

Optica Laser Congress Session Guide

Disclaimer: this guide is limited to technical program with abstracts and author blocks as of 3 October. For updated and complete information with special events, reference the online schedule or mobile app.

Monday, 09 October

08:00 -- 09:00

Ballroom A: Room

AM1A • New Concepts for Crystals

Presider: Patrice Camy; CIMAP-ENSICAEN, France

AM1A.1 • 08:00 (Invited)

Rare-Earth Doped Crystals for Quantum Photonics, Philippe Goldner¹; ¹*PSL Univ./CNRS, France*. Rare-earth ions combine long-lived optical and spin transitions at low temperatures, a unique case in the solid state. Recent developments in rare-earth platforms for optical quantum technologies like as quantum memories will be discussed.

AM1A.2 • 08:30

Visible Multi-Wavelength Combiner With High Extinction Ratio and Fast-Response Optical Shutter Using Silica-Based Planar Lightwave Circuit, Junji Sakamoto¹, Satomi Katayose¹, Yuji Fujiwara¹, Toshikazu Hashimoto¹; ¹*NTT Device Technology Labs, Japan*. We fabricated a visible multi-wavelength combiner with a high extinction ratio and fast response optical shutter using optical waveguide that has an extinction ratio over 60 dB and a response time of about 0.5 ms.

AM1A.3 • 08:45

Optical Metasurfaces for GHz Free Space Optical Communications: Prospects and Prototype Validation, Kaloyan C. Georgiev^{1,2}, Anton Trifonov^{4,2}, Khosro Z. Kamali³, Lyuben Petrov^{1,2}, Dragomir Neshev³, Ivan Buchvarov^{1,2}; ¹*Sofia Univ. St. Kliment Ohridski, Bulgaria*; ²*John Atanasoff Center for Bio and Nano Photonics (JAC BNP), Bulgaria*; ³*ARC Centre of Excellence TMOS, Research School of Physics, Australian National Univ., Australia*; ⁴*IBPhotonics Ltd., Bulgaria*. An all-optical modulation of light based on crystalline silicon metasurfaces is presented, where a carrier-driven absolute amplitude modulation of over 72% is demonstrated with about 100 ps response times.

09:15 -- 10:15

Room: Ballroom A

JM2A • Joint Plenary Session I

Presider: Mark Dubinskii; US Army Research Laboratory, USA

JM2A.1 • 09:15 (Plenary)

50 Years of Laser Development Leading to NIF Breakthrough, Mary Spaeth¹ Ken Manes¹; ¹*Lawrence Livermore National Laboratory, USA*. Meeting the stiff scientific and engineering challenges leading to the NIF laser ignition driver took five generations of hardware and multiple generations of personnel. We follow these challenges and their solutions from 1970 to the present.

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10:45 -- 12:45

AM3A • High Energy Sources

Room: Ballroom A

Presider: Charles Yu; Lawrence Livermore National Lab, USA

AM3A.1 • 10:45 (Invited)

MegaJoule Laser, Sebastien Montant¹; ¹CEA Cesta, France. An overview of the LMJ installation is presented with details of the laser system. Current studies for improving LMJ laser performance are also presented.

AM3A.2 • 11:15

2.5 Hz and 10 Hz Operation of the HF-2PW Laser of ELI ALPS at the 400 TW Level, Roland Nagymihály¹, János Bohus¹, Viktor Pajer¹, Levente Lehotai¹, Abdollah Malakzadeh¹, Benoit Bussiere², Franck Falcoz², Mikhail Kalashnikov¹, Katalin Varjú¹, Gábor Szabó¹, Catalin Neacsu², Pierre-Mary Paul², Adam Borzsonyi¹; ¹ELI ALPS, ELI-HU Non-Profit Ltd., Hungary; ²Amplitude, France. Results on the long-term operation of the HF-2PW laser of ELI ALPS at 2.5 Hz and 10 Hz repetition rates will be presented at the compressed energy of 10 J with <25 fs pulse duration.

AM3A.3 • 11:30

2.7J, 800ps Pulses Delivered by Bonded-Chip Amplifier Operated at Room-Temperature, Vincent Yahia^{1,2}, Arvydas Kausas^{2,1}, Akihiro Tsuji^{2,1}, Mitsuhiro Yoshida³, Takunori Taira^{2,1}; ¹Inst. for Molecular Science, Japan; ²Riken SPring-8 Center, Japan; ³KEK, Japan. A compact diode-pumped solid-state laser has been developed, with a modular combination of room-temperature-bonded Nd:YAG ceramic-chips and Sapphire heat sinks as gain medium. The system delivers 2.7J, 800ps pulses with stable operation up to 10Hz.

AM3A.4 • 11:45

Contamination-Resistant Antireflective Coatings for Laser Optics, Christophe Boscher¹, Marion Jégou¹, Frédéric Bertin¹, Nathalie Martins¹, Philippe Belleville¹, Alexandre Beaudier¹; ¹CEA, France. This study presents various results concerning the improvement of antireflective coating to resist the organic pollution responsible of the decrease of optical performances in the CEA Megajoule Laser facility (LMJ).

AM3A.5 • 12:00

Development of the L2-DUHA High Repetition Rate, 100 TW OPCPA System for Laser Wakefield Acceleration, Jonathan Green¹, Jan Bartonicek^{1,2}, Lukas Indra^{1,3}, Martin Fibrich¹, Jan Eisenschreiber^{1,4}, Jakub Novák¹, Karel Majer¹, Boguslaw Tykalewicz¹, Bedrich Rus¹; ¹Extreme Light Infrastructure, Czechia; ²Mechanical Engineering, Czech Technical Univ., Czechia; ³Nuclear Sciences and Physical Engineering, Czech Technical Univ., Czechia; ⁴Mathematics and Physics, Charles Univ., Czechia. The L2-DUHA laser is a 100 TW laser system under development at the ELI-Beamlines facility with target output parameters 3 J, 25 fs, and 50 Hz. It is based entirely on DPSSL-pumped OPCPA with a front end pumped by a picosecond pulse thin disk laser and high energy amplifier pumped by a cryogenically cooled Yb:YAG laser.

AM3A.6 • 12:15

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Improved Stability Frequency Conversion of a Diode-Pumped Yb:YAG Laser at the 0.5 kW-Level, Danielle Clarke^{1,2}, P. J. Phillips¹, Martin Divoky³, Jan Pilar³, Petr Navratil³, Martin Hanus³, Patricie Severova³, Ondrej Denk³, Tomas Paliesek³, Martin Smrz³, Paul D. Mason¹, Thomas J. Butcher¹, Chris Edwards¹, John Collier¹, Tomas Mocek³; ¹*Rutherford Appleton Labs, UK*; ²*School of Engineering and Physical Sciences, Heriot-Watt, UK*; ³*HiLASE Centre, Czechia*. We report stable type-I phase-matched frequency conversion of a nanosecond high-energy, diode-pumped, Yb:YAG laser, producing 48.9 J at 10 Hz with a 73.8% conversion efficiency and 0.5% energy stability. This is important reliably operating high-energy, frequency-doubled laser.

10:45 -- 12:45

Room: 407

LM3B • Laser Shock Peening & Forming

Presider: Tomokazu Sano; Osaka Univ., Japan

LM3B.1 • 10:45 (Invited)

Laser Peening With an SBS Phase Conjugated Nd:Glass Laser System, Lloyd Hackel¹; ¹*Curtiss-Wright Surface Technologies, USA*. A Nd:glass laser producing 20 J/pulse at selectable 10 ns to 30 ns pulse duration and 5 Hz repetition rate is used for laser peening. Stimulated Brillouin scattering phase conjugation maintains wavefront control to avoid internal optics damage at the 1000 MW peak power level. Recent research focuses on improving fatigue life of single crystal superalloys and slowing hydrogen induced cracking.

LM3B.2 • 11:15 (Invited)

Influence of Pulse Duration on Mechanical Properties and Dislocation Density of Dry Laser Peened Aluminum Alloy Using Ultrashort Pulsed Laser-Driven Shock Wave, Masayuki Yoshida¹, Itsuki Nishibata¹, Tomoki Matsuda¹, Yusuke Ito², Naohiko Sugita², Ayumi Shiro³, Takahisa Shobu⁴, Kazuto Arakawa⁵, Akio Hirose¹, Tomokazu Sano¹; ¹*Osaka Univ., Japan*; ²*The Univ. of Tokyo, Japan*; ³*National Inst. for Quantum Science and Technology, Japan*; ⁴*Japan Atomic Energy Agency, Japan*; ⁵*Shimane Univ., Japan*. This study aims to investigate the influence of the pulse duration on the mechanical properties and dislocation density of an aluminum alloy treated using dry laser peening (DLP), which is a laser peening technique that uses ultrashort pulsed laser-driven shock wave to eliminate the need for a sacrificial overlay under atmospheric conditions.

LM3B.3 • 11:45 (Invited)

Laser Shock Peening of Ceramic Materials: New Applications and Mechanisms, Bai Cui¹; ¹*Univ. of Nebraska-Lincoln, USA*. A novel high-temperature LSP process has been developed by our group. Localized plastic deformation is generated in brittle ceramics at room and elevated temperatures, which improve their mechanical properties such as hardness and fracture toughness.

LM3B.4 • 12:15 (Invited)

Laser Peening Applied at Hundred Hertz Range: Challenges and Demonstration, Alexandre Rondepierre¹; ¹*Osaka Univ. - Riken SPRING-8, Japan*. Challenges related with the development of a laser shock peening (LSP) process at high-repetition rate, up to 200 Hz, are presented. The feasibility of such fast LSP configuration was demonstrated and the importance of both parasite breakdowns and water confinement renewal was highlighted.

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12:45 -- 14:00

Room: Science and Industry Showcase

JM4A • Joint Poster Session I

JM4A.1

Raman Gain Measurements at the Boson Peak in Phosphosilicate Fiber, Andrew Yandow¹, Charles X. Yu¹; ¹*Lawrence Livermore National Laboratory, USA*. Stimulated Raman gain measurements taken at the boson peak (3.6 THz) line in a phosphosilicate fiber referenced in recent studies are presented and a discrepancy with the gain spectrum referenced in other studies is resolved.

JM4A.2

Dynamics of Shared Signal Wave Resonance for Generating mid-IR Laser in Intracavity OPO With Multi-Wavelength Pump Wave, Chun-Yu Cho¹, Bao-Te Chen¹, Shin-Lin Tsai¹; ¹*National United Univ., Taiwan*. Dynamics of multi-wavelength idler wave generation is investigated. It is observed that the multi-wavelength pump wave can contribute to shared signal wave resonance by using quasi-phase-matching OPO and successfully decreased overall threshold requirement.

JM4A.3

Overview of Optical Characterisation Capabilities for Assessing Suitability of Optics for High-Energy, High Repetition Rate Lasers, Gary Quinn^{1,2}, Danielle Clarke^{1,2}, Mariastefania De Vido¹; ¹*STFC, UK*; ²*Inst. of Photonics and Quantum Sciences, Heriot-Watt Univ., UK*. We present an overview of the optical characterisation capabilities available at the Central Laser Facility and describe how they are used to assess the suitability of optics and coatings for high-energy, high repetition rate lasers.

JM4A.4

Comparative Study on the Multi-Channel Phase Control Performances Between SPGD and CMA-ES Algorithms, Hansol Kim¹, Minsu Yeo¹, Yoonchan Jeong¹; ¹*Seoul National Univ., Korea (the Republic of)*. We carry out a numerical study on coherent control of multi-phase with SPGD and CMA-ES algorithms. We compare their performances and identify the distinct characteristic of each algorithm when used for phase control.

JM4A.5

Modelling the Energetics of a Potential New-Look 10 Hz, 100 J Class DiPOLE Amplifier, Luke McHugh¹, Paul D. Mason¹, P J. Phillips¹, Thomas J. Butcher¹, Cristina Hernandez-Gomez¹; ¹*STFC Rutherford Appleton Laboratory, Central Laser Facility, UK*. Modelling the energetics of a proposed new iteration of a 10 Hz, 100 J DiPOLE system to pump the Ti:Sa amplifier currently under construction in the Extreme Photonics Applications Centre (EPAC).

JM4A.6

1.6 μm Vortex MOPA, Shiyao Fu¹, Lan Hai¹, Zhichao Zhang¹, Chunqing Gao¹; ¹*Beijing Inst. of Technology, China*. A four-pass Er:YAG vortex master-oscillator-power-amplification (MOPA) system enabling power amplification of 1.6 μm single-frequency high-order vortex beams is demonstrated. The gain up to 2.36 with no mode purity and linewidth loss, is achieved.

JM4A.7

a Simple Single-Pass Divided-Pulse Amplification Scheme, Alan B. Petersen¹, James D. Kafka¹; ¹*MKS/Spectra-Physics, USA*. A divided-pulse amplification scheme is described and

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demonstrated using a free-space delay line, single-pass amplifier and minimum components. This arrangement should be suitable as a final amplifier stage in either psec or stretched fsec systems.

JM4A.8

NEGF-Based Optimization of Gain Medium in QCL, Andrzej Kolek¹, Grzegorz Haldas¹; ¹*Rzeszów Univ. of Technology, Poland*. Numerical simulations which use non-equilibrium Green's function formalism are employed to optimize the gain region of a quantum cascade laser that emits radiation at $\sim 5 \mu\text{m}$ wavelength. The optimization strategy uses electron-photon self-energies to find characteristics of devices, which interact with the laser field.

JM4A.9

Tm³⁺ Ions Doped Mixed Sesquioxides Laser Ceramics: an in-Depth Characterization of Spectroscopic, Structural and Laser Behavior, Angela Pirri¹, Roman N. Maksimov³, Alberto Santonocito⁴, Vladislav A. Shitov³, Barbara Patrizi², Matteo Vannini², Vladimir V. Osipov⁵, Guido Tocì²; ¹*CNR-IFAC, Inst. of Applied Physics "Carrara", Italy*; ²*CNR-INO, Italy*; ³*Inst. of Electrophysics UrB RAS, Russian Federation*; ⁴*Dipartimento di chimica e Chimica Industriale, Università di Pisa, Italy*; ⁵*Ural Federal Univ. named after the first President of Russia B.N. Yeltsin, Russian Federation*. We report on the fabrication, structural and spectroscopic characterizations, as well as the laser behavior of some mixed sesquioxides laser ceramics, *i.e.* $(\text{Sc}_x\text{Y}_{1-x})_2\text{O}_3$, fabricated with different Y/Sc balance and doped with 5at.% Tm³⁺.

JM4A.10

Quantitative CMOS(QCMOS) Camera Capabilities With a Focus on Quantum Optics, Brad Coyle¹, Klea Dhimitri¹, Stephanie Fullerton¹, Keith Bennett², Taiki Miura², Takafumi Higuchi², Tadahashi Maruno²; ¹*Hamamatsu Corporation, USA*; ²*Hamamatsu Photonics K.K., Japan*. Scientific CMOS (sCMOS) cameras have developed rapidly over the past decade. This poster will provide an overview on Hamamatsu's ORCA-Quest quantitative CMOS (qCMOS) camera and discuss the role of qCMOS cameras for quantum optics application.

JM4A.11

High-Gain Water-Cooled Diode Pumped Yb:YAG Amplifier With Advanced Thermal Management for Pumping High Repetition Rate OPCPA, Jan Bartonicek^{1,2}, Martin Fibrich¹, Jonathan T. Green¹, Petr Vlcek², Bedrich Rus¹; ¹*Extreme Light Infrastructure ERIC, Czechia*; ²*Department of Physics, Faculty of Mechanical Engineering, Czech Technical Univ. in Prague, Czechia*. A water-cooled diode pumped single rod Yb:YAG amplifier was developed providing high energy nanosecond pulses with 20Hz repetition rate. Undoped endcaps and crystal's cooling architecture yielded in high gain and low lensing and depolarization effect.

