Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

Topical Meeting and Tabletop Exhibit

Technical Conference: January 31–February 3, 2010
Exhibition: February 1–3, 2010
The Westin San Diego
San Diego, CA, USA

Postdeadline Submission Deadline: January 13, 2010 12:00 p.m. noon EST (17.00 GMT)
Hotel Reservation Deadline: Extended through January 7, 2010
Lower Hotel Rate Now Available!
Pre-Registration Deadline: January 12, 2010

Part of Lasers, Sources and Related Photonic Devices:

OSA Optics & Photonics Congress

Featuring Three Collocated Topical Meetings:

Advanced Solid-State Photonics (ASSP)
Applications of Lasers for Sensing and Free Space Communications (LS&C)
Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

About LACSEA

This interdisciplinary meeting will focus on recent advances in analytical laser spectroscopy, i.e. on the development of new laser-analytical principles but also on new components, systems and new applications.

Contemporary scientific topics will be highlighted in areas such as:

- New laser, optical, and spectroscopic science for analytical sensing
- New fundamental spectro-analytical principles and techniques including:
- Nonlinear and ultra fast spectroscopy, analytical use of optical frequency combs and others
- New laser light sources, optical components and detectors for analytical systems from the VUV, UV, to the FIR and THz spectral range
- Improved data retrieval techniques in laser spectroscopic analysis
- New laser analytical instrumentation including:
    - Optical and micro-optical laser-based systems for chemical analysis and monitoring
    - Laser analytical lab-on-chip systems
    - Distributed laser optical sensor networks
- Innovative analytical applications of optical methods

The meeting also highlights the latest developments in the application of laser-analytical methods in fields such as:

- Combustion
- Atmospheric measurements and environmental issues
- Biochemical/biophysical and medical applications of laser techniques
- Security applications of laser-based analytical methods
- Other new analytical applications using light matter interactions

Program Committee

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Sune Svanberg, *Lund Univ., Sweden*
Petter Weibring, *Natl. Ctr. for Atmospheric Res., USA*

Topics to be Considered:

- Contemporary scientific topics will be highlighted in areas such as:
    - New laser, optical, and spectroscopic science for analytical sensing
    - New fundamental spectro-analytical principles and techniques including:
        - Nonlinear and ultra fast spectroscopy
        - Analytical use of optical frequency combs
        - Others
    - New laser light sources, optical components and detectors for analytical systems from the VUV, UV, to the FIR and THz spectral range
    - Improved data retrieval techniques in laser spectroscopic analysis
    - New laser analytical instrumentation including:
        - Optical and micro-optical laser-based systems for chemical analysis and monitoring
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        - Distributed laser optical sensor networks
    - Innovative analytical applications of optical methods

  The meeting also highlights the latest developments in the application of laser-analytical methods in fields such as:

    - Combustion
    - Atmospheric measurements and environmental issues
    - Biochemical/biophysical and medical applications of laser techniques
    - Security applications of laser-based analytical methods
    - Other new analytical applications using light matter interactions

Special Events

Conference Banquet
Joint Symposium

Conference Banquet

Tuesday, February 2, 2010
7:30 p.m.–10:00 p.m.
Emerald Ballroom

Banquet Speaker

Early Developments in Laser Science, Orazio Svelto; *Politecnico di Milano, Italy*

Orazio Svelto is professor of Physics of Matter at the Polytechnic Institute of Milan. His research has covered a wide range of activity in the field of Laser Physics and Photonics, starting from the early beginning (1962) of these disciplines. This activity includes ultrashort-pulse generation and applications, physics of laser resonators and techniques of mode selection, laser applications in biology and biomedicine, and physics of solid-state lasers. Professor Svelto is the author of more than 200 scientific papers and holds 3 patents; his researches have been the subject of more than 60 invited papers at international conferences. He is also the author of the book *Principles of Lasers* (Springer, 5th Ed., 2009) which has currently been adopted at several universities in Europe and United States and whose previous editions were also translated in Russian, Chinese, Greek, Farsi and Arabic languages.

He served as a Program Chairman, Conference Chairman or Honorary Chairman at several international conferences; in particular, he was program chair of the IX International Quantum Electronics Conference (Amsterdam, 1976), general co-chair of the first CLEO-Europe Conference (Amsterdam, 1994) and program co-chair for 2002 International Quantum Electronics Conference (Moscow).

He is the recipient of several awards including the Italgas prize for research and technology innovation, the Quantum Electronics Prize of the European Physical Society, and the Charles H. Townes Award of The Optical Society.

He is fellow of The Optical Society and of the Institute of Electrical and Electronics Engineers and he is an elected member of several Italian academies including the National Academy of Sciences and the "Accademia dei Lincei."

Joint Symposium

Tuesday, February 2, 2010
8:00 a.m.–10:00 a.m.

JTuA1, **External Cavity Quantum Cascade Lasers: Recent Advances, Applications, and Comparisons with Alternative Sources in the MIR,** Timothy Day; *Daylight Solutions, USA*

JTuA2, **Applications of High-Repetition Rate Diode-Pumped Solid-State Lasers for Combustion Diagnostics,** W. Meier[1], I. Boxx[1], C. Arndt[1], C. D. Carter[2], M. Stöhr[1], A. Steinberg[1], J. H. Frank[3]; [1]*German Aerospace Ctr. (DLR), Germany,* [2]*AFRL, USA,* [3]*Sandia Natl. Labs, USA*

JTuA3, Progress in Laser Communications, Larry B. Stotts,[1] Sherman Karp[2], Alan Pike[3], Paul Kolodzy[4]; [1]*DARPA, USA,* [2]*Consultant, USA,* [3]*Defense Strategies and Systems, Inc., USA,* [4]*Kolodzy Consulting, USA*

JTuA4, **Multi-Disciplinary Lidar Applications,** Kerstin Barup, Mikkel Brydegaard, Zuguang Guan, Anders Hedenström, Jenny Hellström, Märta Lewander, Patrik Lundin, Christer Löfstedt, Aboma Merdasa, Annika Olsson, Anna Runemark, Gabriel Somesfalean, Erik Svensson, Maren Wellenreuther, Susanne Åkesson, Sune Svanberg; *Lund Univ., Sweden*

Invited Speakers

LMA1, **On Recent Progress Using QCLs for Molecular Trace Gas Detection - from Basic Research to Industrial Applications**, Jürgen Röpcke[1], Paul Davies[2], Frank Hempel[1], Marko Huebner[1], Sven Glitsch[1], Norbert Lang[1], Markus Naegele[3], Antoine Rousseau[4], Stephan Wege[5], Stefan Welzel[1,6]; [1]*INP Greifswald, Germany,* [2]*Univ. of Cambridge, United Kingdom,* [3]*OptoPrecision GmbH, Germany,* [4]*LPTP, École Polytechnique, France,* [5]*Qimonda Dresden GmbH & Co. OHG, Germany,* [6]*Eindhoven Univ. of Technology*, *Netherlands*

LMA2, **Single-Mode Room-Temperature CW Interband Cascade Lasers Covering the λ = 3-4 µm Spectral Band**, Mijin Kim, William W. Bewley, J. R. Lindle, Chulsoo Kim, Chadwick L. Canedy, Joshua Abell, Igor Vurgaftman, Jerry Meyer; *NRL, USA*

LMA4, **Tunable Difference Frequency Generation Laser Spectrometers: Successes, Challenges, and Opportunities**, Dirk Richter[1], Petter Weibring[1], Alan Fried[1], Lars Rippe[1], Märta Lewander[1,2], Oscar Batet[1,3], James G. Walega[1], Scott Spuler[1]; [1]*Natl. Ctr. for Atmospheric Res., USA,* [2]*Atomic Physics Div., Lund Univ., Sweden,* [3]*Dept. of Signal Theory and Communications, Technical Univ. of Catalonia*, *Spain*

LMB1, **Applications of cw Cavity Ring-Down Spectroscopy to the Study of Trace Atmospheric Constituents**, R. Grilli, D. Mellon, J. Kim, M. S. I. Aziz, D. Hamilton, A. J. Orr-Ewing; *Univ. of Bristol, United Kingdom*

LMB4, **Quartz Enhanced Photoacoustic Spectroscopy: Today and Beyond**, Anatoliy A. Kosterev; *Rice Univ., USA*

LMC1, **Coherent Detection Schemes for Ultra-Sensitive Molecular Spectroscopy in the Mid-IR**, Gerard Wysocki; *Princeton Univ., USA*

LTuA1, **Spectroscopy with Shaped Laser Pulses**, B. von Vacano[1,2], Marcus Motzkus[1,3]; [1]*Philipps Univ. Marburg, Germany,* [2]*Polymer Physics, BASF SE, Germany,* [3]*Ruprecht-Karls Univ. Heidelberg*, *Germany*

LTuA4, **Terahertz Time Domain Spectroscopy for Nondestructive Testing and Sensing Applications**, F. Ellrich[1], M. Herrmann[1], J. Jonuscheit[1], M. Theuer[2], G. Torosyan[1], D. Molter[1], S. Wiegand[2], S. Wohnsiedler[1], René Beigang[1,2,3]; [1]*Fraunhofer Inst. for Physical Measuring Techniques, Germany,* [2]*Dept. of Physics , Univ. of Kaiserslautern, Germany,* [3]*Res. Ctr. OPTIMAS, Univ. of Kaiserslautern*, *Germany*

LTuA5, **Slits, Curves, Chains and Rings: How to Mix the Right Ingredients for Surface-Emitting THz Quantum Cascade Lasers**, Alessandro Tredicucci; *NEST, CNR-INFM and Scuola Normale Superiore*, *Italy*

LTuB3, **Fiber-Coupled Picosecond Coherent Anti-Stokes Raman Scattering (CARS) Spectroscopy**, Paul S. Hsu[1], Anil K. Patnaik[1], James R. Gord[1], Sukesh Roy[2], Waruna D. Kulatiaka[2], Terrence R. Meyer[3]; [1]*AFRL, USA,* [2]*Spectral Energies, LLC, USA,* [3]*Iowa State Univ.*, *USA*

LTuB4, **Effects of Molecular Interference on Femtosecond-CARS Spectroscopy**, Waruna D. Kulatilaka[1], Sukesh Roy[1], Robert P. Lucht[2], James R. Gord[3]; [1]*US AFRL / Spectral Energies LLC, USA,* [2]*School of Mechanical Engineering, Purdue Univ., USA,* [3]*US AFRL, USA*

LTuC1, **Linear and Nonlinear Optical Methods for Multi-Gas and Multi-Parameter Sensing**, P. Ewart, B. Williams, Y. Arita, M. Hamilton, G. A. D. Ritchie; *Oxford Univ., United Kingdom*

LTuC2, **Low Cost, High Performance TDL Gas Sensors for Widespread Network Deployment**, **David M. Sonnenfroh**, Krishnan Parameswaran; *Physical Sciences Inc., USA*

LTuD1, **High Precision Trace Gas Measurements with Quantum Cascade Laser Spectroscopic Instruments**, J. Barry McManus[1], Mark Zahniser[1], David D. Nelson[1], Joanne H. Shorter[1], Rick A. Wehr[2], Greg W. Santoni[3], Ben H. Lee[3]; [1]*Aerodyne Res. Inc., USA,* [2]*Univ. of Arizona, USA,* [3]*Harvard Univ., USA*

LWA2, **Ultra High Framing-Rate Laser Diagnostics for High-Speed Reacting and Non-Reacting Flows**, Naibo Jiang[1], Matthew C. Webster[1], Kathryn N. Gabet[1], Randy L. Patton[1], Igor Adamovich[1], Jeffrey A. Sutton[1], Walter R. Lempert[1], Joseph D. Miller[2], Terrence R. Meyer[2], Jenifer A. Inman[3], Brett Bathel[3], Steve B. Jones[3], Paul M. Danehy[3]; [1]*Ohio State Univ., USA,* [2]*Dept. of Mechanical Engineering, Iowa State Univ., USA,* [3]*NASA Langley Res. Ctr., USA*

LWA3, **High Speed Imaging in Reactive Flows Using Hyperspectral Tomography and Photodissociation Spectroscopy**, Lin Ma; *Clemson Univ., USA.*

LWB1, **Real-Time Diagnostics in Exhaust Plumes, Flames, and the Atmosphere Using an Intra-Pulse Quantum Cascade Laser Spectrometer**, Geoffrey Duxbury, Kenneth G. Hay, Paul Black, Nigel Langford; *Univ. of Strathclyde*, *UK*

LWB3, **Laser Diagnostic Techniques for Shock Tube Studies of Combustion Chemistry**, Ron K. Hanson; *Stanford Univ., USA*

LWB4, **Towards Quantitative Measurements of Soot Concentrations in Strongly Sooting Turbulent Jet Diffusion Flames**, Christopher R. Shaddix, Jiayao Zhang, Robert W. Schefer; *Sandia Natl. Labs, USA*

LWC1, **Perspectives of Laser Spectroscopic Methods for Security, Industrial and Biochemical Applications**, Peter Jander; *Fraunhofer-Inst. für Lasertechnik Aachen, Germany*

LWC5, **Quantum Cascade Lasers for the Detection of Hazardous Materials**, Ulrike Willer[1], Christoph Bauer[1], Wolfgang Schade[1,2]; *[1]Laser Application Ctr., Clausthal Univ. of Technology, Germany, [2]Fraunhofer Heinrich-Hertz Inst., Germany*

LWD1, **Laser-Induced Breakdown Spectroscopy (LIBS) for the Rapid Field Identification and Classification of Pathogenic Bacteria**, Steven J. Rehse, Qassem Mohaidat, Sunil Palchaudhuri; *Wayne State Univ., USA*

LWD5, **Standoff Detection of Vapor and Trace Amounts of Explosives by Raman Technique**, Henric Östmark, Sara Wallin, Anna Pettersson, Anneli Ehlerding, Ida Johansson, Markus Nordberg; *FOI, Swedish Defence Res. Agency*, *Sweden*

Short Courses

Short Courses are a wonderful way to enhance your knowledge of the optical field. ASSP selects experts in their fields to provide you with an in-depth look at intriguing topics. The courses are designed to increase your knowledge of a specific subject while offering you the experience of knowledgeable teachers. An added benefit of the courses is the availability of continuing education units (CEUs).

CEUs are awarded to each participant who successfully completes the course. The CEU is a nationally recognized unit of measure for continuing education and training programs that meet established criteria. Toearn CEUs, a participant must complete the CEU credit form and course evaluation and return it to the course instructor at the end of the course. CEUs will be calculated and certificates will be mailed to participants.

- Tuition for the Short Course is a separate fee, and advance registration is recommended. The number of seats in the course is limited.
- The Short Courses will sell out quickly! There will be no waiting list for the Short Courses.
- Short Course Notes are not available for purchase.

Schedule

Sunday, January 31, 2010

8:00 a.m.–12:00 p.m.

SC343 **High-Power Solid-State Laser Technologies**, Rüdiger Paschotta; *RP Photonics Consulting GmbH, Switzerland*
Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

SC351 **THz Technology for Sensing Applications**, René Beigang, *Fraunhofer IPM Standort Kaiserslautern, Germany*

2:00 p.m.–6:00 p.m.

SC290 **High Power Fiber Lasers and Amplifiers**, Johan Nilsson; *Univ. of Southampton, UK*
Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

SC344 **Quasi-Phasematching: Materials and Devices**, Martin M. Fejer; *Stanford Univ., USA*

SC350 **Tunable Laser Spectroscopy for Combustion,** Scott Sanders; *Univ. of Wisconsin-Madison, USA*
Level: Intermediate (prior knowledge of topic is necessary to appreciate course material)

Course Descriptions

SC290 **High Power Fiber Lasers and Amplifiers**, Johan Nilsson; *Univ. of Southampton, UK*
Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Course Description

This course describes the principles and capabilities of high power fiber lasers and amplifiers, with output powers that can exceed a kilowatt. It describes the fundamentals of such devices and discusses current state of the art and research directions of this rapidly advancing field. Fiber technology, pump laser requirements and input coupling will be addressed. Rare-earth-doped fiber devices are the focus of the course, but Raman lasers and amplifiers will be considered, too, if time allows. This includes Yb-doped fibers at 1.0 - 1.1 µm, Er-doped fibers at 1.5 - 1.6 µm, and Tm-doped fibers at around 2 µm. Operating regimes extending from continuous-wave single-frequency to short pulses will be considered. Key equations will be introduced to find limits and identify critical parameters. For example, pump brightness is a critical parameter for some devices in some regimes but not always. Important limitations relate to nonlinear and thermal effects, as well as damage, energy storage and, of course, materials. Methods to mitigate limitations in different operating regimes will be discussed. Fiber, laser and amplifiers designs for different operating regimes will be described.

Benefits and Learning Objectives

This course should enable you to:

- Describe the fundamentals of high power fiber lasers and amplifiers.
- List key strengths, relative merits, and specific capabilities of high power fiber lasers and amplifiers.
- Assess performance limitations and describe the underlying physical reasons in different operating regimes.
- Design or specify basic fiber properties for specific operating regimes.
- Describe the possibilities, limitations, and implications of current technology regarding core size and rare earth concentration of doped fibers.
- Discuss different options for suppressing detrimental nonlinearities.
- Design basic high power fiber lasers and amplifier systems.
- List strengths and weaknesses of different pumping schemes.

Intended Audience

This course is intended for scientists and engineers involved or interested in commercial and military high power fiber systems. This includes system designers, laser designers, fiber fabricators, and users. A basic knowledge of fibers and lasers is needed.

Biography

Johan Nilsson is a professor in the Optoelectronics Research Centre (ORC), University of Southampton, England. He received a doctorate in engineering sciences from the Royal Institute of Technology, Stockholm, Sweden, in 1994, for research on optical amplification. Since then, he has worked on optical amplifiers and amplified lightwave systems, optical communications, guided-wave lasers and nonlinear optics, first at Samsung Electronics and now at the ORC, where he is leading a research group in the field of high-power fiber devices and applications. His research has primarily focused on devices but has also covered system, fabrication and materials aspects. He has given courses on high-power fiber sources at Photonics West and OFC.

SC343 **High-Power Solid-State Laser Technologies**, Rüdiger Paschotta; *RP Photonics Consulting GmbH, Switzerland*
Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Course Description

This course starts with an overview on competing technologies for high-power solid-state laser sources, including bulk lasers, amplified and fiber-based sources. The primary topic is the analysis of performance potentials of different technologies in situations with different boundary conditions, such as continuous-wave operation with no restrictions or with high beam quality and/or a limited emission bandwidth, and the generation of intense laser pulses with nanosecond, picosecond or femtosecond durations. In this context, the concept of power scaling is given a meaningful basis, and scaling considerations are demonstrated in example cases.

Benefits and Learning Objectives

This course should enable you to:

- List and categorize different laser technologies for the generation of high optical powers or energies
- Understand the basic physical performance limitations for different laser types
- Understand a methodology for comparing performance potentials
- Explain the principle of power scaling, and apply scaling considerations to concrete cases

Intended Audience

This course is designed for researchers and engineers who are interested in the development of high-power laser sources. It should be particularly useful for those who need to compare different laser technologies.

Biography

Rüdiger Paschotta started his career in scientific research. In 2002, he achieved the habilitation in applied physics at ETH Zürich and received the Fresnel Prize of the European Physical Society (EPS). In 2004, he started RP Photonics Consulting GmbH in Zürich, Switzerland. His full-time occupation is now to serve companies in the photonics industry worldwide. Typical tasks are to work out feasibility studies and designs for lasers and other photonic devices, to identify and solve technical problems, to find suitable laser sources for specific applications, and to do tailored staff training courses on specialized subjects.

SC344 **Quasi-Phasematching: Materials and Devices**, Martin M. Fejer; *Stanford Univ., USA*

Course Description

Quasi-phasematching (QPM) has become an important technique for nonlinear optical frequency conversion, and more recently for optical signal processing devices. In addition to large nonlinear susceptibilities, and noncritical phasematching across broad wavelength ranges, QPM offers control over parameters that allow engineering of properties such as the spectral and spatial distribution of gain. Well known applications in parametric frequency conversion devices such as harmonic generators and parametric oscillators are now complemented by developments for signal processing applications such as wavelength convertors and gated mixers for communication systems, and attojoule autocorrelators and time lenses for ultrafast signal analysis. Recent developments such as supercontinuum generation and single-photon devices for quantum optics, including photon-counting with efficient up-conversion and correlated photon generation by parametric down conversion will also be discussed. The success of QPM is fundamentally tied to developments in microstructured nonlinear materials, such as periodically-poled ferroelectrics and patterned III-V semiconductors, whose properties will be reviewed as part of the course.

Benefits and Learning Objectives

This course will enable participants to:

- Explain the basic ideas of QPM and methods for analyzing QPM interactions
- Relate properties of QPM interactions to the more familiar birefringent phasematching
- Discuss qualitative insights and quantitative data on QPM materials like PPLN and OPGaAs
- Review coherent source applications of QPM media
- Explain novel methods such as generation and manipulation of ultrafast pulses based on aperiodic QPM

- Understand waveguide devices for nonlinear interactions at low power levels

Intended Audience

This course is intended for individuals with at least a basic knowledge of lasers and nonlinear optical frequency conversion, though background information necessary for understanding the material in the course will be covered. No prior knowledge of optical signal processing necessary for optical communications topics.

Biography

Martin Fejer is a professor of Applied Physics and Senior Associate Dean of Natural Sciences at Stanford University. His research focuses on microstructured nonlinear materials, guided wave optics, and devices for generating coherent radiation and for optical signal processing. He received the OSA's Wood prize in 1998 for his work in quasi-phasematched nonlinear optics.

SC350 **Tunable Laser Spectroscopy for Combustion,** Scott Sanders; *Univ. of Wisconsin-Madison, USA*
Level: Intermediate (prior knowledge of topic is necessary to appreciate course material)

Course Description

This course covers hyperspectral light sources including tunable diode lasers and their application to measurements of gas properties in combustion test articles.

Benefits and Learning Objectives

This course should enable you to:

- Understand the strengths and weaknesses of the various laser sources available for combustion spectroscopy
- Gain familiarity with spectroscopic simulation, particularly at high temperatures using databases including HITRAN, HITEMP, BT2, and CDSD
- Gain familiarity with strategies for selecting the optimum wavelengths for various measurement goals
- Predict the precision of measured gas temperature and absorber mole fraction from experimental noise levels
- Gain familiarity with strategies for optical access to combustion devices, and understand the associated compromises in measurement fidelity

Intended Audience

Researchers, students, managers, product developers, etc. interested in learning more about the topics listed above.

Biography

Prof. Scott Sanders joined the faculty at the University of Wisconsin in 2001 as a member of the school's Engine Research Center, having obtained his PhD at Stanford University. His research work includes the development of advanced optical diagnostics and sensors for combustion applications. Specifically, his research group designs hyperspectral sources and spectrometers, and applies them to measure gas properties in environments ranging from internal combustion engines to hospital intensive care units. He has published widely and has received 6 patents on his light source technologies. More information is available at http://www.engr.wisc.edu/me/faculty/sanders_scott.html.

SC351 **THz Technology for Sensing Applications**, René Beigang, *Fraunhofer IPM Standort Kaiserslautern, Germany*
Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Course Description

This course covers the field of generation and application of photonic terahertz (THz) radiation. It starts with an overview of photonic THz technologies including pulsed and continuous-wave systems. Also competing technologies based on electronic sources are discussed briefly. The primary topic is the application of pulsed broadband THz sources for industrial and fundamental sensing applications, including applications in non-destructive testing, thickness measurements, biological and biomedical sensing, gas analysis and sensing of drugs and explosives under real world conditions. Performance potentials, application possibilities and limits of this technology will be critically evaluated.

Benefits and Learning Objectives

This course should enable you to:

- Understand the basic operation principles of photonic THz systems, in particular, broadband THz systems based on femtosecond laser technology
- Understand the strengths and weaknesses of the various THz systems for specific applications
- Understand the basic physical performance limitations for different terahertz systems
- Understand a methodology for comparing performance potentials
- Decide which THz system is applicable for a specific type of application

Intended Audience

This course is designed for researchers and engineers who are interested in the application of THz sources. It should be useful for those who need to evaluate the possibilities and benefits of THz technologies for their particular application.

Biography

Rene Beigang got his PhD from the University of Hannover in Hannover, Germany. He spent 3 years as a post doc and visiting scientist at the IBM TJ Watson Research Center in Yorktown Heights, NY, USA. He is now a full professor at the Department of Physics of the University of Kaiserslautern. Since 2005 he is also head of the department Terahertz Measurement and Systems of the Fraunhofer Institute for Physical Measurement Techniques. His current research interests include nonlinear optics, generation and application of THz radiation, THz spectroscopy and applications of THz radiation in science and technology. More information is available at http://www.physik.uni-kl.de/beigang.

Publications

Conference Program

The *Conference Program* will be available on the web in November 2009. Authors submitting papers, past meeting participants and current committee members will automatically be notified by email when the *Conference Program* is available.

Technical Digest on CD-ROM

The LACSEA *Technical Digest* will contain PDFs of paper summaries presented during the meeting as they were submitted by the authors; the *Technical Digest* will be produced on CD-Rom. At the meeting, each registrant will receive a copy of the *Technical Digest* on CD-Rom. Extra copies can be purchased at the meeting for a special price of US$ 100.

Students

Student members are an important and active part of the OSA community. Student benefits are built around the unique needs of those preparing to enter the professional world of optics. As an OSA Student Member, you join a worldwide community of optics and photonics scientists, engineers and business leaders. Join us today.

