Coherent Optical Technologies and Applications (COTA)

Topical Meeting and Tabletop Exhibit

Collocated with:
Slow and Fast Light (SL)
Integrated Photonics and Nanophotonics Research and Applications (IPNRA)
Quantum Entanglement and Decoherence: 3rd International Conference on Quantum Information (ICQI)

July 13-16, 2008

Boston Marriott Copley Place Hotel
Boston, Massachusetts, USA

Submission Deadline Extended: March 10, 2008 (12:00 p.m. noon EDT; 16.00 GMT)
Hotel Reservation Deadline: June 11, 2008
Pre-Registration Deadline: June 26, 2008

General Chairs
Guifang Li, *CREOL, USA*
Stojan Radic, *Univ. of California at San Diego, USA*

Program Chairs
Steve Pappert, *DARPA, USA*
Alan Willner, *Univ. of Southern California, USA*

Due to increasing delays in securing visas to the US, we strongly encourage international attendees to begin this process as early as possible (but no later than three months before the meeting) to ensure timely processing. Please refer to the Letters of Invitation section of this website for additional information.

View the Meeting Archives for COTA 2006 highlights.

Summer Optics and Photonics Congress

Join your colleagues July 13-16 in Boston, Massachusetts!

Collocated Topical Meetings

Coherent Optical Technologies and Applications (COTA)	Register Now
Integrated Photonics and Nanophotonics Research and Applications (IPNRA)	Register Now
Slow and Fast Light (SL)	Register Now
Quantum Entanglement and Decoherence: 3rd International Conference on Quantum Information (ICQI)	Register Now

Dates and Location	Important Deadlines
July 13-16, 2008 Boston Marriott Copley Place Hotel Boston, Massachusetts, USA	Submission Deadline Extended: March 10, 2008 (12:00 p.m. noon EDT; 16.00 GMT) Hotel Reservation Deadline: June 11, 2008 Pre-Registration Deadline: June 26, 2008

To find out more about how to exhibit at one of these meetings, please contact Anne Jones at 202.416.1942 or email ajones@osa.org. Reserve your exhibit space today!

Exhibitor

Discovery Semiconductor, Inc.
IPG Photonics
Optiwave
Photon Design
Photonics Spectra

Topics to be Discussed

COTA Topics

- Sources (i.e., high-power, narrow linewidth, phase-locked, stable, tunable)
- Phase preservation over temporal/spectral domains
- Receiver design
- Signal-detection techniques
- Phase locking techniques
- Phase estimation
- Phase, frequency and polarization modulators
- Phase-sensitive amplifiers
- Polarization management
- Data modulation formats/signaling/protocols
- Phase-sensitive systems

SL Topics

- **Physics of Light Control:**
  - Electromagnetically induced transparency
  - Coherent population oscillations
  - Four-wave mixing and parametric processes
  - Absorption or gain saturation
  - Stimulated Brillouin and Raman scattering
  - Passive and active manipulation in periodic structures and resonators
  - New schemes and physical effects
- **Materials and Engineered Structures for Light Control:**

- Free-space (spaceborne/airborne) communications
- Optical fiber communication systems and networks
- Analog links
- Secure communications
- Remote sensing
- Synthetic aperture Lidar/Ladar
- Fiber sensors
- Microsensing in spectroscopic applications
- Biosensing
- Statistical and cellular nature of biosensors
- Optical signal processing
- Arbitrary waveform generation and filtering
- A/D conversion
- Optical correlation
- Wavelength conversion

IPRNA Topics

- **Active Devices:** III-V semiconductor devices; silicon active devices; **LiNbO3 and other metal-oxide-based devices;** modulators; switches; wavelength converters; emitters; VCSELs; amplifiers; integrated scanners; quantum optoelectronic devices; complex circuits; new fabrication methods; materials and processing; reliability advances and issues.
- **Passive Devices and Integration: Dielectric, polymer, or semiconductor waveguide devices;** Integrated planar waveguides; active/passive integrated components; switches; variable optical attenuators; filters; resonators; integrated isolators and circulators; planar dispersion compensators; micro-optic components; optical interconnects; hybrid integration; reliability advances and issues; novel assembly and manufacturing techniques; emerging packaging technologies; testing and characterization; materials and fabrication technologies.