JM4A.12

3.5 MW-Peak and 17 Watt-Average Power LED-Pumped Nd:YAG Laser, Long X. Ho¹, Ming-Hsiung Wu¹, Yen-Chieh Huang¹; ¹*Inst. of Photonics Technologies, National Tsinghua Univ., Taiwan*. We have generated 17-W average power of quasi-CW pulses at 50 Hz and 3.5 MW peak power of Q-switched pulses at 10 Hz from a LED-pumped solid-state laser.

JM4A.13

Thermo-Optic Constants of 1mol% MgO Doped Stoichiometric LiTaO₃ in the Visible and Near UV, Nobuhiro Umemura¹, Tomosumi Kamimura², Junji Hirohashi³; ¹*Chitose Inst. of Science and Technology, Japan*; ²*Osaka Inst. of Technology, Japan*; ³*Oxide Corp., Japan*. We measured the thermo-optic constants dn_e/dT and dn_o/dT of 1mol% MgO doped stoichiometric

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LiTaO₃ in the visible and near UV ranges by prism deviation method. The experimental data for the temperature-dependent quasi phase-matching properties were obtained down to 0.308 μm.

JM4A.14

Development of an Ultra-Narrowband 130 ps Erbium-Ytterbium-Doped Fiber Laser Oscillator, Reza Amani¹, Guoqi Ren¹, Yusuke Ito¹, Naohiko Sugita¹, Yasuo Nabekawa², Atsushi Iwasaki¹; ¹*Univ. of Tokyo, Japan*; ²*RIKEN Center for Advanced Photonics, Japan*. We report a 32.96 MHz, 130 ps erbium-ytterbium-doped fiber laser oscillator with a spectral bandwidth of 0.22 cm⁻¹ at 1559.6 nm. It could provide a new route in high-power laser development and high-resolution spectroscopy.

JM4A.15

How Radial Power Improves Efficiency: a Case Study for Nonlinear Optics and Further Applications, Thomas A. Lobay¹; ¹*BAE Systems, Inc., USA*. High efficiency and reliability are competing demands for optical generation. For continuous wave or high pulse rate applications, radial power is our reliability constraint. Analysis shows how to increase efficiency, with a case study for ZnGeP₂ (ZGP).

JM4A.16

Actively Q-Switched Tm:YLF Laser Based on a Trapezoid Electrooptical KLTN Deflector, Salman Noach¹, Yechiel Bach¹, Mulkan Adgo², Yehudit Garcia², Yaakov Glick³, Aharon J. Agranat²; ¹*Jerusalem College of Technology, Israel*; ²*Department of Applied Physics, The Hebrew Univ. of Jerusalem, Israel*; ³*Applied Physics Division, Soreq Nuclear Research Center, Israel*. An actively Q-switched Tm:YLF laser is presented. The Q-switched modulation achieved with a novel quadratic electrooptical KLTN deflector, utilizes the induced electric field gradient along the vertical axis caused by the deflector trapezoid shape.

JM4A.17

Development of Direct-Bonded Yb:YAG Thin Rod Amplifier, Yasuhiro Kamba¹, Atsushi Fuchimukai¹, Taisuke Miura¹, Miyuki Uomoto^{2,4}, Takehito Shimatsu^{2,4}, shotaro Hirao³, Hiroki Morita³, Takeshi Higashiguchi³; ¹*Gigaphoton Inc., Japan*; ²*Research Inst. of Electrical Communication, Tohoku Univ., Japan*; ³*Utsunomiya Univ., Japan*; ⁴*Frontier Research Inst. for Interdisciplinary Sciences, Tohoku Univ., Japan*. We report on an Yb:YAG thin rod amplifier mounted on aluminum heatsink using the atomic diffusion bonding (ADB). Owing to the low thermal resistivity of ADB, thermally induced distortion of amplified beam profile was suppressed.

JM4A.18

Linear Thermal Expansion Coefficient of Single- and Poly-Crystalline YAG Doped With Various RE-Ions, Yoichi Sato^{1,2}, Takunori Taira^{1,2}, Tomohisa Takemasa³; ¹*RIKEN SPring-8 Center, Japan*; ²*Inst. for Molecular Science, Japan*; ³*Konoshima Chemical Co., Ltd., Japan*. The linear thermal expansion coefficients of Nd:YAG single crystals and YAG ceramics doped with Nd³⁺, Yb³⁺, Er³⁺, Sm³⁺, and Cr⁴⁺ ions were evaluated. We experimentally detected no significant differences larger than measurement errors.

JM4A.19

Intra-Pulse Dynamics in Active Q-Switched Mode-Coupled Vortex Lasers in an Azimuthal Symmetry Breaking Laser Resonator, YuanYao Lin¹, Zhi-Nan Chen¹; ¹*Department of Photonics, National Sun Yat-sen Univ., Tajikistan*. Actively q-switched mode-coupled optical vortex lasers emitted from an azimuthal symmetry breaking ring resonator. As the vortex lasers

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are formed by off-axis traveling waves, complex spatio-temporal-spectral dynamics within a Q-switched pulse were observed.

JM4A.20

Fabrication of Laser Induced High-Quality Porous Graphene Electrode on Patterned Metal Electrode for Electrochemical Energy Device, Hak-Jong Choi¹, Soongeun Kwon¹, Hyung Cheoul Shim¹, Geehong Kim¹, Hyungjun Lim¹, Junhyoung Ahn¹, Ki-Bong Choi¹, Jae Jong Lee¹; ¹*Korea Inst. of Machinery & Materials, Korea (the Republic of)*. High quality porous graphene electrode is formed on patterned metal electrode using high-power carbon dioxide (CO₂) laser to carbonize the polyimide film working as electrochemical energy device

JM4A.21

High-Throughput Laser Hardening of Steel With a 120 kW Laser, Stefan Reich¹, Dominic Heunoske¹, Martin Lueck¹, Jens Osterholz¹; ¹*Fraunhofer EMI, Germany*. Lasers are common tools for surface hardening of metals. With a 120 kW laser a strongly increased throughput can be achieved. We demonstrate steel hardening of 5 cm²/s with 0.6 mm depth from 160 to 600 HV100

JM4A.22

Laser and Optical System for Sequential Excitation of Hydrogen Ion Beams at the Spallation Neutron Source, Abdurahim Rakhman¹; ¹*Oak Ridge National Laboratory, USA*. We report the design and operation of 140 mJ UV (355 nm) laser and optical system used in the sequential excitation of hydrogen ion beams recently demonstrated at the Spallation Neutron Source accelerator.

JM4A.23

High-Beam Quality Highly-Efficient High-Average-Power Pulse Amplification in Ho³⁺:YAG, Katharina Goth^{1,2}, Inès Vergara^{1,3}, Michael Griesbeck¹, Madeleine Eitner¹, Marius Rupp^{1,2}, Marc Eichhorn^{1,2}, Christelle Kieleck¹; ¹*Fraunhofer IOSB, Germany*; ²*Karlsruhe Inst. of Technology, Germany*; ³*Institut d'Optique Graduate School, France*. We present an actively Q-switched Ho³⁺:YAG master oscillator power amplifier system with 67.5 % slope efficiency and 122 W average power and a pulse energy of 2.4 mJ. The dual-end-pumped system achieves a near-diffraction-limited beam quality factor of $M^2 \approx 1.2$.

JM4A.24

Riesz Transform Phase-Shifting Technique From a Single Fringe Pattern, Yassine Tounsi¹, Manoj Kumar², Karmjit Kaur³, Fernando-Mendoza Santoyo⁴, Osamu Matoba², Abdelkrim Nassim¹; ¹*Chouaib Doukkali Univ., Morocco*; ²*Graduate School of System Informatics, Japan*; ³*Govt. P.G. College, Ambala Cantt. Haryana, India*; ⁴*Centro de Investigaciones en Optica, Mexico*. A computational four-step phase-shifting method based on the Riesz transform is proposed for optical phase extraction from a single fringe pattern. It provides a robust solution in interferometry and can replace the conventional phase-shifting techniques.

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14:00 -- 16:00

Room: Ballroom A

AM5A • Visible and UV Lasers

Presider: Yushi Kaneda; University of Arizona, College of Optical Sciences, USA

AM5A.1 • 14:00 (Invited)

Pr :YLF Monolithic Diode-Pumped Solid-State Lasers, Thierry Georges¹; ¹*OXXIUS, France*. Neodymium based monolithic lasers are known to be efficient, in particular when they include intracavity frequency doubling (ref 1). They can provide emission with highly stable frequency (ref 2). Finally, since optical degradation is more likely to occur at crystal interfaces, reliability is expected to be improved by monolithic designs. The advent of high power blue diode lasers has allowed to pump other rare earths, such as Praseodymium, emitting directly in the visible range and potentially emitting in the UV range with appropriate intracavity frequency doubling stage. In order to optimize the performances of these new lasers, it is interesting to develop monolithic designs of the lasers. Compared to Nd:YAG based monolithic lasers, several new challenges are induced by the new crystals and shorter wavelengths. First challenges are related to the Pr:YLF crystal. It is a fragile crystal that can easily break under thermal constraints and its interfaces can be degraded by strong pump intensity at high temperature. In addition, thermal load induces a cylindrical thermal lens, which may strongly degrade polarization based filtering (such Lyot filtering). The use of undoped YLF crystal assembled to the input facet of Pr:YLF crystal may strongly reduce detrimental effects. This is currently under test. Cylindrical lensing impact can be eliminated by inserting the Pr:YLF crystal in the middle of a pair of 45° quarter wave plates. Improved circularization of the pumping beam is also an option because it reduces the pump intensity at beam waist. Second challenges are related to UV generation. LBO or BBO frequency doublers have very narrow acceptance and cannot be thermally tuned. We have solved this issue by polishing large plates, measuring error and correcting the error by a second polishing. This process is however still to be industrialized. Fragility of BBO and large coefficient of thermal expansion (CTE) of CTE requires an elastic bonding. The challenge of elastic bonding is related to the UV transparency of the solgel. Both optical contacting and UV-proof solgels are being investigated. Results at 640nm, 607nm, 698nm, 720nm and 320nm will be presented at the conference. They will include slope efficiency, single frequency operation and reliability. In particular, long term operation of a 200mW single diode pumped 320nm laser will be discussed.

AM5A.2 • 14:30

Femtosecond Fiber Laser at 635 nm, Michel Olivier^{1,2}, Marie-Pier Lord¹, Martin Bernier¹, Réal Vallée¹; ¹*Centre d'optique, photonique et laser, Université Laval, Canada*; ²*Département de physique, Cegep Garneau, Canada*. We present an ultrafast fiber laser operating at 635 nm. It emits 168 fs pulses at a repetition rate of 137 MHz. Mode-locking is based on nonlinear polarization evolution in a single-mode praseodymium-doped fluoride fiber.

AM5A.3 • 14:45 (Student Paper Finalist)

Orange Surface Waveguide Laser in Pr:LiYF₄ Produced by Femtosecond Laser Inscription, Amandine Baillard¹, Pavel Loiko¹, Carolina Romero², Victor Arroyo², Javier R. de Aldana², Michaël Fromager¹, Alain Braud¹, Patrice Camy¹, Xavier Mateos³; ¹*CIMAP, UMR 6252 CNRS, Université de Caen Normandie, France*; ²*Univ. of Salamanca, Spain*; ³*Universitat Rovira i Virgili, Spain*. Depressed-cladding low-loss (0.14 dB/cm) surface channel waveguides were fabricated in bulk Pr:LiYF₄ by Ultrafast Laser Inscription. An orange waveguide laser generated 274 mW at 604.3 nm with 28.4% slope efficiency and 29 mW laser threshold.

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AM5A.4 • 15:00 (Student Paper Finalist)

UV-Diode-Pumping and Prospects of Violet-Blue Lasing of Tb³⁺-Doped Fluorides, Moritz Badtke¹, Sascha Kalusniak¹, Stefan Pueschel¹, Hiroki Tanaka¹, Christian Kraenkel¹; ¹*Leibniz-Institut für Kristallzüchtung, Germany*. We present a UV-diode-pumped yellow and green Tb:LLF laser and investigate the influence of the UV-pump wavelength. Moreover, we evaluate the potential of low doped Tb:YLF for direct laser emission at wavelengths around 415 nm.

AM5A.5 • 15:15

10-Watt 640-nm Single-Frequency Source, Vladimir Karpov¹, Frank Eory¹, Jevgenij Kosenko¹, Wallace R. Clements¹; ¹*MPB Communications Inc., Canada*. We study the optical properties of a narrowband single-frequency 1280-nm laser amplified in a Raman phosphorous-doped fiber amplifier and its second harmonic. A highly-efficient 10-Watt 640-nm single-frequency source will be presented.

AM5A.6 • 15:30

Dual-Pulse Dual-Wavelength Sub-Nanosecond Raman Fiber Amplifier Based Red-Orange Light Source, Serguei Papernyi¹, Youngjae Kim¹, Dmitri Snejko¹, Pierre De Villers¹, Wallace R. Clements¹; ¹*MPB Communications Inc., Canada*. A fully-integrated backward-pumped polarization-maintaining Raman phosphosilicate fiber amplifier providing synchronized or separate sub-nanosecond second-harmonic pulses at 655 and 589 nm, each having 3 W average output power at 40-100 MHz repetition rates is reported.

AM5A.7 • 15:45

Red Sm:KGd(WO₄)₂ Laser at 649 nm, Amandine Baillard¹, Pavel Loiko¹, Daniel Rytz², Sebastian Schwung², Michaël Fromager¹, Alain Braud¹, Patrice Camy¹; ¹*Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), UMR 6252 CNRS, Université de Caen Normandie, France*; ²*EOT GmbH, Germany*. We report on polarized spectroscopy and first laser operation of Sm:KGd(WO₄)₂ crystal. Red Samarium laser generated 17.6 mW at 649.1 nm with 16.9% slope efficiency, a threshold down to 29 mW and a linear polarization.

14:00 -- 16:00

Room: 407

LM5B • Laser Induced Damage Test

Presider: Tomokazu Sano; Osaka Univ., Japan

LM5B.1 • 14:00 (Invited)

Advancing Laser Systems Through Optimal Direct Bonding: Insights Into Laser-Induced Damage Threshold Variability, Arvydas Kausas¹, Takunori Taira²; ¹*Kausas of Inst. for Molecular Science, Japan*; ²*RIKEN, Japan*. Achieving robust, defect-free bonding parameters crucial for high-performance laser systems. Measuring LIDT variations in crystals from different manufacturers, provide vital insights and ensuring the quality and performance in composite chips for J-class amplifier system."

LM5B.2 • 14:30 (Invited)

New Gas Optics for High Power Laser Applications, Hitoki Yoneda¹; ¹*Univ. of Electro-Communications, Japan*. Application of diffraction gas optics with high power lasers will be

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reported It can be used at high fluence of nanosecond laser(1.5kJ/cm²) and a 1cm² optics is created only by 60 mJ UV laser.

