OSA Laser Congress

Advanced Solid State Lasers (ASSL)
Application of Lasers for Sensing & Free Space Communication (LS&C)
Laser Applications Conference (LAC)

Technical Conference: 29 September—3 October 2019
Exhibition: 30 September—2 October
Austria Center Vienna
Vienna, Austria

Table of Contents

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Advanced Solid State Lasers Conference (ASSL)

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Thank you to all the

Committee Members for contributing many hours to maintain the high technical quality standards of OSA meetings.

General Information

Registration

Left Wing Main Lobby

Please note: Registration desk will be closed during lunch breaks.

Sunday, 29 September	08:00 – 17:00
Monday, 30 September	07:00 – 18:00
Tuesday, 1 October	07:30 – 18:00
Wednesday, 2 October	07:30 – 17:30
Thursday, 3 October	07:30 – 16:30

Access to the Wireless Internet

Austria Center Vienna offers free WiFi. To access the network connect to the SSID "ACV". No personal information or password is needed for unlimited WiFi access provided in the Center.

Online Access to Technical Digest

Full Technical Attendees have both EARLY and FREE continuous online access to the Congress Technical Digest and Postdeadline papers through OSA Publishing's Digital Library. The presented papers can be downloaded individually or by downloading .zip files (.zip files are available for 60 days).

1. Visit the conference website at www.osa.org/LaserOPC.
2. Select the "Access digest papers" link on the right hand navigation.
3. Log in using your email address and password used for registration. You will be directed to the conference page where you will see the .zip file link at the top of this page.
   Note: if you are logged in successfully, you will see your name in the upper right-hand corner.

Access is limited to Full Technical Attendees only. If you need assistance with your login information, please use the "forgot password" utility or "Contact Help" link.

About OSA Publishing's Digital Library

Registrants and current subscribers can access all of the meeting papers, posters and Postdeadline Papers on OSA Publishing's Digital Library. The OSA Publishing's Digital Library is a cutting-edge repository that contains OSA Publishing's content, including 18 flagship, partnered, and co-published peer-reviewed journals and one magazine. With more than 370,000 articles, including papers from more than 700 meetings, OSA Publishing's Digital Library is the largest collection of peer-reviewed optics and photonics content.

Update Sheet

All technical program changes will be communicated in the on-site Congress Program Update Sheet. All attendees receive this information with registration materials and we encourage you to review it carefully to stay informed of changes in the program.

Poster Presentation PDFs

Authors presenting posters have the option to submit the PDF of their poster, which will be attached to their papers in OSA Publishing's Digital Library. If submitted, poster PDFs will be available about three weeks after the meeting. While accessing the papers in OSA Publishing's Digital Library look for the multimedia symbol shown above.

Congress App

Manage your congress experience by downloading the congress app to your smartphone or tablet.

Download the app in any of these three ways:

1. Visit www.osa.org/laserapp
2. Search for 'OSA Events' in your preferred app store.
3. Scan the QR code below

Schedule

Search for congress presentations by day, topic, speaker or program type. Plan your schedule by setting bookmarks on programs of interest. Technical attendees can access technical papers within presentation descriptions.

Show Floor

Search for exhibitors or view the complete list. Bookmark exhibitors as a reminder to stop by their booth. Tap on the map icon with a description to find their location on the show floor map.

Access Technical Digest Papers

Full technical registrants can navigate directly to the technical papers right from the congress app. Locate the session or talk in "Schedule" and click on the "Download PDF" link that appears in the description.

IMPORTANT: You will need to log in with your registration email and password to access the technical papers. Access is limited to Full Conference attendees only.

Need assistance?

Contact our support team, available 24 hours a day Monday through Friday, and from 09:00 to 21:00 EDT on weekends, at +1.888.889.3069 option 1.

General Information

Anti-harassment Policy and Code of Conduct

OSA is committed to providing an environment that is conducive to the free and robust exchange of scientific ideas. This environment requires that all participants be treated with equal consideration and respect. While OSA encourages vigorous debate of ideas, personal attacks create an environment in which people feel threatened or intimidated. This is not productive and does not advance the cause of science. All participants in OSA and OSA-managed events and activities are therefore expected to conduct themselves professionally and respectfully. It is the policy of The Optical Society that all forms of bullying, discrimination, and harassment, sexual or otherwise, are prohibited in any OSA or OSA-managed events or activities. This policy applies to every individual at the event, whether attendee, speaker, exhibitor, award recipient, staff, contractor or other. It is also a violation of this policy to retaliate against an individual for reporting bullying, discrimination or harassment or to intentionally file a false report of bullying, discrimination, or harassment. Bullying, discrimination, and harassment of any sort by someone in a position of power, prestige or authority is particularly harmful since those of lower status or rank may be hesitant to express their objections or discomfort out of fear of retaliation. OSA may take any disciplinary action it deems appropriate if, after thorough investigation, it finds a violation occurred. If you wish to report bullying, discrimination, or harassment you have witnessed or experienced, you may do so through the following methods: contact any OSA staff member (if onsite at an event or meeting); use the online portal osa.org/IncidentReport; or email CodeOfConduct@OSA.org.

Restrooms

The Optical Society invites all people to use the restroom that aligns with their gender identity. For anyone who would like to use a gender-neutral restroom, we have worked with the facility to identify a restroom near the Entrance Hall area.

Awards

IPG Student Presentation Contest

IPG, Premier Corporate Sponsor of OSA Laser Congress, provides funding for various paper presentation awards, which are determined by the Congress Technical Program Committee Chairs. All current students presenting a paper during the Congress are eligible for these awards. The Chairs will present several awards for outstanding poster and oral presentations by students.

Up to six awards winners will be selected during Laser Congress 2019: Best Contributed Oral Presentation and up to two runners up, and Best Poster Presentation and up to two runners up.

OSA thanks IPG who has supported student awards for this conference for many years!

Special Events

Congress Reception
Sunday, 29 September, 17:30 – 19:00
Vienna City Hall

Join fellow Laser Congress attendees at the Opening Reception in the Vienna City Hall, the stunning centrepiece on Rathausplatz that is visually one of the most magnificent pieces of architecture in this beautiful city. City Hall was erected between 1872 and 1883 and was built in gothical style. The Reception will be held in the Festival Hall in an elegant atmosphere with vaulted ceilings, chandeliers, marble and parquet floors. On the front sides of the hall there are two orchestra niches with corners decorated with relief portraits of four great composers: Mozart, Haydn, Gluck and Schubert. Brilliant lighting is provided by 16 magnificent chandeliers. The reception is free to technical attendees, $75.00 US for all others who wish to attend. Please check with Meeting Management at registration desk to purchase guest tickets - contingent on availability.

Recent Trends in Laser Technology and its Applications in Manufacturing Technical Group Panel Discussion
Monday 30 September, 12:30 – 14:00
Room 0.11-0.12

Join the OSA Lasers in Manufacturing Technical Group for a guided networking session during lunch to bring together international scientists in research and industry to discuss the latest emerging trends in the lasers in manufacturing field. In additional to learning more about the technical group, you will have an opportunity to hear from our featured speakers and have discussions with your fellow attendees on interesting topics such as macro processing, micro processing, additive manufacturing, and future job opportunities in the field. Space for this event is limited; please RSVP first to let us know you are interested in attending. To RSVP please visit osa.org/LaserOPC, click on Programs then on Special Events.

Hosted by

OSA Lasers in Manufacturing Technical Group

Poster Sessions
Monday, 30 September – Thursday, 3 October
Entrance Hall, Hall F

Poster presentations offer an effective way to communicate new research findings and provide a venue for lively and detailed discussion between presenters and interested viewers. Don't miss this opportunity to discuss current research one-on-one with the presenters. Each author is provided with a board to display the summary and results of his or her paper.

*Monday, 30 September	18:30 – 20:00
Tuesday, 1 October	11:30 – 14:00
Wednesday, 2 October	10:00 – 11:30
Thursday, 3 October	12:30 – 14:30

* Student Poster Session sponsored by IPG.
Selected student presenters will be presenting their research during this poster session. All attendees are welcome to network with students and learn about their work.

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Poster Set-Up and Removal

All posters must be set by the start of the poster session.
The presenter must remain in the vicinity of their poster for the duration of the session. All presenters must remove their posters at the conclusion of the session. Management will remove and discard any remaining posters after the time listed below.

Student & Early Career Professional Development & Networking Lunch and Learn
Tuesday, 1 October, 11:30 – 12:30
Room 0.11-0.12

This program will provide a unique opportunity for students and early career professionals, who are close to finishing or who have recently finished their doctorate degree, to interact with experienced researchers. Key industry and academic leaders in the community will be matched for each student based on the student's preference or similarity of research interests. Students interested in all career paths – from those seeking an academic position, to those wishing to start a technology business, to those interested in government/public service, to those looking to translate their benchwork skills to product development – are encouraged to apply. Students will have an opportunity to discuss their ongoing research and career plans with their mentor, while mentors will share their professional journey and provide useful tips to those who attend. Lunch will be provided.

This Workshop is complimentary for OSA Members and space is limited. Space is limited and priority will be given to those who have most recently graduated or are close to graduation. Please register at osa.org/LaserOPC, click on Programs then on Special Events.

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Extreme Laser Sources & Applications Roundtable
Wednesday, 2 October, 16:00 – 18:00
Hall E1

Speakers:
Andrius Baltuska, *Technische Universität Wien, Austria*
Gérard Mourou, *Ecole Polytechnique, France*
Peter Moulton, *Massachusetts Inst. of Tech. Lincoln Lab, USA*
Jon Zuegel, *University of Rochester, USA*

Joint Postdeadline Papers Session
Tuesday, 1 October, 18:30 –19:30
Hall E1

The Congress Technical Program Committees have accepted a limited number of postdeadline papers for oral presentations. The purpose of postdeadline papers is to give participants the opportunity to hear new and significant material in rapidly advancing areas. See the Update Sheet for the list of Postdeadline Papers. The Postdeadline Papers can be found in OSA Publishing's Digital Library by visiting www.osa.org/LaserOPC and select "Access Digest Papers" link on the right hand navigation.

Special Events

Congress Banquet

Wednesday, 2 October, 19:00 – 21:00
Kunsthistorisches Museum

Plan on spending an elegant evening with colleagues and friends at the Kunsthistorisches Museum. The Museum was erected from 1871–1891 and was commissioned by the emperor in order to find a suitable shelter for the Habsburgs' formidable art collection and to make it accessible to the general public. With its ornate façade, it is one of the most distinguished and impressive museum buildings of the 19th century.

The interior of the building is beautiful, with its soaring rotunda, dramatic patterned floors and marble halls decorated with frescoes and gold leaf. The magnificent main staircase is one of the highlights of Viennese 19th-century architecture. It is also a treasure trove of art history — from a vast coin collection and unforgettable pieces of ancient Egyptian and Greek art, to rooms dedicated to great European masters featuring 16th- and 17th-century works by German, Dutch, Flemish, and Italian greats. Please note the $10.00 fee for registered technical attendees, $95.00 US for all others who wish to attend. Please check with Meeting Management located at registration desk to purchase guest tickets- contingent on availability.

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Directed Energy Professional Society Special HEL Defense Application Session

Thursday, 3 October, 08:00 – 16:30
Room 1.61-1.62

The Directed Energy Professional Society will host a special session that will explore defense applications using High Energy Laser solutions to counter emerging threats to military operations, both domestically and abroad. The session will include international presentations that address their respective mission needs, as well as the state-of the-science that underlies High Energy Laser applications, from the Joint Directed Energy Transition Office. The session is open to Laser Congress attendees from USA, NATO (North Atlantic Treaty Organization) allies, EOP (Enhanced Opportunities Partnership) partners, Japan, South Korea, and Switzerland.

The Directed Energy Professional Society (DEPS) was founded in 1999 to foster the research, development and transition of Directed Energy (DE) technology for national defense and civil applications through professional communication and education. DEPS intends to be recognized as the premier organization for exchanging information and advocating research, development and application of Directed Energy, which includes both high energy lasers (HEL) and high power microwaves (HPM). DEPS is incorporated as a nonprofit corporation in New Mexico, organized and operated exclusively for charitable, scientific, and educational purposes.

Short Courses

Short Courses cover a broad range of topic areas at a variety of educational levels. They are an excellent opportunity to learn about new products, cutting-edge technology and vital information at the forefront of your field. They are designed to increase your knowledge of a specific subject while offering you the experience of knowledgeable teachers.

Short Courses are complimentary for technical congress attendees, but a separate registration is required to attend and space is limited.

SC491: Ultrafast Lasers
09:00-12:00
Rüdiger Paschotta, *RP Photonics, Netherlands*

Level: Advanced Beginner

Course Description: This course gives detailed insight into the operation principles and essential limitations of lasers for ultrashort pulse generation in the picosecond or femtosecond regime. Mode-locked lasers of different kinds, including particularly solid-state bulk lasers and fiber lasers, and the different active and passive mode-locking mechanisms used in those lasers are discussed in detail. For example, it is explained what kinds of saturable absorbers can be used for passive mode locking, and which issues arise in the context of fast and slow absorbers, including instabilities of the circulating pulses. Various numerical simulations are used for demonstrating relevant details, and typical parameter values as well as various performance limitations are explained.

Benefits and Learning Objectives:

- Understand the principles of pulse generation with mode locking
- Name several factors which can cause instabilities in mode-locked lasers
- Describe the essential differences between bulk laser and fiber laser technology
- Identify various limiting effects for the performance of ultrafast lasers
- Know essential methods required for the efficient development of ultrashort pulse sources

Intended Audience: This course is intended for laser engineers and researchers interested in the development of ultrafast laser systems based on different technologies. They should already have some knowledge of optics and lasers.

SC492: Laser Beam Combining
14:00-17:00
Tso Yee (T.Y.) Fan, *MIT Lincoln Laboratory, USA*

Short Course Description: There is continuing interest in increasing the power and improving the beam quality of laser sources for a variety of applications including materials processing, pumping, power transmission, and illumination. One approach is to continue to develop improved lasers with higher power and good beam quality. Another approach, particularly relevant to semiconductor and fiber lasers, is to beam combine large arrays of lasers. Beam combining has become increasingly viable as the community has developed a better understanding of the requirements imposed by beam combining, and various implementations have been successfully demonstrated.
Key metrics for high-power arrays include the output power, the brightness, and the spectral width. To achieve high brightness, both high power and good beam quality are required. There are two approaches, wavelength beam combining (WBC) and coherent beam combining (CBC), to scaling the brightness by large amounts, in principle by as much as the number of elements. In WBC, the array elements operate at different wavelengths and a dispersive optical system is used to overlap the different wavelengths spatially. This is equivalent to what is done in wavelength division multiplexing for optical communications. In CBC, the beams are interferometrically combined, or phased. If the beams are phased properly, then constructive interference occurs and the power can be combined into a single beam.

This short course will cover the fundamentals of laser beam combining, including requirements on the array elements, basic scaling laws, and implementations. Examples from the literature will be used to show the progress being made.

Benefits and Learning Objectives

- Explain wavelength (spectral) and coherent beam combining
- Determine the suitability of laser gain elements for beam combinability
- Assess design trades among gain bandwidth, number of elements, and size of WBC systems
- Compare implementation architectures for CBC systems
- Identify and compare phase-control systems and phase actuators in CBC systems
- Identify possible sources of beam combining inefficiency

Intended Audience: This course is intended for individuals who want to learn broadly about the core principles and capabilities of beam combining approaches, particularly for power and brightness scaling of laser systems. Appropriate for B. S.-level graduates with a background in lasers and optics.

SC493: Emerging Solid-State Gain Media
14:00-17:00
Christian Kränkel, *Leibniz-Institut für Kristallzüchtung, Germany*

Level: Advanced Beginner (Basics in atomic and laser physics are recommended)

Short Course Description: Double-tungstates and -molybdates, garnets and sesquioxides in single-crystalline or ceramic form, fluoride and chalcogenide as crystals and glasses, CALGO and other disordered, mixed and tailored host materials: It is hard to keep track of the variety of existing and emerging gain media for solid-state lasers. Yb, Ho, Er, Tm, Pr, Cr, Fe and other doping ions enable an almost infinite number of material combinations, but up to now only a very limited number has found its way to commercial applications.

This course will introduce the most important material classes for solid-state lasers with their advantages and disadvantages. It will introduce the basic mechanical, thermal, and spectroscopic host material requirements for different doping ions and laser wavelength ranges as well as their interplay. Modern and existing gain materials for solid-state lasers from the UV to the mid-infrared spectral range will be evaluated with respect to these properties. It will turn out that in many cases simple rule-of-thumb estimations enable to rule out gain media while in other cases a closer look is required. The practical application of solid-state laser materials in real-world applications is also largely determined by the availability of these. To evaluate the potential of different laser materials in this respect, the course will also introduce some basics on their fabrication by different crystal growth approaches and reveal 'tricks' to tweak properties by tailoring the material composition.

Benefits and Learning Objectives:

- List the main host material properties required for lasers based on the most common active ions
- Explain the advantages and drawbacks of different crystal growth techniques
- Evaluate the potential of emerging and existing gain materials based on these properties
- Discuss potential measures to tailor the gain media properties for the required application
- Identify the most suitable (available) gain material for their intended application

Intended Audience: This course is intended to provide laser engineers, operators and developers in science and industry from PhD student to postdoc level with a working knowledge of solid-state laser materials physics and chemistry required to estimate the potential of gain materials for particular solid-state laser applications.

Plenary and Keynote Speakers

Joint Plenary Session I

Monday, 30 September, 08:00 – 10:00
Hall E1

Klaus Loeffler

TRUMPF Laser GmbH + Co KG, Germany

Industrial Laser Applications: Still A Multi Niche Solution or Ready for the Big Breakthrough?

Industrial laser applications have enabled many successful products. New features on products have resulted in a quick hype for lasers. These installations have not been a sustainable business for the laser manufacturers. Will newly developed laser applications change this picture?

Klaus Loeffler is the Managing Director of the TRUMPF Business Field Laser Technology/Electronics with responsibility for sales and services. He has been with TRUMPF since 1991 with a brief break from 2001 to 2006 when he went to work for Volkswagen AG with the responsibility of developing and implementing new and existing joining processes. Loeffler received his degree as a Machine Tool Engineer from the University of Stuttgart and in 2013 was President of the Laser Institute of America.

Clara Saraceno

Ruhr Universität Bochum, Germany

Trends, Challenges and Applications of High-average Power Ultrafast Thin-disk Lasers

This talk will review latest progress in ultrafast disk laser systems, next steps and challenges towards further scaling, as well as ongoing and new application areas open by their unique performance.

Clara Saraceno received her Diploma in Engineering and an MSc at the Institut d'Optique Graduate School, Paris, in 2007. She completed a PhD in Physics at ETH Zürich in 2012, for which she received among others the EPS-QEOD thesis prize in applied aspects in 2013. From 2013-2014, Saraceno worked as a Postdoctoral Fellow at the University of Neuchatel and ETH Zürich, followed by a postdoc position from 2015 - 2016 at ETH Zürich. In 2016, she received a Sofja Kovalevskaja Award of the Alexander von Humboldt Foundation and became Associate Professor of Photonics and Ultrafast Laser Science at the Ruhr University Bochum, Germany. In 2018 she received an ERC Starting Grant. The current main research topics of her group include high-power ultrafast lasers and Terahertz science and technology.

Joint Keynote Plenary Session II

Tuesday, 1 October, 10:30 – 11:30
Hall E1

Gérard Mourou

Ecole Polytechnique, France

Passion for Extreme Light

The stunning capabilities of extreme light produced by Chirped Pulse Amplification (CPA) laser will be presented as well as the vast application it offers for science and society.

Gérard Mourou is Professor Haut-Collège at the École Polytechnique. He is also the A.D. Moore Distinguished University Emeritus Professor of the University of Michigan. He received his undergraduate education at the University of Grenoble (1967) and his PhD from University Paris VI in 1973. He has made numerous contributions to the field of ultrafast lasers, high-speed electronics and medicine. But his most important invention, demonstrated with his student Donna Strickland while at the University of Rochester is the laser amplification technique known as Chirped Pulse Amplification (CPA). CPA revolutionized the field of optics, opening new branches like attosecond pulse generation, nonlinear QED and compact particle accelerators. It extended the field of optics to nuclear and particle physics. In 2005, Mourou proposed a new infrastructure, the Extreme Light Infrastructure (ELI), which is distributed over three pillars located in the Czech Republic, Romania and Hungary. He also pioneered the field of femtosecond ophthalmology that relies on a CPA femtosecond laser for precise myopia corrections and corneal transplants. Over a million such procedures are now performed annually. Mourou is member of the US National Academy of Engineering, and a foreign member of the Russian Science Academy, the Austrian Sciences Academy and the Lombardy Academy for Sciences and Letters. He is Chevalier de la Légion d'honneur and was awarded the 2018 Nobel Prize in Physics with his former student Donna Strickland.

Exhibits / Buyers' Guide

The Exhibits are located in the Eingangshalle and Exhibit Hall F. All registered attendees have access to the exhibits. Visit a diverse group of companies, representing all aspects of solid-state laser system design and implementation. Coffee breaks, lunches and poster sessions will be held in conjunction with the exhibition.

Monday, 30 September Exhibits & Complimentary Lunch Exhibits & Coffee Break Exhibits & Student Poster Session	 12:30 – 14:00 16:00 – 16:30 18:30 – 20:00
Tuesday, 1 October Exhibits & Coffee Break Exhibits, Poster Session & Complimentary Lunch Exhibits & Coffee Break	 10:00 – 10:30 11:30 – 14:00
Wednesday, 2 October Exhibits, Poster Session & Coffee Break Exhibits & Complimentary Lunch Exhibits & Coffee Break	 10:00 – 11:30 12:30 – 13:30 15:30 – 16:00

For the latest list of all Congress exhibitors and sponsors, please visit the Congress App.

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Exhibits / Buyers' Guide

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Tabletop 304F
7770 Jefferson Street NE, Suite 440
Albuquerque, NM 87109, USA
Email: office@deps.org
URL: www.deps.org

Founded in 1999 to foster research, development and transition of Directed Energy (DE) technology for national defense and civil applications through professional communication and education. We intend to be recognized as the premier organization for exchanging information about and advocating research, development and application of DE, which includes both high energy lasers (HEL) and high power microwaves (HPM). DEPS is organized and operated exclusively for charitable, scientific, and educational purposes.

Edmund Optics
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EKSMA Optics
Tabletop 100
Mokslininku str. 11
Vilnius 08412, Lithuania
Email: info@eksmaoptics.com
URL: www.EksmaOptics.com

EKSMA Optics is a manufacturer and global supplier of precision optical components and optical systems for high power laser applications, laser media & nonlinear frequency conversion crystals, electro-optical Pockels cells with drivers and HV power supplies, laser electronics and ultrafast pulse picking systems used in lasers and other optical instruments.

EKSPLA
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Savanoriu av. 237
Vilnius 02300, Lithuania
Email: sales@ekspla.com
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Innovative manufacturer of lasers from unique custom system to small OEM series. In-house R&D team and more than 26 years' experience enable to tailor products for specific applications and/or according to specific requirements. Main products are: femtosecond, picosecond, nanosecond lasers, tunable systems, high energy systems, ultrafast fiber lasers, spectroscopy systems.

Electro-Optics Technology, Inc.
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Traverse City, MI 49686, USA
Email: sales@eotech.com
URL: www.eotech.com

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EOT manufactures Faraday rotators and isolators to protect laser diodes, fiber lasers, and solid-state lasers from back reflections while providing high transmission and excellent beam quality. EOT also stocks a complete line of photodetectors for time domain and frequency response measurements. The addition of FEE GmbH has added crystal growth and fabrication to its list of capabilities.

FLIR Scientific Materials Corp.
Tabletop 308F
31948 East Frontage Road
Bozeman, MT 59715, USA
Email: sales@scientificmaterials.com
URL: www.scientificmaterials.com

FLIR Scientific Materials specializes in CZ crystal growth and laser component manufacturing of high purity low-loss laser materials. Rare -earth and transition metal doped YAG,LUAG,YAP,TGG, Spinel and YSO for gain media, passive Q-switches, Faraday Isolators, and quantum state memory storage applications. High performance laser components and custom material development for niche applications.

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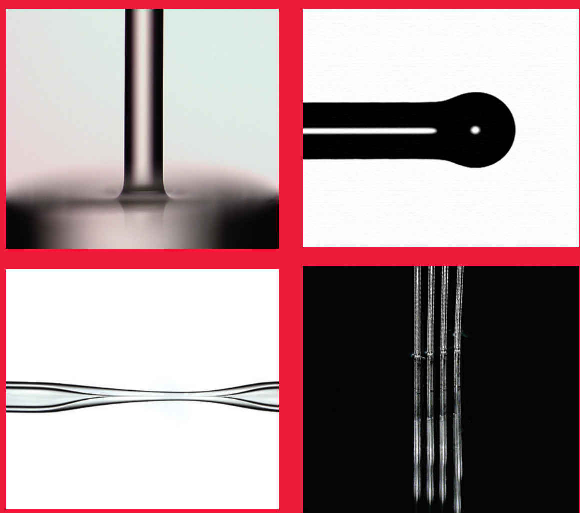

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Explanation of Session Codes

AM2B.4

Meeting Name

A= ASSL
L=LS&C
J = Joint

Number

Presentation order within session

Day of the Week

M=Monday
Tu=Tuesday
W= Wednesday
Th=Thursday

Series

1=1st of series
2=2nd of series
3=3rd of series
4=4th of series
5=5th of series

Session Designation

A=1st Parallel Session
B=2nd Parallel Session
C=3rd Parallel Session
D=4th Parallel Session

The first letter of the code designates the meeting. The second element denotes the day of the week . The third element indicates the session series in that day (for instance, 1 would denote the first sessions in that day). Each day begins with the letter A in the fourth element and continues alphabetically through the parallel session. The lettering then restarts with each new series. The number on the end of the code (separated from the session code with a period) signals the position of the talk within the session (first, second, third, etc.). For example, a presentation coded AM2B.4 indicates that this paper is being presented as part of the ASSL meeting on Monday (M) in the second series of sessions (2), and is the second parallel session (B) in that series and the fourth paper (4) presented in that session.

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Agenda of Sessions

Sunday, 29 September	
08:00—17:00	Registration, *Left Wing Main Lobby*
09:00—12:00	Short Course: SC491: Ultrafast Lasers, *Room 0.11 - 0.12*
14:00—17:00	Short Courses: SC492: Laser Beam Combining, *Room 0.11 - 0.12* SC493: Emerging Solid-State Gain Media, *Room 0.94 - 0.95*
17:30—19:00	Congress Reception, *Vienna City Hall*

Monday, 30 September			
	Hall E1	Hall M2	Hall M1
	Advanced Solid State Lasers	Lasers for Sensing & Free Space Communication	Laser Applications Conference
07:00—18:00	Registration, *Left Wing Main Lobby*		
08:00—10:00	JM1A • Joint Plenary Session I, *Hall E1*		
10:00—10:30	Coffee Break, *Entrance Hall*		
10:30—12:30	AM2A • High Power CPA	LM2B • Direct Detection and Imaging Lidar	Laser Induced Damage Test
12:30—14:00	Complimentary Lunch in Exhibit Halls		
12:30—14:00	Recent Trends in Laser Technology and its Applications in Manufacturing Technical Group Panel Discussion, *Room 0.11 - 0.12*		
14:00—16:00	AM3A • Laser Materials (Crystals)	LM3B • Coherent Lidar	LIDT II/Lasers for Space Applications
16:00—16:30	Coffee Break, *Entrance Hall, Hall F*		
16:30—18:30	AM4A • Ultrafast and High Energy techniques	LM4B • Doppler Lidar and Novel Sensing	Laser-Based Additive Manufacturing
18:30—20:00	AM5A • Student Poster Session in Exhibit Halls, *Sponsored by* IPG PHOTONICS		

Tuesday, 1 October			
	Hall E1	Hall M2	Hall M3
	Advanced Solid State Lasers	Lasers for Sensing & Free Space Communication	Laser Applications Conference
07:30—18:00	Registration, *Left Wing Main Lobby*		
08:00—10:00	ATu1A • CW Fibers and Waveguides	LTu1B • Lidar and the Atmosphere	EUV and X-Ray Generation/Lasers for Mobility
10:00—10:30	Coffee Break, *Entrance Hall, Hall F*		
10:30—11:30	JTu2A • Joint Keynote Plenary Session II, *Hall E1*		
11:30—14:00	JTu3A • Joint Poster Session Complimentary Lunch, *Entrance Hall, Hall F* *Sponsored by* IPG PHOTONICS		
11:30—12:30	Student & Early Career Professional Development & Networking Lunch and Learn, *Room 0.11-0.12*		
14:00—16:00	ATu4A • Transition Metal Doped II-VI mid-IR Materials, Lasers and Optics	LTu4B • Lidar for Autonomous Applications	Brittle Materials
16:00—16:30	Coffee Break, *Entrance Hall, Hall F*		
16:30—18:00	ATu5A • Ceramic Materials, Glasses, Lasers	LTu5B • Lidar Processing and Exploitation	Lasers for Mobility (ends at 18:30)
18:00—18:30	Break		
18:30—19:30	ATu6A • Joint Postdeadline Paper Session, *Hall E1*		

Agenda of Sessions

Wednesday, 2 October			
	Hall E1	Hall M2	Hall M1
	Advanced Solid State Lasers	Lasers for Sensing & Free Space Communication	Laser Applications Conference
07:30—17:30	Registration, *Left Wing Main Lobby*		
08:00—10:00	AW1A • Nonlinear Materials and Processes	LW1B • Sources & Techniques for Sensing and Communication	Surface Modification
10:00—11:30	JW2A • Joint Poster Session and Coffee Break, *Entrance Hall, Hall F*		
11:30—12:30	AW3A • High Power Optics	LW3B • Receiver Technologies for Sensing & Communication	Laser Shock Peening
12:30—13:30	Complimentary Lunch, *Entrance Hall, Hall F*		
13:30—15:30	AW4A • Middle Infrared Fiber Lasers, Materials and Processes	LW4B • Laser Sources for Lidar & Free Space Communication	
15:30—16:00	Coffee Break, *Entrance Hall, Hall F*		
16:00—18:00	Extreme Laser Sources & Applications Roundtable, *Hall E1*		
19:00—21:00	Conference Banquet, *Kunsthistorisches Museum, Sponsored by* IPG PHOTONICS		

Agenda of Sessions

Thursday, 3 October			
	Hall E1	Hall M2	Hall M1
	Advanced Solid State Lasers	Lasers for Sensing & Free Space Communication	Directed Energy Professional Society Special HEL Defense Applications Session
07:30—16:30	Registration, *Left Wing Main Lobby*		
08:00—10:00	ATh1A • Pulse Compression and High Power Systems	LTh1B • Free Space Laser Communication	Directed Energy Professional Society Special HEL Defense Applications Session I
10:00—10:30	Coffee Break, *Entrance Hall*		
10:30—12:30	ATh2A • Fiber Laser Techniques	LTh2B • Novel Laser Sensing	Directed Energy Professional Society Special HEL Defense Applications Session II
12:30—14:30	JTh3A • Joint Poster Session*, Entrance Hall, Hall F*		
12:30—14:30	Lunch Break (on your own)		
14:30—16:30	ATh4A • Lasers for Special Applications	LTh4B • Sensing Technologies	Directed Energy Professional Society Special HEL Defense Applications Session II
16:30—17:00	Awards and Closing Gathering, *Hall E*		

07:00—18:00 • Registration, *Left Wing Main Lobby*

Hall E1

Joint Plenary Session

08:00 -- 10:00
JM1A • Plenary Session
Presiders: Johannes Trbola; Dausinger + Giesen GmbH, Germany and Edward Watson; University of Dayton, USA

JM1A.1 • 08:00 Plenary
Industrial Laser Applications: Still a multi niche solution or ready for the big breakthrough? Klaus Loeffler[1]; [1]*TRUMPF Laser GmbH + Co KG , Germany.* Industrial laser applications have enabled many successful products. New features on products have resulted in a quick hype for lasers. These installations have not been a sustainable business for the laser manufacturers. Will newly developed laser applications change this picture?

JM1A.2 • 09:00 Plenary
Trends, Challenges and Applications of High-average Power Ultrafast thin-disk Lasers, Clara Saraceno[1], [1]Ruhr Universität Bochum, Germany. This talk will review latest progress in ultrafast disk laser systems, next steps and challenges towards further scaling, as well as ongoing and new application areas open by their unique performance.

10:00—10:30 • Exhibition Opening and Coffee Break, *Entrance Hall*

Hall E1 — ASSL

10:30 -- 12:30
AM2A • High power CPA
Presider: Niklaus Wetter; Centro de Lasers e Aplicações - IPEN/SP, Brazil

AM2A.1 • 10:30
Power scaling of few-cycle PPLN-based mid-IR OPCPA, Justinas Pupeikis[1], Pierre-Alexis Chevreuil[1], Chris Phillips[1], Ursula Keller[1]; [1]*ETH Zurich, Switzerland.* We present a mid-infrared (mid-IR) optical parametric chirped-pulse amplifier (OPCPA) generating 15 fs pulses centered at 2.1 µm with an average power of 22 W and peak power of 13 GW at repetition rate of 100 kHz.

AM2A.2 • 10:45
Few-cycle near-IR OPCPA system with 22 W average power and 100 kHz repetition rate, Stefan Hrisafov[1], Justinas Pupeikis[1], Benjamin Willenberg[1], Fabian Brunner[1], Nicolas Bigler[1], Chris Phillips[1], Ursula Keller[1]; [1]*ETH Zurich, Switzerland.* We present a near-infrared optical parametric chirped-pulse amplifier (OPCPA) system producing transform-limited pulses of duration 9.3 fs, centered at 800 nm, with an average power of 22.5 W at a repetition rate of 100 kHz.

AM2A.3 • 11:00
Novel method for CEP-stable seeding of few-cycle OPCPAs, Giovanni Cirmi[1,2], Huseyin Cankaya[1,2], Peter Krogen[3], Anne-Laure Calendron[1,2], Yi Hua[1], Benoit Debord[4], Frederic Gerome[4], Fetah Benabid[4], Franz X. Kaertner[1,2]; [1]*DESY/CFEL, Germany;* [2]*Center for Ultrafast Imaging, Germany;* [3]*MIT, USA;* [4]*Xlim Research Inst., France.* We demonstrate a novel energy-efficient method for seeding CEP-stable OPCPAs. We couple the CEP-stable idler of a broadband OPCPA into a Kagome fiber thus compensating for its angular chirp. We show the pulse compressibility.

