroscopy and laser operation of Nd,Mg:Sl2O3. The laser operated in the three-level-scheme at 899.8nm with a maximum output power of 297mW and a slope efficiency of 23% under tisapphire pumping at 798.2nm.

TuP-T1-P-27
Holmium-doped KYW conical refraction laser emitting at 2 µm
Romain Cattoor1, 2, Inka Manek-Höningner1, 2, Daniel Ryz1, Lionel Canioni1, Marc Eichhorn1
1 Institut Franco-Allemand de recherches de Saint-Louis, Saint-Louis, France
2 Laboratoire Ondes et Matière d’Aquitaine (LOMA-CNRS-UMR 5798), Talence, France
We present a quasi-three-level Conical Refraction (CR) laser using a Holmium doped KYW crystal. Up to 1.5W of output power was obtained. The lasing threshold and slope efficiency of the CR laser are compared with a classical “Gaussian” laser operating near the optic axis.

TuP-T1-P-28
Piezoelectric Resonance Laser Calorimetry for Precise Measurement of Crystal Optical Absorption
Aleksey Konyashkin1, 2, 3, Oleg Ryabushkin1, 2, 3
1 NTO «IRE-Polus», Fryazino, Russia
2 Moscow Institute of Physics and Technology, Dolgoprudny, Russia
3 Kotel’nikov Institute of Radio-engineering and Electronics of RAS, Fyazino, Russia
Impedance spectroscopy technique is implemented for measurement of piezoelectric crystal temperature during its interaction with laser radiation. Optical absorption and heat transfer coefficients of crystal can be measured in calorimetry experiment using crystal piezoelectric resonance frequency temperature dependence.

TuP-T1-P-29
Spectroscopy and 900-nm Laser Operation of Nd,Mg-doped SrAl2O4
Daniel-Timo Marzohl1, Liang Gong1, Thomas Calmano1, 2, Fabian Reichert1, Christian Kränkel1, 2, Günter Huber1, 2
1 Institut für Laser-Physik, Universität Hamburg, Hamburg, Germany
We present, for the first time, a direct comparison of the free-running f25 linewidth using multi-transversal-mode pumping with and without a brightness converter. High brightness pumping results in a strongly reduced f25 linewidth and reduced amplitude noise at higher frequencies. This pumping scheme will allow for stabilized gigahertz frequency combs.
TuP-T1-P-33

Plasma-driven instability in solids subject to stimulated Brillouin scattering and Kerr filamentation

Jérémie Rolle, Luc Bergé, Christian Kohler

CEA, DAM, DIF, Arpajon, France

The interplay between Brillouin scattering and Kerr self-focusing in silica is numerically investigated. Nanosecond filaments in solids are shown to trigger plasma generation, which initiates modulational instability near the entrance face of the material due to strong backscattering. Phase modulations are used to inhibit backscattered waves together with plasma-driven instabilities.

TuP-T1-P-34

Thermo-optic characterization of Yb:YAl(BO 3 ) 4 laser crystal

Pavel Lokko 1, Valery Filippo 2, Nikolai Kuleshov 3, Nikolai Leonuyk 4, Viktor Mal'tsev 5, Konstantin Yumashev 6

1 Center for Optical Materials and Technologies, Belarusian National Technical University, Minsk, Belarus
2 B.I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Minsk, Belarus
3 Faculty of Geology, Moscow State University, Moscow, Russia

Thermo-optic coefficients are measured for Yb:YAl(BO 3 ) 4 laser crystal by a modified minimum deviation method, and thermo-optic dispersion formulas are presented. The optical power of thermal lens is determined for principal crystal cuts (a or c-cut), as well as laser polarizations (π or σ).

TuP-T1-P-35

Comparison of Fe:ZnSe and Fe:ZnMgSe laser characteristics in dependence on temperature

Maxim E. Doroshenko 1, Helena Jelinkova 2, Michal Nemec 3, Jan Sulík 3, Michal Jelinek 2, Yuri A. Zagoruiko 4, Nazar O. Kovalenko 4, Andrey S. Gerasimenko 4, Vyacheslav M. Puzikov 4, Vitaly K. Komar 5

1 A. M. Prokhorov General Physics Institute, Russian Academy of Sciences, Laser Materials and Technology Research Center, Vavilov Str. 38, Moscow, Russia
2 Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering, Břehová 7, Prague 1, Czech Republic
3 Institute for Single Crystals, NAS of Ukraine, 60 Lenin Ave., Kharkiv, Ukraine

Temperature dependence of spectroscopic and laser properties of bulk Bridgman-grown Fe:ZnSe and Fe:Zn1-xMgxSe single crystals with two various Mg concentrations x were investigated. The emission wavelength shift from 4100 nm for Fe:ZnSe up to 4800 nm for Fe:Zn1-xMgxSe (x=0.38) at 88 K was obtained.

TuP-T1-P-36

Circular polarized second harmonic generation in single-layered gold sawtooth structures

Yuxiang Guo, Huimin Su, Wensheng Gao, Wing Yim Tam, Che Ting Chan, Kam Sing Wong

Department of Physics, The Hong Kong University of Science and Technology, Kowloon, Hong Kong

We report on the study of circular polarized second harmonic generation of single-layered gold sawtooth gratings consisting of H and N basic unit incident by left hand and right hand circular polarized light. The result shows that the chiral properties of the structure lead to the chiral nonlinear optical properties.

TuP-T1-P-37

Investigation on Crystal Geometry for a Continuous-Wave High-Power 1.6 μm Er 3+ :YAG Laser

Marie Blättmann 1, Thierry Ibach 1, Stefano Bigotta 1, Bruno Serio 1, Pierre Pfeiffer 1, Marc Eichhorn 2

1 French-German Research Institute of Saint-Louis (ISL), Saint-Louis, France
2 Laboratoire d’Éude, Université de Strasbourg, Illkirch-Graffenstaden, France

We present a design study on laser crystal geometry for an “eye-safe” 1.6μm erbium laser based on Zigzag-slab architecture. To improve laser efficiency, the slab geometry is optimized by simultaneously taking into account detrimental effects like undesirable thermal issues, pump distribution inhomogeneity and parasitic lasing.

TuC-T1-O-01 (Invited)

Flexible burst-mode ultrastap pump-probe laser for user experiments at the European X-Ray Free-Electron Laser Facility

Max Lederer, Mikhail Pergament, Martin Kellert, Kai Kruse, Jinxiang Wang, Guido Palmer, Gerd Priebe, Laurens Wissmann, Ulrike Wegner, Moritz Emmons

European X-Ray Free-Electron Laser-Facility GmbH, Hamburg, Germany

We present the concept and development status of our pump-probe laser to be installed at experimental stations of the European XFEL. To date, features such as burst-mode operation with intra-burst frequencies up to 4.5MHz and arbitrary pulse selection are demonstrated at single pulse energies up to 180μJ and 15fs pulsewidth.

TuC-T1-O-02

Picoscosecond, burst-mode fiber laser amplifier with 150 W average power

Saniye Sinem Yılmaz 1, Parviz Elahi 1, Hamit Kalayçoğlu 1, İhor Pavlov 2, Fatih Ömer Ilday 1

1 Department of Physics, Bilkent University, Ankara, Turkey
2 Department of Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey

We investigated the burst-mode operation, including ASE generation for a burst-mode fiber laser system which reaches 150 W average power and results indicate that ASE ratio remains in the range of harmless for 200 kHz and higher burst repetition periods and laser system does not require pulsed pumping.

TuC-T1-O-03

Burst-mode Yb fiber amplifier system able to produce 400 microjoule individual pulses compressible to 350 femtoseconds

Hamit Kalayçoğlu, Onder Akcaalan, F. Ömer Ilday
Wednesday sessions

Bilkent University, Physics Department, Ankara, Turkey
We demonstrate a Yb fiber amplifier system able to produce 10-pulse bursts of 400 mJ total energy with the individual pulses of 40 mJ energy compressible to a width of 350 fs. A chirped fiber bragg grating and 1800 l/mm grating compressor is used.

TuC-T1-O-04 17:15
Generation of sub-100-fs pulses in an Yb:CaGdAlO4 nonlinear regenerative amplifier
Julien Poussegur1,2, Martin Delaigue1, Yoann Zaouter2, Clemens Höninger1, Eric Mottay1, Anaël Jaffrés1, Pascal Loiseau1, Bruno Viana1, Patrick Georges2, Frederic Druon2
1 Amplitude Systemes, Pessac, France
2 Laboratoire Charles Fabry, Palaiseau, France
Chimie-Paristech, Laboratoire de Chimie de la Matière Condensée de Paris, Paris, France
Sub-100-fs high-quality pulses have been obtained in an Yb:CALGO regenerative amplifier integrating nonlinear effects. It demonstrates 97 fs pulses at 1047 nm with 24-μJ energy and 19-nm spectral bandwidth for a gain of 50 dB.

TuC-T1-O-05 17:30
Energy scaling of femtosecond Yb:YAG single-crystal rod amplifiers using coherent beam combination
Marco Kienel1,2, Michael Müller1, Stefan Demmler1, Jan Rothhardt1,2, Arno Klenke1,2,3, Tina Eidam1,2, Jens Limpert2,3, Andreas Tünnermann2,3
1 Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Jena, Germany
2 Helmholtz-Institute Jena, Jena, Germany
3 Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany
The coherent combination of two Yb:YAG single-crystal rod amplifiers is demonstrated as energy boosters in a fiber chirped-pulse amplification system. In this proof-of-principle experiment, combined and compressed pulses with a duration of 695 fs and an energy of 3 mJ are obtained with a combining efficiency as high as 94%.

TuC-T1-O-06 17:45
4-fold increase of the mode instability threshold with an Yb-doped multi-core fiber amplifier
Hans-Jürgen Otto1, Arno Klenke1,2, Cesar

TuC-T1-O-07 18:00
Yb-doped rod-type fiber amplifier emitting 2 kW average power
Hans-Jürgen Otto1, Cesar Jauregui1, Fabian Stutzki2, Norbert Modsching1, Jens Limpert1,2, Andreas Tünnermann2,3
1 Institute of Applied Physics, Jena, Germany
2 Helmholtz-Institute Jena, Jena, Germany
3 Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany
A robust and compact setup which employs a multicore fiber with four signal cores is presented. An average output power of 536 W has been extracted, which constitutes a four-fold higher power than possible from a single-core emission of the same fiber due to the onset of mode instabilities.

Walk to Harbour - 18:15 - 18:30
Boat Trip - 18:30 - 20:15

Aula des Jeunes-Rives

Lasers for Spectroscopy, Sensing and Imaging - 08:00 - 10:00
Special Symposium
Chairied by: Ingmar Hartl, DESY, Hamburg, Germany

WeA-T3-K-01 (Keynote) 08:00
Frequency comb measurements outside the laboratory
Nathan Newbury
NIST, Boulder, United States
Frequency combs have been exploited in an expanding range of precision measurements, but so far primarily within the metrology laboratory. I will discuss development of a fieldable frequency comb, and experiments that send comb light across outdoor air paths to explore both accurate atmospheric gas measurements and optical time-frequency transfer.

WeA-T3-O-02 08:45
High-power 5-GHz Yb:CALGO with sub-100 fs pulses
Alexander Klenner, Matthias Golling, Ursula Keller
Department of Physics, Institute for Quantum Electronics, ETH Zurich, Auguste-Piccard-Hof 1, Zurich, Switzerland
A compact 5GHz Yb:CALGO laser delivers 4.12W average output power in sub-100-fs pulses. Stable cw modelocking is achieved using a fast SESAM and a self-stabilizing mechanism against damage from Q-switching. The record-high peak power of 7.5 kW at 5 GHz is expected to be sufficient for stable frequency comb generation.

WeA-T3-O-03 (Invited) 09:00
Fourier Domain Mode Locking (FDML) for Multi-Megahertz Optical Coherence Tomography (OCT) and Hyperspectral Stimulated Raman Imaging
Robert Huber
Institut für Biomedizinische Optik, Universität zu Lübeck, Lübeck, Germany
Fourier Domain Mode Locked lasers use a kilometer long fiber cavity to generate very rapid, narrow linewidth wavelength sweeps over a wide spectral range. These lasers enable optical coherence tomography at Megahertz line rate (MHz-OCT) and time encoded molecular stimulated Raman (Ti-Co-Raman) microscopy.