Student Members attend OSA conferences, exhibits and educational sessions at reduced rates. Frontiers in Optics (OSA's Annual Meeting), the Optical Fiber Communication Conference & Exposition and National Fiber Optic Engineers Conference (OFC/NFOEC), the Conference on Lasers and Electro-Optics (CLEO) and more than 20 topical meetings are among the many annual events hosted by OSA.

OSA Foundation Student Travel Grants

The OSA Foundation is pleased to offer travel grants to students working or studying in a qualifying developing nation who plan to attend Laser Applications to Chemical, Security and Environmental Analysis (LACSEA) 2010.

Applications are no longer being accepted for the 2010 meeting.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	Topaz Room Applications of Lasers for Sensing and Free Space Communications (LS&C)	Diamond Room Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

7:00 a.m.–5:00 p.m. Registration Open, *Ballroom Foyer*
10:00 a.m.–5:00 p.m. Exhibit Open, *Crystal Ballroom*

AMA • Novel Sources

Monday, February 1
8:00 a.m.–10:00 a.m.
Ingmar Hartl; IMRA America, Inc., USA, Presider

8:00 a.m.–8:15 a.m.
Opening Remarks

AMA1 • 8:15 a.m. Invited
Phasing of High Power Fiber Amplifier Arrays, *Thomas M. Shay[1], J. T. Baker[2], Anthony D. Sancheza[1], C. A. Robin[1], C. L. Vergien[1], Angel Flores[1], C. Zerinque[1], D. Gallant[2], Chunte A. Lu[1], Benjamin Pulford[1], T. J. Bronder[1], Arthur Lucero[2]; [1]AFRL, USA, [2]Boeing LTS Inc., USA.* We report locking the phase of a five element 725-W amplifier array and in addition we report phase locking off the backscatter from a remote object. The rms phase error was measured to be $\lambda/60$.

AMA2 • 8:45 a.m.
Coherent Combining of a 1.26-kW Fiber Amplifier, *Stuart J. McNaught, Joshua E. Rothenberg, Peter A. Thielen, Michael G. Wickham, Mark E. Weber, Gregory D. Goodno; Northrop Grumman Aerospace Systems, USA.* A 1.26-kW, multi-stage Yb fiber MOPA was coherently combined using active polarization and phase control with 94% visibility to a second fiber amplifier, consistent with estimated decoherence effects from fiber nonlinearity, linewidth, and phasing accuracy.

AMA3 • 9:00 a.m.
Diffraction-Limited Operation from Multimode and Multi-Core Fibers Using Active Digital Holography Precompensation, *Mathieu Paurisse[1], Marc Hanna[1], Frederic Druon[1], Patrick Georges[1], Cindy Bellanger[2], Arnaud Brignon[2], Jean-Pierre Huignard[2]; [1]Lab Charles Fabry de l'Inst. d'Optique, France, [2]Thalès Res. and Technology, France.* We demonstrate beam pre-compensation shaping using digital holography allowing diffraction limited operation out of a multimode LMA fiber and a multi-core fiber in CW and pulsed regime.

LSMA • Performance Analysis of Experimental FSO Systems

Monday, February 1
8:00 a.m.–10:00 a.m.
Steve Koutsoutis; US Army CERDEC, USA, Presider
Linda Thomas; NRL, USA, Presider

LSMA1 • 8:00 a.m. Invited
Adaptive Optics for Free Space Laser Communications, *Mikhail Vorontsov[1], Thomas Weyrauch[1], Gary Carhart[2], Leonid Beresnev[2]; [1]School of Engineering, Univ. of Dayton, USA, [2]ARL, USA.* We discuss adaptive optics (AO) role in free-space laser communications with focus on two major challenges: The high cost of AO deployment, and high intensity scintillation levels that are typical for most communication scenarios.

LSMA2 • 8:30 a.m. Invited
Presentation to Be Announced

LSMA3 • 9:00 a.m. Invited
Air to Ground Lasercom System Demonstration, *George Nowak; United States Military Acad., USA.* Abstract not available.

LMA • Advances in Mid-IR Sources for Spectroscopy

Monday, February 1
8:00 a.m.–10:00 a.m.
Presider to Be Announced

LMA1 • 8:00 a.m.
Invited
On Recent Progress Using QCLs for Molecular Trace Gas Detection - from Basic Research to Industrial Applications, *Jürgen Röpcke[1], Paul Davies[2], Frank Hempel[1], Marko Huebner[1], Sven Glitsch[1], Norbert Lang[1], Markus Naegele[3], Antoine Rousseau[4], Stephan Wege[5], Stefan Welzel[1,6]; [1]INP Greifswald, Germany, [2]Univ. of Cambridge, UK, [3]OptoPrecision GmbH, Germany, [4]LPTP, Ecole Polytechnique, France, [5]Qimonda Dresden GmbH & Co. OHG, Germany, [6]Eindhoven Univ. of Technology, Netherlands.* Quantum Cascade Lasers offer attractive options for applications of MIR absorption spectroscopy for basic research and industrial process control. The contribution reviews applications for plasma diagnostics and trace gas monitoring in research and industry.

LMA2 • 8:30 a.m.
Invited
Single-Mode Room-Temperature CW Interband Cascade Lasers Covering the λ = 3-4 μm Spectral Band, *Mijin Kim, William W. Bewley, J. R. Lindle, Chulsoo Kim, Chadwick L. Canedy, Joshua Abell, Igor Vurgaftman, Jerry Meyer; NRL, USA.* Interband cascade lasers emitting at 3.6 μm operated to a maximum temperature of 335 K and produced 59 mW of cw power at room temperature. Single-mode cw emission with 12 mW of power was demonstrated.

LMA3 • 9:00 a.m.
Spectroscopic Applications of External Cavity Quantum Cascade Laser with Fast Tuning, *Tracy R. Tsai, Gerard Wysocki; Princeton Univ., USA.* Littrow-based folded external cavity QCL capable of tuning up to 7cm-1 at kHz rates is presented. Laser capabilities in pulsed and cw modes are demonstrated by performing absorption spectroscopy of ammonia and ethylene at ~10μm.

Emerald Ballroom	Topaz Room	Diamond Room
Advanced Solid-State Photonics (ASSP)	Applications of Lasers for Sensing and Free Space Communications (LS&C)	Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AMA • Novel Sources–Continued

AMA4 • 9:15 a.m.
High Repetition Rate Fiber Laser Systems for High Field Physics, *Steffen Hädrich[1], Manuel Krebs[1], Stefan Nolte[1], Jens Limpert[1], Andreas Tünnermann[1,2]; [1]Friedrich Schiller Univ. Jena, Germany, [2]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* We show generation of XUV radiation at 23.9 nm at 50 kHz via HHG of a fiber amplification system. Postcompression of this system to 70 fs, 200 μJ, 2 GW pulses shows further scaling potential.

AMA5 • 9:30 a.m. **Invited**
Recent Advances of Table-Top Soft X-ray Lasers, *J. J. Rocca, F. J. Furch, B. A. Reagan, Y. Wang, D. Alessi, D. Martz, B. M. Luther, A. H. Curtis, S. P. Meehan, S. Domingue, D. Kemp; Colorado State Univ. at Fort Collins, USA.* We review recent advances in the development of high repetition rate table-top soft X-ray lasers that includes their extension to wavelengths down to 10.9 nm and the first demonstration of an all-diode-pumped soft x-ray laser.

LSMA • Performance Analysis of Experimental FSO Systems–Continued

LSMA4 • 9:30 a.m. **Invited**
Differential Phase-Shift Keying in Multi-Wavelength Spatial Diversity Links, *Todd Ulmer, Scott R. Henion, Frederick G. Walther, Peter A. Schulz; MIT Lincoln Lab, USA.* We investigate the use of differential phase-shift keying in multi-wavelength spatial diversity transmitters that mitigate atmospheric fading.

LMA • Advances in Mid-IR Sources for Spectroscopy–Continued

LMA4 • 9:15 a.m.
Invited
Tunable Difference Frequency Generation Laser Spectrometers: Successes, Challenges, and Opportunities, *Dirk Richter[1], Petter Weibring[1], Alan Fried[1], Lars Rippe[1], Märta Lewander[1,2], Oscar Batet[1,3], James G. Walega[1], Scott Spuler[1]; [1]Natl. Ctr. for Atmospheric Res., USA, [2]Atomic Physics Div., Lund Univ., Sweden, [3]Dept. of Signal Theory and Communications, Technical Univ. of Catalonia, Spain.* We will review the state of development and applications of difference-frequency generation based laser spectrometers to atmospheric research and discuss the operating conditions and techniques that enable high precision performance for ground and airborne environments.

LMA5 • 9:45 a.m.
Characterization of Highly Stable Mid-IR, GaSb-Based Laser Diodes, *Andrey V. Okishev[1], Ding Wang[2], David Westerfeld[3], Leon Shterengas[2], Gregory Belenky[2]; [1]Univ. of Rochester, USA, [2]SUNY Stony Brook, USA, [3]Power Photonic Corp., USA.* Highly stable, room-temperature mid-IR, GaSb-based laser diodes have been characterized at various temperatures and driver currents. Up to 54 mW of output power was demonstrated in a 3150-3180-nm wavelength range with <20-nm FWHM spectral width.

10:00 a.m.–10:30 a.m. Coffee Break/Exhibits, *Crystal Ballroom*

Monday, February 1
Ballroom Foyer
10:00 a.m.–11:30 a.m.

AMB1

High-Energy Femtosecond Er-Doped Fiber Laser at 1.6 μm: Influence of Pumping Scheme, *Franck Morin, Frédéric Druon, Marc Hanna, Patrick Georges; Lab Charles Fabry de l'Inst. d'Optique, CNRS, Univ. Paris-Sud, France.* We present the first microjoule-class sub-picosecond erbium-doped fiber laser at 1600 nm, and demonstrate the generation of 1.5 μJ, 605 fs pulses at 300 kHz. Both 980 nm and 1540 nm pumping schemes are investigated.

AMB2

Thulium Fiber Lasers Stabilized by a Volume Bragg Grating in High Power, Tunable and Q-Switched Configurations, *Timothy S. McComb, Lawrence Shah, Christina C. C. Willis, R. Andrew Sims, Pankaj K. Kadwani, Vikas Sudesh, Martin Richardson; CREOL, College of Optics and Photonics, Univ. of Central Florida, USA.* Thulium fiber lasers are spectrally stabilized using a volume Bragg grating. 159 W power and >100 nm tuning range are achieved in CW configurations, and pulses <115 ns with >350 μJ are generated when Q-switched.

AMB3

Beam Quality and Spectral Evolution in Large-Core Cladding-Pumped Cascaded-Raman Fiber Converter, *Junhua Ji, Christophe A. Codemard, Alexander Boyland, Jayanta K. Sahu, Johan Nilsson; Optoelectronics Res. Ctr., Univ. of Southampton, UK.* We fabricate the first large-core double-clad Raman fiber and use it for efficient pulsed cladding-pumped fiber Raman amplification. The beam-quality of the output beam improves to diffraction-limited through cascaded Raman scattering.

AMB4

Pulse Quality Improvement in Nonlinear Fiber-Amplifiers by Using Circularly Polarized Light, *Enrico Seise[1], Damian N. Schimpf[1], Tino Eidam[1], Steffen Hädrich[1], Jens Limpert[1], Andreas Tünnermann[2]; [1]Inst. of Applied Physics, Friedrich Schiller Univ. Jena, Germany, [2]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* We experimentally present the advantage of using circularly polarized light during laser amplification to reduce the accumulated Kerr-nonlinearity. The theoretical value of 2/3 for the reduction of the B-integral is verified in a fiber CPA-system.

AMB5

Diode Side Pumping of a Gain Guided, Index Anti-Guided Large Mode Area Neodymium Fiber Laser, *William B. Hageman[1], Ying Chen[1], Michael Bass[1], Vikas Sudesh[1], Tim McComb[1], Martin Richardson[1], Gyu Kim[2]; [1]CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA, [2]Kumoh Natl. Inst. of Technology, Republic of Korea.* Diode side pumping of a gain guided, index anti-guided neodymium doped fiber laser is demonstrated. This method of pumping may lead to a scalable approach to create high power, extremely large mode are`a fiber lasers.

AMB6

Spectral Beam Combining of 2 μm Tm Fiber Laser Systems, *Robert A. Sims[1], Christina C. C. Willis[1], Pankaj Kadwani[1], Timothy S. McComb[1], Lawrence Shah[1], Vikas Sudesh[1], Zachary A. Roth[2], Menelaos K. Poutous[2], Eric G. Johnson[2], Martin Richardson[1]; [1]CREOL, College of Optics and Photonics, Univ. of Central Florida, USA, [2]Ctr. for Optoelectronics and Optical Communications, Univ. of North Carolina at Charlotte, USA.* We report spectral beam combining of three 2-μm Tm fiber lasers each locked to slightly different wavelengths, using a new spectral-limiting device, providing a path forward to beam-combining at the multi-kW level.

AMB7

Over 20W Pico-second Vortex Output from a Large-Mode-Area Fiber MOPA System, *Yuichi Tanaka, Mio Koyama, Masahito Okida, Katsuhiko Miyamoto, Takashige Omatsu; Chiba Univ., Japan.* We scale the power of a pico-second vortex master-oscillator power amplifier system based on a stressed large-mode-area fiber amplifier. The vortex output power of >20 W with the corresponding peak power of >30kW was obtained.

AMB8

All-Fiber Q-Switched and Cavity Dumped Laser Using an Electrically Addressed Microstructured Fiber, *Mikael Malmström1, Walter Margulis[2,1], Zhanwei Yu[1], Oleksander Tarasenko[2], Fredrik Laurell[1]; [1]Dept. of Applied Physics, Royal Inst. of Technology (KTH), Sweden, [2]Dept. of Fiber Photonics, Acreo AB, Sweden.* We report on a pulsed fiber laser with two regimes of operation, one where cavity-roundtrip pulse durations are produced (85 ns long, 40 Wpp) and one with high power pulses (2 ns long, 148 Wpp).

AMB9

Pump-Seed Synchronization Measurements for High-Power Short-Pulse Pumped Few-Cycle OPCPA System, *Izhar Ahmad[1], Sandro Klingebiel[1], Christoph Skrobol[1], Christoph Wandt[1], Sergei Trushin[1], Zsuzsanna Major[1,2], Ferenc Krausz[1,2], Stefan Karsch[1,2]; [1]Max-Planck Inst. for Quantum Optics, Germany, [2]Ludwig-Maximilians-Univ. München, Germany.* We present the development of an optically synchronized frontend of a high-power short-pulse pumped few-cycle OPCPA system and single shot pump-seed timing jitter measurements at the position of its first OPCPA stage.

AMB10

Amplification of Picosecond Pulses Generated in a Carbon Nanotube Modelocked Thulium Fiber Laser, *Timothy S. McComb[1], Pankaj Kadwani[1], Robert Andrew Sims[1], Lawrence Shah[1], Christina C. C. Willis[1], Gavin Frith[2], Vikas Sudesh[1], Bryce Samson[3], Martin Richardson[1]; [1]Townes Laser Inst., CREOL, College of Optics and Photonics, Univ. of Central Florida, USA, [2]Macquarie Univ., Australia, [3]Nufen Inc., USA.* Generation of 5ps, 32pJ pulses from a carbon nanotube modelocked thulium fiber oscillator and their amplification to 0.6W average power, 2.6kW peak power, 13nJ pulses by an LMA thulium fiber amplifier is discussed.

AMB11

Amplification of a Passively Q-Switched Nd:YAG Microlaser in a Crystal Fiber, *Igor Martial[1], Heather Ferguson[1], Nabil Douri[1], Damien Sangla[1], François Balembois[1], Julien Didierjean[2], Patrick Georges[1]; [1]Lab Charles Fabry de l'Inst. d'Optique, France, [2]Fibercryst SAS, France.* A passively Q-switched Nd:YAG microchip laser generating 18.6 μJ, 5.5 ns pulses with a repetition rate of 29 kHz was efficiently amplified by a diode-pumped Nd:YAG crystal fiber amplifier to obtain 250 μJ pulses.

AMB12

High Performances in Continuous-Wave and Q-Switch Operation of a Narrow Linewidth Nd:YVO_4 Oscillator Using a Volume Bragg Grating, *Michaël Hemmer, Martin Richardson; CREOL, College of Optics and Photonics, Univ. of Central Florida, USA.* A quasi-single-longitudinal mode Nd:YVO_4 oscillator providing up to 11 W CW is presented. In Q-switched regime, up to 1.2 mJ output energy with spectral linewidth narrower than 20 pm at 1kHz repetition rate were obtained.

AMB13

High-Power Ho:YAG Laser in-Band Pumped by Laser Diodes at 1.9 μm and Wavelength-Stabilized by a Volume Bragg Grating, *Samir Lamrini[1], Philipp Koopmann[1], Karsten Scholle[1], Peter Fuhrberg[1], Martin Hofmann[2]; [1]LISA laser products OHG, Germany, [2]Ruhr-Univ. Bochum, Germany.* The first high-power Ho:YAG laser wavelength-stabilized by a volume Bragg grating is reported. A maximum output power of 15 W and a slope-efficiency of 37% were achieved using in-band diode pumping.

AMB14

High Efficient Q-Switched Ho:LuAG Laser with High Repetition Rates, *Xiaoming Duan, Baoquan Yao, Gang Li, Youlun Ju, Yuezhu Wang; Harbin Inst. of Technology, China.* We present the high efficient Q-switched Ho:LuAG laser at 2.1µm pumped by diode-pumped Tm:YLF laser. The average output power at 10kHz of 9.9W with slope efficiency of 69.9% relative to absorbed pump power was obtained.

AMB15

Inband Pumped Er:Lu_2O_3 and (Er,Yb):YVO_4 Lasers near 1.6 µm for CO_2 LIDAR, *Christian Brandt[1], Nikolai A. Tolstik[2], Nikolai V. Kuleshov[2], Klaus Petermann[1], Guenter Huber[1]; [1]Inst. of Laser-Physics, Univ. of Hamburg, Germany, [2]Inst. for Optical Materials and Technologies, Belarus Natl. Technical Univ., Belarus.* Er:Lu_2O_3 and (Er,Yb):YVO_4 provide suitable spectra for CO_2-LIDAR systems around 1.6µm. First inband pumped laser experiments show output powers up to 1.26W and slope efficiencies of up to 48% with respect to absorbed pump power.

AMB16

Estimation of Gain Bandwidth Limitation of Short Pulse Duration Based on Competition of Gain Saturation, *Masaki Tokurakawa, Akira Ahirakawa, Ken-ichi Ueda; Univ. of Electro-Communications, Japan.* We show the gain bandwidth limitation of the short pulse duration by time independent rate equations including the reabsorption effect, laser mode diameters and wavelength integration parts. The necessary conditions for mode-locked operation are obtained.

AMB17

Relation between Group Delay and Energy Storage in Dispersive Dielectric Mirror Coatings, *Peter Gyula Antal, Robert Szipocs; Res. Inst. for Solid State Physics and Optics, Hungary.* We show that the reflection group delay of a highly reflective, dielectric multilayer mirror is proportional to the energy stored by the standing wave electromagnetic field built up in such 1D photonic bandgap (PBG) structures.

AMB18

Multi Photon Absorption Induced Amplified Ultraviolet Emission from Hydrothermally Grown ZnO Nanorods, *Gaurav Shukla, Alika Khare; Indian Inst. of Technology Guwahati, India.* Multi photon absorption induced ultra-violet (UV) photoluminescence, second harmonic generation at 532 nm and amplified spontaneous emission at 392 nm from hydrothermally grown ZnO nanorods arrays upon nano-second infrared excitation is reported in the paper.

AMB19

Intrinsic Reduction of the Depolarization in Nd:YAG Crystals, *Henrik Tünnermann[1], Oliver Puncken[1], Peter Weßels[1,2], Maik Frede[1,2], Dietmar Kracht[1,2], Jörg Neumann[1,2]; [1]Laser Zentrum Hannover e.V., Germany, [2]Ctr. for Quantum Engineering and Space-Time Res. (QUEST), Leibniz Univ. Hannover, Germany.* Thermally induced depolarization in Nd:YAG lasers can be reduced by choice of the crystal cut. Experimental results and corresponding simulations at pump powers around 140W are presented for [111]-, [100]- and [110]-cut crystals.

AMB20

Generation of Cylindrical Vector Beams of a Single Higher Order Transverse Mode, *Akihiko Ito, Yuichi Kozawa, Shunichi Sato; Tohoku univ., Japan.* Generation of cylindrical vector beams of a single higher order transverse mode is demonstrated using a rear mirror with a low reflectivity area near the beam axis. Both Laguerre-Gaussian and Bessel-Gaussian vector beams are identified.

AMB21

Cavity Length Resonances in a Singly Resonant Optical Parametric Oscillator with a Volume Bragg Grating, *Markus Henriksson[1,2], Lars Sjöqvist[1], Valdas Pasiskevicius[2], Fredrik Laurell[2]; [1]FOI, Swedish Defence Res. Agency, Sweden, [2]Royal Inst. of Technology (KTH), Sweden.* Resonant output energy enhancement in a singly resonant nondegenerate type-I optical parametric oscillator with a volume Bragg grating output coupler is demonstrated when there is a low fraction cavity length ratio between laser and OPO.

AMB22

Phase Locking Control of the Multichannel Holographic Laser System with the Help of Passive Q-Switch, *Tasoltan T. Basiev[1], Alexander V. Fedin[2], Andrey V. Gavrilov[2], Sergey N. Smetanin[2]; [1]A.M. Prokhorov General Physics Inst. of RAS, Russian Federation, [2]Kovrov State Technological Acad., Russian Federation.* Method of phase-locking control of the multichannel laser system by use of a passive Q-switch is proposed. For the first time a phase-locked and Q-switched oscillation of the multichannel Nd:YAG-laser system is realized.

AMB23

Coherent Picosecond Pulse Stacking by Cascaded Fiber Bragg Gratings for Flat-Top Pulse Generation, *Jan Rothhardt[1], Steffen Hädrich[1], Thomas Gottschall1, T. Clausnitzer[1], Jens Limpert[1], Andreas Tünnermann[1,2], Manfred Rothhardt[3], Martin Becker[3], Sven Brückner[3], Hartmut Bartelt[3]; [1]Friedrich-Schiller-Univ. Jena, Germany, [2]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany, [3]Inst. of Photonic Technology, Germany.* We present a simple and robust pulse shaping device based on coherent pulse stacking. The device is based on fiber Bragg gratings written in a polarisation maintaining step index fiber and a fiber optical circulator.

AMB24

Fiber Amplified Q-Switched ns-Sources Spectrally Combined by the Use of Interference Filters, *Oliver Schmidt[1], Christian Wirth[1], Dirk Nodop[1], Jens Limpert[1], Thomas Schreiber[2], Ramona Eberhardt[2], Andreas Tünnermann[2,1]; [1]Friedrich-Schiller-Univ. Jena, Germany, [2]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* We report on a simple scheme to spectrally combine four ns-pulsed sources using three off-the-shelf dielectric interference-filters as combining elements. 208W of average power and 6.3mJ of pulse energy are obtained at different repetition frequencies.

AMB25

Dynamic Multimode Analysis of High-Power Lasers with Super-Gaussian Beam Profile Using Precombined Gaussian Modes, *Matthias Wohlmuth[1], Konrad Altmann[2], Michaël Hemmer[3], Mario Goehre[4], Christoph Pflaum[1], Martin Richardson[3]; [1]Univ. Erlangen-Nuremberg, Germany, [2]LAS-CAD GmbH, Germany, [3]Townes Laser Inst., CREOL, College of Optics and Photonics, Univ. of Central Florida, USA, [4]Clean-Laserysteme GmbH, Germany.* Dynamic Multimode Analysis investigates mode competition including thermal, spatial, and dynamic effects. However, the computational effort increases dramatically for super-gaussian beams in high-power lasers. We explain how this can be solved by precombining Gaussian modes.

AMB26

Experimental Confirmation of Quasi-Soliton Pulse Formation in Ultrafast VECSELs, *Oliver D. Sieber, Martin Hoffmann, Deran J. H. C. Maas, Valentin J. Wittwer, Matthias Golling, Thomas Südmeyer, Ursula Keller; ETH Zurich, Switzerland.* A detailed experimental study on pulse formation in ultrafast VECSELs confirms that shortest pulses require slightly positive dispersion to balance saturation effects. These results are in good agreement with simulations, confirming the quasi-soliton pulse-formation theory.

AMB27

Waveguide Devices Produced by Adaptive Femtosecond Laser Writing, *Matthias Pospiech[1], Moritz Emons[1], Benjamin Väckenstedt[1], Roberto Osellame[2], Nicola Bellini[2], Giulio Cerullo[2], Uwe Morgner[1,3]; [1]Inst. of Quantum Optics, Leibniz Univ. Hannover, Germany, [2]Inst. di Fotonica e Nanotecnologie - CNR, Dept. di Fisica, Politecnico di Milano, Italy, [3]Laser Zentrum Hannover e.V., Germany.* We report a novel method to create waveguide devices such as couplers in fused silica. A combination of adaptive beam shaping with femtosecond laser writing is used to simultaneously write two waveguides with changing separation.