    - Metamaterials, including plasmonic structures
    - Photonic crystal waveguides and periodic structures
    - Optical fibers including holey fibers
    - Semiconductor nanostructures, including quantum wells and quantum dots
    - Saturable optical amplifiers and absorbers
    - BEC and hot vapor cells
    - Crystals and other solid-state materials
    - New materials and structures
- **Applications:**
    - Optical communications; all-optical buffers, routers, etc.
    - Microwave photonics; microwave filters and phased array systems
    - Sampling systems
    - Enhanced optical nonlinear response
    - Sensors and improved measurement systems
    - Figures-of-merit and fundamental limitations
    - New applications
- **Physics of Light Control:**
    - Electromagnetically induced transparency
    - Coherent population oscillations
    - Four-wave mixing and parametric processes
    - Absorption or gain saturation
    - Stimulated Brillouin and Raman scattering
    - Passive and active manipulation in periodic structures and resonators
    - New schemes and physical effects
- **Materials and Engineered Structures for Light Control:**
    - Metamaterials, including plasmonic structures
    - Photonic crystal waveguides and periodic structures
    - Optical fibers including holey fibers
    - Semiconductor nanostructures, including quantum wells and quantum dots
    - Saturable optical amplifiers and

- **Modeling, Numerical Simulation and Theory:** Optical-system modeling; numerical and semi-analytical methods for guided-wave optics; active, passive and nonlinear component modeling; WDM component design; simulation and modeling of photonic crystal, microcavity, and other high confinement structures; simulation and modeling of metallic and metallodielectric waveguides; advances in computational algorithms, physics and coupled models for integrated photonic circuits.
- **Nanophotonics:** Microcavity and other high confinement structures; photonic crystal waveguides and devices; photonic crystal fiber; **nano-engineered devices;** metallic and metallodielectric waveguide devices;resonators; filters; modulators; add-drop integrated optical circuits; light sources; quantum information; nano-MEMS; biophotonics; biological and chemical transducers and sensors; efficient mode matching; nanofabrication technology; growth and deposition approaches; self-organized methods; characterization tools on the nanoscale; **and nanoscale integration of planar, free-space, and mixed subsystems.**
- **Inhomogeneous Materials (e.g., Composite Dielectrics, Semiconductors, Metals and Metallodielectrics):** Anisotropic; dispersive; efficient light extraction; nonlinear optical materials; and dynamically configurable.

absorbers
    - BEC and hot vapor cells
    - Crystals and other solid-state materials
    - New materials and structures
- **Applications:**
    - Optical communications; all-optical buffers, routers, etc.
    - Microwave photonics; microwave filters and phased array systems
    - Sampling systems
    - Enhanced optical nonlinear response
    - Sensors and improved measurement systems
    - Figures-of-merit and fundamental limitations
    - New applications
- **Implementation Techniques:**
    - Experimental techniques
    - Theoretical techniques
    - Effective numerical simulation techniques
    - Experimental techniques
    - Theoretical techniques
    - Effective numerical simulation techniques

ICQI Topics

- Entanglement
- Decoherence
- Quantum imaging and lithography
- Quantum communication and cryptography, quantum channels, repeaters
- Algorithms, walks on graphs, spin chains, phase transitions, chaos and localization
- Emerging topics: cluster states, adiabatic quantum computing, topological quantum computing
- Optical and other implementations (linear optics, cavity QED, ion traps, solid state, etc.)
- Quantum state reconstruction, superresolution, metrology
- Storage and transfer of quantum information

About COTA

July 13-16, 2008

Detecting slight changes in the phase of the high-frequency optical wave provides a superb opportunity to dramatically enhance performance for a host of applications. Given the rapid advance of phase-based optical technologies, there have been significant recent advances in coherent devices, subsystems and systems, and this topical meeting will build on the excitement begun by the first COTA that was held in 2006.