WeA-T3-O-04 09:30
Efficient HHG of High Average Power Fiber Lasers Yields More than 100 μW per Harmonic
Stephan Hädrich1,2, Jan Rothhardt1,2, Arno Klenke1,2, Manuel Krebs1, Armin Hoffmann1, Oleg Pronin2, Vladimir Pervak1, Jens Limpert2,3, Andreas Tünnermann2,3
1 Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller Universität Jena, Albert-Einstein-Straße 15, Jena, Germany
2 Helmholtz-Institute Jena, Fröbelstieg 3, Jena, Germany
3 Ludwig-Maximilian-Universität München, Am
Excitation source for deep tissue MPM, such as wavelength, pulse energy, and repetition rate, are discussed.

WeB-T3-I-02 (Invited) 11:00

Looking inside the brain: A fiber-optic platform for neurophotonics

Aleksei Zheltikov1,2,4, L.V. Doronina-Amitonova1,2, I.V. Fedotov2,4, O.V. Ivashkina1, M.A. Zots1,4, A.B. Fedotov2,4, K.V. Anokhin2,4
1 Moscow State University, Moscow, Russia
2 Kurchatov Institute National Research Center, Moscow, Russia
3 Institute of Medical Physics and Astronomy, Texas A&M University, College Station, Texas, United States
4 New fiber-optic neurointerfaces are shown to offer a unique tool for continuous online quantitative monitoring of transcription factor dynamics in the brain of freely behaving mice, suggesting new ways toward understanding neuron plasticity, learning, and memory.

WeB-T3-O-03 11:30

First Demonstration of a Room-Temperature CW Mid-IR Microcavity Laser

Ravi Jain, Mani Hossein-Zadeh
University of New Mexico, Albuquerque, United States

We reported the first demonstration of a cw room-temperature mid-IR (2.7-micron) microcavity laser based on a high-Q 180-micron Er:ZBLAN spherical microresonator pumped by a 980 nm laser diode. Such compact and low-threshold power (140 µW) MIR microlasers show strong promise for high-sensitivity ultrasensitive molecular sensor applications.

WeB-T3-O-04 11:45

6.5 W ZnGeP2 OPO directly pumped by a Q-switched Tm3+-doped single-oscillator fiber laser

Christelle Kieleck1, Antoine Berrou1, Brenda Donelan1, Benoît Cadier1, Thierry Robin1, Marc Eichhorn2
1 IIST, French-German Research Institute of Saint-Louis, Saint-Louis, France
2 IXFiber, Lannion, France

In this paper we report (to the best of our knowledge) the highest ever demonstrated mid-IR output power, 6.5 W, from a directly Tm3+-fiber laser pumped ZnGeP2 OPO. The pump laser consists of a polarization-maintaining actively Q-switched, Tm3+-doped single-oscillator fiber laser.
Jonathan Brons, Vladimir Pervak, Elena Fedulova, Marcus Seidel, Dominik Bauer, Dirk Sutter, Vladimir Kalashnikov, Alexander Apolonski, Oleg Pronin, Ferenc Krausz

1 Max-Planck-Institute of Quantum Optics, Garching, Germany
2 Ludwig-Maximilians-University Munich, Garching, Germany
3 TRUMPF-Laser GmbH + Co. KG, Schramberg, Germany
4 Photonics Institute, TU Wien, Wien, Austria

WeC-T1-O-03 14:30
100 MHz, MW-level thin-disk oscillator and repetition rate scaling toward 1 GHz
Jinwei Zhang, 1, 2, Nikolai Lilienfein, 1, Jonathan Brons, 1, Marcus Seidel, 3, Joachim Puepeza, 1, 2, Dominik Bauer, 1, Dirk Sutter, 1, Vladimir Pervak, 1, Zhiyi Wei, 1, Alexander Apolonski, 1, 2, Oleg Pronin, 3, Ferenc Krausz, 1

1 Max-Planck-Institute of Quantum Optics, Hans-Kopfermann-Str. 1, 85748 Garching, Germany, Garching, Germany
2 Beijing National Laboratory for Condensed Matter Physics and Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China, Beijing, China
3 Ludwig-Maximilians-University Munich, Am Coulombwall 1, 85748 Garching, Germany, Garching, Germany
4 TRUMPF-Laser GmbH and Co. KG, Aichallder Straße 39, 78713 Schramberg, Germany, Schramberg, Germany

A Kerr-lens mode-locked Yb:YAG thin-disk laser delivering 90-W, 250-fs, 0.9-µJ and 50-W, 24-fs, 0.5-µJ (after broadening and compression) pulses at 100 MHz repetition rate is presented. Concepts of scaling the repetition rate up to 1 GHz together with preliminary results are reported.

WeC-T1-O-04 14:45
SEASAM-modelocked dual-gain thin-disk laser based on the sesquioxides Yb:Lu$_2$O$_3$ and Yb:Sc$_2$O$_3$
Cinia Schriber, 1, Floriana Emaury, 1, Andreas Diebold, 1, Matthias Golling, 1, Kolja Beil, 1

Christian Kränke, 1, Clara Saraceno, 2, Thomas Südmeyer, 3, Ursula Keller
1 Institute of Quantum Electronics, Physics Departement, ETH Zurich, 8093 Zurich, Switzerland
2 Institut für Laser-Physik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany
3 The Hamburg Centre for Ultrafast Imaging, Luruper Chaussee 149, 22761 Hamburg, Germany

We present for the first time a SESAM-modelocked thin-disk laser that incorporates two gain materials with different emission spectra in a single resonator. We demonstrate pulse durations of 103 fs with 1.4 W of average power and 124-fs pulses with 8.6 W at a repetition rate of 41.7 MHz.

WeC-T1-O-05 15:00
Toward millijoule-level modelocked laser oscillators
Clara Saraceno, 1, 2, Florian Emaury, 1, Cinia Schriber, 1, Martin Hoffmann, 1, Diebold Andreas, 1, Golling Matthias, 1, Südmeyer Thomas, 3, Ursula Keller 1
1 ETH Zurich, Zurich, Switzerland
2 University of Neuchatel, Neuchatel, Switzerland

We investigate energy scaling of SESAM-modelocked thin-disk lasers (TDLs) towards the millijoule level. We used a high-power TDL (9.7 MHz, up to 180 W) in a pressure-controlled environment and investigated experimentally the influence of different gases at varying pressure levels on the pulse parameters, stability and noise of the oscillator.

WeC-T1-O-06 15:15
Power Scaling of Solid-State Lasers Using a Rotating Cavity Configuration
Matthew Eckold, Callum R Smith, Jacob I Mackenzie, W Andrew Clarkson
ORC, University of Southampton, Southampton, United Kingdom

Using a novel Rotating Cavity Laser architecture we have generated 120W of output at 1.06 mm from a single end-pumped ceramic Nd:YAG disk. Evidence confirming the effectiveness of this approach as a technique for mitigating thermally-induced effects as well as preliminary amplifier performance for continuous-wave and Q-switched seed lasers are presented.
We report on an experimental and theoretical study of a novel technique, which termed gain isolation by spectral filtering. By this method the reflection beam during material processing, which is coupled into the laser, is attenuated and prevents damage of the laser system due to back reflection.

WeP-T2-P-07

Imposing Temporal and Frequency Characteristics in a Two-Arm Coherently Combined Q-Switched Photonic Crystal Fiber Laser

Boris Rosenstein, 1 Avry Shirakov, 1, 2, Daniel Belker, 1, Amiel Ishaya 1

1 Department of Electrical and Computer Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel
2 Department of Physics, Ben-Gurion University of the Negev, Beer-Sheva, Israel

We experimentally investigate passive interferometric coherent combining of two photonic crystal fiber laser channels within a common cavity, wherein only one channel is Q-switched.

WeP-T2-P-08

Graphene Oxide paper as a saturable absorber for erbium and thulium doped fiber lasers

Jakub Boguslawski, 1 Jaroslav Sotor, 1 Grzegorz Sobon, 1 Jan Tarka, 2 Karol Kzempnek, 1 Rafal Kozinski, 1 Krysztof Librant, 1 Ludwika Lipinska, 1 Krysztof Abramski 1

1 Laser & Fiber Electronics Group, Wroclaw University of Technology, Wroclaw, Poland
2 Institute of Electronic Materials Technology, Warsaw, Poland

We report an ultra-short pulse generation in 1.5 and 2 μm spectral ranges using graphene oxide paper based saturable absorbers. Er-doped and Tm-doped fiber lasers produces 515 fs and 1.36 ps soliton pulses, respectively. Simplicity and versatility are major advantages which makes it a promising material for saturable absorber application.

WeP-T2-P-09

Optical Fiber Grating Ultrasonic Imaging for Sesimic Physical Modeling Experiments

Jingjing Guo, 1 Changxi Yang, 1 Qun Zhao 1

1 Tsinghua University, Beijing, China

2 Sinopac Geophysical Research Institute, Nanjing, China

2D ultrasonic imaging of seismic physical model is achieved using a phase-shifted fiber grating. Both PZT ultrasonic source, and phase-shifted fiber grating as receiver are mounted on a precise position scanning system. By scanning the phase-shifted grating, 2D image is obtained according to the time-lapse changes in ultrasonic reflection.

WeP-T1-P-10

Passively Q-switched, single frequency, 20μm core Yb-doped fiber amplifier

Enkeleda Balliu, 1 Magnus Engholm, 1 Jonas Hellström, 1 Gunnar Elgcrona, 2 Håkan Karlsson 2

1 Mid Sweden University, Sundsvall, Sweden
2 Cobolt AB, Solna, Sweden

We report on a single frequency, nanosecond pulsed, single stage fiber amplifier operating at 1064nm by using an overall fiber core/cladding diameter of 20/125μm. An SBS mitigation technique is applied to the active fiber resulting in average output powers up to 10W and pulse energies up to 337μJ.

WeP-T1-P-11

Limits of the ultra-short pulse energy scalability

Vladimir Kalashnikov

Aston Institute of Photonic Technologies, Aston University, Aston Triangle, Birmingham, United Kingdom Institute for Photonics, TU Wien, Wien, Austria

The principles of dissipative soliton energy scalability are investigated with taking into account the quantum noises. It is found, that the noises squeeze the energy scalability but the “noise maintaining” would allow enhancing the over-micro-Joule-level pulse generation from a mode-locked laser.

WeP-T1-P-12

Ultrafast Soliton Switching in Dual-Core Photonic Crystal Fibre

Pavol Stajanca, 1 Ignac Bugar 3

1 Faculty of Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovakia
2 International Laser Centre, Bratislava, Slovakia
3 Photonics Institute, Vienna University of Technology, Vienna, Austria

The optimized dual-core photonic crystal fibre for ultrafast all-optical switching of sub-100 pJ pulses at 1500 nm requiring only sub-centimetre fibre length was designed. Proposed fibre supports nonlinear single-soliton switching with extinction ratio difference in excess of 15 dB at simultaneous pulse compression from 100 fs to 10 fs.
WeP-T1-P-13
Characterization of Obesity in Murine Skin in vivo by CARS and SHG Microscopy Using a Cost Efficient, Fiber Laser Based Wavelength Extension Unit
Dóra Halusza1,2, Robert Szipós3, Norbert Wikond41, Attila Kolonics2,2
1 Institute for Solid State Physics and Optics of Wigner RCP, Budapest, Hungary
2 Department of Dermatology, Venereology and Dermato- Oncology, Semmelweis University, Budapest, Hungary
3 R&D Ultrafast Lasers Ltd, Budapest, Hungary
Inverse correlation was identified between dermal collagen content and the size of the adipocytes in skin of diabetic animal model by a cost efficient, fiber laser based wavelength extension unit for SHG/CARS microscopy.

WeP-T1-P-14
Coherent Giant Chirp Pulse in Mode-locked Yb-doped Fiber Laser with Excess Dispersion
Huihui Li, Jiang Liu, Zhaochen Cheng, Pu Wang
National Center of Laser Technology, Institute of Laser Engineering, Beijing University of Technology, Beijing, China
Coherent giant chirp pulses in Yb-doped fiber laser with excess dispersion were demonstrated. Completely mode-locked operation overcame noise burst with evidences of experimental characteristic cat-ear spectrum and consistent theoretical modeling. Dissipative soliton dynamics were verified as the essence of the coherent mode-locked giant chirp pulse.

