Salon I	Salon II	Salon III	Salon VI	Salon VII
8:30 AM–10:00 AM **Session MA1:** Label-Free Super-Resolution: Novel Approaches I **Session Chair:** Zhaowei Liu, *University of California, San Diego, USA*	**8:30 AM–10:00 AM** **Session MB1:** Avalanche Photodetectors **Session Chair:** Joe Campbell, *University of Virginia, Charlottesville, VA, USA*	**8:30 AM–10:00 AM** **Session MC1:** Photonics for Data Com **Session Chair:** Luke Mawst, *University of Wisconsin-Madison, Madison, WI, USA*	**8:30 AM–9:45 AM** **Session MD1:** Integrated Optical Sources **Session Chair:** Shamsul Arafin, *University of California, Santa Barbara, Santa Barbara, CA, USA*	**8:30 AM–10:00 AM** **Session ME1:** Nanosensing and Plasmonics **Session Chair:** David Sampson, *University of Western Australia, Perth, Australia*
MA1.1 8:30 AM–9:00 AM (Invited) Beating the Diffraction Limit in IR Microscopy through Detecting the Thermal Effect D. Zhang and J.-X. Cheng, *Boston University, Boston, MA, USA* We report a mid-infrared photothermal microscope with sub-micron spatial resolution. Such performance has exceeded the diffraction limit of infrared microscopy and allowed label-free three-dimensional chemical imaging of live cells and organisms. Distributions of endogenous lipid and exogenous drug inside single cells were visualized.	**MB1.1 8:30 AM–9:00 AM (Invited) Silicon Photomultipliers and Avalanche Pixel Photodetector Structures** V. Saveliev, *Huazhong University of Science and Technology, Wuhan, China* Silicon Phptomiltiplier (SiPM) is novel photodetector structure for the detection of the low photon flux, up to single photons. Advanced Avalanche Pixel Photodetector Structures based on the SiPM principle allows develop of fully Digital Silicon Photomultiplier Imager with unique characteristics and wide area of applications.	**MC1.1 8:30 AM–9:00 AM (Invited) Photonics in Data Centers** M. Haney, *ARPAE*	**MD1.1 8:30 AM–9:00 AM (Invited) High Speed Light Sources for Optical Communication System Using Active Passive Integration Technology** S. Tanaka, *Oclaro Japan, Inc., Sagamihara, Japan* Integration technology for optical communication devices has become important not only in realizing high performance devices but also from the view point of packaging. In this presentation, our approach to utilize integration technology for high speed light sources and passive alignment is reported.	**ME1.1 8:30 am–9:00 am *(Invited)* Designing Gold Nanostar Probes for Optical and Magnetic Resonance Imaging** T. Odom, *Northwestern University, Evanston, IL, USA* This talk will describe how therapeutic gold nanostars can behave as multi-spectral optical probes to interrogate how nanoconstructs interact with cancer cells at the nanoscale and how their shape can significantly boost MRI contrast signals.
MA1.2 9:00 AM–9:30 AM (Invited) Nano Rods Based Label Free Time Multiplexing Super Resolving Microscopy O. Wagner, M. Schultz, A. Meiri, E. Edri, R. Meir, E. Sloutskin and Z. Zalevsky, *Bar Ilan University, Ramat Gan, Israel* In this paper we demonstrate an effective way to image a sample using specialized eccentric gold nanoparticles while exploiting the polarization dependency of their plasmonic resonance. Temporal modulation of the illumination polarity causes appropriate temporal flickering of the nanoparticles. The method enhances localization by eliminating...	**MB1.2 9:00 AM–9:30 AM (Invited) Novel Applications of Avalanche Detector Structures and Photodetectors for High Energy Physics** A. Savoy-Navarro, *University Paris Diderot / CNRS-IN2P3, Paris, France* Silicon PMTs revolutionized the High Energy Physics instrumentation, first for the Calorimeters. Exploiting the Silicon PM technology and further on their pixel structure and avalanche regime leads to novel tracking techniques, either applied to large area tracking systems or digital 3D avalanche pixel devices.	**MC1.2 9:00 AM–9:30 AM (Invited) Reliability of Quantum Well and Quantum Dot Lasers for Silicon Photonics** R. W. Herrick, *Intel Corporation, Santa Clara, CA, USA,* D. Jung, A. Liu, J. Norman, *University of California, Santa Barbara, Santa Barbara, CA, USA,* C. Jan, *Intel Corporation, Santa Clara, CA, USA* and J. Bowers, *University of California, Santa Barbara, CA, USA* After discussing the reliability issues limiting existing quantum well InP-based lasers, and the past reliability challenges of lasers grown on silicon substrates, we will show the recent reliability test results of a few different types of quantum dot lasers grown on different silicon-substrate templates.	**MD1.2 9:00 AM–9:15 AM Continuous Wave Integrated DBR Laser in an InP Membrane Platform** V. Pogoretskiy, Y. Jiao, M. Smit and J. van der Tol, *Eindhoven University of Technology, Eindhoven, The Netherlands* We present the first demonstration of a continuous wave DBR laser for the Indium Phosphide Membrane On Silicon (IMOS) platform. Laser with 500 µm long cavity has a threshold current density of 2.5 kA/cm^2 and total output power in a waveguide of 0.6 mW.	**ME1.2 9:00 AM–9:15 AM Optical Trapping Assisted Enhancement of On-Chip Single Molecule Detection Rate with a Solid-State Nanopore** M. Rahman, M. Harrington, *University of California, Santa Cruz, Santa Cruz, CA, USA,* M. A. Stott, *Brigham Young University, Provo, UT, USA,* T. D. Yuzvinsky, Y. Li, *University of California, Santa Cruz, Santa Cruz, CA, USA,* A. R. Hawkins, *Brigham Young University, Provo, UT, USA* and H. Schmidt, *University of California, Santa Cruz, Santa Cruz, CA, USA* A novel optical method for enhancing nanopore-based single molecule detection is demonstrated. Microbeads containing DNA targets are optically trapped under a nanopore to locally increase the concentration. Thermally released DNAs are then detected electrically when moving through the pore at up to 91× higher rates.

PHOTOGRAPHY

Attendance at, or participation in, this conference constitutes consent to the use and distribution by IEEE of the attendee's image or voice for informational, publicity, promotional and/or reporting purposes in print or electronic communications media. No flash photography will be used.

Video recording by participants and other attendees during any portion of the conference is not allowed without special prior written permission of IEEE.

Photographs of copyrighted PowerPoint or other slides are for personal use only and are not to be reproduced or distributed. Do not photograph any such images that are labeled as confidential and/or proprietary

COPYRIGHTS

The proceedings of this event are made available to all conference registrants.

However, technical session presentations are the sole property of the presenter and not considered part of the conference proceedings.

Therefore, it is against IEEE Photonics Society policy to record or copy any and all of the presentation materials and information unless having prior written consent from the author.

Anyone who does not adhere to this policy may be subject to disciplinary actions.

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
8:30 AM–10:00 AM **Session MF1:** Receiver Technologies **Session Chair:** Zhengyuan Xu, *University of Science and Technology of China, Hefei, China*	**8:30 AM–10:00 AM** **Session MG1:** Nanoscale LEDs & Lasers **Session Chair:** Javier Aizpurua, *Center for Material Physics, San Sebastian, Spain*	**8:30 AM–10:00 AM** **Session MH1:** SDM and Submarine System **Session Chair:** Gabriella Bosco, *Politecnico di Torino, Torino, Italy*	
MF1.1 8:30 AM–9:00 AM (Invited) Optical Wireless Communication with Monolithic Avalanche Photodiode Receivers D. Milovančev, T. Jukić, B. Steindl, M. Hofbauer, R. Enne, K. Schneider-Hornstein and H. Zimmermann, *Vienna University of Technology, Vienna, Austria* Receivers in 0.35µm BiCMOS with highly efficient integrated 200µm and 400µm avalanche photodiodes will be introduced. Results of optical wireless communication up to 12m at 2 Gbit/s and 20 m at 1 Gbit/s in presence of 2000 lux lighting are presented. Possibilities of further improvement will be discussed.	**MG1.1 8:30 AM–8:45 AM Controlling Surface Recombination in a Nanoscale III-V Light Emitting Diode** S. A. Fortuna, *University of California, Berkeley, Berkeley, CA, USA,* C. Heidelberger, *Massachusetts Institute of Technology, Cambridge, MA, USA,* N. M. Andrade, E. Yablonovitch and M. C. Wu, *University of California, Berkeley, Berkeley, CA, USA* We demonstrate low surface recombination velocity (~8700 cm/s) and reduction of non-radiative lifetime in an InP/InGaAs nanoscale light emitting diode using a sacrificial aluminum oxide layer. We predict high efficiency operation is possible after modest enhancement of spontaneous emission rate with an optical antenna.	**MH1.1 8:30 AM–9:00 AM (Invited) Power Efficient Long-Haul Transmission Using Multi-Core Fiber** A. Turukhin, *TE Subcom* Focusing on an SDM-based approach, we show that MCF can be used to increase capacity and improve power efficiency for power limited systems. We review recent long-haul high capacity experiments using MCF and discuss design options to improve power efficiency and capacity.	
MF1.2 9:00 AM–9:15 AM A Comparison Between the Sensitivities of VLC Receivers Containing an Off-the-Shelf SPAD Array and an APD L. Zhang, H. Chun, G. Faulkner, D. O'Brien and S. Collins, *University of Oxford, Oxford, United Kingdom* This paper proposes a method to detect photon counts from a commercial off-the-shelf SPAD array. Experiments show that using this method the sensitivity of a VLC receiver that incorporates this SPAD array approaches the limit set by Poisson noise.	**MG1.2 8:45 AM–9:00 AM Cubic Phase Light Emitters Hetero-Integrated on Silicon** C. Bayram and R. Liu, *University of Illinois at Urbana-Champaign, Urbana, IL, USA* GaN emitters have historically been of hexagonal phase due to natural crystallization. Here we introduce a cubic phase GaN emitter technology that is polarization-free via co-integration on cheap and scalable CMOS-compatible Si(100) substrate.	**MH1.2 9:00 AM–9:15 AM Two-Dimensional Spatial Coherent Matched Detection Scheme for Modal Separation and Homodyne Detection of Mode-Division Multiplexed Signals** T. Sakamoto, *National Institute of Information and Communications Technology, Tokyo, Japan and Japan Science and Technology Agency,* T. Umezawa, N. Yamamoto, *National Institute of Information and Communications Technology, Tokyo, Japan* and T. Kawanishi, *National Institute of Information and Communications Technology, Tokyo, Japan and Waseda University, Tokyo, Japan* We propose and investigate two-dimensional spatial coherent matched detection using high-speed photodiode array. Without optical spatial filtering/splitting, all mode-division multiplexed (MDM) channels are coherently demultiplexed and detected, ideally yielding 3-dB optical loss for any MDM signals.	

PHOTOGRAPHY

Attendance at, or participation in, this conference constitutes consent to the use and distribution by IEEE of the attendee's image or voice for informational, publicity, promotional and/or reporting purposes in print or electronic communications media. No flash photography will be used.

Video recording by participants and other attendees during any portion of the conference is not allowed without special prior written permission of IEEE.

Photographs of copyrighted PowerPoint or other slides are for personal use only and are not to be reproduced or distributed. Do not photograph any such images that are labeled as confidential and/or proprietary

COPYRIGHTS

The proceedings of this event are made available to all conference registrants.

However, technical session presentations are the sole property of the presenter and not considered part of the conference proceedings.

Therefore, it is against IEEE Photonics Society policy to record or copy any and all of the presentation materials and information unless having prior written consent from the author.

Anyone who does not adhere to this policy may be subject to disciplinary actions.

Salon I	Salon II	Salon III	Salon VI	Salon VII
MA1.3 9:30 AM–10:00 AM (Invited) Optical Super-Oscillations: Subwavelength Single-Photon Focusing and Unlabelled Super-Resolution Imaging E. T. F. Rogers, S. Quraishe, *University of Southampton, Southampton, United Kingdom,* Y. Guanghui, *Nanyang Technolgical University, Sinagpore,* J. E. Chad, P. J. S. Smith, T. A. Newman and N. I. Zheludev, *University of Southampton, Southampton, United Kingdom* Super-oscillation is a fascinating phenomenon that allows, in principle, focusing of light with unlimited resolution. We have developed a number of super-oscillatory focusing and imaging technologies, including demonstration of single-photon super-oscillations. Recently, we have applied these systems to create unlabelled super-resolution images of living cells.	**MB1.3 9:30 AM–9:45 AM CMOS Based, Temporally-Oversampled X-Ray Photon Counting Sensor for Low Dose Fluoroscopy** D. B. Hondongwa and E. R. Fossum, *Dartmouth College, Hanover, NH, USA* We present the design of an x-ray quanta image sensor (XQIS) utilizing oversampling and CMOS image sensor technology.	**MC1.3 9:30 AM–10:00 AM (Invited) Nonlinear Comb Generation** T. Kippenberg, *EPFL, Lausanne, Switzerland*	**MD1.3 9:15 AM–9:30 AM Self-Coupled Mode-Locked Laser with Switchable Repetition-Rate for mmW/THz Pulse Generation** M.-C. Lo, R. Guzmán, *Universidad Carlos III de Madrid, Leganés, Spain,* C. Gordón, *Universidad Técnica de Ambato, Ambato, Ecuador,* M. Ali and G. Carpintero, *Universidad Carlos III de Madrid, Leganés, Spain* A monolithically integrated mode-locked laser cavity design with coupled feedback is proposed. It features switchable repetition rate. Optical frequency combs with mode spacing of 50 and 100 GHz are demonstrated. 350-GHz and 450-GHz pulse trains are shown through autocorrelation traces.	**ME1.3 9:15 AM–9:30 AM Hyperspectral Expansion Microscopy** C. Artur, T. Womack, J. Li, J. Eriksen, D. Mayerich and W.-C. Shih, *University of Houston, Houston, TX, USA* We demonstrate high-throughput hyperspectral surface-enhanced Raman scattering based expansion microscopy. NeuN expression in neurons is imaged by antibody conjugated-dye labeled SERS nanoprobes. The technique offers rapid data acquisition, high image contrast, immunity to photobleaching, and abundant information content for potential channel multiplexing.
	MB1.4 9:45 AM–10:00 AM Novel Advances in Avalanche Pixel Structures N. D'Ascenzo, V. Saveliev and Q. Xie, *Huazhong University of Science and Technology, Wuhan, China* We present the recent results of the development and study of the avalanche pixel structures designed for Silicon Photomultipliers designed for the first time on a CMOS Technology line compatible with standard electronics. The designed and produced sensor exhibits an excellent single photon resolution.		**MD1.4 9:30 AM–9:45 AM Optimization of On-Chip Colliding Pulse Mode-Locked Semiconductor Lasers** C. Gordon, M. Cumbajin, *Universidad Técnica de Ambato, Ambato, Ecuador,* R. Guzman, M.-C. Lo and G. Carpintero, *Universidad Carlos III de Madrid, Madrid, Spain* We report the experimental optimization of the absorber length of the on-chip colliding pulse mode-locked semiconductor laser working at 50 GHz repetition rate. The fundamental approach is that the active-passive integration provides freedom to choose the desired gain section to saturable absorber length ratio optimized.	**ME1.4 9:30 am–10:00 am (Invited) High-Quality Microresonators for Detection and Measurement of Nanoscale Objects** L. Yang, *Washington University in St. Louis, St. Louis, MO, USA* Whispering-gallery-mode (WGM) optical microresonators have shown their great potentials for sensing applications. In this talk, I will explain the sensing mechanisms of WGM microresonators and report exceptional points enhanced sensing for nanoscale objects. I will introduce a customized iOS app for wireless WGM sensing technology.

10:00 AM–10:30 AM – EXHIBITS / COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
MF1.3 9:15 AM–9:30 AM **A 2.2-mW 24-Mb/s CMOS LiFi Receiver System-on-a-Chip with Ambient Light Rejection and Post-Equalization** X. Li, B. Hussain, L. Wang, J. Jiang and C. P. Yue, *Hong Kong University of Science and Technology, Hong Kong* This paper presents a visible light communication (VLC) receiver SoC that utilizes ambient light rejection and post-equalization techniques for emerging LiFi applications. Based on ordinary phosphorescent white LEDs, a 24-Mb/s IEEE 802.15.7-compliant LiFi link is demonstrated over 1.6 m with a BER below 10^{-9}.	**MG1.3 9:00 AM–9:30 AM (Invited)** **Parity-Time Symmetry Photonics** X. Zhang, *University of California, Berkeley, Berkeley, CA, USA*	**MH1.3 9:15 AM–9:30 AM** **Mode Characterization of Rectangular Core Fiber** L. Rechtman, D. M. Marom, *The Hebrew University, Jerusalem, Israel,* J. S. Stone, G. Peng and M.-J. Li, *Corning, Inc., Corning, NY, USA* A few-mode fiber prototype having a rectangular core geometry is experimentally characterized for its modal delays and field profiles by time-gated interferogram analysis. Good agreement to numerical simulations is established.	
MF1.4 9:30 AM–10:00 AM (Invited) **From Linear to Geiger Mode Avalanche Detectors for ADC-Less VLC Receiver Architectures** O. Almer, *University of Edinburgh, Edinburgh, United Kingdom,* S. Gnecchi, *SensL Technologies Ltd., Cork, Ireland* and R. Henderson, *University of Edinburgh, Edinburgh, United Kingdom* This paper reviews the hardware requirements of generalised single photon ADC-less receiver circuits for visible light communications. A receiver based on parallel banks of pulse combiners and pipelined adders is shown to provide over a magnitude of circuit area reduction over the generalised structure.	**MG1.4 9:30 AM–9:45 AM** **Spectral Response of an Active Photonic Cavity at the Poynting's Threshold** A. K. Jahromi, S. Shabahang, H. E. Kondakci, *University of Central Florida, Orlando, FL, USA,* P. Melanen, S. Orsila, *Modulight, Inc., Tampere, Finland* and A. F. Abouraddy, *University of Central Florida, Orlando, FL, USA* We establish a sub-lasing critical gain in a linear cavity at which Poynting's vector vanishes at the cavity entrance. We show the cavity reflection spectrum becomes flat at this critical gain, and the device becomes indistinguishable from a perfect mirror – that nevertheless transmits light.	**MH1.4 9:30 AM–10:00 AM (Invited)** **The New Era of Open Submarine Cables** S. Grubb, *Facebook*	
	MG1.5 9:45 AM–10:00 AM **A Novel Thin-Film Blue Light Emitting Diode via GaN-on-Graphene Technology** C. Bayram, *University of Illinois at Urbana-Champaign, Urbana, IL USA,* J. Kim, *University of Illinois at Urbana-Champaign, Urbana, IL USA and T. J. Watson Research Center, Yorktown Heights, NY, USA,* H. Park, C. W. Cheng, *T. J. Watson Research Center, Yorktown Heights, NY, USA,* C. Dimitrakopoulos, *University of Massachusetts Amherst, Amherst, MA USA,* J. Ott, K. B. Reuter, S. W. Bedell, and D.K. Sadana, *T. J. Watson Research Center, Yorktown Heights, NY, USA* Fully functional thin-film blue LED was fabricated by novel means of (1) performing epitaxial growth of a single crystalline InGaN/GaN heterostructure on a recycled graphene/SiC substrate (2) followed by release and transfer of the heterostructure. .		

10:00 AM–10:30 AM – EXHIBITS / COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

Salon I	Salon II	Salon III	Salon VI	Salon VII
10:30 AM–12:00 PM **Session MA2:** Label-Free Super-Resolution: Novel Theory and Concepts **Session Chair:** Ji-Xin Cheng, *Purdue University/Boston University*	**10:30 AM–12:00 PM** **Session MB2:** Integrated Photodetector Systems **Session Chair:** Nicola Dascenzo, *Huazhong University of Science and Technology*	**10:30 am–12:00 pm** **Session MC2:** GaN Materials, LEDs and AMOLEDs **Session Chair:** Jian Xu, *Penn State University, USA*	**10:30 AM–12:00 PM Salon VI** **Session MD2:** Datacom VCSELs **Session Chair:** Anders Larsson, *Chalmers University of Technology, Gothenburg, Sweden*	**10:30 AM–12:00 PM** **Session ME2:** Datacenter Architectures **Session Chair:** George Papen, *University of California, San Diego, San Diego, CA, USA*
MA2.1 10:30 AM–11:00 AM (Invited) **Perfect Imaging Via Transformation Optics** U. Leonhardt, *Weizmann Institute of Science, Rehovot, Israel* Absolute optical instruments are, in principle, able to image with unlimited resolution. In practice, their operating bandwidth is limited due to the interaction of sources and drains. The lecture discusses the fundamental limits of such instruments and the practical experience gained.	**MB2.1 10:30 am–11:00 am (Invited)** **1.3 µm III-Nitride Nanowire Monolithic Diode Lasers and Photonic Integrated Circuits on (001) Silicon** P. Bhattacharya and A. Hazari, *University of Michigan, Ann Arbor, MI, USA* We have realized monolithic InGaN/GaN disk-in-nanowire edge-emitting lasers on (001)Si with emission from 0.53 to 1.3 µm. Results on photonic integrated circuits consisting of 1.3 µm laser and detector and a passive dielectric waveguide in between will be presented.	**MC2.1 10:30 AM–11:00 AM (Invited)** **Progress in GaN Substrates for Lighting and Beyond** S. Pimputkar, *Lehigh University, Bethlehem, PA, USA* Significant advances in bulk GaN grown using the ammonothermal and Na-flux methods have led to improved purity, transparency, growth rates and boule diameters. In situ monitoring and analysis of the chemical composition of growth solutions is providing new insight and promises further improvements.	**MD2.1 10:30 AM–11:00 AM (Invited)** **Optical Components for 56Gbps Datalinks** P. Westbergh, D. Gazula, G. Landry, T. Gray, E. Shaw and J. Tatum, *Finisar Corporation, Allen, TX, USA* Datacom VCSELs continue to evolve to higher speeds to meet demands for bandwidth. We will review the current state of Datacom VCSELs and how the shift towards 56Gbps datalinks is progressing. We will also present results on Finisar's VCSELs for NRZ, PAM4, and SWDM.	**ME2.1 10:30 AM–11:00 AM (Invited)** **Inter Datacenter Networking** M. Ghobadi, *Microsoft Research* To keep pace with the bandwidth growth in cloud networking, network efficiency becomes imperative. We conduct a large-scale study of the physical layer of a cloud provider for two years. Our analysis uncovers opportunities to improve the efficiency by leveraging software-defined networking in optical layer.
MA2.2 11:00 AM–11:30 AM (Invited) **Hyper-Structured Illumination: Label-Free Super-Resolution Imaging with Hyperbolic Metamaterials** E. E. Narimanov, *Purdue University, West Lafayette, IN, USA* We present a new approach to super-resolution optical imaging, based on structured illumination in hyperbolic media that support subwavelength optical patterns. The proposed system has planar geometry, offers unlimited field of view, and is robust with respect to optical noise and material losses.	**MB2.2 11:00 AM–11:15 AM** **Waveguide-Integrated High-Speed and High-Power Photodiode with >105 GHz Bandwidth** Q. Li, K. Sun, K. Li, Q. Yu, J. Zang, Z. Wang, *University of Virginia, Charlottesville, VA, USA,* P. Runge, W. Ebert, *Fraunhofer Heinrich-Hertz-Institut, Berlin, Germany,* A. Beling and J. C. Campbell, *University of Virginia, Charlottesville, VA, USA* We demonstrate evanescently-coupled waveguide modified uni-traveling-carrier (MUTC) photodiodes with more than 105 GHz bandwidth. The photodiodes have dark currents as low as nA and deliver RF output powers of 5.1 dBm, 4.4 dBm and 3.5 dBm at 75 GHz, 80 GHz and 90GHz, respectively.	**MC2.2 11:00 AM–11:30 AM (Invited)** **Multi-Color Nanowire LEDs on a Single Chip** Z. Mi, *University of Michigan, Ann Arbor, MI, USA and McGill University, Montreal, QC, Canada*, Y.-H. Ra, R. Wang and R. Rashid, *McGill University, Montreal, QC, Canada* We report on the monolithic integration of RGB InGaN dot-in-a-wire LEDs on a single chip. The correlated color temperature can be continuously varied in the range of 1900K to 6800K, while maintaining excellent color rendering index capability (CRI > 90). Moreover, submicron scale RGB pixels were demonstrated.	**MD2.2 11:00 AM–11:15 AM** **High-Speed Zn-Diffusion/Oxide-Relief VCSELs with Stable High-Temperature Performance at 940 nm Wavelength** K.-L. Chi, Z.-T. Xie and J.-W. Shi, *National Central University, Taoyuan, Tawian* By use of Zn-diffusion and oxide-relief apertures in 940 nm VCSEL, state-of-the-art dynamic performance has been demonstrated. A low differential resistance (50 Ohm) and a near 30 GHz 3-dB E-O bandwidth can be sustained from room-temperature to 85°C operations.	**ME2.2 11:00 AM–11:30 AM (Invited)** **Optical Technologies for Scaling Datacenters** C. Xie, *Alibaba Group* Fast growing Internet services and cloud computing drive network traffic in hyperscale datacenters to double every one or two years, which presents a big challenge for connectivity in datacenter networks. We will discuss how to use optical technologies to meet connectivity demands in scaling datacenters.

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
10:30 AM–12:00 PM **Session MF2:** Sources for LiFi and Laser Lighting **Session Chair:** Martin Dawson, *University of Strathclyde, Glasgow, United Kingdom*	**10:30 AM–11:45 AM Kahiki/Lily** **Session MG2:** Plasmonics **Session Chair:** Andrei Faraon, *California Institute of Technology, Pasadena, CA, USA*	**10:30 AM–12:00 PM** **Session MH2:** Tutorial / Probabilistic Shaping **Session Chair:** Hussam Batshon, *TE SubCom*	
MF2.1 10:30 AM–11:00 AM (Invited) **Novel Phosphors and Integrated Devices for Laser Lighting and High Rate VLC** B. Ooi, *KAUST, Thuwal, Saudi Arabia* Laser-based photonic systems are promising for compact, droop-free, and high-speed white lighting and visible-light communication applications. In this paper, our recent progress on the development of perovskite-based phosphors and the on-chip integration of GaN-based modulators, photodetectors and SOA with laser diodes will be discussed.	**MG2.1 10:30 AM–11:00 AM (Invited)** **Molecular Optomechanics in Atomic-Scale Plasmonic Hot Spots** M. Schmidt, *Center for Materials Physics (CSIC-UPV/EHU) and Donostia International Physics Center (DIPC), Donostia-San Sebastián, Spain,* A. Gonzalez-Tudela, *Max-Planck-Institut fur Quantenoptik, Garching, Germany,* G. Giedke, T. Neuman, Y. Zhang, R. Esteban, and J. Aizpurua, *Center for Materials Physics (CSIC-UPV/EHU) and Donostia International Physics Center (DIPC), Donostia-San Sebastián, Spain* We introduce a Quantum Electrodynamics (QED) approach to describe inelastic scattering processes of molecules in atomic-scale plasmonic picocavities. By solving the corresponding optomechanical dynamics, we identify nonlinear inelastic signals related to vibrational pumping, together with dynamical backaction and strong correlations of the photons emitted.	**MH2.1 10:30 AM–12:00 PM (Tutorial)** **Probabilistic Shaping Benefits and Practicality for Higher-Order QAM** G. Böcherer, P. Schulte and F. Steiner, *Technical University of Munich, Munich, Germany* Probabilistic shaping schemes and their benefits are reviewed. Probabilistic Amplitude Shaping (PAS) is presented, a layered architecture currently considered for industrial applications. Implementation challenges and proposed solutions are discussed, including distribution matching algorithms for shaping, integration with forward error correction, and digital signal processing.	
MF2.2 11:00 AM–11:15 AM **MicroLED-Pumped Perovskite Quantum Dot Color Converter for Visible Light Communications** M. F. Leitão, *University of Strathclyde, Glasgow, United Kingdom,* M. S. Islim, L. Yin, *University of Edinburgh, Edinburgh, United Kingdom,* S. Viola, S. Watson, A. Kelly, *University of Glasgow, Glasgow, United Kingdom,* X. Li, D. Yu, H. Zeng, *Nanjing University of Science and Technology, Nanjing, China,* S. Videv, H. Haas, *University of Edinburgh, Edinburgh, United Kingdom,* E. Gu, N. Laurand and M. D. Dawson, *University of Strathclyde, Glasgow, United Kingdom* The visible light communications properties of a microLED-pumped inorganic perovskite quantum dot color converter are reported. Free-space data communications at 364 Mb/s, using solely the color-converted light as the data signal optical carrier, is demonstrated.	**MG2.2 11:00 AM–11:15 AM** **Design of Plasmonic Modulators with Vanadium Dioxide on Silicon-On-Insulator** M. Sun, W. Shieh and R. R. Unnithan, *University of Melbourne, Melbourne, Australia* We propose a novel plasmonic modulator of only 200*150 nm modulating section within 3 μm footprint using Vanadium dioxide(VO_2) as modulating material realised on SOI wafer, which can realise 600 nm wavelength range around optical communication wavelength 1.55 μm and high modulation depth 21.5 dB/um.		

.