COTA 2008 will provide a forum for discussing the most up-to-date science and engineering of encoding, manipulating and detecting the phase, polarization and frequency of an optical wave. Moreover, we will highlight various applications that are critically impacted by fundamental and technological breakthroughs in coherent optics.
This meeting is meant to be inter-disciplinary, covering communications, imaging, sensing and signal processing.

Important Dates

Submission Deadline: March 3, 2008 (12:00 p.m. noon EST; 17.00 GMT)
Hotel Reservation Deadline: June 11, 2008
Pre-Registration Deadline: June 26, 2008

Meeting Topics

Specific coherent optical device, subsystem and system topics could include:

- Sources (i.e., high-power, narrow linewidth, phase-locked, stable, tunable)
- Phase preservation over temporal/spectral domains
- Receiver design
- Signal-detection techniques
- Phase locking techniques
- Phase estimation
- Phase, frequency and polarization modulators
- Phase-sensitive amplifiers
- Polarization management
- Data modulation formats/signaling/protocols
- Phase-sensitive systems
- Free-space (spaceborne/airborne) communications
- Optical fiber communication systems and networks
- Analog links
- Secure communications
- Remote sensing
- Synthetic aperture Lidar/Ladar
- Fiber sensors
- Microsensing in spectroscopic applications
- Biosensing
- Statistical and cellular nature of biosensors
- Optical signal processing
- Arbitrary waveform generation and filtering
- A/D conversion
- Optical correlation
- Wavelength conversion

Technical Program Committee

General Chairs

Guifang Li, *CREOL, USA*
Stojan Radic, *Univ. of California at San Diego, USA*

Program Chairs

Steve Pappert, *DARPA, USA*
Alan Willner, *Univ. of Southern California, USA*

Committee

Young-Kai Chen, *Alcatel-Lucent, USA*
Zhongping Chen, *Univ. of California at Irvine, USA*
Pak S. Cho, *CeLight, USA*
Aristide Dogariu, *CREOL & FPCE/College of Optics and Photonics, Univ. of Central Florida, USA*
Daniel Dolfi, *Thales Res. and Technology, France*
Frank Hanson, *SPAWAR Systems Ctr. San Diego, USA*
Richard M. Heinrichs, *MIT Lincoln Lab, USA*
Hamid Hemmati, *Jet Propulsion Lab, USA*
Paul Juodawlkis, *MIT Lincoln Labs, USA*
Ricky Keang-Po Ho, *SiBEAM, Taiwan*
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Dennis K. Killinger, *Univ. of South Florida, USA*
Juerg Leuthold, *Univ. of Karlsruhe, Germany*
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Bryan Stossel, *Lockheed Martin, USA*

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Discovery Semiconductors, Inc. is an industry leader in manufacturing ultrafast, high optical power handling InGaAs photodetectors, RF over fiber optical receivers, balanced optical receivers and several custom products for applications ranging from analog RF links to ultrafast digital communications. Discovery's instrumentation includes their Lab Buddy and Optical Coherent Receiver System. Contact: Jay Magbitang.

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IPG manufactures fiber lasers and amplifiers for 1.0, 1.5 and 2.0 microns wavelengths. Output powers are from 100mWs to 50kW and available for CW or pulsed operation. For scientific applications linearly polarized and kHz linewidths products are available; for optical trapping, frequency doubling, free space communications. Industrial applications we provide diode Q-switched, and high power CW lasers; marking, welding, micro machining. Telecommunications we offer Raman and Erbium lasers and amplifiers; FTTH, CATV, ultra long haul. Contact Diana Ferreira, Sales. Tel: +1 508.373.1169, Fax: +1 508.373.1103. dferreira@ipgphotonics.com.

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Photon Design, founded 1992, provides a wide range of photonics software for integrated and fibre-based component design. Products include FIMMPROP–our revolutionary bi-directional optical propagation tool, FIMMWAVE – our famous mode solver, PICWave - our new active/passive photonic-IC circuit simulator, CrystalWave–photonic crystal simulator, OmniSim–general purpose 3D FDTD simulator.