WeP-T1-P-15
Ultrashort-Pulse Nonlinear Fiber CPA System Performance Using Power Amplifiers with Core Diameter from 12.5 to 33 μm
Julijanas Želedevičius, Rokas Danilevičius, Karolis Viskontas, Nerijus Rusteika, Kęstutis Regelskis
Institute for Solid State Physics and Optics of Academy of Sciences of Lithuania, Vilnius, Lithuania
We investigate experimentally nonlinear fiber CPA system, in which self-phase modulation is utilized both in the fiber stretcher and the power amplifier in order to achieve ultrashort output pulses. System performance in terms of achievable output pulse energy is evaluated using three different Yb-doped fibers for the power amplifier.

WeP-T1-P-16
60W Nanosecond Pulsed All-Fiber Laser Amplifier
Yigit Ozan Aydin, Koray Eken, Serper Salman
FiberLAST Inc., Ankara, Turkey
In this study, a ytterbium doped all-fiber laser amplifier with 60 W average power and more than 20 kW peak power at 1 μm wavelength was developed. This master-oscillator power-amplifier (MOPA) architected system is composed of pulses, produced by electronically pumped diode, and amplified by a series of fiber amplifiers.

WeP-T1-P-17
LED pumped Qcw Nd3+:YVO4 laser
Adrien Barbet1, Amandine Paut1, Jean-Philippe Blanchot1, Anne-Lise Viotti1, Frédéric Druon1, François Balembois1
1 Laboratoire Charles Fabry, UMR 8501, Institut d’Optique, CNRS, Université Paris Sud 11, Palaiseau, France
2 Effilux, Les Ulis, France
We present the first demonstration of a LED pumped Nd:YVO4 laser at 1064 nm. Transversally pumped by two Qcw LED arrays centered at 850 nm, the laser emits an energy of 40 μJ at 250 Hz for an input pump energy of 7.5 mJ, at room temperature.

WeP-T1-P-18
Pump threshold optimization of a continuous-wave optical parametric oscillator using a variable-reflectivity volume Bragg grating
Peter Zeil, Nicky Thilman, Valdas Pasiskievicius, Fredrik Laurell
Laser physics, KTH Royal Institute of Technology, Stockholm, Sweden
We present a cw OPO utilizing a 50 mm MgO:PPLN to convert 20 W of pump at 1 μm to 8.2 W of signal power and 5.2 W of idler power at 1.5 μm and 3.4 μm, respectively. A variable-reflectivity volume Bragg grating was employed to optimize the output coupling.

WeP-T1-P-19
Stable, High-Power, Fiber-Based, Picosecond Ultraviolet Source at 355 nm
Chaitanya Kumar Suddapalli1, Enrique Sanchez Bautista1, Majid Ebrahim-Zadeh1,2
1 ICFO-Institut de Ciencies Fotoniques, Mediterranean Technology Park, 08860 Castelldefels, Barcelona, Spain
2 Instituto Catalana de Recerca i Estudis Avancats (ICREA), Passeig Lluís Companys 23, Barcelona, Spain
We report a compact, stable, Yb-fiber-based, all-BIBO, picosecond UV source generating 164 mW of power at 355 nm and 80-MHz repetition-rate with a stability of better than 0.6% rms over 6 hours, in good spatial-beam-quality. The source also provides 4.9 W of green power with 0.4% rms stability in high-brightness.

WeP-T1-P-20
Tm,Ho:KLu(WO4)2 laser mode-locked around 2 μm by single-walled carbon nanotubes
Veselin Aleksandrov1,2, Alexander Gluth1, Valentin Petrov1, Ivan Buchvarov1, Sun Young Choi1, Mi Hyo Kim1, Fabian Rotermand1, Xavier Mateos1, Francesc Díaz2, Uwe Griebner1
1 Physics Department, Sofia University, Sofia, Bulgaria
2 Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany
Tm,Ho:codoped laser mode-locking based on a single-walled carbon nanotube saturable absorber which is applied to the Ho-ion transition at 2 μm is reported. The Tm,Ho:KLu(WO4)2 laser emits nearly time-bandwidth limited pulses with a duration of 2.8 ps at a repetition rate of 91 MHz and 97 mW output power.

WeP-T1-P-21
Solitary Pulse-on-Demand Production by Optical Injection Locking of Passively Q-Switched InGaN Diode Lasers Near Lasing Threshold
Xi Zeng1, Luca Sulmoni2, Jean-Michel Lamy2, Thomas Stadelmann1, Sylvain Grossmann1, Arno Hoogerwerf1, Nicolas Grandjean1, Dmitri Boiko1
1 Centre Suisse d’Electronique et de Microtechnique SA (CSEM), Neuchâtel, Switzerland
2 Institute of Condensed Matter Physics (ICMP), École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland
We report on optical injection locking of Q-switched InGaN multi-section diode laser from CW tunable laser to produce solitary pulses at precise wavelength. To the best of our knowledge, this has never been done before.
WeP-T1-P-22
Laser-induced damage of CdSiP₂ and comparison with ZnGeP₂ at two OPO pump wavelengths: 1.064 μm and 2.09 μm
Anne Hildenbrand¹, Christelle Kieleck³, Aleksey Tyashev³, Georgi Marchev³, Peter G. Schunemann⁴, Valentin Petrov⁵, Marc Eichhorn¹
¹ French-German Research Institute of Saint-Louis (ISL), Saint-Louis, France
² Max-Born-Institute for Nonlinear Optics and Ultrafast Spectroscopy, Berlin, Germany
³ BAE Systems, Nashua, United States
CdSiP₂ (CSP) is a very promising nonlinear crystal for mid-infrared optical parametric oscillators (OPOs). In this work, the damage resistivity of uncoated CSP is compared to ZnGeP₂ (ZGP) at two wavelengths, 1.064 μm and 2.09 μm, to investigate current limitations and future routes of optimization.

WeP-T1-P-23
Carrier-envelope Phase Changes of Few-cycle Pulses Focused by Lenses: Simulations and Measurements
Balazs Major¹, Miguel A. Porras², Daniel Nemes³, Attila P. Kovacs³, Zoltan L. Horvath³
¹ Department of Optics and Quantum Electronics, University of Szeged, Szeged, Hungary
² Departamento de Física Aplicada a los Recursos Naturales and Grupo de Sistemas Complejos, Universidad Politécnica de Madrid, Madrid, Spain
We present simulations and measurements on the carrier-envelope phase (CEP) changes of few-cycle optical pulses focused by lenses or lens systems. We show how undistorted focusing is possible with lenses and how the focal CEP shift can be tailored by special separable achromatic doublets.

WeP-T1-P-24
A high power Ti:sapphire laser with synchronized Yb-fiber amplifier for nonlinear optical microscopy and optical coherence tomography
A Fernandez¹, A Verhoeft², T Kamali³, A Hansen³, O Jensen²⁵, P Andersen¹, B Sump⁴, G Erbert¹, P Petersen¹, A Baltuska¹
¹ Photonics Institute, TU Wien, Wien, Austria
² Medical University Vienna, Wien, Austria
³ Department of Photonics Engineering, Technical University of Denmark, Roskilde, Denmark
⁴ Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik, Berlin, Germany
A simple scheme of a compact femtosecond Ti:sapphire laser with synchronized Yb-fiber amplifier implemented in a combined coherent Anti-Stokes Raman and optical coherence tomography platform is presented. Through spectral shifting part of the Ti:sapphire output and amplification in the Yb-fiber amplifier CARS signals in the lipid region can be addressed.

WeP-T1-P-25
Single-longitude-mode emission of multime-mode interferometer-Fabry-Perot laser diode
Hua Yang¹, Padraic Morrissey¹, Brian Corbett¹, Frank Peters²,³
¹ Tyndall National Institute, UCC, Cork, Ireland
² Department of Physics, University College Cork, Cork, Ireland
We demonstrate a novel multimode-interferometer-Fabry-Perot laser diode generating a single wavelength emission. The designed and fabricated laser shows a SMSR 25dBm and can be tuned over a certain range using injection current. The simple structure significantly eases the processing enabling an increase in the yield and a reduction in the cost.

WeP-T1-P-26
A Frequency-locked and Frequency-Doubled Q-switched Yb:KYW Laser at 515 nm
Staffan Tjärnhammar, Andrius Zukauskas, Carlota Canalias, Valdas Pasiskevicius, Fredrik Laurell
Department of Applied Physics, KTH, Stockholm, Sweden
A compact, hybrid Q-switched Yb:KYW laser was frequency doubled in PPKTP with a conversion efficiency of 66%. The laser was frequency locked and stabilized with a volume Bragg grating and the repetition frequency could be varied between 30 Hz and 3 kHz giving pulse energies between 200 and 250 μJ.

WeP-T1-P-27
Diode-Pumped Actively Mode-Locked Tm:YLF Laser
Jiri Muzik, Michal Jelinek, David Vyhildal, Václav Kubeček
Czech Technical University, Faculty of Nuclear Sciences and Physical Engineering, Prague, Czech Republic
To our knowledge, this is the first report of realization of an actively mode-locked, continuously pumped Tm:YLF laser. Stable train of pulses with repetition rate of 150 MHz, width of 220 ps and maximum optical output power of 2.6 W at 1910 nm was achieved.

WeP-T1-P-28
Effects of Chemical Mechanical Polishing on the Laser Induced Damage Threshold of ZnGeP₂
Oliver Muller¹, Anne Hildenbrand¹, Christelle Kieleck³, Antoine Berrou⁴, Florencio Moitrier⁵, Marc Eichhorn¹, Lothar Ackermann⁶, Klaus Dupré⁶, Johan Petit⁷, Antoine Godard⁸
¹ ISL French-German Research Institute of Saint-Louis, Saint-Louis, France
² FFE Forschungsinstitut für mineralische und metallische Werkstoffe-Edelsteine/Edelmetalle, Idar-Oberstein, Germany
³ ONERA - The French Aerospace Lab, Châtillon, France
⁴ ONERA - The French Aerospace Lab, Palaiseau, France
It is known that laser-induced damage in ZnGeP₂ single crystals always initiates at the surfaces rather than in the bulk, making the surface preparation of major importance. We studied two chemical mechanical polishing processes. Peak to valley flatness and laser-induced damage threshold were analyzed and compared to commercial polish results.

WeP-T1-P-29
Spatial Hole Burning in Yb:YAG Thin-Disk Lasers: effects of polarization and spectral gain
Christian Vorholt, Ulrich Wittrock
Photonics Laboratory, University of Applied Sciences, Steinfurt, Germany
We have investigated the influence of spatial hole burning on the optical spectrum and output power in Yb:YAG thin-disk lasers in cw-operation. Simulation results of I-shaped and V-shaped resonators are in very good agreement with our measurements. It is shown that many subtle effects are directly related to spatial hole burning.

WeP-T1-P-30
Peculiarities of second harmonic generation with a constant wave-number mismatch gradient along a nonlinear crystal
Kęstutis Regelskis, Julijanas Zeļuvedvičius, Viktorija Žvirblyte, Gediminas Račiukaitis
Department of Laser Technology, Center for
We investigated peculiarities of the second harmonics generation with constant wave-number mismatch gradient along a nonlinear crystal. Behaviour of the second harmonic complex amplitude was geometrically visualized by means of the Cornu spiral. Phase-matching bandwidths of the second harmonics generation with and without wave-number mismatch gradient are compared.

**WeP-T1-P-31**

**Pumping wavelength influence on Tm:Ho:CaF$_2$ ceramics laser**

Jan Sulc$^1$, Michal Nemec$^1$, Maxim Doroshenko$^1$, Helena Jeřinková$^1$, Martin Fibrich$^1$, Pavel Fedorov$^1$, Jatčheslav Osiko$^1$

$^1$ Czech Technical University in Prague Faculty of Nuclear Sciences and Physical Engineering, Prague, Czech Republic

Performance of Tm:Ho:CaF$_2$ (2%Tm, 0.3%Ho) ceramics laser, operating at wave-length 2.1 μm, pumped successively at wavelengths 782 nm, 1700 nm, and 1945 nm, is presented. It was found, that the laser slope efficiency (better than 10%) in respect to absorbed pumping power is not significantly dependent on pumping channel.