	Salon II	Salon III	Salon VI	
MA2.3 11:30 am–12:00 pm (Invited) Super-Resolution Imaging with Near-Field Probes Having Complex Point Spread Functions M. Sumetsky, *Aston University, Birmingham, United Kingdom*	**MB2.3 11:15 AM–11:30 AM Si_3N_4 Photonic Integrated Circuit for Multi-Baseline Interferometric Imaging** G. Liu, T. Su, S. Li, J. Chun, W. Lai, M. Prost, *University of California, Davis, Davis, CA USA,* C. Ogden, *Lockheed Martin ATC, Palo Alto, CA, USA,* S. T. Thurman, *Lockheed Martin Coherent Technologies, Louisville, CO, USA,* R. L. Kendrick, A. Duncan, *Lockheed Martin ATC, Palo Alto, CA, USA* and S. J. B. Yoo, *University of California, Davis, Davis, CA USA* We present design, fabrication and characterization of a compact photonic integrated circuit consisting of tri-layer Si_3N_4 platform including path-length-matching waveguides, multi-layer vertical couplers, arrayed waveguide gratings as demultiplexers, multimode interferometers and heater based phase tuner for long-baseline interferometric imaging.	**MC2.3 11:30 AM–11:45 AM Dilute-Anion Boron Nitride Semiconductor for Light Emitters** C.-K. Tan, *Clarkson University, Potsdam, NY, USA and Lehigh University, Bethlehem, PA, USA,* D. Borovac, W. Sun and N. Tansu, *Lehigh University, Bethlehem, PA, USA* First-principle analysis of the band structures for dilute-anion BN-based semiconductor was performed, and the findings indicated a direct bandgap properties of this alloy in deep ultraviolet regime as compared to the indirect band gap BN alloy.	**MD2.3 11:15 AM–11:30 AM 1060 nm Single and Multimode VCSELs for Up to 50 Gb/s Modulation** E. Simpanen, J. S. Gustavsson, E. Haglund, E. P. Haglund, T. Lengyel, A. Larsson, P. A. Andrekson, *Chalmers University of Technology, Gothenburg, Sweden,* W. V. Sorin, S. Mathai, M. Tan, *Hewlett Packard Enterprise, Palo Alto, CA, USA* and S. Bickham, *Corning R&D Corporation, Painted Post, NY, USA* We present the design and performance of 1060 nm VCSELs with up to 50 Gb/s modulation capacity and demonstrate 25 Gb/s transmission over 1000 m of 1060 nm optimized MMF using a single-mode VCSEL and mode-selective launch.	**ME2.3 11:30 AM–12:00 PM (Invited) Web-Scale Data Center Interconnect Market and Technologies** S. Elby, *Infinera, Sunnyvale, CA, USA* Data Center Interconnect bandwidth growth is dramatically outpacing the WDM market. The specific requirements of the DCI market will be addressed. Competing architectural approaches and technologies will be examined, including integrated packet optical platforms, coherent and non-coherent transponders, photonic integrated circuits and DSPs.
	MB2.4 11:30 AM–11:45 AM Thermal Investigation of High-Power Photodiodes Y. Shen, J. Gaskins, X. Xie, B. M. Foley, R. Cheaito, P. E. Hopkins and J. C. Campbell, *University of Virginia, Charlottesville, VA, USA* The performance of high power photodiodes flip-chip bonded on multi-crystal aluminum nitride (AlN), single-crystal AlN, and diamond submounts are compared. The thermal boundary conductance of submount-Ti interfaces was measured and found to be the primary impedance to heat dissipation.	**MC2.4 11:45 AM–12:00 PM Applying Inverter Circuitry to the Driving Scheme of Active-Matrix Organic Light-Emitting Displays** H. Yang and P.-J. Huang, *National Taipei University of Technology (Taipei Tech), Taipei, Taiwan* We applied the inverter circuitry to investigate the feasibility of reducing current surges occurred as organic light-emitting diode pixels undergo alternating-current driving scheme in active-matrix organic light-emitting display (AMOLED) and discovered that the current surge can decrease 3.64% by peak-to-peak comparison via SPICE simulation.	**MD2.4 11:30 AM–12:00 PM (Invited) Low Dimension High Bandwidth 980-nm VCSELs for Very-Short-Reach Optical Interconnects and Integration** J. A. Lott, *Technische Universität Berlin, Berlin, Germany* Simplicity-in-design and processing to reach minimum operating power and maximum bandwidth, energy efficiency, and temperature stability limits of vertical-cavity surface-emitting lasers (VCSELs) by for example reducing the vertical and lateral dimensions are explored. We seek optimized VCSELs for data communications and photonic integration.	
	MB2.5 11:45 AM–12:00 PM Nonplanar Focal Plane with Silicon Based Photodetector Z. Ma, X. Wang, K. Rehshaw, and H. Cho, *University of Central Florida, Orlando, FL, USA* A fabrication process is demonstrated to form curved image sensors based on CMOS image sensor technology. A stretchable polymer backplane is fabricated monolithically on the backside of the wafer before a DRIE etch is performed to segment the wafer and make the circuit stretchable.			

12:00 PM–1:30 PM – LUNCH (ON OWN)

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
MF2.3 11:15 AM–11:30 AM **Development, Performance and Application of Novel GaN-Based Micro-LED Arrays with Individually Addressable n-Electrodes** E. Xie, M. Stonehouse, R. Ferreira, J. J. D. McKendry, J. Herrnsdorf, X. He, *University of Strathclyde, Glasgow, United Kingdom,* S. Rajbhandari, H. Chun, *University of Oxford, Oxford, United Kingdom,* A. V. N. Jalajakumari, O. Almer, S. Videv, *University of Edinburgh, Edinburgh, United Kingdom,* G. Faulkner, *University of Oxford, Oxford, United Kingdom,* I. M. Watson, E. Gu, *University of Strathclyde, Glasgow, United Kingdom,* R. Henderson, *University of Edinburgh, Edinburgh, United Kingdom,* D. O'Brien, *University of Oxford, Oxford, United Kingdom,* H. Haas, *University of Edinburgh, Edinburgh, United Kingdom* and M. D. Dawson, *University of Strathclyde, Glasgow, United Kingdom* We demonstrate the development, performance and application of a GaN-based micro-light emitting diode array sharing a common p-electrode with individual-addressed n-electrodes. These individually-addressed n-electrodes minimize the series-resistance difference from conductive paths, and offer compatibility with n-type metal–oxide–semiconductor transistor-based drivers for faster modulation.	**MG2.3 11:15 AM–11:30 AM** **Geometry Dependence and Effects in Plasmonic Lattices** R. Guo, T. K. Hakala and P. Törmä, *Aalto University, Aalto, Finland* We investigate how the lattice geometry affects the collective modes supported by nanoplasmonic arrays. Experimental measurements show that arrays with different geometries have different dispersions which are also dependent on the polarization. We further study the possibility of observing topologically-nontrivial phenomenon in plasmonic system.		
MF2.4 11:30 AM–12:00 PM (Invited) **The Development of High-Speed III-Nitride Based Light-Emitting Diode for Visible Light and Plastic Optical Fiber Communications** J.-W. Shi, *National Central University, Taoyuan, Taiwan* and J.-K. Sheu, *National Cheng Kung University, Tainan, Taiwan* We review our work on GaN high-speed LEDs. By optimizing MQWs structure in our device, record-high data rates (5.5 Gbit/sec) over POF among all visible LEDs can be achieved. Besides, a high-lumens, high-CRI (95), and high-speed white-light LED has been demonstrated for indoor VLC.	**MG2.4 11:30 AM–11:45 AM** **Electro-Absorption Plasmonic Modulation in Lithium Niobate** J. Ali and O. Eknoyan, *Texas A&M University, College Station, TX* Efficient electro-absorption modulator integrated with Ti diffused $LiNbO_3$ waveguide consisting of stack of ITO/SiO_2/Au and TiO_2 film extended partially over the waveguide is presented. Simulation predicts insertion loss to be 0.04dB and extinction ratio to be 3.75dB for 20μm device under 2V switching voltage.		

12:00 PM–1:30 PM – LUNCH (ON OWN)

Salon I

1:30 PM–3:00 PM
Session MA3: Devices for Microwave Photonic Applications
Session Chair: Frank Quinlan, *National Institute of Standards and Technology*

MA3.1 1:30 PM–1:45 PM
Low-Dark Current III-V Photodiodes Grown on Silicon Substrate
K. Sun, *University of Virginia, Charlottesville, VA, USA,* D. Jung, C. Shang, A. Liu, J. Bowers, *University of California Santa Barbara, Santa Barbara, CA, USA* and A. Beling, *University of Virginia, Charlottesville, VA, USA*
InAlGaAs/InP p-i-n photodiodes epitaxially grown on silicon substrate with a dark current density as low as 1.3 mA/cm^2 at –3 V are demonstrated. Responsivity, bandwidth, and output power at 1-dB compression are 0.76 A/W, 8 GHz, and –3.4 dBm, respectively.

MA3.2 1:45 PM–2:00 PM
110 GHz Zero-Bias Based UTC-PD for Radio-Over-Fiber Transmission Through Multicore Fiber
T. Umezawa, P. T. Dat, A. Kanno, N. Yamamoto, *National Institute of Information and Communications Technology (NICT), Tokyo, Japan* and T. Kawanishi, *National Institute of Information and Communications Technology (NICT), Tokyo, Japan and Waseda University, Tokyo*
We developed a zero-bias operational UTC-PD, which exhibited wide bandwidth over 110 GHz. The photoreceiver was demonstrated for high-data-rate (12 Gbps, OFDM, 16-QAM) radio-over-fiber transmission through multicore fiber. BER $\leqq 1 \times 10^{-3}$ without crosstalk from outer cores could be confirmed.

MA3.3 2:00 PM–2:15 PM
Temperature Dependence of Nonlinearity in High-Speed, High-Power Photodetectors
J. Davila-Rodriguez, H. Leopardi, T. M. Fortier, *NIST, Boulder, CO, USA,* X. Xie, J. C. Campbell, *University of Virginia, Charlottesville, VA, USA,* J. Booth, N. Orloff, S. A. Diddams, and F. Quinlan, *NIST, Boulder, CO, USA*
We present an experimental study of the nonlinearity of modified uni-traveling carrier (MUTC) photodiodes at cryogenic temperatures. At 120 K, the amplitude-to-phase (AM-to-PM) conversion nonlinearity is reduced by up to 10 dB, resulting in nearly 40 dB AM-to-PM rejection over a broad photocurrent range.

Salon II

1:30 PM–2:45 PM
Session MB3: Hybrid Detectors and Phased Arrays
Session Chair: Aurore Savoy-Navarro, *University of Paris, Paris, France*

MB3.1 1:30 PM–2:00 PM (Invited)
Near-Infrared and Mid-Infrared Integrated Photonics Based on Ge-on-Insulator Platform
M. Takenaka, J. Kang and S. Takagi, *University of Tokyo, Tokyo, Japan*
We present the Ge-on-insulator platform for photonic integrated circuits. We have successfully demonstrated Ge photodetector integrated with a-Si waveguide. Ge passive waveguides and carrier-injection modulator operating at 2 μm wavelength are also demonstrated.

MB3.2 2:00 PM–2:15 PM
Germanium-on-Silicon Nitride: A Promising Platform for Mid-IR Sensing Applications
W. Li, P. Anantha, *Nanyang Technological University, Singapore, Singapore,* K. H. Lee, *Singapore-MIT Alliance for Research and Technology (SMART), Singapore,* H. D. Qiu, X. Guo, L. Zhang, H. Wang, *Nanyang Technological University, Singapore, Singapore* and C. S. Tan, *Nanyang Technological University, Singapore, Singapore and Singapore-MIT Alliance for Research and Technology (SMART), Singapore*
A new germanium-on-silicon nitride platform is fabricated and tested for mid-IR sensing applications. Waveguides with low bending loss are demonstrated allowing one to design compact on-chip sensors. Spiral waveguide sensors have been studied for potential drug detection and food processing applications.

MB3.3 2:15 PM–2:45 PM (Invited)
Photodiode-Integrated UWB Phased Array Antennas
D. D. Ross, M. R. Konkol, S. Shi, and D. W. Prather, *University of Delaware, Newark, DE, USA*
High-power, high-linearity CC-MUTC photodiodes, directly integrated into connected and tightly coupled array antennas enable ultra-wideband (UWB) phased array operation with improved size, weight, and power (SWaP). Presented is high-fidelity beam steering and bandwidth performance of several of these one-dimensional photodiode-integrated antenna arrays.

Salon III

1:30 PM–3:00 PM
Session MC3: SL Tutorial
Session Chair: Dieter Bimberg, *Technical University Berlin, Berlin, Germany*

MC3.1: 1:30 PM–2:30 PM (Tutorial)
Wavelength Beam Combined High-Brightness kW Class Direct Diode Lasers
H. Zimer, *TRUMPF Photonics, Inc., Cranbury, NJ, USA*

MC3.2 2:30 PM–2:45 PM
Numerical and Experimental Investigation of Near-Field Narrowing in Broad-Area Laser Diodes due to Longitudinally Asymmetric Self-Heating
S. Rauch, M. Haas, *TRUMPF Laser GmbH, Schramberg, Germany* and H. Zimer, *TRUMPF Photonics, Inc., Cranbury, NJ, USA*
We investigate the longitudinal temperature profile in broad-area laser diodes and its influence on the lateral near-field width by the use of quasi three-dimensional numerical simulations in comparison with experimental measurements.

MC3.3 2:45 PM–3:00 PM
Blue and Red Shifted, Partially Intermixed InGaAsP Quantum Well Semiconductor Laser Diodes
T. Tabbakh and P. LiKamWa, *University of Central Florida, Orlando, FL, USA*
InGaAsP quantum well structures are intermixed to varying degrees when rapidly annealed at elevated temperatures while capped with films of SiN_x, and SiO_yN_x of different compositions. Laser diodes are fabricated with both blue and red shifted samples and their performances are reported.

Salon VI

1:30 PM–2:45 PM
Session MD3: Modulated and Tunable Microresonators
Session Chair: Misha Sumetsky, *Aston University, UK*

MD3.1 1:30 PM–2:00 PM (Invited)
Synthetic Dimensions in Dynamically Modulated Resonators
S. Fan, *Stanford University, Stanford, CA, USA*

MD3.2 2:00 PM–2:15 PM
Piezoelectric Tuning of a Suspended Silicon Nitride Ring Resonator
W. Jin, E. J. Stanton, N. Volet, *University of California, Santa Barbara, Santa Barbara, CA, USA,* R. G. Polcawich, *U.S. Army Research Laboratory, Adelphi, MD, USA,* D. Baney, *Keysight Technologies, Santa Clara, CA, USA,* P. Morton, *Morton Photonics, West Friendship, MD, USA* and J. E. Bowers, *University of California, Santa Barbara, Santa Barbara, CA, USA*
A piezoelectric thin film deposited on a suspended silicon nitride-based waveguide provides tuning via mechanical deformation. The fabricated ring resonator device is capable of tuning across a full FSR with under 16 V applied bias

MD3.3 2:15 PM–2:30 PM
Tunable Optical Delay Line Based on Si_3N_4 Ring Resonators
C. Xiang, M. L. Davenport, *University of California, Santa Barbara, Santa Barbara, CA, USA,* J. B. Khurgin, *Johns Hopkins University, Baltimore, MD, USA,* P. A. Morton, *Morton Photonics, West Friendship, MD, USA* and J. E. Bowers, *University of California, Santa Barbara, Santa Barbara, CA, USA*
We demonstrate a tunable optical time delay line based on Si_3N_4 ring resonators. A continuously tunable 1.4 ns optical delay is achieved with over 3.5 GHz bandwidth. The maximum tunable delay can be easily extended to several nanoseconds by modifying the ring coupler κ.

Salon VII

1:30 PM–3:00 PM
Session ME3: Photonic Components for Datacenters
Session Chair: Chongjin Xie, *Alibaba Group, USA*

ME3.1 1:30 PM–2:00 PM (Invited)
Partially Configurable Optical Switching for Data Center Networks
W. M. Mellette, J. E. Ford and G. Porter, *University of California San Diego, La Jolla, CA, USA*
We investigate partially configurable optical circuit switches as a means to circumvent the physical and control layer scaling challenges of optical crossbar switches. We present the optical design and characterization of a prototype partially configurable switch as well as network architectures which employ these switches.

ME3.2 2:00 PM–2:30 PM (Invited)
Petascale Networking for Datacenters
D. Marom, *University of Jerusalem, Israel*

ME3.3 2:30 PM–3:00 PM (Invited)
Hybrid Optical Routing Switches for Datacenter Applications
I. White, *University of Cambridge, Cambridge, United Kingdom*
In response to the rapid growth in the capacity of datacenters, research has focussed on high port count optical routers which can be rapidly reconfigured. This paper will review progress on hybrid SOA-MZI switch architectures which have benefits in system margin, scalability and power consumption.

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
1:30 PM–2:45 PM **Session MF3:** LiFi and Optical Wireless Applications **Session Chair:** Dominic O'Brien, *University of Oxford, Oxford, United Kingdom*	**1:30 PM–2:45 PM Kahiki/Lily** **Session MG3:** Quantum Photonics **Session Chair:** Vinod Menon, *City College of New York, New York, NY, USA*	**1:30 PM–3:00 PM** **Session MH3: Nonlinear Optics in Fibers** **Session Chair:** Kym Kyung Taec, *Institute of Basic Science, Gwanju, Korea*	
MF3.1 1:30 PM–2:00 PM (Invited) Optical Wireless Communications in Industrial Manufacturing Environments P. Wilke Berenguer, D. Schulz, J. K. Fischer and V. Jungnickel, *Fraunhofer Institute for Telecommunications Heinrich Hertz Institute, Berlin, Germany* We present 6 × 8 MIMO broadband channel measurements in an industrial manufacturing environment. Motivated by the observation of sudden fades with 10–20 dB due to slight rotations/ translational movements and thus line-of-sight blockage, multiple antenna diversity schemes are evaluated in transmission experiments for increased robustness.	**MG3.1 1:30 PM–1:45 PM Performance Limit of Monolithically Integrated Gaussian Modulated Coherent States Quantum Key Distribution Receiver in Silicon-on-Insulator CMOS** S.-W. Chung, *University of Southern California, Los Angeles, CA, USA,* A. B. Ravindranath, GlobalFoundries, Malta, NY, USA and X. Yang, Massachusetts Institute of Technology, Cambridge, MA, USA For the silicon-photonics implementation of a continuous-variable quantum key distribution system using Gaussian modulated coherent states, we investigate the performance limit of balanced receivers in the presence of thermal noise, predicting a multi-gigabit/sec secure data rate in 28 nm SOI CMOS technologies for monolithic integration.	**MH3.1 1:30 PM–1:45 PM Observation of Stimulated Brillouin Scattering in Si_3N_4 Waveguides** R. Dehghannasiri, A. A. Eftekhar and A. Adibi, *Georgia Institute of Technology, Atlanta, GA, USA* Here, we report the first observation of stimulated Brillouin scattering (SBS) in Si_3N_4 waveguides. The waveguides are designed as a line defect in a membrane phononic crystal (MPnC). The observed SBS frequency is at 1.55 GHz within the first phononic bandgap of the host MPnC.	
MF3.2 2:00 pm–2:30 pm (Invited) MEMS-Based Reconfigurable Optical Wireless Networking in Data Centers M. Kavehrad, *State College, PA, USA* A flexible wireless Data Center (DC) network based on precise steerable Free Space Optical (FSO) links is described as a promising solution to meet future DC demands of high-throughput, with robustness to dynamic traffic patterns, reducing cabling complexity and increased energy efficiency.	**MG3.2 1:45 PM–2:15 PM (Invited) Quantum Light-Matter Interfaces Based on Rare-Earth Ions and Nano-Photonics** A. Faraon, T. Zhong, J. M. Kindem, I. Craiciu, J. G. Bartholomew, E. Miyazono and J. Rochman, *California Institute of Technology, Pasadena, CA, USA* I present our progress towards developing on-chip quantum light-matter interfaces like quantum memories and quantum transductors based on nanophotonic resonators coupled to rare-earth ions (Neodymium, Erbium, Ytterbium) in crystals.	**MH3.2 1:45 PM–2:00 PM Nonlinear Aharonov-Bohm Suppression of Optical Tunneling in Twisted Multicore Optical Fibers** M. Parto, H. Lopez, M. Khajavikhan, R. Amezcua Correa and D. N. Christodoulides, *University of Central Florida, Orlando, FL, USA* We show that an Aharonov-Bohm like suppression of optical tunneling can take place in linear and nonlinear twisted multicore optical fiber structures. The energy exchange is analyzed under nonlinear conditions and a viable setting to observe these effects is suggested.	
MF3.3 2:30 PM–2:45 PM An Integrated Indoor Visible Light Communication and Positioning System Based on FBMC-SCM H. Yang, C. Chen, W.-D. Zhong, S. Zhang and P. Du, *Nanyang Technology University, Singapore* This paper presents an integrated visible light communication and positioning (VLCP) system using filter bank multicarrier-based subcarrier multiplexing (FBMC-SCM). The proposed VLCP system achieves higher positioning accuracy and better BER performance than the VLCP system employing conventional orthogonal frequency division multiplexing-based subcarrier multiplexing (OFDM-SCM).	**MG3.3 2:15 PM–2:45 PM (Invited) An Integrated Diamond Nanophotonics Platform for Quantum-Optical Networks** A. Sipahigil, *Harvard University, Cambridge, MA, USA* We integrate silicon-vacancy color centers into diamond nanophotonic devices. Using this platform, we demonstrate a quantum-optical switch controlled by a single color center and entanglement generation between two emitters in a single nanophotonic device. Finally, we demonstrate extended qubit coherence by operating at sub-Kelvin temperatures.	**MH3.3 2:00 PM–2:15 PM Soliton Microcomb Operation to 778 nm** Q.-F. Yang, S. H. Lee, D. Y. Oh, B. Shen, H. Wang, K. Y. Yang, Y. H. Lai, X. Yi, K. Vahala, *California Institute of Technology, Pasadena, CA, USA* Soliton microcombs are demonstrated at both 1064 nm and 778 nm by dispersion-engineering on-chip silica resonators. These are the shortest wavelength soliton microcombs demonstrated to date and have potential applications in optical clocks and metrology.	

Salon I	Salon II	Salon III	Salon VI	Salon VII
MA3.4 2:15 PM–2:30 PM **Microring Weight Bank Designs with Improved Channel Density and Tolerance** A. N. Tait, A. X. Wu, T. Ferreira de Lima, M. A. Nahmias, B. J. Shastri and P. R. Prucnal, *Princeton University, Princeton, NJ, USA* Microring weight banks enable reconfiguration in analog photonic networks and multi-channel RF front-ends. We demonstrate 2-ring weight banks and show that they are tolerant to fabrication and thermal effects. Weights consisting of two microrings can potentially increase channel capacity by a factor of 2.72-fold.			**MD3.4 2:30 PM–2:45 PM** **Heterogeneous MOS Microring Resonators** X. Huang, D. Liang, C. Zhang, G. Kurczveil, X. Li, J. Zhang, M. Fiorentino, R. Beausoleil, *Hewlett Packard Enterprise, Palo Alto, CA, USA* We demonstrate a heterogeneous microring resonator with integrated InP-dielectric-Si metal-oxide-semiconductor (MOS) capacitor by high-k dielectric wafer bonding. HfO_2 is used for its extremely high k value (20–30) and enables optical tuning range more than twice better than Al_2O_3 based MOS devices.	
MA3.5 2:30 PM–3:00 PM (Invited) **Integrated Photodiodes for Microwave Photonics Applications** A. Beling, *University of Virginia, Charlottesville, VA, USA* The talk reviews recent results from high-power high-speed photodiodes. Waveguide photodiodes and integrated photodiode-antenna emitters for 100 GHz are described.				

3:00 PM–3:30 PM – EXHIBITS / COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
		MH3.4 2:15 PM–2:30 PM **Generation of a 128-GHz Optical Pulse Train from a 250-MHz Frequency Comb Using Temporal Self-Imaging** M. Seghilani, R. Maram, L. Romero Cortés and J. Azana, *INRS-EMT, Montreal, QC, Canada* This work reports generation of a 128-GHz optical pulse train starting from a 250-MHz CEO-stabilized frequency comb, using dispersion-induced repetition-rate multiplication by temporal self-imaging. This demonstration should prove useful in bridging the current gap between CEO-stabilized MHz-rate pulse trains and highly demanded GHz-rate ones.	
		MH3.5 2:30 PM–2:45 PM **Demonstration of Diffraction-Free, Acceleration-Free Space-Time Airy Beams** H. E. Kondakci and A. F. Abouraddy, *University of Central Florida, Orlando, FL, USA* We experimentally demonstrate pulsed Airy beams that are diffraction-free and acceleration-free by introducing a tight correlation between the spatial and temporal spectra of a femtosecond-pulsed beam via a two-dimensional pulse shaper. Such beams only exhibit transverse acceleration only in the pulse local time-frame.	
		MH3.6 2:45 PM–3:00 PM **All-Fiber Chalcogenide Raman Laser at 2 µm** N. Abdukerim, L. Li, *McGill University, Montreal, Canada,* M. El Amraoui, Y. Messaddeq, *Laval University, Quebec City, Canada,* and M. Rochette, *McGill University, Montreal, Canada* We present an all-fiber Raman laser based on a mid-infrared compatible and highly nonlinear $As_{38}Se_{62}$ core/$As_{38}Se_{62}$ cladding chalcogenide microwire. The laser operates at a wavelength of 2.025 µm with a low threshold peak power of 4.6 W. Pulsewidth can be compressed to femtosecond scale.	

3:00 PM–3:30 PM – EXHIBITS / COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

Salon I

3:30 PM–4:30 PM
Session MA4: High Speed and Digital Communications
Session Chair: Eric Adles, *JHU/APL, Laurel, MD, USA*

MA4.1 3:30 PM–3:45 PM
Wireless Multi-Subcarrier THz Communications Using Mixing in a Photoconductor for Coherent Reception
T. Harter, M. M. H. Adib, S. Wolf, S. Muehlbrandt, M. Weber, M. Blaicher, F. Boes, *Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany,* H. Massler, A. Tessmann, *Fraunhofer Institute for Applied Solid State Physics (IAF), Freiburg, Germany,* S. Nellen, T. Goebel, J. Giesekus, *Heinrich Hertz Institute (HHI), Berlin, Germany,* M. Walther, *Fraunhofer Institute for Applied Solid State Physics (IAF), Freiburg, Germany,* T. Zwick, W. Freude, S. Randel, C. Koos, *Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany*
We show coherent wireless transmission at carrier frequencies within 0.30 ± 0.02 THz using up to 20 QPSK-modulated subcarriers with a symbol rate of 0.75 GBd each, leading to an aggregate line rate of 30 Gbit/s. We exploit optoelectronic techniques, both for THz generation and coherent reception.

MA4.2 3:45 PM–4:00 PM
144 Gb/s Dual-Polarization Photonic Wireless Link Operating in the V-Band
M. Jenkins, E. Soto and R. DeSalvo, *Harris Corporation, Palm Bay, FL, USA*
We demonstrate a 144 Gb/s dual-polarization photonic wireless link on a single carrier at 63.5 GHz over a distance of 2.5 meters with a bit-error rate less than 3.8×10^{-3}. An overview of system components and architecture is provided, along with results and conclusions.

MA4.3 4:00 PM–4:15 PM
Recovery of Spectrally Overlapping QPSK Signals Using a Nonlinear Optoelectronic Filter
W. Loh, S. Yegnanarayanan, K. E. Kolodziej and P. W. Juodawlkis, *MIT Lincoln Laboratory, Lexington, MA, USA*
We demonstrate recovery of a QPSK signal buried 35-dB beneath an interfering and spectrally overlapped QPSK signal. This optoelectronic filter technique requires no a priori knowledge of either signal and opens new directions for communications.

Salon II

3:30 PM–5:00 PM
Session MB4: Tutorial / Advances in Infrared Detectors
Session Chair: Andrew Sarangan, *University of Dayton, Dayton, OH, USA*

MB4.1 3:30 PM–4:30 PM (Tutorial)
Photonic Infared Detector Technologies
S. Krishna, *Ohio State University, Columbus, OH, USA*
There has been significant advancement in photonic infrared (IR) detector technology in the past decade. In this tutorial, I will cover the basics of photonic IR detectors including the detection mechanisms and figures-of-merit. I will end with a survey of a few current technologies.

MB4.2 4:30 PM–4:45 PM
Operation Stability Study of AlInAsSb Avalanche Photodiodes
M. Ren, Y. Yuan, A. H. Jones, *University of Virginia, Charlottesville, VA, USA,* S. J. Maddox, *University of Texas, Austin, TX, USA,* M. E. Woodson, *University of Virginia, Charlottesville, VA, USA,* S. R. Bank, *University of Texas, Austin, TX, USA* and J. C. Campbell, *University of Virginia, Charlottesville, VA, USA*
We report temperature-dependence and temporal stability studies of $Al_xIn_{1-x}As_ySb_{1-y}$-based avalanche photodiodes (APDs). Multiplication gain and breakdown voltage of $Al_xIn_{1-x}As_ySb_{1-y}$ APDs have shown low gain-temperature coefficients for a wide range of temperature.

MB4.3 4:45 PM–5:00 PM
Aspects of Type-II Superlattice Infrared Detectors: Minority Carrier Lifetimes and Conductivity Effective Masses
D. Z. Ting, L. Höglund, A. Soibel, A. Khoshakhlagh, S. A. Keo, A. M. Fisher, S. B. Rafol, E. M. Luong, C. J. Hill, J. M. Mumolo, J. K. Liu, B. J. Pepper and S. D. Gunapala, *California Institute of Technology, Pasadena, CA, USA*
Significant advances in type-II superlattice infrared detectors and focal plane arrays have been achieved in the past decade. We briefly explore two challenging aspects for type-II superlattice based infrared detectors, namely, minority carrier lifetime and conductivity effective mass.

Salon III

3:30 PM–5:00 PM
Session MC4: Integrated Grating Based Lasers
Session Chair: Hagen Zimer, *Trumpf USA*

MC4.1 3:30 PM–4:00 PM (Invited)
Low-Threshold Membrane DFB and DR Lasers
S. Arai, *Tokyo Institute of Technology, Tokyo, Japan*
Low-threshold current and high-speed direct modulation features of membrane-based distributed-feedback and distributed-reflector lasers will be presented. A power conversion efficiency of 12.5% was achieved with the DR laser by adopting a special design to reduce both the waveguide loss and the series resistance.

MC4.2 4:00 PM–4:30 PM (Invited)
Tunable Distributed Reflector Lasers Combined by Monolithically Integrated AWG Coupler
T. Suzuki, K. Kiyota, S. Okuyama, M. Ariga, Y. Inaba, K. Yamaoka, H. Mori and T. Kurobe, *Furukawa Electric Co., Ltd., Ichihara, Japan*
A tunable light source integrated with a DR laser array and an AWG coupler was proposed for digital coherent communication. Fiber output power as high as 19 dBm and spectral linewidth as narrow as 70 kHz were obtained as a tunable light source module.

MC4.3 4:30 PM–4:45 PM
Analysis of Integrated Tunable III-Nitride Lasers with Dual Distributed Bragg Reflectors
E. T. Reid and N. Tansu, *Lehigh University, Bethlehem, PA, USA*
The designs for the integrated tunable III-nitride diode lasers employing lateral distributed Bragg reflectors (DBRs) are presented. The threshold characteristics of the integrated tunable nitride-based lasers with short column and tall column DBRs are compared.

Salon VI

3:30 PM–5:00 PM
Session MD4: Nonlinear Fiber Propagation
Session Chair: Kwang Yong Song, *Chung-Ang University, Seoul, South Korea*

MD4.1 3:30 PM–4:00 PM (Invited)
Prospects for Nonlinear Fourier Transform Based Transmission
S. Turitsyn, *Aston University, Birmingham, England*

MD4.2 4:00 PM–4:15 PM
Performance Study of a 10 GHz Dispersion-Tuned Wavelength-Swept All-PM Figure-8 Hybrid Mode-Locked Er-Doped Fiber Laser
C.-J. Luo, C.-H. Hung and Y. Lai, *National Chiao Tung University, Hsinchu, Taiwan*
Based on an all-PM figure-8 fiber loop cavity configuration with in-loop phase modulation, we demonstrate a 10 GHz dispersion-tuned wavelength-swept hybrid mode-locked Er-doped fiber laser with reasonably fast wavelength sweeping rate and excellent environmental stability.

MD4.3 4:15 PM–4:30 PM
Optimized Pump Compensation of a BOTDA System with Distributed Brillouin Amplification
Y. H. Kim and K. Y. Song, *Chung-Ang University, Seoul, South Korea*
We demonstrate a BOTDA system based on optimized compensation scheme for the propagation loss of the pump pulse by distributed Brillouin amplification. Near-constant Brillouin gain is obtained in the distributed measurement of Brillouin freqency along 51.2 km optical fiber with 20 cm spatial resolution.