Hall M2 — LS&C

10:30 -- 12:30
LM2B • Direct Detection and Imaging Lidar
Presider: Edward Watson; Univ. of Dayton, USA

LM2B.1 • 10:30 Invited
Past And Present Laser Sensing Activities at the Swedish Defence Research Agency (FOI). Ove K. Steinvall[1]; [1]*Swedish Defence Research Agency, Sweden.* This talk will summarize some of my experience from 50 years of laser sensing research at the Swedish Defense Research Agency (FOI). I will also try to give some ideas for the future in military laser sensing.

LM2B.2 • 11:00 Invited
DIAL Lidars for Safety and Security Applications, Jean-Baptiste Dherbecourt[3], Jean-Michel Melkonian[3], Rosa Santagata[3], Julie Armougom[3], Thomas Hamoudi[3,1], Quentin Berthomé[3,2], Philippe Nicolas[3], Cedric Blanchard[3], Vincent Lebat[3], Nicolas Tanguy[3], Antoine Godard[3], Myriam Raybaut[3], Nicolas Cezard[4], Béatrice Augère[4], Claudine Besson[4], Agnès Dolfi-Bouteyre[4], Didier Fleury[4], Didier Goular[4], Simon Le Méhauté[4], Julien Le Gouët[4], Christophe Planchat[4], Matthieu Valla[4], Thierry Huet[5]; [1]*Laboratoire Charles Fabry, Institut d'Optique Graduate School, CNRS, Université Paris-Saclay, France;* [2]*Teemphotonics, France;* [3]*DPHY, ONERA, Université Paris Saclay, France;* [4]*DOTA, ONERA, Université Paris Saclay, France;* [5]*ONERA/ DOTA, Université de Toulouse, France.* DIfferential Absorption Lidars (DIAL) can be powerful tools for remote detection of various gaseous species. We report here on the instruments that we have recently developed, based on specific optical sources, for industrial safety applications, as well as for defense applications.

Hall M1 — LAC

10:30 -- 12:30
Laser Induced Damage Test
Organizer: Danijela Rostohar, Institute of Physics of the ASCR, HiLASE Centre, Czech Republic

In the era of new generation high intensity lasers and their application, development and testing of new optical components and their coatings plays a crucial importance. Laser Induced Damage Threshold (LIDT) measurements are an essential part in understanding a very complex mechanism of damage occurrence. LIDT is a function of various parameters including laser wavelength, pulse duration, pulse repetition frequency, spot size, temporal and spatial profile, and angle of incidence. The purpose of this session is to bring attention to existing limitations in development of optical components and their coatings as well as requirements for establishing new techniques and standards on their LIDT testings.

10:30 Invited
Highest laser powers – not without understanding the limits of the coatings, Lars O. Jensen[1], Tammo Böntgen[1], Istvan Balasa[1]; [1]*Laser Zentrum Hannover e.V., Germany.* An overview on limiting mechanisms for the interaction of pulsed laser radiation with dielectric multi-layer structures and some recent concepts how to go beyond the state-of-the-art.

11:00 Invited
Laser Damage of Reflective Optics in the Sub-ps Regime: Physical Mechanisms and Technological Issues, Laurent Gallais[1]; [1]*Fresnel Institut, France.* We will give an overview of our recent studies on the laser damage resistance of optical components, that was focused on reflective optics operating at 1030/1053nm wavelengths for 500fs to few ps pulses applications.

Hall E1 — ASSL

10:30 -- 12:30
AM2A • High Power CPA- Continued
Presider: Niklaus Wetter; Centro de Lasers e Aplicações - IPEN/SP, Brazil

AM2A.4 • 11:15
Tunable, Few-Cycle, CEP-Stable Mid-IR Optical Parametric Amplifier for Strong-Field Applications, Mikayel Musheghyan[1,2], Prabhash Prasannan Geetha[3], Davide Faccialà[3], Aditya Pusala[3], Gabriele Crippa[4], Anna G. Ciriolo[3], Michele Devetta[3], Andreas Assion[1], Cristian Manzoni[3], Caterina Vozzi[3], Salvatore Stagira[3,4]; *[1]Spectra-Physics Rankweil (Standort Wien), Austria; [2]Inst. of Physics, Univ. of Kassel, Germany; [3]Istituto di Fotonica e Nanotecnologie, CNR, Italy; [4]Dipartimento di Fisica, Politecnico di Milano, Italy.* We present a tunable, Ti:Sa-pumped mid-IR OPA with CEP-stable, few-cycle output. The pulses are compressed in bulk, resulting in 56.5-fs,

AM2A.5 • 11:30
Generation of Sub-millijoule Few-optical-cycle Mid-IR Pulses via Cascaded Parametric Down-conversion, Ignas Astrauskas[1], Giedre M. Archipovaite[2], Valentina Shumakova[1], Guangyu Fan[1], Tan Lihao[3], Edgar Kaksis[1], Eric Cormier[2], Tadas Balciunas[1], Audrius Pugzlys[1,4], Andrius Baltuska[1,4]; *[1]Photonics Inst., TU Wien, Austria; [2]CELIA, Universite de Bordeux-CNRS-CEA, France; [3]DSO National Labs, Singapore; [4]Center for Physical Sciences and Technology, Lithuania.* Gigawatt-peak-power radiation, tunable in the 5-9 µm spectral window is generated as a difference frequency between the signal and idler pulses, originating from a KTA optical parametric amplifier pumped by 100-mJ, 200-fs Yb.

AM2A.6 • 11:45
Micro-joule, 10 kHz, sub-two-cycle, long wavelength mid-infrared laser source based on the 9 µm OPCPA, Shizhen Qu[1], Xiao Zou[1], Kun Liu[1], Wenkai Li[1], Hon Luen Seck[2], Qi Jie Wang[1], Ying Zhang[2], Houkun Liang[2]; *[1]Nanyang Technological Univ., Singapore; [2]Singapore Inst. of Manufacturing Technology, Singapore.* We report the first LiGaS2-based mid-IR OPCPA, delivering 13.8µJ, 10kHz, 145fs, 9µm pulses. A 5-mm thick KrS5 crystal is employed to further compress the pulse to the 45fs (1.5 cycle) pulse duration.

AM2A.7 • 12:00
Development and optimization of a compact TW-class laser with improved performance, Paulius P. Mackonis[1], Aleksej Rodin[1], Augustinas Petrulenas[1], Vytenis Girdauskas[1]; *[1]Ctr for Physical Sciences & Technology, Lithuania.* We report on the development of a compact TW-class laser containing Yb:YAG pumping source, a multi-octave supercontinuum in YAG, with the shaping of 1.1 ps pulses for pumping NOPCPA and reusing energy at the last NOPA stage.

AM2A.8 • 12:15

Withdrawn

Hall M2 — LS&C

10:30 -- 12:30
LM2B • Direct Detection and Imaging Lidar-Continued
Presider: Edward Watson; Univ. of Dayton, USA

LM2B.3 • 11:30 Invited
Application and Differentiation of Global Shutter 3D Flash LIDAR, Bradley Short[1], Tyler N. Bourbeau[1], Lane Fuller[1], James Curriden[1], Michael J. Dahlin[1]; *[1]Advanced Scientific Concepts LLC, USA.* The adaptation of LIDAR sensing for space-based applications has grown dramatically over the past decade. Global shutter flash LIDAR has emerged as the LIDAR sensor modality of choice for space craft operations.

LM2B.4 • 12:00 Invited
Voxtel Direct Detection Flash Lidar Sensors, George M. Williams[1]; *[1]Voxtel Incorporated, USA.* The architecture and performance of three Flash Ladar sensors will be presented: (1) a dual-mode 256 x 256 Silicon single photon avalanche detector (SPAD) focal plane array, capable of both photon counting imaging and time-of-flight (tof) lidar, (2) a 128 x 128 InGaAs Flash Ladar sensor capable of capturing both tof and signal amplitude, and (3) a 128 x 128 ladar sensor, capable of better than 2-ns time resolved full-waveform signal sampling. The general architecture of each ladar sensor will be presented, along with performance data, and ladar and pulse sampling imagery.

Hall M1 — LAC

10:30 -- 12:30
Laser Induced Damage Test- Continued
Presider: Danijela Rostohar, Institute of Physics of the ASCR, HiLASE Centre, Czech Republic

11:30 Invited
Importance of Laser Induced Damage Threshold in Laser Applications, Jan Vanda[1], Jan Brajer[1], Jan Kaufman[1], Mihai-George Muresan[1], Tomas Mocek[1]; *[1]HiLASE Centre, Inst. of Physics CAS, Czechia.* Since their invention in 1960, lasers have become essential to many applications and industries. Such development puts certain pressure on device reliability, where laser induced damage plays a key role.

12:00 Invited
Investigating the Long-Term Stability of LiB_3O_5 (LBO) Frequency Conversion Crystals at 355nm using Photothermal Deflection and LIDT measurements, Roelene Botha[1,2], Heidi Cattaneo[2], Martin Stahel[2], Thomas Gischkat[1], Igor Stevanovic[1], Zoltan Balogh-Michels[1], Carsten Ziolek[2]; *[1]Rhy Search, Switzerland; [2]NTB Univ. of Applied Science, Switzerland.* In order to gain an understanding of the fluctuating long-term stability of LBO crystals, photothermal deflection measurements are used to identify absorbing impurities and defects, followed by multiple pulse LIDT testing to identify possible correlations.

12:30—14:00 • Complimentary Lunch, *Entrance Hall, Hall F*

12:30—14:00 • Recent Trends in Laser Technology and its Applications in Manufacturing Technical Group Panel Discussion, *Room 0.11-0.12*

Hall E1

ASSL

14:00 -- 16:00
AM3A • Laser Materials (crystals)
Presider: Takunori Taira; RIKEN / IMS, Japan

AM3A.1 • 14:00 Invited
Laser and Nonlinear Materials for Intense Ultrafast Lasers, Peter F. Moulton[1]; *[1]Massachusetts Inst of Tech Lincoln Lab, USA.* Abstract to be announced.

AM3A.2 • 14:30
Undoped, Yb- and Nd-Doped LGSB Czochralski-Grown Nonlinear and Laser Crystals, Lucian Gheorghe[1], Madalin Greculeasa[1,2], Alin Broasca[1], Flavius Voicu[1], George Stanciu[1], Stefania Hau[1], Cristina Gheorghe[1], Catalina Alice Brandus[1,2], Gabriela Croitoru[1], Nicolaie Pavel[1]; *[1]National Inst. for Laser, Plasma and Radiation Physics, Romania; [2]Doctoral School of Physics, Univ. of Bucharest, Romania.* Pure, Yb- and Nd-doped $La_xGd_ySc_{4-x-y}(BO_3)_4$ incongruent melting nonlinear optical and laser crystals were successfully grown by the Czochralski method, for the first time, and their optical properties and laser performances were evaluated.

AM3A.3 • 14:45
Broadly tunable laser based on novel leaky-waveguide metallic diffraction grating, Yauhen Baravets[1], Petr Dvorak[1], Filip Todorov[1], Jiri Ctyroky[1], Pavel Peterka[1], Pavel Honzatko[1]; *[1]Inst. of Photonics and Electronics, Czechia.* Brand new leaky-waveguide metallic diffraction gratings are presented. Their potential is demonstrated on the example of semiconductor optical amplifier-based fiber laser, broadly tunable in a range from 1450 nm to 1615 nm.

AM3A.4 • 15:00
Spectroscopy and High-Power Laser Operation of Monoclinic Yb^{3+}:$MgWO_4$ crystal, Pavel Loiko[3], Mengting Chen[5], Josep M. Serres[4], Lizhen Zhang[1], Zhoubin Lin[1], Haifeng Lin[1], Ge Zhang[1], Yicheng Wang[2], Valentin Petrov[2], Uwe Griebner[2], Shibo Dai[5], Zhenqiang Chen[5], Patrice Camy[3], Magdalena Aguiló[4], Francesc Díaz[4], Weidong Chen[1,2], Xavier Mateos[4]; *[1]Fujian Inst of Res Structure of Matter, China; [2]Max Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany; [3]Centre de recherche sur les Ions, les Matériaux et la Photonique (CIMAP), France; [4]Universitat Rovira i Virgili (URV), Spain; [5]Jinan Univ., China.* Monoclinic 1.25 at.% Yb^{3+}:$MgWO_4$ crystals are grown by the Top-Seeded-Solution-Growth method and their room- and low-temperature spectroscopy is studied. A diode-pumped Yb^{3+}:$MgWO_4$ laser generates 18.2 W at ~1056 nm with a slope efficiency of ~89%.

AM3A.5 • 15:15
Ultrafast Laser Inscribed Waveguide Lasers in Tm:CALGO, Esrom Kifle[2], Pavel Loiko[1], Victor Llamas[2,3], Carolina Romero[5], Javier Rodriguez Vazquez de Aldana[5], Zhongben Pan[6,4], Josep M. Serres[2,3], Hualei Yuan[6], Xiaojun Dai[6], Huaqiang Cai[6], Yicheng Wang[4], Yongguang Zhao[4,7], Magdalena Aguiló[2], Francesc Díaz[2], Uwe Griebner[4], Valentin Petrov[4], Patrice Camy[1], Xavier Mateos[2]; *[1]CIMAP, Université de Caen Normandie, France; [2]Universitat Rovira i Virgili, Spain; [3]Eurecat, Centre Tecnològic de Catalunya, Spain; [4]Max Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany; [5]Univ. of Salamanca, Spain; [6]Inst. of Chemical Materials, China Academy of Engineering Physics, China; [7]Jiangsu Normal Univ., China.* Depressed-index channel waveguides are produced in Tm:CALGO by femtosecond direct-laser-writing. Under in-band-pumping at 1679 nm by a Raman fiber laser, the waveguide laser generates 0.81 W at 1866-1947 nm with

Hall M2

LS&C

14:00 -- 16:00
LM3B • Coherent Lidar
Presider: Sammy Henderson; Beyond Photonics, USA

LM3B.1 • 14:00 (ends at 14:45) Invited
Coherent Laser Radar: from Wind to Gravitational Waves, Robert L. Byer[1]; *[1]Stanford Univ., USA.* Coherent Laser Radar based on solid state lasers was motivated by coherent, lasers for observation of global wind. The challenge led to the invention of the monolithic NPRO Nd;YAG oscillator and its use in the detection of gravitational waves in 2015.

LM3B.2 • 14:45
Laser System for the LISA Mission, Stefan Kundermann[1], Lauriane Karlen[1], Nicolas Torcheboeuf[1], Erwin Portuondo-Campa[1], Ewelina Obrzud[1], Jonathan Bennès[1], Fabien Droz[1], Emmanuel Onillon[1], Anatoliy Savchenkov[2], Skip Williams[2], Andrey Matsko[2], Steve Lecomte[1]; *[1]CSEM SA, Switzerland; [2]OEwaves, USA.* LISA aims at the detection of GWs in space with optical interferometry. We will present the architecture of such a LISA laser system breadboard and the obtained results which almost fully meet the mission requirements.

LM3B.3 • 15:00 Invited
Applications of Digital Holographic Laser Remote Sensing at Lockheed Martin Coherent Technologies, Philip Gatt[1], Samuel T. Thurman[1], Brian W. Krause[1], Kalle Anderson[1], Andrew Bratcher[1], Chris Ryan[1], and Thomas G. Alley[1]; *[1]Lockheed Martin Coherent Technologies, USA.* In this paper, we provide an overview of the various unique applications of digital holographic imaging being developed at Lockheed Martin Coherent Technologies (LMCT). Digital holography is a coherent detection imaging scheme which provides direct access to the signal complex amplitude (amplitude and phase) with near single photon sensitivity. This enables many day/night active imaging paradigms including range, Doppler, multi-aperture, synthetic aperture, and inverse synthetic aperture imaging. We review the digital holographic approach and describe LMCT's research and development activities in these unconventional imaging technologies using fundamentally the same hardware. We also show key dual relationships between range and Doppler imaging and describe the similarities between synthetic and inverses synthetic

Hall M1

LAC

14:00 -- 16:00
Laser Induced Damage Test II/Lasers for Space Applications
Presider: Thomas Dekorsy; DLR, Germany

Laser systems become of increased relevance for applications in space. These applications cover remote sensing, laser based detection of gravitational waves, and laser communication. In addition, the growing problem of space debris will lead to important applications for lasers such as laser ranging and mitigation of space debris. The operation of lasers in space is connected with challenges different from laser systems operated on ground which will be addressed in the session.

14:00 Invited
Qualification of Laser Optics for Challenging Space LIDAR Missions, Wolfgang Riede[1]; *[1]German Aerospace Center, Germany.* Validation procedures for high-power laser optics have been developed and applied during the qualifying process, mainly in preparation of the ESA AEOLUS mission. On-ground tests of the AEOLUS instrument were performed demonstrating fitness for launch.

14:30 Invited
Space based lasers for gravitational wave detection, Christian Greve[1], Katrin Dahl[2], Geoffrey Barwood[3], Jonathan Bennès[4], Claus Braxmaier[7], Pelin Cebeci[5], Christoph Deutsch[6], Oliver Fitzau[5], Mher Ghulinyan[8], Martin Giesberts[5], Patrick Gill[3], Brigitte Kassner[1], Silvio Koller[1], Evgeny Kovalchuk[9], Markus Krutzik[9], Stefan Kundermann[4], Steve Lecomte[4], Roland Le Goff[10], Christophe Meier[4], Markus Oswald[7], Achim Peters[9], Sana Amairi Pyka[9], Jose Sanjuan[7], Max Schiemangk[11], Stéphane Schilt[12], Thilo Schuldt[7], Alexander Sell[1], Christian Stenzel[1], Kai Voss[2], Andreas Wicht[11], Anton Zhukov[2]; *[1]Airbus GmbH, Germany; [2]Space Tech GmbH, Germany; [3]National Physics Lab, UK; [4]Centre Suisse d'Electronique et de Microtechnique, Switzerland; [5]Fraunhofer Inst. for Laser Technology, Germany; [6]Crystalline Mirror Solution, Austria; [7]Deutsches Zentrum für Luft- und Raumfahrt, Inst. of Space Systems, Germany; [8]Fondazione Bruno Kessler, Italy; [9]Humboldt-Universitaet zu Berlin, Germany; [10]Sodern, France; [11]Ferdinand-Braun-Institut, Leibniz-Institut für Hoechstfrequenztechnik, Germany; [12]Laboratoire Temps-Fréquence, Université de Neuchâtel, Switzerland.* We present the requirements, design, and tests of a potential laser system for the Laser Interferometer Space Antenna (LISA) mission as well as a potential frequency stabilization system.

15:00 Invited
Laser-based Space Debris Mitigation in the Low Earth Orbit, Stefan Scharring[1], Raoul-Amadeus Lorbeer[1], Jürgen Kästel[1], Wolfgang Riede[1]; *[1]German Aerospace Center, Germany.* Laser ablation is discussed as a method for ground-based orbit modification of space debris in the Low Earth Orbit with the purpose of collision avoidance and debris removal by high energy lasers.

Hall E1	Hall M2	Hall M1
ASSL	LS&C	LAC

ASSL — Hall E1

14:00 -- 16:00
AM3A • Laser Materials (crystals)- Continued
Presider: Takunori Taira; RIKEN / IMS, Japan

AM3A.6 • 15:30
Novel acousto-optical KYW and KGW Q-switches for powerful 3-µm lasers, Andrey V. Pushkin[1], Mikhail Mazur[2], Anatoly Sirotkin[3], Fedor V. Potemkin[1], Vyacheslav Gordienko[1]; *[1]Lomonosov Moscow State Univ., Russia; [2]Federal State Unitary Enterprise (FSUE) ''National Research Inst. for Physicotechnical and Radio Engineering Measurements ''VNIIFTRI'', Russia; [3]A. M. Prokhorov General Physics Inst., Russian Academy of Sciences, Russia.* The first application of a KYW and KGW acousto-optical shutters in 3-um lasers is reported. The Cr:Er:YSGG laser provides 29.6-mJ 75-ns pulses. The energy is scaled to 85.7 mJ in the MOPA system.

AM3A.7 • 15:45
52-fs SESAM Mode-Locked Tm,Ho:CALGO Laser, Yicheng Wang[1], Yongguang Zhao[1], Pavel Loiko[2], Zhongben Pan[1], Weidong Chen[1], Mark Mero[1], Xiaodong Xu[3], Jun Xu[4], Xavier Mateos[5], Arkady Major[6], Soile Suomalainen[7], Antti Härkönen[7], Mircea Guina[7], Uwe Griebner[1], Valentin Petrov[1]; *[1]Max Born Inst., Germany; [2]Université de Caen, France; [3]Jiangsu Normal Univ., China; [4]Tongji Univ., China; [5]Universitat Rovira i Virgili, Spain; [6]Univ. of Manitoba, Canada; [7]Tampere Univ. of Technology, Finland.* A SESAM mode-locked Tm,Ho:CALGO laser emitting at 2.015 µm due to the combined gain of both dopants generates pulses as short as 52 fs with a maximum output power of 376 mW

LS&C — Hall M2

14:00 -- 16:00
LM3B • Coherent Lidar– Continued
Presider: Sammy Henderson; Beyond Photonics, USA

LM3B.4 • 15:30
Sensing and Imaging Aerosol Particles with Digital Holography from a UAV, Matthew J. Berg[1], Osku Kemppinen[1], Jesse Laning[1], Ryan Mersmann[1]; *[1]Physics, Kansas State Univ., USA.* Digital holography is a powerful method to study aerosol particles in a contact -free way. This work describes our development and use of a new UAV-mounted instrument that images aerosol particles with digital holography in the atmosphere.

LM3B.5 • 15:45
Phase retrieval of a transparent object from intensity measurements, Dahi Abdelsalam[1]; *[1]National Inst. of Standards, Egypt.* Surface characterization using a non-interferometric optical system is presented. The 3D phase of the object is extracted based on the Stokes vector estimation. Merits of the proposed system are that it is simple and robust.

LAC — Hall M1

14:00 -- 16:00
Laser Induced Damage Test II/Lasers for Space Applications– Continued
Presider: Thomas Dekorsy; DLR, Germany

15:30 Invited
Development of Single-frequency Lasers for Space-based Remote Sensing, Patrick M. Burns[1], Floyd E. Hovis[1], Moran Chen[1], Kegan Orlowski[1], Slava Litvinovitch[1], Chris Lin[1], Fran Fitzpatrick[1]; *[1]Fibertek Inc., USA.* Single-frequency lasers are a key enabling technology for deployable space-based Differential Absorption Lidar (DIAL) and wind lidar systems. Fibertek is developing single frequency lasers for space-based methane/water vapor DIAL and coherent wind lidar measurement systems.

16:00—16:30 • Coffee Break, *Entrance Hall, Hall F*

Hall E1	Hall M2	Hall M1
ASSL	LS&C	LAC

ASSL — Hall E1

16:30 -- 18:30
AM4A • Ultrafast and High Energy Techniques
Presider: Clara Saraceno; Ruhr Universität Bochum, Germany

AM4A.1 • 16:30 Invited
Nonlinear Pulse Evolution: Beyond the Gain-narrowing Limit, Pavel Sidorenko[1], Walter Fu[1], Frank Wise[1]; *[1]Cornell Univ., USA.* We demonstrate a short-pulse fiber amplifier in which nonlinearity is managed by gain. We show numerically and experimentally that this gain-managed pulse evolution paves the way toward simple, compact fiber systems producing high-energy, ~30-fs pulses.

AM4A.2 • 17:00
Flexible Sub-1 ps Ultrafast Laser Exceeding 1 kW of Output Power for High-Throughput Surface Structuring, Christoph J. Röcker[1], André Loescher[1], Martin Delaigue[2], Clemens Hönninger[2], Eric Mottay[2], Thomas Graf[1], Marwan Abdou Ahmed[1]; *[1]IFSW Univ. of Stuttgart, Germany; [2]AMPLITUDE SYSTEMES, France.* We report on a flexible ultrafast thin-disk laser system delivering sub-1ps pulses at 1kW of average power. To enable high-throughput material processing a fast modulation scheme based on polarization-multiplexing and a burst-mode operation were implemented.

AM4A.3 • 17:15
Soliton-Modelocked Thin-Disk Laser Oscillator with 350 W Average Power and Sub-ps Pulses, Francesco Saltarelli[1], Ivan Graumann[1], Lukas Lang[1], Dominik Bauer[2], Chris Phillips[1], Ursula Keller[1]; *[1]ETH Zurich, Switzerland; [2]TRUMPF Laser GmbH, Germany.* We present a 350-W 940-fs thin-disk oscillator. We achieve this new record-high average power ultrafast oscillator through vacuum operation, multiple passes on the disk, and large pump spot. Systematic power-scaling through multi-pass cavities is discussed.

LS&C — Hall M2

16:30 -- 18:30
LM4B • Doppler Lidar and Novel Sensing
Presider: Farzin Amzajerdian; NASA Langley Research Center, USA

LM4B.1 • 16:30 Invited
Techniques for Simultaneous Quadrature Image Detection for Imaging SAL and Vibrometry, Matthew Dierking[2,1]; *[1]Univ. of Dayton, USA; [2]Exciting Technologies, LLC, USA.* Techniques for simultaneous detection and pre-processing of spatially resolved quadrature signals are explored for applications to synthetic aperture lidar and imaging vibrometry. Analytic descriptions, simulations and experimental results will be presented.

LM4B.2 • 17:00
Laser Doppler Multi-Beam Differential Vibration Sensor for Acoustic Detection of Buried Objects, Vyacheslav Aranchuk[1], Ina Aranchuk[1], Brian Carpenter[1], Craig Hickey[1]; *[1]Univ. of Mississippi, USA.* A Laser Doppler multi-beam differential vibration sensor which has low sensitivity to the motion of the sensor itself has been developed. The application of the sensor for vibration imaging of buried objects has been demonstrated.

LM4B.3 • 17:15
High Peak Power Doppler Lidar Based On A 1.5µm Compressive-Strained-Singlemode Fiber Amplifier, Laurent Lombard[1], Béatrice Augère[1], Anne Durécu[1], Didier Goular[1], François Gustave[1], Matthieu Valla[1], Agnès Dolfi-Bouteyre[1]; *[1]Office Natl d'Etudes Rech Aerospatiales, France.* We present a comparison of a commercial LMA-fiber-amplifier and an Onera-patented Compressive-Strained-Singlemode-fiber-amplifier as high power laser sources in a coherent wind LIDAR system. Lidar performance is similar whereas Onera amplifier only uses singlemode components.

LAC — Hall M1

16:30 -- 18:30
Laser-Based Additive Manufacturing
Organizer: Thomas Grunberger, Plasmo Industrietechnik GmbH, Austria

Additive manufacturing is a fast growing segment and well known since many years (e.g. pyramids in egypt was built additive 4500 years ago). Especially laser technology enabled us in the last few decades to develop new manufacturing processes. Are we in the phase of a second hype of this technology or are we at the step from prototyping to industrial production? The session covers different technologies and will show already successful examples and future trends. There are 2 different principal technologies using lasers as energy source, powder bed fusion and laser based direct energy deposition (feedstock wire and powder). The session starts with a presentation about the motivation for additive manufacturing and examples in the area powder bed fusion from an OEM perspective. Additve manufacturing systems are available for different materials like metals, ceramics and plastics. The second presentation shows a novel approach for additive manufacturing of high performance polymers. The third presentation deals with a future approach, hybrid manufacturing, means combining additive manufacturing with other conventional or other additive techniques which is expected to be one of the big drivers for AM in future. The last presentation covers wire based laser metal deposition and special aspects in printing titanium parts. Especially aviation industry is a key driver for the future of this technology, so we get the information about the status and future topics using this technology.

Hall E1 — ASSL

16:30 -- 18:30
AM4A • Ultrafast and High energy Techniques–Continued
Presider: Clara Saraceno; Ruhr Universität Bochum, Germany

AM4A.4 • 17:30
Sub-10 fs, Ultrabroadband, CEP-stable Multipass Ti:Sa Amplifier, Mikayel Musheghyan[1,2], Fabian Lücking[3], Zhao Cheng[4], Praveen Maroju[5], Harald Frei[1], Andreas Assion[1]; *[1]Spectra-Physics Rankweil (Standort Wien), Austria; [2]Inst. of Physics, Univ. of Kassel, Germany; [3]XARION Laser Acoustics GmbH, Austria; [4]Laboratoire d'Optique Appliquée, ENSTA-Paris Tech, France; [5]Albert Ludwig Univ. of Freiburg, Germany.* We present a compact scheme for generating sub-10-fs, CEP-stable pulses. The output of a CEP-stable ultrabroadband 3-mJ, 12-fs Ti:Sa amplifier is spectrally broadened in bulk and compressed, resulting in sub-10 fs pulses.

AM4A.5 • 17:45
Generation of 23-fs Pulses at 850 nm from a Carbon Nanotube Mode-Locked Solid-State Laser , Gokhan Tanisali[1], Isinsu Baylam[2], Ferda Canbaz[1], Ji Eun Bae[3], Fabian Rotermund[3], Umit Demirbas[4,5], Alphan Sennaroglu[1,2]; *[1]Koc Universitesi, Turkey; [2]Koç Univ. Surface Science and Technology Center, Turkey; [3]Physics, Korea Advanced Inst. of Science and Technology (KAIST), Korea (the Republic of); [4]Electrics and Electronics Engineering, Antalya Bilim Univ., Turkey; [5]Deutsches Elektronen-Synchrotron DESY, Germany.* We report, to the best of our knowledge, direct generation of the shortest pulses from a single-walled carbon nanotube mode-locked solid-state laser with a Cr:LiSAF gain medium, yielding 23-fs, nearly transform-limited pulses at 850 nm.

AM4A.6 • 18:00
0.7mJ and 12ns Pulses at 2.72µm from a 70µm Core Er:ZBLAN Fiber Amplifier, Weizhi Du[1], Xuan Xiao[1], Yifan Cui[1], John Nees[1], Igor Jovanovic[1], Almantas Galvanauskas[1]; *[1]Univ. of Michigan, USA.* We demonstrate 667µJ and 11.5ns pulses at 2.72µm from an LMA Er:ZBLAN fiber amplifier with 70µm core. This represents the highest energy and peak power ever obtained in mid -IR with a fiber laser source.

AM4A.7 • 18:15
Highly Efficient THz Generation by Mid-IR Pulses, Claudia Gollner[1], Anastasios Koulouklidis[2,3], Mostafa Shalaby[4,5], Corinne Brodeur[4], Vladimir Fedorov[2,6], Valentina Shumakova[1], Stelios Tzortakis[2,3], Andrius Baltuska[1,7], Audrius Pugzlys[1,7]; *[1]TU Wien, Austria; [2]Science Program, Texas A&M Univ. at Qatar, Qatar; [3]Inst. of Electronic Structure and Laser (IESL), Foundation for Research and Technology - Hellas (FORTH), Greece; [4]Swiss Terahertz Research-Zurich, Switzerland; [5]Key Lab of Terahertz Optoelctronics, Beijing, China; [6]P. N. Lebedev Physical Inst. of the Russian Academy of Sciences, Russia; [7]Center for Physical Sciences & Technology, Lithuania.* We report on THz generation driven by 3.9 µm pulses, via either optical rectification in organic crystals or in two-color plasma filaments. Outstanding THz conversion efficiency of more than 2% and bandwidth exceeding 15 THz are achieved.

Hall M2 — LS&C

16:30 -- 18:30
LM4B • Doppler Lidar and Novel Sensing–Continued
Presider: Farzin Amzajerdian; NASA Langley Research Center, USA

LM4B.4 • 17:30
Characterization of a Coherent Doppler Lidar for Operation Onboard Aerial and Space Vehicles, Farzin Amzajerdian[1], Glenn D. Hines[1], Diego F. Pierrottet[2], Aram Gragossian[2], bruce w. barnes[1], Jay n. Estes[3], John M. Carson[3]; *[1]NASA Langley Research Center, USA; [2]Coherent Applications, USA; [3]NASA Johnson Space Center, USA.* A Doppler lidar instrument has been developed to provide velocity and altitude data for precision navigation of space and terrestrial vehicles. Performance of this lidar is characterized through a series of ground and flight tests.

LM4B.5 • 17:45
Coherent Fiber Lidar at 1645 nm for simultaneous measurements of methane, wind speed, and aerosols, Nicolas Cezard[1], Simon Le Méhauté[1], Agnès Dolfi-Bouteyre[1], Claudine Besson[1], Julien Le Gouët[1]; *[1]Office Natl d'Etudes Rech Aerospatiales, France.* We report on measurement results obtained with the first coherent fiber CH_4/Doppler lidar, called VEGA. The instrument measure simultaneously range-resolved profiles of methane concentration, wind speed, and relative aerosol load.

LM4B.6 • 18:00
High-speed 2D Single-shot Surface Profilometry for Industrial Inspection under Vibrational Environment, Toshiki Awane[1], Tuan Q. Banh[2]; *[1]Saitama Univ., Japan; [2]Sevensix, Japan.* The image of 2D single-shot interferometry based high-speed camera at a shutter speed of ~1µs, which crosses over the limit of conventional OCTs, was experimentally observed. The optical shapes were captured even under vibrational environment.

LM4B.7 • 18:15
Astronomy Beyond The Diffraction Limit Using Optical Amplifier, Gal Gumpel[1], Erez N. Ribak[1]; *[1]Technion Israel Inst. of Technology , Israel.* We describe a new method to overcome the diffraction limit in astronomy, by amplification of photon wave packets. This method was demonstrated in theory, by computer simulation, and is now being experimentally tested.

Hall M1 — LAC

16:30 -- 18:30
Laser-Based Additive Manufacturing–Continued
Organizer: Thomas Grunberger, Plasmo Industrietechnik GmbH, Austria

16:30 Invited
The Role of Monitoring in Industrial Additive Manufacturing (AM), Martin Steuer[1], [1]EOS GmbH Electro Optical Systems, Germany. Where and how has manufacturing adopted industrial 3D printing (laser powder bed fusion technology), what are advantages of AM and its use case and which role monitoring plays in developing application and quality assurance?