**WeP-T1-P-32**

**Active image wavelength up-conversion from the 1550 nm spectral region to 631 nm in an Nd$^{3+}$:YVO$_4$ laser with an intra-cavity PPLN crystal using ASE illumination**

Adrian J. Torregrosa$^1$, Haroldo Maestre$^1$, Maria Luisa Ríos$^1$, Juan Capmany$^2$

$^1$ Department of Communications Engineering, Miguel Hernandez University, Elche, Spain

$^2$ Department of Computer Technology, University of Alicante, Alicante, Spain

We present an active image wavelength conversion system based on sum-frequency mixing of a 1550 nm ASE illuminated target and a 1064 nm Nd$^{3+}$:YVO$_4$ continuous-wave laser with an intra-cavity periodically poled lithium niobate crystal.

**WeP-T1-P-33**

**Joint Influence of Cubic Nonlinearity and Thermally Induced Birefringence on the Radiation Polarization in High Peak Power Lasers**

Maryana Kuzmina, Efim Khazanov, Andrey Stepanov

Nonlinear Dynamics and Optics Division, Institute of Applied Physics of the Russian Academy of Sciences, Nizhny Novgorod, Russia

Co-influence of the cubic nonlinearity and the thermally induced birefringence on the radiation polarization in high peak and average power lasers was investigated. Both effects introduce polarization distortions in the laser beam, giving rise to power losses. Methods that significantly reduced the revealed negative impact were developed for key optical laser elements.

**WeP-T1-P-34**

**Theoretical analysis for ultrashort pulse mode-locked Yb:YAG lasers with an intra-cavity highly nonlinear medium**

Akiyuki Maruoka, Takeshi Yoshida, Masatoshi Nishio, Keisuke Kyomoto, Kento Kato, Hiroaki Okunishi, Sakae Kawato

University of Fukui, Fukui, Japan

From the theoretical analysis on a mode-locked Yb:YAG laser with an intra-cavity highly-nonlinear medium, the output bandwidth was stretched to approximately 5 times broader than the gain bandwidth. The results agree with the experiments qualitatively.

**WeP-T1-P-35**

**Investigation of Resonator Mirrors GDD Influence on Synchronously Pumped Femtosecond OPO Tuning Properties**

Karolina Stankevičiūtė$^1$, Simonas Kėčas$^2$, Ieva Pipinytė$^1$, Mikas Vengris$^1$, Rimantas Grigonis$^1$, Ramutis Drądzys$^2$, Valdas Sirutkaïtis$^1$

$^1$ Laser Research Center, Vilnius University, Vilnius, Lithuania

$^2$ Center for Physical Sciences and Technology, Vilnius, Lithuania

Influence of the cavity dispersion on synchronously pumped femtosecond BBO OPO tuning properties was investigated. Cavity dispersion was estimated from GDD measurements of all resonator mirrors performed by white light interferometry. Experimentally observed jumps from one wavelength to another in the vicinity of GDD oscillations.

**WeP-T1-P-36**

A high repetition rate, diode pumped, mechanically Q-switched Er:YSGG laser at 3μm

Emma Arbabzadah, Francis Murphy, Chris Phillips, Michael Damzen

Imperial College London, London, United Kingdom

High repetition rate, mechanical Q-switching of a diode-pumped Er:YSGG laser at ~3μm is presented. Two configurations are investigated, with a rotating polygon acting as a rotating back mirror or intracavity chopper to induce Q-switching. Pulse energies >0.5mJ, repetitions rates of 200Hz and pulse durations as short as 83ns are achieved.

**WeP-T1-P-37**

**Broadband near-infrared luminescence from bismuth-doped leucite and pollucite aluminosilicate crystals. Evidence for the univalent bismuth Bi$^+$ monocation as the new luminescent center.**

Alexey Romanov$^1$, Alexander Veber$^2$, Zukhra Fattakhova$^1$, Elena Haula$^1$, Daria Vtyurina$^1$, Dmitry Shashkin$^1$, Vladimir Korchak$^1$, Vladimir Tsvetkov$^1$, Vladimir Sulimov$^1$

$^1$ Research Center of M.V. Lomonosov Moscow State University, Moscow, Russia

$^2$ A.M. Prokhorov General Physics Institute, Russian Academy of Sciences, Moscow, Russia

$^3$ N.N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, Moscow, Russia

Near-IR photoluminescence from monocations Bi$^+$ was demonstrated for the first time from bismuth-doped aluminosilicates leucites and pollucite. Bi$^+$ can substitute isomorphically for K$^+$ and Cs$^+$ in these crystals. The photoluminescence spectra of bismuth-doped leucites are sharper, then the spectra of glasses with the same composition.

**WeP-T1-P-38**

**Improved power-scaling performance of semiconductor disk lasers with non-circular pump spots**

Loyd McKnight, John-Mark Hopkins

Fraunhofer Centre for Applied Photonics, Glasgow, United Kingdom

Power scaling in semiconductor disk lasers is limited by the thermal impedance of the DBR and the substrate for an unthinned device. In this work we show with finite element thermal modelling that improved power-scaling performance can be achieved with elliptical pump geometries for non-ideal thin disk lasers.
Temporal Soliton Generation in Chip-based Silicon Nitride Microresonators
Victor Brach, Tobias Herr, Martin Huber, Peter Pfeiffer, John David Jost

We demonstrate temporal dissipative soliton generation in silicon nitride microresonators for the first time. It is shown that this state generates a low noise RF beatnote. Temporal soliton states allow for low-noise RF-generation, smooth frequency comb spectra and produce ultra-short optical pulses on a chip.

Temporal Solitons in Optical Microresonators:

WeD-T2-O-02 17:15
Design Criteria and Spectral Broadening
Tobias Herr1, John Jost1, Victor Brach1, Ivan Mirgorodski1, Grigoriy Liakhchev2, Michael Gorodetsky1,2, Tobias Kippenberg1

1 Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland
2 Faculty of Physics, M.V.Lomonosov Moscow State University, Moscow, Russia

Temporal dissipative cavity solitons enable ultra-short high repetition rate optical pulse and frequency comb generation in microresonators. We investigate soliton formation in multi-mode microresonators and derive resonator design criteria. Moreover, we demonstrate nonlinear spectral broadening of the soliton pulses to more than two-thirds of an octave as required for self-referencing.

Waveguide- and Microresonator-based Sources - 17:00 - 18:45

Fibre and Waveguide Devices
Chaired by: Johan Nilsson, University of Southampton, ORC, Southampton, United Kingdom

Waveguide Devices

DiLIN, Peter Shardlow, Martynas Beresna, Peter Kazarsky, Andrew Clarkson
Optoelectronics Research Centre, University of Southampton, SOUTHAMPTON, United Kingdom

We demonstrate efficient conversion of a linearly-polarized Gaussian beam to a radially-polarised doughnut beam in the two-micron band using a continuously space-variant half-waveplate created by femtosecond writing of subwavelength gratings. The low scattering loss (<0.07) of this device indicates that it would be suitable for use with high power lasers.

Diamond diced Yb+ doped InO3 ridge waveguides
Sven H. Woeselmann1, Sebastian Heinrich2, Christian E. Rüter1, Detlef Kip1, Christian Kränkel1, Günter Huber1,2

1 Institut für Laser-Physik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Hamburg, Germany
2 Faculty of Electrical Engineering, Helmut Schmidt Universität, 22043 Hamburg, Hamburg, Germany

Thin Yb+ doped Indium Oxide films were grown epitaxially on Lutetium Oxide substrates via pulsed laser deposition. In order to prepare ridge waveguides, precise diamond blade dicing was applied. Due to the high refractive index difference compared to Lutetium Oxide, the InO3 ridges are interesting for small optically active waveguides.

Break and Walk to Dinner
18:45 – 19:15

Conference Dinner
19:15 – 21:30

THURSDAY SESSIONS

Efficient red and orange laser action and first green laser operation with a Pr-doped YLF, epitaxial waveguide
Western Bolaños, Alain Braud, Jean Louis Doualan, Gurvan Brasse, Richard Moncorge, Patrice Camy

Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CEA-CNRS-Ensicaen, Caen, France

Green laser emission at 522.5 nm with an average output power of 66 mW and a slope efficiency of 11% is demonstrated for the first time with a crystalline fluoride waveguide. Improved laser efficiencies of 32% and 40% are also obtained at 604 and 639 nm in the cw regime.

Supercontinuum generation in thick silicon nitride waveguides
Jörn Epping1, Tim Hellwig1, Marcel Hoekman2, Arne Leinse1, Rene Heideman1, Peter van der Slot1, Chris Lee1, Carsten Fallnich1, Klaus Boller1, Richard Mateman1, Albert van Rees2

1 University of Twente, Enschede, Netherlands
2 University of Münster, Münster, Germany
3 Lionix BV, Enschede, Netherlands
4 University of Twente, Enschede, Netherlands
5 XIO Photonics BV, Enschede, Netherlands

Based on a novel method for fabricating crack-free and thick silicon nitride waveguides with a thickness of up to 800 nm, phase-matching for nonlinear optics is achieved. We demonstrate the high suitability of these waveguides for nonlinear optics through supercontinuum generation across more than 460 nm spectral bandwidth.

Multi-Watt Continuous Wave Output Power and Q-switched Laser Operation of Femtosecond-Laser Incribed Yb:YAG Based Waveguides
Thomas Calmano1, Sebastian Müller1, Christian Kränkel1, Günter Huber1,2

1 Institut für Laser-Physik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Hamburg, Germany
2 The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Hamburg, Germany

Channel waveguides were fabricated in Yb:YAG and composite Yb:YAG/ Cr4+:YAG by femtosecond-laser writing. OPS-pumped continuous wave Yb:YAG waveguide-lasers exhibited output powers of 5.2W and optical-to-optical efficiencies of 68%. Q-switched laser operation with ns pulse duration at 600kHz repetition rate and μJ pulse energy was demonstrated with Ti:sapphire-laser-pumped Yb:YAG/ Cr4+:YAG waveguides.

Efficient conversion to radial polarisation in the two-micron band using a continuously space-variant half-wave plate

WeD-T2-O-06 18:15
WeD-T2-O-04 17:45

Efficient conversion to radial polarisation in the two-micron band using a continuously space-variant half-wave plate
A-T2-K-01 (Keynote) 08:00

Performance Scaling of Ultrafast Fiber Laser Systems

Jens Limpert
Friedrich-Schiller-Universität Jena, Jena, Germany

The presentation will review challenges and achievements of ultrashort pulse amplification in rare-earth-doped fibers as well as the basics of the concept “coherent addition of pulsed laser radiation” and its use for performance scaling. Finally, a design is presented which targets joule-class femtosecond pulses at repetition rates beyond 10kHz.

A-T2-T2-I-02 (Invited) 08:45

Ultrashort-pulse Enhancement Cavities and Applications

Ioachim Pepeza1, 2, Simon Holzberger1, 3, Henning Carstens1, 2, Nikolai Lileenfein1, 2, Tino Eidam1, Christoph Jocher1, Vladimir Pervak2, Alexander Apolonski3, 4, Jens Limpert5, Andreas Tünnermann5, Ernst Fill5, 2, Ferenc Krausz1, 2

1 Max-Planck-Institut für Quantenoptik, Garching, Germany
2 Ludwig-Maximilians-Universität München, München, Germany
3 Friedrich-Schiller-Universität Jena, Institut für Angewandte Physik, Jena, Germany

We review the challenges and the newest developments in scaling the performance of ultrashort-pulse enhancement cavities. Using state-of-the-art Yb-fiber lasers, custom mirrors and cavity designs, we demonstrate at 78-MHz repetition rate 1.9-kW average-power 40-fs pulses and, at 250 MHz, 400 kW with 250-fs pulses and 670 kW with 10-ps pulses.

A-T2-T2-O-03 09:15

88 W sub-ps thulium-doped fiber CPA system

Fabian Stutzki1, Christian Gaida2, Martin Gebhardt3, Florian Jansen3, Andreas Wienke4, Cesar Jauregui5, Jens Limpert5, 2, 4, Andreas Tünnermann5, 2, 4, Frank Fuchs1, Dieter Wandt2, Dietmar Kracht2

1 Institute of Applied Physics, Jena, Germany
2 Laser Zentrum Hannover e.V., Hannover, Germany
3 Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany
4 Helmholtz-Institute Jena, Germany, Jena, Germany

We demonstrate a Tm-doped fiber CPA system with a new record compressed average output power of 88 W and a peak power of 2MW. This record is enabled by the use of Tm-doped photonic crystal fibers with 36μm mode field diameter and more than 50% slope efficiency.