LM5B.3 • 15:00 (Invited)

Measurement of Optical Coatings Absorption and Simulations of Photo-Induced Modifications of Spectral Function Under High Power CW Laser Exposition, Laurent Gallais¹; ¹*Fresnel Institut, France*. This study delves into developing robust optics for high-power laser communication with geostationary satellites at 1570nm. It employs Lock-In Thermography and modeling to assess absorption and photoinduced effects, enhancing photonic system design reliability. This steady evolution of 2PP with its ever-increasing performance translates into a continuous growth of applications for science and industry. The focus of the talk addresses use-cases in the field of optics and photonics benefitting from sub-micrometer features and nanometric surface roughnesses.

16:30 -- 18:30

Room: Ballroom A

AM6A • Mid-IR Lasers

Presider: Jonathan Evans; *US Air Force Inst. of Technology, USA*

AM6A.1 • 16:30

Room Temperature, 55 mJ/Pulse, Gain-Switched Fe:ZnSe Laser System Pumped by Radiation of Electro-Optically Q-Switched Cr:Er:YSGG MOPA, Dmitry V. Martyshev¹, Vladimir Fedorov¹, Scott Halmin², Sergei Tochitsky³, Sergey Mirov¹; ¹*Univ. of Alabama at Birmingham, USA*; ²*Megawatt Lasers Corporation, USA*; ³*Univ. of California, Los Angeles, USA*. We report on room temperature tunable mid-IR Fe:ZnSe laser system pumped by radiation of electro-optically Q-switched Cr:Er:YSGG MOPA system. The output energy of 55mJ at 4400 nm was demonstrated in 90 ns pulses

AM6A.2 • 16:45 (Student Paper Finalist)

Tunable Mid-Infrared All-Fiber Laser for Real-Time Active Imaging of Greenhouse Gases., Louis-Charles Michaud¹, Tommy T. Boilard¹, Sébastien Magnan-Saucier¹, Pascal Paradis¹, Lauris Talbot¹, Antoine Thibault¹, Daniel F. Nadeau¹, Réal Vallée¹, Martin Bernier¹; ¹*Université Laval, Canada*. We report a tunable all-fiber laser emitting a maximum output power of 2.55 W around 3240 nm with a tuning range of 1.5 nm used on field as an illumination source for active imaging of methane and water vapor.

AM6A.3 • 17:00

6 W Diode-Pumped Tm:GdVO₄ Laser at 2.29 μm, Xiaoxu Yu², Kirill Eremeev¹, Zhongben Pan², Pavel Loiko¹, Hongwei Chu², Fangyuan Zha², Han Pan², Shengzhi Zhao², Weidong Chen³, Alain Braud¹, Patrice Camy¹, Dechun Li²; ¹*CIMAP, UMR6252 CNRS, Université de Caen Normandie, France*; ²*School of Information Science and Engineering, and Key Laboratory of Laser and Infrared System of Ministry of Education, Shandong Univ., China*; ³*Fujian Inst. of Research on the Structure of Matter, Chinese Academy of Sciences, China*. A diode-pumped Tm:GdVO₄ laser operating on the ³H₄→³H₅ transition generated 6.09 W at 2.29 μm with 30.8% slope efficiency and linear polarization (π). The polarized spectroscopic properties of Tm³⁺ ions in GdVO₄ were also revised.

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AM6A.4 • 17:15

Efficient Femtosecond Mid-IR Optical Parametric Generation at 10 MHz Pumped by a Mamyshev Fiber Oscillator and Amplifier, Sara Pizzurro¹, Sukeert², Adolfo Esteban-Martín³, Riccardo Gotti¹, Luca Carrà⁴, Giuliano Piccinno⁴, Antonio Agnesi¹, Federico Pirzio¹, Chaitanya Suddapalli Kumar⁵, Majid Ebrahim-Zadeh^{2,6}; ¹*Department of Electrical, Computer and Biomedical Engineering, Università degli Studi di Pavia, Italy*; ²*ICFO—Institut de Ciències Fotòniques, Spain*; ³*Departament d'òptica i Optometria i Ciències de la Visió, Universitat de València, Spain*; ⁴*Bright Solutions Srl, Italy*; ⁵*Tata Inst. of Fundamental Research Hyderabad, India*; ⁶*Institució Catalana de Recerca i Estudis Avançats (ICREA), Spain*. We report highly efficient (~60%) femtosecond mid-IR optical parametric generation at 10-MHz repetition rate exploiting zero-group-velocity-mismatch condition in 19-mm-long PPLN and 42-mm-long MgO:PPLN crystals. We obtain 300-fs signal pulses with 3.4–4.1 μm idler tuning.

AM6A.5 • 17:30

Laser Performance and Spectral Behavior of a Cryogenic Diode-Pumped 3- μm Er:YLF, Nikolay Ter-Gabrielyan¹, Mark A. Dubinskii¹, Viktor Fromzel¹; ¹*US Army Research Laboratory, USA*. We performed, what is believed to be, the first-time analysis of spectral and polarization kinetic of cryogenically cooled, pulsed 3- μm Er:YLF laser. As a result, we achieved an over 5-fold improvement in laser performance vs RT operation.

AM6A.6 • 17:45

Compact Ultrastable Seed Laser for Mid-IR OPCPA, Will Hettel³, Grzegorz Golba³, Drew Morrill³, Daniel Carlson³, Peter Chang^{2,1}, Tsung-Han Wu^{2,1}, Scott Diddams^{2,1}, Henry Kapteyn^{3,4}, Margaret Murnane³, Michael Hemmer³; ¹*Physics, Univ. of Colorado Boulder, USA*; ²*Electrical, Computer and Energy Engineering, Univ. of Colorado Boulder, USA*; ³*Physics, JILA & STROBE NSF Science & Technology Center, Univ. of Colorado & NIST, USA*; ⁴*Kapteyn-Murnane Laboratories, Inc., USA*. We present a fiber-based laser delivering synchronized pulses at 2 μm and 3 μm wavelengths to seed an OPCPA system. The simple architecture provides robust, stable mid-IR light for amplification to generate SXR high harmonics.

AM6A.7 • 18:00 (Student Paper Finalist)

Investigation of High-Power Ho³⁺:YAG Lasers With Homogeneous and Segmented Crystals, Katharina Goth^{1,2}, Marius Rupp^{1,2}, Michael Griesbeck¹, Madeleine Eitner¹, Marc Eichhorn^{1,2}, Christelle Kieleck¹; ¹*Fraunhofer IOSB, Germany*; ²*Inst. of Control Systems, Karlsruhe Inst. of Technology, Germany*. We compare Ho³⁺:YAG laser resonators with a homogeneously doped and a segmented laser crystal. Thermal lens investigations are shown for both crystals in optimized resonator configurations. Up to 20 ns, 2.2 mJ Q-switched pulses are generated with the homogeneously doped crystal.

AM6A.8 • 18:15

Comparison of Er³⁺- and Dy³⁺-Doped Low-Phonon Hosts as Gain Media for 4.1-4.8 μm Lasers, Ei Ei E. Brown¹, Zackery Fleischman¹, Jason McKay¹, Larry Merkle¹, Uwe H. Hommerich², Witold Palosz³, Sudhir Trivedi³, Mark A. Dubinskii¹; ¹*DEVCOM Army Research Laboratory, USA*; ²*Physics, Hampton Univ., USA*; ³*Brimrose Technology Corporation, USA*. The comparative analysis of Er³⁺- and Dy³⁺-doped low-phonon laser gain materials aiming to identify the best dopant for directly diode-pumped mid-infrared lasers operating in the 4.1-4.8 μm spectral domain has been performed for the first time.

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16:30 -- 18:30

Room: 407

LM6B • Submicron Material Processing

Presider: Johannes Trbola, Trbola Engineering, Germany

LM6B.1 • 16:30 (Invited)

Fabrication of Optical Components by Sub-Micron Accurate Laser 3D Printing, Simon Thiele¹; ¹*Printoptix GmbH, Germany*. Laser-based 3D printing by multi-photon polymerization has developed into a versatile tool that enables new types of highly compact and powerful optical components. Technological improvements have greatly increased fabrication speed and now enable series production of complex micro-optics. We present different examples of 3D printed optical components that offer unique value propositions in applications such as the medical field, AR/VR, optical sensing, or laser beam shaping.

LM6B.2 • 17:00 (Invited)

Laser Induced Structures - Functionalization of Medical Component Surfaces, Martin Kohse¹; ¹*Fraunhofer IPT, Germany*. Biological or bio inspired production will fuel the next major change in our industry. Well into the industrial revolution of Industry 4.0 and digitalization laser induced micro- and sub micrometer structures are promising to advance biocompatibility of mechanical engineering. I will give insights into our current research. Highlights include an increase in robustness and durability of the bioactive coatings on dental implants up to the capable imitation of organic structures to minimize clot adhesion in complex mechanical circulatory support devices shown on an artificial heart.

LM6B.3 • 17:30 (Invited)

Laser Based Additive Manufacturing of Diffractive and Refractive Optics, Martin Hermatschweiler¹; ¹*Nanoscribe GmbH, Germany*. Additive manufacturing based on two-photon polymerization (2PP) has evolved from a scientific curiosity to an industrial mastering and emerging production tool. The talk highlights recent technical advancements based on 2PP and two-photon grayscale lithography (2GL) that enhance the productivity whilst even increasing the shape accuracy and surface quality. Additional sub-wavelength alignment capabilities derived from lithography and automation routines open up simplified fabrication routes in the field of integrated photonics. The vast design freedom furthermore results in superior performance compared to established, yet design limited technologies.

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Tuesday, 10 October

08:00 -- 10:00

Room: Ballroom A

ATu1A • Nonlinear Compression

Presider: Arno Klenke; Helmholtzinstitut Jena, Germany

ATu1A.1 • 08:00 (Invited)

Multipass Cells for Few-Cycle Pulses, Christian Grebing¹; ¹*Inst. of Applied Physics, Germany.*

The efficient generation of high-power few-cycle pulses in two-stage noble gas-filled multipass cells is discussed. Compression results for various pulse energies achieved in the 1 μm wavelength range are reviewed.”

ATu1A.2 • 08:30 (Invited)

Advances in Bulk Multi-Pass Cell Spectral Broadening, Anne-Lise Viotti¹; ¹*Lund Univ., Sweden.* Recent studies of bulk multi-pass cells for pulse post-compression in supercritical peak power regimes are reviewed. A setup employing hybrid multi-pass multi-plates schemes to reach the sub-10 fs regime is also presented.

ATu1A.3 • 09:00 (Invited)

Nonlinear Temporal Cleaning of Ultrashort Laser Pulses in Multipass Cells, Jaismeen Kaur¹, Louis Daniault¹, Zhao Cheng¹, Oscar Tourneur¹, Olivier Tcherbakoff², Fabrice Réau², Jean-François Hergott², Rodrigo Lopez-Martens¹; ¹*Laboratoire d'Optique Appliquée (LOA), France;* ²*Univeristé Paris-Saclay, CEA, CNRS, LIDYL, France.* We explore the possibility of integrating third-order nonlinear optical filtering techniques in a multipass cell architecture in order to achieve simultaneous temporal compression and cleaning of ultrashort laser pulses.

ATu1A.4 • 09:30

Robust Post-Compression of Multi-mJ Pulses at 800 nm Central Wavelength With a Single Thin YAG Plate, Roland Nagymihály¹, Viktor Pajer¹, Levente Lehotai¹, János Bohus¹, Abdollah Malakzadeh¹, Mikhail Kalashnikov¹, Bálint Kiss¹, Adam Borzsonyi¹; ¹*ELI-ALPS, ELI-HU Non-Profit Ltd., Hungary.* 5 mJ, 25 fs laser pulses at 800 nm central wavelength were post-compressed, for the first time, in a single thin YAG plate to 8.3 fs with 3 mJ output energy with high beam quality.

ATu1A.5 • 09:45 (Student Paper Finalist)

High Quality Pulse Post-Compression in a Multi-Pass Cell Employing Enhanced Frequency Chirping, Maximilian Benner¹, Maximilian Karst^{1,2}, Philipp Gierschke^{1,3}, Henning Stark^{1,3}, Mahmoud Abdelaal¹, Jens Limpert^{1,3}; ¹*Friedrich Schiller Univ. Jena, Germany;* ²*Helmholtz-Inst. Jena, Germany;* ³*Fraunhofer IOF, Germany.* We demonstrate experimentally an increased peak power and significantly reduced pedestal pulses in a millijoule pulse energy multi-pass cell post-compression scheme employing the concept of enhanced frequency chirping.

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08:00 -- 10:00

Room: 407

LTu1B • EUV, X-Ray Generation & Particle Acceleration

Presider: Lahsen Assoufid; Argonne National Laboratory, USA

LTu1B.1 • 08:00 (Invited)

Multipass Cell Based Spectral Broadening of High Energy and High Average Power Thin-Disk Amplifiers, Sandro Klingebiel¹; ¹*TRUMPF Scientific Laser GmbH + Co KG, Germany*. We report nonlinear spectral broadening of 200 mJ from a Yb-doped thin-disk amplifier at 5 kHz repetition rate using a Herriott-type multipass cell and show its compressibility to below 50 fs.

LTu1B.2 • 08:30 (Invited)

High Repetition Rate & High Peak Power Lasers for Laser Plasma Accelerators and Their Applications, Oliver Chalus¹, Alain Pellegrina¹, Christophe Derycke¹, Antoine Jeandet¹, Loïc Lavenu¹, Christophe A. Simon-Boisson¹, Hervé Besaucèle¹; ¹*Thales LAS France, France*. Laser plasma accelerators have seen an incredible development over the 2 past decades, leading to production of high electron energy close to 10 GeV. Both performance and reliability can be further improved thanks to the latest generation multi-PW lasers like the 10 PW laser of ELI-NP having performed its first shots on target few months ago. Some data about users experiments with the 3 types of beams at ELI-NP (100 TW, 1 PW, 10 PW) are presented. In the same time, low repetition rate of these lasers prevents their use in many applications in industry and medicine where high accelerator currents are required for efficiency and speed of the process. This is why Thales and its academic partner in France LOA (Laboratoire d'Optique Appliquée) have decided to develop a new electron acceleration platform within the LAPLACE HC project, using a brand new high repetition rate TiSa laser system operating at a repetition rate of 100 Hz becoming therefore compatible with the requirements of most societal applications of electron acceleration. We present results obtained for a 200 mJ – 100 Hz TiSa laser system based on an high energy amplifier using a thick disk of TiSa crystal in active mirror configuration with backside cooling to improve the temperature gradient within the crystal. We present the latest results of an higher energy amplification stage. This amplifier, operating at room temperature, delivers more than 850 mJ per pulse at a repetition rate of 100 Hz.

LTu1B.3 • 09:00 (Invited)

Supercontinuum-Seeded 4-Micron KTA Optical Parametric Amplifier for Seeding a High Energy Fe:ZnSe Multipass Amplifier and Related Applications in Particle Physics, Tsuneto Kanai¹, Edgar Kaksis², Audrius Pugzlys², Andrius Baltuška², Daiki Okazaki¹, Ryo Yasuhara³, Shigeki Tokita¹; ¹*Kyoto Univ., Japan*; ²*Vienna Univ. of Technology, Austria*; ³*National Inst. for Fusion Science, Japan*. We developed a 4-micron KTA OPA for seeding a high energy 4-micron Fe:ZnSe multipass amplifier. Its unique design leads to prepulse-free and carrier-envelope phase stabilization features, which are ideal for attosecond and plasma physics.

LTu1B.4 • 09:30 (Invited)

Enhanced Ion Acceleration From Transparency-Driven Foils Demonstrated at Two Ultra-Intense Laser Facilities, Mamiko Nishiuchi¹; ¹*National Inst. Quantum & Rad Sc & Tech, Japan*. By careful matching of the laser temporal pulse shape at two independent PW-class laser systems, similar ion acceleration performance was achieved, showing the temporal pulse shape plays a vital role in an laser-driven ion acceleration.