17:00 Invited
Laser-based Additive Manufacturing of High Performance Polymers, Wolfgang Steiger[1], Bernhard Busetti[1], Robert Gmeiner[1]; *[1]Cubicure GmbH, Austria.* For industrial applications laser scanning systems based on diode lasers offer unique advantages. Their fast modulation and high beam quality allow the additive production of precise polymer parts with excellent surface and material properties.

17:30 Invited
Hybrid Manufacturing – the Future of 3D Metal Printing, Markus Wolf[1], [1]Coherent (Deutschland) GmbH, Germany. AM processes are widely related with low surface quality and accuracy, especially when it comes to certain industries. This is where the hybrid AM process exploits its full potential when combining additive and subtractive manufacturing techniques.

18:00 Invited
Multiphysical Approach for the Simulation of Powder-based Laser Additive Manufacturing Processes, Andreas Otto[1] and Rodrigo Gómez Vázquez[1]; *[1]Technical University of Vienna, Austria.* Numerical simulations have shown to be a useful tool for supporting theoretical studies on a wide range of laser assisted manufacturing processes. Applied to the optimization of a process, the virtually unlimited post-processing possibilities help to elucidate interacting mechanisms and ultimate causes for failures, thus allowing more efficient selection of correcting actions. With a proper setup, the multiphysical simulation of these processes can even supply geometries that are comparable with the experimental ones, but also further valuable information that may be critical for the success of a process (e.g. thermal-history curves). With the purpose of extending the current studies towards powder-based additive processes, a convenient combination of mesh-based Eulerian methods (for the continuous phases i.e. workpiece) with mesh-free Lagrangian ones (for representing the particles) allows the simulation of these processes in a macroscopic scale without having to neglect the mechanistical effects. In this regard, an overview of present development work aimed to the simulation of laser cladding and selective laser melting will be presented.

18:30 -- 20:00

JM5A • Joint Student Poster Session, *Sponsored by* IPG Photonics

JM5A.1

Withdrawn

JM5A.2

30 mJ Sub-nanosecond Burst-mode Nd:YAG MOPA Laser, Wentao Wu[1], Xudong Li[1], Renpeng Yan[1], Feng Mei[1], Deying Chen[1]; [1]*Harbin Inst. of Technology, China.* We demonstrated a sub-nanosecond burst-mode Nd:YAG laser. Output with the single pulse energy of 30 mJ and the pulse width of 900 ps at 1 kHz is obtained within the burst duration of 100 ms.

JM5A.3

Power Scaling of Yb:YAG Thin-Disk-Laser and Zero-Phonon-Line Pumping , Saeid Radmard[1], Shahram kazemi[1], Mohammad Aghaie[1]; [1]*Iranian Natl Ctr for Laser Sci & Tech, Iran (the Islamic Republic of).* Increasing the power scaling potential of Yb:YAG thin -disk-lasers utilizing zero-phonon-line pumping is investigated and thoroughly discussed. Numerical predictions compared with experimental results for 969 nm pumping sources.

JM5A.4

Spectroscopic Characterisation of Yb:LiLuF$_4$ Between (63-293)K, Silvia Cante[1], Jacob I. Mackenzie[1]; [1]*Optoelectronics Research Centre, UK.* Absorption and emission cross-section spectra for Yb:LuLiF$_4$ are reported for sub-ambient temperatures. Significant deviation from reciprocity between them highlights the importance of electron-phonon coupling in this material and benefits thereof for diode-laser pumping.

JM5A.5

Efficient High-Power Self-Raman Laser with Adjustable Power-Ratio between Lime and Green Emission, Yu Cheng Liu[1], Chia-Han Tsou[3], Hsing-Chih Liang[2], Kuan-Wei Su[3], Yung-Fu Chen[3]; [1]*National Chiao Tung Univ., Taiwan;* [2]*National Taiwan Ocean Univ., Taiwan.* The efficient high-power self-Raman laser with adjustable power-ratio between lime and green emission is developed by using two different lithium triborate (LBO) crystals.

JM5A.6

Clinically Relevant Ultrafast Pulsed Laser Ablation of *Ex Vivo* Ovine Lung Tissue, Susan E. Fernandes[1], Katjana Ehrlich[1,2], Kev Dhaliwal[1], Robert R. Thomson[1,2]; [1]*Univ. of Edinburgh, UK;* [2]*Heriot-Watt Univ., UK.* Ultrafast pulsed lasers may enable minimally invasive lung cancer treatment. Femtosecond pulsed ablation of ovine lung tissue, characterised using microCT, demonstrated clinically relevant volume ablation rates, and potentially represents novel therapeutic modality in lung cancer.

JM5A.7

2.94 µm and 2.1 µm tunable laser based on Yb,Ho-doped GGAG crystal, Richard Svejkar[3], Jan Sulc[3], Pavel Bohacek[1], Helena Jelínková[3], Bohumil Trunda[1], Lubomír Havlák[1], Martin Nikl[2], Karel Jurek[2]; [1]*Dept. of Condensed Matter Physics, Inst. of Physics of the Czech Academy of Sciences, Czechia;* [2]*Dept. of Solid State Physics, Inst. of Physics of the Czech Academy of Sciences, Czechia;* [3]*Faculty of Nuclear Sciences and Physical Engineering,, Czech Technical Univ. in Prague, Czechia.* For the first time, laser based on Yb,Ho:GGAG crystal emitting radiation at 2.09 µm and 2.94 µm is presented. The tunability of Yb,Ho:GGAG laser was obtained in spectral bands 2063 - 2113 nm and 2860 - 2944 nm.

JM5A.8

Characterizing the Topological Charges in the Astigmatic Transformation from Hermite-Gaussian Modes to Hermite-Laguerre-Gaussian Modes, Y. H. Hsieh[1], Yu-Hsiang Lai[1], Min-Xiang Hsieh[1], Kai-Feng Huang[1], Yung-Fu Chen[1]; [1]*Electrophysics, National Chiao Tung Univ., Taiwan.* The topological charges distribution for Hermite-Laguerre-Gaussian (HLG) modes are explored theoretically and experimentally. Successively increasing the astigmatism will leads to the split. the combination, and the cancellation of topological charges.

JM5A.9

Impact of the heat load on the laser performance of Chirally-Coupled-Core fibers, Shicheng Zhu[1,2], Li jinyan[2], Li Li[1], Kexiong Sun[1], Chang Hu[3], Xiuquan Ma[1]; [1]*School of Mechanical Science and Engineering, Huazhong Univ of Science and Technology, China;* [2]*Wuhan National Lab for Optoelectronics, Huazhong Univ. of Science and Technology, China;* [3]*School of Materials Science and Engineering, Huazhong Univ. of Science and Technology, China.* As the heat load can change the designed refractive index profile of Chirally-Coupled -Core (CCC) fibers through the thermo-optic effect, its impact on the laser performance of CCC fibers is investigated.

JM5A.10

Continuous-Wave and Graphene Mode-Locked Operation of a Tm^{3+}:KY$_3$F$_{10}$ Laser at 2.3 µm, Abdullah Muti[1], Mauro Tonelli[2], Ji Eun Bae[3], Fabian Rotermund[3], Valentin Petrov[4], Alphan Sennaroglu[1,5]; [1]*Koç Univ., Turkey;* [2]*NEST Istituto Nanoscienze-CNR and Dipartimento di Fisica dell'Università di Pisa, Italy;* [3]*Physics, Korea Advanced Inst. of Science and Technology, Korea (the Republic of);* [4]*Max Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany;* [5]*Koç Univ. Surface Science and Technology Center, Turkey.* We report, for the first time to our knowledge, continuous-wave, broadly tunable laser operation of the Tm^{3+}:KY$_3$F$_{10}$ gain medium between 2260 and 2385 nm and graphene mode locking, yielding 976-fs pulses near 2340 nm.

JM5A.11

A stable watt-class 813-nm Tm^{3+}-doped ZBLAN fiber MOPA with photobleaching, Eiji Kajikawa[1], Tomohiro Ishii[1], Kazuhiko Ogawa[2], Mitsuru Musha[1]; [1]*Inst. for Laser Science, Univ. of Electro-Communications, Japan;* [2]*FiberLabs Inc., Japan.* With the help of photobleaching at 532 nm, a watt-class stable light source at 813 nm has been realized by a Tm^{3+}-doped ZBLAN fiber amplifier for the lattice laser of Sr optical lattice clock.

JM5A.12

Asymmetrical Vortex Beams in the Spherical Cavities, Y. H. Lai[1], M. X. Hsieh[1], Y. H. Hsieh[1], Hsing-Chih Liang[1], Kai-Feng Huang[1], Yung-Fu Chen[1]; [1]*Electrophysics, National Chiao Tung Univ., Taiwan.* The integral representation with spatial damping effect is derived to characterize the asymmetrical vortex beams in the spherical cavities. It is found that the spatial damping will lead to the split of central degenerate singularities.

JM5A.13

Withdrawn

JM5A.14

Measurement of Temperature Gradient in Periodically Poled Lithium Niobate Crystal in Process of Second Harmonic Generation of Near-IR Pump Laser Radiation, Grigorii Y. Ivanov[1], Aleksei V. Konyashkin[2], Oleg Ryabushkin[2]; [1]*MIPT, Russia;* [2]*IRE RAS, Russia.* Temperature gradient of PPLN crystal in process of SHG was measured using transparent tiny piezoelectric crystals as thermal sensors. Temperature of each sensor was determined directly by measuring induced frequency shifts of its piezoelectric resonances.

JM5A.15

Stability Demands for Laser-systems in Plasma Acceleration , Timo F. Eichner[1], Thomas Hülsenbusch[1,2], Cora Braun[1], Lars hübner[1], Sören Jalas[1], Manuel Kirchen[1], Tino Lang[2], Phuoc Thien Le[1], Vincent Leroux[1,2], Philipp Messner[1], Matthias Schnepp[1], Max Trunk[1], Lutz Winkelmann[2], Paul Winkler[1,2], Ingmar Hartl[2], Andreas R. Maier[1]; [1]*Center for Free-Electron Laser Science/Univ. of Hamburg, Germany;* [2]*Deutsches Elektronen-Synchrotron DESY, Germany.* We report on the long-term stability of the 200TW ANGUS laser system and approaches for overcoming the limits of Ti:Sapphire laser systems to fulfill the stability demands of laser- plasma accelerators.

JM5A.16

Stable High Power Sub-50 fs Kerr-Lens Mode-Locked Yb:CaYAlO$_4$ Laser, Geyang Wang[1], Wenlong Tian[1], Han Liu[1], Rui Xu[1], Chuan Bai[1], Dacheng Zhang[1], Xiaodong Xu[2], Jiangfeng Zhu[1], Zhiyi Wei[3]; [1]*Xidian Univ., China;* [2]*Jiangsu Normal Univ., China;* [3]*Inst. of Physics, Chinese Academy of Sciences, China.* We demonstrate a stable high-power Kerr-lens mode-locked Yb:CaYAlO$_4$ laser, delivering 49 fs pulses with central wavelength at 1032 nm. The average power is 1.1 W with root mean square fluctuation of 0.62% over 300 hours.

JM5A.17

ReSe$_2$-based Saturable Absorber for Femtosecond Mode-locking of a Fiber Laser, Jinho Lee[1], Kyungtaek Lee[1], Ju Han Lee[1]; [1]*Univ. of Seoul, Korea.* We demonstrate a femtosecond fiber laser incorporating a ReSe$_2$/PVA-based saturable absorber (SA). Using a ReSe$_2$/PVA-based SA, stable ~862-fs pulses are shown to be readily obtained from an erbium-doped fiber ring cavity at 1561.2 nm.

JM5A.18

Highly coherent supercontinuum generation in chalcogenide all-solid hybrid microstructured optical fibers, Hoa P. Nguyen[1], Hoang Tuan Tong[1], Than Singh Saini[1], Takenobu Suzuki[1], Yasutake Ohishi[1]; [1]*Toyota Technological Inst., Japan.* We propose chalcogenide all-solid hybrid microstructured optical fibers for mid-infrared supercontinuum generation pumped with lasers at short wavelengths. The supercontinuum spectra are from 1.3 to 7 µm and highly coherent.

JM5A.19

Organic Solid-State Laser for Silicon Nitride Photonic Integrated Circuits, Florian Vogelbacher[1,2], Joerg Schotter[1], Martin Sagmeister[3], Jochen Kraft[3], Xue Zhou[4], Jinhua Huang[4], Mingzhu Li[4], Ke-Jian Jiang[4], Yanlin Song[4], Karl Unterrainer[2], Rainer Hainberger[1]; [1]*Center for Health & Bioresources, AIT Austrian Inst. of Technology GmbH, Austria;* [2]*Photonics Inst., TU Wien, Austria;* [3]*ams AG, Austria;* [4]*Inst. of Chemistry, Chinese Academy of Sciences, China.* Coherent light sources are a key component for photonic integrated circuits. Organic solid-state lasers can be monolithically integrated and are highly cost-effective. We report silicon nitride organic hybrid laser designs pumped with a laser diode.

18:30 -- 20:00
JM5A • Joint Student Poster Session – Continued

JM5A.20
High-power Femtosecond Optical Frequency Comb, Zhiwei Zhu[1], Daping Luo[1], Lian Zhou[1], Zejiang Deng[1], Yang Liu[1], Chenglin Gu[1], Wenxue Li[1]; *[1]East China Normal Univ., China.* We report on an 80-W, 50-fs self -similar-amplification comb and a 100-W, 150-fs chirpedpulse amplification comb. Frequency stability and noise characteristics of two locked pulse trains can confirm the generation of these high-power frequency fiber combs.

JM5A.21
Single Shot Modal Decomposition of Optical Fiber Output in OAM Basis using Optical Correlation Technique, Pachava Srinivas[1], Balaji Srinivasan[1]; *[1]Indian Instisute of Technology Madras, India.* We represent the optical fibre output beam as a linear superposition of orbital angular momentum (OAM) modes to quantify its purity. We present single shot modal decomposition methodology and verify the method for different test cases using simulations.

JM5A.22
Effect of Polarization on the Raman Scattering of the 2D Material -Tungsten Disulphide, Shubhayan Bhattacharya[1], Aneesh V. Veluthandath[1], Chung C. Huang[2], Ganapathy S. Murugan[2], Prem B. Bisht[1]; *[1]Indian Inst. of Technology, Madras, India; [2]Optoelectronics Research Centre, UK.* Raman-spectra of a few-layer tungsten disulphide (WS_2) on fused-silica substrate have been recorded with varying polarization of the excitation-laser. The polarization dependence of one of the Raman modes has been explained using the Raman cross-section.

JM5A.23
Energy transfer parameters of Tm ions in $KY(WO_4)_2$ and $KLu(WO_4)_2$ crystals, Natali Gusakova[2], Anatolii Yasukevich[2], Anatolii Pavlyuk[1], Nikolai Kuleshov[2]; *[1]Inst. of Inorganic Chemistry, Russia; [2]Center for Optical Materials and Technologies, BNTU, Belarus.* We studied the energy migration and cross-relaxation between Tm^{3+} ions in tungstate crystals by means of Dexter and Förster models and perform mathematical modeling of Tm:KYW and Tm:KLuW lasers with different thulium concentrations.

JM5A.24
Ho:YAG single-crystal fiber amplifier, Jianlei Wang[2], Qingsong Song[2], Yongguang Zhao[1], Chongfeng Shen[2], Weichao Yao[2], Xiaodong Xu[2], Jun Xu[3], Deyuan Shen[2]; *[1]Max-Born Inst., Germany; [2]Jiangsu Normal Univ., China; [3]Tongji Univ., China.* We study the amplification properties of Ho:YAG SCF grown by μ-PD technique. Output power of 8 W is achieved with 1 W seed, corresponding to a gain of 8 and a slope efficiency of 46.3%.

JM5A.25
Radiation hardening of ytterbium-doped silica fiber for space application, Chongyun Shao[1], Fengguang Lou[1], Meng Wang[1], Lei Zhang[1], Shikai Wang[1], Chunlei Yu[1], Lili Hu[1]; *[1]Shanghai Inst of Optics & Fine Mech Lib, China.* The ytterbium doped preforms were pre-treated by loading gases, pre-irradiation combined with thermal annealing. Effects of pre-treatment conditions on laser performance and radiation resistance of optical fiber were investigated.

JM5A.26
$Cr^{2+} \rightarrow Fe^{2+}$ Energy Transfer Parameters in $Zn_{1-x}Mn_xSe:Cr^{2+},Fe^{2+}$ (x = 0.3) Crystal and 4.4 μm Fe^{2+} Lasing under 1.7 μm Pumping, Adam Riha[1], Maxim E. Doroshenko[2], Helena Jelínková[1], Michal Nemec[1], Jan Sulc[1], David Vyhlídal[1], Michal Jelinek[1], Alexander G. Papashvili[2], Nazar O. Kovalenko[3], Andrey Gerasimenko[3]; *[1]Dept. of Physical Electronics, Czech Technical Univ. in Prague, Czechia; [2]Laser Materials and Technology Research Center, General Physics Inst., Russia; [3]Inst. for Single Crystals, National Academy of Sciences of Ukraine, Ukraine.* Two different pumping of $Zn_{1-x}Mn_xSe:Cr^{2+},Fe^{2+}$ (x=0.3) crystal at ~1.7 μm at ~ns and for the first time at ~ms ranges followed by the $Cr^{2+} \rightarrow Fe^{2+}$ ions energy transfer resulting in the ~4.4 μm laser radiation are reported.

JM5A.27
7 W Mid-Infrared Supercontinuum Generation up to 4.7 μm in an Indium-Fluoride Optical Fiber Pumped by a High-Peak Power Thulium-Doped Fiber Single-Oscillator, Giuseppe Scurria[1,2], Inka Manek-Hönninger[2], Jean-Yves Carrée[3], Anne Hildenbrand-Dhollande[1], Stefano Bigotta[1]; *[1]French-German Research Inst. of Sain, France; [2]CELIA UMR5107, Université Bordeaux CNRS CEA, France; [3]Le Verre Fluoré, France.* High-power supercontinuum generation is achieved with a maximal all bands output power of 7 W and spectrum extension up to 4.7 μm in an InF_3 fiber pumped by a picosecond thulium-doped fiber single-oscillator.

JM5A.28
All fiber combined Er/Er-Yb amplifier for efficient amplification of high peak power single frequency pulses, Maksim Khudyakov[1,2], Denis S. Lipatov[3], Aleksey N. Guryanov[3], Mikhail Bubnov[1], Mikhail E. Likhachev[1]; *[1]Fiber Optics Research Center of the Russian Academy of Sciences, Russia; [2]Moscow Inst. of Physics and Technology (State Univ.), Russia; [3]G.G. Devyatykh Inst. of Chemistry of High-Purity Substances, Russian Academy of Sciences, Russia.* Novel configuration of fiber amplifier based on combining Er-doped Yb-free and Er-Yb codoped fiber in single amplifier was realized. Peak power of 3.7 kW in 150 ns single-frequency pulses with differential efficiency of 23% was demonstrated.

JM5A.29
Effect of pumping configuration on the transverse mode instability power threshold in a 3.02 Kw fiber laser oscilator, Ali Roohforouz[1,2], Reza Eyni chenar[2], Saeed Azizi[2], Reza Rezaei Nasirabad[2], Kamran Hejaz[2], Ali Abedi Najafi[2], Vahid Vatani[2], seyed hasan nabavi[2]; *[1]Kharazmi Univ., Iran (the Islamic Republic of); [2]Iranian National Center for Laser Science and Technology, Iran.* The transverse mode instability power threshold in a 3.02 kW fiber oscillator have been compared in co -, counter- and bidirectional pumping schemes and results show that the threshold is higher in the bidirectional pumping configuration.

JM5A.30
Multispectral wavefront sensor for Petawatt class compressor alignment and optimisation, Lucas Ranc[1,2], Catherine LeBlanc[1], Ji-Ping ZOU[1], Xavier Levecq[3], Frédéric Druon[4], Dimitris Papadopoulos[1]; *[1]Laboratoire pour l'Utilisation des Lasers Intenses (LULI), France; [2]Thales LAS France SAS, France; [3]Imagine Optic, France; [4]Laboratoire Charles Fabry, IOGS, France.* This study presents theoretical and experimental investigations on a compressor alignment using a multi -spectral wavefront sensor. This technique is capable to optimize and characterize the spatio-temporal coupling of a PW class laser facility.

JM5A.31
Mode-Locked Laser in Modeless Cavity, Dan Cheng[1,2], Yujun Feng[1], Meng Ding[1], Johan Nilsson[1]; *[1]Univ. of Southampton, UK; [2]Beijing Jiaotong Univ., China.* A passively mode-locked erbium-doped fiber laser incorporates an intra-cavity electro-optic phase modulator. Stable soliton mode-locking was achieved even when the phase modulator was driven with noise to render the cavity modeless.

JM5A.32
Measurement of optical rotatory power of quartz between 77 K and 325 K at 1030 nm wavelength, Mariastefania De Vido[1,2], Klaus Ertel[1], Agnieszka Wojtusiak[1,3], Paul D. Mason[1], Saumyabrata Banerjee[1], Jonathan Phillips[1], Jodie Smith[1], Thomas Butcher[1], Chris Edwards[1]; *[1]STFC Rutherford Appleton Lab, UK; [2]Inst. of Photonics and Quantum Sciences, Heriot-Watt Univ., UK; [3]Loughborough Univ., UK.* We report on the experimental characterization of the temperature dependence of the optical rotatory power of crystalline quartz at 1030 nm wavelength between 77 K and 325 K.

JM5A.33
Temperature dependence of spectroscopic properties of cryogenically cooled $Tm^{3+}:LuF_3-CaF_2$ diode pumped laser, Karel Veselsky[1], Jan Sulc[1], Helena Jelínková[1], Maxim E. Doroshenko[2], Kseniia A. Pierpoint[2], Vasilii A. Konyushkin[2], Andrey N. Nakladov[2], Vjatcheslav V. Osiko[2]; *[1]Czech Technical Univ. in Prague, Czechia; [2]Prokhorov General Physics Inst. of the Russian Academy of Sciences, Russia.* Temperature dependence of spectroscopic and laser properties of diode pumped laser based on new $Tm^{3+}:LuF_3-CaF_2$ crystal were investigated for the first time with maximum output energy up to 20 mJ and slope efficiency 64 %.

JM5A.34
Optical Supercontinuum Source at 2 to 3.2 μm, Caterina Clemente[1,2], Nikolai Tolstik[2,3], Mario Christian Falconi[1], Francesco Prudenzano[1], Irina T. Sorokina[2]; *[1]Polytechnic of Bari, Italy; [2]NTNU, Norway; [3]ATLA Lasers AS, Norway.* We report supercontinuum generation (SC) in a chalcogenide fiber between 1.9-3.2 μm at up to 180 mW output power pumped with Cr:ZnS laser, operating at 2360 nm,1 nJ 100-fs pulses and 144 MHz repetition rate.

JM5A.35
Beam quality in high-power thin-disk lasers: influence and measurement of the radial inversion profile, Francesco Saltarelli[1], Daniel Koenen[1], Lukas Lang[1], Ivan Graumann[1], Chris Phillips[1], Ursula Keller[1]; *[1]ETH Zurich, Switzerland.* Beam quality plays a pivotal role in modelocking high-power oscillators. We identify the causes, which determine the beam quality in thin-disk lasers and suggest guidelines to maximize the power range of optimal beam quality.

JM5A.36
Phase-Locked Programmable Femtosecond Pulse Bursts from a Regenerative Amplifier, Tobias Flöry[1], Vinzenz Stummer[1], Edgar Kaksis[1], Audrius Pugzlys[1,2], Andrius Baltuska[1,2]; *[1]Photonics Inst., TU Wien, Austria; [2]Center for Physical Sciences & Technology, Lithuania.* We demonstrate phase-controlled pulse-burst amplification based on differential pathlength stabilization between the master oscillator and the amplifier cavities. This technique boosts the safe level of extractable burst energy and suppresses fluctuations in various burst-mode applications.

Entrance Hall, Hall F

18:30 -- 20:00

JM5A • Joint Student Poster Session– Continued

JM5A.37

Fiber-laser ablation of high-temperature TiN–TiB_2 ceramics for protective coating , Igor V. Melnikov[1], Marina V. Vlasova[2], Vladimir N. Tokarev[3], Yakov S. Fironov[1], Eugeny R. Nadezhdin[1]; *[1]Moscow Inst. of Physics and Technology, Russia; [2]CIICAp - UAEM, Mexico; [3]Prokhorov General Physics Inst. of Russian Academy of Sciences, Russia.* In this report, the process of local laser heating of TiN–TiB_2 ceramics in the air is presented with emphasis on the formation of vaporous ablation products, which are, among others, TiO_2 and B_2O_3 and which percipitation on a substrate yields in deposition of a variety pf protecting $Ti_xB_yO_z$ films.

JM5A.38

Coherence properties of the flat-top supercontinuum between 1.9 and 2.4 um, Roland A. Richter[1], Nikolai Tolstik[1], Irina T. Sorokina[1]; *[1]Norwegian Univ of Science and Technology, Norway.* In this paper we investigate noise and coherence properties of a flat-top supercontinuum generated directly from the ccompact Tm-fiber MOPA and show that highly coherent spectrum is achievable at optimised laser parameters.

JM5A.39

All-fiber ultrashort pulse amplifier at a wavelength of 1.9 µm with thulium-doped fiber, Vasiliy Voropaev[1], Alexander Donodin[1], Dmitrii Vlasov[1], Daniil Batov[1], Andrei Voronets[1], Mikhail Tarabrin[1,3], Vladimir Lazarev[1], Mikhail Melkumov[2], Valeriy E. Karasik[1]; *[1]Bauman Moscow State Technical Univ., Russia; [2]Fiber Optics Research Center of the Russian Academy of Sciences, Russia; [3]P. N. Lebedev Physical Inst. of the Russian Academy of Sciences, Russia.* We developed an all-fiber ultrashort pulse amplifier at a wavelength of 1.9~\textmu m based on thulium-doped fiber with negative group velocity dispersion. The minimum pulse duration was 109 fs, the maximum power was 800 mW.

JM5A.40

Czochralski Growth and Characterization of Pure and Yb-Doped $La_xY_ySc_{4-x-y}(BO_3)_4$ Nonlinear and Laser Crystal, Alin Broasca[1], Lucian Gheorghe[1], Madalin Greculeasa[1,2], Flavius Voicu[1], George Stanciu[1], Stefania Hau[1], Cristina Gheorghe[1], Gabriela Croitoru[1], Nicolaie Pavel[1]; *[1]National Inst. for Laser, Plasma and Radiation Physics, Romania; [2]Doctoral School of Physics, Romania.* Nonlinear optical (NLO) and laser crystals with incongruent melting of pure and Yb-doped $La_xY_ySc_{4-x-y}(BO_3)_4$ - LYSB were grown by the Czochralski method for the first time. Their main NLO properties and laser performances are reported.

JM5A.41

Characterizing self-written waveguides for near infrared wavelengths, Derek J. Cassidy[1]; *[1]Univ. College Dublin, Ireland.* The creation of self-written waveguides within photopolymer material and their permanent nature are optically characterized and investigated for the purpose of propagating near infrared wavelengths for use within optoelectronics systems and communication networks.

JM5A.42

Manufacturing of Arbitrary Shaped Optical Elements by 3D Laser Lithography, Dovile Andrijec[1,2], Linas Jonusauskas[1,2], Agne Butkute[1,2], Tomas Baravykas[1,2], Darius Gailevicius[1,2], Zigmas Balevicius[3], Mangirdas Malinauskas[2]; *[1]Femtika, Lithuania; [2]Laser Research Center, Vilnius Univ., Lithuania; [3]State Research Inst. Center for Physical and Technological Sciences, Vilnius Univ., Lithuania.* We present 3D laser lithography of arbitrary shaped microoptical elements. Their quality, functionality and resiliency to intense femtosecond laser radiation is investigated quantitatively and qualitatively. Ways to increase throughput while maintaining surface quality are proposed.

JM5A.43

Performance Analysis of FSO Systems Using DWT-OFDM in Different Weather Conditions, Jie Pang[1], Shencheng Ni[1], Feng Wang[1], Shuying Han[1], Shanhong You[1], Xiang Li[2], Ming Luo[2], Zichen Liu[2]; *[1]School of Electronic & Information Engineering, Soochow Univ., China; [2]State Key Lab of Optical Communication Technologies and Networks, Wuhan Research Inst. of Posts & Telecommunications, China.* We demonstrated a FSO system with the simulated atmospheric channels in different weather conditions and propose to apply DWT-OFDM in this system. The experimental results show that the FSO system using DWT-OFDM has better anti-interference performance.

JM5A.44

Light Yield Nonlinearity of LSO Crystal Excited by Picosecond Ultraviolet Laser, Kun Wei[1,2], Dongwei Hei[2], Jun Liu[2], Xiufeng Weng[2], Xinjian Tan[2], Bin Sun[2]; *[1]Dept. of Engineering Physics, Tsinghua Univ., China; [2]State Key Lab of Intense Pulsed Radiation Simulation and Effect, China.* Relationship between light yield and excitation fluence was studied by changing laser intensity and the distance between focal spot and LSO crystal. Results show that nonlinear energy threshold of LSO crystal is about 3 J/cm^3.

JM5A.45

Withdrawn

JM5A.46

Noise Characteristic Analysis Technique for TDC based LIDAR using High-resolution Eye-safe Low-SWaP LIDAR, Munhyun Han[2,1], Gyudong Choi[1], Hongseok Seo[1], Jeongdan Choi[1], Bongki Mheen[1,2]; *[1]ETRI, Korea; [2]ICT(Advanced Device Technology), Univ. of Science and Technology, Korea.* We proposed the noise analysis technique not only for obtaining the real-time accurate noise distribution but also used for on-board noise performance optimization, which is important to the most Low-SWaP LIDAR systems.

JM5A.47

Spectral Dependence of Optical Radiation Losses in Metal-Coated Optical Fibers, Pavel Cherpak[1], Renat Shaidullin[2], Oleg Ryabushkin[2]; *[1]MIPT, Russia; [2]IRE RAN, Russia.* A method for measurements of optical losses of metal-coated fibers in a wide wavelength range is introduced. It is based on measurements of metal coating electrical resistance change induced by radiation transmitted inside the fiber.

JM5A.48

Compact Single-channel Interferometer for the Study of Light Propagation through Thin Diffusers, Sruthy J L[1], A Vijayakumar[1], Shanti Bhattacharya[1]; *[1]IIT Madras, India.* A compact, single-channel interferometer is developed by spatial-random multiplexing of two phase masks for producing axial planes suitable for diffusing one of the two co-propagating waves for the study of light propagation through thin diffusers.

JM5A.49 • 18:30

Post-optical-amplification of Confocal Amplitude and Phase Images in Scan-less Confocal Dual-Comb Microscopy, Takuya Tsuda[1,2], Takahiko Mizuno[1,2], Eiji Hase[1], Takeo Minamikawa[1,2], Hirotsugu Yamamoto[3,2], Takeshi Yasui[1,2]; *[1]Tokushima Univ., Japan; [2]JST ERTATO MINOSHIMA IntelligentnOptical Synthesizer, Japan; [3]Utsunimoya Univ., Japan.* We combined dual-comb microscopy and post-amplification technique for rapid acquisition of confocal amplitude and phase images. This combination enables us to improve SNR in both images while achieving rapid image acquisition.

JM5A.50 • 18:30

A Novel Voxel-based Spatial Elongation Filtering Method for Single-Photon Lidar Data, Tong Luo[1], Rongwei Fan[1], Zhaodong Chen[1], Zhiwei Dong[1], Wentao Wu[1]; *[1]Harbin Inst. of Technology, China.* A voxel-based spatial elongation filtering method is proposed to remove noise and preserve signal in SPL data. The false alarm rate using our method is 18.6% smaller than that using the voxel-based spatial filtering method.

JM5A.51 • 18:30

Acquisition, tracking and pointing system without independent fine beacon light, Xueqiang Zhao[1,2], Xia Hou[1], Jianfeng Sun[1], Ren Zhu[1], Tai Li[1], Qiong Hu[1], Yan Yang[1], Weibiao Chen[1]; *[1]shanghai Inst. of Optics and Fine Mechanics, China; [2]Univ. of Chinese Academy of Science, China.* We propose a pointing, acquisition and tracking (PAT) system without independent fine beacon for coherent receiver in inter-satellite optical communication, which is compatible with two modes: no beacon mode and no fine beacon mode.

JM5A.52 • 18:30

Experimental Investigation of Coherent All-Optical Relaying System Based on Spatial Light Modulator, Yang Hu[1], Shanyong Cai[1], Biao Gong[1], Zhiguo Zhang[1]; *[1]Beijing Univ. of Posts and Telecommunications, China.* Coherent all-optical relaying system is experimentally investigated using spatial light modulator and EDFA in this paper. Compared with non-relay system, the bit error rate performance is significantly improved.

JM5A.53 • 18:30

Measuring Linewidth Enhancement Factor by Laser Dynamics, Zhuqiu Chen[1], Yuxi Ruan[1], Bairun Nie[1], Yanguang Yu[1], Qinghua Guo[1], Jiangtao Xi[1], Jun Tong[1]; *[1]Univ. of Wollongong, Australia.* A new method for measuring linewidth enhancement factor of a semiconductor laser (SL) is proposed by using laser dynamics. This method can work when the SL suffer very strong optical feedback.

JM5A.54 • 18:30

Mode-locked fibre laser damage on amplification due to multi-pulsing, Ikram Khan[1], Shree Krishnamoorthy[1], Anil Prabhakar[1]; *[1]IIT Madras, India.* Semiconductor saturable absorber mirror based mode-locked fiber laser was built. On amplification, a chain action caused saturable absorber damage, initiated by backward amplified spontaneous emission, multi-pulsing and self-pulsing was

07:30—18:00 • Registration, *Left Wing Main Lobby*

Hall E1 — ASSL

08:00 -- 10:00
ATu1A • CW Fibers and Waveguides
Presider: Yushi Kaneda; Univ. of Arizona, USA

ATu1A.1 • 08:00
Fiber Raman Laser Pumped by Five Wavelength-Combined Multimode Diode Lasers from 915 to 976 nm, Soonki Hong[1], Yutong Feng[1], Johan Nilsson[1]; [1]*Optoelectronic Research Centre, UK.* A fiber Raman laser pumped by five multimode diode lasers at 976, 969, 950, 940, and 915 nm generates 31.5 W of output power at a single wavelength of 1018 nm with 42% slope-efficiency.