ThA-T2-O-04 09:30

Overcoming gain-narrowing in femtosecond fiber amplifiers using coherent combining of separately amplified spectra

Florent Guichard1, 2, Marc Hanna3, Laurent Lombard1, Yoann Zouater1, Clemens Höninger1, Franck Morin1, Frederic Druon1, Eric Mottay1, Patrick Georges1

1 Laboratoire Charles Fabry, Palaiseau, France
2 Amplitude Systèmes, Pessac, France
3 Office National d’Etudes et de Recherches Aéronautiques, Palaiseau, France

We demonstrate spectral coherent combining of two FCPA seeded by a common oscillator. 130 fs pulses with a spectral width of 19 nm at high gain value of 30 dB are thus generated, highlighting the strong potential of pulse synthesis for the reduction of the minimum pulse duration in FCPA.

ThA-T2-O-05 09:45

High power radially-polarized Yb-doped fiber laser

DI LIN, Joe Daniel, Mindaugas Gecevičius, Martynas Beresna, Peter Kazansky, Andrew Clarkson

Optoelectronics Research Centre, University of Southampton, SOUTHAMPTON, United Kingdom

A simple technique for directly generating a radially-polarized output beam from an ytterbium-doped fiber laser using an intracavity spatially-variant waveplate is reported. The laser yielded 32 W of output with a corresponding slope efficiency of 65.8% in a radially-polarized beam with beam propagation factor ~2.1 and polarization purity >95%.

Coffee Break - 10:00 - 10:30

Aula des Jeunes-Rives

Cafeteria

Frequency Combs and Supercontinua - 10:30 - 12:15

Solid-State Lasers

Chair: Andrius Baltuska, Vienna University of Technology, Vienna, Austria

ThB-T1-O-01 10:30

SESAM-based fast Actuator for DPSSL Comb Frequency Stabilization

Stéphane Schilt, Hoffmann Martin, Thomas Südmeyer
Laboratoire Temps-Fréquence, Université de Neuchâtel, Neuchâtel, Switzerland

We evaluate the performance of a SESAM as fast opto-optical modulator for stabilization of a DPSSL frequency comb. 10-time higher modulation bandwidth of fCEO and frep is shown compared to gain-modulation, leading to comb self-referencing with significantly improved noise performance and high potential for phase-locking to an optical reference.

ThB-T1-O-02 10:45

Wavelength Conversion by Injection Locking to an Optical Comb for Optical Frequency Transfer Applications

Joonyoung Kim1, David Wu1, Guiseppe Marra1, David Richardson1, Radan Slavik2

1 Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom
2 National Physics Laboratory, Teddington, United Kingdom

We propose use of optical injection locking of a semiconductor laser to an optical comb to enable wavelength conversion in precision optical frequency transfer applications. We were able to perform wavelength conversion up to 500 GHz (4 nm) which was limited due to the tuning range of the slave laser.

ThB-T1-O-03 11:00

Self-referenceable frequency comb with 140 W of average power

Andreas Diebold1, Florian Emaury1, Cinia Schrier1, Clara Saraceno1, 2, Thomas Südmeyer1, Ursula Keller2

1 Institute of Quantum Electronics, ETH Zurich, Zurich, Switzerland
2 Laboratoire Temps-Fréquence, Université de Neuchâtel, Neuchâtel, Switzerland

We detected the carrier-envelope-offset (CEO) frequency of a 9MHz, 760fs SESAM-modelocked Yb:YAG thin-disk laser delivering 140 W of average power. We compressed a small fraction of the power (1.5W) to 63fs in a standard photonic-crystal-fibre and detected strong CEO beats (signal-to-noise ratio >33 dB, resolution-bandwidth 100kHz) using an f-to-2f interferometer.
ThB-T1-O-04 11:15

Supercontinuum Generation from a 1.75-GHz SESAM Modelocked VECSEL and Carrier Envelope Offset Frequency Detection
Christian A. Zauß1, Alexander Klenner1, Mario Mangold1, Aline S. Mayer1, Sandro M. Link1, Matthias Golling1, Emilio Gini1, Clara J. Saraceno1,2, Bauke W. Timlo1, Ursula Keller1, Florian Emary1

1 ETH Zürich, Department of Physics, Institute for Quantum Electronics, Zürich, Switzerland
2 ETH Zürich, FIRST Center for Micro- and Nanoscience, Zürich, Switzerland

We detect the carrier envelope offset frequency of a modeled vertical-external-cavity surface-emitting laser (VECSEL). The octave-spanning super-continuum, required for the f-to-2f-interferometer, was generated with a highly nonlinear photonic-crystal-fiber. Prior to that, 1.75-GHz, 240-fs pulses (100 mW) from the VECSEL were amplified and compressed to 105 fs (1.4 W).

ThB-T1-O-07 12:00

Full 3D Simulation of White-Light Generation in Bulk Materials
Aradhana Choudhuri1, Haider Zia1, Ann-Laure Cadelron2, Huseyin Cankaya2, Franz X. Kärntner3, Ingmar Hartf, R.J. Dwayne Miller1, Axel Ruehl1

1 Max-Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany
2 Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany
3 Department of Physics and The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Hamburg, Germany

We present the first full-3D approach to simulating white-light generation in bulk materials. Our approach employs the split-step method by operating in the momentum-frequency/spatio-temporal domains, and uses a derived summation identity to model all higher-order dispersion without Taylor expansion. Simulation results are in good agreement with experimental data.

ThB-T1-O-05 11:30

Tunable quasi-phase-matched high-order harmonic generation
Kevin O'Keefe1, David Lloyd1, Simon Hooker1
Department of Physics, University of Oxford, Oxford, United Kingdom

Tunable quasi-phase-matched high-order harmonic generation is demonstrated using trains of counter-propagating ultrafast pulses, in which the linear separation between pulses can be varied continuously over a large range.

ThB-T1-O-06 11:45

High-Power Few-Cycle Pulse Generation by Spectral Broadening in Bulk Material
Marcus Seidel1, Jonathan Brons2, Elena Fedulova1, Vladimir Pervak1, Alexander Apolonski2, Oleg Pronin1, Ferenc Krausz1,2

1 Max-Planck-Institute of Quantum Optics, Munich, Germany
2 Ludwig-Maximilians-University, Munich, Germany

The first 10-W, 10-fs amplification-free laser is presented. Bulk spectral broadening is utilized to reach the pulse duration of less than three optical cycles. By stronger focusing, spectral broadening down to a sub-two-cycle pulse Fourier transform limit is shown. Spectral homogeneity and good quality of the laser beam are demonstrated.

ThB-T2-O-02 13:30

Precision Limitation in Coherent Laser Ranging due to Speckle phase-noise
Esther Baumann1, Jean-Daniel Deschênes2, Fabrizio R. Giorgetta1, William C. Swann1, Ian Coddington1, Nathan R. Newbury2

1 NIST, Boulder, United States
2 National Physical Laboratory, Teddington, United Kingdom

The ultimate precision of coherent laser three-dimensional mapping of a diffusely scattering surface will be determined by speckle noise. Speckle phase noise gives rise both to apparent range outliers and to excess range noise during lateral scans. Nevertheless at 1 THz optical bandwidth, range precisions below 10 µm are achievable.

ThB-T2-O-03 13:45

Relative intensity noise of Raman solitons
Gengji Zhou1, Wei Liu1, Jinkang Lim2, Hung-Wen Chen3, Franz Kärntner1,2, Guoqing Chang1

1 Center for Free-Electron Laser Science, DESY, Hamburg, Germany
2 Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, United States
3 Physics Department, University of Hamburg, Hamburg, Germany

By experimentally and numerically study the relative intensity noise (RIN) of Raman solitons, we show that, depending on the fiber’s dispersion, earlier ejected Raman soliton exhibits lower or higher RIN than the later one. Using fiber with right dispersion, we demonstrate low-noise watt-level, 3-GHz Raman soliton source at 1350 nm.

ThC-T2-O-04 14:00

Tunable diode laser absorption spectroscopy of CO2 at 2051 nm using sealed hollow core fibre cells
Christopher Edwards1, Geoffrey Barwood1, Patrick Gill1, Natalie Wheeler1, John Wooler1, Yong Chen1, Francesco Poletti2, Marco Petrovich1, David Richardson1, Richard Phelan1,2

1 National Physical Laboratory, Teddington, United Kingdom
2 Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom
3 Eblana Photonics, Dublin, Ireland

The first 10-W, 10-fs amplification-free laser is presented. Bulk spectral broadening is utilized to reach the pulse duration of less than three optical cycles. By stronger focusing, spectral broadening down to a sub-two-cycle pulse Fourier transform limit is shown. Spectral homogeneity and good quality of the laser beam are demonstrated.
Diode laser spectroscopy with sealed CO2-filled photonic crystal microcells is under development for atmospheric greenhouse gas monitoring at 2051 nm. This paper presents the fabrication and spectroscopic evaluation of low and high pressure fibre cells.

We demonstrate a real-time spectral measurement technique, combining optical heterodyning with reconstruction of spatio-temporal evolution of radiation inside a fibre laser cavity. Under a slowly varying sinusoid approximation, the fast Fourier transform allows recovery of frequency from the phase domain, providing an improvement in resolution by two orders of magnitude.

ThP-T2-O-02 15:00
High-power ultra-short pulse generation from an Er-doped fiber amplifier
Hongjie Wang1, Leonid Kotov2, Dmitry Gaponov3, Mikhail Yashkov4, Denis Lipatov5, Mikhail Likhachev6, Jean-Louis Oudar7, Sébastien Favier8, Ammar Hideur1
1 CORIA - Université de Rouen, Rouen, France
2 FORC - Russian Academy of Sciences, Moscow, Russia
3 ICHPS - Russian Academy of Sciences, Nizhny Novgorod, Russia
4 LPN, Paris, France
5 XLIM - University of Limoges, Limoges, France

We report on the development of an all-fiber chirped-pulse amplifier system featuring an efficient Yb-free Er-doped large-mode-area fiber. The system is seeded by a chirped-pulse-oscillator and produces 8 W of average output power at 35 MHz repetition rate.

ThP-T2-P-03
Intermodal Third Harmonic Generation In Germanium-Doped Silica Optical Fiber
Adrien Borne1, Tomotaka Katsura1, Benoit Boulanger1, Corinne Félix1, Patricia Segonds2, Kamel Bengheith1, Juan Ariel Levenson3
1 Université Joseph Fourier, Grenoble, France
2 Mitsubishi Electric Corporation, Amagasaki, Japan
3 Laboratoire de Photonique et Nanostructures CNRS, Marcoussis, France

We performed a full characterization of intermodal third harmonic generation around 515 nm in a germanium-doped silica optical fiber. We evidenced and accurately modeled through a uniaxial symmetry of the third order electric susceptibility the complex polarization behavior involving all the possible phase-matching types that simultaneously occur.

ThP-T2-P-04
All-fibre dissipative soliton laser oscillator with high pulse energy (>30 nJ) based on single-walled carbon nanotube saturable absorbers

ThC-T2-O-05 14:15
High-Resolution CO2 Phase Spectra Measured over an Open Air Path with a Dual-Comb Spectrometer
Fabrizio Giorgetta1, Greg Rieker2, Ian Coddington3, William Swann4, Alex Zolot5, Laura Sinclair6, Esther Baumann1, Christopher Cromer7, Nathan Newbury7
1 NIST, Boulder, United States
2 Stable Laser Systems, Boulder, United States
3 University of Colorado, Boulder, United States

High efficiency generation of a narrow linewidth laser source at 780 nm is reported. 7.6 W is achieved from a compact cavity-enhanced second-harmonic generation seeded with 10 W at 1560 nm. Intermodal third harmonic generation around 515 nm in a germanium-doped silica optical fiber.
Hwanseong Jeong, Sun Young Choi, Fabian Rotermund, Dong-Il Yeom
Aju University, Dept of Physics & Energy Systems Research, Suwon, Korea, Republic of (South)
We fabricate high quality carbon nano-tube saturable absorber on side-polished fibre with optimized condition for high power operation of fibre laser. The all-fibre dissipative soliton laser oscillator including our saturable absorber stably delivers laser output pulse width pulse energy of 34 nJ at the average output power of 335 mW.