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10:45 -- 12:45

Room: Ballroom A

ATu2A • Femtosecond Lasers and Pulse Compression

Presider: Arno Klenke; Helmholtzinstitut Jena, Germany

ATu2A.1 • 10:45 (Invited)

Nonlinear Pulse Compression at 2 μm , Jens Limpert¹; ¹*Friedrich-Schiller-Universität Jena, Germany*. We report on an intense few-cycle sources at 2 μm wavelength delivering >100W average power at >1mJ pulse energy. The results are enabled by post-compression of an ultrafast thulium-doped fiber laser in gas-filled capillary or multipass-cell.

ATu2A.2 • 11:15

Ultrafast Thulium-Based High-Power Lasers for Scientific and Industrial Applications, Christian Gaida¹, Frieder Jansen¹, Malte Kumkar², Christian Kern¹, Christian Grebing¹, Anke Heilmann¹, Oliver Herrfurth¹, Sven Breitkopf¹, Tino Eidam¹, Jens Limpert¹; ¹*Active Fiber Systems GmbH, Germany*; ²*TRUMPF Laser GmbH, Germany*. We report on our progress in developing a compact laser that uses thulium-based fiber CPA technology emitting >30W at 2 μm and a >100W ultrafast laser for scientific applications based on coherent combination.

ATu2A.3 • 11:30

High-Precision Measurement of the Period Chirp of Pulse Compression Gratings, Florian Bienert¹, Thomas Graf¹, Marwan Abdou Ahmed¹; ¹*IFSW - Universität Stuttgart, Germany*. We present the development of a setup dedicated to the measurement of the period chirp of optical gratings and the exemplary characterization of two pulse compression gratings fabricated with LIL and SBIL.

ATu2A.4 • 11:45

Low Repetition Rate Dispersion-Managed Mamyshev Oscillator, Michel Olivier^{1,2}, Vincent Boulanger¹, Alexandre Chevrette¹, François Trépanier³, Michel Piché¹; ¹*Centre d'optique, photonique et laser, Université Laval, Canada*; ²*Département de physique, Cégep Garneau, Canada*; ³*TeraXion Inc., Canada*. We present an all-PM-fiber Yb-doped Mamyshev oscillator with a linear cavity bounded by chirped fiber Bragg gratings. It emits 25 nJ pulses at 1 MHz, the lowest repetition rate achieved by Mamyshev oscillators to our knowledge.

ATu2A.5 • 12:00

Microchip Laser Started, 1-MW Peak Power Mamyshev Oscillator at 1 μm , Riccardo Gotti¹, Luca Carrà², Sara Pizzurro¹, Giuliano Piccinno², Antonio Agnesi¹, Federico Pirzio¹; ¹*Department of Electrical, Computer and Biomedical Engineering, Università degli Studi di Pavia, Italy*; ²*Bright Solutions srl, Italy*. A hybrid single/double-clad Mamyshev ring-oscillator was reliably started by a 1064-nm PQS microchip laser. At 5-W pump-power we obtained 12-MHz repetition rate, ~115-nJ mode-locked pulses with >65-nm FWHM spectrum and 50-fs duration after compression.

ATu2A.6 • 12:15

Versatile Ultrashort Pulse Laser Tunable up to Nanosecond Range, Tadas Bartulevicius¹, Mykolas Lipnickas¹, Karolis Madeikis¹, Raimundas Burokas^{1,2}, Deividas Andriukaitis¹, Andrejus Michailovas^{1,2}; ¹*EKSPLA, Lithuania*; ²*Center for Physical Sciences and Technology, Lithuania*. A versatile industrial-grade 30 W-level average power femtosecond laser operating in single-

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pulse, GHz-burst (short-, long-bursts, GHz-bursts-in-MHz-bursts) regimes, with the ability to tune pulse duration from femtosecond up to nanosecond range is introduced in this work.

ATu2A.7 • 12:30 (Student Paper Finalist)

Characterizing Carrier Envelope Frequency Correlation From a Polarization Multiplexed Free Running Single-Cavity Dual-Comb Laser, Alexander Nussbaum-Lapping¹, José Gómez Torres¹, Christopher R. Phillips¹, Ursula Keller¹; ¹*ETH Zurich, Switzerland*. Using a single f-2f interferometer, we measure the correlation between the carrier-envelope offset frequencies of the two combs generated in a polarization-multiplexed dual-comb laser. Noise is suppressed by 20 dB via the shared cavity architecture

10:45 -- 12:45

Room: 407

LTu2B • Laser-based Additive Manufacturing

Presider: Johannes Trbola; Trbola Engineering, Germany

LTu2B.1 • 10:45 (Invited)

Additive Manufacturing of Thermoplastic Structures by Directed Energy Deposition With a Thulium-Doped Fiber Laser, Alexander Wittmann¹; ¹*Univ. of Erlangen-Nuremberg, Germany*. The presented absorber-free Directed Energy Deposition process with a thulium-doped fiber laser offers the possibility to build thermoplastic 3D structures. The functional properties of the produced structures demonstrate the potential for various industrial applications.

LTu2B.2 • 11:15 (Invited)

Next Level Characterization of Scanning Laser Beams – How Precise in-Line Knowledge of the Laser Scan Field Pushes Quality in Powder Bed Fusion, Andreas Rudolf¹; ¹*PRIMES GmbH, Germany*. In L-PBF, proper scan field calibration is key to printing high-quality parts. Still, calibration is usually performed offline at irregular intervals. We present technology for an in-line method, pushing quality assurance to a new level.

LTu2B.3 • 11:45 (Invited)

Towards a More Efficient Single Laser SLM Machine – Leveraging in Process Monitoring and High Throughput Inspection, Fred Carter¹; ¹*DMG MORI Advanced Solutions, USA*. A new approach leveraging a programmable laser technology for PBF-LB enabling a hybrid toolpath workflow using different laser profiles within a single optical processing head. Based on In-situ Monitoring and XCT results show significant changes in melt pool dynamics, enlarged processing domain, and improved processing time while maintaining near identical part properties.

LTu2B.4 • 12:15 (Invited)

Online Data Analytics in Additive Manufacturing - a Structured Approach, Maximilian Backenstoss¹; ¹*DatenBerg GmbH, Germany*. Unpacking the Serialization Challenge in Laser-Based Additive Manufacturing: Explore how data analytics methods, including statistical modeling and machine learning, are being used to achieve better traceability and consistency in manufacturing processes.

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14:00 -- 15:00

Room: Ballroom A

JTu3A • Joint Plenary Session II

JTu3A.1 (Plenary)

Development and Application of a 100 Watt Average Power SBS Phase-Conjugated

Nd:glass Laser System, Lloyd Hackel¹, ¹*Curtiss-Wright Corporation, USA*. A Nd:glass laser producing 20 J/pulse at selectable 10 ns to 30 ns pulse duration and 5 Hz repetition rate was developed and used in applications from coherent satellite illumination to very successful laser peening.

15:30 -- 17:30

Room: Ballroom A

ATu4A • Modelocked Oscillators

Presider: Tino Eidam; Active Fiber Systems GmbH, Germany

ATu4A.1 • 15:30 (Invited)

Dual-Comb Optically Pumped Semiconductor Thin Disk Lasers at a Center Wavelength of 2 μm , Ursula Keller¹; ¹*ETH Zurich, Switzerland*. In this invited talk we present several milestone results that highlight the abilities of our dual-comb MIXSEL technology in the long-wavelength regime.

ATu4A.2 • 16:00

Kerr-Lens Mode-Locked Tm³⁺-Doped Mixed Sesquioxide Single Crystal Laser at 2.1 μm , Anna Suzuki^{1,2}, Sascha Kalusniak³, Steffen Ganschow³, Christian Kraenkel³, Masaki Tokurakawa^{1,2}; ¹*ILS, UEC, Japan*; ²*CNBE, UEC, Japan*; ³*IKZ, Germany*. We report on a Kerr-lens mode-locked Tm³⁺:YScO₃ mixed sesquioxide crystal laser. Pulses as short as 49 fs corresponding to 7 optical cycles were achieved with an average output power of 126 mW at 2128 nm.

ATu4A.3 • 16:15

SESAM Mode-Locked Femtosecond Yb:YLF Laser at GHz Repetition Rate, Serdar Okuyucu^{1,2}, Umit Demirbas^{1,2}, Jelto Thesinga¹, Marvin Edelman^{1,3}, Mikhail Pergament¹, Franz Kaertner^{1,3}; ¹*German Electron Synchrotron (DESY), Turkey*; ²*Department of Electrical and Electronics Engineering, Antalya Bilim Univ., Turkey*; ³*Physics Department, Univ. of Hamburg, Germany*. We report 210 fs pulses at 1.1 GHz with 40 mW average power from a self-starting, diode-pumped Yb:YLF laser. The spectrum is 5.6 nm wide at 1050 nm and integrated relative intensity noise <0.45%.

ATu4A.4 • 16:30

Diode-Pumped Femtosecond Ti:Sapphire Laser Operating Beyond 900 nm, Alexander A. Lagatsky¹; ¹*Fraunhofer UK Research Ltd., UK*. A diode-pumped femtosecond Ti:sapphire laser operating beyond 900 nm is reported. 85fs-pulses with an average power of 95 mW are produced at 930 nm. Wavelength tunability in the 920-950 nm range is demonstrated.

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ATu4A.5 • 16:45

Broad CW Tuning (996-1073 nm) and Multi-Watt SESAM Mode-Locking in Diode-Pumped Yb:LLF Laser, Serdar Okuyucu^{1,2}, Umit Demirbas^{1,2}, Jelto Thesinga¹, Mikhail Pergament¹, Franz Kaertner^{1,3}; ¹*German Electron Synchrotron (DESY), Turkey*; ²*Department of Electrical and Electronics Engineering, Antalya Bilim Univ., Germany*; ³*Physics Department, Univ. of Hamburg, Germany*. We report record CW tuning range (996-1073 nm) and 181 fs (110 fs) pulses with highest average power 1.6-2.8 W (352-570 mW) and pulse energies 6.2-10.9 nJ (1.6-2.6 nJ) from SESAM mode-locked diode-pumped Yb:LLF laser.

ATu4A.6 • 17:00 (Student Paper Finalist)

Modelocked Solid-State Yb:YAG Laser Oscillator With Gigahertz Repetition Rate at 2-W Average Output Power, Moritz Seidel¹, Jérémie Pilat¹, Lukas Lang¹, Christopher R. Phillips¹, Ursula Keller¹; ¹*ETH Zurich, Switzerland*. We present a modelocked Yb:YAG laser oscillator providing 760 fs pulses at 1.09 GHz repetition rate delivering 2 W of average power. This constitutes the first gigahertz repetition-rate solid-state laser at 1030 nm.

ATu4A.7 • 17:15 (Student Paper Finalist)

Modelocked Thin-Disk Laser Oscillator Providing More Than 400 W Average Output Power With a Replicating Cavity Design, Moritz Seidel¹, Lukas Lang¹, Christopher R. Phillips¹, Ursula Keller¹; ¹*ETH Zurich, Switzerland*. We demonstrate an ultrafast thin-disk laser oscillator providing 410 W average power with a pulse duration of 751 fs at a repetition rate of 7.77 MHz. This is enabled by a replicating cavity scheme and sapphire SESAMs.

15:30 -- 17:30

Room: 407

LTu4B • Lasers for Mobility and Space

Presider: Gerald Uyeno; Raytheon Technologies, USA

LTu4B.1 • 15:30 (Invited)

New Class of GaN-Based Laser Technology for Mobility Applications, Changmin Lee¹; ¹*KYOCERA SLD Laser, USA*. We present advances in InGaN-based laser diodes, photodiodes, and systems leveraging these devices. This new GaN technologies can enable a wide variety of new mobility applications in illumination, sensing and communication.

LTu4B.2 • 16:00 (Invited)

Laser Component Requirements for Enabling Consumer Grade Automotive LIDAR, Lawrence Shah¹; ¹*Luminar Technologies, USA*. Automotive applications present unique challenges for photonics components. As part of common challenges to minimize cost, reduce size/weight, and deliver long term reliability; automotive lidar requires photonic components to operate robustly and with minimal performance variation over wide temperature ranges. It is particularly challenging to minimize the impact of temperature induced variations in device efficiency. While thermal management can prevent temperature variation, that rapidly increases power consumption, size, and cost. In this presentation, we describe several photonic components and modules developed by Luminar Technologies for automotive lidar and discuss challenges.

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17:30 -- 19:00

Room: Science and Industry Showcase

JTu5A • Joint Student Paper Poster Session II and Reception

JTu5A.1

Modeling of a Mid-Infrared CW Raman Laser in InF₃-Based Optical Fibers, Alexandre Michaud¹, Vincent Fortin¹, Pascal Paradis¹, Réal Vallée¹, Martin Bernier¹; ¹*Université Laval, Canada*. We report on the modeling of a CW Raman laser operating at 3300 nm with a low loss InF₃ fiber. With performant FBGs and a 2825 nm fiber laser as pump, multi-watt-level emission is expected.

JTu5A.2

Phase Noise in DFB Lasers for Different Optical Injection Locking Regimes, Arbnor Berisha^{2,1}, Patrick Runge¹, Martin Schell^{1,2}; ¹*Fraunhofer Heinrich Hertz Inst., Germany*; ²*Inst. for solid state physics, Technische Universität Berlin, Germany*. We investigate the locking behavior of a DFB laser as a function of master laser wavelength and intensity. We find significantly more phase noise reduction when injecting with a negative frequency offset. This can be replicated in numerical modelling and explained by the bogatov effect.

JTu5A.3 (Student Paper Finalist)

Enhancing Optimal Performance of Bonded Composite Material for J-Class Laser System, Arvydas Kausas^{2,1}, Vincent Yahia^{1,2}, Akihiro Tsuji^{2,1}, Takunori Taira^{2,1}; ¹*Inst. for Molecular Science, Japan*; ²*Laser-Driven Electron-Acceleration Technology Group, SPring-8 Center, RIKEN, Japan*. This study focuses on optimizing bonding strength through temperature annealing and material evaluation for composite chips in J-class laser systems. Valuable insights are provided for maximizing efficiency and performance. 2.7 J output was achieved for two stage amplifier system.

JTu5A.4 (Student Paper Finalist)

Experimental Optimization of Orbital Angular Momentum Beams Generated by Coherent Beam Combining Digital Laser, Claude-Alban Ranely-Vergé-Dépré^{1,2}, Rezki Becheker¹, Ihsan Fsaifes¹, Miloš Burger³, Igor Jovanovic³; ¹*LULI, CNRS, École Polytechnique, CEA, Sorbonne Université, Institut Polytechnique de Paris, France*; ²*Thalès LAS, France*; ³*Gérard Mourou Center for Ultrafast Optical Science, Univ. of Michigan, USA*. We experimentally implemented a genetic algorithm to improve the uniformity of a Laguerre-Gaussian beam generated with a 61-channels coherent beam combining digital laser.

JTu5A.5 (Student Paper Finalist)

A 607-mW, Dy³⁺-Doped ZBLAN Fiber Laser, Core-Pumped at 1100 nm, Junha Jung¹, Kyungtaek Lee¹, Jeehwan Kim¹, Ju Han Lee¹; ¹*Univ. of Seoul, Korea (the Republic of)*. An efficient Dy³⁺-doped ZBLAN fiber laser core-pumped at 1100 nm is experimentally demonstrated with AlF₃ no-core fiber end-caps for better heat conduction. The maximum output power and slope efficiency were 607 mW and 25%, respectively.