ATu1A.2 • 08:15
First demonstration of kilowatt-level ytterbium-Raman fiber amplifiers with narrow-linewidth and near-diffraction-limited beam quality, Pengfei Ma[1], Yu Miao[1], Wei Liu[1], Daren Meng[1], Rongtao Su[1], Pu Zhou[1]; [1]*National Univ. of Defense Technolog, China.* Here, a kilowatt-level, narrow-linewidth fiber amplifier operating at 1120 nm is firstly designed and fulfilled by comprehensively suppressing stimulated Brillouin scattering, alleviating spectral broadening, and avoiding the power limitation of traditional wavelength division multiplexer.

ATu1A.3 • 08:30
2 kW High-efficiency Raman Fiber Amplifier Based on Graded-index Passive Fiber, Yizhu Chen[1], Tianfu Yao[1], Yi An[1], Jiaxin Song[1], Xu Jiangming[1], Hu Xiao[1], Jinyong Leng[1], Pu Zhou[1]; [1]*National Univ of Defense Technology, China.* In this paper, continuous-wave Raman fiber amplifier based on multi-mode graded-index passive fiber with record 2.087 kW output power at 1130 nm is proposed with the optical-to-optical efficiency of 90.1%.

ATu1A.4 • 08:45
High power, tunable, narrow linewidth dual gain hybrid laser, Jörn P. Epping[1], Ruud Oldenbeuving[1], Dimitri Geskus[1], Ilka Visscher[1], Robert Grootjans[1], Chris Roeloffzen[1], René Heideman[1]; [1]*LioniX International BV, Netherlands.* We present the first hybrid integrated laser with two gain sections coupled to one tunable cavity. The resulting laser has a output power of up to 85 mW and an intrinsic linewidth of 320 Hz.

ATu1A.5 • 09:00
Characterization and Long-Term Operation of a 200 W Single-Frequency Fiber Amplifier for Gravitational Wave Detectors, Felix Wellmann[1], Michael Steinke[1], Fabian Meylahn[2], Nina Bode[2], Benno Willke[2], Ludger Overmeyer[1,3], Peter Weßels[1], Jörg Neumann[1], Dietmar Kracht[1]; [1]*Laser Zentrum Hannover e.V., Germany;* [2]*Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut), Germany;* [3]*Institut für Transport- und Automatisierungstechnik, Germany.* We developed and operated a 200 W single-frequency fiber amplifier at 1064 nm for > 695 h. We observed no signs of stimulated Brillouin scattering. Excellent noise properties and a TEM_{00}-mode content of 94.8% were demonstrated.

ATu1A.6 • 09:15
Tunable all-polarization-maintaining single-cavity dual-color/dual-comb from an Yb:fiber laser, Jakob Fellinger[1], Aline S. Mayer[1], Georg Winkler[1], Wilfrid Grosinger[1], Gar-Wing Truong[2], Stefan Droste[3], Chen Li[3], Christoph M. Heyl[3,4], Ingmar Hartl[3], Oliver Heckl[1]; [1]*Faculty of Physics, Univ. of Vienna, Austria;* [2]*Crystalline Mirror Solutions LLC, USA;* [3]*Deutsches Elektronen-Synchrotron DESY, Germany;* [4]*Helmholtz-Inst. Jena, Germany.* We demonstrate the generation of a tunable single-cavity dual-comb out of an all-polarization-maintaining ytterbium fiber laser via spectral subdivision. The feasibility of spectroscopy measurements is demonstrated by measuring the transmission of a 5-mm thick etalon.

Hall M2 — LS&C

LS&C Room
08:00 -- 10:00
LTu1B • Lidar and the Atmosphere
Presider: Matthew Berg; Kansas State Univ., USA

LTu1B.1 • 08:00 Invited
The Application of LiDAR in Atmospheric Research, Qiaoyun Hu[1]; [1]*Universite de Lille 1, France.* This study presents the application of multiwavelength Raman-Mie LiDAR on the detection of aerosols, clouds, trace gases and polluants.

LTu1B.2 • 08:30 Invited
Atmospheric Propagation and Correction of Laser Beams for Communication and Sensing Applications, Christelle Kieleck[1]; [1]*Fraunhofer IOSB, Germany.* Adaptive optics (AO) perform correction of atmospheric effects on light propagation. Nevertheless, strong turbulence can lead to high failure rates of the traditional AO systems. Fraunhofer IOSB develops unconventional wavefront sensors to address this issue.

LTu1B.3 • 09:00 Invited
Light Propagation in Clouds: from Digital Holography to Non-exponential Extinction, Raymond Shaw[1]; [1]*Michigan Technological Univ., USA.* Optical propagation is strongly influenced by the number concentration, size distribution, thermodynamic phase, and spatial distribution of particles in atmospheric clouds. These properties have been investigated in the field using an airborne digital holographic instrument. A Lab facility has also been developed, in which optical propagation is being investigated in steady-state turbulent-cloud conditions.

Hall M1 — LAC

08:00 -- 10:00
EUV and X-Ray Generation
Presider: Lahsen Assoufid,; Argonne National Laboratory, USA

The rapid progress in extreme-power laser technology opened a path to the development of a new generation of small-scale EUV, X-ray, and Gamma-ray light sources with unprecedented brightness and short pulses. These sources, which could fit on a tabletop or in a small-scale laboratory, will revolutionize many industrial, research, medical, defense, and security applications. Their development relies on the progress in laser technology and performance. This session will give an update on the latest development, needs and challenges in high-power laser technologies tailored to methods for short (EUV, X- and Gamma-ray) wavelength generation (laser-produced plasma, high harmonic generation, inverse Compton scattering), and laser plasma acceleration.

08:00 Invited
PW Class Laser Application for the Next Generation Heavy Ion Cancer Therapy Machine, Kiminori Kondo[1]; [1]*Kansai Photon Science Inst., JAEA, Japan.* PW class laser has a potential of generating enough number of energetic heavy ion beam for the next generation heavy ion cancer therapy machine, which might induce the innovation in cancer therapy.

08:30 Invited
Compact Femtosecond X-ray Sources Based on the Laser Wakefield Accelerator, Dino A. Jaroszynski[1]; [1]*Univ. of Strathclyde, UK.* We present several examples of radiation sources based on the laser wakefield accelerator. These have unique characteristics compared with conventional devices. They include ultra-compact femtosecond synchrotron sources and possibly a free-electron laser in the future.

09:00 Invited
Towards Laser Plasma Accelerated Electrons based Free Electron Lasers, Marie-Emmanuelle Couprie[1]; [1]*Synchrotron SOLEIL, France.* The recently developed laser plasma accelerators delivering GeV/cm electron beams can be qualified by undulator and free electron laser light source applications. First results, including electron beam manipulation, will be given.

09:30 Invited
High-Power Ultrafast Industrial Thin-Disk Lasers, *Peter Krötz[1], Christian Grebing[1], Clemens Herkommer[1], Robert Jung[1], Sandro Klingebiel[1], Stephan Prinz[1], Catherine Y. Teisset[1], Christoph Wandt[1], Knut Michel[1] and Thomas Metzger[1];* [1]*TRUMPF Scientific Lasers GmbH + Co. KG, Germany.* Ultrafast amplifiers using industrial thin-disk technology from TRUMPF deliver record pulse energies of 200 mJ at 5 kHz. In addition, multipass amplifiers to increase the average power and pulse energy and concepts for nonlinear compression to reach pulse durations below 50 fs will be discussed.

Hall E1

ASSL

08:00 -- 10:00
ATu1A • CW Fibers and Waveguides– Continued
Presider: Yushi Kaneda; Univ. of Arizona, USA

ATu1A.7 • 09:30
Yb:CALGO Waveguide Laser Written with 1 MHz-Repetition Rate fs-Laser, Kore Hasse[1,2], Christian Kraenkel[2,3]; [1]*Institut für Laser-Physik, Universität Hamburg, Germany;* [2]*The Hamburg Center for Ultrafast Imaging, Germany;* [3]*Center for Laser Materials, Leibniz-Institut für Kristallzüchtung, Germany.* We report on the first MHz-fs-laser inscribed waveguide lasers in Yb:CALGO. Slope efficiencies of 67% at 3.9 W of output power were realized under 7 W

ATu1A.8 • 09:45
Diode-pumped Yellow Laser Emission of Tb^{3+}:$LiLuF_4$, Elena Castellano-Hernández[1], Sascha Kalusniak[1], Christian Kränkel[1]; [1]*Center for Laser Materials, Leibniz-Institut für Kristallzüchtung, Germany.* We report on the first diode-pumped yellow laser operation of a Tb^{3+}-laser. Without any nonlinear frequency conversion, the laser delivers 13.8 mW at a wavelength of 587.4 nm with a slope efficiency of 22%.

Hall M2

LS&C

LS&C Room
08:00 -- 10:00
LTu1B • Lidar and the Atmosphere– Continued
Presider: Matthew Berg; Kansas State Univ., USA

LTu1B.4 • 09:30 Invited
Development of a Space Pathfinder Coherent Lidar for Global 3D Wind Measurement, Jirong Yu[1]; [1]*NASA Langley Research Center, USA.* Abstract be announced.

10:00—10:30 • Coffee Break, *Entrance Hall, Hall F*

Hall E1

Joint Session

10:30 -- 11:30
JTu2A • Joint Keynote Plenary Session II
Presider: Irina Sorokina, Norges Teknisk Naturvitenskapelige University, Norway

10:30 -- 11:30 Plenary
Passion for Extreme Light, Gérard Mourou[1]; [1]*Ecole Polytechnique, France.* The stunning capabilities of extreme light produced by Chirped Pulse Amplification (CPA) laser will be presented as well as the vast application it offers for science and society.

11:30 -- 14:00
JTu3A • Joint Poster Session

JTu3A.1
Ultrafast Ho-doped Fiber Oscillator with Intracavity Dispersion Compressor, Maria Pawliszewska[1], anna duzynska[2], Mariusz Zdrojek[2], Jaroslaw Sotor[1]; *[1]Faculty of Electronics, Wroclaw Univ. of Science and Technology, Poland; [2]Faculty of Physics, Warsaw Univ. of Technology, Poland.* We report on an holmium-doped fiber oscillator incorporating a Martinez-type compressor. The laser operates in anomalous, stretched-pulse and net-normal dispersion regimes. Additionally, wavelength tuning in 2021 – 2096 nm range is demonstrated.

JTu3A.2
Self-referenceable Yb:CaF_2 oscillator pumped by a single-mode laser diode, Maciej Kowalczyk[1], Michal Porebski[1], Jaroslaw Sotor[1]; *[1]Wroclaw Uni. of Science and Technology, Poland.* We present a carrier-envelope offset frequency detection of an Yb:CaF_2 mode-locked oscillator pumped by a single-mode fiber-coupled laser diode. The detection scheme is based on a standard f-to-$2f$ interferometer.

JTu3A.3
Origin of Lasing Modes Changing from Low-Order Hermite-Gaussian modes to High-Order geometric modes in Off-Axis Pumped Degenerate Cavities, M. X. Hsieh[1], Y. H. Hsieh[1], Y. H. Lai[1], Kai-Feng Huang[1], Yung-Fu Chen[1]; *[1]Electrophysics, National Chiao Tung Univ., Taiwan.* The wave-packet representation for geometric rays are developed to unify the eigenmodes and geometric modes in the degenerate cavities. The comparisons between theoretical and experimental results provide deeper understanding of the ray-wave correspondence.

JTu3A.4
Exploring the High-Order Transverse Modes in Optically-Pumped Semiconductor Lasers, C. C. Lee[1], Chia-Han Tsou[1], Y. H. Hsieh[1], Hsing-Chih Liang[2], Kai-Feng Huang[1], Yung-Fu Chen[1]; *[1]National Chiao Tung Univ., Taiwan; [2]National Taiwan Ocean Univ., Taiwan.* Several high-order patterns formation in an optically pumped semiconductor laser (OPSL) belonging to the Hermite-Laguerre-Gaussian (HLG) modes are observed when scanning a large-ratio pump beam to specific positions on the gain chip.

JTu3A.5
Unstable ring resonator with multipass telescopic scheme for disk-shaped active elements, Mikhail R. Volkov[1], Ivan I. Kuznetsov[1], Ivan B. Mukhin[1], Oleg V. Palashov[1]; *[1]Inst. of Applied Physics of the RAS, Russia.* We present an unstable ring optical cavity with disk active element and multipass system. The modeling shows that unstable cavities are preferable for lasers with large fundamental mode size. Lasing with different magnification is demonstrated, the best beam quality is M^2=2.5.

JTu3A.6
Passively Q-switched Thulium Laser with CWCVD Synthesized MoS_2 Saturable Absorber, Natali Gusakova[1], Xingli Wang[2], Julia Gusakova[3], Anatolii Pavlyuk[4], Beng K. Tay[2,3], Nikolai Kuleshov[1]; *[1]Center for Optical Materials and Technologies, BNTU, Belarus; [2]CINTRA UMI CNRS/NTU/THALES, Singapore; [3]Novitas Center, Nanyang Technological Univ., Singapore; [4]Inst. of Inorganic Chemistry, Russia.* We demonstrate a passively Q-switched Tm:KLuW microchip laser with SA based on MoS_2 layer grown by cold-wall chemical vapor deposition technique (CWCVD). Laser generates pulses with 1.4 µJ and 310 ns at 330 kHz.

JTu3A.7
Experimental Results on an OPCPA Seed System for a Laser-Plasma Acceleration Drive Laser, Thomas Hülsenbusch[1,2], Timo F. Eichner[1], Tino Lang[2], Lutz Winkelmann[2], Ingmar Hartl[2], Andreas R. Maier[1]; *[1]Center for Free-Electron Laser Science & Dept. of Physics, Univ. of Hamburg, Germany; [2]Deutsches Elektronen-Synchrotron, Germany.* We present results of a white light seeded OPCPA, developed to seed a Ti:SA CPA system driving a laser-plasma accelerator. The development focuses on overall stability to extend long term operation of the drive laser.

JTu3A.8
Design Study for a Multi-mJ, Few-cycle, 3 µm Optical Parametric Chirped Pulse Amplifier, Joana Alves[1], Hugo Pires[1], Celso P. Joao[1], Gonçalo Figueira[1]; *[1]IPFN/IST, Portugal.* We present the design of an ultrafast optical parametric chirped pulse amplifier (OPCPA) operating at 3 µm yielding multi-mJ output energy driven by a 10 Hz, 100 mJ-level CPA picosecond Yb-based laser source.

JTu3A.9
Actively Q-switched Tunable Narrowband 2 µm Tm:YAP Laser Using a Transversally Chirped Volume Bragg Grating, Quentin Berthomé[1,2], Arnaud Grisard[3], Basile Faure[1], Grégoire Souhaité[1], Eric Lallier[3], Antoine Godard[2], Vadim Smirnov[4], Ruslan Vasilyeu[4]; *[1]Teem Photonics, France; [2]DPHY, ONERA, France; [3]Thales Research & Technology, France; [4]OptiGrate Corp., USA.* A pulsed, narrow-linewidth, wavelength-tunable Tm:YAP laser was realized. 1 kHz stable operation with 200 µJ, 50 ns pulses is reported. Spectrum was narrowed to 0.2 nm and tuned from 1940 to 1960 nm with a transversally chirped volume Bragg grating.

JTu3A.10
Supercontinuum Generation with Ultrashort Pulsed Ho-Fiber Laser , Caterina Clemente[1,2], Nikolai Tolstik[2,3], Mario Christian Falconi[1], Francesco Prudenzano[1], Irina T. Sorokina[2]; *[1]Polytechnic of Bari, Italy; [2]NTNU, Norway; [3]ATLA Lasers AS, Norway.* We report supercontinuum generation (SC) in a germano -silicate commercial fiber in the 1.9-2.3 µm range at up to 54.3 mW of output power pumped by a picosecond Holmium-based all-fiber laser at 2090 nm.

JTu3A.11
Direct generation of pulsed vortex beam from a Tm:LuYAG laser at 2018 nm, Ying Chen[2], Manman Ding[2], Jianlei Wang[2], Yongguang Zhao[1], Deyuan Shen[2]; *[1]Max-Born Inst., Germany; [2]Jiangsu Normal Univ., China.* Vortex pulses in the 2 µm spectral region are directly generated from a Q-switched Tm:LuYAG laser. Pulse energies of 1.48 mJ for $LG_{0,+1}$ mode and 1.51 mJ for $LG_{0,-1}$ mode are respectively achieved.

JTu3A.12
Pareto-Optimized Modulation Formats for Suppression of Stimulated Brillouin Scattering in Optical Fiber Amplifiers, Yusuf Panbiharwala[1], Harish V. Achar[2,1], Deepa Venkitesh[1], Johan Nilsson[2], Balaji Srinivasan[1]; *[1]Indian Inst. of Technology, Madras, India; [2]Optoelectronic Research Center, Univ. of Southampton, UK.* With the help of a robust model for stimulated Brillouin scattering (SBS) in Yb-doped fiber amplifiers, we Pareto-optimize phase modulation formats for suppressing SBS. We achieved 1.6 times enhancement in SBS threshold for 100MHz linewidth.

JTu3A.13
SBS threshold suppression in Er-doped fiber amplifier by using fibers with different core composition, Maksim Khudyakov[1,2], Mikhail V. Yashkov[3], Denis S. Lipatov[3], Aleksey N. Guryanov[3], Mikhail Bubnov[1], Mikhail E. Likhachev[1]; *[1]Fiber Optics Research Center of the Russian Academy of Sciences, Russia; [2]Moscow Inst. of Physics and Technology (State Univ.), Russia; [3]G.G. Devyatykh Inst. of Chemistry of High-Purity Substances, Russian Academy of Sciences, Russia.* Two Er-doped fibers with different core compositions and similar waveguiding properties were used to demonstrate an increase in SBS threshold to 1.8 kW, which is 2.5 dB higher compared to single-fiber amplifier.

JTu3A.14
Design of a 10 J, 100 Hz diode-pumped solid state laser, Mariastefania De Vido[1,2], Klaus Ertel[1], Agnieszka Wojtusiak[1,3], Nathan O'Donoghue[1], Stephanie Tomlinson[1], Martin Divoky[4], Magdalena Sawicka[4], Jan Pilar[4], Paul D. Mason[1], Jonathan Phillips[1], Saumyabrata Banerjee[1], Jodie Smith[1], Thomas Butcher[1], Chris Edwards[1], John Collier[1], Tomas Mocek[4]; *[1]STFC Rutherford Appleton Lab, UK; [2]Inst. of Photonics and Quantum Sciences, Heriot-Watt Univ., UK; [3]Loughborough Univ., UK; [4]HiLASE Facility, Czechia.* We present the design of a compact 1 kW average power nanosecond diode-pumped solid state laser operating at 10 J pulse energy and 100 Hz pulse repetition rate.

JTu3A.15
Extraction and amplification of a single frequency comb tooth using an auxiliary laser in a feedforward scheme, Pierre Brochard[1], Benjamin Rudin[2], Florian Emaury[2], Valentin Wittwer[1], Stéphane Schilt[1], Thomas Südmeyer[1]; *[1]Laboratoire Temps-Fréquence, Switzerland; [2]Menhir Photonics AG, Switzerland.* We present a simple method to simultaneously extract and amplify a single tooth of an optical frequency comb using a feedforward scheme that faithfully transfers its frequency noise and stability to an auxiliary continuous-wave laser.

JTu3A.16
Electro-Optic Sampling of Terahertz Pulses in Multilayer Crystals, Emma Kueny[1,2], Anne-Laure Calendron[1,3], Franz X. Kaertner[1,2]; *[1]DESY, Germany; [2]Dept. of Physics, Universität Hamburg, Germany; [3]The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Germany.* The analytical formalism for the reconstruction of terahertz pulses measured via electro -optic sampling is generalized for multilayer crystals.

JTu3A.17
Comparison of two low-noise CEP stabilization methods for an environmentally stable Yb:fiber oscillator, Haydar S. Salman[1,2], Yuxuan Ma[1], Kutan Gurel[3], Stéphane Schilt[3], Chen Li[1], Philip Pfäfflein[2], Christoph Mahnke[1], Jakob Fellinger[4], Stefan Droste[5], Aline S. Mayer[4], Oliver Heckl[4], Thomas Südmeyer[3], Christoph M. Heyl[1,2], Ingmar Hartl[1]; *[1]fs-la, DESY, Germany; [2]HI JENA, Germany; [3]Laboratoire Temps-Fréquence, Université de Neuchâtel, Switzerland; [4]Univ. of Vienna, Austria; [5]SLAC National Accelerator Lab, USA.* We demonstrate a low-noise carrier-envelope-offset frequency stabilized all-PM Yb:fiber oscillator. Two different stabilization methods lead to sub 200 mrad integrated f_0 phase noise (10 Hz to 1 MHz), suitable for comb spectroscopy applications.

JTu3A.18
Subnanosecond Ho:fiber Laser System Seeded by a Gain-switched Diode Laser at 2.09 um, Nikolai Tolstik[1,2], Marius Skogen[1], Irina T. Sorokina[1,2]; *[1]Dept. of Physics, NTNU Norwegian Univ. of Science and Technology, Norway; [2]ATLA Lasers AS, Norway.* We demonstrate for the first time the subnanosecond holmium fiber laser system seeded by a gain-switched laser diode at 2.09 um. Modelling shows the feasibility to reach picosecond pulses with peak powers above 250kW.

11:30 -- 14:00
JTu3A • Joint Poster Session– Continued

JTu3A.19
Properties of Picosecond Supercontinuum Generated in Long Bulk YAG, Lukáš Indra[1,2], František Batysta[1,2], Petr Hribek[1], Jakub Novák[1], Jonathan T. Green[1], Jack A. Naylon[1], Pavel Bakule[1], Bedrich Rus[1]; [1]*ELI Beamlines, Czechia;* [2]*CTU FNSPE, Czechia.* We measure parameters of a stable supercontinuum generated in long YAG crystal, driven by 3 ps pulses at 1030 nm and evaluate the impact of initial conditions on supercontinuum stability.

JTu3A.20
Large Core, Low-NA Neodymium-Doped Fiber for High Power CW and Pulsed Laser Operation near 900 nm, Kilian Le Corre[1,2], Herve Gilles[1], Sylvain Girard[1], Alexandre Barnini[2], Thierry Robin[2], Benoit Cadier[2], Giorgio Santarelli[4], Thomas Godin[3], Ammar Hideur[3], Mathieu Laroche[1]; [1]*CIMAP, France;* [2]*iXBlue, France;* [3]*Coria, France;* [4]*LP2N, France.* 13W output power near 900nm in CW laser regime (beam quality factor $M^2 \sim 1.2$) and pulse energy of 0.54 mJ in actively Q-switched regime was obtained using 30µm diameter core, low-NA (0.045) Neodymium-doped fiber.

JTu3A.21
Broadband Femtosecond Dispersion Compensator for Fiber CPA Systems Using Controlled Optical Aberrations, Siyun Chen[1]; [1]*Univ. of Michigan, USA.* We experimentally demonstrate a novel broadband dispersion compensator designed for ~50fs-150fs pulses that uses controlled optical aberrations to compensate third and fourth order dispersion accumulated in ~50m long fiber path of a fiber CPA system.

JTu3A.22
Spectroscopy of an Yb:Er:Tm:Ho four-doped germanate glass for broadband amplification and lasing, Marcin Kochanowicz[3], Jacek Zmojda[3], Piotr Miluski[3], Dominik Dorosz[2], Stefano Taccheo[1]; [1]*Swansea Univ., UK;* [2]*AGH - Univ. of Science and Technology, Poland;* [3]*Bialystok Univ. of Technology, Poland.* We report on the first spectroscopic characterization of a four-doped Yb:Er:Tm:Ho germanate glass. Overlapping of the Er, Tm and Ho may provide gain from 1550 nm to about 2150 nm with optimized concentration.

JTu3A.23
Piezooptic Coefficients Measurement of Ceramic YAG, Koichi Hamamoto[1,2], Ryo Yasuhara[3], Shigeki Tokita[1], Michal Chyla[4], Junji Kawanaka[1]; [1]*Osaka Univ., Japan;* [2]*Mitsubishi Heavy Industries, Ltd., Japan;* [3]*National Inst. for Fusion Science, Japan;* [4]*HiLASE, Czechia.* Piezooptic coefficients of ceramic YAG were measured by four-point bending method. To our best knowledge, this is the first report for measurement of ceramic YAG.

JTu3A.24
Absolute Absorption Measurements in Nonlinear Optical Crystals, Christian Muehlig[1], Simon Bublitz[1]; [1]*Leibniz Instit. for Photonic Technology, Germany.* The Sandwich concept of the laser induced deflection (LID) technique is applied to characterize nonlinear optical crystals from the near infrared to the deep UV wavelengths. In particular, nonlinear bulk absorption at 355nm and 266nm is investigated in BBO, CLBO and LBO, respectively.

JTu3A.25
Absorption Jump and Recovery of Radiation Transmission in the Area of Small-Scale Self-Focusing of Short Laser Pulse in Neodymium Glass, Yury Senatsky[1], Nikolay Bykovsky[1]; [1]*Lebedev Physics Insitute of RAS, Russia.* Absorption jump at 0.66 and 1.06 µm wavelengths in the area of 0.5ns laser pulse self-focusing in Nd glasses followed by 5-35 ns transmission recovery was registered. A physical model explaining this dynamics is presented.

JTu3A.26
Photo-Thermo-Refractive Glass Doped with Rare Earth Ions as a Promising Laser and Holographic Medium, Nikolay V. Nikonorov[1], Sergey Ivanov[1], Khaldoon Nasser[1], Vladimir Aseev[1], Alexander Ignatiev[1]; [1]*ITMO Univ., Russia.* Laser and holographic properties of a new photo-thermo-refractive glass doped with neodymium and ytterbium-erbium ions have been studied. The glass is a promising medium for monolithic integration of laser and holographic elements.

JTu3A.27
3-µm Q-switch operation assisted by cascade lasing at 1.6 and 1.7 µm in Er-doped YLF, Nikolay Ter-Gabrielyan[1], Viktor Fromzel[1]; [1]*US Army Research Lab, USA.* We studied Q-switching at the 3 µm, assisted by CW lasing at the 1.7 µm and the gain-switched cascade lasing at the 1.6 µm. The former increases pulse energy, the latter allows increasing pulse frequency.

JTu3A.28
Permanent-Magnet Faraday Isolator with High Intensity of the Magnetic Field (> 3 T) for Perspective Lasers, Evgeniy Mironov[1], Oleg V. Palashov[1]; [1]*Inst. of Applied Physics of RAS, Russia.* Permanent-magnet system for Faraday isolator with maximal field strength exceeding 3 T was developed. This result was achieved due to use of magnetic conductors in its central region and optimization of their shapes.

JTu3A.29
Numerical Model Describing Thermal-Lens Induced Mode Coupling in Fiber Amplifiers, Jianqiu Cao[1], Wenbo Liu[1], Jinbao Chen[1]; [1]*National Univ of Defense Technology, China.* Numerical model describing the thermal-lens induced mode coupling in the fiber amplifier is presented based on which the thermal-lens induced mode coupling in a short-cavity single-frequency fiber amplifier is briefly discussed.

JTu3A.30
Nd: Phosphate split-slab liquid cooled kJ amplifier for high power laser, Pierre-Marie Dalbies[1], Nathalie Blanchot[1], Richard Chonion[1], Edouard Bordenave[1], Jérôme Neauport[1], Baptiste Cadilhon[1], Sandy Cavaro[1], Pierre Depeyris[1], Eric Lavastre[1], Patrick Manac'h[1], Yann Modin[1], Gaël Paquignon[1], Patrice Patelli[1], Jean-Michel Sajer[1], Daniel Taroux[1]; [1]*CEA-CESTA, France.* We present our first experimental results (laser gain > 1.1) confirmed by numerical simulations, of a liquid cooled Nd:Phosphate glass split-disk amplifier, designed to operate at 1053nm, with a repetition rate of 1 shot/minute.

JTu3A.31
Modeling of a 980-nm pumped Yb:Er:Tm:Ho co-doped glass device for homogeneous gain and lasing over a 600-nm wavelength interval, Mario Christian Falconi[2], Dario Laneve[2], Vincenza Portosi[2], Stefano Taccheo[1], Francesco Prudenzano[2]; [1]*Swansea Univ., UK;* [2]*Politecnico di Bari, Italy.* We model and show a 980-nm pumped quadruple-doped Yb:Er:Tm:Ho glass offering an ultra-wide broadband from 1550-nm to about 2150-nm, through which homogeneous gain and lasing power above 50 mW are achievable.

JTu3A.32
Backward-Wave Induced Modulational Instability in Normal Dispersion, Nikita M. Kondratyev[1], Valery E. Lobanov[1], Dmitry V. Skryabin[2,1]; [1]*Russian Quantum Center, Russia;* [2]*Dept. of Physics, Univ. of Bath, UK.* We study theoretically and numerically the coupled forward and backward wave nonlinear dynamics in a microring resonator and demonstrate modulational instability and frequency comb generation in the normal dispersion regime.

JTu3A.33
Spectroscopic and Lasing Properties of Er:GGAG Crystal in Temperature Range 80 to 340 K, Michal Nemec[1], Pavel Bohacek[2], Richard Svejkar[1], Jan Sulc[1], Helena Jelínková[1], Bohumil Trunda[2], Lubomír Havlák[2], Martin Nikl[2], Karel Jurek[2]; [1]*Czech Technical Univ. in Prague, Czechia;* [2]*Inst. of Physics of the Czech Academy of Sciences, Czechia.* Spectroscopic and laser characteristics of Er-doped $Gd_3Ga_3Al_2O_{12}$ (Er:GGAG) are presented in the temperature range 80 - 300 K. The significant influence of crystal temperature on resonantly diode pumped Er:GGAG laser, emitting at 1648nm, was observed.

JTu3A.34
Super-quadratic Upconversion Luminescence of Nd^{3+} Ions in $GdVO_4$ and $LaSc_3(BO_3)_4$ Laser Crystals, Irene Carrasco[1], Laetitia Laversenne[2], Stefano Bigotta[3], Alessandra Toncelli[3], Mauro Tonelli[3], Alexander Zagumennyi[4], Markus Pollnau[1]; [1]*Univ. of Surrey, UK;* [2]*Institut Néel, Université Grenoble Alpes, France;* [3]*NEST-Istituto Nanoscienze-CNR and Dipartimento di Fisica, Universita di Pisa, Italy;* [4]*Russian Academy of Sciences, Prokhorov Inst. of General Physics, Russia.* We measured upconversion (visible) and direct (infrared) luminescence decay of Nd^{3+}-doped laser materials under equivalent pump conditions. We found a strongly super-quadratic instead of the expected quadratic dependence between these curves. Calculations partially explain experiments.

JTu3A.35
Mid-infrared comb generation of ultrashort pulses tunable between 3.3 and 5.2 µm, Lian Zhou[1], Yang Liu[1], Gehui Xie[1], Chenglin Gu[1], Daping Luo[1], Zejiang Deng[1], Zhiwei Zhu[1], Wenxue Li[1]; [1]*East China Normal Univ., China.* We report on a mid-infrared (MIR) comb based on a Yb-fiber self-similar amplifier. The MIR comb has a tunable spectral coverage from 3.3 to 5.2 µm with a maximum average power of 90 mW.

JTu3A.36
The luminescence in the range of 3-5 µm of ZnSe:Fe^{2+} excited by electron beam with energy of dozen of keV, Andrey A. Gladilin[1], Oleg Uvarov[1], Nikolay il'ichev[1], Sergey Mironov[1], Vladilir Chegnov[2], Olga Chegnova[2], Mikhail Chukichev[3], Renat Rezvanov[4], Viktor Kalinushkin[1]; [1]*Prokhorov General Physics Inst. of the Russian Academy of Sciences, Russia;* [2]*Research Inst. of Materials Science, Russia;* [3]*Faculty of Physics, Lomonosov Moscow State Univ., Russia;* [4]*National Research Nuclear Univ. 'MEPhI', Russia.* The influence of iron concentration and annealing process with Zn atmosphere on mid-IR kinetics and luminescence intensity of ZnSe crystal doped with iron excited by hot electrons were demonstrated. The mechanisms of excitation are discussed.

JTu3A.37
YCOB-based, mJ-level, 20 fs OPCPA laser system, Hugo Pires[1], Joana Alves[1], Victor Hariton[1], Mario Galletti[1], Celso P. Joao[1], Gonçalo Figueira[1]; [1]*IPFN, Portugal.* We describe the experimental performance of a near-IR OPCPA laser system using YCOB. The system aims to deliver ~20 fs laser pulses at the mJ energy level, while allowing scalability to high repetition rates.

JTu3A.38
Laser Operation of Cleaved Single-Crystal Plates and Films of Tm:KY$(MoO_4)_2$, Pavel Loiko[1], Anna Volokitina[1], Josep M. Serres[2], Vyacheslav Trifonov[3], Anatolii Pavlyuk[3], Sami Slimi[4], Ezzedine Ben Salem[4], Rosa Maria Solé[2], Magdalena Aguiló[2], Francesc Díaz[2], Xavier Mateos[2]; [1]*ITMO Univ., Russia;* [2]*Universitat Rovira i Virgili, Spain;* [3]*A.V. Nikolaev Inst. of Inorganic Chemistry, Russia;* [4]*I.P.E.I. of Monastir, Tunisia.* We report on the crystal growth and spectroscopy of novel orthorhombic Tm:KY$(MoO_4)_2$ crystals with a layered structure. CW 2-µm laser operation in cleaved single-crystal plates and films of Tm:KY$(MoO_4)_2$ (thickness: down to 70 µm) is achieved.

11:30 -- 14:00
JTu3A • Joint Poster Session– Continued

JTu3A.39
High Power Nd:GdVO$_4$ Oscillator with Orthogonal Thermal Compensation for Astigmatism Mitigation, Di Sun[1,2], Jie Guo[1], Xiaoyan Liang[1]; [1]*Shanghai Inst of Optics & Fine Mechanics, China;* [2]*Center of Materials Science and Optoelectronics Engineering, Univ. of Chinese Academy of Sciences, China.* We present a Nd:GdVO$_4$ bulk crystal oscillator with a 71.2 W TEM$_{00}$ laser output based on the orthogonal thermal compensation architecture. The asymmetry of thermo -optical effects in the anisotropic crystal was well compensated.