**ThP-T2-P-05**

Towards the implementation of large mode area all-glass leakage channel fibres by Sol-Gel silica powder based preform design
Jonas Scheuner¹, Manuel Ryser², Valerio Romano²
¹ Universität Bern, Bern, Switzerland
² Berner Fachhochschule Technik und Informatik, Burgdorf, Switzerland
Leakage channel fibres are intended to be realised by the sol-gel silica sand method. This procedure allows for great flexibility in the transverse structure. A positioning accuracy of structure elements of 1/10mm is aimed. Furthermore, losses are minimised by the application of a heat treatment of the preform, prior to the drawing.

**ThP-T2-P-06**

Saturable absorber based on monolayer graphene deposited on D-shaped fiber for passively mode-locked fiber laser
Tao Chen¹, Dongning Wang¹, Changrui Liao¹, Yiping Wang²
¹ Hong Kong Polytechnic University, Kowloon, Hong Kong
² College of Optoelectronic Engineering, Shenzhen University, Shenzhen, Guangdong, China
Monolayer graphene deposited on D-shaped fiber is used as the saturable absorber for passive mode-locked fiber laser operation. The graphene covered on D-shaped fiber allows light-graphene interaction via the evanescent field and the fiber optical power-induced thermal damage can be effectively avoided due to the large length of graphene.

**ThP-T2-P-07**

Radiofrequency Impedance Spectroscopy of Laser Fiber Heating
Oleg Ryabushkin¹,², Renat Shaidullin¹,², Ilya Zaytsev²
¹ Moscow Institute of Physics and Technology, Dolgoprudny, Russia
² Kotelinkov Institute of Radio Engineering and Electronics of RAS, Fryazino, Russia
We report a monolithic ytterbium-doped high power single mode fibre laser oscillator with an output power of 128W. The oscillator can be used for core-pumping of amplifier systems. An in-house developed WDM combines a seed and a pump signal into one fibre core with a power handling capacity up to 140W.

**ThP-T1-P-11**

6 ns passively Q-switched core-pumped fiber laser at 976nm
Baptiste Leconte¹, Mathieu Laroche¹, Benoit Cadier¹, Hervé Gilles¹, Sylvain Girard¹, Thierry Robin²
¹ CMAP Caen, France
² IXFIBER, Lannion, France
We present a passively Q-switched fiber laser at 976nm using a resonant semiconductor saturable absorber mirror (SESAM) and a double-clad Nd-doped fiber laser emitting at 927nm as pump source. Low time-jitter pulses with duration of 6ns is demonstrated using a short length, highly Yb-doped LMA fiber.

**Optimization of Nonlinear Fiber CPA System by Selection of Spectral Region of Operation**
Julijanas Želudavičius, Kęstutis Regelskis
Center for Physical Sciences & Technology, Vilnius, Lithuania
We investigate numerically optimization prospects of nonlinear fiber CPA system with respect to spectral region of operation (within Yb-doped fiber gain band) and fiber amplifier parameters.

**ThP-T1-P-13**

High peak power flexible photonic crystal fiber laser oscillator
Avry Shirakov¹,², Boris Rosenstein¹, Daniel Belker¹, Amiel Ishaaya¹
¹ Department of Electrical and Computer Engineering, Ben-Gurion University of the Negev, Beer-Sheva 84105, Israel, Beer Sheva, Israel
² Department of Physics, Ben-Gurion University of the Negev, Beer-Sheva 84105, Israel, Beer Sheva, Israel
We present an actively Q-switched photonic crystal fiber laser in an oscillator configuration. The laser is based on flexible-type photonic crystal fiber. At a repetition rate of 15 kHz, we obtain pulse energy of 0.6 mJ with pulse duration of 20 ns, and average power of 12 W.
Morphology of nanoholes in borate crystals and glasses fabricated by femtosecond laser ablation

Nobuhiro Kodama, Tomoko Takahashi, Tomomi Sakashita, Tougo Shimonaga, Ryosuke Nishi, Masahiro Tsukamoto, Naoki Ikeda, Yoshimasa Sugimoto

1 Akita University, Akita, Japan
2 Osaka University, Osaka, Japan
3 National Institute for Materials Science, Ibaraki, Japan

The morphologies of borate crystals and glasses formed by femtosecond laser ablation are investigated with respect to realizing 2D photonic crystals. In addition, the photonic band structures of the fabricated air nanohole arrays are calculated and the electromagnetic wave propagation in arrays containing a line defect (waveguide structures) is examined.

Femtosecond pulsed laser co-deposited Er-Yb monolayer implanted waveguides on silica

Jayakrishnan Chandrappan, Gin Jose, Animesh Jha, Tarun Kakkar, Matthew Murray, Paul Steenson

1 Institute for Materials Research, Faculty of Engineering, University of Leeds, Leeds, United Kingdom
2 Institute of Microwave and Photonics, Electronic and Electrical Engineering, Faculty of Engineering, University of Sheffield, Sheffield, UK

Multimode femtosecond planar waveguides are realized with a femtosecond pulsed laser fabrication process. Sequential ablation of rare-earth doped tellurite glasses (TeO2 - ZnO - Na2O - Er2O3 / Yb2O3) results in a 10.3% step change in the effective index. Details of the homogenized metastable Er3+ - Yb3+ co-deposited waveguides on silica and the amplifier characteristics will be presented.

Efficient near-infrared laser emission of Pr:LiYF4 at 907 and 915nm

Biao Qu, Saiyu Luo, Xin Xu, Huiying Xu, Zhiping Cai, Huiying Xu, Biao Qu

1 Xiamen University, Xiamen, China
2 CIMAP-University of Caen, Caen, France

The presentation reports on the luminescence spectra and the 3P0 to 1G4 laser emission of Pr:LiYF4 at the near-infrared laser wavelengths of 907 and 915nm. An output power of 218 mW with a laser slope efficiency of 24% is obtained for the first time at 915 nm.
Thursday sessions

ThP-T1-P-22
Crystal growth, spectroscopy, and laser operation of Pr\(^{3+}\) in the novel hexagonal host material β-NaGdF\(_{4}\)
Philipp Werner Metz\(^{1}\), Daniel-Timo Marzahn\(^{1}\), Fabian Reichert\(^{2}\), Christian Kränkel\(^{1,2}\), Günter Huber\(^{1,2}\)
\(^{1}\) Institut für Laser-Physik, Universität Hamburg, Hamburg, Germany
\(^{2}\) The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Hamburg, Germany
We report on the growth and spectroscopic characterization of Pr\(^{3+}\)-doped β-NaGdF\(_{4}\) crystals. Moreover, we present the first application of β-NaGdF\(_{4}\) as laser host. Laser diode excited laser oscillation of praseodymium was obtained at 608 nm and 642 nm.

ThP-T1-P-23
Power-scaled laser-diode pumped 747 nm Pr:YAlO\(_4\) laser in microchip resonator arrangement
Martin Fibrich\(^{1,2}\), Jan Sulc\(^{1}\), Helena Jelineková\(^{1}\), Michal Němec\(^{1}\)
\(^{1}\) Czech Technical University in Prague, Prague, Czech Republic
\(^{2}\) Institute of Physics ASCR, Prague, Czech Republic
Continuous-wave laser operation of 1-W InGaN laser-diode both-side pumped Pr:YAlO\(_4\), microchip crystal at room temperature is reported. The microchip geometry was formed by dielectric mirrors directly deposited on the crystal facets. 490 mW of output power at 747 nm with the slope efficiency of 45% has been demonstrated.

ThP-T1-P-24
Few Cycle Femtosecond OPCPA Front-End based on Picosecond Fiber Laser Seed and Picosecond Solid State Regenerative Amplifier Pump
Rokas Danilevičius\(^{1,2}\), Rimantas Budriuunas\(^{1,2}\), Andrejus Michailovas\(^{1,2}\), Audrius Zaukevičius\(^{3}\), Fabian Reichert\(^{2}\), Christian Kränkel\(^{1,2}\), Richard Moncorgé\(^{3}\), Katsuhiko Audrius Zaukevicius\(^{3}\), Christian Kränkel\(^{3}\), Katsuhiko Audrius Zaukevicius\(^{3}\), Christian Kränkel\(^{3}\)
\(^{1}\) The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Hamburg, Germany
\(^{2}\) Department of Quantum Electronics, Vilnius University, Vilnius, Lithuania
\(^{3}\) EKSPLA, Vilnius, Lithuania
In this work we constructed a novel few cycle femtosecond OPCPA front-end. Picosecond all-in-fiber oscillator was used to generate both seed and pump pulses. 10 fs pulses with broadband spectrum around 800 nm were measured at the system output.

ThP-T1-P-25
Diffraction-limited, high-power pico-second laser formed of a Nd:YVO\(_4\)/sapphire composite bounce amplifier
Masashi Abe\(^{1}\), Yuta Sasaki\(^{1}\), Katsuhiko Miyamoto\(^{1}\), Takashige Omatsu\(^{1,2}\)
\(^{1}\) Chiba University, 1-33 Yayoi-cho, Inage-ku, Chiba, Japan
\(^{2}\) CREST, 4-1-8 Honcho, Kagawuchi, Saita, Japan
We demonstrate the diffraction limited (M\(^2\)<1.1), high average power (>40W), pico-second (~8ps) output from a pico-second master-oscillator and a sapphire end-capped Nd:YVO\(_4\) slab bounce amplifier. A corresponding optical-optical efficiency of 53% from the pump laser diode to the pico-second output was achieved.

ThP-T1-P-26
Efficient actively Q-switched Nd:KLu(WO\(_4\))\(_2\) self-Raman laser
Zhenhua Cong\(^{1}\), Zhaojun Liu\(^{1}\), Xingyu Zhang\(^{1}\), Huiqin Zhang\(^{1}\), Jing Li\(^{2}\), Haohai Yu\(^{2}\), Xiaohan Chen\(^{1}\), Zengguang Qin\(^{1}\), Weitao Wang\(^{1}\), Ning Li\(^{1}\), Qiang Fu\(^{1}\)
\(^{1}\) School of Information Science and Engineering and Shandong Provincial Key Laboratory of Laser Technology and Application, Shandong University, Jinan, China
\(^{2}\) State Key Laboratory of Crystal Materials, Shandong University, Jinan, China
Abstract: An efficient 1185 nm Nd:KLu(WO\(_4\))\(_2\) self-Raman laser was demonstrated for the first time. At pulse repetition frequencies of 10, 15 and 20 kHz, the output power of 1.12 W, 1.32 W and 1.51 W were obtained with conversion efficiencies of 8.86%, 9.16% and 9.78%, respectively.

ThP-T1-P-27
2 µm ytterbium-sensitized Tm\(^{3+}:\)CaF\(_2\) laser pumped at 980 nm
Jean-Louis Doualan, Alain Braud, Abdelmjid Benayad, Vivien Ménard, Richard Moncorgé, Patrice Camy
Centre de recherche sur les Ions, les Matériaux et la Photonique (CIRMAP), UMR CNRS-CEA-Enseicaen, Universite de Caen, 6 Boulevard Maréchal Juin, F-14050 Caen, France, CAEN, France
Laser operation around 2 µm is reported with a Yb:Ti:CaF\(_2\) crystal pumped at 980 nm. The maximum output power is 138 mW, and the slope efficiency obtained with an output coupler having a transmission of 1.8% is 17% with respect to the incident pump power.

ThP-T1-P-28
High average power high repetition rate chirped pulse amplifier for OPCPA pumping
Kirilas Michailouas\(^{1}\), Andrejus Michailovas\(^{1,2}\), Audrius Zaukevičius\(^{1}\), Valerijus Smigevicus\(^{1}\)
\(^{1}\) EKSPLA, Vilnius, Lithuania
\(^{2}\) Center for Physical Sciences and Technology, Vilnius, Lithuania
We present a high average power (~100W) picosecond pulses amplifier operating at 1 kHz repetition rate based on Nd:YAG active medium that should be an effective pump source for an OPCPA system.

ThP-T1-P-29
Development of a 20 mJ, 1050 nm diode-pumped Yb:CaF\(_2\)/YAG amplifier for seeding a 10-level TW Nd:glass laser
Celso João, Hugo Pires, Gonçalo Figueira
Instituto de Plasmas e Fusão Nuclear, Lisbon, Portugal
We report a 20 mJ diode-pumped, double-stage CPA laser amplifier operating at 1050 nm, fully based on Yb-doped Gain media. The system consists of a 3 mJ Yb:CaF\(_2\) regenerative amplifier and a 20 mJ, eight passes Yb:YAG amplifier and is designed to seed a 10-level TW Nd:glass laser.