AMB28

The Effect of the Longitudinal Electric Field of a Radially Polarized Laser Beam for Second Harmonic Generation, *Yuichi Kozawa, Akihiko Ohtsu, Shunichi Sato; Inst. of Multidisciplinary Res. for Advanced Materials, Tohoku Univ., Japan.* Second harmonic generation is demonstrated for radially and azimuthally polarized beams. The contribution of longitudinal electric field generated by a focused radially polarized beam is clearly distinguished from that by an azimuthally polarized beam.

AMB29

Power Scaling of a Compact and Efficient Blue Diode Pumped Solid State Laser Emitting Green Light, *Michael Strotkamp, Thomas Schwarz, Bernd Jungbluth; Fraunhofer Inst. For Laser Technology, Germany.* A green, efficient bDPSSL for use in digital projectors has been developed. The use of Pr:YLF in an extremely short resonator and the power scaling with new pump diodes is shown.

AMB30

Stable Half-watt 355 nm generation with PPMgSLT, *Junji Hirohashi, Tatsuo Fukui, Yasunori Furukawa; OXIDE corp., Japan.* A half-watt of 355nm laser is achieved from PPMgSLT by sum-frequency generation of fundamental and second harmonic of pulsed Nd: YVO_4 laser. Over 24 hours stable generation was confirmed.

NOTES

Emerald Ballroom	Topaz Room	Diamond Room
Advanced Solid-State Photonics (ASSP)	Applications of Lasers for Sensing and Free Space Communications (LS&C)	Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AMC • Infrared Lasers

Monday, February 1
11:30 a.m.–1:00 p.m.
Upendra Singh; NASA Langley Res. Ctr., USA, Presider

LSMB • Laser Communication Systems and Channel Characterization for Laser Comm Systems

Monday, February 1
10:30 a.m.–1:00 p.m.
Larry Andrews; Univ. of Central Florida, USA, Presider
Presider to Be Announced

LSMB1 • 10:30 a.m. **Invited**
Coherent Free-Space Optical Communication Using Electronic Wavefront Correction, *Guifang Li; Univ. of Central Florida, USA.* Mitigation of wavefront distortion due to atmospheric turbulence using coherent detection and digital signal processing will be presented. The advantages of this electronic wavefront correction technique over adaptive optics will be described.

LSMB2 • 11:00 a.m. **Invited**
On the Achievable Performance of Non-Line-of-Sight Ultraviolet Communications, *Qunfeng He[1], Brian Sadler[2], Zhengyuan Xu[1]; [1]Univ. of California, USA, [2]US ARL, USA.* We show achievable data rates for outdoor non-line-of-sight communications in the deep UV (UV-C) band as a function of modulation scheme, power, range, background noise, and pointing geometry. Both theoretical and numerical results are presented.

LMB • Cavity-Enhanced and Advanced Detection Strategies

Monday, February 1
10:30 a.m.–12:30 p.m.
Anatoliy A. Kosterev; Rice Univ., USA, Presider
Houston Miller; George Washington Univ., USA, Presider

LMB1 • 10:30 a.m. **Invited**
Applications of cw Cavity Ring-Down Spectroscopy to the Study of Trace Atmospheric Constituents, *R. Grilli, D. Mellon, J. Kim, M. S. I. Aziz, D. Hamilton, A. J. Orr-Ewing; Univ. of Bristol, UK.* Diode laser cavity ring-down spectroscopy is a versatile method for quantitative determination of trace atmospheric constituents. Examples include measurement of mixing ratios of small organic compounds, isotopologue-specific spectroscopy, and optical extinction by atmospheric aerosol particles.

LMB2 • 11:00 a.m.
Broadband Cavity Enhanced Trace Sensing Using Supercontinuum Light Sources, *Toni K. Laurila[1], Rosalynne S. Watt[1], Clemens F. Kaminski[1,2]; [1]Dept. of Chemical Engineering and Biotechnology, Univ. of Cambridge, UK, [2]School of Advanced Optical Technologies, Max-Planck-Inst. for the Science of Light, Germany.* Broadband multi-species detection at low concentrations in the gas and liquid phase has been achieved by coupling supercontinuum radiation and cavity enhanced absorption spectroscopy.

LMB3 • 11:15 a.m.
Pseudo-Random Modulation Methods for Cavity-Enhanced Spectroscopy, *David C. Hovde, Steve M. Massick, Daivd S. Bomse; Southwest Sciences, USA.* Both pseudo-random amplitude modulation and pseudo-random tone-burst modulation methods were applied to determine range resolved cavity losses in a cylindrical-mirror cavity excited by a distributed feedback laser. Gas concentrations were determined.

Emerald Ballroom	Topaz Room	Diamond Room
Advanced Solid-State Photonics (ASSP)	Applications of Lasers for Sensing and Free Space Communications (LS&C)	Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AMC • Infrared Lasers–Continued

AMC1 • 11:30 a.m.

Single-Frequency Narrow-Linewidth 2µm Fiber Laser Using Tm-Doped Silicate Glass Fiber, *Jihong Geng[1], Qing Wang[1], Tao Luo[1], Shibin Jiang[1], Farzin Amzajerdian[2]; [1]AdValue Photonics Inc., USA, [2]NASA Langley Res. Ctr., USA.* Single-frequency laser operation near 2µm has been demonstrated in an all-fiber DBR cavity using both cladding- and core-pump configurations in newly developed heavily Tm-doped silicate fiber with laser linewidth as narrow as 3 kHz.

AMC2 • 11:45 a.m.

Ultrabroad Continuous-Wave Tuning of Ceramic Cr:ZnSe and Cr:ZnS Lasers, *Evgeni Sorokin[1], Irina T. Sorokina[2], Mike S. Mirov[3], Vladimir V. Fedorov[4], Igor S. Moskalev[3,4], Sergey B. Mirov[4,3]; [1]Technische Univ. Vienna, Austria, [2]Norwegian Univ. of Science and Technology, Norway, [3]Photonics Innovations, Inc., USA, [4]Univ. of Alabama at Birmingham, USA.* Using a single set of optics, we demonstrate ultrabroad tuning over more than 1300 nm from 1973 to 3349 nm in Cr:ZnSe and from 1962 to 3195 nm in Cr:ZnS at <10 GHz linewidth.

AMC3 • 12:00 p.m.

Diode-Pumped Er^{3+}:Y_2O_3 Ceramic Laser at ~3-um, *Tigran Sanamyan, Jed F. Simmons, Mark Dubinskii; US ARL, USA.* We report on spectroscopy and diode-pumped ~3-µm laser operation of Er^{3+}:Y_2O_3 ceramic resonantly pumped into upper level. This is believed to be the first laser based on $^4I_{11/2} \Rightarrow {}^4I_{13/2}$ transitions of Er^{3+} in Y_2O_3.

LSMB • Laser Communication Systems and Channel Characterization for Laser Comm Systems–Continued

LSMB3 • 11:30 a.m. **Invited**

Observations of Power-in-Fiber Statistics in Two Recent Free-Space Communication Link Experiments, Ron Parenti, Steven Michael, *Jeffrey M. Roth, Timothy M. Yarnall; MIT Lincoln Lab, USA.* Lincoln Laboratory conducted two free-space optical communication experiments designed to test the ability of beam diversity, symbol encoding, and interleaving to reduce the effects of turbulence induced scintillation. This article presents a small sample of the power-in-fiber data obtained from those experiments.

LSMB4 • 12:00 p.m. **Invited**

Characterization of Free-Space Optical Paths with Lidar, *Gary G. Gimmestad; Georgia Tech Res. Inst., USA.* The utility of free-space optical communication channels is often limited by atmospheric turbulence and turbidity. Lidar techniques are described for characterizing such optical paths, in support of both field measurements and modeling.

LMB • Cavity-Enhanced and Advanced Detection Strategies–Continued

LMB4 • 11:30 a.m. **Invited**

Quartz Enhanced Photoacoustic Spectroscopy: Today and Beyond, *Anatoliy A. Kosterev; Rice Univ., USA.* Current theoretical understanding and practical applications of the trace gas sensing technique called quartz enhanced photoacoustic spectroscopy (QEPAS) will be presented. Work in progress and planned QEPAS developments will be discussed.

LMB5 • 12:00 p.m.

Real Time Determination of Water Isotope Ratios by Laser Absorption Spectroscopy at 2.73 µm Using Kalman Filter, *Tao Wu[1,2], Weidong Chen[1], Eirk Kerstel[3], Eric Fertein[1], Pascal Masselin[1], Xiaoming Gao[2], Johannes Koeth[4], Karl Rößner[4], Daniela Bruekner[4]; [1]Lab de Physicochimie de l'Atmosphère, Univ. du Littoral, France, [2]Anhui Inst. of Optics and Fine Mechanics, Chinese Acad. of Sciences, China, [3]Univ. of Groningen, Netherlands, [4]Nanoplus Nanosystems and Technologies GmbH, Germany.* Kalman filter was applied to measurements of water isotopologue ratios by laser spectroscopy at 2.73 µm. The results obtained in 1-s showed a 1σ precision that required ~30-s averaging when using a simple average approach.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	Topaz Room Applications of Lasers for Sensing and Free Space Communications (LS&C)	Diamond Room Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AMC • Infrared Lasers–Continued

AMC4 • 12:15 p.m.
Reduction of Timing-Jitter in a Passively Q-Switched Microchip Laser Using Self-Injection Seeding, *Alexander Steinmetz, Dirk Nodop, Jens Limpert, Andreas Tünnermann; Inst. of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany.* We present a simple technique for the timing jitter reduction in passively Q-switched microchip-lasers by self-injection seeding using a fiber delay line. The jitter is reduced by several orders of magnitude.

AMC5 • 12:30 p.m.
Semiconductor Q-Switched, Short-Pulse, High-Power, MHz-Rate Laser, *Alex Dergachev[1], Peter F. Moulton[1], Gale S. Petrich[2], Leslie A. Kolodziejski[2], Franz X. Kärtner[2]; [1]Q-Peak, Inc., USA, [2]MIT, USA.* We report a 0.8-5.0 ns-width, 0.1-2 MHz-rate Nd-MOPA laser passively Q-switched with a semiconductor saturable Bragg reflector producing 7.5 W of average power at 532 nm in a diffraction limited beam.

AMC6 • 12:45 p.m.
Periodically Poled $KTiOAsO_4$ for Mid-Infrared Light Generation, *Andrius Zukauskas, Nicky Thilmann, Valdas Pasiskevicius, Fredrik Laurell, Carlota Canalias; Royal Inst. of Technology, Sweden.* A periodically poled $KTiOAsO_4$ crystal was fabricated at room temperature. The poled crystal shows a d_{eff} of 10.1 pm/V and gives a parametric conversion efficiency of 45%.

LSMB • Laser Communication Systems and Channel Characterization for Laser Comm Systems–Continued

LSMB5 • 12:30 p.m. **Invited**
Measurements of Atmospheric Turbulence Characteristics for Laser Channel Characterization, *Mikhail Belenkii; Trex Enterprises Corp., USA.* A novel LIDAR technique for turbulence profile determination with high spatial and temporal resolution is presented. An overview of measurements of turbulence inner scale, anisotropy coefficient, and outer scale on space-to-ground propagation paths is given.

LMB • Cavity-Enhanced and Advanced Detection Strategies–Continued

LMB6 • 12:15 p.m.
Fast Multispecies Gas Monitoring Based on a Single Modulated Grating Y-Branch Diode Laser Operating between 1529 nm and 1565 nm, *Märta L. Lewander[1,2,3], Alan Fried[2], Dirk Richter[2], Petter Weibring[2], Lars Rippe[2,3]; [1]Lund Univ., Sweden, [2]Earth Observing Lab, Natl. Ctr. for Atmospheric Res., USA, [3]Advanced Study Program, Natl. Ctr. for Atmospheric Res., USA.* A multispecies sensor based on one single modulated grating Y-branch diode laser is presented. Sequential scanning of three gases with absorption lines separated 30 nm in less than 20 ms is demonstrated.

1:00 p.m.–2:30 p.m. Lunch Break *(on your own)*

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	Topaz Room Applications of Lasers for Sensing and Free Space Communications (LS&C)	Diamond Room Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AMD • Ultrafast Lasers I

Monday, February 1
2:30 p.m.–4:00 p.m.
Takunori Taira; Laser Res. Ctr. for Molecular Science, Inst. for Molecular Science, Japan, Presider

AMD1 • 2:30 p.m.
Continuous-Wave Yb-Doped Sesquioxide Thin Disk Lasers with up to 300 W Output Power and 74% Efficiency, *Oliver H. Heckl[1], Rigo Peters[2], Christian Kränkel[1], Cyrill R. E. Baer[1], Clara J. Saraceno[1], Thomas Südmeyer[1], Klaus Petermann[2], Ursula Keller[1], Günter Huber[2]; [1]ETH Zurich, Switzerland, [2]Univ. of Hamburg, Germany.* We obtained 301W of output power, 88% slope efficiency, and 74% optical-to-optical efficiency with VBG-diode-pumped $Yb:Lu_2O_3$ thin disk lasers. $Yb:Sc_2O_3$ and $Yb:LuScO_3$ showed comparable performance, delivering 264W and 250W of output power, respectively.

AMD2 • 2:45 p.m.
Efficient Mode-Locked $Yb:Lu_2O_3$ Thin Disk Laser with an Average Power of 103 W, *Cyrill R. E. Baer[1], Christian Kränkel[1], Clara J. Saraceno[1], Oliver H. Heckl[1], Matthias Golling[1], Thomas Südmeyer[1], Ursula Keller[1], Rigo Peters[2], Klaus Petermann[2], Günter Huber[2]; [1]Dept. of Physics, Inst. of Quantum Electronics, ETH Zurich, Switzerland, [2]Inst. of Laser-Physics, Univ. of Hamburg, Germany.* We demonstrate power scaling of an $Yb:Lu_2O_3$ thin-disk laser to an average power of 103 W setting a new record for mode-locked laser oscillators. The laser generates 885-fs pulses with an optical-to-optical efficiency of 42%.

LSMC • Free Space Optics Modulation Techniques

Monday, February 1
2:00 p.m.–4:30 p.m.
David Hughes; US AFRL, Italy, Presider
Brian Stadler; US AFRL, USA, Presider

LSMC1 • 2:00 p.m. **Invited**
Role of Quantum Noise and Entanglement in Free-Space Optical Communications, *Prem Kumar; Northwestern Univ., USA.* Fundamental photonic granularity of light embedded in its quantum state can instill new features in free-space optical communications. Photon number-phase uncertainty enables physical-layer security, whereas entangled photons allow key generation between link terminals.

LSMC2 • 2:30 p.m. **Invited**
Application of Adaptive Optics to Lasercom, *Malcolm Northcott; Aoptix Technologies, USA.* Lasercom technology offers the provision very high data rates over long distances. A unique set of capabilities, but multiple challenges. I will describe Lasercom architectures, and the benefits of AO correction in the lasercom context.

LMC • Trace Gas and Remote Sensing

Monday, February 1
2:00 p.m.–4:00 p.m.
Markus W. Sigrist; ETH Zurich, Switzerland., Presider

LMC1 • 2:00 p.m. **Invited**
Coherent Detection Schemes for Ultra-Sensitive Molecular Spectroscopy in the Mid-IR, *Gerard Wysocki; Princeton Univ., USA.* Different coherent detection schemes and their impact on sensitivity of mid-infrared laser spectrometers used for chemical detection will be discussed. Several example applications will be given.

LMC2 • 2:30 p.m.
Broadband High-Resolution Spectroscopy Based on Adjustable Vernier-Frequency-Scale Sliding - Application to CO_2 Remote Sensing, *Lucile Mussio, Bertrand Hardy, Myriam Raybaut, Antoine Godard, Ajmal K. Mohamed, Michel Lefebvre; ONERA, France.* We present a novel method for broadband spectroscopy. Due to the entanglement of two cavities within an optical parametric oscillator, frequency resolution and span are widely adjustable. The technique is applied to CO_2 remote sensing.

LMC3 • 2:45 p.m.
A Laser Sounder for Global Measurements of CO_2 from Space, *Haris Riris[1], Jim Abshire[1], Graham Allan[2], William Hasselbrack[2], Clark Weaver[3], Jianping Mao[3]; [1]NASA Goddard Space Flight Ctr., USA, [2]Sigma Space Corp., USA, [3]Goddard Earth Sciences and Technology Ctr., Univ. of Maryland, Baltimore County, USA.* We have developed a laser technique for the remote measurement of the tropospheric CO_2 concentrations from space. Our goal is to develop a space instrument and mission approach for active CO_2 measurements.

Emerald Ballroom	Topaz Room	Diamond Room
Advanced Solid-State Photonics (ASSP)	Applications of Lasers for Sensing and Free Space Communications (LS&C)	Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AMD • Ultrafast Lasers I–Continued

AMD3 • 3:00 p.m.
Directly Chirped Laser Source for Chirped-Pulse Amplification, *Ran Xin, Jonathan D. Zuegel; Univ. of Rochester, USA.* A programmable, all-fiber, chirped-pulse seed laser system based on direct phase modulation produces 2.5-ns optical pulses with 0.78-nm bandwidth centered at 1053 nm that are suitable for chirped-pulse amplification.

AMD4 • 3:15 p.m.
Spatio-Temporal Behaviour of fs Laser Pulses in a Freely Suspended Silica Glass Nanoweb, *Christine Kreuzer, Alexander Podlipensky, Philip St.J. Russell; Max-Planck Inst. for the Science of Light, Germany.* The spatio-temporal propagation of fs laser pulses is studied in an optical fibre containing a freely suspended silica nanoweb. Self-focusing leads to beam collapse, resulting in the creation of damage tracks.

AMD5 • 3:30 p.m.
Compression of mJ-Scale Chirped-Amplified Pulses to sub-20 fs Using High-Dispersive Mirrors, *Izhar Ahmad[1], Vladimir Pervak[2], Sergei Trushin[1], Zsuzsanna Major[1,2], Stefan Karsch[1,2], Ferenc Krausz[1,2]; [1]Max-Planck Inst. for Quantum Optics, Germany, [2]Ludwig-Maximilians-Univ. München, Germany.* We presented the development of an all-dispersive-mirror compressor for sub-TW CPA systems. The compression of 4.8-ps 1.4-mJ amplified stretched pulses to 19.1 fs is demonstrated, using 52 reflections on high-dispersive mirrors with ~90% throughput.

AMD6 • 3:45 p.m.
0.4 μJ, Sub-10-fs Pulses from a MHz-NOPA, *Moritz Emons[1], Andy Steinmann[1,2], Thomas Binhammer[3], Guido Palmer[1], Uwe Morgner[1,4]; [1]Inst. of Quantum Optics, Leibniz Univ. Hannover, Germany, [2]4th Physics Inst., Univ. of Stuttgart, Germany, [3]VENTEON Femtosecond Laser Technologies GmbH, Germany, [4]Laser Zentrum Hannover (LZH), Germany.* We present a non collinear optical parametric amplifier (NOPA) delivering sub-10-fs pulses with 420nJ of pulse energy. The system is driven by pulse trains at 1-MHz repetition rate from an amplified Yb:KYW oscillator with cavity-dumping.

LSMC • Free Space Optics Modulation Techniques–Continued

LSMC3 • 3:00 p.m. **Invited**
Free-Space Quantum Key Distribution with Multilevel Encoding via Transverse Field Modulation, *Mark T. Gruneisen; AFRL, USA.* Transverse modulation of the complex optical field defines sets of orthogonal states for multilevel quantum key distribution. Principles of holography are evaluated as a means of generating and sorting the single photon states.

LSMC4 • 3:30 p.m. **Invited**
Free-Space Analog Optical Links: Systems, Performance and Statistical Properties, *Frank Bucholtz[1], C. I. Moore[1], H. R. Burris[1], C. S. McDermitt[1], R. Mahon[1], M. R. Suite[1], J. V. Michalowicz[2], G. C. Gilbreath[1], W. S. Rabinovich[1]; [1]NRL, USA, [2]Global Strategies Group, North America, Inc., USA.* We review properties of free-space optical links for analog transmission including RF performance for various photoreceiver configurations and experimental results at 1 GHz over a 32 km link.

LMC • Trace Gas and Remote Sensing–Continued

LMC4 • 3:00 p.m.
Detecting Trace Species in Air Using Radar REMPI, *Arthur Dogariu[1], Patrick M. Madden[2], Richard B. Miles[1]; [1]Princeton Univ., USA, [2]Yale Univ., USA.* Microwave scattering based REMPI is used to detect NO, CO, Xe, and Ar in pure form and in atmospheric air. The spectra, dynamics, and the detection limits of trace species in air are studied.

LMC5 • 3:15 p.m.
High Brightness, Parametric Frequency Conversion Based, 2 μm Laser Transmitter for CO_2 DIAL, *Myriam Raybaut[1], Antoine Godard[1], Ajmal K. Mohamed[1], Michel Lefebvre[1], Fabien Marnas[2], Pierre Flamant[2], Axel Bohman[3], Peter Geiser[3], Peter Kaspersen[3]; [1]ONERA, France, [2]Lab de Météorologie Dynamique, École Polytechnique, France, [3]Norsk Elektro Optikk A/S, Norway.* A novel, high brightness, transmitter for CO_2 DIAL is presented. The single-mode output of a frequency controlled, entangled-cavity nanosecond OPO is amplified to >10 mJ at 2.05μm, with 3MHz frequency stability and M2 < 1.5.

LMC6 • 3:30 p.m.
LIDAR Technology for Measuring Trace Gases on Mars and Earth, *Haris Riris, Steve Li, Kenji Numata, Stewart Wu, Anthony Yu, John Burris, Michael Krainak, Jim Abshire; NASA Goddard Space Flight Ctr., USA.* We report remote sensing measurements of methane using optical parametric generation at 1.65 μm and 3.3 μm for trace gas monitoring on Earth and Mars.

LMC7 • 3:45 p.m.
Atmospheric Propagation and LIDAR Modeling of LITE Remote Sensing of Distant Compounds, *Denis V. Plutov, Dennis K. Killinger; Univ. of South Florida, USA.* Atmospheric propagation simulations of Stand-off Laser-Induced-Thermal-Emission spectroscopy (Stand-off LITE) have been carried out taking into account molecular and aerosol attenuation of the atmosphere and a modified lidar equation.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	**Topaz Room** Applications of Lasers for Sensing and Free Space Communications (LS&C)	**Diamond Room** Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AMD • Ultrafast Lasers I–Continued

LSMC • Free Space Optics Modulation Techniques–Continued

LSMC5 • 4:00 p.m.
Performance Analysis of Free Space Optical Communication Based on DPSK Modulation, *Guodong Xie, Anhong Dang, Hong Guo; Peking Univ., China.* Coherent differential phase-shift keying (DPSK) transmission system is very suitable for atmosphere channels. Based on Gamma-Gamma channel model, the error probability expressions of three different detection schemes associated with DPSK are derived in this paper.

LMC • Trace Gas and Remote Sensing–Continued

4:00 p.m.–5:00 p.m. Coffee Break/Exhibits, *Crystal Ballroom*

NOTES

AME • Optical Parametric Chirped Pulse Amplifiers

Monday, February 1
Emerald Ballroom
4:30 p.m.–6:00 p.m.
Andrius Baltuska; Vienna Univ. of Technology, Austria, Presider

AME1 • 4:30 p.m.
Novel Ultra Broadband Front-End System for Vulcan 10 PW OPCPA Project, *Yunxin Tang, A. Lyachev, C. Hernandez-Gomez, I. Musgrave, I. N. Ross, O. Chekhlov, P. Matousek, J. Collier; Rutherford Appleton Lab, UK.* We report the recent progress in the development of a novel broadband front-end system, capable of producing sub-30fs pulses centered at ~910nm with 0.4J pulse energy at 2Hz for the Vulcan 10 PW OPCPA project.

AME2 • 4:45 p.m.
Gigawatt Peak Power - 35 fs Pulses Delivered by Fiber Amplifier Pumped OPCPA System, *Jan Rothhardt[1], Steffen Hädrich[1], Thomas Gottschall[1], Tina Clausnitzer[1], Jens Limpert[1], Andreas Tünnermann[1,2]; [1]Friedrich-Schiller-Univ. Jena, Germany, [2]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* We report on an OPCPA system, seeded by a broadband Ti:Sa oscillator and pumped by a frequency doubled picosecond fiber amplifier. The system delivers 35 fs, 53 μJ pulses with 1.1 GW peak power.

AME3 • 5:00 p.m.
First Experimental Demonstration of Optical Parametric Chirped Pulse Amplification in an Optical Fiber, *Damien Bigourd[1], Christophe Caucheteur[2,3], Emmanuel Hugonnot[1], Pascal Szriftgiser[2], Alexandre Kudlinski[2], Arnaud Mussot[2]; [1]Commissariat à l'Energie Atomique, Ctr. d'Etudes Scientifiques et Techniques d'Aquitaine, France, [2]Lab PhLAM, Univ. des Sciences et Technologies de Lille, France, [3]Electromagnetism and Telecom Unit, Univ. de Mons, Belgium.* Optical parametric chirped pulse amplification is experimentally demonstrated in an all fibered optical system. A single chirped fiber Bragg grating achieving the stretching/compression stages is combined to a continuous wave pumped Fiber optical parametric amplifier.