Salon VII

3:30 PM–5:00 PM
Session ME4: Optical Network Design and Performance Optimization
Session Chair: Andreas Stoehr, *University of Duisburg Essen, Germany*

ME4.1 3:30 PM–4:00 PM (Invited)
Multi-Broker Based Software-Defined Optical Networks
X. Chen, *University of California, Davis, Davis, CA, USA,* Z. Zhuy, *University of Science and Technology of China, Hefei, China,* A. Castro, R. Proietti and S. J. B. Yoo, *University of California, Davis, Davis, CA, USA*
This paper investigates the multi-broker based network control and management paradigm for realizing scalable and cost-effective service provisioning in multi-domain softwaredefined optical networks. Experimental results verify the feasibility of the proposal and demonstrate ~7.6× blocking reduction comparing with the conventional single-broker based solution.

ME4.2 4:00 PM–4:30 PM (Invited)
Metro-Scale Optical Access Supporting Service Convergence and SDN Controlled Reconfigurability
G. Talli, S. Porto, D. Carey, N. Brandonisio, P. Ossieur, *University College Cork, Cork, Ireland,* F. Slyne, S. McGettrick, C. Blümm, M. Ruffini, A. Hill, D. Payne, *Trinity College, Dublin, Ireland* and P. Townsend, *University College Cork, Cork, Ireland*
Metro-scale TDM-DWDM PONs can enable consolidation of network resources and convergence of multiple service types on the same infrastructure. Two different SDN enabled metro-scale PON configurations are reported, for densely and sparsely populated areas, supporting 10G PON channels, wireless fronthaul and 100G enterprise service.

ME4.3 4:30 PM–5:00 PM (Invited)
Performance Optimization of 64QAM for Next-Generation High Capacity Transmission Link
S. Ralph, *Georgia Institute of Technology, Atlanta, GA, USA*

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
3:30 PM–5:00 PM **Session MF4:** Coupling & Multilayer Integration **Session Chair:** Ozan Yilmaz, *Inphi Corporation, Westlake Village, CA, USA*		**3:30 PM–5:15 PM** **Session MH4:** Nonlinear Optics in the Mid-Infrared **Session Chair:** Paul Barclay, *University of Calgary, Calgary, Alberta, Canada*	
MF4.1 3:30 PM–4:00 PM (Invited) **Multilayer Silicon Integrated Photonic Platforms for 3D Photonic Devices and Circuits** J. K. S. Poon, *University of Toronto, Toronto, ON, Canada* This talk presents my group's progress in multilayer silicon nitride-on-silicon integrated photonic platforms. These platforms are useful for the implementation of very large-scale, three-dimensional silicon photonic circuits.		**MH4.1 3:30 PM–4:00 PM (Invited)** **Generation and Characterization of a Single Cycle Laser Pulse** K. T. Kim, *Institute for Basic Science, Gwangju, South Korea and Gwangju Institute of Science and Technology, Gwangju, South Korea,* S. I. Hwang, S. B. Park, K. Kim, *Institute for Basic Science, Gwangju, South Korea,* W. Cho, *Institute for Basic Science, Gwangju, South Korea and Gwangju Institute of Science and Technology, Gwangju, South Korea,* I. Ivanov, *Institute for Basic Science, Gwangju, South Korea* and C. H. Nam, *Institute for Basic Science, Gwangju, South Korea and Gwangju Institute of Science and Technology, Gwangju, South Korea* A single cycle laser pulse is generated using a two stage compressor consisting of a hollow core fiber and multiple fused silica plates. The single cycle laser pulse is sampled using the sub-cycle tunneling ionization in a gaseous medium or air.	
MF4.2 4:00 PM–4:15 PM **Scalable Broadband Optical Interface for Silicon Photonics to Fiber Coupling Using Polymer Waveguides** R. Dangel, A. La Porta, D. Jubin, N. Meier, F. Horst and B. J. Offrein, *IBM Research – Zurich, Rüschlikon, Switzerland* We present a optical interface for silicon photonics based on adiabatic optical coupling to polymer waveguides. Coupling losses below 1.5 dB were achieved for the entire O- and C-band. At 1310 nm, losses <0.6 dB for TM and <1.4 dB for TE were found.		**MH4.2 4:00 PM–4:15 PM** **Regenerative Multi-Tone Injection Locking for Linewidth Enhancement and Repetition Rate Stabilization of a PIC Mode-Locked Laser** R. B. Ramirez, M. E. Plascak, K. Bagnell, *University of Central Florida, Orlando, FL, USA,* A. Bhardwaj, J. Ferrara, G. Hoefler, *Infinera Corporation, Sunnyvale CA, USA,* M. C. Wu, *University of California at Berkeley, Berkeley, CA, USA* and P. J. Delfyett, *University of Central Florida, Orlando, FL, USA* We report the stabilization of a 10 GHz monolithic passively mode-locked laser using a novel combination of multi-tone injection locking and regenerative mode-locking via optoelectronic loop. Comb-teeth linewidths are narrowed by 4000× and repetition rate is stabilized to better than $10^{-10}/\tau$ at 1 second.	
MF4.3 4:15 PM–4:30 PM **Monolithic Integration of Waveguide Photodiodes (WGPD) with Vertically Integrated AlGaAs Waveguides** Z. Liao and J. S. Aitchison, *University of Toronto, Toronto, ON, Canada* We designed a three-guide-layer AlGaAs chip consisting of a lower layer facilitating end-fire coupling, a middle layer for high confinement waveguides and a top SQW-based waveguide photodiode layer. We simulated an overall conversion efficiency of 95% and a responsivity of 0.8 A/W for the WGPD.		**MH4.3 4:15 PM–4:30 PM** **InP Integrated Pulse Shaper with 48 Channel, 50 GHz Spacing Amplitude and Phase Control** K. A. McKinzie, D. E. Leaird, *Purdue University, West Lafayette, IN, USA,* D. Mathine, M. Anagnosti, G. E. Hoefler, *Infinera Corporation, Sunnyvale, CA, USA,* Z. Kong, C. Bao, *Purdue University, West Lafayette, IN, USA,* V. Lal, A. Hosseini, F. Kish, *Infinera Corporation, Sunnyvale, CA, USA* and A. M. Weiner, *Purdue University, West Lafayette, IN, USA* We report preliminary characterization of a 48 channel pulse shaper with 50 GHz channel spacing integrated on an InP chip. Channel-by-channel phase adjustors and semiconductor optical amplifier gain elements are employed for line-by-line pulse shaping.	

Salon I	Salon II	Salon III	Salon VI	Salon VII
MA4.4 4:15 PM–4:30 PM **Millimeter-Wave-Band Array-Antenna-Electrode Electro-Optic Modulator for Orthgonal Polarization Operation** T. Inoue, S. Ueda, H. Murata and A. Sanada, *Osaka University, Osaka, Japan* We have proposed and developed array-antenna-electrode electro-optic modulators for 5G mobile communication systems in dense user environments. In this paper, we report a newly-designed device for the operation in 60 GHz band with the orthogonal polarization. This device is applicable for MMW wireless polarization multiplexing.		**MC4.4 4:45 PM–5:00 PM** **Graphene Integrated Hybrid Silicon DFB Laser** Z. L. Ren, I*nstitute of Semiconductors, CAS, Beijing, China and Tsinghua University, Beijing, China,* Q. Kan, *Institute of Semiconductors, CAS, Beijing, China and University of Chinese Academy of Science, Beijing, China,* H. Yu, B. Wang, *Institute of Semiconductors, CAS, Beijing, China,* W. Chen, G. Ran, *Peking University, Beijing, China* and K. He, *Tsinghua University, Beijing, China* We demonstrated the distributed optoelectronic properties enabled by graphene Bragg gratings (GBGs) to realize a hybrid single mode laser on silicon. A remarkable side-mode suppression ratio (SMSR) of 48 dB is achieved, benefitting from the complex coupling of the GBGs.	**MD4.4 4:30 PM–5:00 PM (Invited)** **Progress in Nonlinear Topographic Optical Fibers** A. Mussot, M. Conforti, G. Bouwmans, *Université Lille 1, Villeneuve d'Ascq, France,* S. Trillo, *Università di Ferrara, Ferrara, Italy,* F. Copie and A. Kudlinski, *Université Lille 1, Villeneuve d'Ascq, France* We investigate basic nonlinear effects in optical fibers which opto-geometrical parameters oscillate along the propagation axis. These "topographic" fibers provide an additional degree of freedom leading to multiple quasi-phase matched modulation instability side lobes in single pass configuration or in passive cavities.	

IEEE PHOTONICS SOCIETY WELCOME AND AWARDS BANQUET DINNER – 7:00 PM–9:00 PM – SALON IV/V
Session Chair: Hilmi Volkan Demir, *NTU Singapore, Singapore and Bilkent University, Turkey*

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV

MF4.4 4:30 PM–4:45 PM
Passive Tuning of Optical Couplers Using a Thin Film Cladding Material
U. J. Nsofor, *University of Delaware, Newark, DE, USA*, P. L. Yao, *Phase Sensitive Innovation Inc., Newark, DE, USA*, S. Shi and D. W. Prather, *University of Delaware, Newark, DE, USA*
We report the demonstration of a novel method to passively control the coupling ratio of a Ti-indiffused lithium niobate ($LiNbO_3$) 3-dB directional coupler using a silicon-rich nitride cladding material to compensate for variations arising from fabrication tolerances that can significantly impact coupling.

MH4.4 4:30 PM–4:45 PM
Widely Tunable Mid-Infrared Wavelength Converters Based on Chalcogenide Microwires
L. Li, N. Abdukerim and M. Rochette, *McGill University, Montreal, QC, Canada*
We demonstrate all-fiber and widely tunable mid-infrared wavelength converters using As_2Se_3 microwires cladded with fluorine-based Cyclic Transparent Optical Polymer. Normal dispersion parametric processes are utilized to achieve far-detuned wavelength conversion of 49.3 THz, representing the largest frequency shift reported in soft glass materials.

MF4.5 4:45 PM–5:00 PM
Beam Deflection on Optical Phased Arrays with Electro-Optic Polymer Waveguides
Y. Hirano, Y. Motoyama, K. Tanaka, K. Machida, H. Kikuchi, *Japan Broadcasting Corporation (NHK), Tokyo, Japan*, T. Yamada and A. Otomo, *National Institute of Information and Communications Technology, Kobe, Japan*
We present the design of optical phased array devices using electro-optic polymer waveguides. EO polymer phase shifters have been investigated and applied to optical phased array devices. We found support for the basic characteristics of OPAs theoretically and demonstrated the designed OPAs using numerical simulations.

MH4.5 4:45 PM–5:00 PM
Characteristics of a 40 GHz Asynchronous Harmonic Mode-Locked Er-Doped Fiber Laser
C.-C. Wen, C.-J. Luo, S.-M. Wang and Y. Lai, *National Chiao Tung University, Taiwan, R.O.C.*
A 40 GHz asynchronous harmonic modelocked Er-doped fiber laser is demonstrated for the first time. Long-term stability is achieved through low frequency electronic feedback and the impact of modulation depth on allowable detuning range is investigated.

MH4.6 5:00 PM–5:15 PM
Dual Repetition-Rate Harmonically Mode-Locked Fiber Laser Using Intracavity Temporal Talbot Effect
M. Seghilani, R. Maram, L. Romero Cortés and J. Azana, *INRS-EMT, Montreal, QC, Canada*
We propose and experimentally demonstrate a dual repetition-rate harmonically mode-locked picosecond fiber laser. Dual repetition-rate is achieved by a dispersion-induced fractional temporal Talbot effect inside the laser cavity. This laser represents a simple way to generate two locked pulse trains with different and tunable repetition-rates.

IEEE PHOTONICS SOCIETY WELCOME AND AWARDS BANQUET DINNER – 7:00 PM–9:00 PM – SALON IV/V
Session Chair: Hilmi Volkan Demir, *NTU Singapore, Singapore and Bilkent University, Turkey*

Salon I	Salon II	Salon III	Salon VI	Salon VII
8:30 AM–10:00 AM **Session TuA1:** Microwave Photonic Signal Processing **Session Chair:** Anders Wiberg, *University of California, San Diego, San Diego, CA, USA*	**8:30 AM–10:00 AM** **Session TuB1:** Microresonator Fabrication Methods **Session Chair:** Paolo De Natale, *CNR-INO, Florence, Italy*	**8:30 AM–9:45 AM** **Session TuC1:** Nanomaterials and Displays **Session Chair:** Nicolas Laurand, *University of Strathclyde, Glasgow, United Kingdom*	**8:30 AM–10:00 AM** **Session TuD1:** GaSb- and GaN-Based VCSELs **Session Chair:** James Lott, *Technical University of Berlin, Berlin, Germany*	**8:30 AM–9:30 AM** **Session TuE1:** Label-Free Super-Resolution: Novel Approaches II **Session Chair:** Ulf Leonhardt, *Weizmann Institute of Science, Rehovot, Israel*
TuA1.1 8:30 AM–9:00 AM (Invited) **Sub-Sampled Optical Techniques for Wideband Spectral Monitoring** J. D. McKinney and R. T. Schermer, *U.S. Naval Research Laboratory, Washington, DC, USA* Photonic sampling techniques for wideband signal detection have gained substantial interest in recent history. This talk will detail work at the U.S. Naval Research Laboratory in using sub-Nyquist sampled optical links to achieve signal detection and disambiguation across a >40 GHz instantaneous bandwidth.	**TuB1.1 8:30 AM–8:45 AM** **Miniaturized High-Q Silicon Nitride Resonators at Visible Wavelengths** H. Moradinejad, *Georgia Institute of Technology, Atlanta, GA, USA,* M. Askari, A. H. Atabaki, Z. Xia, *Sinoora Inc., Atlanta, GA, USA,* A. A. Eftekhar, *Georgia Institute of Technology, Atlanta, GA, USA and Sinoora Inc., Atlanta, GA, USA* and A. Adibi, *Georgia Institute of Technology, Atlanta, GA, USA* We present a simple device architecture enabled by an effective fabrication process to realize high-Q, ultra-compact microresonators with large free spectral ranges on silicon nitride at visible wavelengths. We demonstrate Qs > 60 K for microdisks with radii as small as 2.5 μm.	**TuC1.1 8:30 aM–9:00 AM (Invited)** **Colloidal $APbX_3$ Nanocrystals [A=Cs^+, $CH_3NH_3^+$, $CH(NH_2)_2^+$, X=Cl, Br, I] with Bright Photoluminescence Spanning from Ultraviolet to Near-Infrared Spectral Regions** M. V. Kovalenko, *ETH Zürich, Zurich, Switzerland and Empa-Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, Switzerland* Chemically synthesized inorganic nanocrystals (NCs) are considered to be promising building blocks for a broad spectrum of applications including electronic, thermoelectric, and photovoltaic devices. We have synthesized monodisperse colloidal nanocubes (4–15 nm edge lengths) of fully inorganic cesium lead halide perovskites ($CsPbX_3$, X = Cl, Br, and I or mixed halide systems Cl/Br and Br/I) using inexpensive commercial precursors.	**TuD1.1 8:30 AM–8:45 AM** **Analysis of GaSb-Based Vertical Cavity Surface Emitting Lasers at λ = 3.93 μm** G. K. Veerabathran, S. Sprengel, A. Andrejew and M.-C. Amann, *Technische Universität München, Garching, Germany* GaSb-based electrically-pumped vertical-cavity surface-emitting lasers at 3.93μm, using type-II quantum wells are analyzed. Current broadening due to radial diffusion of carriers in the active region is estimated to be 4.2 μm and this is determined to be a major factor in limiting their performance.	**TuE1.1 8:30 AM–9:00 AM (Invited)** **Plasmonic Nanoantennas for Nanoscale Confinement of Light and Enhanced Biosensing** J. Wenger, *Aix Marseille Université, Marseille, France*
TuA1.2 9:00 AM–9:15 AM **Real-Time Fourier Transformation Based on Photonic Reservior** J. Li, Z. Qin, Y. Dai, F. Yin and K. Xu, *Beijing University of Posts and Telecommunications, Beijing, China* Enlightened by photonic reservoir computing, we present a novel concept for realization of real-time Fourier transformation, i.e., frequency-to-time mapping (FTM), of temporal waveforms based on a coherently driven passive fiber cavity with a frequency resolution of 25 MHz and extremely simple structure.	**TuB1.2 8:45 AM–9:00 AM** **Integrated Polarization-Selective Microring Resonators and Beam Taps via Topographically Anisotropic Photonics** T. Sjaardema, *University of Central Florida, Orlando, FL, USA,* Jeff Chiles, *University of Central Florida, Orlando, FL, USA and National Institute of Standards and Technology, Boulder, CO, USA,* A. Rao, and S. Fathpour, *University of Central Florida, Orlando, FL, USA* Topographically anisotropic photonics is used to demonstrate polarization-selective microring resonators and beam taps. Both fabricated devices exhibit strong polarization-selectivity. The beam tap is shown to be broadband, as it retains this selectivity over a bandwidth of over 80 nm.	**TuC1.2 9:00 AM–9:30 AM (Invited)** **Graphene-Enabled Electrochromic Displays on Paper** C. Kocabas, *Bilkent University, Ankara, Turkey* In this talk I will discuss a new class of optoelectronic devices on a piece of printing paper using graphene as an electrically reconfigurable optical medium. Our approach relies on electro-modulation of optical properties of multilayer graphene on paper via blocking the interband electronic transitions.	**TuD1.2 8:45 AM–9:15 AM (Invited)** **High-Performance GaN-based VCSELs** T. Takeuchi, S. Kamiyama, M. Iwaya and I. Akasaki, *Meijo University, Nagoya, Japan* We have developed GaN-based VCSELs containing lattice-matched AlInN/GaN bottom DBRs, emitting 410 nm wavelength. A room temperature continuous wave operation with the threshold current of 6 mA was obtained, resulting in the maximum light output power of 4.2 mW.	**TuE1.2 9:00 AM–9:30 AM (Invited)** **Plasmonics Enhanced Super-Resolution Microscopy** Z. Liu, *University of California, San Diego, San Diego, CA, USA* I will review some of our recent work on super resolution microscopy, i.e. plasmonics enhanced structured illumination microscopy, which uniquely combine the super resolution with high imaging speed and achieve 50nm resolution and real video speed simultaneously. Potential biological applications will also be discussed.
TuA1.3 9:15 AM–9:30 AM **Photonic Generation of Simultaneous Multiple Chirped Microwave Waveforms** P. Moslemi, L. R. Chen and M. Rochette, *McGill University, Montreal, QC, Canada* We demonstrate simultaneous generating multiple microwave waveforms based on optical spectral shaping and wavelength-to-time mapping (WTM) technique. The spectral shaper is based on an arrayed waveguide Sagnac interferometer incorporating linearly chirped fiber Bragg gratings.	**TuB1.3 9:00 AM–9:15 AM** **Characterization of Lithium Niobate Microdisk Resonators with Grating Couplers** A. Kar, A. Gao, L. L. Goddard and S. Gong, *University of Illinois at Urbana-Champaign, Urbana, IL, USA* We present the design and characterization of lithium photonic microdisk resonators with grating couplers fabricated in lithium niobate thin-films. The Q-factor was 7.4×10^4 for a 75 μm diameter microdisk.	**TuC1.3 9:30 AM–9:45 AM** **The Effect of Fourth Color Component on Enhancement of Color Gamut** S. Genc, *Abdullah Gul University, Kayseri, Turkey,* M. Uguz, *Arcelik A.Ş., İstanbul, Turkey,* and E. Mutlugun, *Abdullah Gul University, Kayseri, Turkey* In this work, we simulate and analyse the peak emission wavelength and full-width-at-half-maximum (FWHM) parameters of nano emitters using four-color mixing approach to provide a tetragonal area as large as possible in CIE-1931, reaching over 160% NTSC area using emitters having 30 nm FWHM.	**TuD1.3 9:15 AM–9:30 AM** **Design Analysis of Subwavelength Grating Mirror for GaN Based VCSELs Structure** A. M. Slosberg and N. Tansu, *Lehigh University, Bethlehem, PA, USA* A GaN subwavelength grating is designed that can exhibit ultrahigh reflectivity for blue spectral regime opening the door for implementation in GaN based VCSELs with practical reflector design.	

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
8:30 AM–10:00 AM **Session TuF1:** Image Communications **Session Chair:** Robert Henderson, *University of Edinburgh, Edinburgh, United Kingdom*	**8:30 AM–10:00 AM** **Session TuG1:** III-V Photonic Materials **Session Chair:** John Bowers, *University of California, Santa Barbara, Santa Barbara, CA, USA*	**8:30 AM–10:00 AM** **Session TuH1:** Extreme Non-Linear Optics **Session Chair:** Majed Chergui, *EPFL, Lausanne, Switzerland*	
TuF1.1 8:30 AM–9:00 AM (Invited) Modulation and Coding for Image Sensor Communication K. Kamakura, *Chiba Institute of Technology, Narashino, Japan* and T. Yamazato, *Nagoya University, Nagoya, Japan* Most practical visible light communication (VLC) systems being currently deployed with image sensor receivers use intensity modulation and direct detection scheme for outdoor and indoor applications. A number of modulation and coding techniques that are used for image sensor-based VLC systems are presented.	**TuG1.1 8:30 AM–8:45 AM Mid-Infrared Quantum Well Lasers on Multi-Functional Metamorphic Buffers** D. Jung, *Yale University, New Haven, CT, USA,* L. Yu, S. Dev, D. Wasserman, *University of Illinois at Urbana-Champaign, Urbana, IL, USA* and M. L. Lee, *Yale University, New Haven, CT, USA* In this talk, we demonstrate the concept of a multi-functional metamorphic buffer (MFMB) layer that not only allows for growth of highly lattice-mismatched active regions on InP substrates, but also serves as a bottom cladding layer for optical confinement in a laser waveguide.	**TuH1.1 8:30 AM–9:00 AM (Invited) Towards 10 TW Few-Cycle Infrared Pulses Using Frequency Domain Optical Parametric Amplification (FOPA)** V. Gruson, *Centre Énergie Matériaux et Télécommunications, Varennes, QC, Canada and Ohio State University, Columbus, OH USA,* G. Ernotte, P. Lassonde, *Centre Énergie Matériaux et Télécommunications, Varennes, QC, Canada,* L. Di Mauro, *Ohio State University, Columbus, OH USA,* P. Corkum, *University of Ottawa and National Research Council of Canada, Ottawa, ON, Canada,* H. Ibrahim, *Centre Énergie Matériaux et Télécommunications, Varennes, QC, Canada,* B. Schmidt, *Centre Énergie Matériaux et Télécommunications, Varennes, QC, Canada and few-cycle Inc., Montreal, QC, Canada* and F. Légaré, *Centre Énergie Matériaux et Télécommunications, Varennes, QC, Canada* Using a non-collinear FOPA, a source delivering 1.8 µm, 30 mJ, 13 fs laser pulses is demonstrated. This is the first step towards 100 mJ for ~10 TW. This laser opens the way for high brightness soft X-ray attosecond pulses.	
TuF1.2 9:00 AM–9:15 AM Performance of Image Sensor Communication W. Huang, *University of Science and Technology of China, Hefei, China* and Z. Xu, *University of Science and Technology of China, Hefei, China and Tsinghua University, Shenzhen, China* We analyze the noise characteristics and system performance for image sensor communication with mixed signal dependent Gaussian noise. Moreover, the channel capacity is achievable by a discrete input distribution of finite number of probability mass points.	**TuG1.2 8:45 AM–9:00 AM Bright Single InAs Quantum Dots at Telecom Wavelengths in Site-Selective InP Nanowires** S. Haffouz, D. Dalacu, P. J. Poole, K. Mnaymneh, J. Lapointe, G. . Aers, D. Poitras and R. L. Williams, *National Research Council Canada, Ottawa, ON, Canada* We demonstrate bright single InAs QDs in InP nanowires that emits in the telecom O-band. We control the arsenic composition of the QDs in the range of 20–75%. To maintain high spontaneous emission rate at longer wavelength, nanowires of cladding diameter of 340 nm were synthesized.	**TuH1.2 9:00 AM–9:15 AM Amplified Octave-Spanning Supercontinuum from Chalcogenide Waveguides for Second-Harmonic Generation** M. Malinowski, *University of Central Florida, Orlando, FL, USA,* J.-E. Tremblay, *University of California, Berkeley, Berkeley, CA, USA,* G. F. C. Gonzalez, A. Rao, S. Khan, *University of Central Florida, Orlando, FL, USA,* P.-K. Hsu, *University of California, Berkeley, Berkeley, CA, USA,* A. Yadav, K. A. Richardson, P. Delfyett, *University of Central Florida, Orlando, FL, USA,* M. C. Wu, *University of California, Berkeley, Berkeley, CA, USA* and S. Fathpour, *University of Central Florida, Orlando, FL, USA* Octave-spanning supercontinuum is generated in chalcogenide, $Ge_{23}Sb_7$-S_{70}, waveguides pumped at 1550 nm. The 2 µm side is subsequently amplified in a Thulium-doped fiber amplifier and utilized for second-harmonic generation (SHG). The generated signal has 55 dB of signal-to-noise ratio	
TuF1.3 9:15 AM–9:30 AM An Adaptive Threshold Decoding Algorithm for Visible Light Communication Data Recovery from LED-Based Display Systems L. Sun, X. Li, B. Hussain and C. P. Yue, *Hong Kong University of Science and Technology, Hong Kong* An adaptive threshold decoding algorithm is propsed for recovering visible light communication signals transmitted by a LED-based display. The measured BER of data received from a 4-frame/s micro-LED display is improved from 6.9×10^{-2} to 4.4×10^{-4} using the proposed algorithm compared to conventional constant threshold scheme.	**TuG1.3 9:00 AM–9:30 AM (Invited) Growth and Characterization of III/V Nano Ridge Laser on Si Substrate** B. Kunert, Y. Mols, *Imec, Leuven, Belgium,* Y. Shi, D. Van Thourhout, *Ghent University, Ghent, Belgium,* M. Pantouvaki, J. Van Campenhout and R. Langer, *Imec, Leuven, Belgium* The selective area growth of III/V nano ridge laser on trench-patterned 300 mm (001) Si substrate is a new laser integration approach to realize an optical gain medium with low defect density and being compatible to the CMOS process at the same time.	**TuH1.3 9:15 AM–9:30 AM Broadband Supercontinuum Generation in Highly Nonlinear Fiber with Carbon-Nanotube-Based Passively Mode-Locked Erbium-Doped Fiber Laser** Y. S. Rao, A. Alphones and S. Ping, *Nanyang Technological University, Singapore* We present a broadband supercontinuum (SC) generation in highly nonlinear fiber (HNLF) with carbon-nanotube (CNT)-based passively mode-locked erbium-doped fiber laser (EDFL).The passively mode-locked EDFL incorporating CNT-based saturable absorber (SA) has achieved a pulse width of 570 fs with a repetition rate of 18.3 MHz	

Salon I	Salon II	Salon III	Salon VI	Salon VII
TuA1.4 9:30 AM–9:45 AM **Photonic Generation of Microwave Arbitrary Waveforms Based on Gain-Transparent SBS-Induced Phase Shift** J. Liu, C. Huang and C. Shu, *Chinese University of Hong Kong, New Territories, Hong Kong* We demonstrate a new approach to generate microwave arbitrary waveforms by phase modulation and optical carrier processing based on gain-transparent SBS. Triangular waveforms at repetition rates of 5.64 and 7.87 GHz, and rectangular waveforms at repetition rates of 5.04 and 7.01 GHz are generated.	**TuB1.4 9:15 AM–9:30 AM** **Fully Integrated Lithium Niobate Electro-Optic Modulator Based on Asymmetric Mach-Zehnder Interferometer Etched in LNOI Platform** M. Mahmoud, C. Bottenfield, L. Cai and G. Piazza, *Carnegie Mellon University, Pittsburgh, PA, USA* An asymmetric Mach-Zehnder electro-optic modulator is fabricated through etching in 500 nm thin film of Y-cut Lithium Niobate. A half wave voltage length product of 16.8 Vcm and modulation efficiency of 9.4 × 10^{-3} V^{-1} were measured for this device which is very close to what we expect from theory.		**TuD1.4 9:30 AM–10:00 AM (Invited)** **Nonpolar GaN-Based Vertical-Cavity Surface-Emitting Lasers** C. A. Forman, S.-G. Lee, E. C. Young, J. T. Leonard, D. A. Cohen, B. P. Yonkee, T. Margalith, R. M. Farrell, S. P. DenBaars, J. S. Speck and S. Nakamura, *University of California, Santa Barbara, Santa Barbara, CA, USA* We demonstrate electrically injected III-nitride VCSELs with ion implanted apertures, tunnel junction intracavity contacts, and a dual dielectric DBR flip-chip design. Precise cavity length control has been achieved using photoelectrochemical band gap selective etching of InGaN/GaN multiple quantum wells.	
TuA1.5 9:45 AM–10:00 AM **Photonic Downsampling Receiver for Millimeter-Wave Communications** J. H. Kalkavage, K. G. Petrillo, E. J. Adles and T. R. Clark, *Johns Hopkins University Applied Physics Laboratory, Laurel, MD, USA* We report on a photonic downsampling receiver architecture for millimeter-wave communication systems. Conversion loss advantage of >16 dB is shown compared to modulator-based photonic downconversion. 3 Gb/s millimeter-wave communication system performance is demonstrated.	**TuB1.5 9:30 AM–10:00 AM (Invited)** **Realization of High-Q Cavities and Lasers Using Soft Nano Imprinting Lithography** J. Scheuer, O. Bar-On, *Tel-Aviv University, Tel-Aviv, Israel,* P. Brenner, *Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany,* R. Gvishi, *Soreq NRC, Yavne, Israel,* and U. Lemmer, *Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany* We present and demonstrate the realization of high quality 3D ring resonators based on sol-gel technology fabricated using Soft Nano Imprint Lithography. Passive and active (lasers) cavities are fabricated and characterized experimentally, exhibiting excellent optical performance and Q-factor exceeding 10^5.			