JTu5A.6

Increasing the Stimulated Brillouin Scattering Threshold in Single-Mode Passive Fiber With a Frequency Comb, Louise Esberard¹, Laurent Lombard¹, Jean-Philippe Ovarlez¹; ¹*Onera, France*. We generate a frequency comb by modulating a 1545 nm laser phase with an

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electro-optical modulator and measure the SBS threshold enhancement factor in a single-mode passive fiber as a function of the comb shape.

JTu5A.7 Student Paper Finalist)

Sub 130-fs mJ-Level Yb:CALGO Diode Pumped Regenerative Amplifier, Lyuben Petrov¹, Dimitar Velkov¹, Kaloyan Georgiev¹, Anton Trifonov², Xiaodong Xu³, Ivan Buchvarov^{1,4}; ¹*Sofia Univ. St. Kliment Ohridski, Bulgaria*; ²*IBPhotonics Ltd., Bulgaria*; ³*Jiangsu Normal Univ., China*; ⁴*John Atanasoff Center for Bio and Nano Photonics (JAC BNP), Bulgaria*. We report a 1 kHz, Yb-based regenerative amplifier providing 126 fs output pulses with 1.76 mJ of energy at 1038 nm, developed using a single disordered Yb:crystal-Yb:CaGdAlO₄ (Yb:CALGO).

JTu5A.8

Experimental Demonstration of a Cesium Vapor Fiber Ring Cavity, Seokjin Kim¹, Mingyu Lee¹, SungHoon Jeong¹, Kyunghwan Oh¹; ¹*Yonsei Univ., Korea (the Republic of)*. We experimentally demonstrated a cesium fiber ring cavity. The maximum 37.5 mW was achieved with 22% of slope efficiency, and 25 mW of threshold power in the pump power range of 51 to 196 mW.

JTu5A.9

a Bulk-Structured, GeS Saturable Absorber for a 1550-nm Femtosecond Fiber Laser, Suh-young Kwon¹, Jeehwan Kim¹, Ju Han Lee¹; ¹*School of Electrical and Computer engineering, Univ. of Seoul, Korea (the Republic of)*. We experimentally demonstrate a femtosecond mode-locked fiber laser incorporating a fiberized saturable absorber based on mechanically-exfoliated, bulk-structured GeS particles. Stable optical pulses with a temporal width of ~796 fs were readily produced at ~1556 nm.

JTu5A.10

Nanosecond Mode-Locked Laser Using an Artificial Saturable Absorber, Varsha Varsha¹, Gautam Das¹; ¹*Lakehead Univ., Canada*. Authors proposed and demonstrated a nanosecond mode-locked fiber laser using an artificial saturable absorber in the laser cavity. Mode-locked pulses were produced by adjusting the cavity loss.

JTu5A.11 (Student Paper Finalist)

Modeling of High-Power Er-Doped Fluoride Fiber Lasers Using a New Energy Transfer Rate Equation, William Bisson¹, Alexandre Michaud¹, Pascal Paradis¹, Réal Vallée¹, Martin Bernier¹; ¹*Université Laval, Canada*. Modeling of high power Er-doped fluoride fiber lasers operating around 2.8 microns has been an unsolved challenge for many years, so we propose a new theoretical energy transfer equation to accurately simulate five lasers.

JTu5A.12

Quantum-Dash Mode-Locked Laser Behavior Under External Optical Feedback Strength, Youcef Driouche¹, Kamel Merghem¹, Badr-Eddine Benkelfat¹; ¹*Electronique et Physique, Télécom SudParis, France*. We experimentally identified different optical coherent feedback sub-regimes of a quantum-dash mode-locked laser as a function of the feedback strength. The results render the laser a versatile source.

JTu5A.13

Broadband all-Fiber Bessel-Like Beam Generator and its Application for Optical Trapping of Plasmonic Materials, Mingyu Lee¹, Hyeonwoo Lee¹, Kyunghwan Oh¹; ¹*Yonsei Univ., Korea (the Republic of)*. This paper introduces a broadband all-fiber Bessel beam generator (BBG).

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Additionally, we discuss the potential applications of the BBG in optical trapping, with a focus on plasmonic materials, and outline plans for future experiments.

JTu5A.14

NIR-VSHG: a new Nonlinear Vibrational Spectroscopy of Interfaces, Somaiyeh Dadashi¹, Hao Li¹, Bijoya Mandal¹, Eric Borguet¹; ¹*Temple Univ., USA*. NIR-vSHG a new nonlinear vibrational spectroscopy technique used to investigate the overtones of free OH of mica at air and CH stretch mode of chloroform and acetonitrile at Al₂O₃ (0001) surface as a benchmark system.

JTu5A.15

Monolithic Beam Combined Quantum Cascade Laser Arrays With Integrated Arrayed Waveguide Gratings, Tushar Sanjay Karnik¹, Laurent Diehl², Khoi Phuong Dao¹, Qingyang Du¹, Christian Pfluegl², Daryoosh Vakhshoori², Juejun Hu¹; ¹*Massachusetts Inst. of Technology, USA*; ²*Pendar Technologies, USA*. We demonstrate, for the first time, an on-chip closed-loop wavelength beam combining of quantum cascade laser arrays using a monolithic structure. The technology can be used to manufacture at low-cost, compact, high-power and/or broadband mid-infrared sources.

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Wednesday, 11 October

08:00 -- 10:00

Room: Ballroom A

W1A • Laser Materials and Spectroscopy

Presider: Christian Kraenkel; Leibniz-Institut für Kristallzüchtung, Germany

AW1A.1 • 08:00 (Invited)

Optical Floating Zone Growth of Highly Melting Oxide Crystals, Huaijin Zhang¹; ¹*Shandong Univ., China*. Several high-quality oxide laser crystals are successfully grown via the high-temperature optical floating zone method. The physical properties and fascinating lasing performance of these crystals indicate their application potential in the development of solid-state lasers.

AW1A.2 • 08:30

Additively Manufactured Laser Gain Media for Novel Solid-State Laser Designs, Stephen A. Payne¹, Nerine J. Cherepy¹, Ross A. Osborne¹, Thomas J. Rudzik¹, Alexander D. Drobshoff¹, Zachary M. Seeley¹, Timothy D. Yee¹, Tyler J. Wineger¹, Mark A. Dubinskii², Yimin Wang³, Michael R. Squillante³; ¹*Lawrence Livermore National Laboratory, USA*; ²*Army Research Laboratory, USA*; ³*Radiation Monitoring Devices, USA*. We describe our progress in developing additively manufactured transparent optical ceramic gain media, including gradient-doped parts, thin disk gain elements, variously cladded slabs and rods, as well as planar and channel waveguides.

AW1A.3 • 08:45

Ytterbium-Fiber Laser Pumped Yb,Tm:LiYF₄ Lasers at 1.5 μ m and 2.3 μ m, Ahmed Nady¹, Pavel Loiko¹, Alain Braud¹, Ammar Hideur², Patrice Camy¹; ¹*CIMAP, UMR6252 CNRS, Université de Caen Normandie, France*; ²*CORIA, UMR6614 CNRS, Université de Rouen Normandie, France*. Yb,Tm:LiYF₄ laser pumped by a 976-nm ytterbium-fiber laser generated 0.70 W at 2.3 μ m with 26.7% slope efficiency, 46 mW laser threshold and linear polarization. Polarization switching in the 1.5- μ m laser is also reported.

AW1A.4 • 09:00

Growth, Spectroscopy and Laser Operation of Disordered Tm,Ho:NaGd(MoO₄)₂ Crystal, Xavier Mateos¹, Ghassen Z. ZinElabedine¹, Zhongben Pan², Pavel Loiko³, Hongwei Chu², Dechun Li², Ahmed Nady³, Kirill Subbotin⁴, Sergei Pavlov⁴, Patrice Camy³, Alain Braud³, Sami Slimi¹, Rosa M. Solé¹, Magdalena Aguilo¹, Francesc Díaz¹, Weidong Chen^{5,6}, Valentin Petrov⁶; ¹*Universitat Rovira i Virgili, Spain*; ²*Shandong Univ., China*; ³*Université de Caen Normandie, France*; ⁴*Prokhorov General Physics Inst., Russian Federation*; ⁵*Fujian Inst. of Research on the Structure of Matter, China*; ⁶*Max Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany*. We report on the first laser operation of the disordered Tm³⁺,Ho³⁺-codoped NaGd(MoO₄)₂ tetragonal double molybdate crystal delivering 549 mW at 2.05 μ m with a slope efficiency of 32.4% and a laser threshold of 119 mW.

AW1A.5 • 09:15

Monoclinic Tm³⁺:ZnWO₄: Novel 2- μ m Laser Crystal, Xavier Mateos¹, Ghassen Z. ZinElabedine¹, Kirill Subbotin², Pavel Loiko³, Zhongben Pan⁴, Yulia Zimina², Kristina Kuleshova², Anatoly Titov², Ahmed Nady³, Patrice Camy³, Alain Braud³, Rosa M. Solé¹, Magdalena Aguilo¹, Francesc Díaz¹, Weidong Chen^{5,6}, Valentin Petrov⁶; ¹*Universitat Rovira i*

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Virgili, Spain; ²*Prokhorov General Physics Inst., Russian Federation;* ³*Université de Caen Normandie, France;* ⁴*Shandong Univ., China;* ⁵*Fujian Inst. of Research on the Structure of Matter, China;* ⁶*Max Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany.* We report on the Czochralski growth, polarized spectroscopy and first laser operation of Tm³⁺ in Na⁺(Li⁺) codoped monoclinic zinc monotonungstate crystals, ZnWO₄, featuring strongly polarized, smooth and broad emission spectra extending beyond 2 μm.

AW1A.6 • 09:30

Wavelength and Polarisation Dependence of Dynamic Pump-Induced Loss in Titanium:Sapphire, Niall D. Simpson¹, Martin Lee¹, Alan Kemp¹; ¹*Univ. of Strathclyde, UK.* We use the wavelength and polarisation-dependent power response of Ti:Sapphire resonators to demonstrate that the phenomenon of pump-induced loss in Ti:Sapphire is the product of two separate electronic excitations that interact.

AW1A.7 • 09:45

Novel Approach to Deriving the Efficiency of Self-Terminating Four-Level Q-Switched Laser, Larry Merkle¹, Ei Ei E. Brown¹, Zackery Fleischman¹, Jason McKay¹, Mark A. Dubinskii¹; ¹*DEVCOM Army Research Laboratory, USA.* We have developed a simple approach to deriving the efficiency of Q-switched four-level lasers, valid for long lower laser level lifetimes. Its threshold and limiting slope efficiency provide useful estimates for free-running four-level lasers as well.

08:00 -- 10:00

Room: 407

LW1B • Brittle Materials Processing (Presentations and Panel Discussion)

Presider: Qiongying Hu; Coherent Corp., USA

LW1B.1 • 08:00 (Invited)

Best Optic and Process for Glass Cutting by Filamentation With Ultra-Short Pulse Laser, Tony Lee¹; ¹*Coherent Corp., USA.* Using ultra-short pulse (USP) lasers for cutting transparent brittle materials by laser filamentation is increasing in the high tech consumer and commercial markets, most notably for semiconductor substrates and glass displays. As a substrate material, glass offers superior optical quality, mechanical resistance, chemical consistency, and temperature stability. Compared with longer pulsed lasers such as nanosecond laser, ultra-short pulse (picosecond, femtosecond) lasers offer higher cut quality, measured by edge strength, chip-out size, micro-cracks, heat affect zone (HAZ), and cut surface roughness. Laser ablation and laser filamentation can both be used to cut glass. However, laser filamentation offers additional advantages of speed, zero taper, and zero-kerf cutting. We investigate the dependence of pulse energy, pulse width, and focusing optic, on filamentation cutting of transparent brittle materials, using IR USP laser. Of particular interest is determining which laser process parameters and focusing optic provide the best performance in terms of cut thickness, cut quality, singulation, and bend strength.

LW1B.2 • 08:30 (Invited)

Industrial Applications of Ultrafast Laser Processing for Transparent Materials: Welding, Cutting, and Polishing, Craig Ungaro¹; ¹*Corning Inc., USA.* We discuss laser processes such as the welding, cutting, polishing, and micromachining of glass substrates and explore novel

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light-matter interactions and their applications in areas such as co-packaged optics, semicon fab, and telecommunications.

LW1B.3 • 09:00 (Invited)

Surface Form and Irregularity of Tungsten Carbide Using Laser Assisted Diamond Turning, Jonathan Ellis¹; ¹*Micro LAM Technologies Inc., USA*. Binderless tungsten carbide is a material widely used for optical modeling application. Conventional diamond turning of tungsten carbide results in rapid and catastrophic tool wear. However, with laser-assisted diamond turning, where a high intensity laser is passed through the diamond tool to the cutting edge, tungsten carbide can be directly diamond turned, improving the manufacturing efficiency of optical molds. This paper details the surface irregularity achievable with this process.

10:00 -- 11:00

Room: Science and Industry Showcase
JW2A • Joint Poster Session III (Virtual Only)

JW2A.1

Enhanced Nonlinear Saturable Absorption of Fe₂O₃/PANI Nanocomposite Films., Arjun K¹, Karthikeyan Balasubramanian¹; ¹*NIT Trichy, India*. Compared to pure Fe₂O₃ and PANI films, prepared Fe₂O₃/PANI nanocomposite films on glass substrates showed enhanced saturable absorption, which is investigated using the open-aperture Z-scan technique with a nanosecond laser at 532 nm.

JW2A.2

Fluorescence and Optical Properties of Er and Ce Doped Fluorapatite (FAP) Transparent Ceramics, Abu Yousuf¹, Yuki Mochizuki¹, Shigeto Hirai¹, Tomoya Ohno¹, Koji Morita², Byung-Nam Kim², Tohru Suzuki², Hiroaki Furuse²; ¹*Kitami Inst. of Technology, Japan*; ²*National Inst. for Materials Science, Japan*. Er³⁺ and Ce³⁺ doped hexagonal fluorapatite transparent ceramics were fabricated and their optical and fluorescence properties were studied. In addition, their potential application as laser materials and visible lighting are discussed.

JW2A.3

Tuning Emissions of Optical Fiber Laser by a Mach-Zehnder Interferometer Based on Super-Mode Interference in a Seven-Core Fiber, Ramon Genaro vallejo-Carrillo¹, Mauricio Torres-Torres¹, Jose Enrique Antonio-Lopez², Rodrigo Amezcua-Correa², Guillermo Salceda-Delgado¹; ¹*Universidad Autónoma de Nuevo León, Mexico*; ²*CREOL, Univ. of Central Florida, USA*. Tuning the emission of optical fiber laser based on super-mode interference is presented. A Mach-Zehnder interferometer constructed with a piece of seven-core fiber spliced between two single-mode fibers is used as a tuning element.

JW2A.4

Effects of Chalcogenides Atoms in Up-Conversion Photoluminescence, Ankit Sharma¹, C S Rout², K. V. V. Adarsh¹; ¹*IISER Bhopal, India*; ²*Jain Univ., India*. Here, we demonstrated the effect of chalcogenides (O to Te) in up-conversion photoluminescence at nonlinear optical regime. We observed visible light emission at infrared excitation (1.26 eV) which is very far from bandgap (~1.65-1.70 eV).