AME4 • 5:15 p.m.
Ultra-Broadband Optical Parametric Chirped-Pulse Amplifier Based on Aperiodically Poled Mg:LiNbO$_3$ in the Mid-Infrared at High Repetition Rates, *Clemens Heese[1], Lukas Gallmann[1], Ursula Keller[1], Christopher R. Phillips[2], Martin M. Fejer[2]; [1]ETH Zurich, Switzerland, [2]Stanford Univ., USA.* We present an ultra-broadband optical parametric amplification system based on aperiodically poled Mg:LiNbO$_3$ providing 800 nm bandwidth around 3.4 μm in a 7.4-mm long medium. It delivers pulse energies of 1.5 μJ and 75 fs.

AME5 • 5:30 p.m.
High-Resolution Spatio-Spectral Characterization of Noncollinear Optical Parametric Amplifiers, *Jake Bromage, Christophe Dorrer, Jonathan D. Zuegel; Univ. of Rochester, USA.* A MHz-repetition-rate noncollinear optical parametric amplifier is characterized using spatially resolved spectral interferometry. High-resolution images of the frequency-dependent amplitude and phase reveal high-order spatio-spectral coupling, corresponding to spatiotemporal Strehl values as large as 0.86.

AME6 • 5:45 p.m.
Tunable Near Transform Limited Pulses From a cw Seeded Optical Parametric Amplifier, *Steffen Hädrich[1], Thomas Gottschall[1], Jan Rothhardt[1], Jens Limpert[1], Andreas Tünnermann[1,2]; [1]Friedrich Schiller Univ. Jena, Germany, [2]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* Tunable (993nm-1070nm) near transform limited pulses with durations between 190 and 230 fs and up to 7.2 μJ pulse energy are obtained by a cw seeded optical parametric amplifier that also offers variable pulse lengths.

LSMD • LS&C Poster Session

Monday, February 1
Ballroom Foyer
4:30 p.m. – 6:00 p.m.

LSMD1
Mirror Steering with Carbon Nanotube Actuator for Free Space Laser Communications, Yoshihisa Takayama, Morio Toyoshima; *Natl. Inst. of Information and Communications Technology, Japan.* A trial production of an actuator using the carbon nanotube is introduced to control the reflection angle of a mirror for free space laser communications. The production processes and the measured reflection angles are shown.

LSMD2
Optimum Transmitter Radius for Ground-to-Satellite Laser Uplink Communication Systems in the Presence of Beam Wander Effect, *Sinan Zhao, Bin Luo, Anhong Dang, Hong Guo; Peking Univ., China.* Based on weak fluctuation theory and gamma-gamma irradiance distribution model, the combined effect of scintillation and beam wander on ground-to-satellite laser uplink communication systems is analyzed and optimum transmitter radius for the system is proposed.

LSMD3
A Novel Beacon Detection Scheme for Free-Space Optical Communications, *Yaoqiang Han, Anhong Dang, Junxiong Tang, Hong Guo; Peking Univ., China.* In this paper, we propose a correlation beacon detection scheme for optical wireless link establishment under strong interference conditions. An outdoor experiment is demonstrated and validates that the beacon can be effectively detected.

LSMD4
Towards the Minimum Pulse-Duration from mJ-class Fiber CPA-Systems, Damian N. Schimpf, Jens Limpert, Andreas Tünnermann; *Inst. of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany.* An extended bandwidth of the amplified pulse is a key option to increase the peak-power from Yb-doped fiber CPA-systems. We analyze the gain characteristics of state-of-the-art Yb-doped fiber amplifiers with regard to the broadest gain-bandwidth.

LMD • LACSEA Poster Session

Monday, February 1

Ballroom Foyer

4:00 p.m. – 6:00 p.m.

LMD1

Improved Wavelength Tuning of CW Optical Parametric Oscillators, *Markku M. Vainio[1,2], Mikael Siltanen[1], Jari Peltola[1], Lauri Halonen[1]; [1]Univ. of Helsinki, Finland, [2]Ctr. for Metrology and Accreditation (MIKES), Finland.* We discuss a new method for controlled wavelength tuning of cw singly resonant optical parametric oscillators. The method uses a grating for fast and broad wavelength scanning.

LMD2

Gas Diagnostics by Laser-Induced Breakdown Spectroscopy Employing Polarization Filtering, *Johannes Kiefer[1], Johannes W. Tröger[1], Thomas Seeger[1], Alfred Leipertz[1], Bo Li[2], Zhongshan Li[2], Marcus Aldén[2]; [1]Lehrstuhl für Technische Thermodynamik, Univ. Erlangen-Nürnberg, Germany, [2]Div. of Combustion Physics, Lund Univ., Sweden.* In this work we present a setup for laser-induced breakdown spectroscopy (LIBS) employing a polarization filtering approach and use it for gas diagnostics. A one parts-per-million (ppm) detection sensitivity is achieved for hydrogen atoms.

LMD3

A Widely Tunable CW Mid-Infrared Spectrometer Based on Difference Frequency Generation in Orientation-Patterned GaAs, *Peter Geiser[1], Sergey Vasilyev[2], Axel Bohman[1], Zhaowei Zhang[3], Alexander Nevsky[2], Stephan Schiller[2], Morten Ibsen[3], Andy Clarkson[3], Arnaud Grisard[4], David Faye[4], Eric Lallier[4], Peter Kaspersen[1]; [1]Norsk Elektro Optikk A/S, Norway, [2]Inst. für Experimentalphysik, Heinrich-Heine Univ. Düsseldorf, Germany, [3]Optoelectronics Res. Ctr., Univ. of Southampton, UK, [4]Thales Res. and Technology, France.* A widely tunable difference frequency generation based mid-infrared spectrometer for the detection of sulfur dioxide (SO2), nitrous oxide (N2O), and methane (CH4) above 7 μm has been developed for industrial applications.

LMD4

OF-CEAS Detects Leak Rates down to 5·10-9 mbar.L/s, *Agnes Pailloux[1], Julien Cousin[1], Daniele Romanini[2], Marc Chenevier[2], Titus Gherman[3], Catherine Gallou[1], Jean-Marc Weulersse[1]; [1]CEA Saclay, France, [2]Univ. Joseph Fourier, France, [3]FLORALIS, France.* Leak detection and localization is an issue for facility and population security. The paper shows that low leak rates of methane, down to 5 10-9mbar.L/s, are detected by OF-CEAS technique under atmospheric pressure.

LMD5

Comparison of Quartz-Enhanced Photoacoustic Spectroscopy and Conventional Photoacoustic Spectroscopy Based Detectors, *Lei Dong, Rafal Lewicki, Frank Tittel, Anatoliy Kosterev; Rice Univ., USA.* Performance of quartz-enhanced photoacoustic spectroscopy and conventional photoacoustic spectroscopy based detectors applied to trace gas sensing was compared. Nitrogen with 10 ppmv of acetylene and a diode laser accessing 6529.17 cm-1 absorption line were used.

LMD6

Analytical Use of Controlled Photon Source Based on Parametric down Conversion, *Dániel Oszetzky, Aladár Czitrovszky; Res. Inst. for Solid State Physics and Optics, Hungarian Acad. of Sciences, Hungary.* We have developed our pervious experimental setup using correlated photon pairs to realize a controllable photon source. In this paper we propose the analytical use of this unique light source.

6:00 p.m.–8:00 p.m Dinner Break *(on your own)*

8:00 p.m.–10:00 p.m Postdeadline Presentations

NOTES

7:30 a.m.–5:00 p.m. Registration Open, *Ballroom Foyer*
10:00 a.m.–5:00 p.m. Exhibit Open, *Crystal Ballroom*

JTuA • ASSP/ LACSEA/ LS&C Joint Session

Tuesday, February 2
Emerald Ballroom
8:00 a.m.–10:00 a.m.
Alphan Sennaroglu; Koç Univ., Turkey, Presider
Frank K. Tittel; Rice Univ., USA, Presider

JTuA1 • 8:00 a.m. **Invited**

External Cavity Quantum Cascade Lasers: Recent Advances, Applications, and Comparisons with Alternative Sources in the MIR, *Timothy Day; Daylight Solutions, USA.* The performance of external cavity quantum/interband cascade lasers (ECqcL/ECicL) in molecular detection and imaging applications will be discussed. Alternative MIR laser technologies such as OPO and DFG will also be compared.

JTuA3 • 9:00 a.m. **Invited**

Progress in Laser Communications, *Larry B. Stotts; DARPA, USA.* Two major military applications have been heavily investigated over the last 40 years: Free Space Optical Communication (FSOC) and Submarine Laser Communication (SLC). This paper will highlight progress made in these two important applications.

JTuA2 • 8:30 a.m. **Invited**

Applications of High-Repetition Rate Diode-Pumped Solid-State Lasers for Combustion Diagnostics, *W. Meier[1], I. Boxx[1], C. Arndt[1], C. D. Carter[2], M. Stöhr[1], A. Steinberg[1], J. H. Frank[3]; [1]German Aerospace Ctr. (DLR), Germany, [2]AFRL, USA, [3]Sandia Natl. Labs, USA.* A high-speed imaging system consisting of solid-state and dye lasers and CMOS cameras was used for simultaneous measurements of flowfield by PIV and reaction zones by PLIF in turbulent flames at repetition rates ≤10 kHz.

JTuA4 • 9:30 a.m. **Invited**

Multi-Disciplinary Lidar Applications, *Kerstin Barup, Mikkel Brydegaard, Zuguang Guan, Anders Hedenström, Jenny Hellström, Märta Lewander, Patrik Lundin, Christer Löfstedt, Aboma Merdasa, Annika Olsson, Anna Runemark, Gabriel Somesfalean, Erik Svensson, Maren Wellenreuther, Susanne Åkesson, Sune Svanberg; Lund Univ., Sweden.* Lidar is a powerful technique normally associated with atmospheric monitoring. However, lidar-techniques, also of the laser-induced fluorescence and laser-induced break-down spectroscopy varieties, provide many new possibilities in unconventional fields including cultural heritage and ecological applications.

10:00 a.m.–10:30 a.m. Coffee/Exhibits. ***Crystal Ballroom***

NOTES

Tuesday, February 2
Ballroom Foyer
10:00 a.m.–11:30 a.m.

ATuA1

Femtosecond Mode Locking of a Tm,Ho:KYW Laser near 2 µm, *Alexander A. Lagatsky[1], Flavio Fusari[1], Christian T. A. Brown[1], Wilson Sibbett[1], Stephane Calvez[2], Martin D. Dawson[2], Viktor E. Kisel[3], S. V. Kurilchik[3], Nikolai V. Kuleshov[3], J. A. Gupta[4]; [1]School of Physics and Astronomy, Univ. of St. Andrews, UK, [2]Inst. of Photonics, Univ. of Strathclyde, UK, [3]Inst. for Optical Materials and Technologies, Belarus Natl. Technical Univ., Belarus, [4]Inst. for Microstructural Sciences, Natl. Res. Council of Canada, Canada.* Passive mode locking of a Tm^{3+},Ho^{3+}:$KY(WO_4)_2$ laser with an InGaAsSb-based saturable absorber is reported. Transform-limited 570-fs pulses were generated at 2055nm with an average power of 130mW at a pulse repetition frequency of 118MHz.

ATuA2

High Efficiency, High Power 2.097-µm Ho:YAG Laser, *Xiaodong Mu, Helmuth Meissner, Huai-Chuan Lee; Onyx Optics, Inc., USA.* Maximum power of 18.6 W has been measured at pump power of 23.7 W in Tm:fiber laser pumped adhesive-free bonded YAG/Ho:YAG/YAG composite. The corresponding slope efficiency is over 81% for both cw and Q-switched operations.

ATuA3

Single-Walled Carbon Nanotube Saturable Absorber Mode-Locking of a Tm:KLuW Laser Near 2 µm, *Won Bae Cho[1], Jong Hyuk Yim[1], Sun Young Choi[1], Soonil Lee[1], Fabian Rotermund[1], Andreas Schmidt[2], Valentin Petrov[2], Günter Steinmeyer[2], Uwe Griebner[2], Xavier Mateos[3], Maria C. Pujol[3], Joan J. Carvajal[3], Magdalena Aguilo[3], Francesc Diaz[3]; [1]Ajou Univ., Republic of Korea, [2]Max-Born-Inst., Germany, [3]Univ. Rovira i Virgili, Spain.* Stable and self-starting mode-locking of a $Tm:KLu(WO_4)_2$ laser using a single-walled carbon nanotubes based saturable absorber is demonstrated generating ~10-ps pulses near 2 µm with powers up to 220 mW at 126 MHz.

ATuA4

Laser Properties of Na+ Ions Co-Doped PbGa2S4:Dy3+ Crystal, *Tasoltan T. Basiev[1], Maxim E. Doroshenko[1], Vyacheslav V. Osiko[1], Valerii V. Badikov[2], Dmitrii V. Badikov[2]; [1]Laser Materials and Technology Res. Ctr., General Physics Inst., Russian Federation, [2]Kuban State Univ., Russian Federation.* New Na^{+} ions co-doped $PbGa_2S_4$:Dy^{3+} crystals were synthesized and their lasing properties under 1.318 µm excitation were investigated. Output energies at 4.3 µm up to 7.5 mJ with slope efficiency up to 2% were demonstrated.

ATuA5

Continuous-Wave Laser Operation of Tm and Ho Co-Doped $NaY(WO_4)_2$ and $NaLu(WO_4)_2$ Crystals, *X. Han[1], M. D. Serrano[1], J. M. Cano-Torres[1], C. Zaldo[1], F. Fusari[2], Alexander A. Lagatsky[2], C. T. A. Brown[2], W. Sibbett[2]; [1]Inst. de Ciencia de Materiales de Madrid, Consejo Superior de Investigaciones Científicas, Spain, [2]School of Physics and Astronomy, Univ. of St. Andrews, UK.* Spectroscopy and continuous-wave laser operation of Tm,Ho co-doped $NaY(WO_4)_2$ and $NaLu(WO_4)_2$ crystals are reported. A tunability range of 1830-2080nm is demonstrated with a maximum output power up to 290mW at around 2040nm during room-temperature operation.

ATuA6

Diode-Pumped Passively Q-Switched Tm:KLuW Laser with a Cr2+:ZnSe Saturable Absorber, *Martha Segura[1], Xavier Mateos[1], Maria Cinta Pujol[1], Joan Josep Carvajal[1], Magdalena Aguiló[1], Francesc Díaz[1], Vladimir Panyutin[2], Uwe Griebner[2], Valentin Petrov[2]; [1]Univ. Rovira i Virgili, Spain, [2]Max-Born-Inst., Germany.* A passively Q-switched Tm:KLuW laser using Cr^{2+}ZnSe as saturable absorber delivered pulse energies as high as 16 µJ at a repetition rate of 6.5 kHz around 2 µm.

ATuA7

Compact Post-Compression System for Peak Power Enhancement of an Ultrafast Diode-Pumped Laser, *Antoine Courjaud[1], Eric Mével[2], Eric Constant[2], Eric Mottay[1]; [1]Amplitude Systèmes, France, [2]CELIA, Univ. de Bordeaux I, France.* We report on a compact system based on post-compression of an ytterbium ultrafast laser, using Nitrogen-filled hollow fiber, delivering 60fs pulses with 330µJ energy at 2kHz and 200µJ at 5kHz.

ATuA8

Idler Pulse Compression with an Identical Positive Dispersive Media to Signal Pulse Stretcher in Ultrafast Optical-Parametric Chirped Pulse Amplification, *Yutaka Akahane, Kanade Ogawa, Koichi Tsuji, Makoto Aoyama, Koichi Yamakawa; Japan Atomic Energy Agency, Japan.* Optical-parametric chirped-pulse amplification with a positive dispersive media for both signal pulse stretcher and idler pulse compressor was demonstrated. By compressing negatively-chirped idler pulses, high power sub-100 fs pulses were successfully obtained in this manner.

ATuA9

Q-Switched Ho:YAG Laser Intracavity Side-Pumped by a Diode-Pumped Tm:YLF Slab Laser, *Martin Schellhorn, Michael von Salisch, Thierry Ibach; French-German Res. Inst., ISL, France.* We observed stable Q-switch operation from a Ho:YAG laser based on intracavity side-pumping by a Tm:YLF slab laser. At 400 Hz pulse energies of 1.6 mJ were obtained with pulse durations of 160 ns.

ATuA10

589nm Multi-Watt Narrow Linewidth Optically Pumped Semiconductor Laser for Laser Guide Stars, *Tomi Leinonen[1], Anti Härkönen[1], Ville-Markus Korpijärvi[1], Mircea Guina[1], Ryan J. Epstein[2], James T. Murray[2], Gregory J. Fetzer[2]; [1]Optoelectronics Res. Ctr., Tampere Univ. of Technology, Korkeakoulunkatu, Finland, [2]Arete Associates, USA.* We demonstrate >2W of 589nm output from an intra-cavity frequency doubled, optically-pumped GaInNAs/GaAs laser. Single longitudinal mode-operation with linewidths < 50 MHz are shown. Output powers are currently limited by available pump-power and spot size.

ATuA11

Highly-Efficient, Widely-Tunable, Mid-IR Cr:ZnS and Cr:ZnSe CW Lasers Pumped by 1685 nm InP Laser Diode, *Igor S. Moskalev[1], Vladimir V. Fedorov[1], Sergey B. Mirov[1,2]; [1]Univ. of Alabama at Birmingham, USA, [2]Photonics Innovations, Inc., USA.* We demonstrate compact, highly-efficient, widely-tunable, CW Cr^{2+}:ZnSe and Cr^{2+}:ZnS lasers (35% and 44% slope efficiencies, 2200-2650 nm, and 2100-2650 nm tuning ranges, respectively) pumped by a single-emitter 1.5 W 1685 nm InP semiconductor laser diode.

ATuA12

Deep Blue $Nd:LiYF_4$ Laser in Quasi-Continuous and Continous Operation, *Jonas Jakutis Neto, Fabíola A. Camargo, Niklaus Ursus Wetter; Ctr. de Lasers e Aplicações - IPEN/SP, Brazil.* In this work we present continuous and quasi-continuous operation of Nd:YLF operating at 908 nm and frequency conversion to 454 nm using LBO and BIBO nonlinear crystals with different sizes.

ATuA13

High Power SHG at 515 nm by Means of Extracavity Frequency Conversion of Sub-Picosecond Pulses from a Mode-Locked Innoslab MOPA, *Bastian Gronloh, Torsten Mans, Peter Rußbüldt, Bernd Jungbluth, Rolf Wester, Dieter Hoffmann; Fraunhofer Inst. for Laser Technology, Germany.* 190 W output power at 515 nm were achieved by extracavity frequency conversion of sub700 fs pulses at 76 MHz. Numerical simulations considering thermal effects and group velocity dispersion are applied to model the conversion.

ATuA14

20W, Quasi-cw GaSb-Based Semiconductor Disk Laser, *Nils Hempler[1], John-Mark Hopkins[1], Alan Kemp[1], Benno Rösener[2], Marcel Rattunde[2], Joachim Wagner[2], David Burns[1]; [1]Inst. of Photonics, Univ. of Strathclyde, UK, [2]Fraunhofer Inst. for Applied Solid State Physics, Germany.* Quasi-cw operation of a 1.9µm semiconductor disk laser with pulses of 1.3µs duration and 20W output power is demonstrated. The thermally-induced spectral shift of the device was found to reach equilibrium after ~200ns.

ATuA15

Intracavity Semiconductor Disk Laser Pumped Continuous-Wave, Singly-Resonant Mid-IR Optical Parametric Oscillator, *John-Mark Hopkins[1], David J. M. Stothard[2], Malcolm H. Dunn[2], David Burns[1]; [1]Univ. of Strathclyde, UK, [2]Univ. of St Andrews, UK.* A relaxation oscillation free cw-OPO pumped in a semiconductor disk laser with 1.4W extracted down converted radiation is described. A simplified cavity geometry led to enhanced output power of 1.6W at the cost of stability.

ATuA16

Bend-Effects on Brillouin Gain in Large Mode Area Fiber Amplifiers with Acoustic Antiguide, *Johan Nilsson, Seongwoo Yoo, Christophe A. Codemard, Yoonchan Jeong, Francesca Mountfort, Jayanta K. Sahu; Optoelectronics Res. Ctr., Univ. of Southampton, UK.* Model calculations show that a bend radius of 10 cm degrades the Brillouin threshold by 8 dB for a large mode area fiber with an antiguiding acoustic waveguide designed to minimize the straight-fiber Brillouin gain.

ATuA17

High-Efficiency 532-nm Generation with PPSLT, *Bhabana Pati, Kevin F. Wall, Peter F. Moulton; Q-Peak, Inc., USA.* We report 62% and 56% SHG conversion efficiency in generating 532-nm using MgO-doped and undoped PPSLT crystals, respectively. We compare SHG obtained using both materials and discuss their suitability for the generation of Watt-level green-radiation.

ATuA18

A High Contrast Dual OPCPA Pre-Amplifier System Using Both Picosecond and Nanosecond Pump Pulses for the Vulcan Petawatt Facility, *Waseem Shaikh, Ian Musgrave, C. Hernandez-Gomez, B. Parry, D. Johnson; Central Laser Facility, STFC Rutherford Appleton Lab, UK.* We construct a dual OPCPA scheme with a picosecond OPA for seeding the Vulcan pre-amplifier demonstrating a 103 nanosecond contrast improvement. We provide evidence that the nanosecond contrast of this pre- amplifier is ~5*10-10 .

ATuA19

χ(2) Induced Non-Reciprocal Loss and/or Phase Shift for Unidirectional Operation of Ring Lasers, *Peter Tidemand-Lichtenberg, Haynes P. H. Cheng, Christian Pedersen; Technical Univ. of Denmark, Denmark.* Numerical modelling and experimental validation of sum-frequency mixing enforcing stable unidirectional operation of a diode pumped solid-state 1342 nm ring laser with improved stability toward feedback.

ATuA20

KGW and Diamond Picosecond Visible Raman Lasers, *David J. Spence, Eduardo Granados, Helen M. Pask, Richard P. Mildren; Macquarie Univ., Australia.* We present three synchronously pumped Raman lasers generating picosecond visible laser pulses. Using KGW and diamond, we efficiently convert the wavelength of standard neodymium picosecond laser sources, as well as substantially compressing the pulse duration.

ATuA21

Free Standing Single Crystal $LiNbO_3$ Micro-wires Fabricated by Ion Slicing, Transferred and Bonded to SiO_2/Si, *Yoo Seung Lee, Sang Shin Lee, William H. Steier; Univ. of Southern California, USA.* Free standing mm long, 1 micron crystalline $LiNbO_3$ micro-wires have been obtained by ion-slicing. They can be lifted, positioned, and bonded onto SiO_2/Si. This is a promising approach for bringing $LiNbO_3$ into the SOI technology.

ATuA22

Generation of Yellow, Continuous-Wave Emission from an Intracavity, Frequency-Doubled Nd:KGW Self-Raman Laser, *Andrew J. Lee, Helen M. Pask, David J. Spence, James A. Piper; Macquarie Univ., Australia.* We report generation of 450 mW continuous-wave emission at 590 nm from an intra-cavity, frequency-doubled, self-Raman laser utilising Nd:KGW. Power scaling is limited by secondary emission lines, astigmatic thermal lensing and thermally-induced fracture.

ATuA23

Performance Trade-Offs for High-Repetition-Rate Noncollinear Optical Parametric Amplifiers, *Jake Bromage, Christophe Dorrer, Jonathan D. Zuegel; Univ. of Rochester, USA.* MHz-repetition-rate noncollinear optical parametric amplifiers are experimentally evaluated, focusing on the trade-offs that depend on pump-signal spatial walk-off in beta-barium borate. Walk-off compensation improves beam uniformity, but parasitic second-harmonic generation limits the signal tuning range.

ATuA24

Very High Efficiency High-Energy Frequency Doubling in the Alisé Facility, *Gabriel Mennerat, Jacques Rault, Odile Bonville, Philippe Canal, Olivier Hartmann, Elisabeth Mazataud, Laurent Marmande, Loïc Patissou, Jean-François Charrier, Christian Lepage; CEA - Commissariat a l'Energie Atomique, France.* Merits of frequency doublers in single-shot régime are discussed. The choice of KDP for short pulses is illustrated with 86% efficiency of 100J/1ns- and 3ns-pulses. With 12ns-pulses, 217J was demonstrated in LBO with efficiency >90%.

ATuA25

Mid-Infrared Optical Parametric Oscillator Pumped by a Femtosecond Erbium-Doped Fiber Laser, *Magnus W. Haakestad, Helge Fonnum, Espen Lippert, Knut Stenersen; FFI, Norwegian Defence Res. Establishment, Norway.* We report a synchronously pumped optical parametric oscillator, driven by a femtosecond erbium-doped fiber laser. The idler is tunable from 3.96-4.71 µm, with a maximum power of 22 mW at 3.96 µm.

ATuA26

Optical Parametric Oscillations in Walk-off Compensated Adhesive-Free Bond KTP Composites, *Xiaodong Mu, Helmuth Meissner, Huai-Chuan Lee; Onyx Optics, Inc., USA.* Quasi-noncritical phase-matched and quasi-phase-matched 2-µm optical parametric oscillations have been demonstrated and characterized in adhesive-free bonded multilayer walk-off compensated KTP composites with low pulse energy 1.064-µm pump laser.