JTu3A.40
Concentration Effects in Kinetics of Middle-IR Transitions of Dy^{3+} Ions Doped in Silver Halide Crystals., Andrey G. Okhrimchuk[1], Leonide N. Butvina[1]; [1]*Fiber Optics Research Center of RAS, Russia.* Kinetics of mid-IR luminescence is investigated in AgBr$_{0.5}$Cl$_{0.5}$:Dy^{3+}crystals with different level of doping. Clustering of Dy^{3+}ions is proposed, and it has an opposite effect on perspective lasing transitions in mid-IR.

JTu3A.41
Smart Laser Beam Analyzer Based on Deep Learning, Yi An[1], Hongxiang Chang[1], Jun Li[1], Liangjin Huang[1], Jinyong Leng[1], Lijia Yang[1], Pu Zhou[1]; [1]*National Univ of Defense Technology, China.* A deep learning based smart laser beam analyzer, which can perform mode decomposition and M^2 evaluation for ordinary, saturated, noisy or other imperfect laser beam patterns, is firstly proposed and verified through simulation and experiment.

JTu3A.42
Numerical simulations of terahertz pulse generation with two-color laser pulses in the 1.6-10 μm spectral range, Roland Flender[1,2], Adam Borzsonyi[1,2], Bálint Kiss[1], Viktor Chikan[1,3]; [1]*ELI-ALPS, ELI-HU Non-Profit Ltd., Hungary;* [2]*Dept. of Optics and Quantum Electronics, Univ. of Szeged, Hungary;* [3]*Dept. of Chemistry, Kansas State Univ., USA.* In this research the THz generation from two-color mid-infrared pulses were investigated in the range from 1.6μm up to 10μm. The possibility of the relative phase control with thin fluoride plates were investigated also.

JTu3A.43
Scattering Decrease for Chirped Bragg Gratings on PTR glass , Sergey Ivanov[1], Nikolay V. Nikonorov[1], Evgeniy Sgibnev[1]; [1]*ITMO Univ., Russia.* Volume and surface scattering of holographic optical elements on PTR glass have been analyzed. Several approaches for optical losses decrease had been introduced and studied.

JTu3A.44
Seeded fiber laser with nonlinear mirror feedback, Adam Card[1], Feruz Ganikhanov[1]; [1]*Univ. of Rhode Island, USA.* Optical waveform seeding provided an efficient control of key nonlinear effects in fiber laser and resulted in nearly ultimate stabilization of output of Yb-doped fiber laser operating in Q-switching mode due to distributed nonlinear mirror.

JTu3A.45
Ultrashort ps-order Pulse Generation from a SESAM Mode-Locked Czochralski-Grown Nd:LGSB Laser Crystal, Catalina Brandus[1,2], Alin Broasca[1], Madalin Greculeasa[1,2], Flavius Voicu[1], Lucian Gheorghe[1], Traian Dascalu[1]; [1]*INFLPR, Romania;* [2]*Faculty of Physics, Univ. of Bucharest, Romania.* We report the first results on 1.06-μm mode-locking performances of a Czhochralski-grown *a*-cut Nd:LGSB, uncoated medium. Ultrashort pulses of 1.43 ps, at 118-MHz repetition rate are achieved with a Z resonator and SESAM approach.

JTu3A.46
Rapid In-Line WMS Detection for CO$_2$ Reduction Products, Sean W. Fackler[1], Ritobrata Sur[2], Junko Yano[1]; [1]*Chemical Sciences Division, Lawrence Berkeley National Lab, USA;* [2]*Indrio Technologies, USA.* We developed an in-line wave-length modulation spectrometer capable of simultaneous calibration-free CO and CH$_4$ measurement. Gaseous product analysis of CO$_2$ reduction on silver and copper cathodes was analyzed without modification to existing electrochemical cell design.

JTu3A.47
ZnGaO Thin Film of Transparent Oxide Materials By Pulse Laser Deposition, Li Wang[1]; [1]*Beijing Univ. of Technology, China.* The deposition of Zn$_{0.9}$Ga$_{0.1}$O thin films has realized on different substrates by pulsed laser deposition. The structure, optical and electrical properties of films were characterized by X-ray diffractometer, AFM, Spectrophotometer and Hall effect devices.

JTu3A.48
Space and Wavelength Division Multiplexing of Erbium Doped Seven-core Fiber Amplifier, Ali Nassiri[1], Abdelkader Boulezhar[2], Hafida Idrissi Azami[1]; [1]*Faculty of sciences Ibn Zohr Univ., Morocco;* [2]*Physics, Faculty of Sciences Ain chock, Morocco.* We have developed a model for Erbium doped seven-core fiber amplifier for SDM-WDM Systems. A large band of input signals over 44 nm was amplified in each core with a gain higher than 20 dB.

JTu3A.49
Responses of Global Aerosol Distribution on Large-scale Atmospheric Circulation, Zihan Zhang[1]; [1]*Chinese Academy of Sciences, China.* Satellite data and ECMWF reanalysis data was analyzed to search for robustness responses for the climatic variability under the same distribution of aerosols within various simulations, the influence of atmospheric aerosol distribution on large-scale atmospheric circulation is discussed.

JTu3A.50
Key atmospheric profiles parameters to ground and airborne horizontal atmospheric transmittances and radiances, Shengcheng Cui[1]; [1]*Chinese Academy of Sciences, China.* Key impact factors of different atmospheric components were indexed by sorting their contributions to atmospheric transmittances and radiances. The analysis suggests that transmittance variance is mainly related to water vapor content (WVC), while radiance variance is due to temperature and WVC.

JTu3A.51
A New Global View of Boundary Layer Structure by an Improved Idealized-profile Fitting Method for Space-born Lidar Observations, Tao Luo[1]; [1]*Chinese Academy of Sciences, China.* The idealized-profile of ABL aerosol backscattering was taken as an additional constraint to simultaneously retrieve the ABL structure and ABL aerosol optical information based on CALIOP nighttime observations. A new climatology of global ABL structure was derived and presented.

JTu3A.52
Experimental Observations in a Self-mixing Laser Diode, Bin Liu[1,2], Yuxi Ruan[2], Yanguang Yu[2], Jiangtao Xi[2]; [1]*School of Mechatronics and Vehicle Engineering, East China Jiaotong Univ., China;* [2]*Univ. of Wollongong, Australia.* Sensing signals in a self-mixing laser diode are captured at different locations, showing they can be obtained at any positions along the light trace, from which a potential displacement sensing method without ambiguity is proposed.

JTu3A.53
Dimensioning, planning, characterization and assessment of a laser Doppler anemometer as an air borne air data system, Peter Mahnke[1], Oliver Kliebisch[1]; [1]*Inst. of Technical Physics, German Aerospace Center (DLR), Germany.* We report on a full characterization of a laser Doppler anemometer to evaluate an end-to-end model. This model is used to assess the design and predict the performance of an airborne airspeed detector.

JTu3A.54
Development of Cubesat For Quantum and Classical Communication , Vladimir Kurochkin[1], Aleksey Abrikosov[1], Mikhail Balanov[1], Sergey Vorobey[1], Aleksandr Khmelev[1], Yury Kurochkin[1]; [1]*International Center for Quantum Optics, Russia.* The use of satellites is considered a perspective view for laser communication. We present a space-to-ground quantum key distribution (QKD) concept to overcome the limitations for the distance of the secure communication.

11:30—12:30 • Student & Early Career Professional Development & Networking Lunch and Learn, *Room 0.11-0.12*

11:30—14:00 • Complimentary Lunch, *Entrance Hall, Hall F Sponsored by*

Tuesday, 1 October

Hall E1	Hall M2	Hall M1
ASSL	LS&C	LAC

14:00 -- 16:00
ATu4A • Transition Metal Doped II-VI mid-IR Materials, Lasers and Optics
Presider: Sergey Mirov; Univ. of Alabama at Birmingham, USA

ATu4A.1 • 14:00 Invited
Octave Spanning Dispersive Mirror in NIR and MIR, Vladimir Pervak[1]; *[1]Ludwig-Maximillians-Universität Munchen, Germany.* We overview Si/SiO_2 mirrors operating in the spectral range 2-4 um. The coatings exhibit reflectance exceeding 99% and provide group delay dispersion of -200 fs^2. The mirrors are key elements of Cr:ZnS/Cr:ZnSe femtosecond lasers and oscillators.

ATu4A.2 • 14:30
Single crystal growth of pure and Cr-doped ZnSe and ZnS for mid-IR laser applications, Peter G. Schunemann[1], Kevin T. Zawilski[1]; *[1]BAE Systems Inc, USA.* We demonstrated growth of high purity ZnSe and ZnS single crystals (up to one cubic centimeter) by chemical and physical vapor transport respectively. *In-situ* Cr-doping was achieved by iodine-assisted vapor transport of CrSe.

ATu4A.3 • 14:45
2-cycle Cr:ZnS Laser with Intrinsic Nonlinear Interferometry, Sergey Vasilyev[1], Igor Moskalev[1], Viktor Smolski[1], Jeremy Peppers[1], Mike Mirov[1], Sergey Mirov[1,2], Valentin Gapontsev[3]; *[1]IPG Photonics STC, USA; [2]Dept. of Physics, Univ. of Alabama at Birmingham, USA; [3]IPG Photonics Corporation, USA.* We demonstrate a fs laser architecture that enables the direct measurement of the laser's carrier envelope offset frequency. A multi-Watt source is arranged as a full-repetition-rate polycrystalline Cr:ZnS MOPA and covers 3-octaves (0.4–4.2 μm).

ATu4A.4 • 15:00
1.5-mJ Cr:ZnSe Chirped Pulse Amplifier Seeded by a Kerr-Lens Mode-Locked Cr:ZnS oscillator, Sergey Vasilyev[1], Jeremy Peppers[1], Igor Moskalev[1], Viktor Smolski[1], Mike Mirov[1], Evgeny Slobodchikov[2], Alex Dergachev[2], Sergey Mirov[1,3], Valentin Gapontsev[2]; *[1]IPG Photonics STC, USA; [2]IPG Photonics Corporation, USA; [3]Dept. of Physics, Univ. of Alabama at Birmingham, USA.* We report a 1-kHz, 1.5 mJ Cr:ZnSe chirped pulse amplifier with 140 fs pulse width, 9.5 GW peak power at 2.4 μm central wavelength. The amplifier is seeded with a commercial few-cycle Cr:ZnS oscillator.

ATu4A.5 • 15:15
$Zn_{1-x}Mn_xSe:Fe^{2+},Cr^{2+}$ (x=0.3) Laser Operation in the Region 4.4 – 4.65 μm at 78 K Pumped by a 1.94 μm Tm Fiber Laser through $Cr^{2+} \rightarrow Fe^{2+}$ Energy Transfer, Michal Jelinek[1], Maxim E. Doroshenko[2], Helena Jelínková[1], Adam Riha[1], Michal Nemec[1], Vaclav Kubecek[1], Nazar O. Kovalenko[3], Andrey Gerasimenko[3]; *[1]Czech Technical Univ. in Prague, Czechia; [2]General Physics Inst., Russia; [3]Inst. for Single Crystals, NAS Ukraine, Ukraine.* Fe^{2+} ions oscillations in the $Zn_{1-x}Mn_xSe:Fe^{2+},Cr^{2+}$ (x = 0.3) crystal in the wavelength range of 4.4–4.65um was achieved under pumping by a commercial 1.94um Tm fiber laser through $Cr^{2+} \rightarrow Fe^{2+}$ energy transfer.

ATu4A.6 • 15:30
Directly fiber-pumped mid-IR Fe:ZnSe CW laser tunable from 3.8 up to 5.1 μm, Andrey V. Pushkin[1], Ekaterina A. Migal[1], Hiyori Uehara[2], Kenji Goya[2], Shigeki Tokita[2], Mikhail P. Frolov[3], Yuriy Korostelin[3], Vladimir Kozlovsky[3], Yan Skasyrsky[3], Fedor V. Potemkin[1]; *[1]Lomonosov Moscow State Univ., Russia; [2]Inst. of Laser Engineering, Osaka Univ., Japan; [3]P.N.Lebedev Physical Inst., Russian Academy of Sciences, Russia.* The first CW single-crystal Fe:ZnSe laser optically pumped by Er:ZBLAN fiber laser with an output power of 2.1 W is reported. Temperature-dependent spectral characteristics and tuning (3.8-5.1 μm) are investigated.

14:00 -- 16:00
LTu4B • Lidar for Autonomous Applications
Presider: Farzin Amzajerdian; NASA Langley Research Center, USA

LTu4B.1 • 14:00 Invited
Advances in LiDAR: The Autonomous Vehicle Perspective, Lute Maleki[1]; *[1]Cruise, USA.* **Abstract:** Advances in photonics technology have extended applications of LiDAR, including autonomous cars. This application has specific requirements that are driving the LiDAR technology and photonic integrated chips. Recent advances will be discussed.

LTu4B.2 • 14:30 Invited
Coherent Lidar's Growth via Autonomous Driving, Stephen Crouch[1], Zeb Barber[1], Emil Kadlec[1]; *[1]Blackmore Sensors and Analytics Inc., USA.* Autonomous driving has created a need for improved lidar capability. This opportunity has pushed coherent, frequency modulated continuous wave lidar to quickly mature to provide longer range real-time sensing with the benefit of velocity measurement.

LTu4B.3 • 15:00
Withdrawn

LTu4B.4 • 15:30 Invited
Beam steering for LiDAR used in Autonomous Applications., Paul F. McManamon[1]; *[1]Exciting Technology LLC, USA.* Most auto lidars today use mechanical beam steering approaches, but over time non-mechanical approaches will gain traction. In this paper I discuss the benefits of various mechanical and non-mechanical beam steering techniques for auto lidar.

14:00 -- 16:00
Brittle Materials
Organizer: Dirk Mueller; Coherent Inc., USA

Brittle materials pose a significant challenge to mechanical machining. Mechanical processing can introduce micro-cracks, chips and be limited in the geometries. Lasers have a unique advantage in processing a variety of brittle materials as their wavelengths and pulse durations can be tailored to optimize the material interaction. Brittle materials such as glass and sapphire are increasingly benefitting from laser processing. The session will discuss novel laser-based methods to weld brittle materials without frit and discuss new methods of cutting silicon or glass whilst maintaining maximum bend strength and edge fidelity.

14:00 Invited
Gap Bridging and Joining of Glasses Using Ultra-short Pulsed Lasers, Kristian Cvecek[1]; *[1]Universität Erlangen-Nürnberg, Germany.* Glass welding using USP lasers can provide hermetic welding seams which can, however, exhibit cracks if a gap is present during welding. We present a gap bridging method that is less prone to crack formation.

14:30 Invited
Laser Micro Processing of Glass: Drilling, Separation and Patterning, Marc Hueske[1]; *[1]4JET Microtech, Germany.* Glass welding using USP lasers can provide hermetic welding seams which can, however, exhibit cracks if a gap is present during welding. We present a gap bridging method that is less prone to crack formation.

15:00 Invited
Striving for Perfect Edge – Brittle Material Cutting Using Controlled Crack Guiding in μm Range, Dirk Lewke[1]; *[1]3D-Micromac, Germany.* Thermal Laser Separation TLS-dicingTM is a separation technique for brittle materials based on controlled crack guiding cut with thermally induced mechanical stress. This talk presents details on the technology and the variations necessary for different applications.

15:30 Invited
Micromachining of Ceramics Using Ultra-short Pulsed Lasers, Daniel Schwab[1]; *[1]Arges GmbH, Germany.* The availability of ultrashort pulse laser sources enables the implementation of drilling and cutting applications in the semiconductor industry. For this it is necessary to guide and shape the laser beam with highest accuracy, shown in this paper. Furthermore it is presented to position the components to be machined precise and reproducible.

14:00 -- 16:00

ATu4A • Transition metal Doped II-VI mid-IR Materials, Lasers and Optics– Continued

Presider: Sergey Mirov; Univ. of Alabama at Birmingham, USA

ATu4A.7 • 15:45

High-Performance Mid-Infrared Crystalline Bragg Mirrors at 4.5 µm, Georg Winkler[1], Lukas W. Perner[1], Gar-Wing Truong[2], Dominic Bachmann[3], Aline S. Mayer[1], Jakob Fellinger[1], Tobias Zederbauer[3], David Follman[2], Christoph Deutsch[3], Gang Zhao[4], Diana M. Bailey[4], Adam Fleisher[4], Garrett D. Cole[2], Oliver Heckl[1]; *[1]Christian Doppler Lab for Mid-IR Spectroscopy and Semiconductor Optics, Faculty Center for Nano Structure Research, Faculty of Physics, Univ. of Vienna, Austria; [2]Crystalline Mirror Solutions LLC, USA; [3]Crystalline Mirror Solutions GmbH, Austria; [4]National Inst. of Standards & Technology, USA.* We present state-of-the-art mid-infrared high-reflectivity low-loss mirrors at 4.54 µm based on substrate-transferred crystalline coatings. Transmission losses of ~145 ppm and

16:00—16:30 • **Coffee Break**, *Entrance Hall, Hall F*

Tuesday, 1 October

Hall E1 — ASSL

16:30 -- 18:00
ATu5A • Ceramic Materials, Glasses, Lasers
Presider: Stefano Taccheo; Swansea Univ., UK

ATu5A.1 • 16:30 Invited
Fabrication of High Efficiency Sesquioxide-based Laser Ceramics, Dingyuan Tang[1], J. Wang[1], D. L. Yin[1], Peng Liu[2], Jie Ma[2], Deyuan Shen[2]; *[1]Nanyang Technological Univ., Singapore; [2]Jiangsu Normal Univ., China.* Rare-earth doped sesquioxide laser ceramics have been successfully fabricated using a low temperature vacuum sintering plus hot isostatic pressing method. High power high efficiency laser oscillations of the fabricated laser ceramics are experimentally demonstrated.

ATu5A.2 • 17:00
Sub-60-fs Pulse Generation from a SWCNT Mode-Locked $Tm:LuYO_3$ Ceramic Laser at 2045 nm, Yongguang Zhao[1], Li Wang[1], Zhongben Pan[1], Yicheng Wang[1], Jian Zhang[2], Peng Liu[3], Xiaodong Xu[3], Ji Eun Bae[4], Tae Park[4], Fabian Rotermund[4], Pavel Loiko[5], Josep M. Serres[6], Xavier Mateos[6], Weidong Chen[1], Mark Mero[1], Uwe Griebner[1], Valentin Petrov[1]; *[1]Max-Born Inst., Germany; [2]Key Lab of Transparent and Opto-Functional Inorganic Materials, Shanghai Inst. of Ceramics,, China; [3]Jiangsu Normal Univ., China; [4]Korea Advanced Inst. of Science and Technology (KAIST), Korea (the Republic of); [5]ITMO Univ., Russia; [6]Universitat Rovira i Virgili, Spain.* We report on a mode-locked $Tm:LuYO_3$ ceramic laser employing SWCNT as a saturable absorber. Bandwidth-limited 57-fs pulses, i.e., 8 optical cycles, are generated at ~2045 nm at a repetition rate of ~72.6 MHz.

ATu5A.3 • 17:15
Development of a 100 J Class Cryogenically Cooled Multi-disk Yb:YAG Ceramics Laser, Masateru Kurata[1], Takashi Sekine[1], Yuma Hatano[1], Yuki Muramatsu[1], Takaaki Morita[1], Yuki Kabeya[1], Takuto Iguchi[1], Takashi Kurita[1], Yasuki Takeuchi[1], Kazuki Kawai[1], Yoshinori Tamaoki[1], Yoshinori Kato[1], Shigeki Tokita[2], Junji Kawanaka[2]; *[1]HAMAMATSU PHOTONICS K.K., Japan; [2]Inst. of Laser Engineering, Osaka Univ., Japan.* A 100 J class diode-pumped solid-state laser system has been developed as a platform for acceleration of laser processing application. A 117 J output of pulse energy has been demonstrated with its main amplifier.

ATu5A.4 • 17:30
Femtosecond $Tm:Lu_2O_3$ ceramic MOPA at 2080 nm, Neil K. Stevenson[1,2], C Tom A Brown[2], Alexander A. Lagatsky[1]; *[1]Fraunhofer UK, UK; [2]School of Physics and Astronomy, Univ. of St Andrews, UK.* We report on the development of a femtosecond $Tm:Lu_2O_3$ ceramic master oscillator power amplifier system at 2080 nm. A maximum average output power of 816 mW is achieved with the pulse duration of 313 fs.

ATu5A.5 • 17:45
High-Energy, Sub-nanosecond, Eye-safe Laser Pulses from Er,Yb:glass Planar Waveguide Amplifier, Kenichi Hirosawa[1], Narito Samejima[1], Takayuki Yanagisawa[1], Shumpei Kameyama[1], Kenichi Uto[1]; *[1]Mitsubishi Electric Corporation, Japan.* We have demonstrated high-energy amplification of sub-nanosecond laser pulses with an Er,Yb:glass planar waveguide amplifier. The output pulse energy reached 500 µJ at 20 kHz repetition rate, 500 ps duration, and 1534 nm wavelength.

Hall M2 — LS&C

16:30 -- 18:00
LTu5B • Lidar Processing and Exploitation
Presider: Jason Stafford; US AFRL, USA

LTu5B.1 • 16:30 Invited
Title to be announced, Clement Mallet[1]; *[1]Institut National de l'information Geogr, France.* Abstract to be announced.

LTu5B.2 • 17:00 Invited
Precision in Airborne LiDAR Acquisition and Processing for Creating 3D Maps in Railway Environment, Luc Perrin[1], Flavien Viguier[1]; *[1]Altametris, France. UAVs appear as a flexible solution to acquire data. This paper focuses on the precision of 3D point clouds and maps obtained by using ALS on railway environment to extract information in respect with customer specifications.*

LTu5B.3 • 17:30
Viewpoint-Independent Object Recognition using Photon-Counted Point Clouds, Edward A. Watson[1]; *[1]Univ. of Dayton, USA.* We extend photon-counted pattern recognition to viewpoint invariance using 3D point clouds. Images are statistical so we use Monte Carlo methods to generate a metric of point distributions. This metric shows reliable discrimination between two objects.

LTu5B.4 • 17:45
Compact UAV compatible broadband 2D Spectrometer for multi-species atmospheric gas analysis, Julien Gouman[1], Fabian Lütolf[1], Philippe Renevey[1], Stephan Dasen[1], Sanghoon Chin[1], Tobias Herr[1], Gilles Buchs[1], Steve Lecomte[1], Germàn Vergara[2], Hans Martin[5], Peter M. Moselund[3], Frans Harren[4], Laurent Balet[1]; *[1]Systems, CSEM SA, Switzerland; [2]NIT, New Infrared Technologies, Spain; [3]NKT Photonic A/D, Denmark; [4]Trace gas Research Group, IMM, Radboud Univ., Netherlands; [5]SenseAir AB, Sweden.* We present an UAV compatible spectrometer designed for sampling air pollutants in remote locations. Relying on a custom-made Multi-Pass Cell and a 3-5 µm broadband supercontinuum light source, it takes advantage of an uncooled MWIR camera to record 2D cross-dispersed molecular absorption spectra.

Hall M1 — LAC

16:30 -- 18:00
LTu5B • Lasers for Mobility
Presider: Umar Piracha, AEye, Inc., USA

In the past decade, there has been a strong interest in the development of technologies for autonomous mobility applications, such as self driving trucks, cars, drones and robots. The global self driving cars and trucks market size is expected to expand at a compound annual growth rate of 63.1% from 2021 to 2030. A crucial component of such systems is the laser, and properties such as high output power, low power consumption, small form factor, eye safety, and low cost are required to make this vision a reality. This session offers a series of invited talks covering novel laser designs, lidar architectures & laser requirements, and the latest results from some of the leading lidar companies working this area.

16:30 Invited
Evolution of Quanergy's Solid State Lidar, Louay A. Eldada[1]; *[1]Quanergy Systems, Inc, USA.* During this presentation, Louay will discuss Quanergy's solid-state LiDAR, including developmental milestones for the sensors – from technology to decreasing cost. He will also explain how Quanergy began building their solid-state LiDAR for autonomous vehicles and saw market opportunities for the technology to disrupt a variety of industries, from comprehensive security systems to automated industrial robots to surveying drones.

16:50 Invited
Image and Depth Sensing for Mobilty. John Murphy[1], *[1]ON Semiconductor, USA.* We present the anatomy of a LiDAR system for transport applications, with emphasis on how single-photon sensitive SiPM and SPAD array photodetectors can work with modern lasers to push the boundaries of long-range detection.

17:10 Invited
Evolution and Results of the Blickfeld Lidar Technology, Florian Petit[1]; *[1]Blickfeld GmbH, Germany.* Blickfeld has developed a performant, mass-producible MEMS LiDAR technology. This talk will focus on the R&D and the impact of large aperture MEMS on robustness, range and field of view.

17:30 Invited
A Comparison of 3D Imaging Lidar vs 3D Stereo Imaging for Autonomous Vehicles, Paul McManamon[1] and Edward Watson[2]; *[1]Exciting Technology, USA; [2]University of Dayton, USA.* 3D imaging has been shown to be useful for autonomous vehicles. People have advocated stereo imaging as an alternative to 3D lidar. This paper compares the two approaches for 3D imaging on an autonomous vehicle.

17:50 Invited
Photonic Crystal Lasers for Smart Mobility, Susumu Noda[1], *[1]Kyoto University, Japan.* We report that photonic-crystal surface-emitting lasers (PCSELs) with high-power and high-beam-quality is very useful for applications including light detection and ranging (LiDAR) for smart mobility.

18:10 Invited
Clearing Junk from the Trunk: Using Agile LiDAR Technology to Create a Sleeker, Smarter Autonomous Vehicle, Barry N. Behnken[1], *[1]AEye, Inc., USA.* Reliable robotic intelligence requires a more agile form of LiDAR—one that departs from fixed scan patterns and enables a new form of distributed edge processing. This approach enables self-driving cars to make better, faster decisions.

18:30—19:30 • Joint Postdeadline Paper Session, *Hall E1*

07:30—17:30 • **Registration**, *Left Wing Main Lobby*

Hall E1 — ASSL

08:00 -- 10:00
AW1A • Nonlinear Materials & Processes
Presider: Michal Koselja; Inst. of Physics of the ASCR, Czechia

AW1A.1 • 08:00 Invited
PP-LBGO, Its Material/Device Fabrication and Properties as a QPM Device, Junji Hirohashi[1], Mitsuyoshi Sakairi[1], Koichi Imai[1], Shunsuke Watanabe[1], Yasuhiro Tomihari[1]; *[1]Oxide Corporation, Japan.* Novel QPM material, PP-LBGO was investigated from the point of material/device fabrication and its frequency conversion performances. UV generation with circular beam at 355 nm and 266 nm were confirmed by using fabricated devices.

AW1A.2 • 08:30
Cascaded Third-Harmonic Generation in a quasi-periodically poled KTP crystal, Benoit Boulanger[1], Véronique Boutou[1], Augustin Vernay[1], Lucas Bonnet-Gamard[1], Sivan Trajtenberg-Mills[2], Ady Arie[2]; *[1]Institut Néel CNRS Univ. Grenoble Alpes, France; [2]Tel Aviv Univ., Israel.* We performed cascaded Third-Harmonic Generation in a quasi-periodically poled KTP crystal allowing simultaneous phase-matching of the two cascading steps $\omega + \omega \rightarrow 2\omega$ and $2\omega + \omega \rightarrow 3\omega$ with $\lambda_\omega = 1586$ nm.

AW1A.3 • 08:45
High Efficiency Third harmonic Generation at 355 nm in CBF ($Ca_5(BO_3)_3F$) Single Crystal Using Micro-MOPA, Florent Cassouret[1,2], Arvydas Kausas[2], Gérard Aka[1], Pascal Loiseau[1], Takunori Taira[2,3]; *[1]Institut de Recherche de Chimie Paris, France; [2]Inst. for Molecular Science, Japan; [3]RIKEN Harima branch, Japan.* Third harmonic generation of Nd^{3+}:YAG micro-MOPA system was obtained with 16.9% conversion efficiency and energy, pulse duration and peak power equal to 479 µJ, 568 ps and 843 kW, respectively.

AW1A.4 • 09:00
Chalcogenide-Silica Hybrid Planar Platform for High Performance Nonlinear Optic Devices, Duk-Yong Choi[1], Sangyoon Han[2], Joonhyuk Hwang[2], YongHee Lee[2], In Hwan Do[2], Dongin Jeong[2], Hansuek Lee[2]; *[1]Australian National Univ., Australia; [2]KAIST, Korea (the Republic of).* We developed chalcogenide-silica hybrid platform without direct patterning and achieved a record high Q-factor of 13 million in the hybrid resonator. Stimulated Brillouin lasing at 1 mW threshold power is implemented by flip-chip coupling.

AW1A.5 • 09:15
Polarity inversion of crystal quartz using a QPM stamp, Hideki Ishizuki[2,1], Takunori Taira[2,1]; *[1]Inst. for Molecular Science, Japan; [2]Spring-8 Center, RIKEN, Japan.* Stress-induced polarity inversion using a QPM stamp is proposed for realizing a QPM structured crystal quartz. Fabrication of QPM structure and demonstration of QPM-SHG with 2.3 kW peak intensity was realized for initial evaluation.

AW1A.6 • 09:30
Efficient Raman converter at 583 nm using a photonic bandgap fiber filled with a mixture of liquids , Sylvie Lebrun[1], Philippe Delaye[1], Minh Châu Phan Huy[1]; *[1]Laboratoire Charles Fabry, Institut d'Optique, CNRS, Univ. Paris-Sud, France.* We present a Raman converter emitting at 583 nm on the second Stokes order of propan-2-ol pumped by a microlaser at 532 nm in the sub-nanosecond regime with a conversion efficiency of 67%.

AW1A.7 • 09:45
Yellow laser at 573 nm generated by intracavity SHG diode-side-pumped Raman laser, Merilyn S. Ferreira[1], Helen Pask[2], Niklaus U. Wetter[1]; *[1]Center for Lasers and Applications, Instituto de Pesquisas Energeticas e Nucleares - IPEN/SP, Brazil; [2]Dept. of Physics and Astronomy, Macquarie Univ., Australia.* A diode side-pumped $Nd:YLiF_4$ crystal for fundamental wavelength generation and intracavity Stokes conversion in KGW are employed to obtained 6.1W maximum output power, 11.9% slope efficiency and 11.8% diode-to-yellow conversion efficiency at 573 nm.

Hall M2 — LS&C

08:00 -- 10:00
LW1B • Sources & Techniques for Sensing and Communication
Presider: Claudine Besson; Office Natl d'Etudes Rech Aerospatiales, France

LW1B.1 • 08:00
Withdrawn

LW1B.2 • 08:30 Invited
Performances and Applications of Coherent Pulsed Fiber Lidars in Atmospheric Sensing, Jean-Pierre Cariou[1]; *[1]LEOSPHERE, France.* New generation infrared Wind Doppler Lidars benefit from reliable fiber lasers. Thanks to more than 1200 wind Doppler Lidars deployed worldwide by Leosphere, lidar performance is assessed in various atmospheric conditions for wind energy, meteo and airport applications.

LW1B.3 • 09:00 Invited
Precision Optical Time-Frequency Transfer Over Free Space Links With Laser Frequency Combs, Nathan R. Newbury[1]; *[1]NIST, USA.* We describe recent advances in optical two-way time-frequency transfer that uses the coherent exchange of frequency comb pulse trains over the air to compare and synchronize the timing between remote sites to the femtosecond level.

LW1B.4 • 09:30 Invited
Visible GaN Lasers for Quantum Sensing and Communication Applications, S.P. Najda[1], P. Perlin[1], M. Leszczyński[1], S.Stanczyk[1], C.C.Clark[2], T.J.Slight[3], J.Macarthur[4], L.Prade[4], L.McKnight[4], S.Watson[5] and A.E.Kelly[5]; *[1]TopGaN Ltd., Poland; [2]Helia Ltd., Rosebank Technology Park, U.K; [3]Compound Semiconductor Technologies Global Ltd, U.K; [4]Fraunhofer Centre of Applied Photonics, U.K; [5]University of Glasgow, U.K.* We report on GaN lasers with extremely narrow linewidth (<1MHz) at 'magic wavelengths' for cold-atom interferometry quantum sensors, and high frequency (GHz) operation for specialised telecommunication applications.

Hall M1 — LAC

08:00 -- 10:00
Surface Modification & Micromachining
Organizer: Heather George; TRUMPF, USA

Lasers are a critical tool in creating surface modifications to control mechanical or chemical interactions. From cleaning to remove contaminants in preparation for welding to creating a surface texture that has an increased surface area for adhesion, lasers give an unparalleled degree of control. This control is also essential for micromachining, since the very small or thin parts are easily distorted by any type of warp or burr. This session will focus on the latest capabilities of lasers, scanners and processes to control fine structures for emerging market applications.

08:00 Invited
Laser Cleaning and Its Potential Application in Weld Seam Preparation, Melanie Mangang[1]; *[1]EMAG LaserTec GmbH, Germany.* ontaminants on the surface of powertrain parts critically affect the quality of the weld seam. Laser cleaning is an attractive method to remove contaminants (lubricants, coating, rust …) to achieve a process-reliable weld seam.

08:20 Invited
Ultrafast Laser micro Machining with Rotating Beam – high Precision Drilling, Cutting and Turning, Florian Lendner[1]; *[1]GFH GmbH, Germany.* Abstract to be announced.

08:40 Invited
Title to be announced, Ulf Quentin[1]; *[1]TRUMPF Laser GmbH + Co KG, Germany.* Abstract to be announced.

09:00 Invited
Flexible Beam Shaping System for Accelerating Ultrafast Laser Micromachining Applications, Stephan Eifel[1]; *[1]Pulsar Photonics GmbH, Germany.* Beam shaping is a promising approach to accelerate ultrafast laser micromachining in industrial applications. We present the latest results of application development using our self-developed LCoS-SLM based beam shaping system for ultrafast laser micromachining.