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JW2A.5

Ultrafast Ionization of Transparent Materials Under Femtosecond Laser Irradiation, Zeyneb Bedrane¹; ¹*Physics Dpt., Sciences Faculty, Tlemcen, Algeria.* Electron plasma excited by direct femtosecond laser irradiation in diamond material has been investigated using Keldysh theory. The result shows that controlling the impact ionization process is a key factor to improve laser-induced nano-micromachining.

JW2A.6

Effect of Process Parameters on Ni-Based WC Powder-fed Direct Laser Deposition, Samar R. ALSayed Ali¹, Salah Hassab-Elnaby¹, Doaa Youssef¹; ¹*Laser Inst. (NILES) Cairo Univ., Egypt.* This study offers a numerical algorithm to predict the heat distribution during multitrack direct laser deposition of Ni-based WC powder on titanium alloy considering the phase transitions that occur as the materials melt and resolidify.

JW2A.7

Femtosecond Laser Ablation Assisted Single-Step Fabrication of Metal-Semiconductor Interfaced SERS-Active Substrate, M.S.S Bharathi¹, Dipanjan Banerjee¹, Venugopal Rao Soma^{*1}; ¹*Univ. of Hyderabad, India.* A hybrid metal-semiconductor SERS substrate was fabricated in a single step by femtosecond laser ablation in liquid. Ag-TiO₂ nanostructure was employed in the SERS studies, revealing a 16 times superior signal than pure TiO₂ nanostructures.

JW2A.8

Melting Area Probing in a Metal Film on a Transparent Substrate Using an Ultrashort Laser Pulse, S.I. Ashitkov¹, Pavel S. Komarov¹, Evgeniya V. Struleva¹; ¹*Joint Inst. for High Temperatures of RAS, Russian Federation.* Spectral interferometry is used to study picosecond acoustic pulse propagation in metal films heated by femtosecond laser pulses. The melting depth was estimated from a spall pulse arrival, formed due to cavitation in melt during stress relaxation.

JW2A.9

Selective Modification of a Cu/Co Multilayer Structure, Sergey Romashevskiy¹, Andrey Burmistrov¹, Petr Tsygankov²; ¹*Joint Inst. for High Temperatures, Russian Federation;* ²*Universidad Industrial de Santander, Colombia.* The possibility of selective removal of the topmost metal nanolayer in a Cu/Co multilayer thin-film structure with a single femtosecond laser pulse in air is investigated. The formation of metal nanofoam and partial nanolayer removal are observed.

JW2A.10

Iron Doped ZnSe Embedded Tellurite Glasses for Mid-Infrared Emission, Sushil Kanel¹, Hyunjun Kim¹, Jonathan Goldstein², Thomas Harris³, Robert Wheeler⁶, Tom Ridge², Griffin Roberts⁴, John Boeckl⁵, Steven Fairchild⁵; ¹*UES InC/AFRL-RXAP, USA;* ²*RXEP, Air Force Research Laboratory, USA;* ³*Azimuth Corporation, USA;* ⁴*Univ. of Dayton Research Inst., USA;* ⁵*Air Force Research Laboratory, USA;* ⁶*UES, Inc., USA.* We demonstrate the successful incorporation of micron-sized, iron-doped chalcogenide (Fe:ZnSe) in laboratory-synthesized tellurite glass, which emits photoluminescence (PL) in the MIR region (3600 to 4200 nm) at different temperatures.

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JW2A.11

Broadband Frequency Down-Conversion Characteristics of Monoclinic BaGa₄Se₇, Kentaro Miyata¹, Kiyoshi Kato^{2,3}, Valentin Petrov⁴; ¹*RIKEN, Japan*; ²*Chitose Inst. of Science and Technology, Japan*; ³*Okamoto Optics, Inc., Japan*; ⁴*Max Born Inst., Germany*. Broadband mid-infrared frequency down-conversion based on the monoclinic BaGa₄Se₇ is proposed along with the updated index dispersion formulas derived using the temperature-dependent phase-matching conditions measured along the z-axis in the 8–14 μm spectral range.

JW2A.12

Laser-Induced Damage Threshold of Single Crystal ZnGeP₂: Effect of Crystal Lattice Quality and Surface Roughness, Nikolay N. Yudin¹, Victor Dyomin¹, Michael Zinovev¹, Alexander Gribenyukov¹, Oleg Antipov³, Andrey Khudoley², Igor Polovtsev¹, Sergei Podzyvalov¹; ¹*Tomsk State Univ., Russian Federation*; ²*A.V. Luikov Heat and Mass Transfer Inst. NASB, Belarus*; ³*Inst. of Applied Physics RAS, Russian Federation*. We report on studies of the influence of the crystal lattice parameters of a ZGP crystal and the parameters of its surface on the laser-induced breakdown threshold

JW2A.13

Electronically Tuned, Self-Difference Frequency Generation in the 7.6-16 μm Spectral Range, Masaki Yumoto^{1,2}, Kentaro Miyata¹, Yasushi Kawata¹, Satoshi Wada¹; ¹*RIKEN, Japan*; ²*AIST, Japan*. We demonstrated electronic wavelength tuning in the 7.6–16 μm range using self-difference frequency generation based on random quasi-phase matching in an electronically tuned Cr:ZnSe laser and evaluated its usefulness by the trace N₂O detection.

JW2A.14

Single-Mode Distributed-Feedback Lasing Mechanism Based on a Uniform Grating and Auxiliary Si Waveguide, Drew N. Maywar¹; ¹*Rochester Inst. of Technology, USA*. We present a mechanism for achieving single-mode distributed-feedback lasing using a passive waveguide to break the mode degeneracy arising from a uniform grating. Modeled performance surpasses that of the λ/4-shifted DFB laser.

JW2A.15

Role of PEDOT:PSS on Laser-Induced Fluorescence Enhancement for Detection and Classification of Explosives in Water Medium, Janapati Yellaiah¹, A.V. Kidav¹, Prof. A. Chaudary¹; ¹*Univ. of Hyderabad, India*. We demonstrate the 532 nm laser-induced fluorescence (LIF) as a promising technique for detection and classification of explosives. Enhanced LIF spectra mixed with PEDOT:PSS unveiled distinct wavelengths, enabling effective identification of explosive in aqua solution.

11:00 -- 13:00

Room: Ballroom A

AW3A • Novel Concepts and Approaches

Presider: Robert T. Murray; Imperial College London, UK

AW3A.1 • 11:00

Radiation-Balanced Yb:YAG and Yb:KYW Lasers, Long Cheng¹, Laura Andre¹, Daniel Rytz², Stephen Rand¹; ¹*Univ. of Michigan, USA*; ²*FEE GmbH, Germany*. Radiation-balanced lasing and thermal profiling are reported in two Yb-doped laser crystals. In 3% Yb:YAG a record efficiency

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of 30.5% was achieved and radiation-balanced lasing was first demonstrated in impure tungstate crystal 2% Yb:KYW.

AW3A.2 • 11:15

Sub-kHz Free-Running Linewidth Monolithic VECSEL, Paulo Hisao Moriya¹, Martin Lee¹, Jennifer E. Hastie¹; ¹*Inst. of Photonics, Department of Physics, SUPA, Univ. of Strathclyde, UK*. We report the development of a monolithic-cavity GaInP/AlGaInP-based VECSEL at 689 nm with sub-kHz free-running linewidth. A locked Allan deviation of 4×10^{-13} at 1s averaging time is observed, suitable for quantum technology and metrology applications.

AW3A.3 • 11:30

0.3 PW/(sr cm²) Brightness, Passively Cooled Microchip Laser, Hwanhong Lim¹, Takunori Taira^{2,1}; ¹*Inst. for Molecular Science, Japan*; ²*RIKEN SPring-8 Center, Japan*. A passively cooled Nd:YAG/Cr⁴⁺:YAG unstable resonator microchip laser achieves a record-breaking brightness of 300 TW/(sr cm²) with 26.4 MW peak-power, 10.5 mJ energy, 398 ps pulse duration, and M^2 of 2.7 at 10 Hz repetition rate.

AW3A.4 • 11:45

Thin-Disk Multipass Amplifier Delivering Picosecond Pulses With kW Average Power and Highly-Flexible Intra-Burst Repetition: From MHz to Multi-GHz, André Loescher¹, Florian Bienert¹, Lilia Pontagnier², Eric Cormier², Giorgio Santarelli², Annalisa Guandalini³, Matthias Kemnitzer³, Jürg Aus der Au³, Thomas Graf¹, Marwan Abdou Ahmed¹; ¹*Universität Stuttgart, Institut für Strahlwerkzeuge (IFSW), Germany*; ²*Laboratoire Photonique Numérique et Nanosciences (LP2N), UMR 5298, CNRS-IOGS-Université Bordeaux, France*; ³*Spectra-Physics, MKS Instruments, Inc., Austria*. We present for the first time a thin-disk multipass amplifier delivering picosecond pulses with kW average power and highly-flexible MHz to multi GHz intra-burst repetition and at 100 kHz of burst repetition rate.

AW3A.5 • 12:00

Diode Stabilization With Dual Duty-Cycle Resonant Waveguide Grating, Florian Bienert¹, Fanggang Li², Marina Fetisova², Petri Karvinen², Markku Kuittinen², Thomas Graf¹, Marwan Abdou Ahmed¹; ¹*IFSW - Universität Stuttgart, Germany*; ²*Center for Photonics Sciences, Univ. of Eastern Finland, Finland*. We present for the first time the experimental demonstration of resonant waveguide grating (RWG) employing a dual duty-cycle profile for the stabilization of a 50 W laser diode emitting in the near-infrared spectral range.

AW3A.6 • 12:15

Optimising Efficiency in Thin-Slab Thulium Lasers, Jake Sanwell¹, Lucas Groult¹, Richard M. Carter¹, Duncan P. Hand¹, M J Daniel Esser¹; ¹*Heriot-Watt Univ., UK*. Methods for improving diode-end-pumped thin-slab laser efficiency are presented, involving optimised pump delivery, stress-free mounting with interface materials and ASE suppression. Using these, our Tm:YLF system achieves 55-60% slope efficiency, with potential scaling past 300W.

AW3A.7 • 12:30

First Thin-Disk Laser Operation of Ceramic Yb:LuScO₃, Stefan Esser¹, Wei Jing², Xiaodong Xu³, Thomas Graf¹, Marwan Abdou Ahmed¹; ¹*Institut für Strahlwerkzeuge (IFSW), Univ. of Stuttgart, Germany*; ²*Inst. of Chemical Materials, China Academy of Engineering Physics, China*; ³*Jiangsu Key Laboratory of Advanced Laser Materials and, School of Physics and Electronic Engineering, China*. We present the first thin-disk laser operation and thermal

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analysis of ceramic Yb:LuScO₃ in a continuous-wave multimode oscillator delivering a power of 149 W at a slope efficiency of 51.8 %.

AW3A.8 • 12:45

Reconfigurable Brillouin Laser for Linewidth Narrowing and Microwave Spaced Frequency Combs, Adam Sharp¹, David Spence¹, Rich Mildren¹; ¹*Macquarie Univ., Australia*.

We report a Brillouin laser that uses a paratellurite crystal medium and etalon mirror to control cascaded Stokes orders. Reconfigurable operation between linewidth compressor and low noise 104 GHz wide Brillouin comb generator is demonstrated.

11:00 -- 13:00

Room: 407

LW3B • Surface Modification & Micromachining

Presider: Heather George; TRUMPF Inc., USA

LW3B.1 • 11:00 (Invited)

High Average Power Femtosecond Lasers for Surface Processing, Eric Mottay¹; ¹*Amplitude, USA*. Femtosecond lasers have transformed high precision laser manufacturing over the last three decades. Their short pulse duration and associated high peak power allow for micro-machining of any material with high accuracy, small feature size and limited thermal effects. Most current applications require micron-size accuracy over small areas, typically a few square millimeters. A single femtosecond pulse will remove with a very high precision a tiny amount of material, leading to fairly limited ablation efficiency, on the order of a few cubic millimeters/minutes in most cases. Increasing the ablation efficiency would therefore allow for a greater processed volume in the same amount of time. Even if some alternative options, such as GHz processing, are now being actively explored, the main route to increase the ablation efficiency remains an increase in the laser average power. The growing availability of high average power femtosecond lasers, as well as progress in beam engineering and application development means that we are at the edge of a new step in the development of ultrafast laser processing. We report on new developments aimed at improving plane wings aerodynamics by femtosecond laser micro-texturing. The creation of riblets, which are grooves engraved in the direction of air flow, can lead to a reduction of up to 9% in fuel consumption and contaminants emission. Riblets have a small feature size: The pitch and height of the groove is typically on the order of a few tens of micrometers. We present texturing tests that demonstrate the feasibility of the proposed technique.

LW3B.2 • 11:30 (Invited)

Laser Processing Macro-Size Components With Sub-Micrometer Feature Size & Precision, Bryan Germann¹; ¹*Aerotech Inc., USA*. Laser processing at micrometer and sub-

micrometer resolutions is becoming more prominent, driving the equipment used for these processes to meet more demanding specifications. Two-photon polymerization (2PP), selective laser etching of glass and laser micro-machining are emerging processes that fall into this category. They rely on ultrafast lasers in the femtosecond pulse width range that are focused with high numerical aperture focusing optics to achieve sub-micrometer spot size. The small spot size enables impressive processing resolution, but it also creates real challenges for positioning such a small beam and allowing that beam to make large enough parts for practical applications. These challenges can be overcome by using high-dynamic laser scan heads that leverage galvanometer servo motors and precision linear motors to extend the scanning range

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beyond a fixed field of view. When the scanner and linear motor share the laser's processing speed, seamlessly combining their motion requires advanced motion control features. With two such controller features – Infinite Field of View (IFOV) and Position Synchronized Output (PSO) – it's possible to create large parts with nanometer precision. A detailed technical overview of how these features work within a motion controller and the benefit they bring to the aforementioned processes will be discussed. Application examples demonstrating what these two processes can achieve together will also be shown.

LW3B.3 • 12:00 (Invited)

Laser Texturing and Micromachining: State of the art Ultrashort Laser Processing of Complex 3D Surfaces, Rich Klein¹; ¹*GF Machining Solutions LLC, USA*. Ultra-fast laser machining for innovative functional surfaces that improve performance of parts. Session includes examples for osseointegration - medical implants, scratch resistance - consumer products, friction reduction - tool lifetime, and surface preparation - bonding.

LW3B.4 • 12:30 (Invited)

How to Train You Laser, Benjamin Mills¹; ¹*Univ. of Southampton, UK*. Lasers used in manufacturing generally follow a predetermined set of instructions for each task. This talk discusses a new paradigm where the laser can choose its own strategy, and self-correct for errors in real-time

14:00 -- 15:00

Room: Ballroom A

AW4A • ASSL Postdeadline Presentations

Presider: Mark Bowers; Lockheed Martin Aculight Corp., USA

AW4A.1 • 14:00 Postdeadline Submission

Shot-Noise Limited 1-GHz Dual-Comb Supercontinuum From a Single-Cavity Dual-Comb and a Single ANDi Fiber, Sandro L. Camenzind¹, Anupamaa Rampur², Benoît Sierro², Benjamin Willenberg¹, Alexander Heidt², Ursula Keller¹, Christopher R. Phillips¹; ¹*ETH Zurich, Switzerland*; ²*Univ. of Bern, Switzerland*. We report a 1-GHz dual-comb supercontinuum generated from a single-cavity dual-comb in a single ANDi fiber. The combs exhibit record-low noise and approach the shot-noise limit in the performed RIN and dual-comb interferometry measurements.