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Photonics Spectra is the leading photonics magazine serving industries that use photonic technology: lasers, imaging, fiber optics, optics, electro-optics, and photonic component manufacturing. It presents the latest news articles and in-depth reports on photonics technology. It is distributed free to those who use or apply photonics.

The Organizers for the Summer Optics and Photonics Congress

wish to thank the following US Government Agencies

for their generous contributions:

COTA

Air Force Office of Scientific Research

ICQI

Air Force Office of Scientific Research

IPNRA

Defense Advanced Research Projects Agency/

Army Research Laboratory

SL

Air Force Office of Scientific Research

Special Events

Joint Plenary Sessions

Monday, July 14
8:00 a.m.–10:00 a.m.
Salon E

Photonic Entanglement in Quantum Communication and Quantum Computation
Anton Zeilinger, Univ. of Vienna, Austria
In the 1970s Anton Zeilinger started his work on the foundations of quantum mechanics with neutron interferometry. These experiments included confirmation of the sign change of a spinor phase upon rotation, precision tests of the linearity of the Schrödinger equation, and many other fundamental tests.

Going beyond single-particle phenomena, Zeilinger became interested in quantum entanglement, where his most significant contribution is the discovery of what is today called "GHZ states" and their experimental realization. These were the first instances of multi-particle entanglement ever investigated. Such states have become essential in fundamental tests of quantum mechanics and in quantum information science. Since then, Zeilinger has performed many experiments with entangled photons, including quantum teleportation, quantum cryptography, all-optical one-way quantum computation and a number of quantum gates. In single-particle interference, he has performed a number of experiments in atom interferometry and in quantum interference of large molecules, like C60 and C70. These included very detailed studies of quantum decoherence. The technological progress in all these fields is making new fundamental tests possible. Most recently, Zeilinger became interested in tests of Leggett-type nonlocal theories and in fundamental phenomena in quantum entanglement of ultracold atoms, to name two examples.

The most important stages in the career of Anton Zeilinger include the Technical University of Vienna, MIT, the Technical University of Munich, the University of Innsbruck, the Collège de France, the University of Vienna and the Austrian Academy of Sciences.

The Intimate Merger of Photonics and Computing
Ashok V. Krishnamoorthy, SUN Microsystems, USA
Ashok V. Krishnamoorthy currently serves as Distinguished Engineer and Senior Director with the Sun Microsystems Microelectronics Physical Sciences Center in San Diego, California. He leads Sun's photonics technology development effort and is the principal investigator on their DARPA UNIC program. Prior to this he was with AraLight as its President and CTO as part of a Lucent spinout, where he was responsible for leading product design and development for AraLight's optical interconnect products. He has also served as entrepreneur-in-residence at Lucent's New Venture group, and as a member of technical staff in the Advanced Photonics Research Department of Bell Labs where he investigated methods of integrating optical devices to Silicon VLSI circuits. He received the B.S. in engineering (Honors) from the California Institute of Technology, the M.S. in electrical engineering from the University of Southern California, and the Ph.D. in applied physics from the University of California at San Diego.

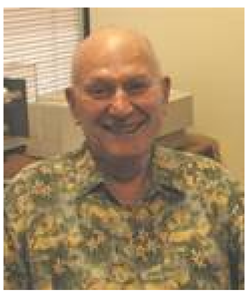
Dr. Krishnamoorthy serves on the technical advisory board for several optical technology start-ups and venture funds, and as a distinguished lecturer for IEEE/LEOS. He holds 40 patents and has contributed 150 technical publications, five book chapters and presented over 45 invited talks at international technical conferences. For his contributions to optoelectronics, and his service to technical societies, the Eta Kappa Nu society named him an outstanding young electrical engineer in 1999. He was awarded the 2004 international prize in optics by the ICO for his technical contributions to optics. He has also won several team awards, including Computerworld's 2005 horizon award for innovation. Most recently, he received the 2006 chairman's award for innovation by Sun Microsystems for his work on silicon optical interconnects for computing systems.

Tuesday, July 15
8:00 a.m.–10:00 a.m.