09:20 Invited
High Throughput and High Quality Surface Texturing with Ultrafast Lasers, T. Kramer[1], S. Remund[1], M. Chaja[1], M. Gafner[2], T. Maehne[2], B. Neuenschwander[1]; *[1]Bern University of Applied Sciences, Institute for Applied Laser, Photonics and Surface technologies ALPS, Switzerland; [2]Bern University of Applied Sciences, Institute for Intelligent Industrial Systems I3S, Switzerland.* The combination of diffractive optical elements (DOE) or spatial light modulators (SLM) with conventional beam guiding technologies as galvo scanning offers the possibility to deal with multi 100 W average power ultra-short pulsed laser systems.

Entrance Hall, Hall F

10:00 -- 11:30
JW2A • Joint Poster Session

JW2A.1
Coherent combing of 60 fiber lasers using stochastic parallel gradient descent algorithm, Rongtao Su[1], Jiachao Xi[1], Hongxiang Chang[1], Yanxing Ma[1], Pengfei Ma[1], Jian Wu[1], Man Jiang[1], Pu Zhou[1], Lei Si[1], Xiaojun Xu[1], Jinbao Chen[1]; *[1]National Univ. of Defense Technolog, China.* We reported a 60 channel coherently combined fiber laser array based on SPGD algorithm. The contrast of the far-field intensity pattern was ~97%, and ~34.7% of the total power was contained in the central lobe.

JW2A.2
Low-saturation-energy Ultrafast Saturable Absorption of High-density Well-aligned Single-walled Carbon Nanotubes, Dmitriy A. Dvoretskiy[1], Stanislav G. Sazonkin[1], Ilya O. Orekhov[1], Igor S. Kudelin[2], Alexey B. Pnev[1], Valeriy E. Karasik[1], Lev K. Denisov[1], Valeriy A. Davydov[3]; *[1]Bauman Moscow State Technical Univ., Russia; [2]Aston Inst. of Photonics Technologies, Aston Univ., UK; [3]Inst. for High Pressure Physics of the Russian Academy of Sciences, Russia.* We have studied low-saturation-energy ultrafast behavior of high-density well-aligned single-walled carbon nanotubes saturable absorber obtained by high-pressure-high-temperature treatment of commercially available single-walled carbon nanotubes.

JW2A.3
Laser Performance of the New IR NLO Crystal $BaGa_4Se_7$, Jiyong Yao[1], Feng Yang[1], Baoquan Yao[2], Degang Xu[3], Haihe Jiang[4], Zhensong Cao[5]; *[1]Technical Inst. of Phys. & Chem., China; [2]Harbin Inst. of Technology, China; [3]Tianjin Univ., China; [4]Anhui Inst. of Optics and Fine Mechanics, CAS, China; [5]Key Lab of Atmospheric Optics, CAS, China.* Excellent "3-12μm" laser output performance has been achieved by OPA, OPO and DFG experiments based on $BaGa_4Se_7$. These results indicate $BaGa_4Se_7$ is a very promising new crystal for practical application.

JW2A.4
Absolute Absorption Measurements: From Bulk to Coatings to Optical Fibers, Christian Muehlig[1], Simon Bublitz[1]; *[1]Leibniz Instit. for Photonic Technology, Germany.* The LID technique for absolute absorption measurements is introduced. From the general principle, several concepts are derived for measurements in optical materials, coatings and fibers. Experimental results will cover nonlinear optical crystals, optical coatings and fiber Bragg gratings.

JW2A.5
Dual-frequency Mid-IR Optical Parametric Oscillation, Suhui Yang[1], Kun Li[1], Zhuo Li[1]; *[1]Beijing Inst. of Technology, China.* A dual-frequency 1064 nm laser pumped an OPO. 2.2 W RF intensity modulated light was obtained at 3.1-3.8 μm. The modulation frequency was 140 MHz-160 MHz. Higher order harmonic was observed in the mid-IR modulation spectra.

JW2A.6
Nd^{3+}-doped tellurite all solid photonic bandgap fiber with one-dimensional asymmetric periodic structure , Hoang Tuan Tong[1], Kohei Suzaki[1], Takenobu Suzuki[1], Yasutake Ohishi[1]; *[1]Toyota Technological Inst., Japan.* An Nd^{3+}-doped tellurite all-solid photonic bandgap fiber with one-dimensional asymmetric periodic structure of high-index rods is demonstrated as a promising solution to suppress the emission at 1.06 μm of Nd^{3+} ions..

JW2A.7
76.5% Conversion-efficiency PPLN Optical Parametric Oscillator Pumped by a Flat-topped Nd:YAG Laser, Xing B. Wei[1], Yuefeng Peng[1], Xingwang Luo[1], Jianrong Gao[1], Jue Peng[1], Weimin Wang[1]; *[1]Inst. of Applied Electronics, China.* We present a high-efficiency PPLN OPO pumped by a flat-topped 1064 nm laser. Output power for both 3.91 μm idler and 1.46 μm signal was 10.1 W at 13.2 W of pump with 76.5% efficiency.

JW2A.8
Laser Induced Damage Study of Different Kinds of Gratings Used to Different High Power Pulse Width Compressed, Jin Yunxia[1]; *[1]R&D Center of Optical Thin Film Coatings, China.* This report is focused on laser induced damages and mechanisms of different pulse compression gratings(PCG) including multilayer dielectric gratings, metal gratings and metal-multilayer dielectric gratings. And the potential of metal-multilayer dielectric gratings is analysed.

JW2A.9

Withdrawn

JW2A.10
A comparison of zero phonon line and conventional pumping in high power CW Yb:YAG thin disk laser, Mohammad Aghaie[1], Shahram Kazemi[1], Saeid Radmard[1], Mahdi Bakhtiary[1]; *[1]InLC Technology Inc, Iran (the Islamic Republic of).* A quantitative comparison between zero phonon line (ZPL) and 940nm pumping of Yb:YAG disk laser with numerical and experimental results is reported. An improvement of optical efficiency, reduction in disk temperature and back reflected pump power at ZPL observed.

JW2A.11
Compact Kerr Frequency Comb Source Self-Injection Locked to a Microresonator for Absorption Spectroscopy, Andrey S. Voloshin[1], Grigory V. Lihachev[1], Sofya E. Agafonova[1,2], Sergey Koptyaev[3], Junqiu Liu[4], Tobias J. Kippenberg[4], Michael Gorodetsky[1,5], Igor A. Bilenko[1,5]; *[1]Russian Quantum Center, Russia; [2]Moscow Inst. of Physics and Technology, Russia; [3]Samsung R&D Inst. Russia, SAIT-Russia Lab, Russia; [4]Ecole Polytechnique Federale de Lausanne, Switzerland; [5]Faculty of Physics, Lomonosov Moscow State Univ., Russia.* We developed a compact Kerr frequency comb (microcomb) source based on high-Q optical microresonator and measured absorption spectra of different glucose solutions. Self-injection locking of a high-power laser diode to the microresonator allowed significantly decreasing the device volume.

JW2A.12
Accuracy of temporal diagnostic of single cycle laser pulses at using of single shot intensity autocorrelator, Igor Kuzmin[1], Sergey Mironov[1]; *[1]Inst. of Applied Physics of RAS, Russia.* Theoretical model of single shot autocorellator operation, which is capable describing of single cycle laser pulse duration measurements, was developed. With help of the model an accuracy of such measurements was analyzed.

JW2A.13
Continuously tunable diamond Raman laser for resonance ionization experiments at CERN, Eduardo Granados[1], Katerina Chrysalidis[1,2], Valentin N. Fedosseev[1], Bruce A. Marsh[1], Shane G. Wilkins[1], Klaus D. A. Wendt[2], Richard P. Mildren[3], David J. Spence[3]; *[1]CERN, Switzerland; [2]Institut fur Physik, Johannes Gutenberg-Universitat, Germany; [3]MQ Photonics Research Centre, Macquarie Univ., Australia.* We demonstrate an efficient, tunable, diamond Raman laser operating in the blue region of the spectrum. The linewidth and tunability of a frequency-doubled Ti:Sapphire laser were transferred to the Stokes output, offering great potential for spectroscopy using an all-solid-state platform.

JW2A.14
Undesirable Modes Suppression in Double-Clad Fibers by Adding Absorbing Inclusions to the First Cladding, Tatyana A. Kochergina[1], Svetlana S. Aleshkina[1], Denis S. Lipatov[2], Mikhail Y. Salganskii[2], Vladimir V. Velmiskin[1], Mikhail Bubnov[1], Aleksey N. Guryanov[2], Mikhail E. Likhachev[1]; *[1]Fiber Optics Research Center of the Russian Academy of Sciences, Russia; [2]G.G. Devyatykh Inst. of Chemistry of High-Purity Substances of the Russian Academy of Sciences, Russia.* To create conditions for an asymptotically-single-mode propagation in double-clad fibers with an increased core size, the technique of undesirable modes absorption in additional inclusions incorporated into the first reflecting silica cladding was experimentally realized.

JW2A.15
Development of Periodically Poled $LaBGeO_5$ Waveguide Device for Frequency Conversion in UV Region, Shunsuke Watanabe[1], Junji Hirohashi[1], Koichi Imai[1], Masayuki Hoshi[1], Satoshi Makio[1]; *[1]Oxide Corporation, Japan.* We developed femtosecond-laser-written waveguides in periodically poled $LaBGeO_5$ frequency conversion device for UV laser source. We characterized the waveguide properties and demonstrated second harmonic 266 nm generation with CW 532 nm laser.

JW2A.16
Optical Parametric Oscillator with intra cavity sum frequency mixing of alternating signal and idler radiation for generating tunable UV ns impulses, Peter Mahnke[1]; *[1]Inst. of Technical Physics, German Aerospace Center (DLR), Germany.* We report on an ns optical parametric oscillator with intra cavity mixing of signal and idler radiation to generate 230-240 nm and 280-290 nm alternating with 355 nm for fluorescence
LIDAR.

JW2A.17
Precisely Measuring the Thermal Focal Length in the Orthogonally Polarized Nd:YLF Laser by Simultaneous Self-Mode-Locking of $TEM_{0,0}$ and $TEM_{1,0}$ Modes, Hsing-Chih Liang[1], En-Hsu Lin[1], Di Li[1]; *[1]National Taiwan Ocean Univ., Taiwan.* We precisely measure the transverse beat frequency in an orthogonally polarized Nd:YLF laser. With the measured beat frequency, the effective focal length of the thermal lensing for π- and σ-polarization can be simultaneously determined as a function of the absorbed power.

10:00 -- 11:30
JW2A • Joint Poster Session- Continued

JW2A.18
50-μJ level, 20-picosecond difference-frequency generation at 4.6-9.2 μm in $LiGaS_2$ and $LiGaSe_2$ at Nd:YAG laser pumping and various crystalline Raman laser seeding, Sergei Smetanin[2], Michal Jelinek[1], Vaclav Kubecek[1], Aleksey Kurus[3], Sergei Lobanov[3,4], Vitaliy Vedenyapin[3,4], Lyudmila Isaenko[3,4]; *[1]Czech Technical Univ. in Prague, Czechia; [2]Prokhorov General Physics Inst., Russia; [3]Sobolev Inst. of Geology and Mineralogy, Russia; [4]Novosibirsk State Univ., Russia.* 50-μJ-level difference-frequency generation at discrete wavelengths of 4.6, 5.4, 7.5, and 9.2 μm in high-damage-threshold $LiGaS_2$ and $LiGaSe_2$ crystals under picosecond Nd:YAG laser pumping and various crystalline ($CaCO_3$, $BaWO_4$, diamond) Raman laser seeding is demonstrated.

JW2A.19
Color domains in passively mode-locked fiber laser, Georges Semaan[1], Yichang Meng[1], Meriem Kemel[1], Mohamed Salhi[1], Andrey K. Komarov[1], Francois Sanchez[1]; *[1]Universite d'Angers, France.* We report the emergence of wavelength-dependent condensate phases leading to the formation of color domains in passively mode-locked fiber lasers. Single, dual or tricolor domain that fill all the cavity have been observed.

JW2A.20
10-mJ-class dual-arm ultra-broadband MIR OPCPA system based on KTA crystals, Szabolcs Tóth[1,2], Roland Nagymihaly[1,2], Alexey Andrianov[3], Roland Flender[1,2], Bálint Kiss[1], Máté Kurucz[1], Ludovit Haizer[1], Eric Cormier[4], Károly Osvay[1]; *[1]ELI-ALPS, ELI-HU Nonprofit Ltd., Hungary; [2]Dept. of Optics and Quantum Electronics, Univ. of Szeged, Hungary; [3]Inst. of Applied Physics of the Russian Academy of Sciences, Russia; [4]CELIA, Université de Bordeaux-CNRS-CEA, France.* A 10 kHz KTA-based OPCPA system was numerically investigated with exceptionally short 43 mJ signal and 10 mJ idler output pulses. Thermal limitations of the amplifier were thoroughly analyzed with special care on power stages.

JW2A.21
Output characteristics of a mode-locked laser oscillator with a SESAM located inside the cavity, Seong-Hoon Kwon[1], Dong Hoon Song[2], Do Kyeong Ko[1]; *[1]Gwangju Inst of Science & Technology, Korea (the Republic of); [2]Electronics and Telecommunications Research Inst., Korea (the Republic of).* We demonstrate novel configuration of mode-locked laser oscillator where a SESAM is located inside the cavity and compared the output characteristics with the laser oscillator where the SESAM at the end of the cavity.

JW2A.22
Second Harmonic Generation under High Dose-Rate Gamma Ray Irradiation, Hwanhong Lim[1], Takunori Taira[1,2], Hironori Ohba[3], Koji Tamura[3]; *[1]Inst. for Molecular Science, Japan; [2]RIKEN SPring-8 Center, Japan; [3]National Inst.s for Quantum and Radiological Science and Technology, Japan.* High brightness microchip-lasers were frequency-doubled using single LBO crystals under high dose-rate gamma-ray irradiation for the first time. Dose-rate dependent exponential-decay of SHG-energy was observed for one-hour continuous operation at dose-rates up to 10 kGy/h.

JW2A.23
Few-cycle mid-infrared ultrafast pulses generation based on continuous-wave seeded optical parametric amplification, Zhong Zuo[1], Chenglin Gu[1], Daowang Peng[1], Xing Zou[1], Daping Luo[1], Lian Zhou[1], Zhiwei Zhu[1], Zejiang Deng[1], Yang Liu[1], Wenxue Li[1]; *[1]East China Normal Univ., China.* We demonstrated a method to directly produce transform-limited few-cycle mid-infrared pulses at 90 fs duration employing optical parametric amplifier seeded by mid-infrared continuous-wave laser and the wavelength tunable ability is also proved.

JW2A.24
Study of Microchip Laser Pulse Shaping under Amplification, Taisuke Kawasaki[2,1], Vincent Yahia[1], Takunori Taira[2,1]; *[1]Inst. for Molecular Science, Japan; [2]Laser Driven Electron Acceleration Technology Group, RIKEN, Japan.* By numerical calculations of pulse propagation in the highly excited Nd:YAG-rod of an amplifier in sub-ns Micro-MOPA, we provedamplification conditions to compress the pulse length.

JW2A.25
Passive Q-switching of a Tm:$LiYF_4$ Waveguide Laser by Cr^{2+}:ZnSe and Co^{2+}:ZnSe Saturable Absorbers, Pavel Loiko[1], Rémi Soulard[1], Gurvan Brasse[1], Lauren Guillemot[1], Alain Braud[1], Aleksey Tyazhev[2], Ammar Hideur[2], Patrice Camy[1]; *[1]CIMAP, Université de Caen Normandie, France; [2]CORIA, CNRS-Université de Rouen, France.* A Tm:$LiYF_4$/$LiYF_4$ channel waveguide laser was passively Q-switched by Cr^{2+}:ZnSe and Co^{2+}:ZnSe saturable absorbers. For Cr^{2+}:ZnSe, the laser operated at 1876.5 nm generating 9 ns/2.1 μJ pulses at a repetition rate of 0.29 MHz.

JW2A.26

Withdrawn

JW2A.27
Impact of Barrier Height on the Interwell Carrier Transport in InGaN/(In)GaN Multiple Quantum Wells, Saulius Marcinkevicius[1], Rinat Yapparov[1], Leah Y. Kuritzky[2], Shuji Nakamura[2], James S. Speck[2]; *[1]KTH Royal Inst Tech, Sweden; [2]Univ. of California, Santa Barbara, USA.* Interwell carrier transport, important for efficient LED and laser diode operation, was studied in InGaN quantum wells by time-resolved photoluminescence. A strong increase in transport efficiency was achieved by when GaN barriers were changed to InGaN.

JW2A.28
Fiber Fuse Effect in Hollow-Core and Solid Core Optical Fibers: Comparison, Igor A. Bufetov[1], Anton Kolyadin[1], Yury Yatsenko[1], Alexey Kosolapov[1]; *[1]Fiber Optics Research Center of RAS, Russia.* The propagation of an optical discharge along hollow-core optical fibers was investigated experimentally. The obtained physical picture of the phenomenon is compared with fiber fuse effect in ordinary silica fibers.

JW2A.29
High Duty Cycle, High Repetition Rate High Brightness Diode Laser Pulsed-Pump-Sources, Marko Hubner[1], Bernd Eppich[1], Andre Maassdorf[1], Dominik Martin[1], Arnim Ginolas[1], Paul Simon Basler[1], Markus Niemeyer[1], Paul Crump[1]; *[1]FBH, Germany.* A diode laser pump source is presented using passive side-cooling to enable >10% duty cycle (optimal cooling, long time constants). 6 kW output (1.4 MW/cm^2/sr ex-fiber) is demonstrated at 940 nm (0.1…100 ms pulses), with 780…980 nm also available.

JW2A.30
Photothermal Deflection Measurements of Sub-Surface-Damage in LBO Crystals, Heidi Cattaneo[1], Roelene Botha[1], Carsten Ziolek[1]; *[1]NTB Univ. of Applied Science, Switzerland.* Photothermal deflection technique is used to detect sub-surface-damages in LBO crystals. Variations in UV-absorption in the material are mapped over the crystal surface and in depth.

JW2A.31
Investigation of Line Broadening Scheme Dependence on Coherent Beam Combination Efficiency, Linslal C.L.[1], Sooraj M. S.[1], Panbiharwala Y[1], Padmanabhan A[1], Dixit A[1], Deepa Venkitesh[1], Balaji Srinivasan[1]; *[1]Electrical Engineering, Indian Inst. of Technology Madras, India.* We report our investigations on the influence of line broadening schemes on the visibility of the coherently combined laser beams.

JW2A.32
Microjoule-level widely tunable gain-switched thulium-doped fiber laser, Svyatoslav Kharitonov[1], Camille-Sophie Brès[1]; *[1]Ecole Polytechnique Federale de Lausanne, Switzerland.* We demonstrate the hybrid-pumped (continuous-wave+pulsed) gain-switched small-core thulium-doped fiber laser tunable in 1825-2064nm spectral range that delivers 50-300ns pulses with energies up to 12μJ (65μJ of injected pump) reaching performance of larger-core gain-switched laser systems.

JW2A.33
High average power laser output in high concentration Yb^{3+} doped low NA PCF origin from Sol-gel process, Chunlei Yu[1], Meng Wang[1], Shikai Wang[1], Suya Feng[1], Lili Hu[1]; *[1]Shanghai Inst of Optics & Fine Mechanics, China.* Yb/Al/P/F high concentration co-doped silica glass PCF was fabricated and a peak power over 1 MW were achieved in a master oscillating power amplification pico-second pulse system.

JW2A.34
Light-intensity Distribution in Bragg Mirrors, Jerry Yeung[1], Cristine Kores[2], Nur Ismail[3], Markus Pollnau[1]; *[1]Univ. of Surrey, UK; [2]Dept. of Applied Physics, Dept. of Materials and Nano Physics, Sweden; [3]Dept. of Materials and Nano Physics, Royal Inst. of Technology, Sweden.* We calculate intensity distributions in a Bragg grating. At the Bragg wavelength the distribution shows a perfectly exponential decay. At wavelengths far away from the Bragg wavelength it becomes sinusoidal, equivalent to damped harmonic oscillators.

JW2A.35
UV-Extended ps-Supercontinuum Generation for Time-resolved Broadband Spectroscopy, Luben S. Petrov[1], Anton Trifonov[1,2], Ivan Buchvarov[1]; *[1]Sofia Univ. St. Kliment Ohridski , Bulgaria; [2]Trifonov Inovatix Ltd., Bulgaria.* Stable UV-extended supercontinuum generation by self-action of Nd:YVO SHG-picosecond pulses in bulk solid and liquid materials is demonstrated. The continuum properties show a strong dependence on the incident beam focusing parameters and SHG-phase mismatch.

JW2A.36
Modal phase-matching in graded index waveguides: unsensitive and efficient phase matched configurations in χ^2 based nonlinear integrated optics devices., Maxim Neradovskiy[1], Hervé Tronche[1], Elizaveta Neradovskaia[1], Pierre Aschieri[1], Florent Doutre[1], Tommaso Lunghi[1], Pascal Baldi[1], Marc D. Micheli[1]; *[1]Université Côte d'Azur - CNRS, France.* We show numerically and experimentally that choosing properly the shape of the index profile of the waveguide and using high order modes for the harmonic, makes the SHG process more efficient and unsensitive to waveguide parameters variations.

Entrance Hall, Hall F

10:00 -- 11:30
JW2A • Joint Poster Session– Continued

JW2A.37
Frequency doubling of multimode diode-pumped graded-index fiber Raman lasers, Sergey A. Babin[1,2], Alexey G. Kuznetsov[1], Ekaterina A. Evmenova[1], Sergey Kablukov[1,2]; *[1]Inst. of Automation and Electrometry, Russia; [2]Novosibirsk State Univ., Russia.* Frequency doubling of multimode diode-pumped graded-index fiber lasers generating high-quality (M^2=2-2.5) beam at 954 and 976 nm is studied. Efficient generation in PPLN crystals of second harmonics at 477 and 488 nm has been demonstrated.

JW2A.38
Anomalous pulse response of a ZnO film photoconductive detector, Jun Liu[1], Liang Chen[1], Xinjian Tan[1], Bodong Peng[1], Xiufeng Weng[1], Bin Sun[1], Zhuming Fu[1]; *[1]Northwest Inst. of Nuclear Technology, China.* The response characteristics of a ZnO photoconductive detector has been investigated using different pulses. Its response to Xe lamp and UV laser was fast and linear as expected, anomalous behaviors were observed under X-ray excitation.

JW2A.39
Using mode-locked laser for shaping many bit information, Ghafurov Halimjon[1]; *[1]Khujand State Univ. (KhSU), Tajikistan.* The mode locking of lasers is quite stable, it suggested use it to generate multi-bit information, which called libit-light binary digit. In this way, you can increase the speed of information processing in the binary system.

JW2A.40
Real-time FPGA-based data acquisition and evaluation scheme of a multi-channel laser Doppler anemometer, Oliver Kliebisch[1], Peter Mahnke[1]; *[1]German Aerospace Center, Germany.* We report on a scalable data processing scheme of a multi-channel laser Doppler anemometer for the application as an optical air data sensor. The pipelined continuous processing enables dead time free measurements.

JW2A.41
Laser ablation in solid states with pulse of complex structure, Ghafurov Halimjon[1], Ibrohim Sarhadov[2]; *[1]Khujand State Univ. (KhSU), Tajikistan; [2]JINR, Russia.* The process of exposure of solid states with ultra-short laser pulse has a priori established relationship between the characteristics of laser radiation and the deformational processes of ablation, it is advisable use them to increasing the efficiency of material processing.

JW2A.42
Common-path optical terminals for Gbps full-duplex FSO communications between a ground and UAVs, Chan Il Yeo[1], Young Soon Heo[1], Hyun Seo Kang[1], Ji Hyoung Ryu[1], Si Woong Park[1], Sung Chang Kim[1]; *[1]Electronics and Telecommunications Research Inst., Korea.* We present common-path optical terminals designed for full-duplex FSO communications to apply for UAVs to ground communication. A preliminary experiment using the FSO terminals installed at fixed position showed a 1.25-Gbps full-duplex error-free link for a bit error rate of ~10^{-12} over 50 m.

JW2A.43
Performances Optimizations of Long Range FSO Link under Tropical Weather Effects, Cheikh amadou Bamba Dath[1]; *[1]Laboratoire Atome Laser/universite Cheikh Anta Diop, Dakar, MESR/UCAD, Senegal.* We investigate on the reliability and performances of a 5 km FSO link simulated by using visibilities records and others tropical weather data measured in Dakar city.The Percentages of availabilities and architectures are proposed for a class1 laser at 1550 nm.

JW2A.44
Turbulence Mitigation By Tiled Aperture Coherent Coupling Of Laser Emitters, Jürgen Kästel[1], Jochen Speiser[1]; *[1]Inst. of Technical Physics, German Aerospace Center, Germany.* Laser propagation is severely affected by atmospheric turbulence. The capability of a tiled aperture coherent coupling approach is investigated numerically regarding the mitigation of such turbulent aberrations w.r.t. the number of emitters and other parameters.

JW2A.45

Withdrawn

JW2A.46
Bessel-Bessel Laser Bullets: Fields and Propagation Characteristics, Yousef I. Salamin[1]; *[1]Physics Dept., American Univ. of Sharjah, United Arab Emirates.* Fields of a laser Bessel-Bessel bullet are presented, from solution to the wave equations of the scalar and vector potentials in the presence of an under-dense plasma. Propagation over many centimeters without distortion is demonstrated.

JW2A.47
Growth of large area MoS_2 monolayers on periodic structures substrate by laser processing, Kai-Hsiang Ke[2], Yao-Ching Chiu[2], Ming-Yen Lu[3], Vladimir E. Fedorov[4], Hsiang-Chen Wang[2], Chie-Tong Kuo[1]; *[1]National Sun Yat-sen Univ., Taiwan; [2]National Chung Cheng Univ., Taiwan; [3]National Tsing Hua Univ., Taiwan; [4]Siberian Branch of Russian Academy of Sciences, Russia.* A large-area monolayer of molybdenum disulfide was grown on a periodic structure substrate by using the APCVD via MoO3 vapor managements. The growth position of structure for a molybdenum disulfide film could be regularly adjusted.

JW2A.48
Manufacturing Optical Products by the Hot Embossing Method, Liya Zhukova[1], Anastasiya Lashova[1], Alexander Lvov[1], Dmitrii Salimgareev[1], Alexander Korsakov[1]; *[1]Ural Federal Univ. named after the, Russia.* The paper present new method for manufacturing optical products based on silver halides and monovalent thallium. The method of hot embossing from monocrystal blanks was compared with the method of plastic deformation of polycrystalline crude.

JW2A.49
Toward Multidirectional Laser-induced Periodic Surface Structure Formation on Metal, Taek Yong Hwang[1], Heedeuk Shin[2], Jeongjin Kang[1], Byounghwak Lee[3], Chunlei Guo[4,5]; *[1]Korea Inst. of Industrial Technology, Korea (the Republic of); [2]Pohang Univ. of Science and Technology, Korea; [3]Korea Military Academy, Korea; [4]Univ. of Rochester, USA; [5]Changchun Inst. of Optics, Fine Mechanics, and Physics, China.* We create femtosecond laser-induced periodic surface structures on metal with multiple orientations by using one aperture and two quartz wedges. The formation mechanism of the structures will be discussed in this work.

JW2A.50
Biomimetic Structuring and Wettability Control of Alumina Toughened Zirconia Composite Ceramics Utilizing Laser Surface Processing, Georgi Georgiev[1], Albena Daskalova[2], Luben S. Petrov[1], Petar Evtimov[1], A. Carvalho[3,4], F Monteiro[3,4], Ivan Buchvarov[1]; *[1]Sofia Univ. St. Kliment "Ohridski", Bulgaria; [2]Inst. of Electronics, Bulgarian Academy of Sciences, Bulgaria; [3]Instituto de Investigação e Inovação em Saúde, Universidade do Porto, Portugal; [4]INEB - Instituto de Engenharia Biomédica, Universidade do Porto, Portugal.* Alumina Toughened Zirconia (ATZ) combining the toughness of alumina with the durability of zirconia are promising implant materials. The topography and wettability, i.e. major bioactivity determinants, of ATZ surfaces were enhanced by femtosecond-laser biomimetic texturing.

JW2A.51
Third harmonic ultrafast feedback during femtosecond micromachining of solids, Evgeniy I. Mareev[1,2], Ekaterina A. Migal[1,2], Igor Novikov[1,2], Fedor V. Potemkin[1,2]; *[1]ILC MSU, Russia; [2]Physics, M.V. Lomonosov MSU, Russia.* We demonstrate that third-harmonic can be applied as a feedback during the process of femtosecond micromachining of solids with tightly focused laser beams. The third harmonic was used for 3D mapping of laser-induced microplasma and micromodification.

JW2A.52
Femtosecond Laser 3D Microfabrication with Single Exposure or 1D Scanning, Yan Li[1], Dong Yang[1], Qian Zhang[1], Hong Yang[1], Qihuang Gong[1]; *[1]Peking Univ., China.* Femtosecond laser microfabrication of a 3D microstructure with single-exposure or 1D scanning is realized by the 3D focal field intensity engineering. The two rapid techniques can be switched to fabricate a complex microstructure.

JW2A.53
Femtosecond Pulse Laser Ablation of Dental Tissue, Hrvoje Skenderovic[1]; *[1]Inst. of Physics Zagreb, Croatia.* Femtosecond laser pulses were employed to make rectangular cavities in hard dental tissue by simultaneously monitoring the temperature rise in tooth. Following 'gentle ablation', the surface left after ablation was smooth with closed dental tubules.

JW2A.54
Tayloring Surface Properties for Biomedical Application Induced by Laser Microprocessing, Jiaru Zhang[1], Yingchun Guan[1]; *[1]Beihang Univ., China.* Laser microprocessing is an advanced method of enhancing surface properties of biomaterials. This work demonstrates the capability of laser microprocessing for biomedical magnesium and titanium alloys, with potential applications in cell adhesion and liquid biopsy.

Hall E1	Hall M2	Hall M1
ASSL	LS&C	LAC

11:30 -- 12:30
AW3A • High Power Optics
Presider: Lynda Busse; US Naval Research Lab, USA

AW3A.1 • 11:30 Invited
The Failure of High Power Optics Due to Dirt and Airborne Particles, Joseph J. Talghader[1]; *[1]Univ. of Minnesota Twin Cities, USA.* Materials with high bandgaps are resistant to particle-induced breakdown under CW illumination because evaporating contaminants then generate fewer free carriers near the surface. Laser-accelerated atmospheric particles induce failure even more strongly than fixed surface particles.

AW3A.2 • 12:00
Spatiotemporal aberrations introduced by thermal effects in a grating compressor of a PW laser, Lucas Ranc[3,2], Zeudi Mazzotta[1], Nathalie Lebas[1], Catherine LeBlanc[1], Ji-Ping ZOU[1], François Mathieu[1], Frédéric Druon[3], Dimitris Papadopoulos[1]; *[1]Laboratoire pour l'Utilisation des Lasers Intenses, CNRS, Ecole Polytechnique, France; [2]THALES LAS FRANCE SAS, France; [3]Laboratoire Charles Fabry, Institut d'Optique, CNRS, Univ. Paris Saclay, France.* In the aim of reaching high-peak-powers, which may induce deleterious thermal loads, we investigate the spatiotemporal thermal distortions in a PW-laser facility studying the thermal effects (up to 130W/cm^2) occurring in a large compressor-gratings.

AW3A.3 • 12:15
Thermal effects in Yb:YAG/Sapphire composite active elements for thin-disk lasers, Ivan Kuznetsov[1], Aleksey Pestov[2], Ivan B. Mukhin[1], Maria Zorina[2], Mikhail R. Volkov[1], Oleg V. Palashov[1], Nikolay Chkhalo[2]; *[1]Inst. of Applied Physics of the RAS, Russia; [2]Inst. for Physics of Microstructures of the Russian Academy of Sciences, Russia.* Yb:YAG/sapphire composite active elements for high-power and high-energy thin-disk lasers are successfully fabricated using thermal diffusion bonding as well as surface activated direct bonding methods and investigated from the point of thermal effects and lasing.

11:30 -- 12:30
LW3B • Receiver Technologies for Sensing & Communication
Presider: Jason Stafford; US AFRL, USA

LW3B.1 • 11:30 Invited
Geiger-mode Avalanche Photodiode (GmAPD) Single Photon Receiver Technology, Piotr Kondratko[1,] Leye Aina[1], Ronda Irwin[1], Jeffrey Wilhite[1], Jacob Wilson[1]; *[1]Ball Aerospace & Technologies, USA.* Ball Aerospace manufactures multi-pixel short-wave infra-red (SWIR) Geiger-mode avalanche photodiode (GmAPD) light detection and ranging (LIDAR) receivers for military and various commercial markets. This work reviews the synchronous and asynchronous single photon-sensitive sensor operation, production, and applications.

LW3B.2 • 12:00 Invited
Integrated Photonics Technologies for Sensing and Free Space Communication, Daniel Renner[1], Milan Mashanovitch[1], Leif Johansson[1], Gordon Morrison[1]; *[1]Freedom Photonics, LLC, USA.* Miniature Optical Sensors and Free-Space-Optical communication transceivers are enabling critical new applications on land, sea, air and space. This paper will review the impact of Photonic Integrated Circuit (PIC) technologies to achieve extremely small size and weight sensors and transceivers.

11:30 -- 12:30
Laser Shock Peening
Organizer: Danijela Rostohar; Inst. of Physics of the ASCR, USA

Laser peening has great potential to prolong the service life of various products and components, and is expanding the application area based on the advancement in high-power laser technology. The purpose of this session is to provide a forum for exchanging the latest results of research, development and innovation in laser peening and related technologies including high power lasers, new processes such as adhesion/damage testing, laser interaction models and application to different types of materials and components with emerging interest.

11:30 Invited
The South African Heartbeat of Laser Shock Peening, Claudia Polese[1, 2], Daniel Glaser[3], Nicholas J. Stiekema[1, 2]; *[1]School of Mechanical, Industrial and Aeronautical Engineering, University of the Witwatersrand, South Africa; [2]DST-NRF Centre of Excellence in Strong Materials, University of the Witwatersrand, South Africa; [3]CSIR National Laser Centre, South Africa.* South African researchers aim at using the acoustic "heartbeat" of Laser Shock Peening, due to a cavitation bubble collapse phenomenon, as a robust in-situ diagnostic and crucial quality control metric for a repeatable industrial process.