ATuA27

Room Temperature Operation of CW Diode Pumped Er:YVO4 Laser at 1.6 µm, *Jan Šulc[1], Helena Jelínková[1], Michal Němec[1], Witold Ryba-Romanowski[2], Tadeusz Lukasiewicz[3]; [1]Czech Technical Univ. in Prague, Czech Republic, [2]Polish Acad. of Sciences, Poland, [3]Inst. of Electronic Materials Technology, Poland.* Power 0.38 W at wavelength 1602 nm was obtained from $Er:YVO_4$ laser, continuously pumped by laser diode operating at wavelength 976 nm. The laser slope efficiency in respect to absorbed pumping power was 24 %.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	**Topaz Room** Applications of Lasers for Sensing and Free Space Communications (LS&C)	**Diamond Room** Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

ATuB • New Laser Materials

Tuesday, February 2
11:30 a.m.–1:30 p.m.
Mark Dubinskii; US ARL, USA, Presider

ATuB1 • 11:30 a.m. **Invited**

Fifty Years of Advances in Solid-State Laser Materials, *Georges Boulon[1,2]; [1]Univ. of Lyon, France, [2]Tohoku Univ., Japan.* Advances in the multidisciplinary field of solid-state laser-type materials based on transition metal or rare earth ions in insulator hosts (crystals, glasses, ceramic) will be presented. Diode-pumped Yb^{3+} lasers will be emphasized.

LSTuA • Optical Receivers

Tuesday, February 2
10:30 a.m.–12:30 p.m.
Presider to Be Announced

LSTuA1 • 10:30 a.m. **Invited**

Analysis of a Field-Conjugation Adaptive Array for Coherent Free-Space Optical Links, *Aniceto Belmonte[1], Joseph M. Kahn[2]; [1]Dept. of Signal Theory and Communications, Technical Univ. of Catalonia, Spain, [2]Stanford Univ., USA.* We study the performance of diversity combining techniques applied to synchronous laser communication through the turbulent atmosphere. We assume that a single information bearing signal is transmitted over statistically independent fading channels, and that the multiple replicas are combined at the receiver to improve detection efficiency.

LSTuA2 • 11:00 a.m. **Invited**

A Review of Vertical Cavity Semiconductor Optical Amplifiers and Applications, *Michael Sánchez; CENTRA Technology, USA.* Vertical cavity semiconductor optical amplifiers are a versatile and unique class of devices with a wide range of possible applications in free-space optics and remote sensing. This paper reviews their properties, recent progress, and applications.

LSTuA3 • 11:30 a.m.

Free Space Quantum Communication with Continuous Polarization Variables, *Bettina Heim, Dominique Elser, Tim Bartley, Metin Sabuncu, Christoffer Wittmann, Denis Sych, Christoph Marquardt, Gerd Leuchs; Inst. of Optics, Information and Photonics, Univ. of Erlangen-Nuremberg, Max Planck Inst. for the Science of Light, Germany.* We experimentally investigate atmospheric influences on quantum communication with continuous polarization variables. Signal and local oscillator are combined in one spatial mode, which leads to perfect interference at the homodyne detection. Fluctuations are thus auto-compensated.

LTuA • THz and Pulse Shaping Techniques

Tuesday, February 2
10:30 a.m.–12:30 p.m.
Dwight Woolard; U.S. Army Res. Office, USA.

LTuA1 • 10:30 a.m. **Invited**

Spectroscopy with Shaped Laser Pulses, *B. von Vacano[1,2], Marcus Motzkus[1,3]; [1]Philipps Univ. Marburg, Germany, [2]Polymer Physics, BASF SE, Germany, [3]Ruprecht-Karls Univ. Heidelberg, Germany.* The combination of ultrabroadband laser pulses and pulse shaping techniques allows the photonic integration of functions such as excitation, probing and interferometry making sophisticated nonlinear spectroscopy like Coherent Anti-Stokes Raman scattering (CARS) extremely simple.

LTuA2 • 11:00 a.m.

Atmospheric Pressure Femtosecond Laser Imaging Mass Spectrometry, *Yves Coello, A. Daniel Jones, Tissa C. Gunaratne, Marcos Dantus; Michigan State Univ., USA.* We demonstrate a novel imaging mass spectrometry technique that uses femtosecond laser pulses to ionize the sample at ambient conditions. The technique provides 10μm resolution, as demonstrated here with a chemical image of vegetable cells.

LTuA3 • 11:15 a.m.

Infrared Time Domain Spectroscopy with Synchronized Frequency Combs, *Nathan R. Newbury, Ian Coddington, William C. Swann; NIST, USA.* We describe a frequency-comb based system for time-domain spectroscopy in the near infrared. Our configuration implements synchronous, repetitive sampling of the time domain signature for real-time coherent signal averaging and improved signal-to-noise ratio.

LTuA4 • 11:30 a.m. **Invited**

Terahertz Time Domain Spectroscopy for Nondestructive Testing and Sensing Applications, *F. Ellrich[1], M. Herrmann[1], J. Jonuscheit[1], M. Theuer[2], G. Torosyan[1], D. Molter[1], S. Wiegand[2], S. Wohnsiedler[1], René Beigang[1,2,3]; [1]Fraunhofer Inst. for Physical Measuring Techniques, Germany, [2]Dept. of Physics , Univ. of Kaiserslautern, Germany, [3]Res. Ctr. OPTIMAS, Univ. of Kaiserslautern, Germany.* Terahertz spectroscopy and imaging using innovative photonic THz sources and detectors have turned out to be very useful techniques for applications in nondestructive testing and sensing. Typical examples of THz imaging and spectroscopy are presented.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	**Topaz Room** Applications of Lasers for Sensing and Free Space Communications (LS&C)	**Diamond Room** Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

ATuB • New Laser Materials–Continued

ATuB2 • 12:00 p.m.
Low-Threshold and Highly Efficient Gd^{3+}, Lu^{3+} Co-doped $KY(WO_4)_2:Yb^{3+}$ Planar Waveguide Lasers, *Dimitri Geskus[1], Shanmugam Aravazhi[1], Edward Bernhardi[1], Christos Grivas[1,2], Kerstin Wörhoff[1], Markus Pollnau[1]; [1]Univ. of Twente, Netherlands, [2]Opoelectronics Res. Ctr., UK.* Co-doping with optically inert Gd^{3+} and Lu^{3+} ions improves refractive-index contrast and light confinement in $KY(WO_4)_2:Yb^{3+}$ planar waveguides. Lasing with 18 mW threshold and record-high slope efficiency of 82.3% versus absorbed pump power is demonstrated

ATuB3 • 12:15 p.m.
Development of Anisotropic Transparent Ceramics for Laser Media, *Jun Akiyama, Takunori Taira; Laser Res. Ctr. for Molecular Science, Inst. for Molecular Science, Japan.* Rare earth doped anisotropic transparent ceramics with oriented micro-domain structure have been developed by means of advanced electromagnetic processing. The cavity loss of Nd:FAP ceramics was significantly improved from α=3.54cm^{-1} (previous report) to 1.14cm^{-1}.

ATuB4 • 12:30 p.m.
Recent Advances in Fluoride Crystal Based GaN-Diode-Pumped Green Praseodymium Lasers, *Nils-Owe Hansen[1], Matthias Fechner[1], Klaus Petermann[1], Günter Huber[1], Daniela Parisi[2], Mauro Tonelli[2]; [1]Inst. of Laser Physics, Univ. of Hamburg, Germany, [2]NEST - CNR - INFM - Dept. di Fisica, Univ. di Pisa, Italy.* We report the first diode-pumped laser oscillation of $Pr:BaY_2F_8$ in the green spectral range, related crystal growth and basic spectroscopic properties. Furthermore, recent results of experiments with $Pr:LiYF_4$, showing efficient green laser action, are presented.

ATuB5 • 12:45 p.m.
Cerium Lasers Generate Ultrafast Deep Ultraviolet Pulses, *Eduardo Granados, David W. Coutts, David J. Spence; Macquarie Univ., Australia.* We demonstrate for the first time that the DUV laser material cerium LiCAF can be mode-locked to produce picosecond pulses in this hard-to-access spectral range, and we discuss the potential to directly generate sub-femtosecond pulses.

LSTuA • Optical Receivers–Continued

LSTuA4 • 12:00 p.m.
BER of Annular Beams in Strong Turbulence, *Hamza Gerçekcioğlu[1], Yahya K. Baykal[2], Halil T. Eyyuboğlu[2]; [1]Prime Ministry Undersecretariat for Maritime Affairs, Turkey, [2]Çankaya Univ., Turkey.* Bit error rate (BER) of annular beams is found in strong turbulence. Examining effects of beam and medium parameters on BER reveal that annular beams become favorable in stronger turbulence and at smaller focal lengths.

LTuA • THz and Pulse Shaping Techniques–Continued

LTuA5 • 12:00 p.m. Invited
Slits, Curves, Chains and Rings: How to Mix the Right Ingredients for Surface-Emitting THz Quantum Cascade Lasers, *Alessandro Tredicucci; NEST, CNR-INFM and Scuola Normale Superiore, Italy.* Mechanisms and structures to achieve surface emission in terahertz quantum cascade lasers are discussed. The necessary symmetry breaking is produced in gratings with a base, or curved, or quasiperiodic, and by the finite device length.

ATuB • New Laser Materials–Continued

ATuB6 • 1:00 p.m.
Highly Efficient Nd:YVO_4 Laser by Direct In-Band Diode Pumping at 914 nm, *Damien Sangla[1,2], Marc Castaing[1,3], François Balembois[1], Patrick Georges[1]; [1]Lab Charles Fabry de l'Inst. d'Optique, France, [2]Lab de Physico-Chimie des Matériaux Luminescents, France, [3]Oxxius, France.* We present the first demonstration of Nd:YVO_4 laser diode-pumped directly in-band at 914-nm. We achieved a slope efficiency of 80.7 % by extracting 11.5W at 1064-nm for 14.6W of absorbed pump power at 914-nm.

ATuB7 • 1:15 p.m.
Modelocked Integrated External-Cavity Surface Emitting Laser (MIXSEL) Generates 660 mW Average Power in 23-ps Pulses at 3 GHz Repetition Rate, *Valentin J. Wittwer, Benjamin Rudin, Deran J. H. C. Maas, Yohan Barbarin, Martin Hoffmann, Matthias Golling, Thomas Südmeyer, Ursula Keller; ETH Zurich, Switzerland.* We present an advanced MIXSEL, a semiconductor disk laser with integrated saturable absorber. Improved thermal management by wafer removal substantially increased the output power. The novel antiresonant design is growth-error tolerant and enables shorter pulses.

NOTES

Emerald Ballroom	Topaz Room	Diamond Room
Advanced Solid-State Photonics (ASSP)	Applications of Lasers for Sensing and Free Space Communications (LS&C)	Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

LSTuB • Naval Laser Applications

Topaz Room
1:30 p.m.–3:30 p.m.
Michael Lovern; SPAWAR Systems Ctr. Pacific, USA, Presider
Peter Poirier; SPAWAR Systems Ctr., USA, Presider

LSTuB1 • 1:30 p.m. **Invited**
Underwater Optical Modulating Retro-Reflector Links, *William S. Rabinovich[1], Rita Mahon[1], Mike Ferraro[1], James Murphy[1], Linda Mullen[2], Brandon Cohenour[2], John Muth[3], Leah Ziph-Schatzberg[4]; [1]NRL, USA, [2]Electro-Optics and Special Mission Sensors Div., Naval Air Systems Command, NAVAIR, USA, [3]North Carolina State Univ., USA, [4]Photonics Ctr., Boston Univ., USA.* We will present experimental tank measurements of an underwater optical modulating retro-reflector link, as well as a theoretical link budget that predicts performance in natural waters.

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LSTuB3 • 2:10 p.m. **Invited**
Blue Green Laser Communications, *Dennis G. Harris, Frederick Vachss; Boeing Co., USA.* An approach to generating blue green wavelengths for submarine laser communications, relying on a Yb:YAG laser and an efficient Optical Parametric Amplifier is presented.

LTuB • Coherent Anti-Stokes Raman Scattering in Flames

Diamond Room
1:30 p.m.–3:30 p.m.
Sukesh Roy; Spectral Energies, LLC, USA, Presider

LTuB1 • 1:30 p.m.
Application of a Dual-Pump Vibrational and Pure Rotational CARS System for Temperature and Multi-Species Measurements inside a Porous Burner, *Thomas Seeger[1], Markus Weikl[1], Sarah Tedder[2], Frank Beyrau[3], Johannes Kiefer[1], Alfred Leipertz[1]; [1]Lehrstuhl für Technische Thermodynamik, Univ. Erlangen-Nürnberg, Germany, [2]NASA Langley Res. Ctr., USA, [3]Imperial College London, UK.* Dual-pump vibrational and dual-broadband rotational coherent anti-Stokes Raman scattering is applied to a porous burner with limited optical access. Temperature and species concentration were determined inside the burner ceramic.

LTuB2 • 1:45 p.m.
Time-Resolved Picosecond Pure-Rotational Coherent Anti-Stokes Raman Spectroscopy for Thermometry and Species Concentration in Combustion Environments, *Christopher J. Kliewer[1], Thomas Seeger[2], Johannes Kiefer[2], Brian D. Patterson[1], Thomas B. Settersten[1]; [1]Sandia Natl. Labs, USA, [2]Lehrstuhl für Technische Thermodynamik and Erlangen Graduate School in Advanced Optical Technologies, Univ. Erlangen-Nuernberg, Germany.* Time-resolved picosecond pure-rotational coherent anti-Stokes Raman spectroscopy is applied for thermometry and 1-D imaging in flames. Time-delaying the probe pulse enables successful suppression of unwanted resonant and non-resonant four wave mixing background signals.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	Topaz Room Applications of Lasers for Sensing and Free Space Communications (LS&C)	Diamond Room Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

LSTuB • Naval Laser Applications–Continued

LSTuB4 • 2:30 p.m. **Invited**

Blue-Green Laser Technology, *Jeremy Young, Brian Mathason, Fran Fitzpatrick, Floyd Hovis, Ralph Burnham; Fibertek Inc., USA.* Advancements in solid-state laser-technology including diode-pumping and availability of high-quality laser materials has enabled a variety of previously unattainable applications. We will review recent developments in solid-state lasers operating in the bluegreen-region of the spectrum.

LSTuB5 • 2:50 p.m. **Invited**

Optical Filter for Submarine Laser Communications, *Fred Levinton; NovaPhotonics, USA.* Optical filters for submarine laser communications (SLC) have been under development for some time. We have developed a wavelength-tunable, wide field-of-view, narrow passband, large aperture filter to address the needs for SLC.

LSTuB6 • 3:10 p.m. **Invited**

A Review of Submarine Laser Communications to Achieve Comms at Speed and Depth, *Greg Mooradian; QinetiQ, USA.* Blue-green Submarine Laser Communications (SLC) has the potential to revolutionize connectivity with submarine assets. To be effective, submarines need communications at speed and depth (CSD). This paper will review both airborne and spaceborne architectures, including downlink, uplink and duplex employments.

LTuB • Coherent Anti-Stokes Raman Scattering in Flames–Continued

LTuB4 • 2:30 p.m. **Invited**

Effects of Molecular Interference on Femtosecond-CARS Spectroscopy, *Waruna D. Kulatilaka[1], Sukesh Roy[1], Robert P. Lucht[2], James R. Gord[3]; [1]AFRL / Spectral Energies LLC., USA, [2]School of Mechanical Engineering, Purdue Univ., USA, [3]AFRL, USA.* We investigate effects of molecular interference resulting from broad bandwidth excitation in femtosecond coherent anti-Stokes Raman scattering (fs-CARS) of N_2 and O_2. Particularly considered are the N_2-CO and O_2-CO_2 polarization beatings in time-resolved fs-CARS thermometry.

LTuB5 • 3:00 p.m.

Theory of Chirped-Probe Pulse Single-Shot Femtosecond Coherent Anti-Stokes Raman Scattering Thermometry in Flames at 1000 Hz, *Daniel R. Richardson[1], Robert P. Lucht[1], Waruna D. Kulatilaka[2], Sukesh Roy[2], James R. Gord[3]; [1]Purdue Univ., USA, [2]Spectral Energies, LLC, USA, [3]AFRL, USA.* A theoretical model and fitting routine for analyzing single-shot femtosecond coherent anti-Stokes Raman scattering (CARS) temperature measurements in flames is discussed. The model is validated in a heated gas cell and laminar H2-air flames.

LTuB6 • 3:15 p.m.

Hybrid fs/ps Coherent Anti-Stokes Raman Scattering for Time- and Frequency-Domain Spectroscopy in Flames, *Joseph D. Miller[1], Mikhail N. Slipchenko[1,2], Terrence R. Meyer[1], Hans U. Stauffer[3], James R. Gord[3]; [1]Iowa State Univ., USA, [2]Purdue Univ., USA, [3]AFRL, USA.* Hybrid fs/ps CARS is employed for time- and frequency-domain spectroscopy in reacting flows. Advantages include nonresonant background suppression, chemical specificity, detection at high pressures, potential for kHz-rate thermometry, and ability to resolve energy transfer phenomena.

3:30 p.m.–4:00 p.m. Coffee Break/Exhibits, ***Ballroom Foyer***

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	Topaz Room Applications of Lasers for Sensing and Free Space Communications (LS&C)	Diamond Room Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

LSTuC • Optical Communications–Theoretical vs. Experimental

Tuesday, February 2
4:00 p.m.–6:00 p.m.
Arun Majumdar; Naval Air Warfare Ctr, USA, Presider
Frederick Walther; MIT Lincoln Labs, USA, Presider

LSTuC1 • 4:00 p.m. **Invited**
Free Space Optical Communications Link Budget Estimation, *Alan Pike; Defense Strategies & Systems, Inc., USA.* We will describe techniques for estimating power levels to be expected in long range optical communications through strong turbulence with adaptive optics systems. Comparison with measurements will be made.

LSTuC2 • 4:30 p.m. **Invited**
Performance Evaluation of an Air Optical Communications Demonstration Air-to-Ground, *Steven Michael, Frederick Walther, Ronald R. Parenti; MIT Lincoln Labs, USA.* MIT Lincoln Laboratory has fielded a 2.67-Gbps optical link between an aircraft and a ground station, demonstrating communications at ranges beyond 50 km. We discuss tracking and communications performance against the atmospheric channel.

LSTuC3 • 5:00 p.m. **Invited**
Moon to Earth FSO Links, *Don Boroson, Bryan Robinson; MIT Lincoln Lab, USA.* NASA is presently overseeing a project to create the world's first free-space laser communications system that can be operated over a range ten times larger than the near-earth ranges that have been demonstrated to date.

LTuC • Multiparameter Gas and Chemical Sensing

Tuesday, February 2
4:00 p.m.–5:30 p.m.
Dirk Richter; NCAR, USA, Presider

LTuC1 • 4:00 p.m. **Invited**
Linear and Nonlinear Optical Methods for Multi-Gas and Multi-Parameter Sensing, *P. Ewart, B. Williams, Y. Arita, M. Hamilton, G. A. D. Ritchie; Oxford Univ., UK.* Linear multi-mode absorption spectroscopy, MUMAS, enhanced by wavelength modulation and cavity methods for simultaneous detection of multiple transitions is reported. Nonlinear laser induced gratings are shown to provide measurements of multiple parameters relevant to combustion.

LTuC2 • 4:30 p.m. **Invited**
Low Cost, High Performance TDL Gas Sensors for Widespread Network Deployment, *David M. Sonnenfroh, Krishnan Parameswaran; Physical Sciences Inc., USA.* We discuss the development of high precision, low cost diode laser-based sensors for monitoring ambient CO_2 in networks. Sensor performance metrics will be highlighted and examples of sensors under development discussed.

LTuC3 • 5:00 p.m.
Optical Fiber Setups for the Improvement of Chemical Sensing, *Christoph Bauer[1], Ulrike Willer[1], Wolfgang Schade[1,2]; [1]Laser Application Ctr., Clausthal Univ. of Technology, Germany, [2]Fraunhofer Heinrich-Hertz-Inst., Germany.* Recent developments on optical fibers have impact on online chemical sensing. The uses of active optical fibers for amplifying short pulses and of passive fibers which are suitable for the coupling of QC-lasers are discussed.

LTuC4 • 5:15 p.m.
A New Raman Spectra Analyzer to Measure Isotope Ratios with High Spectral Resolution, *Manfred K. Fink[1], Philip Varghese[1], Jacek Borysow[2]; [1]Univ. of Texas at Austin, USA, [2]Michigan Technological Univ., USA.* A novel Raman spectral analyzer is presented which measures the concentrations of dilute species with high resolutions (0.3 cm^{-1}), high sensitivity (0.1 Pa) within minutes. Examples are: standard mixtures, breathalyzers, and aqueous dissolved gases.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	**Topaz Room** Applications of Lasers for Sensing and Free Space Communications (LS&C)	**Diamond Room** Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

LTuC4 • 5:15 p.m.
A New Raman Spectra Analyzer to Measure Isotope Ratios with High Spectral Resolution, *Manfred K. Fink[1], Philip Varghese[1], Jacek Borysow[2]; [1]Univ. of Texas at Austin, USA, [2]Michigan Technological Univ., USA.* A novel Raman spectral analyzer is presented which measures the concentrations of dilute species with high resolutions (0.3 cm^{-1}), high sensitivity (0.1 Pa) within minutes. Examples are: standard mixtures, breathalyzers, and aqueous dissolved gases.

LSTuC • Optical Communications–Theoretical vs. Experimental–Continued

LSTuC4 • 5:30 p.m. **Invited**
Submarine Laser Communication Uplinks, *Gary M. Lee; Consultant, USA.* Paper discusses SLC uplink design trade-offs and compares uplinks with downlinks. Modulation formats, receivers, transmitter and optical filters for uplinks are discussed. Uplink radiance profiles under various environmental conditions are determined.

LTuC • Multiparameter Gas and Chemical Sensing–Continued

Coffee Break, 5:30 p.m.–6:00 p.m., ***Ballroom Foyer***

LSTuD • Applications of MIR Spectroscopy
Tuesday, February 2
6:00 p.m.–7:15 p.m.
Wolfgang Schade; Technische Univ. Clausthal, Germany, Presider

LSTuD1 • 6:00 p.m. **Invited**
High Precision Trace Gas Measurements with Quantum Cascade Laser Spectroscopic Instruments, *J. Barry McManus1, Mark Zahniser1, David D. Nelson1, Joanne H. Shorter1, Rick A. Wehr2, Greg W. Santoni3, Ben H. Lee3; 1Aerodyne Res. Inc., USA, 2Univ. of Arizona, USA, 3Harvard Univ., USA.* Newly developed quantum cascade laser spectroscopic instrumentation allows high precision measurements of atmospheric trace gases, including measurements of small fractional ($<10^{-3}$) changes in stable gases (e.g. N_2O), and isotopic ratios (e.g. $^{13}CO_2/^{12}CO_2$, $^{13}CH_4/^{12}CH_4$).

LTuD2 • 6:30 p.m.
Ammonia Sensor for Environmental Monitoring Based on a 10.4 μm External-Cavity Quantum Cascade Laser, *Rafał Lewicki[1], Anatoliy Kosterev[1], David M. Thomazy[1], Longwen Gong[1], Robert Griffin[1], Timothy Day[2], Frank K. Tittel[1]; [1]Rice Univ., USA, [2]Daylight Solutions, USA.* An EC-QCL based sensor employing photo-acoustic spectroscopy as a detection technique for monitoring of atmospheric ammonia will be reported. For the NH_3 absorption line at 965.35 cm^{-1} a detection limit of 3.3 ppbv was obtained.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	**Topaz Room** Applications of Lasers for Sensing and Free Space Communications (LS&C)	**Diamond Room** Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

LTuD3 • 6:45 p.m.
Determining Total Hemoglobin Mass by Means of ^{13}CO Breath Analysis, *Marcus Sowa, Peter Hering; Inst. for Laser Medicine, Heinrich-Heine-Univ., Germany*. Our aim is the development of a method for determining the total hemoglobin mass with a non-invasive method using Cavity Leak-Out Spectroscopy in the mid-infrared region. A possible application would be detection of blood doping.

LTuD4 • 7:00 p.m.
Application of Mid-IR Laser Spectroscopy for the Analysis of Surgical Smoke, *Michele Gianella, Markus W. Sigrist; ETH Zurich, Inst. for Quantum Electronics, Switzerland*. The composition of surgical smoke was quantitatively analyzed by employing infrared laser spectroscopy. *In vitro* and *in vivo* samples were compared. In addition to smoke components, the anesthetic sevoflurane was identified in samples from laparoscopy.

NOTES

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	Topaz Room Applications of Lasers for Sensing and Free Space Communications (LS&C)	Diamond Room Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

7:30 a.m.–5:00 p.m. Registration Open, *Ballroom Foyer*
9:30 a.m.–4:00 p.m. Exhibit Open, *Crystal Ballroom*

AWA • Fiber Lasers
Wednesday, February 3
8:00 a.m.–9:30 a.m.
Gregory D. Goodno; Northrop Grumman Corp., USA, Presider

AWA1 • 8:00 a.m. Invited
Diffraction Limited Ultra-High-Power Fiber Lasers, *Valentin Gapontsev, V. Fomin, A. Ferin, M. Abramov; IPG Photonics Corp., USA.* Power scaling of high power single-mode fiber lasers is limited primarily by three inter-dependent obstacles: Insufficient pump brightness, excess heat generation, and non-linearities in the fiber. In this paper, we review these challenges and describe a novel pumping approach which serves to overcome them.