Salon E

Electro-Optic Modulation of Photons and Biphotons
Stephen E. Harris, Stanford Univ., USA.
Professor Stephen E. Harris received his B.S. in electrical engineering from Rensselaer Polytechnic Institute in 1959. In 1963 he became a member of the Stanford University faculty where he is now the Kenneth and Barbara Oshman Professor of Engineering with appointments in electrical engineering and applied physics. Professor Harris has advised about 60 Ph.D. students and is known for contributions to quantum optics, nonlinear optics and laser science.

Entanglement, Information Processing and Decoherence in Trapped Atomic Ions
David Wineland, NIST, USA
David Wineland received a bachelor's degree from the University of California at Berkeley in 1965 and his Ph.D. from Harvard University in 1970. After a postdoctoral appointment at the University of Washington, he joined NBS (now NIST), where he is the leader of the Ion-Storage Group (http://www.bldrdoc.gov/timefreq/ion) in the Time and Frequency Division at Boulder. The group's research has focused on laser cooling and spectroscopy of trapped atomic ions with applications to atomic clocks, quantum-limited metrology and quantum state control.



Coherence Cloning and Phase Controlled Apertures Using Optical Phase-Lock Loops
Amnon Yariv, Caltech, USA
Amnon Yariv is the Martin and Eileen Summerfield Professor of Applied Physics and Electrical Engineering at Caltech. He obtained the B.S. (1954), M.S. (1956) and Ph.D. (1958) in electrical engineering from the University of California at Berkeley. He went to Bell Telephone Laboratories, Murray Hill, New Jersey in 1959, joining the early stages of the laser effort. He came to the California Institute of Technology in 1964.

On the technical and scientific side, he took part (with various co-workers) in the discovery of a number of early solid-state laser systems, in proposing and demonstrating the field of semiconductor integrated optics, the suggestion and demonstration of the semiconductor distributed feedback laser and in co-pioneering the field of phase conjugate optics. His present research efforts are in the areas of nonlinear optics, semiconductor lasers and integrated optics with emphasis on communication and computation.

Dr. Yariv is a member of the American Physical Society, Phi Beta Kappa, the American Academy of Arts and Sciences, the National Academy of Engineering, the National Academy of Sciences, a Fellow of the Institute of Electrical and Electronics Engineers and the Optical Society of America. He was the recipient of the 1980 Quantum Electronics Award of the IEEE, the 1985 University of Pennsylvania Pender Award, the 1986 Optical Society of America Ives Medal, the 1992 Harvey Prize, the 1998 OSA Beller Medal, an honorary doctorate, December 2000 from Ben Gurion University of the Negev, Israel and received a Laurea Honoris Causa, September 2007 from Universitá degli Studi dell'Aquila. Dr. Yariv was a founder and chairman-of-the-board of ORTEL Corporation (acquired by Lucent Technologies in 1998), and is a founder and a board member of a number of startup companies in the optical communications field.

Joint Poster Session

Monday, July 14
6:30 p.m.–8:00 p.m.
Salon F
A total of 79 posters will be presented during the joint poster session.

Congress Reception

Tuesday, July 15
6:30 p.m.–8:00 p.m.
Salon F
Join your colleagues for a joint reception to include attendees of all four meetings. Hors d'oeuvres, beer and wine will be served.

IPNRA Special Session and Roundtable Discussion

ITuE • Computer Aided Design for Integrated and Nano Photonics
Tuesday, July 15
4:30 p.m.–6:30 p.m.
Salon A/B

A special session for photonic commercial software developers, followed by a roundtable discussion is planned as part of IPNRA and all congress registrants are welcome to attend. The main photonic software companies such as RSoft, Optiwave, Photon Design and JCMWave will be represented. Topics to be discussed include:

- Technical challenges
- Assessment and validation of algorithms/software (standardization/normalization)
- Convergence of technologies (wireless-photonics, displays-photonics, etc.)