10:00 AM–10:30 AM – EXHIBITS / COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
TuF1.4 9:30 AM–9:45 AM **Visible Light Communication Based on CPM-OFDM with Chaotic Interleaving Scheme** H. B. Eldeeb, H. A. I. Selmy, H. M. Elsayed, F. E. Abd El-Samie and R. I. Badr, *Cairo University, Giza, Egypt* A chaotic interleaving continuous phase modulation (CI-CPM) scheme is proposed for the first time in Visible Light Communication Orthogonal Frequency Division Multiplexing (VLC-OFDM) system to mitigate the problem of Peak-to-Average Power Ratio (PAPR) and overcome the multipath effect from reflections	**TuG1.4 9:30 AM–9:45 AM** **Lattice-Matched AlInN/GaN Digital Alloy for Mid- and Deep-Ultraviolet Applications** W. Sun, *Lehigh University, Bethlehem, PA, USA*, C.-K. Tan, *Clarkson University, Potsdam, NY, USA* and N. Tansu, *Lehigh University, Bethlehem, PA, USA* A lattice-matched AlInGaN digital alloy structure is studied based on the lattice-matched AlInN/GaN ultra-short period superlattices. The numerical findings suggest the potential capabilities of such AlInN/GaN digital alloy in mid- and deep-ultraviolet applications attributed to its tunable bandgap and broadband optical transitions.	**TuH1.4 9:30 AM–10:00 AM (Invited)** **Extreme Nonlinear Optics Using Strong Mid-Infrared Laser Pulses** K.-H. Hong, *Massachusetts Institute of Technology, Cambridge, MA, USA* We investigate the extreme nonlinear optical phenomena using mid-infrared pulses: 1) the laser filamentation in ambient air, pumped by a 2 micron kHz source, for atmospheric chemical detections and 2) the high-harmonic generation in solids, driven by sub-cycle 2.5–9.0 micron pulses, towards petahertz electronics.	
TuF1.5 9:45 AM–10:00 AM **Enhanced Disturbance Observer Based on Acceleration Measurement for Fast Steering Mirror Systems** C. Deng, *Chinese Academy of Science, Chengdu, China and University of Chinese Academy of Science, Beijing, China,* T. Tang, Y. Mao and G. Ren, *Chinese Academy of Science, Chengdu, China* In this paper, a modified disturbance observer (DOB) for fast steering mirror (FSM) optical system based on a charge-coupled device (CCD) and inertial sensors is proposed. Combining DOB with the classical cascaded multi-loop feedback control (MFC), the disturbance suppression performance can be significantly improved.	**TuG1.5 9:45 AM–10:00 AM** **Investigation of Refractive Index in Dilute-P GaNP Alloys by First-Principle** D. Borovac, *Lehigh University, Bethlehem, PA, USA,* C.-K. Tan, *Lehigh University, Bethlehem, PA, USA and Clarkson University, Potsdam, NY, USA* and N. Tansu, *Lehigh University, Bethlehem, PA, USA* First-principle analysis on the refractive index of dilute-P $GaN_{1-x}P_x$ alloys have been carried out, and the findings indicate significant refractive index modulation with a minute amount of phosphorus in the GaN material in visible regime.		

10:00 AM–10:30 AM – EXHIBITS / COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

Salon I	Salon II	Salon III	Salon VI	Salon VII
10:30 AM–12:00 PM **Session TuA2:** MWP Tutorial & Photonic Integrated Circuits for Microwave Photonics **Session Chair:** Jean Kalkavage, *Johns Hopkins University, Baltimore, MD, USA*	**10:30 AM–12:00 PM** **Session TuB2:** Super-Resolution, Lasing, and Sensing with Microresonators **Session Chair:** Michael Sumetsky, *Aston University, Birmingham, United Kingdom*	**10:30 AM-12:00 PM Salon III** **Session TuC2:** Lighting and Beyond **Session Chair:** Nelson Tansu, *Lehigh University, Bethlehem, PA, USA*	**10:30 AM–12:00 PM** **Session TuD2:** Novel Fiber Technologies I **Session Chair:** Arnaud Mussot, *Université des Sciences et Technologies de Lille, Villeneuve-d'Ascq, France*	**10:30 AM–12:00 PM** **Session TuE2:** Coherence-Based Imaging **Session Chair:** Yoshiaki Yasuno, *Tsukuba University, Tsukuba, Japan*
TuA2.1 10:30 AM–12:00 PM (Tutorial) **Photonic Integrated Circuits for Microwave Photonics** Jianping Yao, *University of Ottawa, Canada* Photonic integrated circuits are playing an increasingly important role in the implementation of microwave photonic systems for the generation and processing of microwave signals. In this tutorial, techniques to generate and process microwave signals using photonic integrated circuits (both InP and silicon based) will be discussed.	**TuB2.1 10:30 AM–11:00 AM (Invited)** **Microspherical Nanoscopy: Mechanisms of Super-Resolution** V. Astratov, *University of North Carolina, Chapel Hill, NC, USA*, V. Astratov, A. Brettin, F. Abolmaali, *University of North Carolina at Charlotte, NC, USA*, A. Maslov, *University of Nizhny Novgorod, Nizhny Novgorod, Russia*, N. Limberopoulos and A. Urbas, *Air Force Research Laboratory, Dayton, Ohio, USA* We provide a classification of the label-free super-resolution imaging mechanisms with an emphasis on microspherical nanoscopy based on using contact dielectric microspheres. The resolution is analyzed under various conditions including resonant (with whispering gallery modes), non-resonant, incoherent and coherent imaging.	**TuC2.1 10:30 AM–11:00 AM (Invited)** **Pathways to Ultra-Efficient Solid-State Lighting** J. Wierer, *Lehigh University, Bethlehem, PA, USA*	**TuD2.1 10:30 AM–11:00 AM (Invited)** **Novel Hollow Core Fibers for Ultra-High Power Delivery** N. V. Wheeler, Y. Chen, J. R. Hayes, T. D. Bradley, H. C. H. Mulvad, S. Abokhamis Mousavi, S. R. Sandoghchi, M. A. Gouveia, E. Numkam, G. T. Jasion, M. B. S. Nawazuddin, P. Horak, S. U. Alam, M. N. Petrovich, F. Poletti and D. J. Richardson, *University of Southampton, Southampton, United Kingdom* We review and compare recent hollow core photonic crystal fibers, both bandgap-guiding and anti-resonant, which were designed and fabricated for high power laser delivery applications.	**TuE2.1 10:30 AM–10:45 AM** **Light Scattering Characterization of Viscoelastic Modulations in Biopolymer Hydrogels** J. R. Guzman-Sepulveda, J. Deng, J. Fang and A. Dogariu, *University of Central Florida, Orlando, FL, USA* We demonstrate the use of spatiotemporal coherence-gated light scattering for the continuous measurement of the time-evolving mechanical properties of biopolymer hydrogels undergoing viscoelastic modulations. Changes in both the optical and mechanical characteristics of the medium can be monitored using the same instrument and measurement procedure.
	TuB2.2 11:00 AM–11:30 AM (Invited) **Yb-Doped and Raman Microbottle Lasers** S. Bakhtiari Gorajoobi and M. N. Zervas, *University of Southampton, Southampton, United Kingdom* We present our recent works on Microbottle Resonator (MBR) lasers. Wavelength selective and single mode lasing from Ytterbium-doped MBRs and nonlinear processes such as Raman amplification in such resonators are studied.	**TuC2.2 11:00 AM–11:30 AM (Invited)** **The New World of Lighting: Solid State Lighting and Beyond** J. Tsao, *Sandia National Laboratories, Albuquerque, NM, USA* We review the current status of solid-state lighting relative to its ultimate potential to be ultra-efficient, smart, and connected, and thus to enable a new world of lighting that goes beyond simple solid-state lighting for illumination.	**TuD2.2 11:00 AM–11:15 AM** **Multi-Wavelength Brillouin Tm^{3+}-Doped Fiber Laser at 1873 nm Using a Linear Cavity** C. Jia, J. Qiao, N. Abdukerim, M. Rochette and L. R. Chen, *McGill University, Montreal, QC, Canada* We demonstrate a multi-wavelength Brillouin Tm^{3+}-doped fiber laser at 1873 nm in a linear cavity. Five order Brillouin wavelengths with channel spacing of ~0.1 nm are obtained.	**TuE2.2 10:45 AM–11:00 AM** **Local Polarization Properties of Human Anterior Segment with Single-Measurement, Full-Range Polarization-Sensitive OCT** K. Karnowski, Q. Li, *University of Western Australia, Perth, Australia,* M. Villiger, Harvard *Medical School and Massachusetts General Hospital, Boston, MA, USA* and D. D. Sampson, *University of Western Australia, Perth, Australia* We report single-measurement, full-range imaging of local polarization properties in the human anterior segment in vivo with polarization-sensitive optical coherence tomography (PS-OCT). Off-pivot galvanometer-mirror phase shifting used to extend the system's axial imaging range sufficiently to reconstruct local polarization properties of the anterior segment.
	TuB2.3 11:30 AM–11:45 AM **Surface Nanoscale Axial Photonics (SNAP) at the Silica Microcapillary with Ultrathin Wall** T. Hamidfar, *Concordia University, Montreal, QC, Canada and Aston University, Birmingham, United Kingdom*, A. Dmitriev, *Concordia University, Montreal, QC, Canada,* B. Magdan, *OFS Laboratories, Somerset, NJ, USA*, P. Bianucci, *Concordia University, Montreal, QC, Canada* and M. Sumetsky, *Aston University, Birmingham, United Kingdom* We demonstrate SNAP microresonators fabricated in silica capillary fiber with ultrathin walls by local annealing with a focused CO_2 laser and internal etching with hydrofluoric acid. We investigate the introduced capillary wall nonuniformity and demonstrate the feasibility of advanced microfluidic sensing with SNAP microresonators.	**TuC2.3 11:30 AM–11:45 AM** **Engineering the Internal Quantum Efficiency of GaN:Eu Based Red Light Emitting Diodes** I. E. Fragkos, *Lehigh University, Bethlehem, PA, USA*, C.-K. Tan, *Lehigh University, Bethlehem, PA, USA and Clarkson University, Potsdam, NY, USA*, V. Dierolf, *Lehigh University, Bethlehem, PA, USA*, Y. Fujiwara, *Osaka University, Osaka, Japan* and N. Tansu, *Lehigh University, Bethlehem, PA, USA* A current injection efficiency model is developed to identify and understand the limiting factors of the internal quantum efficiency in the GaN:Eu based red LEDs. Through this model the design and fabrication of high efficiency GaN:Eu devices in the red spectra regime is feasible.	**TuD2.3 11:15 AM–11:30 AM** **Numerical Analysis of Misalignment Effects in Few-Mode Multi-Core Fiber Systems** W. Klaus, *National Institute of Information and Communications Technology, Tokyo, Japan,* S. Rommel, *National Institute of Information and Communications Technology, Tokyo, Japan and Technical University of Denmark, Lyngby, Denmark,* J.-M. Delgado Mendinueta, J. Sakaguchi, *National Institute of Information and Communications Technology, Tokyo, Japan,* P. Mitchell, N. Psaila, *Optoscribe Ltd., Livingston, United Kingdom,* J. J. Vegas Olmos, *Mellanox Technologies, Roskilde, Denmark,* I. Tafur Monroy, *Technical University of Denmark, Lyngby, Denmark,* Y. Awaji and N. Wada, *National Institute of Information and Communications Technology, Tokyo, Japan* Few-mode multi-core fiber systems tend to be more prone to core misalignments at splice points. By using the true vector modes of few-mode waveguides we analyze how waveguide properties affect the shape of coupling and mode-dependent loss distributions due to alignment errors between waveguides.	**TuE2.3 11:00 AM–11:15 AM** **Differentiation of Biological Cells Using Optical Coherence Tomography: In Silico Study** P. Ossowski, M. Wojtkowski, *Nicolaus Copernicus University, Torun, Poland,* and P. R. T. Munro, *University College London, UK and University of Western Australia, Perth, Australia* We present an in silico, full-wave, model of a novel OCT based system for distinguishing between biological micro-objects using forward scattered light. We show how the model reveals details of image formation not experimentally accessible and provide a comparison between theory and experiment.

Salon VIII

10:30 AM–11:45 AM
Session TuF2: Systems and Modulation 1
Session Chair: Mohsen Kavehrad

TuF2.1 10:30 AM–11:00 AM (Invited)
High Data Rate Optical Wireless Communications
D. O'Brien, *University of Oxford, Oxford, United Kingdom*
Optical wireless communications has the potential to alleviate the 'spectrum crunch' that is predicted as the demand for wireless communications grows. In this presentation recent results for high-data rate visible and infrared systems will be reported and possible future directions outlined.

TuF2.2 11:00 AM–11:15 AM
Modulation Optimization for Visible Laser Light Communication Systems
L. Wang, B. Hussain, X. Li, and C. P. Yue, *Hong Kong University of Science and Technology, Hong Kong*
This work presents a 650-nm wavelength laser diode-based visible laser light communication (VLLC) system. By optimizing the modulation method, a 140% improvement in data rate is obtained from 90 Mb/s to 220 Mb/s over 1.8 m compared to conventional on-off keying modulation.

TuF2.3 11:15 AM–11:45 AM (Invited)
High Speed Visible Light Communication Based on Advanced Modulation
N. Chi, Y. Zhou, M. Zhang, J. Shi, Y. Wang and X. Huang, *Fudan University, Shanghai, China*
We summarized the latest progress on advanced modulation for high speed VLC system including CAP, adaptive bit loading OFDM and super-Nyquist modulation to achieve high speed and high spectrum efficiency.

Kahiki / Lily

10:30 AM–11:45 AM
Session TuG2: Photonic Integration on Silicon
Session Chair: Minjoo Lawrence Lee, *University of Illinois at Urbana-Champaign, Urbana, IL, USA*

TuG2.1 10:30 AM–10:45 AM
Antimony based Mid-Infrared Semiconductor Materials and Devices Monolithically Grown on Silicon Substrates
P. J. Carrington, E. Delli, P. D. Hodgson, E. Repiso, A. Craig, A. Marshall and A. Krier, *Lancaster University, Lancaster, United Kingdom*
Integration of GaSb onto Silicon would lead to a dramatic reduction in cost of mid-infrared optoelectronic devices and open up new applications in lab-on-chip technologies. Here, we report on novel techniques to grow high quality GaSb materials and devices onto Silicon using molecular beam epitaxy.

TuG2.2 10:45 AM–11:15 AM (Invited)
A Comparison of Bonding and Epitaxial Growth for Heterogeneous Photonic Integrated Circuits
J. E. Bowers, *University of California, Santa Barbara, Santa Barbara, CA, USA*
Direct bonding has been used to demonstrate a variety of III-V on silicon devices, including a 2.54 Tbit/s network on chip. A related approach is to epitaxially grow III-V quantum dot lasers on silicon, which has demonstrated submilliamp laser thresholds and improvement in laser lifetimes.

TuG2.3 11:15 AM–11:30 AM
Analysis of Homogeneous Broadening in n-Type Doped Ge Layers on Si for Laser Application
S. A. Srinivasan, *Imec, Heverlee, Belgium and Ghent University, Ghent, Belgium,* C. Porret, M. Pantouvaki, *Imec, Heverlee, Belgium,* Y. Shimura, *Imec, Heverlee, Belgium and Shizuoka University, Hamamatsu, Japan*, P. Geiregat, *Ghent University, Ghent, Belgium,* R. Loo, J. Van Campenhout, *Imec, Heverlee, Belgium,* D. Van Thourhout, *Ghent University, Ghent, Belgium*
The homogeneous broadening in Phosphorus doped Ge layers is characterized using photoluminescence spectroscopy and absorption measurements. A broadening parameter ΓHOM = 45meV due to carrier scattering effects was extracted leading to an estimated increase in threshold current density for Ge lasers by a factor >4.

Poinsettia / Quince

10:30 AM–12:00 PM
Session TuH2: Digital Signal Processing I
Session Chair: Eduardo Temprana Giraldo, *University of California, San Diego, San Diego, CA, USA*

TuH2.1 10:30 AM–11:00 AM (Invited)
Artificial Neural Networks for Linear and Non-Linear Impairment Mitigation
J. Estara Tolosa, *Nokia Bell Labs*

TuH2.2 11:00 AM–11:15 AM
Silicon Photonics Enabled SSBI Cancellation
M. Lyu and L. A. Rusch, *Université Laval, Quebec, QC, Canada*
We propose a SiP enabled interference cancellation scheme for OFDM. System performance is evaluated by sweeping the signal to carrier ratio, guard band and SiP component parameters.

TuH2.3 11:15 AM–11:30 AM
SiP IQ Modulator Linearization by Memory Polynomial Pre-Distortion Model
S. Zhalehpour, J. Lin and L. Rusch, *University Laval, Quebec, QC, Canada*
Mach-Zehnder modulators introduce nonlinearities for large driving signals that induce bit error rate (BER) penalties. In silicon photonics a nonlinear phase response leads to a more complex nonlinear response. We propose a digital pre-distorter based on a nonlinear memory polynomial model to reduce BER penalty.

Salon IV

10:30 AM–12:00 PM
Session TuI2: High-Power Lasers and Applications
Session Chair: François Légaré, *INRS, Varennes, Canada*

TuI2.1 10:30 AM–11:00 AM (Invited)
kW-Class Picosecond and Nanosecond Lasers at Hilase for Hi-Tech Industrial Applications
M. Smrž, M. Divoký, J. Mužík, O. Novák, M. Chyla, J. Pilař, M. Hanuš, A. Lucianetti, A. Endo and T. Mocek, *Hilase Centre, Dolní Břežany, Czech Republic*
Construction of high power nanosecond and picosecond lasers is important for industry and science. Hilase combined several approaches like diode pumping, disk and slab concept, ceramic gain media, or cryo-cooling, and constructed pulsed lasers with unprecedented power and energy exceeding 1000W and 100J, respectively.

TuI2.2 11:00 AM–11:30 AM (Invited)
Space-Time Metrology and Control of High-Power Femtosecond Lasers
G. Pariente, A. Jeandet, A. Sainte-Marie, A. Borot, O. Gobert and F. Quéré, *Université Paris-Saclay, Gif-sur-Yvette, France*
I will present two techniques for the spatio-temporal metrology of high-power femtosecond lasers, and explain how spatio-temporal couplings can be exploited to get new degrees of control on these beams (e.g. to create laser pulses of arbitrary velocity), and thus on light matter-interactions.

TuI2.3 11:30 AM–12:00 PM (Invited)
High-Brightness Electron and Radiation Sources from a Cascaded Laser Wakefield Accelerator
J. Liu, *Chinese Academy of Sciences, Beijing, China*

Salon I	Salon II	Salon III	Salon VI	Salon VII
	TuB2.4 11:45 AM–12:00 PM **Comparative Study for Coupled High-Q Cavity Quantum Dot System** A. Tügen and S. Kocaman, *Middle East Technical University, Ankara, Turkey* We present the differences between Input-Output formalism and Lindblad Master Equation approach in transmission spectrum of Coupled high-Q Cavity with Quantum Dot system in weak coupling regime. Full-width-half-maximum (FWHM) and the peak transmission of Dipole Induced Transparency (DIT) are analyzed in detail.	**TuC2.4 11:45 AM–12:00 PM** **LED Lights with Hidden Intensity-Modulated Blue Channels for Enhanced Subconscious Visual Responses** G. Vartanian, K. Y. Wong and P. C. Ku, *University of Michigan, Ann Arbor, MI, USA* An LED light suitable for general illumination is proposed to enhance subconscious visual responses, which are essential to our well-being. Using the silent substitution technique, a melanopsin-selective flicker was added into white light. A linear optimization algorithm suppresses perceivable fluctuations of colors of illuminated objects.	**TuD2.4 11:30 AM–11:45 AM** **Fabrication of a Gradient-Index Optical Fiber Lens by Focused Ion Beam** H. Melkonyan, K. Sloyan, P. Moreira and M. S. Dahlem, *Khalifa University of Science and Technology, Abu Dhabi, UAE* We fabricate a gradient-index lens on the end facet of an optical fiber by focused ion beam. At 1550 nm, the lens generates a 2.2 µm spot at a working distance of 4.2 µm. This lens can be used for efficient edge-coupling into optical chip.	**TuE2.4 11:15 AM–11:30 AM** **Dynamic Biological Systems Characterization Using Non-Stationary Stochastic Optical Probe** M. I. Akhlaghi, L. Cilenti, A. S. Zervos and A. Dogariu, *University of Central Florida, Orlando, FL, USA* Enhanced fluctuations of integrated scattered intensity in response to non-stationary random illumination are exploited to characterize the spatial and temporal properties of complex biological systems. To reduce radiant energy density applied to the sample, we demonstrated experimentally the effectiveness of a compressive sensing approach.
			TuD2.5 11:45 AM–12:00 PM **Continuous Fabrication of Metal-Coated Optical Fiber for Distributed Sensing** X. Ke, *Jianghan University, Wuhan, China* and W. Xu, *Broadband Photonics Inc., Newton, MA, USA and Jianghan University, Wuhan, China* We report an innovative magnetron sputtering deposition process to continuously fabricate long metal-coated optical fiber for distributed sensing applications. A 60-meter long optical fiber coated with titanium and palladium was made for distributed hydrogen sensing. Fabrication details and sensing performance are presented.	**TuE2.5 11:30 AM–11:45 AM** **Definitive Depolarization Signatures in Nanomedicine** N. Lippok, Martin Villiger, *Harvard Medical School, Boston, MA, USA and Massachusetts General Hospital (MGH), Boston, MA, USA,* A. Albanese, *Massachusetts Institute of Technology (MIT), Cambridge, MA, USA,* E. F. J. Meijer, *Harvard Medical School, Boston, MA, USA and Massachusetts General Hospital (MGH), Boston, MA, USA*, K. Chung, *Massachusetts Institute of Technology (MIT), Cambridge, MA, USA,* T. P. Padera, *Harvard Medical School, Boston, MA, USA and Massachusetts General Hospital (MGH), Boston, MA, USA,* S. N. Bhatia, *Massachusetts Institute of Technology (MIT), Cambridge, MA, USA* and Brett E. Bouma, *Harvard Medical School, Boston, MA, USA and Massachusetts General Hospital (MGH), Boston, MA, USA* We report on the first measurements of definitive depolarization to access gold nanorod (GNR) perturbation and visualize GNR diffusion, distribution and concentration ex vivo, in vitro and in vivo in biologically and medically relevant scenarios.
				TuE2.6 11:45 AM–12:00 PM **Imaging Reflectivity Profiles with Random Axial Encoding** M. Villiger, P.-C. Hui, N. Uribe-Patarroyo and B. E. Bouma, *Harvard Medical School and Massachusetts General Hospital, Boston, MA, USA* Imaging with random sensing functions may afford novel measurement geometries that circumvent constraints of conventional point by point imaging architectures. Here we demonstrate imaging of axial reflectivity profiles using random temporal-spatial encoding created by mode interference in a multimode fiber.

12:00 PM–1:30 PM – LUNCH (ON OWN)

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
	TuG2.4 11:30 AM–11:45 AM **Mid-Infrared Supercontinuum Generation in High-Contrast, Fusion-Bonded Silicon Membrane Waveguides** J. Chiles, *University of Central Florida, Orlando, FL, USA,* X. Gai, B. Luther-Davies, *Australian National University, Canberra, Australia* and S. Fathpour, *University of Central Florida, Orlando, FL, USA* Fusion-bonded suspended silicon waveguides with exemplary stability and geometrical design flexibility are fabricated at different sizes for nonlinear broadening in the mid-infrared. Pumping with a femtosecond laser source at ~4 μm, broadband supercontinuum spectra are observed from λ = 2–5 and 3–6 μm.	**TuH2.4 11:30 AM–11:45 AM** **Blind Polarization Identification and Demultiplexing Using Statistical Learning** S. Varughese, J. Langston, S. E. Ralph, *Georgia Institute of Technology, Atlanta, GA, USA* and R. DeSalvo, *Harris Corporation, Palm Bay, FL, USA* We propose a blind technique to identify the number of polarization in an optical signal using Principal Component Analysis (PCA). Experimental results verifying the proposed technique are presented. Additionally, the relation between PCA and Independent Component Analysis (ICA) are discussed.	
		TuH2.5 11:45 AM–12:00 PM **Multicarrier Approaches for High-Baudrate Optical-Fiber Transmission Systems with a Single Coherent Receiver** T. T. Nguyen, *Université de Mons, Mons, Belgium and Proximus SA, Brussels, Belgium,* S. T. Le, *Nokia Bell Labs, Stuttgart, Germany,* Q. He, *RWTH Aachen University, Aachen, Germany,* L. V. Compernolle, *Proximus SA, Brussels, Belgium,* M. Wuilpart and P. Mégret, *Université de Mons, Mons, Belgium* In this paper, we show the remarkable timing error (TE) and residual chromatic dispersion (CD) tolerance improvements of the filter bank multicarrier (FBMC) over orthogonal frequency division multiplexing (OFDM) for high-baudrate spectral slicing transmitter and single coherent receiver transmissions.	

12:00 PM–1:30 PM – LUNCH (ON OWN)

Salon I	Salon II	Salon III	Salon VI	Salon VII
1:30 PM–2:30 PM **Session TuA3:** Label-Free Super-Resolution: Novel Approaches III **Session Chair:** Vasily Astratov, *University of North Carolina at Charlotte, Charlotte, NC, USA*	**1:30 PM–2:30 PM** **Session TuB3:** Optical Microresonator Frequency Combs and Laser Stabilization **Session Chair:** Misha Sumetsky, *Aston University, UK*	**1:30 PM–2:30 PM** **Session TuC3:** New Concepts in Lasers **Session Chair:** Shigehisa Arai, *Tokyo Institute of Technology, Japan*	**1:30 PM–3:00 PM** **Sessoin TuD3:** OFT Tutorial and Optics and Acoustics **Session Chair:** Michael Brodsky, *US Army Research Laboratory, Adelphi, MD, USA*	**1:30 PM–2:30 PM** **Session TuE3:** Volumetric Microscopy **Session Chair:** Jonathan Liu, *University of Washington, Seattle, WA, USA*
TuA3.1 1:30 PM–2:00 PM (Invited) Super Resolution Microscopy Techniques Based on Plasmonics and Transformation Optics I. Smolyaninov, *University of Maryland, College Park, MD, USA* and V. Smolyaninova, *Towson University, Towson, MD, USA* Various examples of 2D plasmonic super-resolution imaging techniques will be reviewed. These techniques exhibit spatial resolution of the order of 70 nm. Moreover, utilization of well-known digital image recovery techniques enables further improvement of resolution. However, losses remain an important performance-limiting issue.	**TuB3.1 1:30 PM–2:00 PM (Invited) Crystalline and Liquid Whispering Gallery Mode Resonators for Laser Stabilization and Sensing** S. Borri, *Università di Firenze, Fiorentino, Italy,* S. Avino, *CNR-INO, Pozzuoli, Italy,* M. Siciliani de Cumis, *Centro di Geodesia Spaziale 'Giuseppe Colombo,' Matera, Italy,* A. Giorgini, P. Malara, *CNR-INO, Pozzuoli, Italy,* G. Insero, *Università di Firenze, Fiorentino, Italy,* G. Santambrogio, *Università di Firenze, Fiorentino, Italy and INRIM - Istituto Nazionale di Ricerca Metrologica, Torino, Italy,* A. Savchenkov, D. Eliyahu, V. Ilchenko, A. Matsko, L. Maleki, *OEwaves Inc., Pasadena, CA, USA,* G. Gagliardi, *CNR-INO, Pozzuoli, Italy* and P. De Natale, *Università di Firenze, Fiorentino, Italy* Microresonators have undergone an impressive development in the last decade, opening new pathways to nonlinear optics, laser stabilization, spectroscopy and sensing. Here we present our recent results on linewidth narrowing of quantum cascade lasers and chemical sensing using crystalline solid and liquid whispering-gallery-mode resonators.	**TuC3.1 1:30 PM–2:00 PM (Invited) Topological Insulator Lasers** M. Segev, G. Harari, M. Bandres, *Technion, Haifa, Israel,* S. Wittek, H. Hodaei, *University of Central Florida, Orlando, FL, USA,* Y. Lumer, *Technion, Haifa, Israel,* M. Rechtsman, *Penn State, University Park, PA, USA,* M. Khajavikhan, *University of Central Florida, Orlando, FL, USA,* Y. Chong, *Nanyang Technical University, Singapore,* D. Christodoulides, *University of Central Florida, Orlando, FL, USA* We present the new concept of Topological Insulator Lasers: lasers with cavities acting as superconductors for the light circulating in them. The topologically-protected transport of light in the cavity assures high slope efficiency and single mode lasing even in the presence of defects and disorder.	**TuD3.1 1:30 PM–2:30 PM (Tutorial) The Rise of Phononics: Harnessing Optoacoustic Interactions at Nanoscale** B. Eggleton, *University of Sydney, Sydney, Australia* Stimulated Brillouin Scattering (SBS) in compact chip-scale integrated circuits has been recently achieved. This new platform has opened a range of new chip-based functionalities for optical and wireless communications with record performance and compactness. My talk will introduce this new field, review progress and recent...	**TuE3.1 1:30 PM–2:00 PM (Invited) IsoView: High-speed, Live Imaging of Large Biological Specimens with Isotropic Spatial Resolution** R. Chhetri, *Janelia Research Campus, Loudoun County, VA, USA*
TuA3.2 2:00 PM–2:30 PM (Invited) Super-Resolution Imaging Based on Plasmonic Scattering S. Chu, *National Taiwan University, Taipei, Taiwan* Recently, we have shown saturation, reverse saturation, and all-optical switch of scattering with plasmonic nanoparticles. Combining these novel nonlinear interactions with existing super-resolution geometries, such as SAX and STED microscopies, significant resolution enhancements are demonstrated. Corresponding thermo-plasmonic mechanisms will be discussed in the presentation.	**TuB3.2 2:00 PM–2:30 PM (Invited) Nanomaterial-Enhanced Microcavity-Based Frequency Combs** A. M. Armani, X. Shen, V. Diep, D. Chen, *University of Southern California, Los Angeles, CA, USA,* V. Jankovic, *Northrop Grumman, Redondo Beach, CA, USA,* B. Hudnut, S. Soltani, A. Kovach and H. Choi, *University of Southern California, Los Angeles, CA, USA* By combining new nonlinear optical nanomaterials with ultra-high quality factor silica microcavity devices, improvements in frequency comb generation as well as Raman lasing is obtained.	**TuC3.2 2:00 PM–2:15 PM PT-Symmetry Breaking of Topological Defect-States in SSH Micro-Ring Laser Arrays** S. Wittek, M. Parto, H. Hodaei, *University of Central Florida, Orlando, FL, USA,* G. Harari, M. Bandres, *Technion, Haifa, Israel,* M. Rechtsman, *Pennsylvania State University, University Park, PA, USA,* M. Segev, *Technion, Haifa, Israel,* D. Christodoulides and M. Khajavikhan, *University of Central Florida, Orlando, FL, USA* The PT-symmetry breaking for topological edge-states are studied in SSH micro-resonator laser arrays. For edge modes, the PT-symmetry breaking threshold reduces when the coupling strength between closely paired elements is increased. Such topological edge-modes are demonstrated in a 16-ring SSH PT-laser arrangement.	**TuD3.2 2:30 PM–3:00 PM (Invited) Opto-Mechanical Effects in Standard and Multi-Core Fibers** A. Zadok, Y. Antman, H. Diamandi and Y. London, *Bar-Ilan University, Ramat-Gan, Israel* Guided acoustic waves Brillouin scattering is used in chemical sensing outside the cladding of standard, unmodified single-mode fibers. The phenomenon is also shown to introduce inter-core cross-phase modulation among multiple cores that are optically isolated. Lastly, the mechanism is employed in locking of opto-electronic oscillators.	**TuE3.2 2:00 PM–2:15 PM Numerical Modeling of Illumination and Detection Methods for Light-Sheet Microscopy of Optically Clear Biological Tissues** A. K. Glaser and J. T. C. Liu, *University of Washington, Seattle, WA, USA* We utilize a recently developed fractal propagation method for modeling and assessing the performance of various light-sheet microscopy illumination and collection methods for imaging optically clear human tissues. Our simulation framework opens new possibilities for the design and optimization of next-generation light-sheet microscopes.