AWA2 • 8:30 a.m.
830 W Average Power Femtosecond Fiber CPA System, *Tino Eidam[1], Stefan Hanf[1], Thomas V. Andersen[2], Enrico Seise[1], Christian Wirth[3], Thomas Schreiber[3], Thomas Gabler[4], Jens Limpert[1], Andreas Tünnermann[1,3]; [1]Inst. of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany, [2]NKT Photonics, Denmark, [3]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany, [4]JT Optical Engine, Germany.* We report on the generation of 830 W of compressed average power at 78 MHz pulse repetition frequency from an ultrashort pulse fiber chirped pulse amplification system. The pulses are as short as 640 fs.

LSWA • Ladar Systems I
Wednesday, February 3
8:00 a.m.–10:00 a.m.
Presider to Be Announced

LSWA1 • 8:00 a.m. Invited
Tomographic Lidar, *James T. Murray, Joseph Triscari, Gregory Fetzer, Ryan Epstein, Jeff Plath, William Ryder, Neil Van Lieu; Areté Associates, USA.* High resolution imaging of unresolved targets is achieved using a combination of digital range compression and tomography principles. Image reconstruction of a meter sized target at 22.4 km range with 15 cm resolution is reported.

LSWA2 • 8:30 a.m.
Laser Gas Sensing by Remotely Monitored Porous Silicon Sensor Arrays, *Tanya Hutter, Moran Horesh, Shlomo Ruschin; Tel-Aviv Univ., Israel.* An optical porous silicon sensor array configuration interrogated by a single laser beam is presented. Graded array sensitization and the definition of a normalized correlation coefficient allow reliable identification and enhanced monitoring range.

LWA • New Combustion Imaging Strategies
Wednesday, February 3
8:00 a.m.–10:00 a.m.
Jiayao "Yao" Zhang; Sandia Natl. Labs, USA, Presider

LWA1 • 8:00 a.m.
High-Resolution Imaging of Turbulence Structures in Jet Flames and Non-Reacting Jets with Laser Rayleigh Scattering, *Jonathan H. Frank, Sebastian A. Kaiser; Combustion Res. Facility, Sandia Natl. Labs, USA.* Turbulence structures in jet flames and non-reacting jets are studied with laser Rayleigh imaging. Comparisons of length scales and morphology of dissipation structures in reacting and non-reacting flows reveal effects of heat release on turbulence.

LWA2 • 8:15 a.m. Invited
Ultra High Framing-Rate Laser Diagnostics for High-Speed Reacting and Non-Reacting Flows, *Naibo Jiang[1], Matthew C. Webster[1], Kathryn N. Gabet[1], Randy L. Patton[1], Igor Adamovich[1], Jeffrey A. Sutton[1], Walter R. Lempert[1], Joseph D. Miller[2], Terrence R. Meyer[2], Jenifer A. Inman[3], Brett Bathel[3], Steve B. Jones[3], Paul M. Danehy[3]; [1]Ohio State Univ., USA, [2]Dept. of Mechanical Engineering, Iowa State Univ., USA, [3]NASA Langley Res. Ctr., USA.* The critical features of a burst mode diagnostic imaging system is described, along with representative NO PLIF measurements at 1MHz, in a Mach 10 hypersonic flow, and Rayleigh imaging at 10kHz in a turbulent flame.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	**Topaz Room** Applications of Lasers for Sensing and Free Space Communications (LS&C)	**Diamond Room** Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AWA • Fiber Lasers–Continued

AWA3 • 8:45 a.m.
Tandem Pumping of Large-Core Double-Clad Ytterbium-Doped Fiber for Control of Excess Gain, *Christophe A. Codemard, Johan Nilsson, Jayanta K. Sahu; Optoelectronics Res. Ctr., Univ. of Southampton, UK.* We explain and experimentally verify how to control unwanted excess gain of higher-order modes in cladding-pumped large-core ytterbium-doped fiber amplifiers through high-brightness tandem-pumping with wavelengths close to the signal wavelength.

AWA4 • 9:00 a.m.
Microjoule Pulse Energies at 1 MHz Repetition Rate from an All-Fiber Nonlinear Chirped-Pulse Amplifier, *Bulent Oktem, Hamit Kalaycioğlu, Fatih Ömer ilday; Bilkent Univ., Turkey.* We report a 1-MHz robust, all-fiber amplifier-oscillator system. Amplified pulses of 3.1 uJ are externally compressed to 140 fs. The highest peak power from an integrated fiber source, up to 50 kW, is obtained.

AWA5 • 9:15 a.m.
High Average Power, High Energy Fiber Laser System: Operation at 977 nm and Frequency Doubling at 488 nm, *Johan Boullet[1], Romain Dubrasquet[2], Ramatou Bello-Doua[2], Nicholas Traynor[1], Eric Cormier[1]; [1]Ctr. des Lasers Intenses et Applications, Univ. de Bordeaux, France, [2]Alphanov, Ctr. Technologique Optique et Lasers, France.* A pulsed fiber laser operating at 977 nm generating >0.75 mJ, 12 ns pulses at adjustable multi-10kHz of repetition rate is reported. Generation of 16 W of blue light by frequency conversion is also demonstrated.

LSWA • Ladar Systems I–Continued

LSWA3 • 9:00 a.m. **Invited**
Multi-Pixel (Matrix) Laser Vibrometer, *James Kilpatrick, Vladimir Markov; MetroLaser Inc., USA.* We describe a new optical sensor for real-time 2-D solid-body vibration imaging. Exemplary data reveal previously unobserved transient phenomenon which could elucidate instability in linear dynamic systems or aid development of new non-linear dynamic sensors.

LSWA4 • 9:30 a.m. **Invited**
Photon Counting Lidars for Airborne and Spaceborne Topographic Mapping, *John J. Degnan; Sigma Space Corp., USA.* Photon-counting topographic lidars are the most efficient possible since they require only one detected photon per surface measurement. Daytime images obtained with an airborne photon-counting lidar are presented, and upcoming space applications are discussed.

LWA • New Combustion Imaging Strategies–Continued

LWA3 • 8:45 a.m. **Invited**
High Speed Imaging in Reactive Flows Using Hyperspectral Tomography and Photodissociation Spectroscopy, *Lin Ma; Clemson Univ., USA.* Two techniques are discussed for high speed imaging in reactive flows: a hyperspectral tomography sensor for measuring distributions of temperature and chemical species, and a photodissociation-based diagnostic for imaging two-dimensional mixture fraction.

LWA4 • 9:15 a.m.
Demonstration of Tomographic Imaging of Chemical Species Using THz Time-Domain Absorption Spectroscopy, *Lin Ma[1], Sebastian B. Zhang[1], Weiwei Cai[1], James R. Gord[2], Sukesh Roy[3], Nicholas Schroeder[4], Satya Ganti[4], Stanley Smith, IV[4], Jason A. Deibel[4]; [1]Clemson Univ., USA, [2]AFRL, USA, [3]Spectral Energies LLC, USA, [4]Wright State Univ., USA.* A technique has been developed to image chemical species using THz time-domain absorption spectroscopy. Preliminary demonstration on a jet flow of steam is reported.

LWA5 • 9:30 a.m.
Phosphor Thermometry at an Optically Accessible Internal Combustion Engine, *Jan Brübach, Thilo Kissel, Andreas Dreizler; FG Energie- und Kraftwerkstechnik, Technische Univ. Darmstadt, Germany.* Two-dimensional phosphor thermometry based on the temperature-dependent luminescence lifetime using a CMOS high-speed camera was characterized and applied to an optically accessible diesel engine. A temperature transient was monitored in trailed and in fired operation.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	**Topaz Room** Applications of Lasers for Sensing and Free Space Communications (LS&C)	**Diamond Room** Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

LWA • New Combustion Imaging Strategies–Continued

LWA6 • 9:45 a.m.
Measurements of Liquid Film Thickness by Tracer LIF, Raman Scattering and Diode Laser Absorption Spectroscopy, *Daniel Greszik, Huinan Yang, Thomas Dreier, Christof Schulz; Univ. of Duisburg-Essen, Germany*. Three different diagnostics techniques are compared to measure the liquid film thickness on a transparent quartz glass plate. The comparison shows a consistent trend and reveals application potentials.

9:30 a.m.–10:30 a.m. Coffee Break/Exhibits, *Crystal Ballroom*

NOTES

Wednesday, February 3
Ballroom Foyer
9:30 a.m.–11:00 a.m.

AWB1
Efficient Resonantly-Pumped Eye-Safe Composite Ceramic Er:YAG Laser, *Nikolay Ter-Gabrielyan[1], Larry D. Merkle[1], Mark Dubinskii[1], E. R. Kupp[2], Gary L. Messing[2]; [1]US ARL, USA, [2]Penn State Univ., USA.* Laser operation of a composite ceramic Er:YAG rod is demonstrated at 1645 nm with a slope efficiency of 56.9% under resonant pumping. This is believed to be the first reported composite ceramic Er:YAG laser.

AWB2
50W Pico-Second Nd:GdVO$_4$ Bounce Laser with a Phase-Conjugate Mirror, *Yasuhito Morimoto, Katsuhiko Miyamoto, Yuichi Maeda, Takashige Omatsu; Chiba Univ., Japan.* A 50W pico-second dual Nd:GdVO$_4$ bounce amplifier system with a phase-conjugate mirror is demonstrated. The system has also been extended to generate pico-second mid-infrared radiation with frequency ranges of 1.55-1.57μm and 3.4-3.3 μm.

AWB3
Intracavity Synthetic Diamond: Underpinning Wavelength Diversity in Semiconductor Disk Lasers, *Alan J. Kemp, Alexander J. Maclean, John-Mark Hopkins, Jennifer E. Hastie, Stephane Calvez, Martin D. Dawson, David Burns; Inst. of Photonics, Univ. of Strathclyde, United Kingdom.* Semiconductor disk lasers are diode-pumped solid-state lasers offering broad spectral coverage. An approach to thermal management that is similarly adaptable is thus required: finite element analysis shows that intracavity diamond heatspreaders are such an approach.

AWB4
Progress Towards Monolithic Microchip Lasers Incorporating Diamond, *Rolf B. Birch, Patricia Millar, Yanfeng Zhang, Erdan Gu, Alan J. Kemp, Martin D. Dawson, David Burns; Inst. of Photonics, Univ. of Strathclyde, United Kingdom.* Microchip lasers are robust, alignment-free sources; however, output powers are limited by excessive thermal lensing and stress fracture. The bonding of gain media to diamond is discussed as a means to circumvent this drawback.

AWB5
Semiconductor Disk Lasers Incorporating InP/GaInP Quantum Dots for 716-755 nm Emission, *Peter J. Schlosser[1], Jennifer E. Hastie[1], Stephane Calvez[1], Andrey B. Krysa[2], Martin D. Dawson[1]; [1]Inst. of Photonics, Univ. of Strathclyde, United Kingdom, [2]EPSRC Natl. Ctr. for III-V Technologies, Univ. of Sheffield, United Kingdom.* We report demonstration of semiconductor disk lasers based on InP/GaInP quantum dots for TEM$_{00}$ emission from 716-755nm, and up to 25nm tuning from a single source. Maximum output power of 52mW was achieved at 739nm.

AWB6
High Gain, High Energy Single Stage Chirped Pulse Amplifier System Based on a Short Length Yb-doped Rod Type Fibre, *Yoann Zaouter, Antoine Courjaud, Clemens Hönninger, Eric Mottay; Amplitude Systemes, France.* We report the generation of 90 μJ, 255 fs and > 250 MW peak power pulses from a single stage 47dB of gain Yb-doped rod type photonic crystal fibre chirped pulse amplifier in double-pass configuration.

AWB7
Ultrafast Laser Inscription of a High Gain Er-Doped Bismuthate Glass Waveguide Amplifier , *Robert R. Thomson, Stephen Beecher, Nicholas D. Psaila, Ajoy K. Kar; Heriot Watt Univ., United Kingdom.* An Er-doped bismuthate glass waveguide amplifier has been fabricated using ultrafast laser inscription. The amplifier exhibits a peak net gain of ≈ 16.5 dB, and > 10.0 dB of net gain across the C-telecommunications band.

AWB8
Waveguide Microchip YAG:Nd/YAG:Cr^{4+} Laser Fabricated by the Femtosecond Writing , *Andrey Okhrimchuk[1,2], Alexander Shestakov[3], Ian Bennion[1]; [1]Aston Univ., United Kingdom, [2]Fiber Optics Res. Ctr. of RAS, Russian Federation, [3]Elements of Laser Systems Co., Russian Federation.* Waveguide is fabricated by femtosecond pulses in diffusion bonded YAG:Nd^{3+}/YAG:Cr^{4+} crystals. An efficient Q-switch operation of new microchip laser is obtained under pump with a fiber directly coupled to the waveguide and a laser diode.

AWB9
0.5 MHz 50fs μJ-class Ultrafast Laser Amplifier System, *Xiaoshi Zhang, Sterling J. Backus, Hsiao-hua Liu, Iain T. McKinnie, Henry C. Kapteyn, Margaret M. Murnane; Kapteyn-Murnane Labs Inc., USA.* We report an innovative and robust ultrafast Ti:sapphire regenerative amplifier system accessing a new operating regime tunable from 50kHz up to 500kHz-repetition-rate, up to 10μJ, 50fs pulses, enabling applications in micromachining, imaging, and spectroscopy.

AWB10
Passive All-Fiber Transversal Mode Filter for High-Power CW Fiber Laser Applications, *Cesar Jauregui[1], Fabian Stutzki[1], Jens U. Thomas[1], Christian Voigtländer[1], Stefan Nolte[1], Jens Limpert[1], Andreas Tünnermann[1,2]; [1]Inst. of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany, [2]Inst. for Applied Optics and Precision Engineering, Fraunhofer IOF, Germany.* It is shown that monolithic CW LMA-fiber lasers inherently operate in a transversally multimode regime. Accordingly, a novel all-fiber passive transversal mode filter to improve the performance of CW fiber lasers is proposed.

AWB11
Mode-Locked Thulium-Doped Silicate Fiber Laser with Saturable Absorber Mirror, *Qing Wang, Jihong Geng, Tao Luo, Shibin Jiang; AdValue Photonics Inc., USA.* We report a passively mode-locked fiber laser using a 30-cm long newly developed Tm-doped silicate glass fiber. The mode-locked pulses operate at 1980 nm with duration of 1.5 ps and energy of 0.76 nJ.

AWB12
Single-Frequency Wavelength-Tunable Erbium-Doped Fiber Laser with Simple Ring Scheme, *Chien-Hung Yeh[1], Chi-Wai Chow[2]; [1]Industrial Technology Res. Inst., Taiwan, [2]Dept. of Photonics, Inst. of Electro-Optical Engineering, Natl. Chiao Tung Univ., Taiwan.* We demonstrate a single-longitudinal-mode wavelength-tunable erbium-doped fiber ring laser using simple ring cavity design. Based on the fiber ring design, the mode hopping can be avoided to achieve single-frequency output in C-band operation.

AWB13
Suppression of Parasitic Laser Processes in Cladding Pumped Er:Yb-Codoped Fiber Amplifier via Auxiliary Signal at 1.0 μm, *Vincent Kuhn[1,2], Peter Weßels[1,2], Jörg Neumann[1,2], Dietmar Kracht[1,2]; [1]Laser Zentrum Hannover e.V., Germany, [2]Ctr. for Quantum-Engineering and Space-Time Res. – QUEST, Germany.* We report on an Er:Yb-codoped cladding pumped fiber amplifier simultaneously seeded at 1556nm and 1064nm. We were able to demonstrate stable output power of 8.7W at 1556nm with an amplifier gain of >22dB.

AWB14
Model-Based Phase-Shaping for SPM-Compensation in mJ-Pulse-Energy Fiber CPA-systems, *Damian N. Schimpf, Tino Eidam, Enrico Seise, Jens Limpert, Andreas Tünnermann; Inst. of Applied Physics, Friedrich Schiller Univ. Jena, Germany.* Based on an analytical model for the impact of SPM on stretched ultrashort pulses, the influence of SPM is experimentally controlled in a mJ-pulse-energy fiber-based CPA-system at B-integral as high as 8 rad.

AWB15
All-Fiber Regenerative Amplification of Low Energy 40 ps Seed Pulses from a Gain-Switched Laser Diode at Low Repetition Rates, *Sebastian Kanzelmeyer, Matthias Hildebrandt, Thomas Theeg, Maik Frede, Joerg Neumann, Dietmar Kracht; Laser Zentrum Hannover e.V., Germany.* All-fiber acousto-optic modulator controlled regenerative amplification of low-energy 40 ps pulses from a gain-switched laser diode is demonstrated. Unwanted amplified spontaneous emission is suppressed effectively and gain values of more than 37 dB were achieved.

AWB16
Pump Induced Loss in Directly-Diode Laser Pumped Ti:Sapphire Lasers, *Alexander J. Maclean[1], Peter W. Roth[1], David Burns[1], Alan J. Kemp[1], Peter F. Moulton[2]; [1]Inst. of Photonics, Univ. of Strathclyde, United Kingdom, [2]Q-Peak Inc., USA.* Pump wavelengths of less than 460nm compromise the performance of Ti:sapphire lasers by inducing loss. This - and not pump brightness or absorption - is the primary performance limitation for these lasers.

AWB17
Cavity-Dumped Picosecond Mode-Locked $Nd:YVO_4$ Laser for Micro-Machining Applications, *Joachim Meier, Ulrike Wegner, Max J. Lederer; High Q Laser Innnovation GmbH, Austria.* We present a $Nd:YVO_4$ cavity-dumper with average power of 10W at 1MHz and pulse energies up to 15.6μJ at 10ps. These parameters render it a compact source for picosecond micro-machining, alternative to more complex schemes.

AWB18
Passively Q-Switched Nd:YAG/Cr^{4+}:YAG Laser with a Volume Bragg Gratings Output Coupler, *Nicolaie Pavel[1,2], Masaki Tsunekane[2], Takunori Taira[2]; [1]Natl. Inst. for Laser, Plasma and Radiation Physics, Romania, [2]Inst. for Molecular Science, Laser Res. Ctr., Japan.* A passively Q-switched Nd:YAG/Cr^{4+}:YAG laser with a volume Bragg gratings optical element as output coupler was build and characterized. The laser operated on a limited range of temperature when the pump pulse energy was constant.

AWB19
Efficiency, Energy, and Power Scaling of Diode-Pumped, Short-Pulse Laser Amplifiers Using Yb-Doped Gain Media, *Mathias Siebold[1], Markus Loeser[1], Joerg Koerner[2,3], Markus Wolf[2,3], Joachim Hein[2,3], Christoph Wandt[4], Sandro Klingebiel[4], Stefan Karsch[4], Ulrich Schramm[1]; [1]Res. Ctr. Dresden-Rossendorf, Germany, [2]Inst. for Optics and Quantum Electronics, Friedrich-Schiller-Univ. Jena, Germany, [3]Helmholtz Inst. Jena, Germany, [4]Max-Planck-Inst. for Quantum Optics, Germany.* We present a novel approach to overcome efficiency limitations of nanosecond lasers based on Yb-doped materials. Furthermore, we introduce a combination of bulk and thin-disk design for power scaling of diode-pumped lasers.

AWB20
Concept for Cryogenic kJ-Class Yb:YAG Amplifier, *Klaus Ertel, Cristina Hernandez-Gomez, Paul D. Mason, Ian O. Musgrave, Ian N. Ross, John L. Collier; Science and Technology Facilitities Council, Rutherford Appleton Lab, United Kingdom.* More and more projects and applications require the development of ns, kJ-class DPSSL systems with multi-Hz repetition rate. We present an amplifier concept based on cryogenically cooled Yb:YAG, promising high optical-to-optical efficiency and high gain.

AWB21
Zig-Zag Active-Mirror Laser with Cryogenic Yb:YAG, *Hiroaki Furuse[1], Junji Kawanaka[2], Noriaki Miyanaga[2], Taku Saiki[1], Masayuki Fujita[1], Kazuo Imasaki[1], Kenji Takeshita[3], Shinya Ishii[3], Yasukazu Izawa[1]; [1]Inst. for Laser Technology, Japan, [2]Inst. of Laser Engineering, Osaka Univ., Japan, [3]Mitsubishi Heavy Industries, Japan.* We report on a multiple total-reflection active-mirror laser with cryogenic Yb:YAG ceramics using zigzag optical path. A 214W output power with 62% slope efficiency has been demonstrated.

AWB22
High-Power, Actively Modelocked Cryogenic Yb:YAG Laser, *Juliet T. Gopinath[1], Kevin F. Wall[2], John Hybl[3], Peter F. Moulton[2], T. Y. Fan[3]; [1]Univ. of Colorado, USA, [2]Q-Peak, USA, [3]MIT Lincoln Lab, USA.* A high-power, actively modelocked, cryogenically cooled Yb:YAG laser has been demonstrated. At a repetition rate of 80 MHz, 214-ps pulses with 55 W of output power have been measured.

AWB23
Comparison of Structural and Optical Properties in the Yb^{3+}-doped $(Gd_{0.5}Y_{0.5})_2SiO_5$ (Yb:GYSO) Crystals, *Lihe Zheng[1], Jun Xu[1], Witold Ryba-Romanowski[2], R. Lisiecki[2]; [1]Shanghai Inst. of Ceramics, Chinese Acad. of Sciences, China, [2]Inst. of Low Temperature and Structure Res., Polish Acad. of Sciences, Poland.* Yb:GYSO laser crystals were obtained with different crystal structure by Czochralski method from different seed crystal of Yb:GSO and Yb:YSO, respectively. Low-temperature absorption and emission spectra, as well as lifetime were compared.

AWB24
Design of High Average Power Mode-Locked Oscillator Based on Edge-Pumped All Ceramic Yb:YAG/YAG Microchip, *Atsushi Sugita[1], Tomonori Matsushita[2], Takunori Taira[2]; [1]Shizuoka Univ., Japan, [2]Laser Res. Ctr. for Molecular Science, Inst. for Molecular Science, Japan.* We report the first high-power mode-locked ceramic laser in Yb:YAG/YAG composite microchip. The primal result of 1.0 μJ-pulse energy for 21W-average power was successfully obtained. The future issue of power-scalability and downsizing was also discussed.

AWB25
Profile Analysis of a Yb:YAG Chirped-Pulse Oscillator, *Sadao Uemura, Kenji Torizuka; Natl. Inst. of Advanced Industrial Science and Technology, Japan.* We report a Yb:YAG chirped-pulse oscillator that delivers a pulse energy of 2.1 μJ, and analyze the temporal and spectral profiles of the laser pulse using a chip parameter, which is calculated to be 1.50.

AWB26
Broadband $Yb:CaF_2$ Regenerative Amplifier for Millijoule Range Ultrashort Pulse Amplification, *Sandrine Ricaud[1], Martin Delaigue[1], Antoine Courjaud[1], Frédéric Druon[2], Patrick Georges[2], Patrice Camy[3], Abdelmjid Benayad[3], Jean-Louis Doualan[3], Richard Moncorgé[3], Eric Mottay[1]; [1]Amplitude Systemes, France, [2]Lab Charles Fabry de l'Inst. d'Optique,CNRS, Univ Paris-Sud, France, [3]Ctr. Interdisciplinaire de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP), Univ. de Caen, France.* We report a diode-pumped regenerative amplifier based on $Yb:CaF_2$ material delivering up to 1.8mJ at 100Hz. The pulses have a spectral bandwidth of 16nm, indicating a good potential for millijoule range sub 100fs pulse duration.

AWB27
Milli-Joules, Kilo-Hertz Regenerative Amplifier Using Total-Reflection Active-Mirror with Cryogenic Yb:YAG, *Takuya Nakanishi[1], Yasuki Takeuchi[1], Akira Yoshida[1], Junji Kawanaka[1], Ryo Yasuhara[2], Toshiyuki Kawashima[2], Hirofumi Kan[2]; [1]Osaka Univ., Japan, [2]Hamamatsu Photonics K. K., Japan.* A regenerative amplifier by using total-reflection active-mirror with a cryogenic YAG/Yb:YAG composite ceramics has been demonstrated up to kHz repetition rate. A 6.5-mJ pulse energy and a 9.3% optical efficiency were obtained at 200-Hz.

Emerald Ballroom	Topaz Room	Diamond Room
Advanced Solid-State Photonics (ASSP)	Applications of Lasers for Sensing and Free Space Communications (LS&C)	Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AWC • Optical Combs and Harmonics

Wednesday, February 3
11:00 a.m.–1:00 p.m.
Kaoru Minoshima; AIST, Japan, Presider

AWC1 • 11:00 a.m.
First CEO Frequency Measurement of a SESAM-Modelocked 1.5-µm Solid-State Laser Oscillator, *Selina Pekarek[1], Max C. Stumpf[1], Andreas E. H. Oehler[1], Thomas Südmeyer[1], John M. Dudley[2], Ursula Keller[1]; [1]ETH Zurich, Switzerland, [2]Inst. FEMTO-ST, CNRS, Univ. de Franche-Comté, France.* We present a self-referencable frequency comb by optimized octave-spanning supercontinuum generation of a diode-pumped 170-fs Er:Yb:glass-laser with 110 mW power. The f-to-2f CEO frequency has 49-dB signal-to-noise and >10-times narrower bandwidth than free-running 1.5-µm fiber-systems.