The session will conclude with a roundtable discussion focusing on additional non-technical aspects such as:

- Interaction with academy
- Job opportunities
- Vision of the market

Invited presentations:

Addressing Photonic Applications via a Broad Range of Integrated Simulation Methods, *Robert Scarmozzino, E. Heller, M. Bahl; RSoft Design Group, Inc., USA*

Designing Active Photonic Integrated Circuits Using TDTW, *Dominic F. Gallagher; Photon Design, UK*

Multi-Disciplinary Simulation of Electro-Opto-Thermal Networks Using a SPICE-Like Framework, *Pavan Gunupudi1, Tom Smy1, Jackson Klein2, Jan Jakubczyk2; 1Carleton Univ., Canada, 2Optiwave Systems, Canada*

JCMsuite: An Adaptive FEM Solver or Precise Simulations in Nano-Optics, *Sven Burger, Lin Zschiedrich, Jan Pomplun, Frank Schmidt; JCMwave, Germany*

COTA Plenary and Invited Speakers

Plenary Speaker

Coherence Cloning and Phase Controlled Apertures Using Optical Phase-Lock Loops, *Amnon Yariv; Caltech, USA*

Invited Speakers

CMA1, **Chip-Scale Frequency Combs and Their Stabilization,** *Pascale Del'Haye, Olivier Arcizet, Albert Schliesser, Tobias Wilken, Ronald Holzwarth, Tobias J. Kippenberg; Max Planck Inst. of Quantum Optics, Germany.*

CMA2, **High-Power, Low-Noise 1.5-µm Optical Sources Based on Slab-Couple Optical Waveguide Amplifiers (SCOWAs),** *Paul W. Juodawlkis[1], Jason L. Plant[1], Fred J. O'Donnell[1], Leo J. Missaggia[1], Robin K. Huang[1], Joseph P. Donnelly[1], John B. Schlager[2], William Swann[2], Nathan R. Newbury[2], Sangyoun Gee[3], Sarper Ozharar[3], Franklyn Quinlan[3], Peter J. Delfyett[3]; [1]MIT Lincoln Lab, USA, [2]Natl. Inst. of Standards and Technology, USA, [3]CREOL, Univ. of Central Florida, USA.*

CMB1, **Optical Waveform Generation for Coherent High-Resolution Imaging,** *Kevin W. Holman, David G. Kocher, Sumanth Kaushik; MIT Lincoln Lab, USA.*

CMB2, **Pulse Shaping and Control of Optical and RF Phase,** *Andrew Weiner; Purdue Univ., USA.*

CMB3, **High Resolution Optical Waveform Analysis,** *Peter Andrekson; Chalmers Univ. of Technology, Sweden.*

CMC1, **Electro-Optic Modulators and Modulation for Enhanced LIGO and Beyond,** *Volker Quetschke; Univ. of Florida, USA.*

CTuA1, **Long Range ID Using Sub-Aperture Array Based Imaging,** *Paul McManamon; Exciting Technology LLC, USA.*

CTuA3, **Laser and Lidar Technology Development for Highly Accurate Vertical Profiles of Vector Wind Velocity from Earth Orbit,** *Michael J. Kavaya; NASA Langley Res. Ctr., USA.*

CTuA4, **Digital Holography of Total Internal Reflection,** *M. K. Kim, W. M. Ash; Univ. of South Florida, USA.*

CTuA6, **Quantitative Phase Imaging of Cells and Tissues,** *Gabriel Popescu; MIT, USA.*

CTuB1, **Guiding Laser Thermal Therapy with Optical Frequency Domain Imaging,** *Ben Vakoc; Massachusetts General Hospital, Harvard Univ., USA.*

CTuB2, **CARS Microscopy,** *Sunney Xie; Harvard Univ., USA.*

CTuB3, ***In vivo* Three-Dimensional Optical Coherence Tomography Using Fourier Domain Mode-Locked Laser,** *Yu Chen; Univ. of Maryland, USA.*

CTuB4, **Applications of Highly Coherent Femtosecond Fiber Lasers,** *Nathan R. Newbury; NIST, USA.*