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
1:30 PM–2:30 PM **Session TuF3:** Interconnect Subsystems **Session Chair:** Hussam Batshon, *TE SubCom, USA*	**1:30 PM–2:30 PM** **Session TuG3:** Nanoscale Nonlinear Optics **Session Chair:** Peter Carrington, *Lancaster University, UK*	**1:30 PM–2:30 PM** **Session TuH3:** Digital Signal Processing II **Session Chair:** Jose Manuel Estara Tolosa, *Nokia Bell Labs*	
TuF3.1 1:30 PM–2:00 PM (Invited) High-Speed VCSELs for OOK and Multilevel PAM Modulation A. Larsson, J. S. Gustavsson, E. Haglund, E. P. Haglund, T. Lengyel and E. Simpanen, *Chalmers University of Technology, Gothenburg, Sweden* VCSELs designed for high-speed modulation and a proper balance between optical power and modulation amplitude, intensity noise, and damping of the modulation response have enabled data-rates exceeding 70 Gbit/s under OOK-NRZ modulation and data-rates approaching 100 Gbit/s under PAM-4 modulation.	**TuG3.1 1:30 PM–2:00 PM (Invited) Taming the Dynamics of a Levitated Nanoparticle in Vacuum: From Bistability to Cooling** R. Quidant, *ICFO, Spain*	**TuH3.1 1:30 PM–2:00 PM (Invited) Digital Back-Propagation for Unrepeatered Transmission** D. Lavery, *University College London, London, United Kingdom* Unrepeatered transmission has seen a substantial advance in recent years, largely due to the development of advanced optical fibers and amplifier technologies. Here, the potential, limitations and practicalities of digital nonlinearity compensation to build on this development are explored.	
TuF3.2 2:00 PM–2:15 PM 25-Gb/s Transmission Over 2.5-km SSMF by Silicon MRR Enhanced 1.55-μm III-V/SOI DML V. Cristofori, F. Da Ros, *Technical University of Denmark, Kongens Lyngby, Denmark,* O. Ozolins, *Acreo Swedish ICT, Kista, Sweden,* M. E. Chaibi, L. Bramerie, *University of Rennes 1, Lannion, France,* Y. Ding, *Technical University of Denmark, Kongens Lyngby, Denmark,* X. Pang, *Acreo Swedish ICT, Kista, Sweden,* A. Shen, A. Gallet, G.-H. Duan, *III-V Lab, Palaiseau, France,* K. Hassan, S. Olivier, *CEA-Leti, Grenoble, France,* S. Popov, *KTH Royal Institute of Technology, Kista, Sweden,* G. Jacobsen, *Acreo Swedish ICT, Kista, Sweden,* L. K. Oxenløwe, *Technical University of Denmark, Kongens Lyngby, Denmark* and C. Peucheret, *University of Rennes 1, Lannion, France* The use of a micro-ring resonator (MRR) to enhance the modulation extinction ratio and dispersion tolerance of a directly modulated laser (DML) is experimentally investigated with a bit rate of 25 Gb/s as proposed for the next generation data center communications.	**TuG3.2 2:00 PM—2:15 PM Second Harmonic Generation at the Nanoscale in Isolated and Coupled AlGaAs Nanodisks** D. Rocco, *University of Brescia, Brescia, Italy,* L. Ghirardini, *Politecnico di Milano, Milano, Italy,* V. F. Gili, *Universite Paris Diderot, Paris, France,* L. Carletti, *University of Brescia, Brescia, Italy,* I. Favero, *Universite Paris Diderot, Paris, France,* A. Locatelli, *University of Brescia, Brescia, Italy,* M. Guasoni, *University of Southampton, Southampton, United Kingdom,* M. Finazzi, *Politecnico di Milano, Milano, Italy,* G. Leo, *Universite Paris Diderot, Paris, France,* M. Celebrano, *Politecnico di Milano, Milano, Italy* and C. De Angelis, *University of Brescia, Brescia, Italy* We report theoretical and experimental results on second harmonic generation from individual pillars and dimers monolithic AlGaAs-on-AlOx nanoantennas. We demonstrate peak conversion efficiencies exceeding 10^{-5} for a 1.6 GW/cm^2 pump intensity.	**TuH3.2 2:00 PM–2:15 PM Performance Limits of a Nonlinear Frequency Division Multiplexed System due to the Raman Effect** T. D. S. DeMenezes, *North Dakota State University, Fargo, ND, USA,* V. Besse, *University of Maryland Baltimore County, Baltimore, MD, USA and Université du Maine, Le Mans, France,* C. Tu, *University of Maryland Baltimore County, Baltimore, MD, USA,* V. S. Grigoryan, M. O'Sullivan, *Ciena Corporation, Hanover, MD, USA and Ottawa, ON, Canada,* C. R. Menyuk, *University of Maryland Baltimore County, Baltimore, MD, USA* and I. T. Lima Jr., *North Dakota State University, Fargo, ND, USA* The Raman effect causes higher-order solitons to break apart, leading to inter-symbol interference, even in the ideal case without propagation losses. The power threshold of this effect is 10 dBm for a two-eigenvalue QPSK system.	

Salon I	Salon II	Salon III	Salon VI	Salon VII
	TuB3.3 2:30 PM–2:45 PM **Full Stabilization and Control of an Integrated Photonics Optical Frequency Synthesizer** D. T. Spencer, T. C. Briles, T. Drake, J. Stone, R. Ilic, Q. Li, L. Sinclair, D. Westly, N. Newbury, K. Srinivasan, S. A. Diddams, Scott Papp, *National Institute of Standards and Technology, Boulder, CO USA and Gaithersburg, MD USA*, A. Bluestone, T. Komljenovic, N. Volet, L. Theogarajan, J. E. Bowers, *University of California, Santa Barbara, Santa Barbara, CA USA*, M.-G. Suh, K. Y. Yang, S. H. Lee, D. Y. Oh, K. Vahala, *California Institute of Technology, Pasadena, CA, USA*, M. H. P. Pfeiffer, T. J. Kippenberg, *Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland* and E. Norberg, *Aurrion Inc., Goleta, CA, USA* We demonstrate a frequency-stabilized, dual Kerr microcomb that guides an integrated Vernier-laser optical frequency synthesizer, all derived from an RF clock. The synthesizer's stability is < $10^{-12}/\tau$ with Hz-level tuning resolution across a 32 nm tuning range.	**TuC3.3 2:15 PM–2:45 PM (Invited)** **Lasing in Micro- and Nano-Lasers** W. W. Chow, *Sandia National Laboratories, Albuquerque, NM, USA*, S. Kreinberg, J. Wolters and S. Reitzenstein, *Technische Universität Berlin, Berlin, Germany* Micro- or nano-lasers are interesting experimental platforms for studying laser physics. They further question our understanding of lasing action, especially in cases where all emission (spontaneous and stimulated) is channeled into very few cavity modes.		**TuE3.3 2:15 PM–2:30 PM** **Single Shot Color Imaging Through Scattering Media Using a Monochromatic Camera** S. K. Sahoo, *Nanyang Technological University Singapore, Singapore and National University of Singapore, Singapore,* D. Tang and C. Dang, *Nanyang Technological University Singapore, Singapore* We demonstrated a single-shot high-resolution color-imaging technique through scattering media using a monochromatic camera. This novel approach is enabled by the spectral-decorrelation property and the optical memory-effect of the scattering media. We used deconvolution imaging, which bypasses cumbersome iterative refocusing, scanning or phase-retrieval procedures.
	TuB3.4 2:45 PM–3:00 PM **Multispectral Optical Frequency Comb Based on Microresonator Faraday Instability** S.-W. Huang, A. K. Vinod, J. Yang, *University of California, Los Angeles, CA, USA* and M. Yu, D.-L. Kwong, *Institute of Microelectronics, Singapore, Singapore* and C. W. Wong, *University of California, Los Angeles, CA, USA* We demonstrate a new type of microresonator frequency comb where the momentum conservation law is fulfilled by azimuthal modulation of the waveguide dispersion, mathematically equivalent to the formation of Faraday instability. The concept expands the parametric range in which a microresonator frequency comb is obtained.	**TuC3.4 2:45 PM–3:00 PM** **Towards Neuromorphic Photonic Networks with Vertical-Cavity Surface Emitting Lasers** T. Deng, *University of Strathclyde, Glasgow, United Kingdom and Southwest University, Chongqing, China,* J. Robertson, and A. Hurtado, *University of Strathclyde, Glasgow, United Kingdom* We demonstrate that VCSELs, like neurons in the brain, can successfully generate and communicate photonic spiking signals upon the arrival of external stimuli, yet at sub-nanosecond speeds (eight orders of magnitude faster). This offers great prospects for ultrafast photonic neuronal networks for non-traditional computing paradigms.		**TuE3.4 2:30 PM–3:00 PM (Invited)** **Visualization of 3D Tissue Fiber Organization Using Optical Polarization Tractography** G. Yao, *University of Missouri, Columbia, MO, USA* Fibrous tissues exist in many parts of the body. Alternation of the normal fibrous organization is an important indication of disease progression and treatment response. Optical polarization tractography was recently developed for high-resolution visualization and quantitative assessment of the 3D fiber structure in tissue.

3:00 PM–3:30 PM – EXHIBITS & COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
TuF3.3 2:15 PM–2:30 PM **Low-Loss and Broadband Polarization Splitter and Rotator and Its Application in DWDM Receiver** Y. Zhao, *Shanghai Institute of Microsystem and Information Technology, Shanghai, China and University of Chinese Academy of Science, Beijing, China,* C. Qiu, *Chinese Academy of Science, Nantong, China,* A. Wu, Z. Sheng, *Shanghai Institute of Microsystem and Information Technology, Shanghai, China and Chinese Academy of Science, Nantong, China,* H. Huang, *Shanghai Institute of Microsystem and Information Technology, Shanghai, China and University of Chinese Academy of Science, Beijing, China,* J. Li, W. Li, X. Wang, S. Zou, *Shanghai Institute of Microsystem and Information Technology, Shanghai, China* and F. Gan, *Shanghai Institute of Microsystem and Information Technology, Shanghai, China and Chinese Academy of Science, Nantong, China* A broadband silicon PSR is presented with an insertion loss lower than ~0.7dB/0.3dB and crosstalk lower than 12.1dB/14.7dB for TE and TM mode respectively. By combining the PSR with AWG and Germanium PDs, an integrated polarization insensitive DWDM receiver is further demonstrated.	**TuG3.3 2:15 PM–2:45 PM (Invited)** **Frequency Conversion with Integrated Aluminum Nitride Photonics** H. Tang, *Yale University, New Haven, CT, USA* The wurtzite structure of AlN gives rise to strong quadratic optical nonlinearity and piezoelectric effect. Together with its low optical and mechanical losses, we show that integrated AlN photonics provides unitary frequency conversion between optical carriers and quantum photon conversion is realized without added noises.	**TuH3.3 2:15 PM–2:30 PM** **Timing Mismatch Tolerance of 16QAM OFDM Based Spectrum Slicing Optical Transmission Systems** T. T. Nguyen, *University of Mons, Mons, Belgium,* S. T. Le, *Nokia Bell Labs, Stuttgart, Germany,* M. Wuilpart and P. Mégret, *University of Mons, Mons, Belgium* We propose an effective synchronization and digital signal processing scheme for OFDM spectrum slicing transmissions in the presence of large timing mismatches. Without loss of generality, a 76.8 Gbaud DP-16QAM OFDM three-slice spectrum slicing system was considered.	
TuF3.4 2:30 PM–3:00 PM (Invited) **Some Advances on Optical Interconnects** N. Li, T. Barwicz, W. Green and D. Sadana, *IBM T. J. Watson Research Center, Yorktown Heights, NY, USA* We discuss the advances of several optical interconnect options, including the VCSEL based, the Si-photonics based, and the monolithically integrated approaches. In addition, we discuss the possibility of using optical method to power and connect smartdust type of devices.	**TuG3.4 2:45 PM–3:00 PM** **Switching from Magnetic to Electric Dipole in Second Harmonic Generation from All-Dielectric Nanoantennas** M. Guasoni, *University of Southampton, Southampton, United Kingdom,* L. Carletti, *University of Brescia, Brescia, Italy,* D. Neshev, *Australian National University, Canberra, Australia* and C. De Angelis, *University of Brescia, Brescia, Italy* We report a theoretical model for the study of second harmonic generation in cylindrical structures of finite height. By changing the structure of the pump beam we demonstrate switching from magnetic to electric dipole radiation in the generated second harmonic frequency.	**TuH3.4 2:30 PM–3:00 PM (Invited)** **Fiber-Optic Signal Processing Using Frequency Conversion for Optical Node** T. Kato, S. Watanabe, *Fujitsu Laboratories Ltd., Kawasaki, Japan,* T. Richter, R. Elschner, C. Schmidt-Langhorst, C. Schubert, *Heinrich Hertz Institute, Berlin, Germany* and T. Hoshida, *Fujitsu Laboratories Ltd., Kawasaki, Japan* A concept for optical frequency rearrangement using frequency conversion is presented which is expected to increase the flexibility of optical path and spectral usage in optical nodes. We review experiments of coherent optical subcarrier processing and optical frequency shifter achieved by using highly nonlinear fiber.	

3:00 PM–3:30 PM – EXHIBITS & COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

PLENARY SESSIONS WILL BE LIVE-STREAMED

3:30–5:00 PM – Salon IV/V

Plenary Session I – TuJ4

Session Chair: Hilmi Volkan Demir, *NTU Singapore, Singapore and Bilkent University, Turkey*

TuJ4.1 3:30 PM–4:15 PM (Plenary)

Nonlinear Material Responses and Their Characterization

E. Van Stryland, *University of Central Florida, Orlando, FL, USA*

Nonlinear absorption and refraction responses of a given material depend on wavelength (nonlinear spectroscopy), pulsewidth, polarization, focusing,... and separating these various contributions requires a variety of complementary characterization techniques. I will review the nonlinearities, their connections and various methodologies used including Z-scan and Beam Deflection.

TuJ4.2 4:15 PM–5:00 PM (Plenary)

Semiconductor Nanowires for Optoelectronics Applications

Chennupati Jagadish, *Australian National University, Canberra, Australia*

Semiconductor nanowires and their potential applications will be discussed. How these nanowires can be synthesized and how the shape, size and composition of the nanowires influence their structural and optical properties will be presented. I will present results on lasers, THz detectors and solar cells.

PLENARY SESSIONS WILL BE LIVE-STREAMED

3:30–5:00 PM – Salon IV/V

Plenary Session I – TuJ4

Session Chair: Hilmi Volkan Demir, *NTU Singapore, Singapore and Bilkent University, Turkey*

TuJ4.1 3:30 PM–4:15 PM (Plenary)

Nonlinear Material Responses and Their Characterization

E. Van Stryland, *University of Central Florida, Orlando, FL, USA*

Nonlinear absorption and refraction responses of a given material depend on wavelength (nonlinear spectroscopy), pulsewidth, polarization, focusing,... and separating these various contributions requires a variety of complementary characterization techniques. I will review the nonlinearities, their connections and various methodologies used including Z-scan and Beam Deflection.

TuJ4.2 4:15 PM–5:00 PM (Plenary)

Semiconductor Nanowires for Optoelectronics Applications

Chennupati Jagadish, *Australian National University, Canberra, Australia*

Semiconductor nanowires and their potential applications will be discussed. How these nanowires can be synthesized and how the shape, size and composition of the nanowires influence their structural and optical properties will be presented. I will present results on lasers, THz detectors and solar cells.

Salon I

8:30 AM–10:00 AM
Session WA1: Photonic Filters and Combs for Wideband Applications
Session Chair: William Loh, *Massachusetts Institute of Technology, Cambridge, MA, USA*

WA1.1 8:30 AM–8:45 AM
Dual-Comb Spectrometer for Fast Wideband RF Spectral Analysis
A. Klee, C. Middleton and R. DeSalvo, *Harris Corporation, Melbourne, FL, USA*
We propose a novel spectrum analyzer based on heterodyne down-conversion with two detuned optical frequency combs for rapid, wideband characterization of RF signals. The measurement bandwidth of ~40 GHz is limited by modulator speed and the system latency and frequency resolution are time-bandwidth limited.

WA1.2 8:45 AM–9:00 AM
Continuously Tunable and Reconfigurable Microwave Photonic Multiband Filter Based on Cascaded MZIs
J. Ge and M. P. Fok, *University of Georgia, Athens, GA, USA*
A tunable and reconfigurable microwave photonic multiband filter with up to 13 simultaneous passbands is presented. All the passband frequencies are continuously tunable over 20 GHz, and the number of simultaneous passbands is highly reconfigurable between 1 to 13.

WA1.3 9:00 AM–9:15 AM
Electro-Optic Comb Generation from Noise with a Photonically Filtered Optoelectronic Oscillator
M. E. Plascak, R. Bustos-Ramirez, K. Bagnell and P. J. Delfyett, *University of Central Florida, Orlando, FL, USA*
We present a novel architecture for electro-optic comb generation by utilizing both optical and RF outputs of a photonically filtered optoelectronic oscillator. The output is an EO comb with 10.5 GHz combline spacing generated entirely from noise without an external driving RF signal.

Salon II

8:30 AM–10:00 AM
Session WB1: Fundamentals and Advanced Applications of Microresonators
Session Chair: Vasily Astratov, *University of North Carolina*

WB1.1 8:30 AM–9:00 AM (Invited)
An Integrated Ultra-High-Q Resonator for Optical Clocks, Synthesizers, Gyroscopes and Spectroscopy
K. Vahala, K. Y. Yang, D. Y. Oh, S. H. Lee, X. Yi and Q. F. Yang, *California Institute of Technology, Pasadena, CA, USA*
A microresonator having Q factors greater than 200 million and featuring a silicon-nitride integrated coupling waveguide is described. The device is a critical advance for new microcavity applications requiring integrated, ultra-high-Q and millimeter-scale cavities.

WB1.2 9:00 AM–9:15 AM
Wave Control in Non-Hermitian Disordered Media
K. G. Makris, *University of Crete, Heraklion, Greece,* A. Brandstötter and S. Rotter, *Vienna University of Technology, Vienna, Austria*
In the context of non-Hermitian photonics, we present recent results of wave control in disordered media. We show how engineering the imaginary part of the refractive index can lead to complete wave control inside a disordered scattering system. Perfect transmission and focusing can be achieved.

WB1.3 9:15 AM–9:30 AM
Ultrasensitive Parity-Time-Symmetric Micro-Ring Laser Gyroscope
J. Ren, *University of Central Florida, Orlando, FL, USA,* G. Harari, *Technion, Haifa, Israel,* A. U. Hassan, *University of Central Florida, Orlando, FL, USA,* W. Chow, *Sandia National Laboratories, Albuquerque, NM, USA,* M. Soltani, *Raytheon BBN Technologies, Cambridge, MA, USA,* D. Christodoulides and M. Khajavikhan, *University of Central Florida, Orlando, FL, USA*
A new scheme for ultrasensitive micro-scale ring laser gyroscopes based on the physics of exceptional points is proposed. In judiciously designed non-Hermitian systems, the frequency splitting becomes proportional to the square root of the gyration speed, thus significantly enhancing the sensitivity to low rotations.

Salon III

8:30 AM–10:00 AM
Session WC1: Long Wavelength Lasers and Integration
Session Chair: Dieter Bimberg, *TU Berlin and King Abdulaziz Jeddah*

WC1.1 8:30 AM–9:00 AM (Invited)
Monolithic III-V Laser Integration on Silicon
J. Van Campenhout, *IMEC*

WC1.2 9:00 AM–9:30 AM (Invited)
III-V Lasers Epitaxially Grown on Si
E. Tournié, *Université de Montpellier, Montpellier, France*
The laser source is still a key missing-component for full deployment of Si photonics. I will review the recent progress in the direct epitaxial growth of III-V lasers on Si substrates, from InAs/GaAs quantum dot to GaSb-based quantum well lasers.

WC1.3 9:30 AM–9:45 AM
Low Threshold Epitaxial InAs Quantum Dot Lasers on On-Axis GaP/Si (001)
J. Norman, D. Jung, M. Kennedy, C. Shang, A. C. Gossard and J. E. Bowers, *University of California, Santa Barbara, Santa Barbara, CA, USA*
We report 1300 nm continuous wave lasing on an on-axis GaP/Si (001) virtual substrate operating up to 60°C with record low threshold current of 27 mA. Ridge and broad area lasers were fabricated with seven layers of p-modulation doped quantum dots and as-cleaved facets.

Salon VI

8:30 AM–10:00 AM
Session WD1: Novel Fiber Technologies II
Session Chair: An Li, *Futuwei*

WD1.1 8:30 AM–9:00 AM (Invited)
Few Photon Signal Processing and Detection in Paramteric Devices
A. Pejkic, *University of California, San Diego, La Jolla, CA, USA*
We review recent advances in longitudinal fiber dispersion engineering that have enabled construction of efficient parametric devices operating at a few photon level. We outline principal physical processes and present operational demonstration of parametric devices for high speed signal processing and sensing.

WD1.2 9:00 AM–9:15 AM
A Multi-Core Fiber to Single-Mode Fiber Side-Polished Coupler
H. Zhang, *University of Southampton, Southampton, United Kingdom,* N. Healy, *Newcastle University, Newcastle upon Tyne, United Kingdom,* S. Dasgupta, *University of Southampton, Southampton, United Kingdom and Lightcue, Bangalore, India,* R. Hayes, M. N. Petrovich, D. J. Richardson, and A. C. Peacock, *University of Southampton, Southampton, United Kingdom*
By using a modified side-polishing technique, a low loss, wide-band multi-core to single-mode fiber coupler was demonstrated to access light from a single core of the multi-core fiber without disrupting the remaining cores. The coupling ratio can be continuously tuned over the entire spectral.

WD1.3 9:15 AM–9:30 AM
Modal Dispersion Characterization of Multimode Fibers
I. Roudas, *Montana State University, Bozeman, MT, USA*
The mode-dependent signal delay method can be used for the characterization of modal dispersion of multimode fibers. We revise the formalism used by this method and quantify measurement errors due to setup tolerances and receiver noise.

Salon VII

8:30 AM–9:45 AM
Session WE1: Type-II and Heterovalent Photodetectors
Session Chair: Ganesh Balakrishnan, *University of New Mexico, Albuquerque, NM, USA*

WE1.1 8:30 AM–9:00 AM (Invited)
Simulation of Molecular Beam Epitaxy Type II Infrared Superlattice Growth
C. Grein, *University of Illinois, Chicago, IL, USA*
The modeling of molecular beam epitaxial (MBE) growth has potential benefits in identifying optimal growth conditions and predicting atomic-scale defects that may form in actual growth. We describe the use of software to conduct realistic atomic-scale MBE growth simulations of Type II infrared superlattices.

WE1.2 9:00 AM–9:15 AM
High-Speed Type-II InGaAs/GaAsSb Multiple Quantum-Well Integrated Waveguide Photodiodes at 2 µm Wavelength
B. Tossoun, Y. Wang, *University of Virginia, Charlottesville, VA, USA,* S. Addamane, G. Balakrishnan, *University of New Mexico, Albuquerque, NM, USA,* A. Holmes, Jr. and A. Beling, *University of Virginia, Charlottesville, VA, USA*
We present a high-speed InP-based photodiode with multiple InGaAs/GaAsSb type-II quantum wells for 2 µm detection. The fabricated photodiode exhibits dark current as low as 100nA at –2V, with an external responsivity of 0.27 A/W, and 3 dB bandwidth of 3.5 GHz at 2 µm.

WE1.3 9:15 AM–9:45 AM (Invited)
Heterovalent II-VI and III-V Semiconductor Integration: A Platform for Solar Cell and Other Optoelectronic Device Applications
Y.-H. Zhang, *Arizona State University, Tempe, AZ, USA*
A new material platform, II-VI (MgZnCdHg)(SeTe) and III-V (AlGaIn)(PAsSb) semiconductor materials lattice-matched to GaAs, GaSb, and InSb substrates, has been proposed to demonstrate monolithic integration of heterovalent structures for solar cells, midwave IR VCSEL, and the study of interfacial topological insulators.

Salon VIII

8:30 AM–10:00 AM
Session WF1: Sub-λ Interconnect Devices
Session Chair: Ozan Yilmaz, *Inphi Corporation, USA*

WF1.1 8:30 AM–9:00 AM (Invited) Plasmonic Interconnects – A Dense and Fast Interconnect Solution
J. Leuthold, *ETH Zurich, Zurich, Switzerland*
Plasmonic interconnects are proposed as a solution to offer interconnect densities not to be matched by electronics and with bandwidths exceeding 100 GHz. Key elements such as ultra-fast and compact plasmonic modulators and detectors have already been tested and first demonstrations confirm the viability of...

WF1.2 9:00 AM–9:15 AM Ultra-Broadband Mode (De)Multiplexer Based on a Sub-Wavelength Engineered MMI Coupler
D. González-Andrade, A. V. Velasco, *Instituto de Óptica Daza de Valdés (CSIC), Madrid, Spain,* J. G. Wangüemert-Pérez, A. Ortega-Moñux, R. Halir, *Universidad de Málaga, Málaga, Spain* and P. Cheben, *National Research Council Canada, Ottawa, ON, Canada*
We present an ultra-broadband two-mode de/multiplexer based on a multimode interference coupler with sub-wavelength grating waveguides, a symmetric Y-junction and a 90º phase shifter. Numerical simulations show insertion losses below 0.18 dB and crosstalk lower than –20.6 dB in a 300 nm wavelength range.

WF1.3 9:15 AM–9:30 AM A Silicon Nitride Grating Coupler for Efficent Coupling bewteen Waveguide and Fiber, C. Xu, M. Khajavikhan, P. LiKamWa, *University of Central Florida, Orlando, FL, USA*
A compact grating with relaxed alignment tolerance for coupling between a fiber and a silicon nitride waveguide is presented. The measured peak coupling efficiency is 22% and the 3dB bandwidth is 58 nm. The fabrication of gratings does not require any etching of materials.

Kahiki / Lily

8:30 AM–10:00 AM
Session WG1: Si Photonics
Session Chair: Paul Barclay, *University of Calgary, Calgary, AB, Canada*

WG1.1 8:30 AM–8:45 AM Development of Fully Three-Dimensional Wavefront Matching Method and Its Application to the Design of Ultrasmall Si Mode Converters
Y. Sawada, S. Makino, T. Fujisawa and K. Saitoh, *Hokkaido University, Sapporo, Japan*
Fully three-dimensional wavefront matching method for waveguide discontinuity problem is newly developed. In principle, the developed method can be applied to optimize any geometries including reflection. The application for Si mode converters (TE_0-TE_1 and TE_0-TE_2) are demonstrated and ultrasmall structure with low-loss is obtained.

WG1.2 8:45 AM–9:15 AM (Invited) Silicon Photonics for Generating Photons
S. Mookherjea, *University of California, San Diego, San Diego, CA, USA*

WG1.3 9:15 AM–9:30 AM O-Band Sub-Wavelength Grating Coupler
Y. Wang, L. Xu, A. Kumar, D. Patel, Z. Xing, R. Li, M. G. Saber, Y. D'Mello, E. El-Fiky and D. V. Plant, *McGill University, Montreal, QC, Canada*
We demonstrate a compact, single-etched sub-wavelength grating coupler for the O-band application, which has a measured coupling efficiency of –4 dB, a 3-dB bandwidth of 39 nm, back reflections below –20 dB, and a design footprint of 20 um × 40 um.

Poinsettia / Quince

8:30 AM–10:00 AM
Session WH1: Digital Signal Processing III
Session Chair: Domanic Lavery, *University College London, London, United Kingdom*

WH1.1 8:30 AM–9:00 AM (Invited) Nonlinear Digital Pre-Distortion of Transmitter Components
P. W. Berenguer, *Fraunhofer Institute for Telecommunications Heinrich Hertz Institute, Berlin, Germany,* F. Frey, *Fraunhofer Institute for Telecommunications Heinrich Hertz Institute, Berlin, Germany and Ulm University, Ulm, Germany,* C. Schubert, J. K. Fischer, *Fraunhofer Institute for Telecommunications Heinrich Hertz Institute, Berlin, Germany*
A concept for linear and nonlinear digital pre-distortion tailored to the components of optical high-speed transmitters is introduced and explained. The benefits of the pre-distortion for higher order modulation formats such as PDM-64-QAM and PDM-128-QAM are presented in back-to-back and transmission experiments.

WH1.2 9:00 AM–9:15 AM Impact of Finite-Resolution DAC and ADC on Probabilistically-Shaped QAM Constellations
D. Pilori, G. Bosco, *Politecnico di Torino, Torino, Italy* and C. Fludger, *Cisco Optical GmbH, Nuremberg, Germany*
We analyze the impact of finite resolution of DAC and ADC on the performance of coherent-detection optical communication systems using probabilistically-shaped 64-QAM constellations. We show that no substantial additional penalty is incurred with respect to uniformly distributed constellations with the same net data rate.

WH1.3 9:15 AM–9:30 AM Impact of GVD on Polarization-Insensitive Self-Homodyne Detection Receiver
R. S. Luis, B. J. Puttnam, G. Rademacher, S. Shinada and N. Wada, *National Institute of Information and Communications Technology, Tokyo, Japan*
We investigate the performance of a polarization-insensitive self-homodyne detection receiver. The receiver uses a hybrid coherent and direct detection scheme. Performance is evaluated using QPSK signals and with 500kHz and 30MHz linewidth lasers. Reach up to 120 km is achieved with <1dB penalty.

Salon IV

8:30 AM–10:00 AM
Session WI1: Attosecond Dynamics in Atoms and Solids
Session Chair: Oliver D. Mücke, *DESY CFEL, Hamburg, Germany*

WI1.1 8:30 AM–9:15 AM (Invited) Attoclock Revisited on Quantum Tunneling Time
C. Hofmann, A. S. Landsman, *Max Planck Institute for the Physics of Complex Systems, Dresden, Germany* and U. Keller, *ETH Zurich, Zurich, Switzerland*
Quantum tunneling time is a highly debated topic – we explain why. We discuss the attoclock technique to extracting tunneling delays with regards to the typical approximations such as the dipole approximation, non-adiabatic effects, photoelectron momenta at the tunnel exit, electron correlation and exit coordinate.

WI1.2 9:15 AM–9:45 AM (Invited) Petahertz Optical Drive with Wide-Bandgap Materials
H. Mashiko, K. Oguri, *NTT Basic Research Laboratories, Kanagawa, Japan,* Y. Chisuga, H. Masuda, *NTT Basic Research Laboratories, Kanagawa, Japan and Yokohama National University, Yokohama, Japan,* T. Yamaguchi, *NTT Basic Research Laboratories, Kanagawa, Japan and Tokyo University of Science, Chiba-ken, Japan,* A. Suda, *Tokyo University of Science, Chiba-ken, Japan,* I. Katayama, J. Takeda, *Yokohama National University, Yokohama, Japan* and H. Gotoh, *NTT Basic Research Laboratories, Kanagawa, Japan*
We studied petahertz electronic oscillations with 1.16-PHz frequency using gallium nitride (GaN) wide-bandgap semiconductor. An isolated attosecond pulse with coherent broadband spectrum reveals dipole oscillation with 860-as periodicity in the GaN electron and hole system.