12:00 Invited
Concepts for Adapting Highly Efficient Diode Pumped Laser Technology for Laser Shock Peening, Jörg Körner[1,,2 ,] Sanin Zulic[3], Danijela Rostohar[3], Joachim Hein [1;2], Tomas Mocek[3], Malte C. Kaluza [1;2]; [1]Institute of Optics and Quantum Electronics, Germany; [2]Helmholz Institute Jena, Germany; [3]HiLASE Centre, Institute of Physics of the Czech Academy of Sciences, Czech Republic. We investigated approaches adapting highly efficient diode pumped ytterbium doped laser technology to compact and robust high energy laser systems for laser shock peening. A prototype system generating 12 ns pulses at 1 J / 10 Hz is presented.

12:30—13:30 • Complimentary Lunch, *Entrance Hall, Hall F*

Hall E1

ASSL

13:30 -- 15:30
AW4A • Middle Infrared Fiber Lasers, Materials and Processes
Presider: Brandon Shaw; US Naval Research Lab, USA

AW4A.1 • 13:30 **Invited**
Window of Opportunity: Exploiting the Mid-infrared with Chalcogenide Glass Fibreoptics, Angela Seddon[1], [1]University of Nottingham, UK. Abstract to be announced.

AW4A.2 • 14:00
Power-scaling of 3.5 µm fiber lasers, Frédéric Maes[1], Louis-Philippe Pleau[1], Lauris Talbot[1], Vincent Fortin[1], Martin Bernier[1], Réal Vallée[1]; *[1]Centre d'optique, photonique et laser (COPL), Université Laval, Canada.* A heavily-erbium-doped fiber laser at 3.42 µm achieving a record slope efficiency of 38.6% is reported. Power-scaling perspectives of 3.5 µm fiber lasers and novel phenomena occurring in heavily-doped fibers are also investigated.

AW4A.3 • 14:15
Mid-infrared supercontinuum generation from 2 to 14 µm in various chalcogenide glasses optical fibers, Frederic Smektala[1,2], Arnaud Lemière[1,2], Frédéric Désévédavy[1,2], Bertrand Kibler[1,2], Jean-Charles Jules[1,2], Pierre Béjot[1,2], Franck Billard[1,2], Olivier Faucher[1,2]; *[1]Université de Bourgogne, France; [2]ICB UMR 6303 CNRS Université de Bourgogne Franche Comté, France.* Chalcogenide glasses optical fibers with step index or microstructured profiles are drawn from low toxicity compositions. Supercontinuum generation lead to an infrared spectrum spanning from 2 to 14µm with a 10µm core fiber of 40mm length.

AW4A.4 • 14:30
Ring-Doped Tm Fibres for High-Efficiency Cladding-Pumped 1907 nm Lasers, Matthew J. Barber[1], Peter C. Shardlow[1], Pranabesh Barua[1], Jayanta K. Sahu[1], W A. Clarkson[1]; *[1]Optoelectronics Research Centre, Univ. of Southampton, UK.* A cladding-pumped Tm fibre is designed and fabricated with a ring-structured fibre core geometry, optimised for power-scalable, single-mode 1907 nm operation with 67.0% slope efficiency and demonstrated in an all-fibre laser oscillator configuration.

AW4A.5 • 14:45
Thulium Lasers at ~2.3 µm Based on Upconversion-Pumping Scheme, Lauren Guillemot[1], Pavel Loiko[1], Rémi Soulard[1,2], Alain Braud[1], Jean-Louis Doualan[1], Ammar Hideur[3], Richard Moncorgé[1], Patrice Camy[1]; *[1]CIMAP-ENSICAEN, France; [2]Laboratoire Artemis UMR7250, France; [3]Coria UMR6614, France.* Novel upconversion pumping schemes based on excited-state absorption (ESA) and photon avalanche are proposed for 2.3 µm ($^3H_4 \rightarrow {}^3H_5$) Thulium lasers. Low-threshold $Tm^{3+}:LiYF_4$ laser pumped at 1040 nm generates 102 mW at 2302 nm.

AW4A.6 • 15:00
Material Processing with Picosecond 2-µm Pulses from Ho:YAG Amplifier, Ignas Astrauskas[1], Boris Povazay[2], Audrius Pugzlys[1,3], Andrius Baltuska[1,3]; *[1]Photonics Inst., TU Wien, Austria; [2]EV Group E.Thallner GmbH, Austria; [3]Center for Physical Sciences and Technology, Lithuania.* Robust 2.09-µm, 3.2-ps, 1.6-mJ, 16-W Ho:YAG CPA system with a simple dispersion and bandwidth management is developed and employed for material-processing. Feasibility of 2-µm picosecond pulses for de-bonding of aluminum through silicon wafer is demonstrated.

AW4A.7 • 15:15
Long-term Operation of High-power 3 µm Fiber Lasers, Yigit O. Aydin[1], Vincent Fortin[1], Frédéric Maes[1], Réal Vallée[1], Martin Bernier[1]; *[1]Centre d'optique, photonique et laser, Canada.* We report GeO_2 endcapping on high-power 3 µm -class fluoride fiber laser cavities which minimizes fiber tip degradation and enables their long-term operation.

Hall M2

LS&C

13:30 -- 15:30
LW4B • Laser Sources for Lidar & Free Space Communication
Presider: Nicolas Riviere; Office Natl d'Etudes Rech Aerospatiales, France

LW4B.1 • 13:30 **Invited**
Building Hyperscale DataCenters in Space Using Lasercom, Ohad Harlev[1]; *[1]LyteLoop, USA.* LyteLoop's proprietary, patent pending photonic method of data storage - "Storage in Motion" puts data in a state of perpetual motion. Utilizing ultra-high bandwidth lasers. SIM will not only enable a revolution in ground based Data Centers but will also enable building spaced based Hyperscale Data Centers.

LW4B.2 • 14:00
High frequency dynamics in quantum cascade lasers : a roadmap to free-space communications in the mid-infrared, Olivier Spitz[1,2], Andreas Herdt[3], Grégory Maisons[2], Mathieu Carras[2], Wolfgang Elsässer[3], Frédéric Grillot[1,4]; *[1]Télécom ParisTech, France; [2]mirSense, France; [3]Technische Universität Darmstadt, Germany; [4]Univ. of New-Mexico, USA.* Quantum cascade lasers, which can emit deterministic chaotic patterns, are found to exhibit improved chaos properties when using optical injection instead of feedback. These findings pave a way for high-speed secure communications in the mid-infrared.

LW4B.3 • 14:15
Tunable Mid-IR Hybrid Fiber/Crystal Laser for Gas Sensing, Chems-Eddine Ouinten[1], Florent Défossez[2], Laurent Lamard[3], Alexandre Gognau[1], Raphaël Vallon[2], Bertrand Parvitte[2], Virginie Zéninari[2], Jean-Bernard Lecourt[1], Yves Hernandez[1], André Peremans[4]; *[1]Applied Photonics, Multitel Innovation Center, Belgium; [2]Groupe de Spectrométrie Moléculaire et Atmosphérique, Université de Reims, France; [3]Laserspec, Belgium; [4]Univ. of Namur, France.* A rapidly tunable picosecond PM ytterbium fiber laser pumps an OPO for wavelength conversion to the mid-IR. This compact and transportable source permits fast sensing of methane, and hydrochloric acid with two different detection schemes.

LW4B.4 • 14:30
Temperature phase-matching tuning of $ZnGeP_2$ crystal for CO laser frequency conversion, Yuriy M. Klimachev[1], Andrey Ionin[1], Igor Kinyaevskiy[1], Andrey Kozlov[1], Adilya Sagitova[1], Yuriy Andreev[2,3]; *[1]P.N.Lebedev Physical Inst. of the Russian Academy of Sciences, Russia; [2]Inst. of Monitoring of Climatic and Ecological Systems SB RAS, Russia; [3]Tomsk State Univ., Russia.* Phase-matching tuning of second harmonic and sum frequencies generation in $ZnGeP_2$ crystal was studied with CO laser in mid-IR range. The experiments and calculations showed a promising of this technique for the spectrum control of frequency converted radiation.

LW4B.5 • 14:45
Tunable TW-peak-power few-cycle pulses from a hollow-core-fiber compression of an Yb-amplifier, Giulio Coccia[1], Guangyu Fan[1], Paolo A. Carpeggiani[1], Zhensheng Tao[2], Edgar Kaksis[1], Tadas Balciunas[1,3], Vincent Cardin[4], Francois Légaré[4], Bruno Schmidt[5], Andrius Baltuska[1]; *[1]TU Wien, Austria; [2]Dept. of Physics,, Fudan Univ., China; [3]GAP-Biophotonics, Université de Genève, Switzerland; [4]Institut National de la Recherche Scientifique, Canada; [5]Few-Cycle, Inc, Canada.* Using a gas-filled stretched HCF post-compressor, we demonstrate the generation of 25 fs, 40 mJ pulses at 1 µm wavelength for noble gases and a smooth wavelength tunability up to 1.3 µm for molecular gases.

LW4B.6 • 15:00
Spaceborne Fiber Lasers For Ranging Applications, Sylvain Bordais[1], Julien Salon[1], Andrew Berube[3], Tim Elgin[3], Paul Mouchel[1], Yves Candela[1], Damien Le Bail[1], Stéphane Ruel[2], Guillaume Canat[1]; *[1]Keopsys, Lumibird, France; [2]Lumibird Canada, Canada; [3]Neptec, Canada.* We report on recent developments of pulsed radiation- tolerant fiber-lasers for spaceborne ranging. They generate 6kW peak power and have been tested in relevant environments. Divergence variation of a high precision collimator is also reported.

LW4B.7 • 15:15
Noise Reduction of Single Frequency Fiber Lasers, Kang Ying[1], Liang Hong[1], Dijun Chen[1], Fang Wei[1], Fei Yang[1], Haiwen Cai[1]; *[1]Shanghai Inst Optics & Fine Mech,CAS, China.* This paper reports the noise reduction of fiber lasers. Due to the intracavity feedback, the frequency noise is reduced by a factor of about 20 dB. With an injecting lock scheme, the relaxation oscillation intensity noise is suppressed.

16:00—18:00 • Extreme Laser Sources & Applications Roundtable, *Hall E1*

19:00—21:00 • Conference Banquet, *Kunsthistorisches Museum, Sponsored by*

07:30—16:30 • **Registration**, *Left Wing Main Lobby*

Hall E1 — ASSL

08:00 -- 10:00
ATh1A • Pulse compression and High Power systems
Presider: Mark Bowers; Lockheed Martin Aculight Corp, USA

ATh1A.1 • 08:00
Nonlinear compression of a 100 W amplifier to sub-50 fs, Florent Guichard[1], Axel Chambinaud[1], Julien Pouysegur[1], Martin Cormier[1], alice odier[1], Yoann Zaouter[1], Quentin Mocaer[1], Clemens Hönninger[1], Eric Mottay[1]; *[1]Amplitude Laser Group, France.* We present a high-power70W, sub-50fs, 400µJ source at 200 kHz. This source is based on the high-efficiency nonlinear compression of an industrial grade 100 W, 450 fs amplifier through a gas-filled multipass cell (MPC) scheme.

ATh1A.2 • 08:15
Efficient, ultrafast few-cycle driver based on hybrid nonlinear compression, Florent Guichard[1], Loïc Lavenu[1], Michele Natile[1], Aura Ines Gonzalez[1], Xavier Délen[2], Yoann Zaouter[1], marc hanna[2], Patrick Georges[2]; *[1]Amplitude Laser Group, France; [2]Laboratoire Charles fabry, France.* We present a hybrid dual-stage nonlinear compression scheme allowing to compress 330 fs-pulses generated from a high-energy fiber amplifier down to 6.8 fs pulse duration, with an overall transmission of 61%.

ATh1A.3 • 08:30
27-fs, 166-MW pulses at 98 W average power from highly efficient thin-disk oscillator driven nonlinear compressor, Chia-Lun Tsai[1], Frank Meyer[2], Alan Omar[2], Yicheng Wang[2], An-Yuan Liang[1], Chih-Hsuan Lu[1], Martin Hoffmann[2], Shang-Da Yang[2], Clara J. Saraceno[2]; *[1]Inst. of Photonics Technologies, National Tsing Hua Univ., Taiwan; [2]Photonics and Ultrafast Laser Science, Ruhr Univ. Bochum, Germany.* We demonstrate efficient nonlinear compression of a high-power thin-disk oscillator based on a two-stage (multi-pass-cell and multiple-plate) compression setup, achieving 98-W average power with 27-fs pulses at 13.4 MHz, resulting in 166-MW peak power.

ATh1A.4 • 08:45
Versatile and scalable pulse compression platform , Martin Maurel[1,2], Matthieu Chafer[1], Foued Amrani[1,2], Julien Madéo[3], Chakradhar Sahoo[3], Keshav Dani[3], Benoit Debord[1,2], Benoit Beaudou[1], Frederic Gerome[1,2], Fetah Benabid[1,2]; *[1]GLOphotonics, France; [2]GPPMM, Xlim, France; [3]Femtosecond Spectroscopy Unit, OIST, Japan.* We report on a user-friendly sub-100 fs nonlinear pulse compression platform named FastLas. The compressor is based on gas fillable inhibited-coupling fibers and can be scaled over a large parameter-space of the input pulse.

ATh1A.5 • 09:00
10 PetaWatt Laser System for Extreme Light Physics, François Lureau[1], Guillaume Matras[1], Sébastien Laux[1], Christophe Radier[1], Olivier Chalus[1], Olivier Casagrande[1], Christophe Derycke[1], Sandrine Ricaud[1], Daniel Ursescu[2], Ioan Dancus[2], Pierre Calvet[1], Laurent Boudjemaa[1], Christophe Simon-Boisson[1]; *[1]Thales LAS, France; [2]Horia Holubei Inst. of Nuclear Physics, Romania.* We report first 10 PW light from the ELI-NP laser. We have obtained at 1 shot/min pulses with 332 J energy before compression and 22.3 fs duration leading to a peak power of 10.9 PW.

ATh1A.6 • 09:15
The Current Commissioning Results of the Allegra Kilohertz High-Energy Laser System at ELI-Beamlines, Roman Antipenkov[1], František Batysta[1], Robert Boge[1], Emily Erdman[1], Michael Greco[1], Jonathan T. Green[1], Zbyněk Hubka[1], Lukáš Indra[1], Karel Majer[1], Tomáš Mazanec[1], Petr Mazurek[1], Jack A. Naylon[1], Jakub Novák[1], Václav Šobr[1], Alexandr Špaček[1], Murat Torun[1], Boguslaw Tykalewicz[1], Pavel Bakule[1], Bedrich Rus[1]; *[1]Inst. of Physics ASCR, ELI Beamlines, Czechia.* We report on the status of the Allegra laser beamline, which is designed to provide sub-20 fs pulses with tens of mJ of energy with exceptionally high contrast at a 1 kHz repetition rate.

Hall M2 — LS&C

08:00 -- 10:00
LTh1B • Free Space Laser Communication
Presider: Claudine Besson; Office Natl d'Etudes Rech Aerospatiales, France

LTh1B.1 • 08:00 Invited
NASA's Deep Space Optical Communications – an Update, Abhijit Biswas[1]; *[1]Jet Propulsion Lab, USA.* NASA is developing a new space and ground technologies to demonstrate deep space optical communications in the 2022-2024 time frame. This paper provides an update on the status of this development.

LTh1B.2 • 08:30
Withdrawn

LTh1B.3 • 09:00 Invited
Adaptive Optics Precompensation of a GEO Feeder Link : the FEEDELIO Experiment, Aurelie Montmerle Bonnefois[1], Cyril Petit[1], Caroline Lim[1], Jean-François Sauvage[1], Serge Meimon[1], Philippe Perrault[1], Francis Mendez[1], Bruno Fleury[1], Joseph Montri[1], Jean-Marc Conan[1], Vincent Michau[1], Nicolas Védrenne[1], Zoran Sodnik[2], Christoph Voland[2]; *[1]Office Natl d'Etudes Rech Aerospatiales, France; [2]ESA, Netherlands.* The FEEDELIO experiment took place in Tenerife in April 2019, and proved the efficiency of Adaptive-Optics pre -compensation of atmospheric turbulence, which is a key technology for achieving very high throughput optical GEO feeder links.

Room 1.61-1.62 — DEPS

08:00 -- 10:00
Directed Energy Professional Society Special HEL Defense Applications Session I
Presider: David Mordaunt; Ball Aerospace & Technologies, USA

08:00 Invited
Laser Weapon Activities in Germany - Technology and Operational Safety Aspects, Hans-Albert Eckel[1]; *[1]German Aerospace Center (DLR), Institute of Technical Physics, Germany.* The introduction of laser weapons is not only a technical challenge but also requires a detailed consideration of operational safety aspects. The German activities in this field are discussed.

08:30 Invited
Laser Safety Aspects of High Energy Laser Weapons, Dom Pudo[1]; *[1]Defence R&D Canada, Canada.* As High Energy Laser weapons transition towards an operational status, it is paramount to agree on the quantification of laser hazards associated with their use. Existing laser safety approaches fail to properly address this issue, due to the specificities of laser-target interaction and the complexity of the resulting reflections. New measurement methodologies as well time-domain signal analysis are proposed as a possible means to capture the behaviour of reflections from targets engaged with a high energy laser beam.

09:00 Invited
Overview of Laser Activities in the United Kingdom - Dragonfire, Peter Cooper1; *1University of Southampton.* Abstract to be announced.

09:30 Invited
Introduction to the Joint Directed Energy Transition Office (DE JTO), Larry Grimes[1]; *[1]High Energy Laser Joint Tech Office, USA.* Abstract to be announced.

Thursday, 3 October

Hall E1 — ASSL

08:00 -- 10:00
ATh1A • Pulse compression and High Power systems– Continued
Presider: Mark Bowers; Lockheed Martin Aculight Corp, USA

ATh1A.7 • 09:30
Progress of the Development of the New PW Beamline for Vulcan Laser Facility: 20 fs, sub-mJ OPCPA as a ps Front End, Giedre M. Archipovaite[1], Mario Galletti[1,2], Munadi Ahmad[1], Steve Blake[1], Nicola Booth[1], Oleg Chekhlov[1], Rob Clarke[1], Rob Heathcote[1], Marco Galimberti[1], Ian Musgrave[1], Dave Neely[1], Pedro Oliveira[1], Waseem Shaikh[1], Trevor Winstone[1], Brian Wyborn[1], Cristina Hernandez-Gomez[1], John Collier[1]; *[1]Central Laser Facility, STFC, UK; [2]GoLP/Instituto de Plasmas e Fuso Nuclear, Instituto Superior Tecnico, Universidade de Lisboa, Portugal.* We present a new PW beamline for Vulcan facility with the focus on the ps Front End. This fully OPCPA system is designed to deliver 30 J, 30 fs pulses with a 5 min repetition rate.

ATh1A.8 • 09:45
Towards 2 kW, 20 kHz ultrafast thin-disk based regenerative amplifiers, Peter Kroetz[1], Christoph Wandt[1], Christian Grebing[1], Clemens Herkommer[1], Robert Jung[1], Sandro Klingebiel[1], Stephan Prinz[1], Catherine Teisset[1], Knut Michel[1], Thomas Metzger[1]; *[1]Trumpf Scientific Lasers, Germany.* We present results of an thin-disk based regenerative amplifier. Record high output powers of 1.9 kW at 20 kHz before compression, with good beam quality and a spectrum supporting < 600 fs, could be achieved.

Hall M2 — LS&C

08:00 -- 10:00
LTh1B • Free Space Laser Communication– Continued
Presider: Claudine Besson; Office Natl d'Etudes Rech Aerospatiales, France

LTh1B.4 • 09:30
Local Detection of Orbital Angular Momentum Radiation for Free Space Communication, Bruno Paroli[1], Mirko Siano[1], Marco Potenza[1]; *[1]Universita degli Studi di Milano, Italy.* We show a novel technique and a detection scheme for local measurements of Orbital Angular Momentum radiation based on the inversion of the transverse intrinsic curvature sign of minimal surfaces.

LTh1B.5 • 09:45
Focusing Laser Beam through a Pinhole as an Approach to Enhancing a Free Space Communication Channel via Turbulent Air by Adaptive Optics, Alexander Nikitin[1,2]; *[1]Inst. of Geosphere Dynamics, Russia; [2]AKA OPTICS, France.* Focusing laser beam through a pinhole by adaptive optics is investigated as an approach to the optimization of a fiber-coupled entangled photon source. Efficiencies comparable with the diffraction limited ones are obtained.

10:00—10:30 • Coffee Break, *Entrance Hall*

Hall E1 — ASSL

10:30 -- 12:30
ATh2A • Fiber Laser Techniques
Presider: Balaji Srinivasan; Indian Inst. of Technology, Madras, India

ATh2A.1 • 10:30 Invited
AI Controlled Coherent Beam Combining, Henrik Tuennermann[1], Akira Shirakawa[1]; [1]University of Electro-Communications, Chofu, Japan. We applied deep reinforcement learning for phase control in coherent beam combining. We will discuss potential opportunities and challenges of this approach.

ATh2A.2 • 11:00
Active Instantaneous-Phase Equalization and Amplitude Control in Pulse-Bursts in a Narrow-Linewidth Divided-Pulse Yb-Doped Fiber Amplification System, Huaiqin Lin[1], Yujun Feng[1], Jonathan Price[1], Thomas Hawkins[2], Liang Dong[2], Johan Nilsson[1]; *[1]Univ. of Southampton, UK; [2]Clemson Univ., USA.* We demonstrate active inter-pulse amplitude control and intra-pulse instantaneous-phase equalization in bursts of 50 1-ns pulses in a 1.15-mJ, *B*~16 rad narrow-linewidth linearly-polarized divided-pulse Yb-fiber amplification system and theoretically compute 90% coherent pulse-stacking efficiency.

Hall M2 — LS&C

10:30 -- 12:30
LTh2B • Novel Laser Sensing
Presider: Nicolas Riviere; Office Natl d'Etudes Rech Aerospatiales, France

LTh2B.1 • 10:30 Invited
On-chip Laser Phase and Frequency Control, Firooz Aflatouni[1]; *[1]Univ. of Pennsylvania, USA.* A review of our work in electronic-photonic co-design including integrated LiDAR for 3D imaging with 15 micron resolution at 0.5m range, wideband optical synthesis, and integrated Pound-Drever-Hall stabilization achieving 25dB laser frequency noise reduction is presented.

LTh2B.2 • 11:00 Invited
Single Photon and Single Pixel Technology for Computational LIDAR, Daniele Faccio[1], Alejandro Turpin[1], Gabriella Musarra[1], Francesco Tonolini[1], Roderick Murray-Smith[1]; *[1]Univ. of Glasgow, UK.* We report a new paradigm for single point detector imaging: full-3D images of scene are retrieved via deep learning from a single temporal histogram, that can be implemented with SPADs, RF or acoustic sensors

Room 1.61-1.62 — DEPS

10:30 -- 12:30
Directed Energy Professional Society Special HEL Defense Applications Session II
Presider: David Mordaunt; Ball Aerospace & Technologies, USA

10:30 Invited
Understanding Lethality of High Energy Laser Weapons, Dominik Pudo[1]; *[1]Defence R&D Canada, Canada.* As opposed to kinetic weapons, the lethality of High Energy Lasers relies on the deposition of intense laser radiation on a target's surface. Depending on the target , there are a number of phenomena that subsequently occur, ultimately leading to the target's neutralization. A realistic assessment of high energy lasers effectiveness requires to both understand the localized phenomenology as well as the effect on the entire target. Standardization Agreements (STANAGs) of laser terminal effects and protection against lasers will eventually be needed so as to parallel existing ones for conventional weapon systems.

Hall E1	Hall M2	Room 1.61-1.62
ASSL	LS&C	DEPS

Hall E1 — ASSL

10:30 -- 12:30
ATh2A • Fiber laser techniques– Continued
Presider: Balaji Srinivasan; Indian Inst. of Technology, Madras, India

ATh2A.3 • 11:15
Stimulated Brillouin Scattering Suppression in Pulsed Optical Fiber Amplifier Through Pulse Burst Pumping, Harish V. Achar[1], Johan Nilsson[1]; *[1]Univ. of Southampton, UK.* We suppress stimulated Brillouin scattering (SBS) of narrow-line signal pulses through pulse-burst counter-pumping of an Erbium fiber amplifier. Cross-phase-modulation broadens the Stokes wave, which reduces parasitic SBS power transfer without needing signal-broadening.

ATh2A.4 • 11:30
Generation and Characterization of Polarized Supercontinuum Pulses from ZBLAN Fibers Pumped by Femtosecond 2 µm Pulses from a Regenerative Amplifier, Seyed Ali Rezvani[1], Yutaka Nomura[2], Kazuhiko Ogawa[3], Takao Fuji[1,2]; *[1]Toyota Technological Inst., Japan; [2]Inst. for Molecular Science, Japan; [3]FiberLabs.Inc, Japan.* We have demonstrated polarized supercontinuum generation in a polarization-maintained ZBLAN fiber pumped by 2 µm pulses from a regenerative amplifier. The supercontinuum pulses have been characterized using cross-correlation frequency-resolved optical gating.

ATh2A.5 • 11:45
Generation of pure-quartic solitons from a dispersion managed passively mode-locked fiber laser , Antoine Runge[1], Darren D. Hudson[2], Kevin K. Tam[1], C. M. de Sterke[1,3], Andrea Blanco-Redondo[1,3]; *[1]IPOS, Univ. of Sydney, Australia; [2]MQ Photonics, Macquarie Univ., Australia; [3]Sydney Nano, Univ. of Sydney, Australia.* We report the generation of pure-quartic solitons from a fiber laser. Quartic cavity dispersion is achieved by an intracavity pulse-shaper. The pulses are characterized through spectral and temporal phase-resolved measurements and resonant dispersive wave analysis.

ATh2A.6 • 12:00
1.1 W all-PM fiber laser at 1600 nm delivering 35 fs pulses with 30 nJ energy, Simon Boivinet[1], Philippe Morin[1], Jean-Paul Yehouessi[1], Sébastien Vidal[1], Guillaume Machinet[1], Johan Boullet[1]; *[1]ALPhANOV, France.* We report an all-PM fiber laser based on a mode-locked seeder and only two amplification stages delivering 35 fs pulses with an energy of 30nJ and an average power of 1.13 W at telecom wavelength.

ATh2A.7 • 12:15
Short-Wavelength Thulium-Doped Fiber Laser for Three-Photon Microscopy, Yutaka Nomura[1,2], Hideji Murakoshi[3], Takao Fuji[1,4]; *[1]Inst. for Molecular Science, Japan; [2]JST-PRESTO, Japan; [3]National Inst. for Physiological Science, Japan; [4]Laser Science Lab, Toyota Technological Inst., Japan.* An ultrafast thulium-doped fiber laser operating at 1.8 µm with intensity sufficient for three-photon absorption processes is demonstrated. The pulses can be used to observe cultured cells expressing red-fluorescent dye.

Hall M2 — LS&C

10:30 -- 12:30
LTh2B • Novel Laser Sensing
Presider: Nicolas Riviere; Office Natl d'Etudes Rech Aerospatiales, France

LTh2B.3 • 11:30 Invited
Short-range Multi-static Elastic Lidar: a Novel Approach for High Spatial and Temporal Profiling of Aerosols, Roman Ceolato[1]; *[1]ONERA, France.* We present the recent advances in high spatial and temporal resolution profiling of aerosols with short-range multi-static elastic lidar systems to retrieve the optical, microphysical, and structure properties of particulate clouds. Our results demonstrate the feasibility of robust lidar measurements on soot particles in the near-field with high spatial (<50cm) and temporal (<0.1s) resolution. Continued developments of short-range lidars will

LTh2B.4 • 12:00 Invited
Non-line-of-sight Sensing with Time Correlated Single Photon Counting and Ordinary Cameras, Martin Laurenzis[1]; *[1]French-German Resrch. Inst. of St.-Louis, France.* Optical sensing of objects hidden from direct view can be realized using computational imaging approaches. We demonstrated non-line-of-sight sensing using ps-transient imaging of single photons and ordinary intensity cameras.

Room 1.61-1.62 — DEPS

10:30 -- 12:30
Directed Energy Professional Society Special HEL Defense Applications Session II
Presider: David Mordaunt; Ball Aerospace & Technologies, USA

11:30 Invited
Overview of NATO Task Group SCI-264 Effects Testing, Michelle Hedrick[1]; *[1]AFRL/RD, USA.* Abstract to be announced.

12:00 Invited
Overview of the Joint Laser Deconfliction Safety System (JLDSS), LeAnn Brasure[1]; *[1]Gryphon Schafer, USA.* Abstract to be announced.

12:30 Invited
Joint Laser Systems Effectiveness (JLaSE) Joint Test Overview. Christopher Lloyd[1]; *[1]NSWC Dahlgren, USA.* Abstract to be announced.

12:30—14:30 • Lunch on your own

12:30—14:30 • JTh3A • Joint Poster Session, *Entrance Hall, Hall F*

Entrance Hall, Hall F

12:30 -- 14:30
JTh3A • Joint Poster Session

JTh3A.1
Formation, Stability and Structure of Noise-Like Pulses in Passively Mode-Locked Fiber Lasers, Andrey Komarov[1], Konstantin Komarov[1], Vadim Terentyev[1], Lei Li[2], Luming Zhao[2]; *[1]Inst. of Automation and Electrometry of the Siberian Branch of the Russian Academy of Sciences, Russia; [2]Jiangsu Normal Univ., China.* The generation of noise-like pulse consisting of stochastically varying solitons is analyzed. The mechanism of its stabilization is determined. The transformation of a stationary soliton into a noise-like pulse with increasing pumping is researched.

JTh3A.2
Beam quality characterization of 10-kW CW fiber laser effector, Jan K. Jabczynski[1], Przemyslaw Gontar[1], Lukasz Gorajek[1], Krzysztof Kopczynski[1]; *[1]Wojskowa Akademia Techniczna, Poland.* Lab model of laser effector based on 10-kW CW fiber laser was constructed and characterized. As a result of thermal-optic and random stochastic effects beam quality parameter increased to 2.5 for the highest heat load.

JTh3A.3
Tunable Bound Solitons Generation in a SESAM Mode-Locked Cr:ZnSe Laser, Stanislav O. Leonov[1,2], Mikhail P. Frolov[2], Yuriy Korostelin[2], Yan Skasyrsky[2], Vladimir Kozlovsky[2]; *[1]Bauman Moscow State Technical Univ., Russia; [2]P. N. Lebedev Physical Inst. of the Russian Academy of Sciences, Russia.* We report the generation of the tunable phase-locked bound solitons in a SESAM mode-locked Cr^{2+}:ZnSe laser. The bound solitons generation with the phase-locked pulses number of 4 and 8 were achieved with the pulse separation of 9.39 ps and 19.7 ps.

JTh3A.4

Withdrawn

JTh3A.5
A passive-cooled, Innoslab-based Nd:glass regenerative amplifier with high beam quality, Wenfa Huang[1], Jiangfeng Wang[1], Xinghua Lu[1], Wei Fan[1], xuechun li[1]; *[1]Shanghai Inst of Optics and Fine Mech, China.* We report on a passive-cooled nd:glass regenerative amplifier based on innoslab laser technology. Pulse energies of 16.3 mJ are generated with energy stability of 1.5% (rms) and beam propagation factors M^2 of 1.13.

JTh3A.6
Quasi-cw Er-doped fiber laser near 1535 nm for Er:YAG pumping, Leonid Kotov[2], Valery Temyanko[2,3], Nasser Peyghambarian[2,3], Mikhail Bubnov[1], Maxim Khudyakov[1,4], Mikhail E. Likhachev[1]; *[1]Fiber Optics Research Center RAS, Russia; [2]College of Optical Sciences, Univ. of Arizona, USA; [3]TIPD LLC, USA; [4]Moscow Inst. of Physics and Technology (State Univ.), Russia.* A quasi continuous wave 1535 nm Er-doped all-fiber laser was developed for 1.6 µm Er:crystal lasers pumping. Increase in efficiency of Er:YAG lasers as compare to pumping with commercial 1470 nm pump diodes was demonstrated

JTh3A.7
Research on Blue Semiconductor Pumped Praseodymium Ion Doped Crystal in The Visible Range, Haohai Yu[1,2], Huaijin Zhang[1,2], Jiyang Wang[1,2]; *[1]Shandong Univ., China; [2]State Key Lab of Crystal Materials and Inst. of crystal Materials, Shandong Univ., China.* The theories of blue semicondutor pumped Pr^{3+}ion doped crystals were developed. The Q-swiching and mode-locking lasers in visible range used in Pr^{3+}ion doped crystals were demonstrated and pulse lasers were obtained at different visible wavelengths.

JTh3A.8
Compact monolithic pump light geometry forthin disk lasers, Benjamin Ewers[1], Raoul-Amadeus Lorbeer[1], Alexander Fischer[1]; *[1]German Aerospace Center, Germany.* We present a monolithic pump light geometry for compact thin disk lasers. Trapping of pump light within the laser medium is achieved by proper choice of dielectric coating and angle of the wedged laser disk.

JTh3A.9
Passively Q-switched Device for C-band Erbium Doped Fiber Laser based on Zinc Oxide Nanoparticle Saturable absorber, Abdulhadi Al-Janabi[1], Sarah K. Al -Hayali[1,2]; *[1]Inst. of laser for postgraduate studies, Univ. of Baghdad, Iraq; [2]Al-Turath Univ. college, Iraq.* We demonstrate passively Q-switched erbium-doped fiber laser using zinc-oxide nanoparticles Q-switcher for possible applications in telecommunication, laser processing, and medical community. Q-switched pulses were obtained with the minimum pulse width of 1.6µs at 87.3 kHz.