AWC2 • 11:15 a.m.
Oscillator Pulse Train with Constant Carrier-Envelope-Offset Phase and 65 Attosecond CE Jitter, *Stefan Rausch[1], Thomas Binhammer[2], Anne Harth[1], Uwe Morgner[1,3]; [1]Inst. of Quantum Optics, Leibniz Univ. Hannover, Germany, [2]VENTEON Laser Technologies GmbH, Germany, [3]Laser Zentrum Hannover (LZH), Germany.* We present an octave-spanning Ti:sapphire laser oscillator stabilized to carrier-envelope-offset frequency zero, generating a pulse train with constant CE-phase and 65 attosecond jitter. The stabilization is realized using a modified *f*-to-2*f*-interferometer and phase-coherent locking.

LSWB • Ladar Systems II

Wednesday, February 3
10:30 a.m.–12:00 p.m.
Brian Miles; FastMetrix, Inc., USA, Presider

LSWB1 • 10:30 a.m. Invited
Combating Atmospheric Scintillation and Dispersion on a Laser Imaging Link Using Multiple Parallel Beams, *Mohsen Kavehrad, Zeinab Hajjarian, Jarir Fadlullah; Pennsylvania State Univ., USA.* Inspired by Yun and Kavehrad's multi-spot diffuse indoor wireless optical communications link, a spatially multiplexed MIMO imaging system is proposed and the corresponding performance and image quality is analyzed in a turbid and turbulent atmosphere.

LSWB2 • 11:00 a.m. Invited
3-D Passive Sensing and Multiview Imaging, *B. Javidi[1], E. A. Watson[2], P. F. McManamon[3]; [1]Univ. of Connecticut, USA, [2]U.S. AFRL, Sensors Directorate, USA, [3]Exciting Technology LLC, USA.* We present overview of our work on three-dimensional imaging for object visualization and classification. 3-D imaging presents many benefits for object visualization and identification. Benefits and disadvantages of active and passive sensing-imaging are presented.

LWB • Spectroscopy for Combustion Applications

Wednesday, February 3
10:30 a.m.–12:30 p.m.
Presider to Be Announced

LWB1 • 10:30 a.m.
Invited
Real-Time Diagnostics in Exhaust Plumes, Flames, and the Atmosphere Using an Intra-Pulse Quantum Cascade Laser Spectrometer, *Geoffrey Duxbury, Kenneth G. Hay, Paul Black, Nigel Langford; Univ. of Strathclyde, UK.* Quantitative measurements of real-time variations of the chemical composition of a jet engine plume, laminar flame and ambient atmosphere are demonstrated using 5 and 8 µm intra-pulse quantum cascade laser spectrometers.

LWB2 • 11:00 a.m.
***In situ* Laser Diagnostics of Temperature, Intermediate Species Concentration and Particle Sizes in Gas-Phase Nanoparticle Synthesis**, *Christian Hecht, Huinan Yang, Thomas Dreier, Christof Schulz; Univ. of Duisburg-Essen, Germany.* The development of gas-phase synthesis strategies for specific nanoparticles requires detailed knowledge about the conditions of precursor decomposition, particle inception, and growth. LIF and NIR absorption provide crucial data for understanding and simulating these processes.

LWB3 • 11:15 a.m.
Invited
Laser Diagnostic Techniques for Shock Tube Studies of Combustion Chemistry, *Ron K. Hanson; Stanford Univ., USA.* Laser-based absorption techniques, used to probe species time-histories in shock tube experiments of combustion chemistry, are described. A variety of laser sources are used, providing wavelengths from the deep UV to the mid-IR.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	**Topaz Room** Applications of Lasers for Sensing and Free Space Communications (LS&C)	**Diamond Room** Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AWC • Optical Combs and Harmonics–Continued

AWC3 • 11:30 a.m.
Self-Referenced and Optically Stabilized 10 GHz Frequency Comb, *Dirk C. Heinecke[1,2], Albrecht Bartels[2,3], Tara M. Fortier[1], Danielle A. Braje[1], Leo Hollberg[1], Scott A. Diddams[1]; [1]NIST, USA, [2]Univ. of Konstanz, Germany, [3]Gigaoptics GmbH, Germany.* We demonstrate a self-referenced 10 GHz Ti:sapphire frequency comb where the continuum is generated in microstructured fiber. In addition, we discuss optical stabilization of the comb via saturated absorption in ^{87}Rb with a single mode.

AWC4 • 11:45 a.m.
Visible Spectrum Frequency Comb for Astronomical Spectrograph Calibration, *Andrew Benedick[1], Guoqing Chang[1], Alex Glenday[2], Chi-Hao Li[2], David Phillips[2], Ronald Walsworth[2], Franz Kärtner[1]; [1]MIT, USA, [2]Harvard-Smithsonian Ctr. for Astrophysics, Harvard Univ., USA.* We have developed a visible wavelength frequency comb at 420nm with a 21GHz mode spacing to calibrate astronomical spectrographs used in searches for planets similar to the Earth near stars similar to the Sun.

AWC5 • 12:00 p.m.
Pressure-Controlled Phase-Matching to the Third Harmonic in Ar-Filled Hollow Core PCF, *Johannes Nold, Nicolas Y. Joly, Philipp Hölzer, Alexander Podlipensky, Philip Russell; Max Planck Inst. for the Science of Light, Germany.* Hollow core photonic crystal fibre filled with Ar at pressures of 5 bar offers long interaction lengths and high nonlinearity. Pressure-tuned phase-matched third harmonic and supercontinua are generated from 30 fs pulses at 800 nm.

LSWB • Ladar Systems II–Continued

LSWB3 • 11:30 a.m.
Laser Radar Experiment Using a Signal with Three Sparse, Linearly Chirped Frequencies, *Eric S. Bailey[1], Matthew P. Dierking[2], Peter E. Powers[1,3], Joseph W. Haus[1]; [1]Ladar and Optical Communications Inst. and Electro-Optics Program, Univ. of Dayton, USA, [2]AFRL, AFRL_RYJM, USA, [3]Physics Dept., Univ. of Dayton, USA.* Experiments using three tunable and separate laser lines that are linearly frequency modulated are compared to numerical modeling. Our modeling predicts an increase in the effective bandwidth, which improves the range resolution.

LWB • Spectroscopy for Combustion Applications–Continued

LWB4 • 11:45 a.m. **Invited**
Towards Quantitative Measurements of Soot Concentrations in Strongly Sooting Turbulent Jet Diffusion Flames, *Christopher R. Shaddix, Jiayao Zhang, Robert W. Schefer; Sandia Natl. Labs, USA.* Two-dimensional laser-induced incandescence has been used to quantify soot properties in strongly sooting turbulent nonpremixed flames fueled by ethylene and JP-8 surrogate, despite strong laser attenuation and signal trapping.

12:30 p.m.–1:30 p.m. Lunch Break *(on your own)*

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	**Topaz Room** Applications of Lasers for Sensing and Free Space Communications (LS&C)	**Diamond Room** Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AWC • Optical Combs and Harmonics–Continued

AWC6 • 12:15 p.m.
Femtosecond High Repetition Rate External Cavity beyond the Average Power Limit for Linear Enhancement, *Ioachim Pupeza[1,2], Tino Eidam[3], Oleg Pronin[1,2], Jens Rauschenberger[1,2], Birgitta Bernhardt[1], Akira Ozawa[1], Thomas Udem[1], Ronald Holzwarth[1], Jens Limpert[3], Alexander Apolonski[2], Theodor Hänsch[1], Andreas Tünnermann[3], Ferenc Krausz[1,2]; [1]Max-Planck-Inst. for Quantum Optics, Germany, [2]Dept. für Physik, Ludwig-Maximilians-Univ. München, Germany, [3]Inst. of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany.* We report on the cavity enhancement of a 78MHz, 200fs ytterbium-fiber laser system. Linear enhancement up to a record intra-cavity power of 18kW has been observed. In a non-linear enhancement regime 40kW have been reached.

AWC7 • 12:30 p.m.
High-Power Yb-Frequency Comb Using Fiber Stretcher/Grating Compressor and Linear Amplification, *Axel Ruehl, Ingmar Hartl, Andrius Marcinkevicius, Martin E. Fermann; IMRA America, Inc., USA.* We report on an Yb-fiber frequency comb laser delivering 155fs pulses with 65W. By designing the group-delay between fiber-stretcher and compressor, a compression factor of 4100 could be demonstrated allowing for linear amplification.

AWC8 • 12:45 p.m.
Fully Phase and Amplitude-Locked Multicolor Coherent Pulse Synthesis from a fs Yb:KGW-Driven IR-OPA, *Giedrius Andriukaitis[1], Oliver D. Mücke[1], Aart J. Verhoef[1], Audrius Pugžlys[1], Andrius Baltuška[1], Darius Mikalauskas[2], Linas Giniūnas[2], Romualdas Danielius[2]; [1]Vienna Univ. of Technology, Austria, [2]Light Conversion, Ltd., Lithuania.* Combining active CEP-locking of an Yb-DPSS amplifier with a passive CEP-lock on the idler, we demonstrate a 40-kHz 10-μJ OPA with a shot-to-shot-stable coherent superposition of the signal, idler and pump pulses and their harmonics.

LWB • Spectroscopy for Combustion Applications–Continued

LWB5 • 12:15 p.m.
Fiber Lasers as a Source for Laser-Induced Incandescence in Practical Applications, *John D. Black; Univ. of Manchester, UK.* Laser-induced incandescence (LII) using a fiber laser has been demonstrated in an engine exhaust and ambient air. There are advantages over Nd/YAG in practical applications, but a new model for long pulse LII is required.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	Topaz Room Applications of Lasers for Sensing and Free Space Communications (LS&C)	Diamond Room Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AWD • Nonlinear Optics

Wednesday, February 3
2:30 p.m.–4:00 p.m.
Presider to Be Announced

LSWC • Advanced Systems

Wednesday, February 3
1:00 p.m.–2:30 p.m.
Leaf Jiang; MIT Lincoln Lab, USA, Presider
Nathan R. Newbury; NIST, USA, Presider

LSWC1 • 1:00 p.m. **Invited**
Arrays of Gieger-Mode Avalanche Photodiodes for Ladar and Laser Communications, *Alex McIntosh; MIT Lincoln Lab, USA.* Arrays of photon-counting Geiger-mode avalanche photodiodes bump-bonded to CMOS read-out integrated circuits with per-pixel timing and counting capabilities have been developed for both deep-space laser-communications and for laser radars.

LSWC2 • 1:30 p.m. **Invited**
Coherent Imaging, *Joseph Marron; Lockheed Martin Coherent Technologies, USA.* Experimental results demonstrating coherent imaging at extended ranges are presented. Digital holographic detection is used to record the coherent data. Results presented include 3-D images of dynamic scenes recorded using a pulsed source.

LSWC3 • 2:00 p.m. **Invited**
Phased-Array Laser Radar System Based on Slow Light, *Robert W. Boyd[1], George M. Gehring[1], M. A. Martinez Gamez[1], Aaron Schweinsberg[1], Zhimin Shi[1], Joseph E. Vornehm, Jr.[1], Edward A. Watson[2], Lawrence Barnes[2]; [1]Univ. of Rochester, USA, [2]AFRL, USA.* We describe an electronically steerable laser-radar system based on a sparse phased array and the use of slow-light methods to ensure synchronization of the light leaving each subaperture.

LWC • Spectroscopy for Security and Biochemical Sensing

Wednesday, February 3
1:30 p.m.–3:30 p.m.
Presider to Be Announced

LWC1 • 1:30 p.m.
Invited
Germany Perspectives of Laser Spectroscopic Methods for Security, Industrial and Biochemical Applications, *Reinhard Noll; Fraunhofer-Inst. für Lasertechnik Aachen, Germany.* Abstract not available.

LWC2 • 2:00 p.m.
Tm-Fiber 2 μm Laser for Laser-Induced Plasma Spectroscopy of Organic and Biological Materials, *Matthieu Baudelet, Christina Willis, Lawrence Shah, Martin Richardson; CREOL, College of Optics and Photonics, Univ. of Central Florida, USA.* This study applies a Tm-fiber laser emitting at 2 μm for LIBS analysis of organic samples and discusses the benefits of the use of this fiber laser for analytical applications towards biological samples.

LWC3 • 2:15 p.m.
Withdrawn

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	Topaz Room Applications of Lasers for Sensing and Free Space Communications (LS&C)	Diamond Room Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AWD • Nonlinear Optics–Continued

AWD1 • 2:30 p.m. **Invited**

CW Crystalline Raman Lasers: Multi-Watt and Multi-Wavelength Operation in the Visible, *Helen M. Pask, Andrew J. Lee, David J. Spence, James A. Piper; Macquarie Univ., Australia.* We report the generation of high power, continuous-wave yellow emission from a frequency-doubled, self-Raman laser. Output power of 2.25 W at 586.5 nm is achieved with a diode to yellow conversion efficiency of 13.2%.

AWD2 • 3:00 p.m.

Novel Concept for Generating High Beam Quality from High Pulse Energy Optical Parametric Oscillators, *Øystein Farsund, Gunnar Arisholm, Gunnar Rustad; FFI (Norwegian Defence Res. Establishment), Norway.* Highly improved beam quality from a high pulse energy OPO is demonstrated by using a resonator with two different types of crystals type 2 phase matched for the same interaction, but with orthogonal walk-off directions.

AWD3 • 3:15 p.m.

Generation of Powerful Tunable Mid-Infrared Picosecond Laser Radiation Using Frequency Conversion in Periodically Poled Lithium Niobate, *Gregor Anstett[1], Felix Ruebel[2], Johannes L'huillier[2]; [1]Fraunhofer-FOM, Germany, [2]Photonics Ctr. Kaiserslautern, Germany.*The generation of tunable mid-infrared picosecond laser radiation in the spectral range from 3-5μm by nonlinear frequency conversion in PPLN is reported. More than 3W output power at 3μm and 1W at 4.5μm were achieved.

LSWD • Laser Technology I

Wednesday, February 3
2:30 p.m.–3:30 p.m.
Presider to Be Announced

LSWD1 • 2:30 p.m. **Invited**

Higher-Order-Mode Fiber Amplifiers, *Jeff Nicholson; OFS Labs, USA.* Higher order modes for large-mode-area high power fiber amplifiers are reviewed. Results from amplification in both Yb-doped HOM fiber at 1083 nm and Er-doped HOM fibers at 1550 nm are presented.

LSWD2 • 3:00 p.m. **Invited**

Photonic Crystal Mirrors for Free-Space Communication and Fiber-Optic Sensors, *S. Hadzialic, I. W. Jung, O. Kilic, S. Kim, J. Provine, R. T. Howe, O. Solgaard; Edward L. Ginzton Lab, Stanford Univ., USA.* Use of Photonic Crystals (PCs) to control electromagnetic fields enables-unprecedented scaling of low-loss, free-space optical devices. In this paper, we describe the operation, design, and fabrication of PC mirrors, and demonstrate their applications in microoptical-systems.

LWC • Spectroscopy for Security and Biochemical Sensing–Continued

LWC4 • 2:30 p.m.

Photonic Microring-Chip-Sensor for Explosive Detection, *Rozalia Orghici[1], Peter Lützow[2], Jörg Burgmeier[1], Wolfgang Schade[1,2], Nina Welschoff[3], Siegfried Waldvogel[3]; [1]Clausthal Univ. of Technology, Germany, [2]Fraunhofer Heinrich Hertz Inst., Germany, [3]Kekulé Inst. for Organic Chemistry and Biochemistry, Univ. Bonn, Germany.* A microring resonator sensor for selective and sensitive detection of the explosive TNT (trinitrotoluene) is discussed. The combination of integrated optics and specially developed receptor molecules is used for this optical sensing.

LWC5 • 2:45 p.m. **Invited**

Quantum Cascade Lasers for the Detection of Hazardous Materials, *Ulrike Willer[1], Christoph Bauer[1], Wolfgang Schade[1,2]; [1]Laser Application Ctr., Clausthal Univ. of Technology, Germany, [2]Fraunhofer Heinrich-Hertz Inst., Germany.* The use of quantum cascade lasers for detection of hazardous materials, esp. explosives is discussed. Different schemes for sensitive measurement of trace amounts are described for different classes of materials with substantial different vapor pressure.

LWC6 • 3:15 p.m.

Optimization of an External Cavity Quantum Cascade Laser for Chemical Sensing Applications, *Mark C. Phillips, Bruce E. Bernacki, Matthew S. Taubman, Bret D. Cannon, John T. Schiffern, Tanya L. Myers; Pacific Northwest Natl. Lab, USA.* We describe and characterize an external cavity quantum cascade laser designed for detection of multiple airborne chemicals, and used with a compact astigmatic Herriott cell for sensing of acetone and hydrogen peroxide.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	**Topaz Room** Applications of Lasers for Sensing and Free Space Communications (LS&C)	**Diamond Room** Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AWD • Nonlinear Optics–Continued

LSWD • Laser Technology I–Continued

LWC • Spectroscopy for Security and Biochemical Sensing–Continued

AWD4 • 3:30 p.m.
High Power Picosecond Mid-Infrared and Visible Source Based on Degenerated Four-Wave-Mixing in a Large Mode Area Photonic Crystal Fiber, *Dirk Nodop[1], Cesar Jauregui[1], Damian Schimpf[1], Alexander Steinmetz[1], Jens Limpert[1], Andreas Tünnermann[2]; [1]Inst. of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany, [2]Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* An endlessly-single-mode LMA PCF enables the conversion of a 8W, 1MHz fiber amplified 200ps, 1064nm microchip laser to 3W @ 673nm and 450mW @ 2.539µm by degenerated FWM. Numerical simulations are discussed in theoretical detail.

AWD5 • 3:45 p.m.
Passive Mode-Locking of a $Nd:GdVO_4$ Laser by Intracavity SHG in Periodically-Poled Stoichiometric Lithium Tantalate, *Hristo Iliev[1], Danail Chuchumishev[1], Ivan Buchvarov[1], Sunao Kurimura[2], Valentin Petrov[3], Uwe Griebner[3]; [1]Sofia Univ., Bulgaria, [2]Natl. Inst. for Materials Science, Japan, [3]Max-Born-Inst., Germany.* Stable and self-starting mode-locking is achieved by cascaded second order nonlinearity using PPMgSLT nonlinear crystal in a $Nd:GdVO_4$ laser, achieving average powers up to 5.1 W and pulse durations as short as 3.8 ps.

3:30 p.m.–4:30 p.m Coffee Break, ***Crystal Ballroom***

Emerald Ballroom	Topaz Room	Diamond Room
Advanced Solid-State Photonics (ASSP)	Applications of Lasers for Sensing and Free Space Communications (LS&C)	Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AWE • Ultrafast Lasers II

Wednesday, February 3
4:30 p.m.–6:30 p.m.
Iain T. McKinnie; Kapteyn-Murnane Labs, USA, Presider

AWE1 • 4:30 p.m. **Invited**
Ultrafast, High Power Laser Technologies: Challenges and Perspectives, *Koichi Yamakawa; Japan Atomic Energy Agency, Japan.* Recent advances in ultrafast, high power lasers using chirped-pulse amplification (CPA) are reviewed. Further development of emerging diode-pumped, cryogenically-cooled Yb-doped solid-state CPA lasers is also described.

LSWE • Laser Technology II

Wednesday, February 3
4:00 p.m.–5:30 p.m.
Presider to Be Announced

LSWE1 • 4:00 p.m.
Efficient THz Generation via Triply-Resonant Nonlinear Frequency Mixing: Towards On-Chip Turn-Key THz Sources, *Jorge Bravo-Abad[1], Alex W. Rodriguez[1], Peter T. Rakich[2], John D. Joannopoulos[1], Steven G. Johnson[1], Marin Soljačić[1]; [1]MIT, USA, [2]Sandia Natl. Labs, USA.* We show how the light-confining properties of triply-resonant photonic resonators enable dramatic enhancements of the conversion efficiency of THz generation via nonlinear frequency down-conversion processes, opening the way to room-temperature on-chip turn-key THz sources.

LSWE2 • 4:30 p.m. **Invited**
Controlling Light-Matter Interactions Using Photonic Crystal Fibers, *Philip Russell; Max Planck Inst. for the Science of Light, Germany.* The hollow microstructure of photonic crystal fiber permits low-loss single-mode guidance in both solid and hollow cores, opening up many opportunities for improved control of light-matter interactions in, e.g., gas-laser devices, optical microfluidics and sensors.

LWD • LIBS and Standoff Detection of Hazardous Materials

Wednesday, February 3
4:00 p.m.–6:00 p.m.
Thomas A. Reichardt; Sandia Natl. Labs, USA, Presider

LWD1 • 4:00 p.m. **Invited**
Laser-Induced Breakdown Spectroscopy (LIBS) for the Rapid Field Identification and Classification of Pathogenic Bacteria, *Steven J. Rehse, Qassem Mohaidat, Sunil Palchaudhuri; Wayne State Univ., USA.* LIBS has been utilized to spectrally fingerprint multiple species of bacteria. Differences in the atomic composition of these bacteria allow a real-time classification and identification of unknown samples after a computerized chemometric analysis.

LWD2 • 4:30 p.m.
Progress in Standoff LIBS Detection and Identification of Residue Materials, *Andrzej Miziolek, Frank DeLucia, Jennifer Gottfried, Chase Munson; ARL, USA.* The LIBS group at ARL/APG continues to advance the use of Laser Induced Breakdown Spectroscopy (LIBS) for standoff detection and identification of various residue materials, both hazardous and benign. Progress will be presented.

LWD3 • 4:45 p.m.
Nd:YAG-CO_2 Double-Pulse Laser Induced Breakdown Spectroscopy for Explosive Detection, *Matthew Weidman[1], Matthieu Baudelet[1], Michael E. Sigman[2], Paul J. Dagdigian[3], Martin Richardson[1]; [1]CREOL, College of Optics of Optics and Photonics, Univ. of Central Florida, USA, [2]Natl. Ctr. for Forensic Science, Univ. of Central Florida, USA, [3]Dept. of Chemistry, Johns Hopkins Univ., USA.* A double-pulse Nd:YAG-CO_2 LIBS scheme was applied to the analysis of an organic film of polystyrene and tested on 2,4,6-TNT residues. Different behaviors in atomic and molecular signals are interpreted and discussed for discrimination application.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	Topaz Room Applications of Lasers for Sensing and Free Space Communications (LS&C)	Diamond Room Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AWE • Ultrafast Lasers II–Continued

AWE2 • 5:00 p.m.
Demonstration of a 1 J Diode-Pumped Yb:YAG Chirped Pulse Amplification Laser System, *Brendan A. Reagan, Federico J. Furch, Bradley M. Luther, Alden H. Curtis, Shaun P. Meehan, Jorge J. Rocca; Colorado State Univ., USA.* We have demonstrated a compact diode-pumped chirped pulse amplification laser based on cryogenically-cooled Yb:YAG that produces 1 J, 8.5 ps duration pulses at 10 Hz repetition rate.

AWE3 • 5:15 p.m.
80-nJ Multipass-Cavity Chirped-Pulse Cr^{4+}:Forsterite Laser, *Huseyin Cankaya[1], James G. Fujimoto[2], Alphan Sennaroglu[1]; [1]Koç Univ., Turkey, [2]MIT, USA.* By using 8.5 W of incident pump power, we obtained 80-nJ, 5.5-ps pulses at 1260 nm with a spectral width of 17 nm from a multipass-cavity, chirped-pulse Cr^{4+}:forsterite laser operated at 4.9-MHz repetition rate

AWE4 •5:30 p.m.
Ultra-Broadband (> 500 nm) Single-Walled Carbon Nanotube Saturable Absorber Mode-Locking of Bulk Solid-State Lasers, *Won Bae Cho[1], Jong Hyuk Yim[1], Sun Young Choi[1], Soonil Lee[1], Dong-Il Yeom[1], Kihong Kim[1], Fabian Rotermund[1], Andreas Schmidt[2], Günter Steinmeyer[2], Valentin Petrov[2], Uwe Griebner[2]; [1]Ajou Univ., Republic of Korea, [2]Max-Born-Inst., Germany.* Femtosecond mode-locking of Yb:KYW at 1.04 μm, Cr:forsterite at 1.25 μm and Cr:YAG at 1.50 μm lasers using one and the same transmission-type single-walled carbon nanotube saturable absorber is demonstrated.

LSWE • Laser Technology II–Continued

LSWE3 • 5:00 p.m. **Invited**
Title to Be Announced, *Peter Moulton; Q-Peak Inc., USA.* Abstract not available.

LWD • LIBS and Standoff Detection of Hazardous Materials–Continued

LWD4 • 5:00 p.m.
Spatial Confinement Effects in Laser-Induced Breakdown Spectroscopy, *X. K. Shen, X. N. He, H. Huang, Y.F. Lu; Univ. of Nebraska, USA.* It is very important to improve the detection sensitivity of laser-induced breakdown spectroscopy. In this work, spatial confinement effects of laser-induced Al plasmas using cylindrical walls have been investigated by emission spectra and fast imaging.

LWD5 • 5:15 p.m. **Invited**
Standoff Detection of Vapor and Trace Amounts of Explosives by Raman Technique, *Henric Östmark, Sara Wallin, Anna Pettersson, Anneli Ehlerding, Ida Johansson, Markus Nordberg; FOI, Swedish Defence Res. Agency, Sweden.* The large distances required pose several physical difficulties: The intensity of the return light decreases inversely with the distance squared, absorption losses in air (wavelength dependent) and scattering losses in air (wavelength dependent).