AW4A.2 • 14:15 Postdeadline Submission

High-Power Tm:LiYF₄ Laser at 815 nm, Tso Yee Fan¹, Juan Ochoa¹, Steven Augst¹, Ahmad Azim², Merlin Hoffman³, Amin Nehrir⁴; ¹*Massachusetts Inst. of Tech Lincoln Lab, USA*; ²*IRGlare, USA*; ³*Forward Photonics, USA*; ⁴*NASA Langley Research Center, USA*. A cryogenically cooled (nominal 80 K) Tm:LiYF₄ laser has been demonstrated with >30 W CW power and >15 W average power Q-switched by diode pumping at 791 nm.

AW4A.3 • 14:30 Postdeadline Submission

High-Pulse-Energy Actively Q-Switched Tm³⁺-Doped Photonic Crystal Fiber Laser Operating at 2050 nm With Narrow Linewidth, Julian Schneider^{1,2}, Hugo Lassiette^{1,3}, Dominik Lorenz^{1,2}, Patrick Forster^{1,2}, Dieter Panitzek¹, Jan Lautenschläger^{1,2}, Clement B. Romano¹, Marc Eichhorn¹, Christelle Kieleck¹; ¹*Fraunhofer IOSB, Germany*; ²*Inst. of Control Systems, Karlsruhe Inst. of Technology, Germany*; ³*Institut d'Optique Graduate School, France*. A Q-switched 2050

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nm Tm³⁺-doped flexible photonic crystal fiber laser is reported with maximum pulse energy of 1.5 mJ, pulse width of 89 ns, average output power of 19.7 W, and 3-dB-linewidth of 100 pm.

AW4A.4 • 14:45 Postdeadline Submission

High-Average-Power Single-Mode Pulsed Ho³⁺ and Tm³⁺-Doped Polarization-Maintaining Silica all-Fiber MOPA, Dominik Lorenz^{1,2}, Clement B. Romano¹, Dieter Panitzek^{1,2}, Patrick Forster^{1,2}, Julian Schneider^{1,2}, Jan Lautenschläger^{1,2}, Marc Eichhorn^{1,2}, Christelle Kieleck¹; ¹Fraunhofer IOSB, Germany; ²IRS, KIT, Germany. A pulsed Tm³⁺ and Ho³⁺-doped all-in-fiber single-mode MOPA with 50.9 W average power at 2047 nm is presented. 50 ns square pulses with >10 kW peak-power and 509 μJ pulse energy were obtained.

15:30 -- 17:30

Room: Ballroom A

AW5A • Parametric Interaction

Presider: Yushi Kaneda; University of Arizona, College of Optical Sciences, USA

AW5A.1 • 15:30 (Student Paper Finalist)

Carbon K-Edge Soft X-Rays Driven by a 3 μm, 1 kHz OPCPA Laser System, Daniel Carlson¹, Drew Morrill¹, Will Hettel¹, Jeremy Thurston¹, Grzegorz Golba¹, Daniel Lesko^{1,2}, Scott Diddams^{1,2}, Henry Kapteyn¹, Margaret Murnane¹, Michael Hemmer¹; ¹JILA - Univ. of Colorado, Boulder, USA; ²Time and Frequency Division, NIST, USA. We report the generation of soft X-ray radiation up to the carbon K-edge (284 eV) in nitrogen gas driven by a millijoule-class 3 μm OPCPA featuring 135 fs pulses at 1 kHz repetition rate.

AW5A.2 • 15:45

Recent Progress of ELI-ALPS SYLOS Systems, Janos Csontos¹, Szabolcs Tóth¹, Tomas Stanislauskas², Ignas Balciunas², Jonas Adamonis³, Donatas Lengvinas³, László Tóth¹, Tamás Somoskoi¹, Prabhash P. Geetha¹, Roland Nagymihály¹, Rodrigo Lopez-Martens¹, Katalin Varjú¹, Gábor Szabó¹, Adam Borzsonyi¹; ¹ELI-Hu Nonprofit Kft, Hungary; ²Light Conversion UAB, Lithuania; ³EKSPLA UAB, Lithuania. The SYLOS 1kHz OPCPA systems are the main drivers for attosecond and particle secondary sources at ELI-ALPS. Over the recent years, several upgrades increased their overall performance for the benefit of external user community.

AW5A.3 • 16:00 (Student Paper Finalist)

Intra-Cavity Singly-Resonant OPO Pumped by a Visible VECSEL for low-Noise Down-Conversion to 1.55 μm, Steven Anderson¹, Paulo Hisao Moriya¹, Lucia Caspani¹, Jennifer E. Hastie¹; ¹Inst. of Photonics, Department of Physics, SUPA, Univ. of Strathclyde, UK. We report the first OPO pumped intra-cavity by an AlGaInP-based VECSEL. The continuous-wave, single-frequency OPO is pumped at 690.6 nm, operates with down-conversion efficiency of 68.7%, and is free of relaxation oscillations; of interest for generation of quantum light states.

AW5A.4 • 16:15

Precise fs Synchronization and Arbitrarily Adjustable Delay Between the Two Independent Laser Systems L1-Allegro and F-SYNC, Jakub Novák¹, Emily C. Erdman¹, Roman Antipenkov¹, Jan Fara¹, Martin Horacek¹, Boguslaw Tykalewicz¹, Jack A. Naylor¹, Murat Torun¹, Petr Mazurek¹, Pavel Bakule¹, Bedrich Rus¹; ¹ELI ERIC, Czechia. The F-SYNC project introduces a high-energy OPCPA laser system capable of producing up to 13 mJ output compressible to <15 fs. It achieves fs-level synchronization and arbitrary timing delay with the L1 Allegro laser system (both 1 kHz), enhancing pump-probe experiments.

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AW5A.5 • 16:30

LBO-Based Broadband Visible NOPA Pumped by Yb:KGW Amplifier System, Ahmed R. Ibrahim¹; ¹*The Univ. Of Tokyo, Japan*. LiB₃O₅-based NOPA pumped by the third harmonic of a Yb:KGW laser system is constructed. The CEP stable output that covers from 570 to 830 nm with a pulse energy of 4 μJ is achieved.

AW5A.6 • 16:45

Temporal Contrast Degradation From Post-Pedestals Due to Optical Parametric Chirped-Pulse Amplification, Benjamin Webb¹, Chengyong Feng¹, christophe dorrer¹, Rick Roides¹, Sara Bucht¹, Jake Bromage¹; ¹*Univ. of Rochester, USA*. Temporal contrast pre-pedestal growth from a post-pedestal via optical parametric amplifier saturation is demonstrated for the first time. This mechanism can be a limiting factor for high-contrast OPCPA systems with an existing post-pedestal.

AW5A.7 • 17:00 (Student Paper Finalist)

High-Contrast Dual-Comb Optical Parametric Oscillator at 250-MHz, Carolin P. Bauer¹, Michelle K. Bollier¹, Justinas Pupeikis¹, Benjamin Willenberg¹, Christopher R. Phillips¹, Ursula Keller¹; ¹*ETH Zürich, Switzerland*. We demonstrate a high-contrast spatially-multiplexed dual-comb 250-MHz OPO from a linear single-cavity ideally suited for high-sensitivity dual-comb spectroscopy measurements. The achieved contrast lies at 7.0×10^{-5} .

AW5A.8 • 17:15

Power Scaling of a Narrowband-Seeded PPLN Non-Resonant Optical Parametric Oscillator, Tugba Temel^{1,2}, Robert T. Murray², Li Wang^{1,3}, Weidong Chen^{1,4}, Andre Schirrmacher⁵, Ronan Battle², Valentin Petrov¹; ¹*Max Born Inst., Germany*; ²*Imperial College London, UK*; ³*Anhui Inst. of Optics and Fine Mechanics, China*; ⁴*Fujian Inst. of Research on the Structure of Matter, China*; ⁵*Canlas GmbH, Germany*. A PPLN non-resonant optical parametric oscillator injection-seeded by narrowband sub-100-mW CW radiation at the signal wavelength produces > 3 W idler average power at 2376 nm for a 20-kHz repetition rate, with sub-2-nm spectral linewidth.

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Thursday, 12 October

08:00 -- 09:00

Room: Ballroom A

ATh1A • Material Characterization

Presider: Patricia Segonds; Neel Inst., France

ATh1A.1 • 08:00

Bi-Doped Fiber Amplifier Operating in the Wavelength Range of 1430-1500 nm, Jayanta K. Sahu¹, Yu Wang², Arindam Halder¹; ¹*Univ. of Southampton, UK*; ²*Department of Physics, Imperial College London, UK*. We report Bi-doped germanosilicate fiber amplifier with a 38dB gain at 1455nm and >20dB gain from 1430-1495nm for an input signal of -23dBm. The temperature-dependent-gain coefficients over temperatures spanning from -60C to 80C are <0.06dB/C.

ATh1A.2 • 08:15 (Student Paper Finalist)

Faraday Isolator for a Kilowatt-Class Pulsed Laser, David Vojna^{1,2}, Ondrej Slezak¹, Jan Pilar¹, Martin Divoky¹, Ondrej Denk¹, Martin Hanus¹, Petr Navratil¹, Martin Smrz¹, Antonio Lucianetti¹, Tomas Mocek¹; ¹*HiLASE Centre, FZU - Inst. of Physics of the Czech Academy of Sciences, Czechia*; ²*Department of Physical Electronics, Faculty of Nuclear Sciences and Physical Engineering, Czech Technical Univ. in Prague, Czechia*. We report on the first-ever demonstration of a Faraday isolator for a large-aperture high-energy pulsed laser. The isolator exhibits a stable isolation ratio of 30.46 dB with the 100 J/10 Hz/10 ns pulses at 1030 nm.

ATh1A.3 • 08:30

Verdet Constant Measurement of Calcium Fluoride for Deep-Ultraviolet Optical Isolator, Yuki Tamaru¹, Atsushi Fuchimukai¹, Hiyori Uehara², Taisuke Miura¹, Ryo Yasuhara²; ¹*Gigaphoton Inc., Japan*; ²*National Inst. for Fusion Science, Japan*. The Verdet constant of CaF₂ was found to be 39.4rad/Tm at 193nm and 19.0rad/Tm at 248nm. CaF₂ can be realized the optical isolator for DUV light sources with the moderate magnetic field.

ATh1A.4 • 08:45

Comparative Study of Nanohardness and Young's Modulus of II-IV-v₂ Chalcopyrite Nonlinear Optical Crystals, Ginka Exner², Peter G. Schunemann³, Elizabeth Ivanova², Aleksandar Grigorov², Valentin Petrov¹; ¹*Max Born Inst., Germany*; ²*Plovdiv Univ., Bulgaria*; ³*BAE Systems, USA*. Hardness and Young's modulus of five monocrystalline II-IV-V₂ chalcopyrite semiconductors are measured by nanoindentation using oriented optically polished samples. The values increase linearly with melting temperature, except for CdSiP₂, and the hardness exhibits no anisotropy.

09:15 -- 10:45

Room: Ballroom A

ATh2A • Nonlinear Crystals and Frequency Conversion

Presider: Patricia Segonds; Neel Inst., France

ATh2A.1 • 09:15 (Invited)

Intracavity Spectral Broadening Using Cascaded Quadratic Nonlinearities, Chengyong Feng¹, Robert Holcomb¹, Gregory W. Jenkins¹, Christophe Dorrer¹, Jake Bromage¹; ¹*Univ. of*

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Rochester, USA. We introduce cascaded quadratic nonlinearities in the regenerative amplifier to enable simultaneous ultrashort-pulse amplification and spectral broadening with positive or negative net nonlinearity. We demonstrate a nonlinearity-tunable Yb:YAG thin-disk regenerative amplifier producing millijoule-level, sub-200-fs pulses.

ATh2A.2 • 09:45

Orientation-Patterned Semiconductors: Engineered Nonlinear Crystals for Broad Tunability in the mid-Infrared, Peter G. Schunemann¹; ¹*BAE Systems Inc., USA.* All-epitaxial growth of periodically-inverted GaAs and GaP structures has extended broadly-tunable, highly-efficient, quasi-phase-matched nonlinear frequency conversion deep into the mid-infrared.

ATh2A.3 • 10:00

1.6 MW Peak Power at 266 nm by Frequency Conversion Using YAl₃(BO₃)₄ Nonlinear Single Crystal, Florent Cassouret¹, Arvydas Kausas², Pascal Loiseau³, Gérard AKA³, Daniel Rytz⁴, Takunori Taira^{1,2}; ¹*Division of Research, Innovation and Collaboration, Inst. for Molecular Science, Japan;* ²*Laser-Driven Electron Acceleration Technology Group, Riken SPring-8 Center, Japan;* ³*MPOE team, Institut de Recherche de Chimie Paris, France;* ⁴*EOT GmbH - Coherent, Germany.* In this work 1.6 MW peak power at 266 nm were obtained with 32% power conversion efficiency using YAl₃(BO₃)₄ single crystal to generate the fourth harmonic of a Nd³⁺:YAG/Cr⁴⁺:YAG microchip laser.

ATh2A.4 • 10:15

Efficient High Resolution Broadband SFG Spectrometer Utilizing BGSe Nonlinear Crystal Covering 2.5-10 μm Spectral Range, Julius Lukosiunas¹, Robertas Kananavicius¹, Rokas Danilevicius¹, Regimantas Januskevicius¹, Peter G. Schunemann², Andrejus Michailovas¹; ¹*Ekspla, Lithuania;* ²*BAE Systems, Inc., USA.* Efficient hybrid broadband high resolution SFG spectrometer covering a 2.5-10 μm spectral range based on femtosecond mid-IR OPA source utilizing BGSe nonlinear crystal is demonstrated. The unique characteristics of BGSe crystal makes it a promising material for broadband mid-IR OPA sources pumped at 1 μm and operating at high repetition rates.

ATh2A.5 • 10:30

375-400nm Wavelength Tunable UV Alexandrite Laser Source, Goronwy L. Tawy¹, Noelia Palomar Davidson¹, Lewis D. Wright², Paolo L. Mennea¹, Glenn Churchill¹, Peter G. Smith¹, James C. Gates¹, Corin B. Gawith^{1,2}; ¹*Univ. of Southampton, UK;* ²*Covesion, UK.* We report on our latest developments in tunable ultra-violet (UV) light generation using compact diode-pumped Alexandrite lasers and zinc-indiffused MgO-doped PPLN waveguides for applications including quantum technologies, spectroscopy and biophotonics.

09:15 -- 10:45

Room: 407

LTh2B • Defense Applications I

Presider: Gregory Quarles; Applied Energetics, Inc., USA

LTh2B.1 • 09:15 (Invited)

Directed Energy Overview, Dennis Hammons¹; ¹*Coherent Applications, Inc., USA.* Abstract not available.

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LTh2B.2 • 09:45 (Invited)

The Directed Energy Professional Society and Directed Energy ST&E, Sandra Biedron¹;
¹*Directed Energy Professional Society, USA*. Abstract not available.

LTh2B.3 • 10:15 (Invited)

Lockheed Martin Layered Laser Defense Overview and Field Test Results, Robert S. Afzal¹; ¹*Lockheed Martin Aculight Corp, USA*. On February 12th, 2022, the Layered Laser Defense (LLD) demonstrator negated 2 surrogate cruise missiles at a White Sands Missile Range Test. Lockheed Martin's LLD was developed in partnership with Rolls Royce Liberty Works.