WI1.3 9:45 AM–10:00 AM Attosecond Counter Rotating Wave Effect in Xenon Driven by Strong Fields
M Anand, *Pohang University of Science and Technology, Pohang, South Korea and Max Planck Pohang University of Science and Technology/Korean Res. Init., South Korea,* S. Pabst, *Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA,* O. Kwon and D. E. Kim, *Pohang University of Science and Technology, Pohang, South Korea and Max Planck Pohang University of Science and Technology/Korean Res. Init., South Korea*
Attosecond transient absorption spectroscopy is used for the ultrafast dynamics of Xe driven by strong fields, where the conventional rotating wave approximation breaks down. We present, for the first time, the real-time observation of the counter rotating wave effect in the highly excited 4d-1np xenon.

Salon I	Salon II	Salon III	Salon VI	Salon VII
WA1.4 9:15 AM–9:30 AM **Microcomb Based Microwave True-Time-Delay Beamforming** X. Xue, *Tsinghua University, Beijing, China and Purdue University, West Lafayette, IN, USA,* Y. Xuan, C. Bao, *Purdue University, West Lafayette, IN, USA,* S. Li, X. Zheng, *Tsinghua University, Beijing, China,* M. Qi and A. M. Weiner, *Purdue University, West Lafayette, IN, USA* We propose a photonic microwave beamforming scheme based on spectral shaping of a microresonator frequency comb (microcomb) with programmable dispersive time delays. The scheme can potentially support large-scale phased arrays by exploiting the large bandwidth of microcombs.	**WB1.4 9:30 AM–9:45 AM** **Towards Electrically Injected Parity-Time-Symmetric Micro-Ring Lasers** W. E. Hayenga, M. Parto, H. Garcia-Gracia, E. Sanchez-Cristobal, H. Hodaei, P. Likamwa, D. N. Christodoulides and M. Khajavikhan, *University of Central Florida, Orlando, FL, USA* We present an electrically pumped parity-time-symmetric coupled microring laser. Using the interplay between gain and loss, single mode operation is demonstrated with no penalty in terms of output power or threshold pump intensity.	**WC1.4 9:45 AM–10:00 AM** **Room Temperature Operation of InAs Quantum Dot Lasers Formed by Diblock-Copolymer Lithography and Selective Area MOCVD Growth** H. Kim, W. Wei, T. F. Kuech, P. Gopalan and L. J. Mawst, *University of Wisconsin–Madison, Madison, WI, USA* Nanopattering and selective area MOCVD is utilized to realize wetting-layer-free InAs quantum dot laser diodes with an InGaAs QW carrier collection layer. The influence of the In0.1Ga0.9As QW on the device performance was evaluated at 80K and room temperature.	**WD1.4 9:30 AM–9:45 AM** **Signatures of Exceptional Points in Statistical Non-Hermitian Optical Cavities** A. K. Jahromi, A. U. Hassan, D. N. Christodoulides and A. F. Abouraddy, *University of Central Florida, Orlando, FL, USA* We demonstrate the possibility of observing the signatures of parity-time symmetry in ultralong cavities where the structural parameters are prone to statistical variations. We present a model for analyzing such arrangements, and predict and demonstrate the occurrence of phase transition in a PT-symmetric cavity.	
WA1.5 9:30 AM–10:00 AM (Invited) **Application of Optical Frequency Combs in Extreme Bandwidth Signal Processing** V. Ataie, E. Myslivets, A. O. J. Wiberg and S. Radic, *University of California, San Diego, La Jolla, CA, USA* The application of high-count multi carrier optical sources (i.e. frequency combs) in real-time microwave/millimeter wave signal processing is discussed. The multi heterodyne sensing and classification of up to 110 GHz-wide radio frequency (RF) signals using two set of optical frequency combs is demonstrated.	**WB1.5 9:45 AM–10:00 AM** **Asymmetric Superimposed Optical Vortex Beam Emission at Exceptional Point** J. Y. S. Tan and K. Yu, *Korea Advanced Institute of Science and Technology, Daejeon, South Korea* While mirror-symmetric microring resonators perturbed by periodically spaced scatterers induce symmetric optical orbital angular momentum (OAM) superimposition states, a broken mirror symmetric resonator can induce asymmetric OAM superimposition. The asymmetric OAM behaviour is due to the chiral and non-orthogonal resonator modes at exceptional point.		**WD1.5 9:45 AM–10:00 AM** **On-the-Fly Real-Time Optical Energy Spectrum Recognition System Based on Time-to-Spectrum Convolution** J. Huh and J. Azaña, *INRS-EMT, Montreal, QC, Canada* A fiber-optics system is experimentally demonstrated for real-time identification of an optical energy-spectrum pattern based on dispersion-induced time-to-spectrum convolution, providing an output power above a prescribed threshold when the incoming spectrum matches the programmed driving pattern in a temporal modulator, avoiding spectral detection and post-processing.	

10:00 AM–10:30 AM – EXHIBITS & COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
WF1.4 9:30 AM–10:00 AM (Invited) **From Semiconductor Nanolasers to Photonic Integrated Circuits** Q. Gu, *University of Texas at Dallas, Richardson, TX, USA* Nanolasers have recently become excellent candidates for light sources in densely-packed chip-scale circuits. We summarize recent progress in III-V semiconductor nanolasers and the perspective of their insertion into photonic integrated circuits. We also discuss nanolasers based on emerging semiconducting materials on the silicon platform.	**WG1.4 9:30 AM–10:00 AM (Invited)** **Quantum Optomechanical Control of Phonon Networks** A. Safavi Naeini, *Stanford University, Stanford, CA, USA*	**WH1.4 9:30 AM–9:45 AM** **In-Band Crosstalk Analysis for Nyquist PDM-16QAM in Flexible Grid Transmission** J. Pan and S. Tibuleac, *ADVA Optical Networking, Norcross, GA, USA* The in-band crosstalk weighting metric is assessed using both simulations and experiments for a 200G Nyquist-shaped PDM-16QAM signal in 37.5GHz flexible grid system applications. The frequency offset impact on the weighting accuracy is investigated.	
		WH1.5 9:45 AM–10:00 AM **Performance Evaluation of Underwater Wireless Optical Communications Links in the Presence of Different Air Bubble Populations** H. M. Oubei, R. T. ElAfandy, K.-H. Park, T. K. Ng, M.-S. Alouini and B. S. Ooi, *King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia* We experimentally generate air bubble of different sizes and evaluate their effect on the performance of underwater wireless optical communication (UWOC) systems. We found that there is a tradeoff between mitigating the deep fade caused by large bubbles and the level of received intensity reduced by small bubbles. In addition, we propose beam expansion technique to improve performance degradation caused by air bubbles.	

10:00 AM–10:30 AM – EXHIBITS & COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

Salon I

10:30 AM–12:00 PM
Session WA2: Photonic-Based RF Signal Generation
Session Chair: Jean Kalkavage, *JHU & NRL*

WA2.1 10:30 AM–11:00 AM (Invited)
Photonic Frequency Synthesis From RF to THz
S. Diddams, *National Institute of Standards and Technology*
Optical frequency combs function as extremely broad bandwidth photonic synthesizers, capable of generating ultra-low noise signals from radio frequency to optical domains. We present synthesis results with both mode-locked laser and microresonator frequency combs.

WA2.2 11:00 AM–11:30 AM (Invited)
Low Noise RF Generation with Transportable Optical Cavities
M. Notcutt, *Stable Laser Systems, Boulder, CO, USA*
Stable Laser Systems builds frequency stabilized laser assemblies with Hz linewidth level. Compact and portable frequency stabilized laser assemblies will be discussed, as well as the RF signals generated from these assemblies.

WA2.3 11:30 AM–12:00 PM (Invited)
A 30 GHz Ultra-Low-Phase-Noise Oscillator Using Electro-Optical Frequency Division
J. Li, *hQphotonics Inc., Pasadena, CA, USA* and K. Vahala, *California Institute of Technology, Pasadena, CA, USA*
A 30 GHz ultra-low-phase-noise oscillator is demonstrated using electro-optical frequency division. The measured phase noise is –151 dBc/Hz (10 kHz offset) and –109 dBc/Hz (100 Hz offset). Phase locking to an external reference for long term synchronization is also demonstrated.

Salon II

10:30 AM–11:45 AM
Session WB2: Fundamentals and Applications of Microresonators II
Session Chair: *Jinhan Ren, CREOL, USA*

WB2.1 10:30 AM–11:00 AM (Invited)
Spontaneous Symmetry Breaking in an Ultrahigh-Q Microcavity
Y.-F. Xiao, *Peking University, Beijing, China and Collaborative Innovation Center of Extreme Optics, Shanxi, China,* Q.-T. Cao, H. Wang, *Peking University, Beijing, China,* C.-H. Dong, *University of Science and Technology of China, Hefei, China,* H. Jing, *Henan Normal University, Xinxiang, China,* R.-S. Liu, X. Chen, *Peking University, Beijing, China,* L. Ge, *College of Staten Island, CUNY, Staten Island, New York, USA and CUNY, New York, NY, USA* and Q. Gong, *Peking University, Beijing, China and Collaborative Innovation Center of Extreme Optics, Shanxi, China*
We experimentally demonstrate spontaneous symmetry breaking in a whispering-gallery microcavity. Above a threshold power, the intensities of clockwise and counterclockwise propagating waves in a cavity grow unbalanced, which is induced by the Kerr-nonlinearity-modulated coupling between the counter-propagating waves.

WB2.2 11:00 AM–11:15 AM
Broadband Coherent Perfect Absorption in Graphene Via an Omniresonant Optical Microcavity
A. K. Jahromi, M. L. Villinger, A. El Halawany, S. Shabahang, H. E. Kondakci and A. F. Abouraddy, *University of Central Florida, Orlando, FL, USA*
Coherent perfect absorption refers to total light absorption through interferometric effects, which only occurs at resonance wavelengths. Here we show a perfect absorption continuously across a broad bandwidth through an 'omniresonant cavity': a configuration where every wavelength is assigned to a proper incidence angle.

WB2.3 11:15 AM–11:30 AM
Enhanced Light Emission from MoS_2 in Heterostructure Photonic Crystal Cavities
X. Ge, *University of Texas at Arlington, Arlington, TX, USA,* M. Minkovy, *Stanford University, Stanford, CA, USA,* F. Chowdhury, *University of Texas at Arlington, Arlington, TX, USA,* S. Fany, *Stanford University, Stanford, CA, USA,* X. Liz, *University of Illinois Urbana-Champaign, Urbana, IL, USA* and W. Zhou, *University of Texas at Arlington, Arlington, TX, USA*
A heterostructure photonic crystal band edge mode cavity resonating at the wavelengths of monolayer MoS_2 photoluminescence is presented. The resonant mode is laterally confined by a mode gap near Γ. Emission enhancement of the integrated monolayer MoS_2 is demonstrated experimentally.

Salon III

10:30 AM–12:15 PM
Session WC2: High Frequency
Session Chair: John Bowers, *University of California, Santa Barbara, Santa Barbara, CA, USA*

WC2.1 10:30 AM–11:00 AM (Invited)
Passively Mode-Locked Quantum-Well Laser with a Saturable Absorber Having Gradually Varied Bandgap
J. Xu, S. Liang, S. Liu, L. Qiao, S. Sun, Q. Deng, Y. Huang and H. Zhu, *Chinese Academy of Sciences, Beijing, China*
A novel passively mode-locked quantum-well laser, which saturable absorber (SA) has gradually varied bandgap, is fabricated. Light pulses are obtained at a repetition frequency of 226 GHz with a minimum pulse width of 605 fs under an appropriate mono current bias.

WC2.2 11:00 AM–11:15 AM
Fixed-Point Frequencies Analysis of Monolithic 10 GHz Repetition Rates AlGaInAs Multiple Quantum-Well Laser Diodes
A. Zaman and P. J. Delfyett, *University of Central Florida, Orlando, FL, USA*
We report the first conducted measurements of the fixed-point frequencies on a 10 GHz repetition rate mode locked laser diode. The measurements show that four unique laser parameters can be modulated to independently control the combline offset frequency and comb spacing.

WC2.3 11:15 AM–11:30 AM
Limited Validity Range of the Modulation Current Efficiency Factor of Directly Modulated Semiconductor Lasers
G. Larisch, *Technische Universität Berlin, Berlin, Germany* and D. Bimberg, *Technische Universität Berlin, Berlin, Germany and King Abdulaziz University, Jeddah, Saudi Arabia*
The modulation current efficiency factor (MCEF) of a laser is assumed to be a constant quality parameter of directly modulated semiconductor lasers. Based on theoretical considerations and experiments this is shown to be incorrect. A definition of a realistic validity range of MCEF is introduced.

Salon VI

10:30 AM–12:00 PM
Session WD2: Novel Photodetector Configurations
Session Chair: Christoph Grein, *University of Illinois at Urbana–Champaign, Urbana, IL, USA*

WD2.1 10:30 AM–11:00 AM (Invited)
Luminescent Detectors for Free-Space Optical Communication
T. Peyronel, K. J. Quirk and T. G. Tiecke, *Facebook, Inc., Menlo Park, CA, USA*
We present a fast, large active area, and large field-of-view photodetector; a main challenge of free-space optical communications. We use fluorescent materials to increase the active area of a photodiode by orders of magnitude, maintaining its short response time and large field-of-view.

WD2.2 11:00 AM–11:15 AM
Low-Cost Electroluminescence Imaging for Automated Defect Characterization in Photovoltaic Modules
M. Bazzoli, *University of Illinois at Urbana-Champaign, Urbana, IL, USA and National Renewable Energy Laboratory, Golden, CO, USA,* T. J. Silverman, *National Renewable Energy Laboratory, Golden, CO, USA,* and L. L. Goddard, *University of Illinois at Urbana-Champaign, Urbana, IL, USA*
Electroluminescence (EL) imaging is a fast, well-established, laboratory characterization technique for photovoltaic (PV) modules that typically requires expensive equipment. Here, we present a novel low-cost extensible EL imaging technique that utilizes a modified camera and auxiliary hardware to automate EL imaging of field-deployed PV modules.

WD2.3 11:15 AM–11:30 AM
Video-Rate Photometric Stereo-Imaging with General Lighting Luminaires
J. Herrnsdorf, *University of Strathclyde, Glasgow, United Kingdom,* L. Broadbent, G. C. Wright, *Aralia Systems, Bristol, United Kingdom,* M. D. Dawson and M. J. Strain, *University of Strathclyde, Glasgow, United Kingdom*
3D images of moving objects can be achieved with a surveillance camera and four white light-emitting diodes. With these simple components, an imaging rate of 15 Hz is possible, limited by the camera framerate.

Salon VII

10:30 AM–12:00 PM
Session WE2: Tutorial & Novel Tissue Imaging and Detection Techniques
Session Chair: Xavier Intes, *Renesslaer Polytechnic Institute, Troy, NY, USA*

WE2.1 10:30 AM–11:30 AM (Tutorial)
Multifunctional Imaging of Human Tissue by Jones Matrix Optical Coherence Tomography
Y. Yasuno, *University of Tsukuba, Tsukuba, Japan*
Jones matrix optical coherence tomography (JM-OCT) is the most geenral form of OCT, which measures full Jones matrix distribution of a sample. Clinically usesul imaforamtion including scattering, flow, birefringence, and melanin distributions were deduced from the Jones matrix. We present ophthalmic and dermatologic applications.

WE2.2 11:30 AM–11:45 AM
Dual Detection of Zika Virus Nucleic Acid and Protein Using a Multi-Mode Interference Waveguide Platform
J. W. Parks, A. Stambaugh, *University of California, Santa Cruz, Santa Cruz, CA, USA,* M. A. Stott, *Brigham Young University, Provo, UT, USA,* G. M. Meena, *University of California, Santa Cruz, Santa Cruz, CA, USA,* A. R. Hawkins, *Brigham Young University, Provo, UT, USA* and H. Schmidt, *University of California, Santa Cruz, Santa Cruz, CA, USA*
We report a novel technique for simultaneous detection of nucleic acid and protein biomarkers using multimode interference (MMI) waveguides on an optofluidic chip. Multiplex detection of Zika virus nucleic acids and proteins using two-color multi-spot excitation is demonstrated with excellent specificity.

WE2.3 11:45 AM–12:00 pM
CMOS Fabricated Large Array of Free Standing Substrate-Less Photonic Crystal Cavities for Biosensing Applications
K. Saurav, S. Kumari and N. Le Thomas, *Ghent University-imec, Ghent, Belgium and Ghent University, Ghent, Belgium*
In this work, we present a methodology to post-process a large array of a few hundred nanometer thin photonic membranes that were fabricated using complementary metal-oxide semiconductor (CMOS) technological platform. The post processing results in local removal of the silicon substrate and of the buried oxide (BOX), which provides a free access from both side of the photonic structures. The membranes are patterned with photonic crystal (PhC) cavities by deep ultra-violet (UV) lithography. We show that the proposed process is compatible with the integration of micrometer-sized SU8 based polymer waveguides. These polymer waveguides together with high index contrast adiabatic nanometer-sized silicon inverted tapers act as spot size converters.

Salon VIII

10:30 AM–11:30 AM
Session WF2: Ultrashort Wavelength Nonlinear Optics and Applications
Session Chair: François Légaré, *INRS*

WF2.1 10:30 AM–11:00 AM (Invited)
Energy Scaling of Gas Nonlinear Optics
C. L. Arnold, *Lund University, Lund, Sweden,* C. M. Heyl, *Lund University, Lund, Sweden and JILA, NIST and the University of Colorado, Boulder, USA,* H. Coudert-Alteirac, M. Miranda, M. Louisy, *Lund University, Lund, Sweden,* K. Kovacs, V. Tosa, *National Institute for R&D Isotopic and Molecular Technologies, Romania,* E. Balogh, *Institute for Basic Science, Gwangju, Korea,* K. Varjú, *ELIALPS, Szeged, Hungary and University of Szeged, Szeged, Hungary,* A. Couairon, *École Polytechnique, CNRS, Palaiseau, France* and A. L'Huillier, *Lund University, Lund, Sweden*
Nonlinear light-matter interactions, such as filamentation or high-order harmonic generation, are at the heart of nonlinear optics. Scaling of such effects is crucial to benefit optimally from novel laser developments. We introduce and discuss a general scaling model for nonlinear light-matter interactions in gases.

WF2.2 11:00 AM–11:30 AM (Invited)
Sub-Angstrom and Femtosecond Scale Imaging of Molecular Motion Using Ultrafast X-ray Scattering
A. Natan, M. Ware, J. Glowina, J. Cryan and P. Bucksbaum, *SLAC National Lab, Menlo Park, CA, USA*
Time-resolved femtosecond x-ray diffraction patterns from laser-excited molecular iodine were used to create high fidelity molecular movies de-novo. We use a Legendre decomposition to extract excited state motion and observed electronic population transfer, vibrational motion, dissociation, rotational dephasing and evidence of interference of electronic states.

Kahiki / Lily

10:30 AM–12:00 PM
Session WG2: Metamaterials and Plasmonics
Session Chair: Jamie Phillips, *University of Michigan, Ann Arbor, MI, USA*

WG2.1 10:30 AM–10:45 AM
Modulating Optically Active Signals in a Chiral Metamaterial with Varied Input Intensities
S. P. Rodrigues, S. Lan, L. Kang, Y. Cui, P. W. Panuski, *Georgia Institute of Technology, Atlanta, Georgia, USA,* S. Wang, *Georgia Institute of Technology, Atlanta, Georgia, USA and Wuhan Textile University, Wuhan, China,* A. M. Urbas, *Air Force Research Laboratory, Wright-Patterson Air Force Base, Dayton, OH, USA,* W. Cai, *Georgia Institute of Technology, Atlanta, Georgia, USA*
Here we report an optical metamaterial with tailored chiroptical effects in the nonlinear regime, which exhibits a pronounced shift in its circular dichroism spectrum under a modest level of excitation power. Strong nonlinear optical rotation is observed at key spectral locations.

WG2.2 10:45 AM–11:15 AM (Invited)
Control of Light-matter Interaction in 2D Semiconductors
V. Menon, *City College of New York, New York, NY, USA*
We will discuss enhancement of spontaneous emission, formation of strongly coupled exciton-photon polaritons, valley polaritons and enhancement of nonlinear optical response from 2D transition metal dichalcogenides (TMD) embedded in microcavities, and photonic hypercrystals. Engineered single photon emission from hexagonal boron nitride will also be discussed.

WG2.3 11:15 AM–11:30 AM
Wideband Resonant Metasurfaces: Role of Local Modes
R. Magnusson and Y. H. Ko, *University of Texas at Arlington, Arlington, TX, USA*
We treat subwavelength resonant metasurfaces inscribed with 1D and 2D periodic patterning. We show that local Fabry-Perot modes or Mie modes are not fundamentally needed to achieve wideband response. In fact, device embodiments with such modes being absent yield wider bands.

Poinsettia / Quince

10:30 AM–11:30 AM
Session WH2: Data Centers
Session Chair: Stephen Grubb, *Facebook*

WH2.1 10:30 AM–11:00 AM (Invited)
Transceivers for Inter-Data Center Connections
A. Dochhan, *DVA Optical Networking SE, Meiningen, Germany,* N. Eiselt, *ADVA Optical Networking SE, Meiningen, Germany and Technical University of Denmark (DTU), Kongens Lyngby, Denmark,* H. Griesser, M. Eiselt and J.-P. Elbers, *ADVA Optical Networking SE, Meiningen, Germany*
We discuss options for data-center interconnects with reaches up to 80 km. Besides coherent transmission, direct detect solutions like the presented quantum-dot laser and silicon ring modulator based 56.25-Gb/s DWDM PAM4 TOSA are viable options.

WH2.2 11:00 AM–11:30 AM (Invited)
Optical Technologies and Implementation Challenges for 400G and Beyond for Datacenters
S. Khatana, *Lumentum*

Salon IV

10:30 AM–11:45 AM
Session WI2: High-Order Harmonic Generation in Solids
Session Chair: Zenghu Chang, *University of Central Florida, Orlando, FL, USA*

WI2.1 10:30 AM–11:00 AM (Invited)
S. Ghimire, *Stanford University, Stanford, CA, USA*

WI2.2 11:00 AM–11:30 AM (Invited)
THz-Driven Strong-Field Dynamics in Solids: High-Harmonic Generation and Quasiparticle Collisions
F. Langer, M. Hohenleutner, C. P. Schmid, S. Schlauderer, *University of Regensburg, Regensburg, Germany,* U. Huttner, *University of Marburg, Marburg, Germany and University of Michigan, Ann Arbor, MI, USA,* S. W. Koch, *University of Marburg, Marburg, Germany,* M. Kira, *University of Marburg, Marburg, Germany and University of Michigan, Ann Arbor, MI, USA* and R. Huber, *University of Regensburg, Regensburg, Germany*
Using intense, phase-locked multi-THz waveforms, we drive high-harmonic generation and quasiparticle collisions in solids. By exploiting the crystal symmetry, we shape the high-harmonic carrier field and control the polarization of the emitted pulse train. Many-body effects and intraband acceleration are investigated by high-order sideband generation.

WI2.3 11:30-11:45
High-Order Harmonic Generation in ZnO Using Few-Cycle Mid-IR Pulses Generated via Self-Compression
S. Gholam-Mirzaei, J. Beetar and M. Chini, *University of Central Florida, Orlando, FL, USA*
We exploit nonlinear self-compression in YAG to generate sub-three-cycle, 10 μJ pulses from a 50 kHz mid-IR OPA. Efficiency and cutoff enhancement of generated high-order harmonics in ZnO relative to longer driving pulses demonstrates the potential for solid-state attosecond pulse generation through nonlinear self-compression.

Salon I	Salon II	Salon III	Salon VI	Salon VII
	WB2.4 11:30 AM–11:45 AM **Fabrication of a Centimeter-Long Cavity on Nanofiber for Strong-Coupling Regime of Cavity QED** J. Keloth, K. P. Nayak, J. Wang and K. Hakuta, *University of Electro-Communications, Tokyo, Japan* We report the fabrication of a centimeter-long cavity directly on the nanofiber using femtosecond laser ablation which can operate in both “strong-coupling” and “Purcell” regime of cavity QED with moderate finesse, high cooperativity and high transmission.	**WC2.4 11:30 AM–11:45 AM** **Demonstration of Self-Pulsating InP-on-Si DFB Laser Diodes** M. Shahin, *Ghent University-imec, Ghent, Belgium and Ghent University, Ghent, Belgium,* K. Ma, *Zhejiang University, Hangzhou, China,* A. Abbasi, G. Roelkens and G. Morthier, *Ghent University-imec, Ghent, Belgium and Ghent University, Ghent, Belgium* Self-pulsating InP-on-Si two-section DFB laser diodes are demonstrated. The lasers have stable controllable pulsation frequencies at 12.5, 25 and 40 GHz, RF spectral widths of around 40 MHz and 15 dB extinction ratio.	**WD2.4 11:30 AM–11:45 AM** **High Conversion-Gain Pixels in a Standard CMOS Image Sensor Process** S. Chen and E. R. Fossum, *Dartmouth College, Hanover, NH, USA* This paper presents a new technique to achieve high pixel conversion gain (CG) in a standard 0.18 um CMOS image sensor process. CG of 121 uV/e- and read noise of 3.2 e- rms are measured in the prototype sensor.	
		WC2.5 11:45 AM–12:00 PM **Impact of Laser Dynamics on 56 Gbps PAM-4 Modulation of 25G Class, 1310 nm, Directly Modulated Lasers** P. P. Baveja, M. Li, D. Wang, Y.-Y. Liang, Y. Chen, D. McIntosh-Dorsey, H. Zhang and J. Zheng, *Applied Optoelectronics Inc., Sugar Land, TX, USA* We investigate the effects of large signal dynamics and extinction ratio on the quality of 56 Gbps PAM-4 modulation with 1310 nm, 25G class directly modulated lasers.	**WD2.5 11:45 AM–12:00 PM** **Highly Sensitive Photodetectors Based on Organic-Inorganic Heterostructure** C.-H. Cheng, H. Wang, Z. Li and P. B. Deotare, *University of Michigan, Ann Arbor, MI, USA* We demonstrate hybrid Molybdenum disulfide (MoS_2) photodetector incorporating a thin layer of highly absorbing organic j-aggregate molecules. Due to nearly perfect emission-absorption spectral overlap between the organic-inorganic materials, more than threefold increase in the photoresponsivity was observed in such hybrid devices.	
		WC2.6 12:00 PM–12:15 PM **A Novel Dual-Loop Feedback Scheme to Suppress Phase Noise and Spurious Tones in Self-Mode-Locked Two-Section Quantum Dash Lasers Emitting at 1.55 µm** H. Asghar and J. G. McInerney, *University College Cork, Cork, Ireland* We demonstrate novel dual-loop optical feedback to suppress external-cavity side-modes in self-mode-locked lasers with conventional feedback. We demonstrate that asymmetric dual-loop feedback, with large (~8×) disparity in cavity lengths, eliminates all external-cavity side-modes and produces low timing-jitter compared to single-loop feedback.		
12:00 PM–1:30 PM – LUNCH (ON OWN)				

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
	WG2.4 11:30 AM–11:45 AM **Dielectric Metasurfaces with Independent Angular Control** S. M. Kamali, E. Arbabi, A. Arbabi, Y. Horie, M.-S. Faraji-Dana, and A. Faraon, *California Institute of Technology, Pasadena, CA, USA* We introduce dielectric metasurfaces with independent response at different angles of incidence given the same input polarization. We demonstrate a reflective metasurface grating with different effective grating pitches under two different incident angles, and a hologram that projects different images for different incidence angles.		
	WG2.5 11:45 AM–12:00 PM **Dispersion-Controlled Diffractive Devices with Dielectric Metasurfaces** E. Arbabi, A. Arbabi, S. M. Kamali, Y. Horie and A. Faraon, *California Institute of Technology, Pasadena, CA, USA* Diffractive optical devices follow a negative chromatic dispersion dictated by device function. Here we show that metasurfaces with independent control of phase and group delays enable diffractive devices that break this relation. We demonstrate gratings and focusing mirrors with enhanced negative, zero, and positive dispersion.		