LWD6 • 5:45 p.m.
Detection of Surface-Bound Organophosphate Compounds with Dual-Pulse Photofragmentation / Laser-Induced Fluorescence, *Jeffrey M. Headrick, Roger L. Farrow, Scott E. Bisson, Thomas A. Reichardt, Thomas J. Kulp; Sandia Natl. Labs, USA.* We present a new method for remotely detecting organophosphate-containing chemicals on surfaces. The approach employs two laser pulses - the first to fragment the analyte; the second to measure a selected fragment using laser-induced fluorescence.

Emerald Ballroom Advanced Solid-State Photonics (ASSP)	**Topaz Room** Applications of Lasers for Sensing and Free Space Communications (LS&C)	**Diamond Room** Laser Applications to Chemical, Security and Environmental Analysis (LACSEA)

AWE • Ultrafast Lasers II–Continued

AWE5 •5:45 p.m.
200 W Picosecond Fiber Laser for External Cavity Enhancement: Toward 1 MW Average Power, *Loïc Meignien[1], François Labaye[2], Johan Boullet[2], Ronic Chiche[1], Didier Jehanno[1], Viktor Soskov[1], Fabian Zomer[1], Eric Cormier[2]; [1]Lab de l'Accélérateur Linéaire, Univ. Paris Sud, France, [2]CELIA, Univ. de Bordeaux I, France.* We demonstrate a picosecond amplifier generating 202 W of average power at 1032 nm with narrow linewidth. We achieve a diffraction limited and stable beam suitable for Fabry-Perrot enhanced Compton scattering based X/γ-rays production.

AWE6 • 6:00 p.m.
Picosecond Fiber Source for Coherent Raman Microscopy, *Khanh Kieu[1,2], Brian G. Saar[3], Gary R. Holtom[3], X. Sunney Xie[3], Frank W. Wise[2]; [1]College of Optical Sciences, Univ. of Arizona, USA, [2]Cornell Univ., USA, [3]Harvard Univ., USA.* We report a high power picosecond fiber laser system for coherent Raman microscopy (CRM). The laser system was used to pump an optical parametric oscillator to produce the pump and the Stokes beams for CRM.

AWE7 • 6:15 p.m.
Efficient Ignition of a Real Automobile Engine by a High Brightness, Passively Q-Switched Cr:YAG/Nd:YAG Micro-Laser, *Masaki Tsunekane[1], Takunori Taira[1], Takayuki Inohara[2], Kenji Kanehara[2]; [1]Inst. for Molecular Science, Japan, [2]Nippon Soken Inc., Japan.*A 0.3PW/sr-cm2, high brightness passively Q-switched Cr:YAG/Nd:YAG micro-laser was tested for ignition of a real automobile engine. Stable engine operation was demonstrated with an ignition optical energy of 2.3mJ, lowest ever reported.

NOTES

	ASSP *Emerald Ballroom*	LS&C *Topaz Room*	LACSEA *Diamond Room*
Sunday, January 31			
7:00 a.m.–6:00 p.m.	**Registration Open**, *Ballroom Foyer*		
8:00 a.m.–12:00 p.m.	**SC343: High-Power Solid-State Laser Technologies**, *Rüdiger Paschotta; RP Photonics Consulting GmbH, Switzerland* **SC351: THz Technology for Sensing Applications**, *René Beigang; Fraunhofer IPM Standort Kaiserslautern, Germany*		
2:00 p.m.–6:00 p.m.	**SC290: High Power Fiber Lasers and Amplifiers**, *Johan Nilsson; Univ. of Southampton, UK* **SC344: Quasi-Phased Matched (QPM) Devices**, *Martin M. Fejer; Stanford Univ., USA* **SC350: Tunable Laser Spectroscopy for Combustion**, *Scott Sanders; Univ. of Wisconsin-Madison, USA*		
Monday, February 1			
7:00 a.m.–5:00 p.m.	**Registration Open**, *Ballroom Foyer*		
8:00 a.m.–10:00 a.m.	**Opening Remarks** (8:00 a.m.–8:15 a.m.) **AMA • Novel Sources** (8:15 a.m.–10:00 a.m.)	**LSMA • Performance Analysis of Experimental FSO Systems**	**LMA • Advances in Mid-IR Sources for Spectroscopy**
10:00 a.m.–5:00 p.m.	**Exhibit Open**, *Crystal Ballroom*		
10:00 a.m.–10:30 a.m.	**Coffee Break/Exhibits**, *Crystal Ballroom*		
10:00 a.m.–11:30 a.m.	**AMB • ASSP Poster Session I**, *Ballroom Foyer*		
10:30 a.m.–1:00 p.m.	**AMC • Infrared Lasers** (starts at 11:30 a.m.)	**LSMB • Laser Communication Systems and Channel Characterization for Laser Comm Systems**	**LMB • Cavity-Enhanced and Advanced Detection Strategies** (ends at 12:30 p.m.)
1:00 p.m.–2:30 p.m.	**Lunch Break** (*on your own*)		
2:30 p.m.–4:00 p.m.	**AMD • Ultrafast Lasers I**	**LSMC • Free Space Optics Modulation Techniques** (2:00 p.m.—4:30 p.m.)	**LMC • Trace Gas and Remote Sensing** (starts at 2:00 p.m.)
4:00 p.m.–5:00 p.m.	**Coffee Break/Exhibits**, *Crystal Ballroom*		
4:00 p.m.–6:00 p.m.	**LMD • LACSEA Poster Session**, *Ballroom Foyer*		
4:30 p.m.–6:00 p.m.	**LSMD • LS&C Poster Session**, *Ballroom Foyer*		
4:30 p.m.–6:00 p.m.	**AME • Optical Parametric Chirped Pulse Amplifiers**		
6:00 p.m.–8:00 p.m.	**Dinner Break** (*on your own*)		
8:00 p.m.–10:00 p.m.	**Postdeadline Paper Presentations**		**Postdeadline Paper Presentations**

Key to Shading	
ASSP Sessions	
LS&C Sessions	
LACSEA Sessions	

	ASSP *Emerald Ballroom*	LS&C *Topaz Room*	LACSEA *Diamond Room*
Tuesday, February 2			
7:30 a.m.–5:00 p.m.	**Registration Open,** *Ballroom Foyer*		
8:00 a.m.–10:00 a.m.	**JTuA • ASSP/LACSEA/LS&C Joint Session,** *Emerald Ballroom*		
10:00 a.m.–5:00 p.m.	**Exhibit Open**, *Crystal Ballroom*		
10:00 a.m.–10:30 a.m.	**Coffee Break/Exhibits**, *Crystal Ballroom*		
10:00 a.m.–11:30 a.m.	**ATuA: ASSP Poster Session II**, *Ballroom Foyer*		
10:30 a.m.–12:30 p.m.	**ATuB • New Laser Materials** (11:30 a.m.—1:30 p.m.)	**LSTuA • Optical Receivers**	**LTuA • THz and Pulse Shaping Techniques**
12:30 p.m.–1:30 p.m.	**Lunch Break** (*on your own*)		
1:30 p.m.–3:30 p.m.	**Afternoon Off**	**LSTuB • Naval Laser Applications**	**LTuB • Coherent Anti-Stokes Raman Scattering in Flames**
3:30 p.m.–4:00 p.m.		**Coffee Break,** *Ballroom Foyer*	
4:00 p.m.–6:00 p.m.		**LSTuC • Optical Communications—Theoretical vs. Experimental**	**LTuC • Multiparameter Gas and Chemical Sensing** (ends at 5:30 p.m.)
5:30 p.m.–6:00 p.m.			**LACSEA Coffee Break,** *Ballroom Foyer*
6:00 p.m.–7:15 p.m.			**LTuD • Applications of MIR Spectroscopy**
7:30 p.m.–10:00 p.m.	**Conference Banquet**, *Emerald Ballroom*		
Wednesday, February 3			
7:30 a.m.–5:00 p.m.	**Registration Open,** *Ballroom Foyer*		
8:00 a.m.–10:00 a.m.	**AWA • Fiber Lasers** (ends at 9:30 a.m.)	**LSWA • Ladar Systems I**	**LWA • New Combustion Imaging Strategies**
9:30 a.m.–4:00 p.m.	**Exhibit Open**, *Crystal Ballroom*		
9:30 a.m.–10:30 a.m.	**Coffee Break/Exhibits**, *Crystal Ballroom*		
9:30 a.m.–11:00 a.m.	**AWB • ASSP Poster Session III**, *Ballroom Foyer*		
10:30 a.m.–12:30 p.m.	**AWC • Optical Combs and Harmonics** (11:00 a.m.—1:00 p.m.)	**LSWB • Ladar Systems II** (ends at 12:00 p.m.)	**LWB •Spectroscopy for Combustion Applications**
12:30 a.m.–1:30 p.m.	**Lunch Break** (*on your own*)		
1:30 p.m.–3:30 p.m.	**AWD • Nonlinear Optics** (2:30 p.m.—4:00 p.m.)	**LSWC • Advanced Systems** (1:00 p.m.—2:30 p.m.) **LSWD • Laser Technology I** (2:30 p.m.—3:30 p.m.)	**LWC • Spectroscopy for Security and Biochemical Sensing**
3:30 p.m.–4:30 p.m.	**Coffee Break/Exhibits**, *Crystal Ballroom*		
4:00 p.m.–6:00 p.m.	**AWE •Ultrafast Lasers II** (4:30 p.m.—6:30 p.m.)	**LSWE • Laser Technology II** (ends at 5:30 p.m.)	**LWD • LIBS and Standoff Detection of Hazardous Materials**
6:30 p.m.–6:45 p.m.	**Closing Remarks**		

Key to Authors and Presiders
(**Bold** denotes Presider or Presenting Authors)

• Monday, February 1, 2010 •

Emerald Ballroom
8:00 p.m.–9:36 p.m.
APDP • ASSP Postdeadline Session
James Kafka; Newport/Spectra-Physics., USA, Presider

APDP1 • 8:00 p.m.
Generation of 2-kHz, 40-mJ Picosecond Pulses from a Cryogenic Yb:YAG Chirped-Pulse Amplifier for OPCPA Pumping, *Kyung-Han Hong[1], Juliet Gopinath[2], Darren Rand[2], Aleem Siddiqui[1], Shu-Wei Huang[1], Enbang Li[3], Benjamin Eggleton[3], John Hybl[2], Tso Yee Fan[2], Franz X. Kärtner[1]; [1]MIT, USA, [2]MIT Lincoln Lab, USA, [3]Univ. of Sydney, Australia.* A 2-kHz, 40-mJ picosecond laser system based on chirped-pulse amplification with cryogenic Yb:YAG is demonstrated. 6.5-mJ, ~15-ps pulses with ~0.3% rms energy-stability are obtained from a regenerative amplifier and amplified to 80-W average power.

APDP2 • 8:12 p.m.
400W Resonantly Pumped Cryogenic Er:YAG Slab Laser at 1645nm, *Michael J. Shaw, Scott D. Setzler, Kenneth M. Dinndorf, James A. Beattie, Mark J. Kukla, Evan P. Chicklis; BAE Systems, Inc., USA.* We report a diode face-pumped, face-cooled, Er:YAG slab cryo-oscillator producing 420W quasi-cw at 50% duty-cycle and 386W cw near 1645nm with 0.16nm linewidth, believed to be the highest average power reported for any Er:YAG laser.

APDP3 • 8:24 p.m.
First Theoretical and Experimental Demonstration of Quantum Correlations of Triple Photons, *Audrey Dot[1], Kamel Bencheikh[2], Benoît Boulanger[1], Ariel Levenson[2], Patricia Segonds[1], Antoine Gérardin[1], Corinne Félix[1]; [1]Inst. Neel, Joseph Fourier Univ., France, [2]Lab de Photonique et Nanostructures CNRS, France.* We give prominence to the first experimental and theoretical demonstration of quantum correlations of triple photons produced by a true phase-matched third order non linear process in a KTP crystal pumped at 532 nm.

APDP4 • 8:36 p.m.
High Average Power 5 GW Peak Power Fiber Laser Pumped Few-Cycle OPCPA System, *J. Rothhardt[1], S. Hädrich[1], E. Seise[1], F. Tavella[2], A. Willner[2], S. Düsterer[2], H. Schlarb[2], J. Feldhaus[2], J. Limpert[1,3], J. Rossbach[2,4], A. Tünnermann[1,3]; [1] Institute of Applied Physics, Friedrich-Schiller-Univ. Jena, Germany, [2]Deutsches Elektronensynchrontron DESY, Germany, [3]Helmholtz-Institut Jena, Germany, [4]Univ. Hamburg, Germany.* We report on a few-cycle OPCPA-system delivering 8 fs, 70 µJ pulses at 96 kHz repetition rate. Furthermore CEP stabilization is implemented and high harmonic generation up to the 35th order in demonstrated.

APDP5 • 8:48 p.m.
Few-Cycle OPCPA System at 143 kHz with More than 1 µJ of Pulse Energy, *Marcel Schultze[1], Thomas Binhammer[2], Andy Steinmann[1], Guido Palmer[1], Moritz Emons[1], Uwe Morgner[1,3,4]; [1]Leibniz Univ. Hannover, Germany, [2]VENTEON Laser Technologies GmbH, Germany, [3]Ctr. for Quantum Engineering and Space-Time Research (QUEST), Germany, [4]Laser Zentrum Hannover e.V., Germany.* An OPCPA system delivering 8.8 fs pulses with 1.3 µJ of energy at 143 kHz repetition rate is presented. Pump and seed for the parametric amplification are simultaneously generated by a broadband Ti:sapphire oscillator.

APDP6 • 9:00 p.m.
Power-Scalable Photonic Bandgap Fiber Sources with 167 W, 1178 nm and 14.5 W, 589 nm Radiations, *Akira Shirakawa[1], Christina B. T. Olausson[1,2], Meishin Chen[1], Ken-ichi Ueda[1], Jens K. Lyngsø[2], Jes Broeng[2]; [1]Inst. for Laser Science, Univ. of Electro-Communications, Japan, [2]NKT Photonics A/S, Denmark.* 1178nm ytterbium-doped photonic bandgap fiber amplifier with strictly amplified-spontaneous-emission-free, 167W output has been achieved with 61% slope efficiency. Single-pass frequency doubling to 14.5W 589nm light was also demonstrated with 34% conversion efficiency.

APDP7 • 9:12 p.m.
20-fs 1.6-mJ Pulses from a cw-Diode-Pumped Single-Stage 1-kHz Yb Amplifier, *Giedrius Andriukaitis[1], Daniil Kartashov[1], Audrius Pugžlys[1], Dušan Lorenc[1], Andrius Baltuška[1], Linas Giniūnas[2], Romualdas Danielius[2], Ömer F. Ilday[3]; [1]Photonics Inst., Univ. of Technology, Austria, [2]Light Conversion ltd., Lithuania, [3]Bilkent Univ., Turkey.* 200-fs 2.5-mJ pulses from a fiber-oscillator-seeded DPSS Yb:CaF_2 MOPA are spectrally broadened in Ar and recompressed to 20 fs using a pair of LAK14 prisms. Multi-millijoule 12-fs pulses are feasible upon higher-order spectral phase correction.

APDP8 • 9:24 p.m.
High Efficiency Mid-IR Second Harmonic Generation in Orientation Patterned GaAs Waveguides, *Moshe B Oron, Shaul Pearl, Pinhas Blau; Soreq NRC, Israel.* 21%W^{-1} SHG efficiency at 4µm was demonstrated in OPGaAs waveguides. The high efficiency is attributed to record low waveguide loss of 1.0db/cm, high material quality periodically grown structure and accurate modeling of waveguide effective indices.

• Monday, February 1, 2010 •

Diamond Room

8:00 p.m.–9:00 p.m.

LPDP • LACSEA Postdeadline Session

Gerard Wysocki; Princeton Univ., USA, Presider

LPDP1 • 8:00 p.m.

Mid Infrared Tunable Diode Laser Spectrometer for Sensitive Detection of Acetylene, *Stefan H. Lundqvist, Pawel Kluczynski; Siemens AB, Sweden.* A Mid Infrared Tunable Diode Laser spectrometer utilizing Wavelength Modulation Spectroscopy for sensitive detection of acetylene has been designed. A sensitivity of 18 ppb m at an integration time of 3 seconds was achieved.

LPDP2 • 8:15 p.m.

Sensors at ppb Sensitivity or Better Based on Multiple Line Integration Spectroscopy Techniques, *Gottipaty N. Rao, Andreas Karpf; Adelphi Univ., USA.* Employing integrated absorption of multiple lines or summation of the absolute values of the wavelength modulation spectroscopy signals, we report sensitivities of ppb for the detection of trace gases.

LPDP3 • 8:30 p.m.

Frequency-Dependent Lower-State Energy: A New Spectroscopic Parameter Useful for Designing Laser-Based Thermometers, *Xinliang An[1], Andrew W. Caswell[2], and Scott T. Sanders[1]; [1]Univ. of Wisconsin, USA, [2]Spectral Energies, LLC, USA.* A spectroscopic transition's temperature sensitivity is characterized by its lower-state energy. Here, we define a related parameter that is not fundamental but is a continuous function of frequency and applies to broadened and blended spectra.

LPDP4 • 8:45 p.m.

Vertical Cavity Laser Hygrometer for the National Science Foundation Research Jet, *Mark E. Paige[1], Steven M. Massick[1], Joel A. Silver[1], Mark A. Zondlo[2]; [1]Southwest Sciences, Inc., USA, [2]Dept. of Civil and Environmental Engineering, Ctr. for Mid-Infrared Technologies for Health and the Environment, Princeton Univ., USA.* A vertical cavity diode laser hygrometer has been constructed for performing atmospheric measurements on the National Science Foundation research jet. The design of the hygrometer and its flight performance are presented.

• Wednesday, February 3, 2010 •

Diamond Room

1:30 p.m.–3:30 p.m.

LWC • Spectroscopy for Security and Biochemical Sensing

Wolfgang Schade; Technische Univ. Clausthal, Germany, Presider

LWC3P

Microwave-Assisted LIBS: Towards a New Tool for Trace Element Detection and Molecular Plasma Spectrochemistry, *Yuan Liu, Matthieu Baudelet, Martin Richardson; CREOL, College of Optics of Optics and Photonics, USA.* This study shows the modification of molecular and atomic signals in microwave-assisted laser-induced plasma spectroscopy and the potential for trace element detection and molecular plasma spectroscopy.

Key to Authors and Presiders

(Bold denotes Presider or Presenting Authors)

Lasers, Sources and Related Photonic Devices
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Update Sheet

Withdrawals:

AWB8
AWE5
LSTuB2

Presider Updates:

Iain T. McKinnie; Kapteyn-Murnane Labs, USA, will preside over session **AMD•Ultrafast Lasers I,** on Monday, February 1, 2:30 p.m.– 4:00 p.m. in the Emerald Ballroom.

Larry Andrews; Univ. of Central Florida, USA, will preside over session **LSMB•Laser Communication Systems and Channel Characterization for Laser Comm Systems,** on Monday, February 1, 10:30 a.m.–1:00 p.m. in the Topaz Room.

Paul McManamon; Exciting Technology LLC, USA, will preside over session **LSTuA •Optical Receivers,** on Tuesday, February 2, 10:30 a.m.–12:30 p.m. in the Topaz Room.

Axel Ruehl; IMRA America, Inc., USA, will preside over session **AWD. Nonlinear Optics**, on Wednesday, February 3, 2:30 p.m.– 4:00 p.m. in the Emerald Ballroom.

Takunori Taira; Laser Res. Ctr. for Molecular Science, Inst. for Molecular Science, Japan, will preside over session **AWE•Ultrafast Lasers II,** on Wednesday, February 3, 4:30 p.m.–6:30 p.m. in the Emerald Ballroom.

Dennis K. Killinger; Univ. of South Florida, USA, will preside over session **LSWA•Ladar Systems I,** on Wednesday, February 3, 8:00 a.m.–10:00 a.m. in the Topaz Room.

Paul McManamon; Exciting Technology LLC, USA, will preside over session **LSWB• Ladar Systems II,** on Wednesday, February 3, 10:30 a.m.–12:00 p.m. in the Topaz Room.

Peter Moulton; Q-Peak Inc., USA, will preside over session **LSWD•Laser Technology I,** on Wednesday, February 03, 2:30 p.m.–3:30 p.m. in the Topaz Room.

Edward Watson; AFRL, USA, will preside over session **LSWE •Laser Technology II**, on Wednesday, February 3, 4:00 p.m.–5:30 p.m. in the Topaz Room.

Substituted Papers:

The following paper will be presented in the **LSMA2** time slot: **Lasercom Demonstration in Maritime Environment for Tactical Applications**, ***Juan C. Juarez*[1]**, *Joseph E. Sluz*[1], *David W. Young*[1], *Raymond M. Sove*[1], *Charles Nelson*[2], *Frederic M. Davidson*[2]; [1]*Applied Physics Lab, Johns Hopkins Univ., USA*, [2]*Johns Hopkins Univ., USA.* Results of a lasercom demonstration in the maritime environment conducted off the mid-Atlantic coast near Wallops Island, VA, in July and September 2009 will be presented and performance of the optical channel will be discussed.

Presenter Changes:

AWD2, **Novel Concept for Generating High Beam Quality from High Pulse Energy Optical Parametric Oscillators** will now be presented by ***Øystein Farsund***; *FFI, Norwegian Defence Res. Establishment, Norway.*

The following presentation's title and presenter have been changed: **LWC1, Perspectives of Laser Spectroscopic Methods for Security, Industrial and Biochemical Applications** will now be presented by ***Peter Jander***; *Fraunhofer-Inst. für Lasertechnik Aachen, Germany.*

Postdeadline Paper Programs:

Postdeadline Paper Programs are available at Registration.

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LAS-CAD GmbH presents new version 3.6 of the program LASCAD, which provides a unique combination of simulation tools for LASer Cavity Analysis and Design. Thermal and Structural Finite Element Analysis, Gaussian ABCD Algorithm, and Physical Optics BPM Code are integrated for the first time in one software package to analyze thermal lensing, stability, power output and beam quality of solid state lasers. Version 3.6.1 offers new tool DMA for dynamic analysis of multimode and Q-switched operation. Konrad Altmann, President, dr.altmann@las-cad.com; Harry Skolnik, US sales, hskolnik@comcast.net.

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Update Sheet

Withdrawals:

AWB8
AWE5
LSTuB2

Presider Updates:

Iain T. McKinnie; Kapteyn-Murnane Labs, USA, will preside over session **AMD•Ultrafast Lasers I,** on Monday, February 1, 2:30 p.m.– 4:00 p.m. in the Emerald Ballroom.

Larry Andrews; Univ. of Central Florida, USA, will preside over session **LSMB•Laser Communication Systems and Channel Characterization for Laser Comm Systems,** on Monday, February 1, 10:30 a.m.–1:00 p.m. in the Topaz Room.

Paul McManamon; Exciting Technology LLC, USA, will preside over session **LSTuA •Optical Receivers,** on Tuesday, February 2, 10:30 a.m.–12:30 p.m. in the Topaz Room.

Axel Ruehl; IMRA America, Inc., USA, will preside over session **AWD. Nonlinear Optics**, on Wednesday, February 3, 2:30 p.m.– 4:00 p.m. in the Emerald Ballroom.

Takunori Taira; Laser Res. Ctr. for Molecular Science, Inst. for Molecular Science, Japan, will preside over session **AWE•Ultrafast Lasers II,** on Wednesday, February 3, 4:30 p.m.–6:30 p.m. in the Emerald Ballroom.

Dennis K. Killinger; Univ. of South Florida, USA, will preside over session **LSWA•Ladar Systems I,** on Wednesday, February 3, 8:00 a.m.–10:00 a.m. in the Topaz Room.

Paul McManamon; Exciting Technology LLC, USA, will preside over session **LSWB• Ladar Systems II,** on Wednesday, February 3, 10:30 a.m.–12:00 p.m. in the Topaz Room.

Peter Moulton; Q-Peak Inc., USA, will preside over session **LSWD•Laser Technology I,** on Wednesday, February 03, 2:30 p.m.–3:30 p.m. in the Topaz Room.

Edward Watson; AFRL, USA, will preside over session **LSWE •Laser Technology II**, on Wednesday, February 3, 4:00 p.m.–5:30 p.m. in the Topaz Room.

Substituted Papers:

The following paper will be presented in the **LSMA2** time slot: **Lasercom Demonstration in Maritime Environment for Tactical Applications**, ***Juan C. Juarez***[1], *Joseph E. Sluz*[1], *David W. Young*[1], *Raymond M. Sove*[1], *Charles Nelson*[2], *Frederic M. Davidson*[2]; [1]*Applied Physics Lab, Johns Hopkins Univ., USA,* [2]*Johns Hopkins Univ., USA.* Results of a lasercom demonstration in the maritime environment conducted off the mid-Atlantic coast near Wallops Island, VA, in July and September 2009 will be presented and performance of the optical channel will be discussed.

Presenter Changes:

AWD2, **Novel Concept for Generating High Beam Quality from High Pulse Energy Optical Parametric Oscillators** will now be presented by ***Øystein Farsund***; *FFI, Norwegian Defence Res. Establishment, Norway.*

The following presentation's title and presenter have been changed: **LWC1, Perspectives of Laser Spectroscopic Methods for Security, Industrial and Biochemical Applications** will now be presented by ***Peter Jander***; *Fraunhofer-Inst. für Lasertechnik Aachen, Germany.*

Postdeadline Paper Programs:

Postdeadline Paper Programs are available at Registration.