11:00 -- 12:45

Room: Ballroom A

ATh3A • Beam Combination

Presider: Tino Eidam; Active Fiber Systems GmbH, Germany

ATh3A.1 • 11:00

Post-Compression of Shaped Coherent Beam Combining Femtosecond Digital Laser Pulses, Ihsan Fsaifes¹, CLAUDE-ALBAN RANÉLY-VERGÉ-DÉPRÉ^{1,2}, Rezki BECHEKER¹, Kilian FRITSCH³, Oleg Pronin³, Jean-Christophe Chanteloup¹; ¹*Ecole polytechnique, France*; ²*Thales LAS, France*; ³*n2-Photonics, Germany*. We present the post-compression of 337fs/123W pulse train generated from a 61-tiled channels coherently combined femtosecond digital laser in an Argon-filled multi-pass cell. We also explore the propagation of Laguerre-Gaussian beam in such a cell.

ATh3A.2 • 11:15

Basic Considerations for Incoherent Combination of High-Power Laser Systems, Cesar Jauregui^{1,2}, Mehran Bahri¹, Arno Klenke^{1,2}, Jens Limpert^{1,2}; ¹*Friedrich-Schiller-Universität Jena, Germany*; ²*Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany*. Incoherent combination of laser beams is presented as a viable path for performance scaling, particularly well-suited for multicore fibers. We discuss basic considerations for this approach, revealing its scaling laws and its beam shaping abilities.

ATh3A.3 • 11:30

Orbital Angular Momentum Beams Engineering With Liquid-Crystal Converter and a kW fs Digital Laser, Rezki Bechecker¹, CLAUDE-ALBAN RANÉLY-VERGÉ-DÉPRÉ^{1,2}, Ihsan FSAIFES¹, Gerben Boer³, Jean-Christophe Chanteloup¹; ¹*Laboratoire pour l'utilisation des lasers intenses, France*; ²*Thales, France*; ³*Arcoptix SA, Switzerland*. We report on a versatile orbital angular momentum beam generation from a 61 channels coherent beam combining femtosecond digital laser by using liquid-crystal polarization converter.

ATh3A.4 • 11:45

Coherent Combining 64 Femtosecond Pulses Into mJ by Delay Line Stacking of a Fiber Laser, Yunfeng Wu^{1,2}, Bowei Yang^{3,2}, Yanrong Song¹, Zhigang Zhang²; ¹*Beijing Univ. of Technology, China*; ²*Peking Univ., China*; ³*Univ. of Michigan, USA*. We demonstrate the coherent stacking of 64 femtosecond pulses from a chirp-pulse amplification laser system based on an ytterbium-doped fiber amplifier. It combines into 1.2 mJ pulse energy at 5 kHz repetition rate.

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ATh3A.5 • 12:00

32 mJ, 158 fs Pulses at 20 kHz Repetition Rate by Spatiotemporal Coherent Combination of a Fiber Laser System, Henning Stark^{1,3}, Arno Klenke^{2,1}, Maximilian Benner¹, Joachim Buldt^{1,4}, Jens Limpert^{1,3}; ¹*Inst. of Applied Physics, Abbe Center of Photonics, FSU Jena, Germany*; ²*Helmholtz Inst. Jena, Germany*; ³*Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany*; ⁴*Now with Jabil Optics Germany, Germany*. We introduce a high-energy, high-power ultrafast fiber laser system. 8-pulse bursts are amplified in 16 parallel ytterbium-doped fiber amplifiers and spatiotemporally coherently combined to pulses of 32mJ energy, 158fs duration at 20kHz repetition rate.

ATh3A.6 • 12:15

Rod-Type Multicore Fiber With 49 Cores for Coherent Beam Combination of Femtosecond Pulses, Arno Klenke^{1,2}, Albrecht Steinkopff², Mehran Bahri², Cesar Jauregui^{2,3}, Johannes Nold³, Nicoletta Haarlammert³, Thomas Schreiber³, Andreas Tünnermann^{3,2}, Jens Limpert^{2,3}; ¹*Helmholtz Inst. Jena, Germany*; ²*Inst. of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Germany*; ³*Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany*. We present an Ytterbium-doped, multicore, rod-type fiber comprising 49 signal cores. The fiber has already demonstrated kW-level output average powers. Additionally, we provide first results of coherent beam combination of stretched femtosecond pulses

ATh3A.7 • 12:30

110 mJ Pulse Energy at 5 kHz Repetition Rate Delivered by 49-Core Fiber Laser, Mehran Bahri¹, Albrecht Steinkopff¹, Arno Klenke^{2,1}, Cesar Jauregui¹, Stefan Kuhn³, Johannes Nold³, Nicoletta Haarlammert³, Thomas Schreiber³, Jens Limpert¹; ¹*Inst. of Applied Physics, Abbe Center of Photonics, FSU Jena, Germany*; ²*Helmholtz-Inst. Jena, Germany*; ³*Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany*. We present an Ytterbium-doped 49-core fiber in a MOPA configuration. Pulses of 35-ns duration have been amplified to 110-mJ energy at an intra-burst repetition rate of 5-kHz by an incoherent superposition of the multicore emission.

11:00 -- 12:30

Room: 407

LTh3B • Defense Applications II

Presider: Sandra Biedron; Directed Energy Professional Society, USA

LTh3B.1 • 11:00 (Invited)

Summary of the Basic Research Needs Workshop on Laser Technology, Eric Colby¹, Roark Marsh¹; ¹*U.S. Dept. of Energy, USA*. The DOE Office of Accelerator Research and Development and Production organized a Basic Research Needs workshop to assess R&D needed to enable high-impact scientific applications of laser technology to address current and future needs

LTh3B.2 • 11:30 (Invited)

Research Opportunities With Multi-Terawatt Long-Wave Infrared Lasers, Igor V. Pogorelsky¹; ¹*Brookhaven National Laboratory, USA*. We review the status and emerging capabilities of multi-terawatt long-wave infrared laser technology that enables diverse multi-disciplinary research spanning from new paradigms in particle acceleration to the remote detection of ionizing radiation sources.

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LTh3B.3 • 12:00 (Invited)

Developing Directed Energy Weapons to Operate Across a Range of Atmospheric Conditions, Steven Fiorino¹, Jonathan Evans¹; ¹*Air Force Inst. of Technology, USA*.

Quantification and prediction of atmospheric effects on HELs and other DE systems.

Phenomena include turbulence, molecular, aerosol, and hydrometeor absorption / scattering effects. Enhances laser effectiveness across all weather conditions. Research includes testing and M&S.

13:45 -- 15:30

Room: Ballroom A

ATh4A • Fiber Sources

Presider: Marc Eichhorn; Fraunhofer IOSB, Germany

ATh4A.1 • 13:45 (Invited)

Active Fibers for 2 μm Fiber Lasers, Pavel Peterka¹, Ivan Kašik¹, Ondrej Podrazky¹, Michal Kamrádek¹, Pavel Honzátko¹; ¹*Inst. of Photonics and Electronics of the Czech Academy of Sciences, Czechia*. Recent advances in thulium and holmium doped fibers are reviewed with focus on the design of highly efficient cladding-pumped holmium fibers and on the effect of temperature-dependent spectroscopic parameters on high-power thulium fiber laser operation.

ATh4A.2 • 14:15

1.6 mJ Pulse Energy and 1.2 kW Average Power All-Fiber Amplifier With Diffraction-Limited Beam Quality, Yaakov Glick^{2,1}, Jose Pincha², Ishu Kansal², Robert Windeler², Vasiliy Lukonin², Eric Monberg², Erin Lamb², Lalitkumar Bansal², Jeffrey Nicholson²; ¹*Soreq Nuclear Research Center, Israel*; ²*OFS Labs, USA*. We demonstrate record high energy (1.6 mJ) nanosecond pulses, as well as average powers reaching 1.2 kW and peak powers of >370 kW, with a diffraction limited beam quality of $M^2=1.12$. This with an all-fiber amplifier using a novel 25 μm mode-field diameter Yb-doped gain fiber. The TMI threshold for this fiber was measured to be 1.8kW

ATh4A.3 • 14:30

High-Energy, Narrow-Linewidth Thulium-Doped All-Fiber Amplifier With Active Pulse Shaping, Joel M. Solomon¹, Brian Anderson¹, Colin C. Baker², Daniel Rhonehouse², Jasbinder Sanghera², Angel Flores¹; ¹*Air Force Research Lab, USA*; ²*Naval Research Lab, USA*. A 1.95 μm high-energy nanosecond thulium-doped all-fiber amplifier is demonstrated producing multi-mJ pulses. Phase modulation was used to suppress stimulated Brillouin scattering and maintain narrow linewidth operation for potential compatibility with beam combining architectures.

ATh4A.4 • 14:45

Erbium-Doped Fiber Amplifier With High Pulse Energy, Venkatapuram Sudarshanam¹, Cang Jin¹, Jeffrey Nicholson¹; ¹*OFS Labs, USA*. High pulse energy ~5 mJ within ~2.6 μs FWHM was obtained at 5 kHz repetition rate from 1480 nm core-pumped, Erbium-doped VLMA fiber with 80 μm core diameter and 60 dB/m absorption at 1535 nm.

ATh4A.5 • 15:00

GaSb-Based SESAM Mode-Locking of a Polarization-Maintaining Er:ZBLAN Fiber Laser at 2.8 μm , Simone Normani², Said Idlahcen¹, Pavel Loiko², Pierre-Henry Hanzard¹, Alisson

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Rodrigues De Paula¹, Thomas Godin¹, Thibaud Berthelot³, Solenn Cozic³, Samuel Poulain³, Patrice Camy², Ammar Hideur¹; ¹*CNRS-INSA-Université de Rouen Normandie, CORIA UMR6614, France*; ²*UMR 6252 CEA-CNRS-ENSICAEN, Université de Caen Normandie, Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), France*; ³*Le verre Fluoré, France*. A GaSb-based SESAM enables continuous-wave mode-locked operation with excellent stability of a polarization-maintaining mid-infrared Er:ZBLAN fiber laser continuously tunable across 110 nm (2.706–2.816 μm) with a repetition rate of 32.1 MHz.

ATh4A.6 • 15:15

Time-Domain Mode Selection in Multi-Mode Fiber Laser by Active Mode Locking, Yukiaki Ohnishi¹, Akira Shirakawa¹; ¹*Univ. of Electro-Communications, Japan*. A method to selectively excite a transverse mode in multimode fiber laser, called Time-domain Mode selection, is proposed. By tuning the repetition rate of active mode locking, change of the transverse mode was demonstrated.

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On Demand

SD1 • ASSL On Demand Session

SD1.1

Novel Transparent Ceramics Based on Tm³⁺-Doped Cubic Gadolinia and its Solid-Solutions for 2 μm Lasers, Kirill Ereemeev¹, Pavel Loiko¹, Stanislav Balabanov², Timofey Evstropov², Denis Kosyanov^{2,3}, Sergey Filofeev², Patrice Camy¹, Alain Braud¹; ¹CIMAP, UMR6252 CNRS, Université de Caen Normandie, France; ²G. G. Devyatkh Inst. of Chemistry of High-Purity Substances of RAS, Russian Federation; ³Far Eastern Federal Univ., Russian Federation. Transparent ceramics based on thulium-doped cubic gadolinia Gd₂O₃ and its solid-solutions (Gd,Y)₂O₃, (Gd,Lu)₂O₃ and (Gd,Y,Lu)₂O₃ are fabricated by hot pressing. They feature low phonon energies and broad and smooth gain profiles extending above 2 μm.

SD1.2

Fabrication and Emission Properties of Cr²⁺-Doped ZnS Hot-Pressed Transparent Ceramics, Sharvane Mauree², Kirill Ereemeev¹, Guillaume Durand², Pavel Loiko¹, Alexandre Le Coz², Marine Poitou², Florent Starecki², Virginie Nazabal², Patrice Camy¹, Alain Braud¹, Odile Merdrignac-conanec²; ¹CIMAP, UMR6252 CNRS, Université de Caen Normandie, France; ²Université de Rennes, Institut des Sciences Chimiques de Rennes – UMR 6226 CNRS, France. Transparent Cr²⁺-doped zinc sulfide ceramics are fabricated by hot pressing at 950°C / 120 MPa and their structure and emission properties are studied. The ceramic exhibit broadband emission and a long ⁵E(⁵D) lifetime (~6 μs).

SD1.3 (Student Paper Finalist)

Femtosecond Laser Written Er³⁺:YLiF₄ Channeled Waveguide Laser at 2.8 μm, Berke Ayevi¹, Yagiz Morova^{1,2}, Mauro Tonelli³, Alphan Sennaroglu^{1,2}; ¹Laser Research Laboratory, Departments of Physics and Electrical-Electronics Engineering, Koç Univ., Turkey; ²Koç Univ. Surface Science and Technology Center (KUYTAM), Koç Univ., Turkey; ³Mega Materials srl and Dipartimento di Fisica, Università di Pisa, Italy. We describe a femtosecond laser inscribed depressed-cladding 2.8-μm Er³⁺:YLiF₄ channeled waveguide laser, which generated 31 mW of output power at 2809 nm with 460 mW of pump power and with a slope efficiency of 9.7%.

SD1.4

Kerr-Lens Mode-Locked Tm,Ho:Ga(Gd,Lu)AlO₄ Laser, Li Wang¹, Weidong Chen^{1,2}, Zhongben Pan³, Ji Eun Bae⁴, Fabian Rotermund⁴, Pavel Loiko⁵, Xavier Mateos⁶, Ge Zhang², Uwe Griebner¹, Valentin Petrov¹; ¹Max Born Inst., Germany; ²Fujian Inst. of Research on the Structure of Matter, CAS, China; ³Shandong Univ., China; ⁴Korea Advanced Inst. of Science and Technology, Korea (the Republic of); ⁵Université de Caen, France; ⁶Universitat Rovira i Virgili, Spain. We report on a Kerr-lens mode-locked Tm,Ho:Ga(Gd, Lu)AlO₄ laser generating 38-fs pulses at ~2.04 μm with an average power of 78 mW at a pulse repetition rate of ~87.9 MHz.

SD1.5

Sub-30-fs Kerr-Lens Mode-Locked Yb:Sc₂SiO₅ Laser, Zhang-Lang Lin², Huang-Jun Zeng², Zhi-qiang Li², Ge Zhang², Lihe Zheng³, Liangbi Su⁴, Shande Liu⁵, Pavel Loiko⁶, Xavier Mateos⁷, Valentin Petrov¹, Li Wang¹, Weidong Chen²; ¹Max Born Inst., Germany; ²Fujian Inst. of Research on the Structure of Matter, CAS, China; ³Yunnan Univ., China; ⁴Shanghai Inst. of Ceramics, China; ⁵Shandong Univ. of Science and Technology, China; ⁶Université de Caen,

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France; ⁷Universitat Rovira i Virgili, Spain. We report on the diode-pumped Kerr-lens mode-locked Yb:Sc₂SiO₅ laser generating 29-fs pulses at 1079.6 nm with an average power of 72 mW at a pulse repetition rate of ~66.5 MHz.

SD1.6

Continuous-Wave and Passively Q-Switched Operations of a 2- μ m Upconversion Pumped Tm³⁺:Lu₂O₃ Ceramic Laser, Eylül N. Kamun², Yagiz Morova^{2,1}, Alphan Sennaroglu^{2,1}; ¹*Koç Univ. Surface Science and Technology Center (KUYTAM), Turkey;* ²*Laser Research Laboratory, Departments of Physics and Electrical-Electronics Engineering, Koç Univ., Turkey.* Upconversion pumping of a 2- μ m Tm³⁺:Lu₂O₃ ceramic laser with a 1064-nm Yb-fiber laser yielded 12% power slope efficiency during continuous-wave operation and 4- μ s pulses at the repetition rate of 29 kHz during passive Q switching.