CTuC1, **A High Dynamic Range Coherent Optical RF Digital Receiver,** *Thomas Clark, Michael Dennis; Applied Physics Lab, Johns Hopkins Univ., USA.*

CWA1, **Coherent Communication in Optical Free-Space and Fiber Networks,** *Vincent Chan; MIT, USA.*

CWA2, **Multi-Carrier or Single-Carrier Transmission: An Optical Debate,** *William Shieh, Xingwen Yi; Dept. of Electrical and Electronic Engineering, Univ. of Melbourne, Australia.*

CWA3, **Performance of Synchronous or Nonsynchronous Receivers Using Atmospheric Compensation Techniques,** *Aniceto Belmonte[1,2], Joseph M. Kahn[2]; [1]Dept. of Signal Theory and Communications, Technical Univ. of Catalonia, Spain, [2]Stanford Univ., USA.*

CWB1, **Digital Compensation of Linear and Nonlinear Impairments in Coherent Optical Receivers,** *Ezra Ip, Alan P. T. Lau, Daniel J. F. Barros, Joseph M. Kahn; Stanford Univ., USA.*

CWB2, **Digital Self-Coherent Detection and Mitigation of Transmission Impairments,** *Xiang Liu; Bell Labs, Alcatel-Lucent, USA.*

CWC1, **Real Time 40 Gb/s Coherent System,** *Kim Roberts; Nortel Networks, Canada.*

CWC2, **Beyond 100-Gb/s Optical Transmission Based on Coded Modulation and Coherent Detection,** *Ivan B. Djordjevic; Univ. of Arizona, USA.*

CWC3, **Digital Coherent Communication Algorithms and Architectures,** *Isaac Shpantzer; CeLight Inc., USA.*

Agenda of Sessions

	Salon E	Salons A/B	Salons C/D	Salon G	Salons H–J
Sunday, July 13					
4:00 p.m.–6:00 p.m.	Registration Open (Atrium Foyer)				
Monday, July 14					
7:00 a.m. – 6:00 p.m.	Registration Open (Atrium Foyer)				
8:00 a.m.–10:00 a.m.	JMA • Monday Plenary Session				
10:00 a.m.–10:30 a.m.	Coffee Break (Salon Foyer)				
10:30 a.m.–12:30 p.m.	IMA • Transmitters and Other Devices	IMB • Plasmonic Structures	CMA • Components I	SMA • EIT and Quantum Information	QMA • Entanglement I
12:30 p.m.–2:00 p.m.	Lunch Break				
2:00 p.m.–4:00 p.m.	IMC • Active Silicon Devices	IMD • Photonic Crystal Cavities and Waveguides	CMB • Waveform Synthesis	SMB • Metamaterials	QMB • Entanglement II
4:00 p.m.–4:30 p.m.	Coffee Break (Salon Foyer)				
4:30 p.m.–6:30 p.m.	IME • Silicon Photonic Components	IMF • Nanophotonic Structures	CMC • Components II	SMC • Applications in Optical Communications	QMC • Optical and Other Implementations I
6:30 p.m.–8:00 p.m.	JMB • Joint Poster Session (Salon F)				
Tuesday, July 15					
7:30 a.m.–5:00 p.m.	Registration Open (Atrium Foyer)				
8:00 a.m.–10:00 a.m.	JTuA • Tuesday Plenary Session				
10:00 a.m.–10:30 a.m.	Coffee Break (Salon Foyer)				
10:30 a.m.–12:30 p.m.	ITuA • Planar Lightwave Circuits and Filters	ITuB • Microlasers and Emission	CTuA • Imaging I	STuA • Semiconductor Structures and CPO Effects	QTuA • Entanglement III
12:30 p.m.–2:00 p.m.	Lunch Break				
2:00 p.m.–4:00 p.m.	ITuC • Sensors and Lightwave Circuits	ITuD • Multi-Core Photonics and Simulations	CTuB • Imaging II	STuB • Gratings and Coupled Resonators	QTuB • Quantum Imaging and Emerging Topics
4:00 p.m.–4:30 p.m.	Coffee Break (Salon Foyer)				
4:30 p.m.–6:30 p.m.		ITuE • Computer Aided Design for Integrated and Nano Photonics	CTuC • Analog Photonics	STuC • Slow Light in Optical Fibers	QTuC • Decoherence and Algorithms
6:30 p.m.–8:00 p.m.	Conference Reception (Salon F)				
Wednesday, July 16					
7:30 a.m. – 5:00 p.m.	Registration Open (Atrium Foyer)				
8:00 a.m.–10:00 a.m.	IWA • Micro-Resonators and Lightwave Devices	IWB • Modeling Optical Fibers and Waveguides	CWA • Coherent Communications I	SWA • Fundamental Limitations and New Applications	QWA • Entanglement IV
10:00 a.m.–10:30 a.m.	Coffee Break (Salon Foyer)				
10:30 a.m.–12:30 p.m.	IWC • Photonic Integration	IWD • Solar Cells and Nanostructures	CWB • Coherent Communications II (ends at 12:45 p.m.)	SWB • Metamaterials and Photonic Crystals	QWB • Optical and Other Implementations II, Quantum State Reconstruction, Storage I
12:30 p.m.–2:00 p.m.	Lunch Break				
2:00 p.m.–4:00 p.m.	IWE • Active Structures	IWF • Simulations, Photonic Devices and Materials	CWC • Coherent Communications III (ends at 4:15 p.m.)	SWC • Photonic Crystals	QWC • Quantum Communication
4:00 p.m.–4:30 p.m.	Coffee Break (Salon Foyer)				
4:30 p.m.–6:30 p.m.	IWG • Waveguide Components (ends at 5:45 p.m.)	IWH • Resonant Structures (ends at 5:45 p.m.)		SWD • Slow Light in Atomic Vapors (ends at 6:00 p.m.)	QWD • Metrology, Storage II and Transfer of Quantum Information; Emerging Topics