JTh3A.10
Demonstration of 37-W All-Fiber 980-nm Superfluorescent Fiber Source, Jianqiu Cao[1], Heting Du[1], Aimin Liu[1], Zhiyong Pan[1], Zhihe Huang[1], Jinbao Chen[1]; *[1]National Univ of Defense Technology, China.* A 37-W all-fiber 980-nm superfluorescent fiber source is firstly demonstrated in experiment, to the best of our knowledge. The slope efficiency is about 38.7% with the 3-dB bandwidth about 4.5 nm.

JTh3A.11
Study of Gain Aperture under High Pump Power for the Development of High-brightness Ultra-compact MOPA, Vincent Yahia[1], Takunori Taira[2,1]; *[1]Inst. for Molecular Science, Japan; [2]RIKEN Spring-8 Center, Japan.* Gain aperture (GA) effect can simultaneously clean and amplify a laser beam. Calculations and experiments show that cm-size GA under 600W pump power can amplify laser up to 50 mJ keeping excellent beam quality.

JTh3A.12

Withdrawn

JTh3A.13
Soft-X-Ray High-Harmonic Source for Attosecond Transient Absorption Spectroscopy of Laser Dressed Gases and Solids, Enikoe J. Seres[1], Jozsef Seres[1], John Afa[2], Carles Serrat[2], Shinichi Namba[3]; *[1]Atominstitut E-141, Vienna Univ. of Technology, Austria; [2]Departament de Física, Universitat Politècnica de Catalunya, Spain; [3]Graduate School of Engineering, Hiroshima Univ., Japan.* A soft-X-ray high harmonic source has been developed and applied for time-resolved X-ray absorption spectroscopy of Krypton gas, Silicon and Zirconium solids at laser dressed transitions up to 220 eV with attosecond resolution.

JTh3A.14
Kerr Shutter for the Generation of Optically Synchronized Pump-Signal OPCPA Pairs, Christina Alexandridi[1], Florian Lemaitre[1], Xavier Délen[2], Frédéric Druon[2], Patrick Georges[2], Dimitris Papadopoulos[1]; *[1]Ecole Polytechnique, France; [2]Institut d'Optique, France.* We propose a new method for optically synchronizing pump-signal OPCPA pairs. Based on the Kerr effect and due to its simplicity, this technique could serve as a solution to the expensive and complicated existing methods.

JTh3A.15
Sub-380 mrad CEP-stable Yb-doped amplifier delivering 60 microjoules, 80 fs pulses at 100 kHz, Michele Natile[1,2], Florent Guichard[1], Anna Golinelli[3], marc hanna[3], Yoann Zaouter[1], Ronic Chiche[4], Patrick Georges[3]; *[1]Amplitude Laser Group, France; [2]LIDYL - CEA Saclay, France; [3]Laboratoire Charles Fabry, Institut d'Optique Graduate School, France; [4]Laboratoire de l'Accélérateur Linéaire, IN2P3, CNRS,, France.* We report on the CEP-stabilization of a nonlinear compressed Yb-doped fiber amplifier delivering 60 microjoules, 80 fs at 100 kHz with a measured every shot CEP noise lower than 325 mrad over 1s.

JTh3A.16
Dissipative Kerr Solitons in a Bi-directional Optical Microresonator with Backscattering, Valery E. Lobanov[1], Nikita M. Kondratiev[1], Dmitry V. Skryabin[1,2]; *[1]Russian Quantum Center, Russia; [2]Univ. of Bath, UK.* We report numerical and theoretical results of dissipative Kerr solitons in bi-directional microring resonators in the presence of backscattering. Our results include original analytical model accurately describing linear and nonlinear cross-action of the counter-propagating waves.

JTh3A.17
Diode-pumped Solid-state Lasers for Applications in Quantum Technologies, Mark Mackenzie[1], Paul White[1], Gerald Bonner[2], Brynmor E. Jones[2], Alexander A. Lagatsky[2], Craig Hunter[2], Bence Szutor[1], Jonathan Jones[3], Kai Bongs[3], Yeshpal Singh[3], Fedor Karpushko[1]; *[1]UnikLasers, UK; [2]Fraunhofer CAP, UK; [3]Univ. of Birmingham, UK.* We present research on the development of diode-pumped solid-state lasers suitable for quantum technologies applications at 698.45 nm and 780.24 nm targeting strontium (Sr) and rubidium (Rb) transitions.

JTh3A.18
High-Efficient Resonantly Pumped Q-Switched Ho:LLF MOPA System, Martin Schellhorn[1], Gerhard Spindler[2]; *[1]Inst Franco-Allemand Recherches St Louis, France; [2]Retired, Germany.* A Tm fiber laser pumped Ho:$LuLiF_4$ (Ho:LLF) MOPA system is demonstrated delivering 68.7 W at 2065 nm in TEM_{00} operation at a repetition rate of 10 kHz with an optical-to-optical efficiency of 61.5 %.

12:30 -- 14:30
JTh3A • Joint Poster Session– Continued

JTh3A.19
Hybrid Yb:YAG and Cryogenic Yb:Y_2O_3 Laser, Evgeny A. Perevezentsev[1], Ivan I. Kuznetsov[1], Ivan B. Mukhin[1], Mikhail R. Volkov[1], Olga L. Vadimova[1], Oleg V. Palashov[1]; *[1]Inst. of Applied Physics of the RAS, Russia.* Combination of room temperature Yb:YAG front end together with cryogenic disk multipass Yb:Y_2O_3 amplifier was demonstrated for the first time. 15.8W at 11.5kHz, 0.5ns pulse duration, and 1.2nm spectrum width was achieved.

JTh3A.20
Nonlinear bifurcation in passive Q-switched optical vortex lasers, YuanYao Lin[1]; *[1]National Sun Yat-Sen Univ., Taiwan.* Bifurcation is observed in a passive Q-switched pulsed vortex laser formed by the coherent superposition of off-axis multiple-pass transverse resonant modes, which is modeled by a modified Tang–Statz–DeMars model with inter-modal coupling.

JTh3A.21
Diode-pumped high power sub-100 fs Kerr-lens mode-locked Yb:$CaYAlO_4$ laser with 1.85 MW peak power, Wenlong Tian[1], Chen Yu[1], Jiangfeng Zhu[1], Dacheng Zhang[1], Zhiyi Wei[2], Xiaodong Xu[3]; *[1]Xidian Univ., China; [2]Inst. of Physics, Chinese Academy of Sciences, China; [3]Jiang Su Normal Univ., China.* Abstract: We systematically studied on the diode-pumped high power Kerr-lens mode-locked Yb:$CaYAlO_4$ (Yb:CYA) laser with a dual-confocal cavity. 59 fs pulses with 6.2 W average power were achieved by optimizing both the dispersion and Kerr effect intensity.

JTh3A.22
High power Yb:YAG single-crystal fiber booster with regenerative amplifier based on dual-slab Yb:KGW crystals, Byunghak Lee[1], Bosu Jeong[1], Juhee Yang[1], Jun Wan Kim[1], Elena Sall[1], Chur Kim[1], Seol Won Park[1], Duchang Heo[1], Guang-Hoon Kim[1], Vladimir Yashin[2]; *[1]KERI, Korea; [2]Laser Physics, JSC S.I.Vavilov State Optical Inst., Russia.* We have studied experimentally a high power booster of Yb:YAG single-crystal fiber with regenerative amplifier based on dual-slab Yb:KGW crystals. The booster provided the output power of 45 W with the gain of 3. It allowed the laser system to maintain the spectral bandwidth.

JTh3A.23
1319 nm Nd:YAG Planar Waveguide Laser Amplifier with an optocal to optical Efficiency of 15%, Juntao Wang[1], Weiping Lin[1], Lei Zhang[1], Tangjian Zhou[1], Yanhua Lu[1], Qingsong Gao[1]; *[1]China Academy of Engineering Physics, China.* We present a 1319 nm Nd:YAG planar waveguide laser amplifier with the optical to optical efficiency of 15%. As far as we all know, this is the highest amplification efficiency for 1319 nm.

JTh3A.24
Extensible Multimode-Interference Structures for Tunable Tm/Ho-Codoped Fiber Lasers, Hajime Sakata[1], Masanari Kubota[1], Fuma kosaka[1]; *[1]Shizuoka Univ., Japan.* We present variable single mode-multimode-single mode structures by setting a liquid core halfway in the multimode fiber. The oscillation wavelength of Tm/Ho-codoped fiber laser is changed by extending the length of the multimode section.

JTh3A.25
Microchip Lasers Based on Alexandrite Crystal Operating at 680.4 nm and 749.5 nm, Martin Fibrich[1], Jan Sulc[1], Helena Jelínková[1]; *[1]Czech Technical Univ. in Prague, Czechia.* Continuous-wave blue laser diode pumped Alexandrite microchip lasers designed for operation both at electronic (680.4 nm) and vibronic (749.5 nm) transitions are reported. Microchip geometry was realized by dielectric mirrors directly deposited on the alexandrite crystal surfaces.

JTh3A.26
Thermo-optical Study of 10 J/ 100 Hz Cryogenically Cooled Yb:YAG Diode Pumped Laser System, Magdalena Sawicka-Chyla[1], Martin Divoky[1], Ondrej Slezak[1], Antonio Lucianetti[1], Mariastefania De Vido[2], Klaus Ertel[2], Thomas Butcher[2], Chris Edwards[2], John Collier[2], Tomas Mocek[1]; *[1]HiLASE Centre, Inst. of Physics AS CR, Czechia; [2]Central Laser Facility, STFC Rutherford Appleton Lab, UK.* We present a comparative thermo-optical study of various gain media geometries to minimize depolarization losses and wavefront distortions for a concept of 10 J/ 100 Hz cryo HEC-DPSSL based on 10 J/10 Hz Bivoj/ DiPOLE system.

JTh3A.27
Manipulating optical rogue wave in random fiber laser, Xu Jiangming[1], Jun Ye[1], Jian Wu[1], Pu Zhou[1], Jiaxin Song[1], Hu Xiao[1], Jinyong Leng[1], Hanwei Zhang[1]; *[1]National Univ of Defense Technology, China.* We report the first manipulation of stimulated Brillouin scattering induced optical rogue wave in random fiber laser (RFL) by employing an intensity-fluctuation-controllable superfluorescent-fiber-source, which may highlight a novel field of temporal statistic investigation in RFL.

JTh3A.28
High Energy, kHz-Repetition Rate, Q-Switched Nd:YAG Laser, Using an Electro-Optical Modulator and Variable Reflectivity Mirror, Kaloyan C. Georgiev[1], Vladimir Rusov[3], Sergey Gagarskiy[2], Anton Trifonov[4], Ivan Buchvarov[1,2]; *[1]Sofia Univ. "St. Kliment Ohridski", Bulgaria; [2]ITMO Univ., Russia; [3]S.I. Vavilov State Optical Inst., Russia; [4]IBPhotonics Ltd, Bulgaria.* We present a high energy (25 mJ), 12 ns, 1 kHz laser, generating a super-Gaussian output beam at 1064 nm, using intra-cavity electro-optical KTP modulator with thermally compensated design and variable reflectivity output mirror.

JTh3A.29
Microjoule Sub-three-cycle Long-wavelength Intrapulse Difference Frequency Generation driven at 3 µm, Kun Liu[1], Houkun Liang[2], Wenkai Li[1], Xiao Zou[1], Shizhen Qu[1], Tino Lang[3], Qi Jie Wang[1], Ying Zhang[2]; *[1]Nanyang Technological Univ., Singapore; [2]Singapore Inst. of Manufacturing Technology, Singapore; [3]Deutsches Elektronen-Synchrotron DESY, Germany.* We report a 10.3 µm intrapulse difference frequency generation with a microjoule-level pulse energy and an 85 fs (sub-3 cycle) pulse width, driven at 3 µm wavelength for the first time.

JTh3A.30
Two-cycle pulses in the mid-IR based on hybrid thin plate compression at high average power, Roland Flender[1], Máté Kurucz[1], Ludovit Haizer[1], Roland Nagymihaly[1,2], Szabolcs Tóth[1,2], Adam Borzsonyi[1,2], Eric Cormier[3], Bálint Kiss[1]; *[1]ELI-ALPS, ELI-HU Non-Profit Ltd., Hungary; [2]Optics and Quantum Electronics, Univ. of Szeged, Hungary; [3]CELIA, Centre Lasers Intenses et Applications, France.* We demonstrate an OPCPA driven thin plate compression in the mid-infrared region at 100 kHz with 7 W average output power. The resulting pulses are close to two cycle long and CEP stable.

JTh3A.31
High repetition rate and high power picosecond Nd:$GdVO_4$ laser system with optimized parameters, Jie Guo[1], Wei Wang[1], Xiaoyan Liang[1]; *[1]Shanghai Inst of Optics and Fine Mech, China.* We report on a 100 kHz Nd:$GdVO_4$ regenerative amplifier seeded with a robust and powerful homemade oscillator. A 23 W, 27 ps laser output was obtained with nearly diffraction limited beam quality.

JTh3A.32
Laser Output Radiation Characteristics Controlled by the $GdVO_4$ Crystal Length in the Extracavity Synchronously Pumped Raman Laser with Combined Raman Shift Resulting in Generation of 860 fs Pulses at 1228 nm, Milan Frank[1], Sergei Smetanin[2], Michal Jelinek[1], David Vyhlídal[1], Vladislav Shukshin[2], Petr Zverev[2], Vaclav Kubecek[1]; *[1]Czech Technical Univ. in Prague, Czechia; [2]Prokhorov General Physics Inst., Russian Academy of Sciences,, Russia.* Synchronously-pumped combined-shift $GdVO_4$ Raman laser was investigated in dependence on the crystal length (16-40 mm). The shortest and longest crystals allowed to achieve the shortest pulse of 860 fs or the highest slope efficiency of 49.5%, respectively.

JTh3A.33

Withdrawn

JTh3A.34
Noncollinear phase-matched sum-frequency generation in KTP for photodynamic therapy, Nobuhiro Umemura[1], Liming Li[1], Sergey G. Grechin[2], Tomosumi Kamimura[3]; *[1]Chitose Inst of Science and Technology, Japan; [2]Prokhorov General Physics Inst. of the Russian Academy of Sciences, Russia; [3]Osaka Inst. of Technology, Japan.* We demonstrated noncollinear sum-frequency generation between the signal output of a Nd:YAG laser-pumped optical parametric oscillator and the fundamental wavelength at 1.0642 µm in KTP. The output pulse energies of 4.8±0.4 mJ/pulse were obtained at 656 nm.

JTh3A.35
External-Cavity Yb:KGW IR-to-Visible Image Upconverter, Miguel Cuenca[1], Haroldo J. Maestre Vicente[1], Adrian J. Torregrosa[1], Juan Capmany[1]; *[1]Universidad Miguel Hernandez de Elche, Spain.* An Yb:KGW tunable, intracavity infrared image upconveter is presented. An external cavity is employed for both pump tuning and spectral shaping, which allows for tunable IR image upconversion and field-of-view enhancement under single IR wavelength illumination.

JTh3A.36
High power modulated-longitudinal-mode microsecond-pulse sodium beacon laser development and experimental study, Huaijin Ren[1,2], Yanhua Lu[1,2], Lei Zhang[1,2], Xiafei Xu[1,2], Xiaoming Chen[1,2], Xingbin Wei[1,2]; *[1]Inst. of Applied Electronics, China Academy of Engineering Physics, China; [2]The Key Lab of Science and Technology on High Energy Laser, China Academy of Engineering Physics, China.* A 208 W all-solid-state modulated-longitudinal-mode quasi-continuous-wave sodium beacon laser was developed, and the photon return flux was up to 56800 photons/s/cm^2 during the pulse length without obvious saturation effect.

JTh3A.37
Femtosecond pulse on demand from hybrid laser system, Luka Černe[1], Jaka Petelin[1], Vid Agrez[1], Rok Petkovšek[1]; *[1]Univ. of Ljubljana, Slovenia.* We demonstrate a hybrid laser system that generates femtosecond pulses on demand. For gain control nanosecond idler pulses are used. POD operation is achieved by appropriate modulation of useful and idler signal.

12:30 -- 14:30
JTh3A • Joint Poster Session– Continued

JTh3A.38
Observation of dissipative soliton resonance mode-locking in an all-polarization-maintaining neodymium fiber laser, Rezki Becheker[1,2], Mohamed Touil[1], Kilian Le Corre[3], Thierry Robin[4], Benoit Cadier[4], Mathieu Laroche[3], Thomas Godin[1], Ammar Hideur[1]; *[1]CNRS CORIA, France; [2]Université Mouloud Mammeri de Tizi -Ouzou, Algeria; [3]CIMAP, ENSICAEN-CNRS-CEA, Normandie Université, France; [4]iXblue, France.* We report for the first time a figure-8 all-polarization-maintaining mode-locked Nd-fiber laser operating at 927 nm in the dissipative soliton resonance (DSR) regime.

JTh3A.39
Frequency-Doubled Mode-Lock Fiber Laser Delivering High Energy Picosecond Pulses at 780 nm, Jean-Bernard Lecourt[1], Damien Kinet[2], Chems-Eddine Ouinten[1], Alexandre Gognau[1], Yves Hernandez[1]; *[1]Multitel Innovation Center, Belgium; [2]Electromagnetism and Telecommunication Dept., Univ. of Mons, Belgium.* We have developed a frequency-doubled mode-lock erbium doped fiber laser operating around 780 nm which delivers picosecond pulses with narrow optical spectrum. We expect this laser will be an efficient excitation source for Raman spectroscopy.

JTh3A.40
An improvement in molecular absorption signals of dual-comb spectroscopy based on optical suppression method, Xing Zou[1], Chenglin Gu[1], Zhong Zuo[1], Daping Luo[1], Zhiwei Zhu[1], Lian Zhou[1], Zejiang Deng[1], Yang Liu[1], Wenxue Li[1]; *[1]East China Normal Univ., China.* We demonstrate a dual-comb spectroscopy with a Michelson interferometer which optically suppresses original spectra of the combs. It yields an absorption signal with absolute intensity enhancement ratio of 51.8 compared with conventional dual-comb spectroscopy.

JTh3A.41
Pulse Characterization in a Hybrid CPA Laser System, Peter Šušnjar[1], Luka Černe[1], Rok Petkovšek[1]; *[1]Faculty of Mechanical Engineering, Univ. of Ljubljana, Slovenia.* We demonstrate experimental characterization of pulse evolution and gain spectral filtering in hybrid laser system. Effect of solid-state amplifier on nonlinear spectral phase was studied and characterized along with spectral phase compensation via tunable stretcher.

JTh3A.42
High-Peak Power Diode-Pumped Picosecond Yb-based Laser for OPCPA Pumping, Celso João[1], Victor Hariton[1], Joana Alves[1], Nuno Gomes[1], Hugo Pires[1], Gonçalo Figueira[1]; *[1]Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Portugal.* We present a 10 Hz, 100 mJ-level picosecond diode-pumped hybrid Yb-based laser for OPCPA pumping. In this hybrid configuration a 160 Hz, 2.2 mJ Yb:CaF2 regenerative amplifier seeds a 10 Hz, eight-pass Yb:YAG amplifier.

JTh3A.43
16W Large-mode-area Multicore Q-switched Fiber Laser, Yehuda Benudiz[1], Sidharthan Raghuraman[2], Jichao Zang[2], Udi Ben Ami[1], Seongwoo Yoo[2], Amiel A. Ishaaya[1]; *[1]Ben Gurion Univ. of the Negev, Israel; [2]Nanyang Technological Univ., Singapore.* We demonstrate an Yb-doped multicore Q-switched fiber laser with an all-solid large-core fiber. At 10 KHz repetition-rate, the output power was 16W with 49% slope efficiency, 200ns pulse duration, and M^2~2.

JTh3A.44
Efficient random Raman fiber laser at 1650 nm, Romain Thouroude[1], Herve Gilles[1], Thierry Robin[2], Benoit Cadier[2], Mathieu Laroche[1]; *[1]CIMAP-ENSICAEN, France; [2]IXBLUE, France.* We demonstrate a first-order random Raman fiber laser pumped at 1540nm by an Erbium fiber laser source. The highest output power is 9.2W at 1650nm with a conversion efficiency of 74%.

JTh3A.45
Exploiting Reflected Fabry-Perot Cavity to Narrow Spectral Linewidth in Low-Repetition-Rate Mode-Locked Lasers., Shu-Ching Li[1], Hsing-Chih Liang[2], Chia-Han Tsou[1], Kai-Feng Huang[1], Yung-Fu Chen[1]; *[1]National Chiao Tung Univ., Taiwan; [2]National Taiwan Ocean Univ., Taiwan.* A novel scheme to realize a mode-locked laser with a narrow spectral linewidth is demonstrated by exploiting a reflected Fabry–Perot (FP) cavity to introduce an intense FP effect.

JTh3A.46
Rapid water quality assessment by micro laser - induced fluorescence spectrometer, Zhaoshuo Tian[1], Zongjie Bi[1], Yanchao Zhang[1], Yiwei Wang[1], Zihao Cui[1], Hongyan Zhao[1]; *[1]Harbin Inst. of Technology, China.* A method for rapid water quality assessment was introduced and a micro laser induced fluorescence spectrometer was used to measure five kinds of water. The results show that the method could evaluate water quality well.

JTh3A.47
Directly generating structured light with concentric multi-ring characteristic in multigigahertz self-mode-locked Nd:YVO_4 lasers for 3D shape scanning, Jung-Chen Tung[1], Chia-Ray Chen[1], Yung-Fu Chen[2]; *[1]National Space Organization, Taiwan; [2]National Chiao Tung Univ., Taiwan.* We demonstrate light patterns with features of multiple concentric circles by exploiting tight focusing in Nd:YVO_4 lasers. The temporal dynamics of lasing modes is verified with self-mode-locked properties for the repetition rate of 6.3 GHz.

JTh3A.48
A theoretical study on the continuum generation in a defective core photonic crystal fiber, Kanagaraj Nithyanandan[1], Pavel Peterka[2]; *[1]CNRS/Universite de Grenoble-Alpes, France; [2]Inst. of Photonics and Electronics, Czechia.* An octave-spanning supercontinuum in photon crystal fiber with a sub-micron defect is reported. Role of the defect in the fiber characteristics and the guidelines for the optimum fiber design for the enhanced spectral broadening is emphasized.

JTh3A.49
Dispersion Spectrum Measurement using Scan-less Dual-heterodyne Mixing, NASRIN SULTANA[1], Tada Hiroaki[1], Shioda Tatsutoshi[1]; *[1]Graduate School of Science and Engineering, Saitama Univ., Japan.* Dispersion spectroscopy with high-speed, high-resolution and wide dynamic range by parallel and simultaneous phase measurement using scan-less dual-heterodyne mixing of 1.4- and 50 GHz adjacent frequency intervals of optical frequency comb.

JTh3A.50
Compact 6-mJ multi-plate pulse compression based on line focusing geometry, Paolo A. Carpeggiani[1], Guangyu Fan[1], Zhensheng Tao[2], Giulio Coccia[1], Sheng Zhang[2], Zongyuan Fu[2], Ming C. Chen[3], Shih-Cheng Liu[3], Andy Kung[3], Edgar Kaksis[1], Audrius Pugzlys[1], Andrius Baltuska[1]; *[1]TU Wien, Austria; [2]Fudan Univ., China; [3]Inst. of Photonics Technologies, National Tsing Hua Univ., Taiwan.* In this work we present a route for energy scaling in external pulse compression based on layered Kerr media combined with 1D focusing geometry. A highly stable 92%-efficient 4-fold compression of 1030-nm pulses is demonstrated.

JTh3A.51
Frequency-stabilized 1 GHz turnkey frequency comb, Alexander J. Lind[1,2], Daniel M. Lesko[1,2], Henry Timmers[1], Abijith Kowligy[1], Benjamin Rudin[3], Florian Emaury[3], Scott A. Diddams[1,2]; *[1]Time and Frequency Division, NIST, USA; [2]Dept. of Physics, Univ. of Colorado, USA; [3]Menhir Photonics AG, Switzerland.* We present the characterization and optical stabilization of a turnkey 1 GHz femtosecond laser at 1560 nm, opening new possibilities for metrology and dual-comb spectroscopy with improved SNR and faster acquisition rates.

JTh3A.52
Using Frustrated Total Internal Reflection for High-Power Lasers Monitoring, Dan G. Matei[2], Andrei Naziru[2], Arcadie Sobetkii[1], Daniel Ursescu[2]; *[1]-, MGM Star Construct SRL, Romania; [2]Horia Hulubei National Inst. of Physics and Nuclear Engineering, Romania.* Two glass prisms are brought in close proximity. The evanescent field from the total internal reflection in one prism is used to obtain a beam with an irradiance tunable over 110 dB, with potential applications from medicine to materials processing.

JTh3A.53
Gradient-index measurement method of thermal lens in high-power laser processing, Hiroshi Ohno[1]; *[1]Toshiba Corporation, Japan.* Three-dimensional gradient-index generated by the thermal lens effect in high-power laser processing often causes focal position deviation, which is here shown to be measured on the basis of the Lagrangian optics with the background-oriented schlieren.

JTh3A.54
Dual-wavelength digital holographic microscope for accurate surface micro-topography measurement, Dahi Abdelsalam[1]; *[1]National Inst. of Standards, Egypt.* Dual-wavelength digital holographic microscope utilizing two bandpass filters and two identical CCD cameras is presented. The merit of this microscope is that it can measure in real-time and hence accurate measurement is achieved.

Hall E1 — ASSL

14:30 -- 16:30
ATh4A • Lasers for Special Applications
Presider: Suhui Yang; Beijing Inst. of Technology, China

ATh4A.2 • 14:30 Invited
Ultra-narrow Linewidth Semiconductor Disk Lasers for Cold Atom Quantum Technology, Jennifer E. Hastie[1]; *[1]University of Strathclyde, UK.* We are developing high brightness, sub-kHz-linewidth semiconductor disk lasers at novel wavelengths for quantum technologies based on atoms with narrow optical transitions. We will present recent developments in such lasers for cooling neutral strontium atoms.

ATh4A.2 • 15:00
Tunable Brillouin microlaser based on a hybrid microbottle resonator, Lei Shi[1], Song Zhu[1], Bowen Xiao[1], Bo Jiang[1], Xinliang Zhang[1]; *[1]Wuhan National Lab for Optoelectronics, Huazhong Univ of Science and Technology, China.* We propose and demonstrate a tunable Brillouin laser by using an ultrahigh-quality-factor hybrid microbottle resonator. A Brillouin lasing wavelength tuning range of 2.68 nm is realized.

ATh4A.3 • 15:15
UV-DUV source based on IC-HCPCF filled with Hydrogen, Matthieu Chafer[2], Benoit Beaudou[2], Jonas H. Osorio[1], Foued Amrani[1], Frederic Gerome[2,1], Benoit Debord[2,1], Fetah Benabid[2,1], Frederic Delahaye[1]; *[1]GPPMM, Xlim, CNRS UMR 7252, Limoges Univ, France; [2]GLOphotonics, France.* We report on a compact multi-line Raman source with a spectrum spanning from 250nm to 750nm with spectral densities ranging from 0.2 to 4μW/nm between 250-300nm and 20 to 700 μW/nm for 300-350 nm.

ATh4A.4 • 15:30
VUV Frequency Comb by Cavity-Enhanced High Harmonic Generation on Solid Surfaces, Jozsef Seres[1], Enikoe J. Seres[1], Carles Serrat[3], Erin C. Young[2], James S. Speck[2], Thorsten Schumm[1]; *[1]Atominstitut E-141, Vienna Univ. of Technology, Austria; [2]Materials Dept., Univ. of California, USA; [3]Departament de Física, Universitat Politècnica de Catalunya, Spain.* Using an enhancement cavity, a sub-Watt power Ti:sapphire femtosecond frequency comb is enhanced to 24 W and 3rd, 5th and 7th harmonics are generated in a non-perturbative

ATh4A.5 • 15:45
Diode-pumped Picosecond 640-nm Pr:YLF Regenerative Laser Amplifier, Fumihiko Kannari[1], Yusaku Hara[1], Naoto Sugiyama[1], Shogo Fujita[1], Hiroki Tanaka[1,2]; *[1]Keio Univ., Japan; [2]Leibnz-Institut fur Kristallzuchtung, Germany.* We demonstrated generative picosecond laser pulse amplification at 640 nm for the first time using a Pr^{3+}:YLF crystal, which was continuously pumped by an InGaN diode laser, with a mode-locked Pr^{3+}:YLF oscillator.

ATh4A.6 • 16:00
Development of a Space-Qualified Pulsed Ultraviolet Laser for the Mars Organic Molecule Analyzer (MOMA) on the ExoMars 2020 Rover, Joerg Neumann[1], Alexander Büttner[1], Mathias Ernst[1], Michael Hunnekuhl[1], Roland Kalms[1], Lina Willemsen[1], Peter Wessels[1], Dietmar Kracht[1]; *[1]Laser Zentrum Hannover e.V., Germany.* A space-qualified frequency quadrupled passively Q-switched Nd:Cr:YAG-laser with a pulse energy of 130 μJ at a pulse duration of 1.5 ns and a wavelength of 266 nm is developed for the Mars Organic Molecule Analyzer.

Hall M2 — LS&C

14:30 -- 16:30
LTh4B • Sensing Technologies
Presider: Edward Watson; Univ. of Dayton, USA

LTh4B.1 • 14:30 Invited
How to Mitigate Turbulence Without Adaptive Optics, David Allioux[1], Bertrand Denolle[1], Gautier Trunet[1], Pu Jian[1], Olivier Pinel[1], Guillaume Labroille[1]; *[1]CAILabs SAS, France.* We show that using Multi-Plan Light Conversion technique, we can implement a novel, passive turbulence-mitigating technique. We demultiplexe a perturbated wave-front on a limited number of spatial modes enables to highly increase the collected light.

LTh4B.2 • 15:00
Increasing the Performance of an Adaptive Optical System for Correcting the Laser Wavefront in Free-space Communications Systems, Alexander Nikitin[1,2]; *[1]Inst. of Geosphere Dynamics, Russia; [2]AKA OPTICS, France.* Increasing the performance of an adaptive optical wavefront correction system can be achieved using a field-programmable gate array (FPGA). We consider the data processing algorithm which allows increasing the performance of such a system.

LTh4B.3 • 15:15
Speckle Correlation Technique to Improve the Dynamic Range of an Optical Lever, Shanti Bhattacharya[1], A Vijayakumar[1], Sruthy J L[1], Joseph Rosen[2]; *[1]IIT Madras, India; [2]Electrical and Computer Engineering, Ben Gurion Univ., Israel.* A spatial multiplexing technique is proposed to improve the resolution and dynamic range of a speckle correlation based optical lever in the measurement of small tilts for applications in Laser Interferometer Gravitational-Wave Observatory (LIGO).

LTh4B.4 • 15:30
High-speed and Single-shot Waveform Measurement for Elucidation of Irreversible Chemical Reaction Dynamics, Hiroali Tada[1], Leona Yuda[1]; *[1]Saitama Univ., Japan.* The single-shot optical waveform measurement was measured on a frequency axis by the improved frequency comb analyzer using dual-heterodyne mixing in time-division multiplexing. The 2.7 ps time resolution of the single-shot measurement was performed.

LTh4B.5 • 15:45
Sensing using Dynamics of a Laser Diode with Dual-Cavity, Yuxi Ruan[1], Bairun Nie[1], Zhuqiu Chen[1], Yanguang Yu[1], Jiangtao Xi[1], Qinghua Guo[1], Jun Tong[1]; *[1]Univ. of Wollongong, Australia.* Waveform analysis is conducted on a sensing signal generated by a laser diode with dual-cavity operating at period-one state. The proposed design can achieve high measurement resolution and sensitivity for a moving object.

LTh4B.6 • 16:00
Plasma Diagnostic by Terahertz pulses, massimo petrarca[1,2]; *[1]SBAI, Univ. of Rome: "Sapienza", Italy; [2]Roma1, INFN, Italy.* I present a diagnostic method for the simultaneous characterization of the electron plasma density and temperature based on the exploitation of wideband THz pulses. This method is of particular interest for many applications e.g. plasma-based accelerator, laser-produced plasma.

Room 1.61-1.62 — LAC

14:30 -- 16:30
Directed Energy Professional Society Special HEL Defense Applications Session III
Presider: David Mordaunt; Ball Aerospace & Technologies, USA

Panel discussion will take place during this session. It will kick off with brief overview of national programs followed by discussion questions. Questions will touch on focus area above.

Panel Members:

Matthew Cork, *DSTL, UK*
Hans-Albert Eckel, *German Aerospace Center (DLR), Institute of Technical Physics, Germany*
Dom Pudo, *Defence R&D Canada, Canada*
Larry Grimes, *High Energy Laser Joint Tech Office, USA*
Michelle Hedrick, *AFRL/RD, USA*
Christopher Lloyd, *NSWC Dahlgren, USA*

Hall E1	Hall M2
ASSL	LS&C

14:30 -- 16:30
ATh4A • Lasers for Special Applications– Continued
Presider: Suhui Yang; Beijing Inst. of Technology, China

ATh4A.7 • 16:15
Tunable Picosecond Deep-UV Laser System for Semiconductor Inspection at 213 nm, Kentaro Miyata[1], Akihiro Tanabashi[1], Louis Desbiens[2], Vincent Roy[2], Yves Taillon[2], Mizuki Mohara[4], Kei Shimura[4], Shinichi Nakayama[3], Satoshi Wada[1]; [1]*RIKEN, Japan;* [2]*INO, Canada;* [3]*Megaopto, Japan;* [4]*Hitachi High-Technologies Corporation, Japan.* We report a high-repetition-rate, picosecond fiber master-oscillator and power-amplifier system operating at 120 and 240 MHz in the pulse range of 28-87 ps and its fifth-harmonic generation for semiconductor inspection at 213 nm.

14:30 -- 16:30
LTh4B • Sensing Technologies– Continued

LTh4B.7 • 16:15
State Boundaries in a Laser Diode with Optical Feedback and Its Sensing Application, Bairun Nie[1], Yuxi Ruan[1], Zhuqiu Chen[1], Yanguang Yu[1], Qinghua Guo[1], Jiangtao Xi[1], Jun Tong[1]; [1]*Univ. of Wollongong, Australia.* By studying the influence of system parameters on the dynamical state boundaries in a laser diode with optical feedback, a sensing system working at period-one state for achieving displacement measurement with high resolution is designed.

16:30—17:00 • Awards and Closing Gathering, *Hall E1*

Key to Authors and Presiders

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