12:00 PM–1:30 PM – LUNCH (ON OWN)

Salon I	Salon II	Salon III	Salon VI	Salon VII
1:30 PM–3:00 PM **Session WA3:** Heterogeneous Integration Roadmap **Session Chair:** Amr Hilmy, *University of Toronto, Toronto, ON, Canada*	**1:30 PM–3:00 PM** **Session WB3:** NLUO Tutorial / Leading Concepts in Nonlinear Optics **Session Chair:** Mikhail Belkin, *University of Texas, Austin, Austin, TX, USA*	**1:30 PM–3:00 PM** **Session WC3:** VCSEL Integration and High-Speed SModulation **Session Chair:** Petter Westbergh, *Finisar*	**1:30 PM–3:00 PM** **Session WD3:** Photonic Integrated Circuits **Session Chair:** Christian Koos, *Karlsrule Institute of Technology, Karlsruhe, Germany*	**1:30 PM–3:00 PM** **Session WE3:** Optical System Architecture **Session Chair:** Stephen Ralph, *Georgia Institute of Technology, Atlanta, GA, USA*
WA3.1 1:30 PM–3:00 PM **Heterogeneous Integration Roadmap** B. Bottoms, *3MTS, USA*	**WB3.1 1:30 PM–3:00 PM (Tutorial)** **Parity-Time Symmetry in Optics and Photonics** D. Christodoulides, *University of Central Florida, Orlando, FL, USA*	**WC3.1 1:30 PM–2:00 PM (Invited)** **Silicon-Integrated Hybrid-Vertical-Cavity Lasers for Life Science Applications** J. S. Gustavsson, *Chalmers University of Technology, Göteborg, Sweden,* S. Kumari, *Ghent University-IMEC, Ghent, Belgium and Ghent University, Ghent, Belgium,* E.P. Haglund, J. Bengtsson, *Chalmers University of Technology, Göteborg, Sweden,* G. Roelkens R.G. Baets, *Ghent University-IMEC, Ghent, Belgium and Ghent University, Ghent, Belgium* and A. Larsson, *Chalmers University of Technology, Göteborg, Sweden* Hybrid 850-nm-wavelength vertical-cavity lasers formed by adhesively bonding AlGaAs-material to a dielectric distributed Bragg reflector on Silicon has experimentally enabled sub-mA threshold current and 25Gb/s modulation speed. Numerical calculations estimate >0.3mW/mA slope efficiency for in-plane SiN waveguide coupled light using an intra-cavity grating.	**WD3.1 1:30 PM–1:45 PM** **High Resolution Optical Frequency Domain Reflectometry for Measurement of Waveguide Group Refractive Index** D. Zhao, D. Pustakhod, K. Williams and X. Leijtens, *Eindhoven University of Technology, Eindhoven, The Netherlands* We present a high-resolution optical frequency domain reflectometry for characterization of group refractive index of waveguides in photonic integrated circuits. The method provides a relative accuracy of 10^{-4} for group refractive index measurements and of 10^{-3} for its dispersion.	**WE3.1 1:30 PM–2:00 PM (Invited)** **Convergence of Millmeter-Wave and Optical Access Networks** A. Stoehr, *Unversity of Duisburg Essen, Germany*
		WC3.2 2:00 PM–2:15 PM **Classification of Coherent Supermodes in Photonic Crystal Vertical Cavity Laser Arrays** B. J. Thompson, Z. Gao, H. Dave, *University of Illinois, Urbana, IL, USA,* S. T. M. Fryslie, *Freedom Photonics, Santa Barbara, CA, USA,* K. Lakomy and K. D. Choquette, *University of Illinois, Urbana, IL, USA* Vertical-cavity surface-emitting laser elements are resonantly tuned with independent current injection to achieve multiple coherent output modes. A study of coherent supermodes in a linear 3 × 1 VCSEL array is presented, matching experimental results with 1-dimensional modal simulation.	**WD3.2 1:45 PM–2:00 PM** **Enhancement of SOA-Integrated EAM with Low-Temperature Quantum Well Intermixing through Supercritical Fluid Technique** Y.-J. Chen, C.-L. Chen, S.-A. Yang, R-Y Chen and Y.-J. Chiu, *National Sun Yat-Sen University, Kaoshiung, Taiwan* New scheme of quantum-well-intermixing (QWI) enhancement is proposed for SOA/EAM integration. Using supercritical-fluid, QWI can be performed at low temperature regime, leading to 10 dB improvement in optical modulation. 13 dB modulation, 17 dB gain and >15 GHz f_{-3dB} were observed in 100 μm long EAM, confirming simple integration scheme.	**WE3.2 2:00 PM–2:30 PM (Invited)** **Free-Space Optical Links Enhanced by Twisted Photons** M. Lavery, *University of Glasgow, Glasgow, United Kingdom* Free-space links can be enchanted with incorporation of Space Division Multiplexing (SDM). Orbital Angular Momentum (OAM) multiplexing is potential form of SDM for use in optical links. Optical technologies for OAM multiplexing will be discussed, along with performance results from a 1.6 km urban link.
		WC3.3 2:15 PM–2:30 PM **Coherence Tuning of Pulsed Photonic Crystal VCSEL Arrays** H. Dave, *University of Illinois, Urbana, IL, USA,* S. T. M. Fryslie, *Freedom Photonics, Santa Barbara, CA, USA,* Z. Gao, B. J. Thompson and K. D. Choquette, *University of Illinois, Urbana, IL, USA* Characterization of coherence tuning range for 2 × 1 photonic crystal VCSEL arrays under pulsed excitation is reported. Far field data show the coherence range is larger under pulsed conditions compared to cw operation due to reduction of resistive diode heating.	**WD3.3 2:00 PM–2:30 PM (Invited)** **Optical Frequency Synthesis by Offset-Locking the Tunable Local-Oscillator of a Low-Power Integrated Receiver to a Microresonator Comb** S. Arafin, A. Simsek, S.-K. Kim, *University of California Santa Barbara, Santa Barbara, CA, USA,* W. Liang, D. Eliyahu, *OEwaves Inc., Pasadena, CA, USA,* G. Morrison, M. Mashanovitch, *Freedom Photonics LLC, Santa Barbara, CA, USA,* A. Matsko, *OEwaves Inc., Pasadena, CA, USA,* L. Johansson, *Freedom Photonics LLC, Santa Barbara, CA, USA,* L. Maleki, *OEwaves Inc., Pasadena, CA, USA,* M. Rodwell and L. Coldren, *University of California Santa Barbara, Santa Barbara, CA, USA* A power-efficient and highly-integrated photonic system, producing low phase-noise coherent optical signal with a wavelength range of 23 nm in the C-band, is presented. The system includes novel InP-photonic integrated coherent receiver circuits that consume record-low (approximately 184 mW) electrical power.	**WE3.3 2:30 PM–3:00 PM (Invited)** **Terahertz Systems Based on Resonant Tunneling Diodes and Photonic Crystals** M. Fujita, *Osaka University, Osaka, Japan* Terahertz waves, which represent the frequency region between radio and light waves, offer unique potential applications, including ultra-broadband wireless communication. Here, we report the recent progress of terahertz systems based on resonant tunneling diodes and photonic crystals, which enable compact, low-power-consumption and integrated systems.

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
1:30 PM–3:00 PM **Session WF3:** Systems and Modulation 2 **Session Chair:** Nan Chi, *Fudan University*	**1:30 PM–3:00 PM** **Session WG3:** Novel Photonic Materials and Metamaterials **Session Chair:** Vinod Menon, *City College of New York, New York, New York, USA*	**1:30 PM–2:45 PM** **Session WH3:** Quantum Detectors and Novel Mechanisms **Session Chair:** Tobias Tiecke, *Facebook*	**1:30 PM–3:00 pm** **Session WI3:** Controlling Electronic Dynamics in Solids **Session Chair:** François Légaré, *INRS, Varennes, Canada*
WF3.1 1:30 PM–2:00 PM (Invited) **Spectrally Efficient Visible Light Communications** S. Hranilovic, *McMaster University, Hamilton, ON, Canada*	**WG3.1 1:30 PM–1:45 PM** **Leaky Mode Coupling in Asymmetric Subwavelength Dielectric Gratings** M. Barrow, M. Scherr and J. Phillips, *University of Michigan, Ann Arbor, MI, USA* Asymmetric subwavelength dielectric gratings can couple to symmetry-protected leaky modes, enabling normal incidence filtering. Finite element simulations calculate the transmittance profile and dispersion relation of a two-step high contrast grating. Further, linewidth broadening due to leaky mode coupling and angular dependence are established.	**WH3.1 1:30 PM–2:00 PM (Invited)** **Quantum Detectors Using Cycling Excitation Process in Disordered Medium** Y. Lo, L. Yan, A. Zhang, Y.-H. Liu, D. Hall, J. Zhou, L. Chiang and Y. Lo, *University of California, San Diego, La Jolla, CA, USA* Cycling excitation process (CEP) is a signal amplification mechanism showing high gain, low noise at low operation bias. Depending on Auger excitation that involves localized states, CEP effect may be prominent in amorphous silicon, which has abundant localized states as a disordered material.	**WI3.1 1:30 PM–2:00 PM (Invited)** **Ultrafast Control of Electrons in Materials with the Electric Field of Light** A. E. Schiffrin, *Monash University, Clayton, Australia* Electronics technologies rely on the control of electric current in solid-state devices. Here, we review the feasibility of generating and controlling electric current in semiconductors and insulators with few-cycle optical waveforms, within a single cycle of light, and on a timescale of 1 femtosecond.
WF3.2 2:00 PM–2:15 PM **Reduced Complexity Interleaved Multi-Carrier CDMA for Indoor Visibille Light Communications** A. M. Abdelaziz, M. A. El-Shimy and Z. A. El-Sahn, *Alexandria University, Alexandria, Egypt* We propose a novel technique that we call reduced complexity interleaved multi-carrier CDMA (RC I-MC-CDMA) as an alternative to MC-CDMA for indoor VLC systems. It uses shorter CDMA codes and interleaved sub-bands to lower the overall complexity without a significant additional power penalty.	**WG3.2 1:45 PM–2:00 PM** **Terahertz Frequency-Selective Surface and Guided-Mode Resonance Filters** A. Ferraro, R. Caputo, *University of Calabria, Rende, Italy,* D. C. Zografopoulos and R. Beccherelli, *CNR-IMM, Roma, Italy* Terahertz filters based on frequency-selective surfaces patterned on the low-loss cyclo-olefin polymer Zeonor shows broad and narrow-band resonances. This stem from FSS response and coupling to substrate guided modes, respectively. Very narrow linewidths with quality factors exceeding 100 are measured experimentally and confirmed numerically.	**WH3.2 2:00 PM–2:15 PM** **Mach-Zehnder Interferometer Readout for Instantaneous Sensor Calibration and Extraction of Endlessly Unwrapped Phase** J. Milvich, *Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany and Robert Bosch GmbH, Renningen, Germany,* D. Kohler, W. Freude and C. Koos, *Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany* We demonstrate a robust concept for instantaneous extraction of fringe order and unwrapped phase in integrated Mach-Zehnder sensors without continuous tracking. The scheme exploits a frequency-modulated probe laser and a 2 × 3 MMI at the sensor output and allows for continuous self-calibration and high-resolution phase detection.	**WI3.2 2:00 PM–2:30 PM (Invited)** **Lightwave-Driven Electron Dynamics in Graphene** T. Higuchi, *FAU Erlangen-Nurnberg, Germany* We show that two-cycle laser pulses generate carrier-envelope-phase dependent currents in graphene. The current direction exhibits a reversal with increasing peak field strength, indicating that the electron dynamics turn into the strong-field regime. In this regime, electron dynamics are governed by sub-optical-cycle Landau-Zener-Stückelberg interference.
WF3.3 2:15 PM–2:45 PM (Invited) **Organic Visible Light Communications: Methods to Achieve 10 Mb/s** P. A. Haigh, *University College London, London, United Kingdom,* Z. Ghassemlooy, *Northumbria University, Newcastle upon Tyne, United Kingdom,* S. T. Le, *Nokia Bell Labs, Stuttgart, Germany,* F. Bausi, *University College London, London, United Kingdom,* H. Le Minh, *Northumbria University, Newcastle upon Tyne, United Kingdom,* F. Cacialli and I. Darwazeh, *University College London, London, United Kingdom* In this review, we summarise methods towards achieving 10 Mb/s connectivity for visible light communications links utilising organic polymer based light-emitting diodes as the transmitter. We present two different methods; on-off keying supported by least mean squares equalisation and orthogonal frequency division multiplexing without equalisation.	**WG3.3 2:00 PM–2:30 PM (Invited)** **Long-Wave Infrared Filtering in Subwavelength Dielectric Gratings** J. Phillips, M. Scherr and M. Barrow, *University of Michigan, Ann Arbor, MI, USA* Low-loss dielectric structures with narrowband transmission offer a dramatic impact on imaging capabilities in the long-wavelength infrared (LWIR, 8-12 microns). The design, simulation, and experimental demonstration of silicon/air subwavelength gratings exhibiting LWIR broadband reflectance and narrowband transmittance based on leaky-mode coupling will be presented.	**WH3.3 2:15 PM–2:30 PM** **Quantitative Phase Imaging Through Encoding Phase into the State of Polarization** Shengwei Cui, *College of Optics and Photonics, Orlando, FL, USA and Xiamen University, Xiamen, China,* M. I. Akhlaghi and A. Dogariu, *College of Optics and Photonics, Orlando, FL, USA* Phase can be measured by encoding it in the field's state of polarization. Using heterodyne measurements in multiple states of linear polarization, we demonstrate that quantitative phase imaging can be implemented without sacrificing resolution.	**WI3.3 2:30 PM–2:45 PM** **Universality of Ultrafast Semi-Metallization in Dielectrics in PHz Domain** O. Kwon, *Pohang University of Science and Technology, Pohang, South Korea and Max Planck POSTECH/Korea Res. Init., Pohang, South Korea,* V. Apalkov, M. I. Stockman, *Georgia State University, Atlanta, GA, USA* and D. Kim, *Pohang University of Science and Technology, Pohang, South Korea and Max Planck POSTECH/Korea Res. Init., Pohang, South Korea* The ultrafast semimetalization by light field of various materials have been studied. Despite of their different physical properties, similar semimetallization behavior has been observed, which can be well explained by Wannier Stark localization with Zener type tunneling, taking interband and intraband transition into account.

Salon I	Salon II	Salon III	Salon VI	Salon VII
		WC3.4 2:30 PM–2:45 PM **30-GHz Small-Signal Modulation Bandwidth with Directly Current-Modulated 980-nm Oxide-Aperture VCSELs** R. Rosales, *Technische Universität Berlin, Berlin, Germany,* M. Zorn, *Jenoptik Diode Lab GmbH, Berlin, Germany* and J. A. Lott, *Technische Universität Berlin, Berlin, Germany* Directly current-modulated 980-nm vertical-cavity surface-emitting lasers (VCSELs) with oxide-aperture-diameters of 1.5-micrometers exhibit small-signal –3-dB modulation bandwidths of 31 and 25-GHz and maximum single-mode light-output-powers of 3 and 2-mW at 25 and 85°C, respectively. The side-mode-suppression-ratio exceeds 40-dB at bias currents above threshold.	**WD3.4 2:30 PM–2:45 PM** **Fabrication of Dual Layer, Dual Width Waveguides for Dispersion Engineered InP Photonic Circuits** J. Ø. Kjellman, R. Stabile and K. A. Williams, *Eindhoven University of Technology, Eindhoven, The Netherlands* Dual layer, dual width waveguides exhibiting enhanced chromatic dispersion can enable photonic circuits for ultrafast optical pulses. With common tools and processes we here demonstrate the creation of the necessary waveguide geometry. 2.6 dB/cm shallow waveguide losses validate our process strategy.	
		WC3.5 02:45-03:00 **Harnessing the Asymmetry in Coherently Coupled 2 × 1 VCSEL Arrays** Z. Gao, B. J. Thompson, H. Dave, *University of Illinois, Urbana, IL, USA,* S. T. M. Fryslie, *Freedom Photonics, Santa Barbara, CA, USA,* K. D. Choquette, *University of Illinois, Urbana, IL, USA* Coherently coupled 2 × 1 VCSEL arrays with lithographically defined cavity asymmetries are fabricated and characterized. Shifting of the coherent coupling region controlled by the degree of asymmetry is reported, consistent with a controlled gain/frequency tuning in addition to the current tuning.	**WD3.5 2:45 PM–3:00 PM** **Heterogeneous Integration of Thin-Film Lithium Niobate and Chalcogenide Waveguides on Silicon** A. Honardoost, S. Khan, G. F. Camacho Gonzalez, *University of Central Florida, Orlando, FL, USA,* J.-E. Tremblay, *University of California, Berkeley, Berkeley, CA, USA,* A. Yadav, K. A. Richardson, *University of Central Florida, Orlando, FL, USA,* M. C. Wu, *University of California, Berkeley, Berkeley, CA, USA* and S. Fathpour, *University of Central Florida, Orlando, FL, USA* A heterogeneous platform is demonstrated by integrating lithium niobate and chalcogenide glass waveguides on silicon with optical transition through low-loss mode-converting tapers. The method provides an efficient utilization of second- and third-order nonlinearities on the same chip for applications like stabilized octave-spanning optical combs.	

3:00 PM–3:30 PM – EXHIBITS & COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

PLENARY SESSIONS WILL BE LIVE-STREAMED

3:30–5:00 PM – Salon IV/V

Plenary Session II – WJ4

Session Chair: Hilmi Volkan Demir, *NTU Singapore, Singapore and Bilkent University, Turkey*

WJ4.1 3:30 PM–4:15 PM (Plenary)

Novel Materials for Next Generation Photonic Devices

Michal Lipson, *Columbia University, New York, NY, USA*

We show that graphene can provide electro-optic properties to traditionally passive optical materials and enable efficient integrated active nanophotonic devices. We show devices with GHz absorption modulation based on ring resonators. We also report the first experimental demonstration of a graphene electro-refractive modulator with $V_{\pi}L$.

WJ4.2 4:15 PM–5:00 PM (Plenary)

Ultrafast Photonics Time-Frequency Signal Processing Using Integrated Photonics

Andrew Weiner, *Purdue University, USA*

Selected applications of optical microresonators and other integrated photonics devices for analog signal processing of ultrafast and broadband light are reviewed. Topics include radio-frequency and optical arbitrary waveform generation, optical frequency combs, and time-frequency entangled photons.

POSTER SESSION / STUDENT & YOUNG PROFESSIONALS POSTER COMPETITION AND JOB FAIR

6:00 PM–8:00 PM INTERNATIONAL BALLROOM - CENTER

Session Chair: Nikola Alic, *University of California San Diego, San Diego, CA, USA*

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
	WG3.4 2:30 PM–2:45 PM **Broadband and High-Speed 1300nm Electroabsorption Modulator Using InAlGaAs Multiple Quantum Wells** B.-H. Chen, R.-Y. Chen, C.-L. Chen, *National Sun Yat-Sen University, Kaohsiung, Taiwan,* W. Lin, *LandMark Optoelectronics, Inc., Tainan, Taiwan* and Y.-J. Chiu, *National Sun Yat-Sen University, Kaohsiung, Taiwan* High-bandgap offset 1300nm InAlGaAs quantum well (QW) has been used for electroabsorption modulator. High conduction/valance bandgap offset ratio allows strong exciton effect under high electric field, leading to broadband operation. >10dB extinction ratio from 1280 nm to 1320 nm and 40 GHz of electical-to-optical response has been demonstrated.	**WH3.4 2:30 PM–2:45 PM** **Fourier Transform Spectroscopy via a Single Electro-Optic Frequency Comb** M. I. Kayes and M. Rochette, *McGill University, Montreal, QC, Canada* We demonstrate a single-comb Fourier transform spectrometer by sweeping the pulse repetition frequency of an electro-optic frequency comb. Such combs are more flexible than mode-locked lasers in terms of tunability of the comb repetition rate, which provides an advantage for comb based spectroscopy.	**WI3.4 2:45 PM–3:00 PM** **Spectral Broadening and Pulse Compression of a High Average Power Yb:KGW Laser** J. Beetar, S. Gholam-Mirzaei, S. Buczek, *University of Central Florida, Orlando, FL, USA,* S. Solis, *College of Optics and Photonics, Orlando, FL, USA* and M. Chini, *University of Central Florida, Orlando, FL, USA and College of Optics and Photonics, Orlando, FL, USA* We investigate the broadening and compression of high average power near-infrared pulses from a Yb:KGW laser amplifier that undergo self-phase modulation in a series of thin fused silica plates. The efficiency of the technique is investigated through spectral and temporal characterization of the broadened pulses.
	WG3.5 2:45 PM–3:00 PM **Control of Optical Amplification Process with Extremely Low Background Loss in Er:Al_2O_3 Waveguides** M. Demirtaş, C. Odaci, N. K. Perkgöz, C. Sevik and F. Ay, *Anadolu University, Eskisehir, Turkey* We report on record low-loss single mode a-Al_2O_3 planar waveguides and growth optimization of a-Er_2O_3 layers to control erbium-doping level of a-Al_2O_3 layers realized using Atomic Layer Deposition (ALD). Effect of growth cycle ratio of as grown Er_2O_3/Al_2O_3 layers on Photoluminescence (PL) is reported.		

3:00 PM–3:30 PM – EXHIBITS & COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

PLENARY SESSIONS WILL BE LIVE-STREAMED

3:30–5:00 PM – Salon IV/V

Plenary Session II – WJ4

Session Chair: Hilmi Volkan Demir, *NTU Singapore, Singapore and Bilkent University, Turkey*

WJ4.1 3:30 PM–4:15 PM (Plenary)

Novel Materials for Next Generation Photonic Devices

Michal Lipson, *Columbia University, New York, NY, USA*

We show that graphene can provide electro-optic properties to traditionally passive optical materials and enable efficient integrated active nanophotonic devices. We show devices with GHz absorption modulation based on ring resonators. We also report the first experimental demonstration of a graphene electro-refractive modulator with $V_\pi L$.

WJ4.2 4:15 PM–5:00 PM (Plenary)

Ultrafast Photonics Time-Frequency Signal Processing Using Integrated Photonics

Andrew Weiner, *Purdue University, USA*

Selected applications of optical microresonators and other integrated photonics devices for analog signal processing of ultrafast and broadband light are reviewed. Topics include radio-frequency and optical arbitrary waveform generation, optical frequency combs, and time-frequency entangled photons.

POSTER SESSION / STUDENT & YOUNG PROFESSIONALS POSTER COMPETITION AND JOB FAIR

6:00 PM–8:00 PM INTERNATIONAL BALLROOM - CENTER

Session Chair: Nikola Alic, *University of California San Diego, San Diego, CA, USA*

Salon I	Salon II	Salon III	Salon VI	Salon VII
8:30 AM–9:45 AM **Session ThA1:** Photonic Systems for Aerospace and Antenna Applications **Session Chair:** James Adleman, *SPAWAR*		**8:30 AM–10:00 AM** **Session ThC1:** Novel Attosecond Pulse Sources **Session Chair:** Oliver D. Mücke, *DESY CFEL, Hamburg, Germany*	**8:30 AM–10:00 AM** **Session ThD1:** Fiber Sensing **Session Chair:** Ana Pejkic, *University of California, San Diego, San Diego, CA, USA*	**8:30 AM–10:00 AM** **Session ThE1:** Novel Imaging and Biosensor Systems **Session Chair:** Raghav Chhetri, *HHMI Janelia Farm*
ThA1.1 8:30 AM–9:00 AM (Invited) **DWDM Systems for Aerospace High-Speed Digital and RF Transport** R. Stevens, *Lockheed Martin ATL, Eagan, MN, USA* A Dense Wavelength Division Multplexed (DWDM) system can be used to provide a scalable high-speed digital and RF transport for aerospace applications using C-band optical spacing per the ITU grid enabling multiple digital and analog signals to coexist on a common passive optical transport.		**ThC1.1 8:30 AM–9:00 AM (Invited)** **Intense Supercontinuum Generation in Condensed Media: New Approach to Single-Cycle Pulses and Isolated Attosecond Pulses** A. Kung, *Academia Sinica, Taipei, Taiwan* The generation and power scaling of an octave-spanning supercontinuum by strategically placing a number of thin solid plates at the focused waist of a femtosecond laser beam and compression of the supercontinuum pulse to a single-cycle for isolated attosecond pulse production is discussed.	**ThD1.1 8:30 AM–8:45 AM (Invited)** **Stimulated Brillouin Scattering in Few-Mode Fibers and Its Applications** K. Y. Song, *Chung-Ang University, Seoul, South Korea* In this talk experimental and theoretical studies on the stimulated Brillouin scattering in two- and few-mode fibers are presented including the observation and characterization of intermodal and intramodal Brillouin scatterings and Brillouin dynamic gratings. The potential applications to distributed sensors will be also discussed.	**ThE1.1 8:30 AM–9:00 AM (Invited)** **Mesoscopic Fluorescence Molecular Tomography** X. Intes *Rensselaer Polytechnic Institute, Troy, NY, USA* Mesoscopic Fluorescence Molecular Tomography is an emerging imaging technique with great promise for quantifying molecular expression in the mesoscopic regime. We will present the engineering concepts of MFMT and demonstrate its utility in imaging bioprinted tissues as well as tumor xenogratfs in vivo.
ThA1.2 9:00 AM–9:15 AM **A Photonic Receiver Based on Stretch Processing for Synthetic Aperture Radar** R. Li, M. Ding, Z. Wen, W. Li, Y. Tian and X. Liang *Institute of Electronics Chinese Academy of Sciences, Beijing, China* A novel photonic stretch receiver for synthetic aperture radar is developed and experimentally demonstrated. The photonic receiver is proved in a microwave anechoic chamber, and evaluated through inverse SAR imaging tests in a field trial.		**ThC1.2 9:00 AM–9:30 AM (Invited)** **The Response of Transparent Materials to Intense Ultrashort Light Pulses** P. B. Corkum, *University of Ottawa and National Research Council of Canada, Ottawa, ON, Canada* High harmonics are generated when gases or solids are irradiated with intense ultrashort pulses. The harmonic phase is a signature of the generation mechanism. Perturbing, doping, or structuring a solid patterns the harmonic amplitude and phase, thereby controlling the radiation while identifying the generating mechanism.	**ThD1.2 9:00 AM–9:15 AM** **Complex Domain Brillouin Frequency Estimation for Distributed Fiber Sensing** J. Fang, M. Sun, D. Che, *University of Melbourne, Melbourne, VIC, Australiam* M. Myers, *CSIRO, Kensington, Australia* and W. Shieh, *University of Melbourne, Melbourne, VIC, Australia* We demonstrate a novel technique for distributed Brillouin frequency estimation by fitting the Brillouin transfer function directly in the complex domain. Experimental results show the uncertainty of Brillouin frequency can be significantly reduced compared with the approaches based solely on Brillouin gain or phase.	**ThE1.2 9:00 AM–9:15 AM** **High Fidelity MMI-Based Multi-Spot Excitation for Optofluidic Multiplexing** M. A. Stott, *Brigham Young University, Provo, UT, USA,* V. Ganjalizadeh, H. Schmidt, *University of California, Santa Cruz, Santa Cruz, CA, USA* and A. R. Hawkins, *Brigham Young University, Provo, UT, USA* Producing high fidelity multi-spot patterns from a long ARROW-based multimode interference waveguide is important for optofluidic biosensors that rely on optical multiplexing. We have found that spot pattern fidelity is affected by input waveguide geometry and etching parameters.
ThA1.3 9:15 AM–9:45 AM (Invited) **Photonically-Enabled Imaging Receiver** C. A. Schuetz, *Phase Sensitive Innovations, Newark, DE, USA,* G. J. Schneider, J. Murakowski, S. Shi and D. W. Prather, *University of Delaware, Newark, DE, USA* Recent advances in spatial synchronization of photonically sampled phased array receivers have enabled the creation of massively multibeam non-blocking receivers at microwave and millimeter-wave frequencies. Applications and realizations of these receivers for passive imaging, communications, RADAR, and electronic support in the microwave/millimeter-wave spectrum are presented.		**ThC1.3 9:30 AM–10:00 AM (Invited)** **High-Energy CEP-Stable Few-Cycle Mid-IR Pulses for Generating Attosecond Sub-keV X-Rays** Z. Chang	**ThD1.3 9:15 AM–9:30 AM** **Simultaneous In Situ Monitoring of Axial Stress in Post Tensioned Concrete and Rod Using Fiber Loop Ringdown Sensors** M. Ghimire and C. Wang *Mississippi State University, Mississippi State, MS, USA* In this work, we used two fiber loop ringdown strain sensors for in situ monitoring of the axial stress on a post tension rod and a concrete beam simultaneously during the stressing of the post tension rod embedded into the concrete beam.	**ThE1.3 9:15 AM–9:30 AM** **Laser Micro-Ablated Multi-Point Side-Firing Optical Fiber for Deep-Tissue Light Delivery** H. Nguyen, M. ParvezArnob and W.-C. Shih, *University of Houston, Houston, TX, USA* A compact light delivery device capable of delivering light to multiple desired locations is essential for many biomedical applications. Here, we demonstrate the use of laser micro-ablation to create controllable conical-shaped cavities on optical fiber to enable a multi-point side-firing configuration using a single fiber.

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
8:30 AM–10:00 AM **Session ThF1:** PIC Packaging **Session Chair:** Shigehisa Tanaka, *Oclaro, San Jose, CA, USA*	**8:30 AM–10:00 AM** **Session ThG1:** Strong Nonlinearities Metamaterials, Solids and Applications **Session Chair:** Cord Arnold, *Lundt University, Lund, Sweden*	**8:30 AM–10:00 AM** **Session ThH1:** Free Space Optical Communications **Session Chair:** Rafael Rios Muller, *Nokia Bell Labs*	
ThF1.1 8:30 AM–9:00 AM (Invited) **Optical Pin Arrays for Chip Scale Silicon Photonics Transceiver Packaging** K. Kurata	**ThG1.1 8:30 AM–9:00 AM (Invited)** **Ultrathin Gradient Nonlinear Metasurface with a Giant Nonlinear Response** M. Belkin, *University of Texas, Austin, Austin, TX, USA* I will review our latest results on developing intersubband polaritonic metasurfaces, based on coupling of transitions between electron states in quantum-engineered semiconductor heterostructures with electromagnetic modes in plasmonic nanocavities, for frequency mixing, intensity modulation, and optical power limiting applications in the mid-infrared frequency range.	**ThH1.1 8:30 AM–9:00 AM (Invited)** **Optical Ground Terminals Using Multi-Aperture Digital Coherent Combining** D. J. Geisler, T. M. Yarnall, C. M. Schieler, M. L. Stevens, B. S. Robinson and S. A. Hamilton, *Massachusetts Institute of Technology, Lexington, MA, USA* We discuss an optical ground terminal receiver architecture based on multi-aperture digital coherent combining. Experimental results using four receivers demonstrate lossless coherent combining in the laboratory at power levels below 0.1-photons/bit/receiver, and mitigation of scintillation through a 3.2-km free-space link due to spatial diversity.	
ThF1.2 9:00 AM–9:15 AM **Packaging Silicon Photonics with Polymer Waveguides for 3D Electro-Optical Integration** N. Mangal, *imec, Heverlee, Belgium and imec and Ghent University, Ghent, Belgium,* J. Missinne, G. Van Steenberge, *imec and Ghent University, Ghent, Belgium,* J. Van Campenhout and B. Snyder, *imec, Heverlee, Belgium* We have demonstrated packaging of a silicon photonic chip with polymer multimode waveguides on a package substrate in a face-up electro-optic 3D integration scheme. The optical loss at the die-to-package interface in O-band was measured to be 7.6 dB, which agrees well with simulation.	**ThG1.2 9:00 AM–9:15 AM** **Dispersion of Extremely Nondegenerate Nonlinear Refraction in Semiconductors** P. Zhao, D. J. Hagan and E. W. Van Stryland, *University of Central Florida, Orlando, FL, USA* Dispersion of nondegenerate nonlinear refraction in semiconductors is measured using Beam-Deflection technique. With large nondegeneracy, n_2 is greatly enhanced and exhibits a strong nonlinear dispersion, which rapidly switches sign to negative near the bandgap. Potential applications including nondegenerate all-optical switching and pulse shaping are discussed.	**ThH1.2 9:00 AM–9:15 AM** **10 m Free Space 128 Gbit/s Transmission via Self-Injection Locked Quantum-Dash Laser** M. A. Shemis, *King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia,* E. Alkhazraji, *Jubail Industrial College, Jubail, Saudi Arabia,* A. M. Ragheb, M. Esmail, *KACST-TIC in Radio Frequency and Photonics for the e-Society, Riyadh, Saudi Arabia,* H. Fathallah, *King Saud University, Riyadh, Saudi Arabia and University of Carthage, Tunis, Tunisia,* S. Alshebeili, *KACST-TIC in Radio Frequency and Photonics for the e-Society, Riyadh, Saudi Arabia and King Saud University, Riyadh, Saudi Arabia* and M. Z. M. Khan, *King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia* Self-injection Locking is employed on L-band InAs/InP quantum-dash laser to lock a single Fabry-Perot mode with ~9 dBm power and >30 dB SMSR. Successful 128 Gbit/s DP-QPSK data transmission is demonstrated via this ~1607 nm locked mode over a 10 m indoor FSO channel exhibiting ~–17.5 dBm receiver-sensitivity.	
ThF1.3 9:15 AM–9:30 AM **A Mach-Zehnder Mode Multi/Demultiplexer Based on Si/Silica Hybrid PLC Platform for WDM/MDM Transmission** M. Kudo, S. Ohta, E. Taguchi, T. Fujisawa, *Hokkaido University, Sapporo, Japan,* T. Sakamoto, T. Matsui, K. Tsujikawa, K. Nakajima, *NTT Corporation, Tsukuba, Japan* and K. Saitoh, *Hokkaido University, Sapporo, Japan* A low-loss and low-crosstalk Mach-Zehnder mode/wavelength multi/demultiplexer based on silica-PLC platform is proposed for WDM/MDM transmission. The Mach-Zehnder filter for “mode” and “wavelength” can be constructed by newly designed broadband 3 dB-mode-divider. Furthermore, using Si/silica hybrid platform, footprint of the chip can be drastically reduced.	**ThG1.3 9:15 AM–9:30 AM** **Broadband Wavelength Conversion Based on On-Chip Nonlinear Optical Loop Mirror** Z. Wang, J. Wang, *McGill University, Montreal, QC, Canada,* I. Glesk, *University of Strathclyde, Glasgow, United Kingdom* and L. R. Chen, *McGill University, Montreal, QC, Canada* We demonstrate broadband wavelength conversion of 10 Gb/s RZ-OOK signals using a cross phase modulation based integrated nonlinear optical loop mirror on silicon-on-insulator.	**ThH1.3 9:15 AM–9:30 AM** **Physical-Layer Security in Optical Communications Enabled by Bessel Modes** I. B. Djordjevic, *University of Arizona, Tucson, AZ, USA,* S. Zhang and T. Wang, *NEC Laboratories America, Inc., Princeton, NJ, USA* To address one of key problems for optical communication links, physical layer-security (PLS), Bessel modes are employed in proposed-PLS-scheme, significantly outperforming conventional schemes in secrecy capacity. Simulations indicate that atmospheric turbulence effects can help in improving security under beam-splitting attack.	