ThP-T1-P-30
A continuous-wave vortex Raman laser producing wavelength-selectable visible emission
Andrew Lee
Macquarie University, North Ryde, Australia
We report a continuous wave vortex Raman laser which produces wavelength-selectable output in the visible, operating with vortex fundamental and Stokes fields. Using processes of intracavity second harmonic generation and sum-frequency generation, we produce 1.2 W emission at 532nm, 0.9 W at 559nm, and 0.7 W at 586nm.

ThP-T1-P-31
Pulsed Kgd(WO\(_4\))\(_2\), Raman laser: towards emission linewidth narrowing
Vasili Savitski
Institute of Photonics, University of Strathclyde, Glasgow, United Kingdom
The linewidth of a Kgd(WO\(_4\))\(_2\) pulsed Raman laser is analysed experimentally for different configurations of the Raman and pump resonators. The benefits of a narrow linewidth pump source in combination with
linewidth narrowing elements in the Raman laser cavity for the efficient linewidth narrowing of the Raman emission are explained.

ThP-T1-P-32

Iterative numerical investigation of the thermal dephasing process in second harmonic generation in bulk periodically-poled crystals

Staffan Tjärnhammar, Peter Zeil, Valdas Pasiskevičius, Fredrik Laurell

Laser physics, KTH Royal Institute of Technology, Stockholm, Sweden

We numerically study the detrimental effect of thermal dephasing during second-harmonic generation in quasi-phase matched materials by iteratively solving the coupled wave equations and the heat transfer equation. The variation of different experimental conditions, such as external phase-match temperature and focussing conditions is discussed.

ThP-T1-P-33

Development of CW seeded picosecond mid-IR parametric light source pumped by the high-average-power Yb:YAG thin-disk laser

Ondrej Novák1, Martin Smrz2, Taisuke Miura1, Jaroslav Huynh1,2, Akira Endo1, Tomas Mocek1

1 HILASE Project & Department of Diode-pumped Lasers, Institute of Physics AS CR, v.v.i., Prague, Czech Republic
2 Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Prague, Czech Republic

Development of high-average power CW seeded picosecond mid-IR parametric light source will be presented. The output of the developed 100 kHz thin-disk based regenerative amplifier of 75-W average power is used for pumping. The seeded OPG in the PPLN crystal and its amplification in the KTP crystal will be described.

ThP-T1-P-34

Thermal lensing in Tm:KLu(WO4)2 laser crystals cut along the optical indicatrix axes

Pavel Loiko1, Josep Maria Serres2, Xavier Mateos3, Konstantin Yumashov4, Nikolai Kuleshov5, Valeriy Kuleshov5, Uwe Griebner1, Magdalena Aguiló5, Francesc Díaz6

1 Center for Optical Materials and Technologies, Belarusian National Technical University, Minsk, Belarus
2 Física i Cristalografia de Materials i Nanomatèrics (FiCMA-FiCNA), Universitat Rovira i Virgili, Tarragona, Spain
3 Max-Born-Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany
4 A comparative experimental study of thermal lensing is performed for monocrystalline Tm:KLu(WO4)2 laser crystals cut along the p, m and g optical indicatrix axes. Ng-cut crystal with a pure positive and near-spherical thermal lens allows us to realize quasi-monolithic Tm:KLu(WO4)2 “microchip” laser.

ThP-T1-P-35

Cryogenic spectroscopy of Yb:YAG ceramic for high energy short pulse lasers

Venkatesan Jambunathan1, Lucie Těsnohlídková1, Taisuke Miura2, Akira Endo1, Jan Sulc2, Helena Jelíneková2, Antonio Lucianetti2, Tomas Mocek1

1 HILASE center, Institute of Physics AS CR, v.v.i., Dolní Brezany, Czech Republic
2 Czech Technical University in Prague, Brehová 7, 11519, Prague, Czech Republic

We present here the cryogenic spectroscopy of Yb doped Yttrium gallium aluminium mixed garnet ceramic (Yb:YAG). The emission bandwidth of Yb:YAG is three times higher than that of Yb:YAG at cryogenic temperatures which makes this material promising for the generation of short pulses.

ThP-T1-P-36

Beam profiling of infrared lasers with silicon CCDs by active wavelength up-conversion

Adrian J. Torregrosa1, Haroldo Maestre2, Maria Luisa Rico2, Juan Capmany1

1 Department of Communications Engineering, Miquel Hernandez University, Elche, Spain
2 Department of Computer Technology. University of Alicante., Alicante, Spain

We present an active wavelength conversion system from infrared eye-safe optical beams around 1550 nm to the visible spectrum for their spatial characterization with standard silicon CCD and CMOS cameras based on nonlinear optical sum-frequency mixing with a 1064 nm beam of a diode-pumped Nd3+:YVO4 solid state laser.

ThP-T1-P-37

Infrared Femtosecond Optical Parametric Oscillator Using PPLN and MgO:PPLN Crystals Synchronously Pumped by Yb:KGW Laser

Ieva Pipintė1, Karolina Stankevičiūtė1, Rimantas Grigonis1, Robert Eckardt1, Valdas Sirutkaitis1

1 Laser Research Center, Vilnius University, Saulėtekio ave. 10, LT-10223, Vilnius, Lithuania
2 Goech and Housego (Ohio), 676 Alpha Drive, Highland Hts, Ohio, United States

The efficient operation of the optical parametric oscillator, synchronously pumped by fundamental radiation (1030 nm) of Yb:KGW laser, providing 105 fs pulses at 76 MHz repetition rate was demonstrated. We used PPLN and MgO:PPLN crystals and obtained maximum efficiency >24 % in 1436 – 1463 nm signal spectrum range.

Aula des Jeunes-Rives

Crystallographic Lasers - 16:45 - 18:45

Solid-State Lasers

Chaired by: Majed Ebrahim-Zadeh, ICFO - The Institute of Photonic Sciences, Barcelona, Spain

ThD-T1-I-01 (Invited) 16:45

Micro Domain-controlled Laser Materials Toward Giant Micro-photonics

Takunori Taïra

Laser Research Center for Molecular Science, Institute for Molecular Science, Okazaki, Japan

The past decade has witnessed a veritable revolution in the types and performance levels of solid-state lasers, largely due to development of micro-domain engineered new optical materials: micro-domain structured transparent laser ceramics and ferroelectrics for quasi-phase matched nonlinear optics. We’d like to discuss the capabilities of Giant Micro-photronics for energy.

ThD-T1-O-02 17:15

Direct measurement of the dielectric frame rotation in monocrystalline crystals as a function of the wavelength

Patricia Loren Inacio1, Christian Traum1, Corinne Félié1, Patricia Segonds2, Benoît Boulanger3, Jérôme Debrey1, Alexandra Peña1, Yannick Petit1, Daniel Ryte2, Germano Montemezzani2, Philippe Goldner3, Alban Ferrier4

1 Institut Néel, CNRS – Université J. Fourier, Grenoble, France
2 Institut de la Chimie et de la Matière Condensée de Bordeaux (ICMCB), CNRS Université Bordeaux, Bordeaux, France
3 FEE GmbH, Struthstr, Idar-Oberstein, Germany
4 Laboratoire Matériaux Optiques, Photonique et Systèmes (LOMOPS), Université de Lorraine and Supélec, Metz, France
Th-D-T1-O-03  17:30

Spectroscopy, continuous-wave and Q-switched operation of a 2.04 μm Ho:KYF₃ laser

Daniela Parisi¹, Martin Schellhorn², Marc Eichhorn², Mauro Tonelli³

¹ NEST Istituto Nanoscienze – CNR piazza S. Silvestro 12, I – 56127 Pisa, Italy, Pisa, Italy
² French-German Research Institute, ISL, 5, rue du General Cassagnou, 68301 Saint-Louis, France, Saint-Louis, France
³ Dipartimento di Fisica Università di Pisa, Largo B. Pontecorvo 3, I – 56127 Pisa, Italy, Pisa, Italy

We report on the growth, spectroscopy and laser emission of a Ho:KYF₃ crystal. A maximum laser power of 7.8 W was obtained corresponding to a slope efficiency of 60.7% with respect to absorbed power. At 10 kHz 0.78 mJ energy per pulse was demonstrated with pulse widths of 100 ns.

Th-D-T1-O-04  17:45

Mid-infrared lasing from Ho²⁺ in bulk InF₃ glass and BVF crystal.

Antoine Berrou, Christelle Kieleck, Marc Eichhorn

French-German Research Institute of Saint-Louis (ISL), Saint-Louis, France

First bulk lasing around 4 μm of holmium-doped InF₃-based glass and a comparison to a BVF crystal is reported. BVF shows a lower threshold and a higher slope efficiency than InF₃ glass. At 650 mJ pump energy, 35 mJ (5.4 mJ) was obtained with BVF (InF₃), respectively.

Th-D-T1-O-05  18:00

1.2 mJ, 1 kHz, ps- pulses at 2.05 μm from a Ho:fibre / Ho:YLF laser

Krishna Murari¹, Huseyin Chankaya¹, Peng Li¹, Axel Rueil², Ingmar Hartl², Franz Koertner²

¹ Deutsches Elektronen-Synchrotron (DESY), Notkestrasse 85, 22607 Hamburg, Germany, Hamburg, Germany
² Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA, Boston, United States

We demonstrate a compact 1.1 mJ, 3.5-μs laser operating with a passively modelocked Ho:fiber seed laser following a Ho:YLF regenerative amplifier and single-pass amplifier. Stretching and compression is achieved via chopped vibration grating. A fused quartz-etalon in the regenerative amplifier shortens the pulse duration 2.5 ps.

Th-D-T1-O-06  18:15

Highest power and Q-switched diode end-pumped Alexandrite laser

Michael Damzen¹, Achaya Teppitaksak², Gabrielle Thomas³, Ara Minassian³

¹ The Blackett Laboratory, Imperial College London, London, United Kingdom
² Unilase Ltd, London, United Kingdom
³ Elettra Sincrotrone Trieste & Consorzione Elettra, Trieste, Italy

We describe a method never implemented before and enabling the direct measurement of the dielectric frame rotation of monoclinic crystals. It has the advantage to use slabs and has been validated in Nd³⁺:YLF and BiB₃O₃. We also report for the first time a dielectric frame rotation of 3° in Eu²⁺:Y₂SiO₅.

Th-D-T1-O-07  18:30

290 W fiber-laser-pumped diamond Raman laser

Robert Williams¹, Ondrej Kitzel¹, Johannes Nold², Max Strecker², Aaron McKay³, Thomas Schreiber², Richard Mildren³

¹ MQ Photonics Research Centre, Department of Physics and Astronomy, Macquarie University, North Ryde, Australia
² Fraunhofer Institute of Applied Optics and Precision Engineering, Jena, Germany
³ University of California, Berkeley, Berkeley, USA

We use long-pulse pumping to investigate power-scaling of diamond Raman lasers. Thermal gradients reach steady-state within the pulse duration of quasi-cw Nd:YAG technology (<100 μs). Using this approach, and high-power fiber amplifier technology, we demonstrate record output powers up to 290 W for pulse durations up to 10 ms.

Thursday sessions

Aula des Jeunes-Rives

Post-Deadlines - 19:15 - 20:00

Solid-State Lasers

Chaired by: Thomas Südmeyer, University of Neuchâtel, Neuchâtel, Switzerland

Th-E-T1-O-01  19:15

Mechanical phase matching of birefringent nonlinear crystals

Loïc Deyra¹, François Balembois², André Guilbault¹, Philippe Villeval³, Patrick Georges³

¹ Laboratoire Charles Fabry, UMR 8501, Institut d’Optique, CNRS, Univ Paris Sud, Palaiseau, France
² Cristal Laser, Messein, France
³ Institute of Chemistry, University of Bordeaux, France

We demonstrate a new concept called “mechanical phase-matching”, based on the strong mechanical compression of a nonlinear crystal. We successfully tuned the second harmonic non-critical phase matching wavelength of LiB₃O₃ (LBO) crystal at room temperature from 1200 nm to 1120 nm by applying compressive forces up to 100 MPa.