Salon I	Salon II	Salon III	Salon VI	Salon VII
			ThD1.4 9:30 AM–10:00 AM (Invited) Multi-Parameter Sensing Using Few-Mode Fibers A. Li, *Futurewei Technologies, Inc. Santa Clara, CA, USA,* B. Y. Kim, *Korea Advanced Institute of Science and Technology, Daejeon, South Korea,* Y. Wang and W. Shieh, *University of Melbourne, Melbourne, VIC, Australia* Few mode fiber (FMF) has attracted significant research interest owing to its unique possibility for exploration in a new dimension. In this paper, we review our recent progress in FMF-based optical sensors for single-(absolute) and multi-parameter sensing.	**ThE1.4 9:30 AM–10:00 AM (Invited) Ensemble Plasmonic Coupling in Disordered Nanoparticle Arrays and Applications in Ultra-Sensitive Biosensing and Super-Resolution Histopathology** W. Shih, *University of Houston, Houston, TX, USA* Plasmonic nanostructures permit light-excited surface plasmon resonance for applications in sensing, imaging, energy and catalysis. Ensemble plasmonic coupling (EPC) occurs when plasmonic NPs within a group interact. In this talk, I will discuss new results of far- and near-field EPC for biomolecular sensing and histopathology.

10:00 AM–10:30 AM – EXHIBITS & COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

IPC CLOSING CEREMONY – 10:30 AM–12:00 PM – SALON IV/V

THE IPC CLOSING CEREMONY WILL BE LIVE-STREAMED

Session Chair: Nikola Alic, *University of California, San Diego, San Diego, CA, USA*

BEST STUDENT PAPER AND POSTER AWARDS
POST-DEADLINE SESSION

Salon VIII	Kahiki / Lily	Poinsettia / Quince	Salon IV
ThF1.4 9:30 AM–10:00 AM (Invited) Hybrid Photonic Multi-Chip Integration Enabled by 3D Nano-Printing C. Koos, *Karlsruhe Institute Technology*	**ThG1.4 9:30 AM–10:00 AM (Invited) Probing Nanomechanical and Optomechanical Nonlinearities with Photonic Devices** P. Barclay, *University of Calgary, Calgary, AB, Canada* Nanophotonic optomechanical devices provide a platform for enhancing the per-photon optical radiation pressure imparted upon nanomechanical structures. This talk discuss observation of large nanomechanical and optomechanical nonlinearities that are revealed using silicon and diamond based cavity and waveguide nano-optomechanical devices.	**ThH1.4 9:30 AM–9:45 AM Optimal Wavelength Selection for Entangled Quantum Key Distribution** J. Gariano, I. Djordjevic, *University of Arizona, Tucson, AZ, USA* and T. Liu, *North China Electric Power University, Baoding, China* We study an entangled QKD system using photons at 780 nm, 1550 nm and 4 μm from a SPDC nonlinear crystal, over a 30 km maritime channel. An analysis of the channel at each wavelength is performed and the QKD system is simulated for each wavelength.	
		ThH1.5 9:45 AM–10:00 AM Analysis of Free-Space Coupling to Photonic Lanterns in the Presence of Tilt Errors T. M. Yarnall, D. J. Geisler, C. M. Schieler, *Massachusetts Institute of Technology, Lexington, MA, USA* and R. B. Yip, *Massachusetts Institue of Technology, Cambridge, MA, USA* Free space coupling to photonic lanterns is more tolerant to tilt errors and F-number mismatch than coupling to single-mode fibers. We analyze the coupling efficiency to singlemode fiber, and 3-mode and 6-mode photonic lanterns in the presence of these errors.	

10:00 AM–10:30 AM – EXHIBITS & COFFEE BREAK – INTERNATIONAL BALLROOM SOUTH

IPC CLOSING CEREMONY – 10:30 AM–12:00 PM – SALON IV/V

THE IPC CLOSING CEREMONY WILL BE LIVE-STREAMED

Session Chair: Nikola Alic, *University of California, San Diego, San Diego, CA, USA*

BEST STUDENT PAPER AND POSTER AWARDS
POST-DEADLINE SESSION

Session WP: Poster Session / Student & Young Professionals Poster Competition and Job Fair
Wednesday, 4 October 2017
6:00 PM–8:00 PM
Room: International Ballroom – Center

Session Chair: Nikola Alic, *University of California, San Diego, San Diego, CA, USA*

WP.1
Concept for a Holographic Particle Counter, G. Brunnhofery, *CTR Carinthian Tech Research AG, Magdalen, Austria and Graz University of Technology, Graz, Austria,* A. Bergmanny, *Graz University of Technology, Graz, Austria* and M. Kraft, *CTR Carinthian Tech Research AG, Magdalen, Austria*

A novel holographic-based sensing system for the determination of aerosol particle number concentrations is presented. A model was designed to support both the development of a new counting algorithm and the conception of a measurement setup.

WP.2
High Linearity of Coupling-Modulated Microring Modulators, P. Rabiei, Partow Technologies LLC, Vista, CA, USA

The frequency response of microring modulators is analyzed using the Jacobi–Anger expansion method. The linearity of coupling-modulated microring (CMMR) modulators is analyzed. It is shown that the CMMR modulators can achieve a spurious-free dynamic range (SFDR) that is much higher than Mach-Zehnder modulators (MZMs).

WP.3
Enhaced Spectrophotometric Measurements for Complex Refractive Index Characterization, F. Pudda, G. Cincotti, E. Frangipani and P. Visca, *University Roma Tre, Rome, Italy*

Real-time image data processing tools are proposed to enhance the spectrophotometric absorbance accuracy, using a three-wavelength LED source. The measurements of the beam spot-size allow us to determine the ray displacement in the liquid cuvette and then the corresponding refractive index.

WP.4
Optimization of Light Trapping Micro-Hole Structure for High-Speed High-Efficiency Silicon Photodiodes, E. P. Devine, *University of California, Davis, Davis, CA, USA and W&WSens Devices, Inc., Los Altos, CA USA,* H. Cansizoglu, Y. Gao, K. G. Polat, S. Ghandiparsi, A. Kaya, H. H. Mamtaz, A. S. Mayet, Y. Wang, X. Zhang, *University of California, Davis, Davis, CA, USA,* T. Yamada, *University of California, Santa Cruz, Santa Cruz, CA, USA and W&WSens Devices, Inc., Los Altos, CA USA,* A. F. Elrefaie, *University of California, Davis, Davis, CA, USA and W&WSens Devices, Inc., Los Altos, CA USA,* S.-Y. Wang, *W&WSens Devices, Inc., Los Altos, CA USA* and M. S. Islam, *University of California, Davis, Davis, CA, USA*

We optimized micro-holes in a thin slab for fast Si photodetectors at wavelength 800–950nm. Lateral modes are shown to be responsible for the effective light trapping. Small disorder and cone hole shapes helped achieve uniform quantum efficiency in a wide wavelength range.

WP.5
Tunable Mid-IR Emission through Four-Wave Mixing in Xe-Filled Hollow-Core Photonic Crystal Fiber, C. Keyser, *Air Force Research Laboratory, Eglin, AFB, FL, USA* and J. Beck, *Michigan Technological University, Houghton, MI, USA*

A tunable mid-IR source based on four-wave mixing in Xe-filled hollow-core photonic crystal fiber is investigated numerically. Tunability from the 1.95 μm pump through the mid-IR is demonstrated. In spite of higher loss, modeling suggests that smaller core fiber improves conversion efficiency.

WP.6
Wavelength-Switchable IF over Fiber Network Under Ultra-Dense WDM Configuration for High-Speed Railway Systems, A. Kanno, P. T. Dat, N. Yamamoto, *National Institute of Information and Communications Technology, Tokyo, Japan* and T. Kawanishi, *National Institute of Information and Communications Technology, Tokyo, Japan and Waseda University, Tokyo, Japan*

Ultra-dense wavelength-division-multiplexing-based intermediate frequency over fiber system based on single-sideband suppressed carrier modulation at 15 GHz is demonstrated with a fast wavelength-tunable laser for tracking the train cars in high-speed train systems by switching the wavelengths.

WP.7

Progress on Wavefront Sensorless Adaptive Optics, D. J. Wahl, C. Huang, M.-J. Ju, *Simon Fraser University, Burnaby, BC, Canada,* R. J. Zawadzki, *University of California, Davis, Davis, CA, USA and University of California Davis, Sacramento, CA, USA,* S. Bonora, *CNR-Institute for Photonics and Nanotechnology, Padova, Italy,* Y. Jian and M. V. Sarunic, *Simon Fraser University, Burnaby, BC, Canada*

Adaptive optics has been applied to retinal imaging in order to resolve the cellular features. We are investigating wavefront sensorless adaptive optics (WSAO) for Optical Coherence Tomography and Scanning Laser Ophthalmoscopy, using the image quality to guide the aberration correction.

WP.8

Label-Free DNA Identification Using Light Scattering from Microbeads and Dielectrophoresis Spectroscopy, *F. D. Gudagunti, L. Velmanickam, D. Nawarathna, I. T. Lima Jr., North Dakota State University, Fargo, ND, USA*

We developed a label-free biosensor based on light scattering from polystyrene beads and dielectrophoresis spectroscopy that can identify single stranded DNA. We have demonstrated this method using DNA strands with 16, 17, and 26 base pairs of nucleotides.

WP.9

Switchable Photonic Components Based on Zenithal-Bistable Nematic Liquid Crystal Gratings, D. C. Zografopoulos, *Istituto per la Microelettronica e Microsistemi (CNR-IMM), Roma, Italy,* E. E. Kriezis, *Aristotle University of Thessaloniki, Thessalonikki, Greece* and R. Beccherelli, *Istituto per la Microelettronica e Microsistemi (CNR-IMM), Roma, Italy*

We demonstrate electro-optically switchable photonic components based on zenithal bistable liquid-crystal gratings that operate as switchable beam splitters, beam steerers, quarter-wave plates, and narrowband guided-mode resonant filters. The switching dynamics of the liquid-crystal orientation, coupled to lightwave propagation, are investigated with a tensorial formulation.

WP.10

Multilevel Optical Data Storage Using Samarium-Doped Matlockite Nanocrystals, N. Riesen, *University of South Australia, Mawson Lakes, Australia and University of Adelaide, Adelaide, Australia,* K. Badek, L. T. Kasim, *University of New South Wales, Canberra, Australia,* Y. Ruan, *University of Adelaide, Adelaide, Australia,* T. M. Monro, *University of South Australia, Mawson Lakes, Australia and University of Adelaide, Adelaide, Australia* and H. Riesen, *University of New South Wales, Canberra, Australia*

We present results demonstrating the prospects of samarium-doped nanocrystals for use in ultra-high capacity multilevel optical data storage. Optical data storage is demonstrated through fluorescence tuning of MeFCl:Sm (Me: Ba, Sr) in the deep UV with a 7 orders of magnitude linear dynamic range.

WP.11

Scene Reconstruction via Coherency Imaging, A. El-Halawany, A. Beckus, H. E. Kondakci, M. Monroe, N. Mohammadian, G. K. Atia and A. F. Abouraddy, *University of Central Florida, Orlando, FL, USA*

We implement numerical back-propagation of the experimentally obtained spatial complex coherence function to estimate both the axial and transverse positions of 1D objects. The measurement of the coherence function of partially coherent light is performed using dynamical double slits implemented via digital micromirror device.

WP.12

Ultra-Broadband All-Optical Wavelength Conversion in Tellurite Waveguides with Engineered Dispersion, J. D. Marconi, *Universidade Federal do ABC, CECSS, anto André, Brazil,* E. A. M. Fagotto, *Pontifícia Universidade Católica de Campinas, Campinas, Brazil* and M. L. F. Abbade, *UNESP-Univesidade Estadual Paulista, São João da Boa Vista, Brazil*

An one-(1P) and a two-pump (2P) four-wave mixing ultra-broadband all-optical wavelength converter (AOWC), based on a tellurite waveguide, are proposed and numerically tested using 56 Gb/s QPSK signals. The 1P- and the 2P-AOWC provide wavelength conversion over a 5.5 and 12 THz band, respectively.

WP.13

A Directly Modulated Distributed Feedback Laser for Millimeter-Wave Signal Generation, P. C. Peng, W. C. Tang, M. A. Bitew, H. W. Gu, B. Y. Guo and R. K. Shiu, *National Taipei University of Technology, Taipei, Taiwan*

In this paper, we proposed and experimentally demonstrated a directly modulated distributed feedback laser to generate microwave or millimeter-wave signals. Experimental results revealed that the proposed scheme can generate a four-fold microwave signal with a frequency varying from 60 to 80 GHz.

WP.14

Wavefront Deformation and Stress in Thin Films by Carrier Frequency Interferometry, E. Jankowska, *Colorado State University, Fort Collins, CO, USA,* S. Drobczynski, *Wrocław University of Technology, Wroclaw, Poland* and C. S. Menoni, *Colorado State University, Fort Collins, CO, USA*

We use carrier frequency interferometry to determine the radius of curvature of amorphous thin films deposited onto thick substrates with high accuracy with a relatively simple setup.

WP.15

All-Fiber OAM Generation/Conversion Using Helically Patterned Photonic Crystal Fiber, M. Seghilani and J. Azana, *Institut National de la Recherche Scientifique–Énergie, Matériaux et Télécommunications (INRS-EMT), Montreal, QC, Canada*

We propose an all-fiber Orbital Angular Momentum (OAM) generator/converter based on photonic crystal fiber designed to introduce a high-accuracy helical effective refractive index profile. The design is compact, presents wideband operation (whole C-band), low loss and high OAM purity.

WP.16

Collisions of Bragg Grating Solitons in a Semilinear Coupler with Cubic-Quintic Nonlinearity, M. J. Islam and J. Atai, *University of Sydney, Sydney, Australia*

The collision dynamics of counterpropagating moving Bragg grating solitons in a semilinear coupler with cubic-quintic nonlinearity are investigated. The effects of soliton velocity, quintic nonlinearity and coupling coefficient on the collision outcomes are studied.

WP.17

Moving Gap Solitons in Dual-Core Systems with Separated Nonuniform Bragg Grating and Nonlinearity, T. Ahmed and J. Atai, *University of Sydney, Sydney, Australia*

We investigate the existence and stability of moving gap solitons in a dual core system where one core has only Kerr nonlinearity and the other one is linear and has a Bragg grating with dispersive reflectivity.

WP.18

Diffraction-Free Space-Time Pulsed Light Sheets with Arbitrary Beam Profile, *H. E. Kondakci and A. F. Abouraddyy, University of Central Florida, Orlando, FL, USA*

We experimentally demonstrate one-dimensional diffraction-free pulsed light sheets created via highly correlated spatio-temporal spectra produced using a two-dimensional pulse shaper. The beam profile with arbitrary shape can be synthesized at the pulse center by phase and amplitude spectral modulation.

WP.19

Modal Analysis via Compressive Optical Interferometry, D. Mardani, H. E. Kondakci, L. Martin, A. F. Abouraddy and G. K. Atia, *University of Central Florida, Orlando, FL, USA*

We propose a compressive approach to optical mode analysis of a light beam in an arbitrary basis from a small set of interferogram samples. This yields significant reduction in acquisition time and reconstruction complexity without modifying the native optical interferometer or introducing additional hardware components.

WP.20

Modal Gain Investigation on the GaAs-Based InAs/InGaAs Quantum Dot Mode-Locked Laser, X. Li, H. Wang, Z. L. Qiao, X. Guo, K. S. Ang and C. Y. Liu, *Nanyang Technological University, Singapore*

InAs/InGaAs quantum dot mode-locked lasers are fabricated and characterized. The modal gain as the saturable absorber voltage (SAV) changes is investigated. The ground state lasing dominates at low SAV, and excited state transition emerges when SAV increases.

WP.21

Ideality Factor of 2 µm InGaSb/AlGaAsSb Quantum Well Lasers, X. Li, H. Wang, Z. L. Qiao, X. Guo, *Nanyang Technological University, Singapore,* Y. P. Liao, Y. Zhang, Y. Q. Xu, Z. C. Niu, *Chinese Academy of Sciences, Beijing, China,* C. Z. Tong, *Chinese Academy of Sciences, Changchun, China* and C. Y. Liu, *Nanyang Technological University, Singapore*

The ideality factor of a 2 µm InGaSb/AlGaAsSb quantum well laser is investigated. The total ideality factor comes mainly from the central p-n junction and two metal-semiconductor junctions. It decreases from 4.0 to 3.3 when the temperature is increased from 20 to 80 °C.

WP.22

Active Plasmonic Nanospirals, C. Pelzman and S.-Y. Cho, *New Mexico State University, Las Cruces, NM, USA*

We report on the experimental demonstration of active Archimedean nanospirals that exhibit unique far-field patterns from the interaction of locally excited surface plasmon waves with an active medium. The captured far-field images show complicated internal mode structures such as plasmonic vortex-like modes.

WP.23

Deformable Plasmonic Metamembrane, C. Pelzman and S.-Y. Cho, *New Mexico State University, Las Cruces, NM, USA*

In this presentation, we report on the experimental demonstration of a new class of metasurfaces, plasmonic metamembranes. Compared to conventional plasmonic metasurfaces, the demonstrated metamembrane has a mechanically flexible structure offering new designs and operation of plasmonic metasurfaces.

WP.24

Flexible Visible Photonic Crystal Laser Cavity, J. Zhou, *Peking University, Shenzhen, China,* T. Zhou, J. Li, K. He and Z. Zhang, *Chinese University of Hong Kong, Shenzhen, China*

The authors propose a L3 defect photonic crystal nanolaser embedded in flexible medium for nanoscale strain detections. A theoretical optical strain sensitivity of ~4 nm per ε (1% strain) in the x-direction and ~3 nm per ε (1% strain) in the y-direction is predicted.

WP.25

Photonic Compressed Sensing Nyquist Folding Receiver, R. N. Shmel and P. Pace, *Naval Postgraduate School, Monterey, CA, USA*

We demonstrate how integrated photonic components can be used to generate frequency modulated optical pulses below the Nyquist criteria in order to compress a wideband radio frequency environment for sampling. The compressed signals can be analyzed and extracted using digital signal processing techniques.

WP.26

High Performance InP-Based Ridge-Waveguide Distributed Feedback Lasers with InGaAs Multi-Quantum Wells Emitting at 2004 nm, F. Xu and T. Yang, *Chinese Academy of Sciences, Beijing, China and University of Chinese Academy of Sciences, Beijing, China*

We report on the fabrication and characterization of high performance InP-based ridge-waveguide distributed feedback lasers with InGaAs multi-quantum wells emitting at 2004 nm. By means of a relatively simple fabrication process, the device can operate stably with good performance.

WP.27

High Spatial Quality Beams from PT-Axisymmetric Lasers,
W. W. Ahmed, M. Botey, R. Herrero, *Universitat Politècnica de Catalunya (UPC), Barcelona, Spain* and K. Staliunas, *Universitat Politècnica de Catalunya (UPC), Barcelona, Spain and Institució Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Spain*

We propose PT-axisymmetric potentials including a linear central defect for field localization and enhancement in laser systems, particularly VCSELs, to observe narrow and high spatial quality output beams. The results show significant enhancement in output intensity as compared to saturated laser intensity.

WP.28

Extremely Large Mode-Area Compact Hybrid Multi-Trench Fiber with Controlled Leakage Loss,
B. M. Kurade, N. Prasad, G. T. Raja, *National Institute of Technology, Tamilnadu, India* and S. K. Varshney, *Indian Institute of Technology Kharagpur, India*

We propose an extremely large mode-area compact hybrid multi-trench fiber with ~40 μm core at 1064 nm. High-index arc in trench helps to achieve mode-area of 1300 μm^2 at a practical bending radius of 7.5 cm. Resonant rings and trench gaps maintain effectively single-mode operation and bending loss constraints.

WP.29

Higher Order Micro Transmission Grating Fabrication Inside Quartz Glass by Femtosecond Laser Micromachining, Sanyogita, A. Ghar, U. Das and P. K. Panigrahi, *Indian Institute of Technology Kanpur (UP), Pradesh, India*

We report fabrication of volume grating inside the quartz glass sample using femtosecond direct writing technique with 7 μm grating period. The maximum diffraction efficiency with change in refractive index ~10^{-4} was examined to be 69.69 % for 632.8 nm.

WP.30

Modeling-Guided Design of Pixel Avalanche Structures, N. D'Ascenzo, V. Saveliev, Q. Xie and Z. Xi, *Huazhong University of Science and Technology, Wuhan, China*

We report a mathematical model for the characterization of pixel avalanche structures. Through experimental studies we show that the proposed simulation framework can be used as a solid guidance for the choice of the technological parameters in the R& D of modern avalanche structures.

WP.31

A Vertically-Stacked Anti-Polar Diode (VAD) Pixel for Organic Semiconductor Image Sensors, J. Kassel, Z. Ma and C. K. Renshaw, *University of Central Florida, Orlando, FL, USA*

A novel pixel structure is demonstrated to provide simple patterning for switchable 2-terminal devices with almost 100% fill factor. A blocking diode is grown directly on top of an organic photodiode to provide a vertically stacked structure that can easily be integrated in series.

WP.32

All-Optical Modulation of Ultrasharp Lattice Plasmons, *M. Taghinejad and W. Cai, Georgia Institute of Technology, Atlanta, GA, USA*

A sub-picosecond all-optical plasmonic modulator is demonstrated by leveraging ultrafast injection dynamics of hot-electrons at the interface of gold/ITO, incorporated into a metamaterial absorber. Accurate control over modulation depth and modulation wavelength is achievable in the proposed design.

WP.33

Efficient Single-Mode Waveguide Coupling of Electrically Injected Optical Antenna Based nanoLED, N. M. Andrade, S. A. Fortuna, K. Han, S. Hooten, E. Yablonovitch and M. C. Wu, *University of California, Berkeley, Berkeley, CA, USA*

We propose a novel structure to efficiently couple the output of electrically injected slot antenna-based nanoLED into a single mode waveguide. 3D FDTD simulations show it is possible to achieve 85% waveguide-coupling efficiency with a 250 nm 3 dB bandwidth.

WP.34

Extending the Direct Modulation Bandwidth by Mutual Injection Locking in Integrated Coupled DFB Lasers, Y. Mao, *Chinese Academy of Sciences, Beijing, China and University of Chinese Academy of Science, Beijing, China,* Z. Ren, R. Zhang, *Chinese Academy of Sciences, Beijing, China,* H. Wang, *Chinese Academy of Sciences, Beijing, China and University of Chinese Academy of Science, Beijing, China,* Y. Huang, C. Ji, *Chinese Academy of Sciences, Beijing, China,* Q. Kan and W. Wang, *Chinese Academy of Sciences, Beijing, China and University of Chinese Academy of Science, Beijing, China*

We demonstrate the modulation bandwidth enhancement in integrated coupled DFB lasers. The coupling strength of the dual DFB is tunable duo to a SOA sandwiching in the center. The 3-dB bandwidth is increased from 8.6 GHz to 18.7 GHz under mutual injection locking.

WP.35

Ultrafast Direct Measurement of HBT Effect Between Different Modes by Two-Photon Absorption, B. Bai, H. Chen, J. Liu, H. Zheng, Z. Xu and Y. Zhou, *Xi'an Jiaotong University, Xi'an, China*

HBT effect of thermal light between different modes based on multi-mode interference is directly observed in a modified Michelson interferometer with orthogonal polarizations by a two-photon absorption detector at ultrashort timescale, which serves as a new unique tool for ultrafast quantum bunching distribution.

WP.36

Improving the Performance of Narrow Linewidth Semiconductor Laser through Self-Injection Locking, Z. Li, D. Lu, Y. He, J. Wang, *Chinese Academy of Science, Beijing, China and University of Chinese Academy of Sciences, Beijing, China,* X. Zhou, *Chinese Academy of Science, Beijing, China* and J. Pan, *Chinese Academy of Science, Beijing, China and University of Chinese Academy of Sciences, Beijing, China*

The performance of a narrow linewidth external cavity semiconductor laser was improved in terms of linewidth and working range by using a self-injection scheme. A linewidth narrowing by a factor of 8~22 and a working range improvement by a factor of 1.33 were demonstrated.

WP.37

Fabrication for 3-Dimensionally Shuffled Polymer Waveguide with GI Circular Core Using the Mosquito Method, O. F. Rasel and T. Ishigureb, *Keio University, Yokohama, Japan*

We fabricate 3-dimensional shuffling structure in multimode polymer waveguide with graded-index (GI) circular core for optical printed circuit board (OPCB) using the Mosquito method. The waveguide aligned with a 250-μm inter-channel pitch contains vertically bent structures to achieve greater wiring density for on-board optical interconnects.

WP.38

Design and Fabrication of a Bi-Directional Mode-Division Multiplexer (BMDM) for Optical Interconnects, O. M. Nawwar, H. M. H. Shalaby, *Egypt-Japan University of Science and Technology (E-JUST), Alexandria, Egypt and Alexandria University, Alexandria, Egypt* and R. K. Pokharelk, *Kyushu University, Fukuoka, Japan*

A bi-directional mode-division multiplexer (BMDM) based on strip waveguides is presented. The device is fabricated and tested to prove the concept. Insertion losses less than –3:5 dB with crosstalks less than –15 dB are measured for all multiplexed modes at 1550 nm.

WP.39

Transfer of Complex Spatial Coherence Function in Reflection from Inhomogeneous Scattering Media, M. Baterseh, Z. Shen, R. R. Naraghi, H. Gemar, S. Sukhov and A. Dogariu, *University of Central Florida, Orlando, FL, USA*

We investigate both experimentally and numerically the transformation of spatial coherence function (SCF) during reflection from a scattering medium. We demonstrate that the information about SCF of the incident field survives scattering at grazing angles of incidence and for angularly detuned observation direction.

WP.40

Wide-Field Interferometric Measurements of Nonstationary Complex Coherence Function, H. Gemar, R. R. Naraghi, M. Baterseh, S. Sukhov and A. Dogariu, *University of Central Florida, Orlando, FL, USA*

We demonstrate an optimized two-step procedure for measuring the full complex coherence function. The measurement relies on a wavefront shearing interferometer that permits characterizing nonstationary fields over an extended angular domain. The accuracy of the coherence measurement was demonstrated by excellent agreement with theoretical predictions.

WP.41

Spectral Plasmonic Lensing of an Array of Metallic Nanoslits, M. Shayegannia, Z. Léger, N. Kazemi-Zanjani and N. P. Kherani, *University of Toronto, Toronto, ON, Canada*

We utilized a Monte Carlo optimization algorithm on an array of metallic nanoslits of uniform width to maximize the normalized electric field at a focal point. The results indicate optimal hyperspectral focusing of light in the far-field.

WP.42

A Multi-Frequency Optoelectronic Oscillator Based on a Dual-Output Mach-Zender Modulator and Stimulated Brillouin Scattering, F. Fan, J. Hu, W. Zhu, Y. Gu, and M. Zhao, *Dalian University of Technology, Dalian, China*

A multi-frequency optoelectronic oscillator (MF-OEO) is proposed. The MF-OEO simultaneously implements two tunable oscillation frequencies of microwave signal from 1 GHz to 16 GHz. The phase noises at 10 kHz frequency offset are –92.32 dBc/Hz and –90.75 dBc/Hz for 10 and 15 GHz signals.

WP.43

Self-Injection Locked Quantum-Dash Multi-Wavelength Laser, M. A. Shemis, *King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia,* E. Alkhazraji, *Jubail Industrial College, Jubail, Saudi Arabia,* M. T. A. Khan, *King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia,* A. M. Ragheb, *KACST-TIC in Radio Frequency and Photonics for the e-Society, Riyadh, Saudi Arabia,* H. Fathallah, *King Saud University, Riyadh, Saudi Arabia and University of Carthage, Tunis, Tunisia,* S. Alshebeili, *KACST-TIC in Radio Frequency and Photonics for the e-Society, Riyadh, Saudi Arabia and King Saud University, Riyadh, Saudi Arabia* and M. Z. M. Khan, *King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia*

InAs/InP quantum-dash multi-wavelength laser is reported utilizing self-injection locking coherency boosting technique. Subcarrier controllability between 1–16 Fabry-Perot modes (1600–1610nm) with ~-3–9dBm mode power is achieved. Thereafter, a successful 64 Gbit/s DP-QPSK data transmission is demonstrated via a single self-injection locked mode over 20km single-mode-fiber.

WP.44

An Iterative Reconstruction Algorithm for Optical Diffraction Tomography, S. Fan, S. Smith-Dryden, G. Li and B. E. A. Saleh, *University of Central Florida, Orlando, FL, USA*

An iterative algorithm is presented for optical diffraction tomography beyond the validity of filtered backprojection or backpropagation algorithms. This algorithm is numerically demonstrated to reduce the normalized root-mean-squared error (NRMS) in refractive index of the reconstructed object by a factor of four.

WP.45

Detection System for Point-Of-Care Multiplexed Bead-Based Immunoassays, K. de Haan, J. Dou and J. S. Aitchison, *University of Toronto, Toronto, ON, Canada*

We demonstrate a bead based assay which can detect the presence of an analyte in a small sample using a microfluidic cartridge. The fluorescence emitted by the beads and fluorophores bound to the beads is used to detect the presence of C-reactive protein.

WP.46

Implementation of OCDMA Using Nested Ring Resonators, M A. Elrabiaey, Alexandria University, Alexandria, Egypt and Zewail City of Science and Technology, Giza, Egypt, Z. A. El-Sahn, H. M. H. Shalaby and E.-S. A. Youssef, Alexandria University, Alexandria, Egypt

We present an implementation of an optical code division multiple access (OCDMA) encoder using compact nested two-ring-resonators filter. The encoder is based on silicon on insulator (SOI) technology to filter three wavelengths. The proposed implantation footprint has a 30% reduction of those using cascaded-ring-resonators filters.