Th-E-T1-O-02  19:30

Ti:sapphire-pumped, deep-infrared, intracavity-cascaded femtosecond optical parametric oscillator

Venkata Ramiah-Bardarla¹, Adolfo Esteban-Martin¹, S. Chaitanya Kumar¹, Kavita Devi², Kevin Zawilski³, Peter Schunemann², Majid Ebrahim-Zadeh³

¹ ICFI-The Institute of Photonic Sciences, Mediterranean Technology Park, C/E-08010, Castelldefels, Barcelona, Spain
² Castelldefels, Barcelona, Spain
³ BAE Systems, Inc., MERS-1813, P.O. Box 868, Nashua, New Hampshire 03061-0868, USA, Nashua, United States

We report the first femtosecond OPO for the deep-IR synchronously-pumped by a Ti:sapphire laser. Using a novel intracavity-cascaded pumping technique employing PPLN in combination with CsSIP₂, femtosecond pulses with continuous coverage across 5500-8500 mm are generated using rapid static cavity delay tuning with high output stability at room temperature.

Th-E-T1-O-03  19:45

CEP-Stable, Few-Cycle OPCPA System with more than 15 W of Average Output Power at 300 kHz

Cafeteria

Refreshments - 18:45 - 19:15
We present a CEP-stable, two-stage OPCPA system delivering more than 15 W of compressed output power with pulse durations below 6 fs at 300 kHz repetition rate. The system is based on a broadband CEP-stabilized Ti:Sapphire oscillator and an optically synchronized thin-disk regenerative amplifier. We obtain pulses as short as 7.8 fs, with 380 μJ pulse energy at 100 kHz repetition rate.

FrA-T2-O-03 08:45
Strong field applications of Gigawatt self-compressed pulses from a Kagome fiber
Guangyu Fan
Photons Institute, Vienna University of Technology, Vienna, Austria
GPPMM group, Xim Research Institute, CNRS UMR 7252, University of Limoges, Limoges, France
Blackett Laboratory, Imperial College London, London, United Kingdom
M.V. Lomonosov Moscow State University, Moscow, Russia
Department of Physics and Astronomy, Texas A&M University, Texas, United States
Institute of Optics and Quantum Electronics, Jena, Jena, Germany

We demonstrate efficient self-compression of 1.7 µm infrared pulses to quasi-single cycle duration with sustained 100 µJ level pulse energies in an ultra-broadband Kagome-lattice hollow-core photonic crystal fibre (HC-PCF). To demonstrate applicability of this compact single-cycle source, we launched ATI electron spectrometry measurements and driving high-order harmonic generation.

FrA-T2-O-04 09:00
Pulse compression at 100 W of average power using gas-filled Kagome-type HC-PCF
Florian Emaury1, Clara Saraceno1,2, Benoit Debord1, Cie Fourcade-Dutin1, Frédéric Gerome3, Thomas Südmeyer2, Fetah Benabid1, Ursula Keller1
1 ETH Zürich, Zürich, Switzerland
2 University of Neuchâtel, Neuchâtel, Switzerland
3 University of Limoges, Limoges, France

We demonstrate the nonlinear compression of a fiber chirped-pulse amplifier in an air-filled hypocycloid core Kagome fiber. The unique properties of such fiber allow us to generate 100 fs pulses with an energy of more than 200 µJ together with exceptional overall-transmission efficiency of 90 %.

FrA-T2-O-05 09:15
High peak-power monolithic femtosecond ytterbium fiber chirped pulse amplifier with a spliced-on hollow core fiber compressor
Aart Verhoeven1, Kim Jespersen2, Thomas Andersen3, Lars Grüner-Nielsen3, Tobias Flöry4, Lingxiao Zhu5, Andrius Baltuska1, Alma Fernández2
1 Photonics Institute, TU Wien, Wien, Austria
2 NKT Photonics A/S, Birkerød, Denmark
3 OFS Denmark, Brøndby, Denmark
4 University of Vienna, Wien, Austria
5 Moscow State University, Moscow, Russia

We present a monolithic Yb-fiber chirped pulse amplifier with a spliced-on hollow-core photonic bandgap fiber compressor is presented. The end-facet of the amplifier and entrance facet of the compressor are cleaved with corresponding angles minimizing back-reflection. 226 fs pulses with an energy of 135 nJ are achieved.
Semiconductor and Microchip Lasers - 10:30 - 12:30

Solid-State Lasers

Chaired by: Alphan Sennaroğlu, Koç University, Istanbul, Turkey

Friday sessions

**FrB-T1-O-04**

3.2 W output power of a diode-pumped Tm:KLu(WO₄)₂ microchip laser

Xavier Mateos¹, Josep Maria Serres¹, Pavel Loiko², Konstantin Yumashev², Nikolai Kuleshov², Valentín Petrov³, Uwe Griebner³, Magdalena Aguilo¹, Francesc Diaz²

¹ Física i Cristal·lografia de Materials i Nanomatèrius (FiCMA-FiCNA), Universitat Rovira i Virgili (URV), Campus Sescelades, c/ Marcel·lí Domingo, s/n., Tarragona, Spain
² Center for Optical Materials and Technologies, Belarusian National Technical University, 65/17 Neavizsimostsi Ave., Minsk, Belarus
³ Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, 2A Max-Born-Str., Berlin, Germany

TEM00-mode laser operation with output power higher than 3 W at 1946 nm is demonstrated in a N-cut Tm:KLuW microchip laser. We computed and analyzed the mode-matching and cavity stability of the Tm:KLuW microchip laser with respect to the thermo-optic effects and expect further power scaling.

**FrB-T1-O-05**

Highly efficient cw and mode-locked OPSL-pumped Yb:Lu₂O₃-lasers

Alexander Heuer¹, Kolja Beil¹, Christian Kränkel¹

¹ Institut für Laser-Physik, Universität Hamburg, Hamburg, Germany

We report on an OPSL pumped Yb-doped lutetia laser. In cw mode an output power of 5.75 W was realized in a TEM00 mode with 71% slope efficiency relative to the absorbed pump radiation and 43% optical-to-to efficiency. 2.4-ns pulses at a repetition rate of 1.2-MHz are achieved in a Q-switched operation.

**FrB-T1-O-06**

Red Praseodymium Laser Passively Mode-Locked with a GaInP SESAM

Maxim Gaponenko¹, Philip Metz¹, Antti Härkönen¹, Alexander Heuer¹, Tomi Leinonen¹, Mircea Guina¹, Thomas Südmeyer¹, Günter Huber¹, Christian Kränkel¹

¹ Laboratoire Temps-Fréquence, Université de Neuchâtel, Neuchâtel, Switzerland
2 Institut für Laser-Physik, Universität Hamburg, Hamburg, Switzerland
3 Optoelectronics Research Centre, Tampere University of Technology, Tampere, Finland
4 ReFeKron Ltd., Tampere, Finland
5 The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Hamburg, Germany

We report on the first SESAM mode-locked praseodymium laser. Stable self-starting continuous-wave mode locking operation was realized at a wavelength of 639.5 nm with an output power of 12 mW and a pulse repetition rate of 85.6 MHz.

**FrB-T1-O-07**

Efficient green and yellow lasers in Tb³⁺-doped LiYF₄, LiLuF₄, and KY₃F₁₀ crystals

Philip Werner Metz¹, Christian Kränkel², Günter Huber¹

¹ Institut für Laser-Physik, Universität Hamburg, Hamburg, Germany
² The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Hamburg, Germany

Efficient 2ω-OPSL pumped cw laser operation of Tb³⁺ in LiYF₄, LiLuF₄, and KY₃F₁₀ was realized at 545 nm and 585 nm with low threshold is reported. Up to 55% slope efficiency with 176 mW of maximum output power were obtained from Tb³⁺:LiYF₄.

**FrB-T1-O-08**

Wide wavelength tuning of laser diode pumped Pr³⁺-lasers in LiYF₄, KY₃F₁₀ and BaY₂F₆ crystals

Philip Werner Metz¹, Daniel-Timo Marzahl¹, Fabian Reichert¹, Daniela Parisi³, Mauro Tonelli³, Günter Huber¹, Christian Kränkel¹

¹ Institut für Laser-Physik, Universität Hamburg, Hamburg, Germany
² NEST-Istituto Nanoscienze-CNR and Dipartimento di Fisica, Università di Pisa, Pisa, Italy
³ The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Hamburg, Germany

We report on wavelength tuning with laser diode pumped Pr³⁺-doped fluoride crystals. The largest total tuning range exceeded 100 nm on several intervals between 521 nm and 737 nm was addressed with KYF under q-cw excitation. Similar tuning ranges were obtained with BYF and YLF in true cw.
Meyer, Tobias
Michailovas, Andrejus
Michailovas, Kirilas
Michel, Knut
Mildren, Richard
Miller, R.J., Dwayne
Minassian, Ara
Minkovich, Vladimir
Mirgorodski, Ivan
Miura, Taisuke
Miyamoto, Katsuhiko
Miyagawa, Noriaki
Mizunami, Toru
Mocek, Tomas
Modshing, Norbert
Moitrier, F.
Moitrier, Florence
Moller Isaksen, Stine
Moncorgé, Richard
Montemezzani, Germano
Morgner, Uwe
Morin, Franck
Morrissey, Padraic
Mottay, Eric
Muller, Michael
Müller, Sebastian
Muller, Olivier
Murari, Krishna
Murphy, Francis
Murray, Matthew
Musha, Mitsuru
Muzik, Jiří
Nakagawa, Ken’ichi
Némeck, Michal
Nemes, Daniel
Neumann, Jörg
Newbury, Nathan
Newbury, Nathan R.
Nilsson, Johan
Nishio, Masatoshi
Nishi, Ryosuke
Nold, Johannes
Novak, Ondrej
Ökffe, Kevin
Okhotnikov, Oleg
Okuniishi, Hiroaki
Omatu, Takashige
Osiko, Vjacheslav
Ottenhues, Christoph
Otto, Hans-Jürgen
Oudar, Jean-Louis
Palmer, Guido
Panyutin, Vladimir
Papadopoulos, Dimitris N.
Paris, Daniela
Park, Hyoun Min
Passikhan, Aleksandra
Pasiskevicius, Valdas
Pasternak, I.
Paul, Amandine
Pavel, Nicolaie
Pavlov, Ihor
Peña, Alexandra
Perangement, Mikhail
Pervak, Vladimir
Petersen, P
Peters, Frank
Petit, Johan
Petit, Yannick
Petrovich, Marco
Petrov, Valentin
Pfeiffer, Martin Huber Peter
Pfeiffer, Pierre
Phelan, Richard
Phillips, Chris
Phillips, Christopher R.
Phillips, Jonathan
Piccolini, Riccardo
PIERRE, Christophe
Pilz, Sönke
Pipinytė, Ieva
Pires, Hugo
Pirżio, Federico
Poletti, Francesco
Popp, Jürgen
Porras, Miguel A.
Pouysegur, Julien
Prabakaran, Anil
Priebe, Gerd
Prinz, Stephan
Prochnow, Oliver
Pronin, Oleg
Pugžlys, A.
Pugžlys, Audrius
Pufeza, Joachim
Puzikov, Vyacheslav
Qin, Zengguang
Qu, Biao
Racikaitis, Gediminas
Ramaiah-Bardarla, Venkata
Rame, Jérémy
Rantamäki, Antti
Rausch, Stefan
Raybaut, Myriam
Regelkis, Kestutis
Reichert, Fabian
Richards, David
Richardson, David
Rico, Maria Luisa
Ricker, Greg
Robin, Thierry
Romano, Valerio
Romarova, Alexey
Rosenstein, Boris
Roshuchkin, Dmitry
Rotermund, Fabian
Rothardt, Jan
Ruehl, Axel
Rütter, Christian E.
Rustiketa, Nenary
Ryabushkin, Oleg
Ryser, Manuel
Rytz, Daniel
Saarinen, ESA
Sahm, Jayanta
Sakagawa, Tomokazu
Sakishita, Tomomi
Salamou, Gabriela
Salman, Serper
Saraceno, Clara
Saraceno, Clara J.
Sasaki, Yuta
Savitski, Vasili
Saynèc, Hakan
Schellhorn, Martin
Scheumer, Jonas
Schiött, Stéphane
Schmid, Bruno
Schmitt, Michael
Schmuck, Martin
Schreiber, Thomas
Schröder, Carmen
Schröder, Thibaud
Schultz, Marcel
Schulz, Bastian
Schunemann, Peter
Schunemann, Peter G.
Segonds, Patricia
Seidel, Marcus
Seiro, Bruno
Serres, Josep Maria
Shaidullin, Renat
Shardlow, Peter