Coherent Optical Technologies and Applications (COTA)

Abstracts

• Sunday, July 13 •

Atrium Foyer
4:00 p.m.–6:00 p.m.
Registration Open

• Monday, July 14 •

Atrium Foyer
7:00 a.m.–6:00 p.m.
Registration Open

JMA • Joint Plenary Session I

Salon E
8:00 a.m.–10:00 a.m.
JMA • Joint Plenary Session I

8:00 a.m.
Opening Remarks, *Conference Chairs (COTA, Slow Light, and ICQI).*

8:15 a.m.
ICQI Plenary
Photonic Entanglement in Quantum Communication and Quantum Computation, *Anton Zeilinger; Univ. Wien, Austria.*

9:00 a.m.
Opening Remarks, *Conference Chair (IPNRA).*

9:05 a.m.
IPNRA Plenary
The Intimate Merger of Photonics and Computing, *Ashok V. Krishnamoorthy, SUN Microsystems, USA.*

Salon Foyer
10:00 a.m.–10:30 a.m.
Coffee Break

CMA • Components I

Salons C/D
10:30 a.m.–12:30 p.m.
CMA • Components I
Steve Pappert; DARPA/MTO, USA, Presider

CMA1 • 10:30 a.m. **Invited**
Chip-Scale Frequency Combs and Their Stabilization, *Pascale Del'Haye, Olivier Arcizet, Albert Schliesser, Tobias Wilken, Ronald Holzwarth, Tobias J. Kippenberg; Max Planck Inst. of Quantum Optics, Germany.* It is shown that the optical sidebands generated via optical parametric oscillations in an on-chip microcavity are equidistant thus overcoming the intrinsic cavity dispersion. This leads to the generation of optical frequency combs at input powers < 10 mW with repetition rate in the 80 GHz range.

CMA2 • 11:00 a.m. **Invited**
High-Power, Low-Noise 1.5-µm Optical Sources Based on Slab-Couple Optical Waveguide Amplifiers (SCOWAs), *Paul Juodawlkis; MIT Lincoln Lab, USA.* We describe the performance of single-frequency external-cavity lasers (P > 330mW; Δν < 100kHz) and mode-locked lasers (P > 100mW; jitter = 0.38fs, 1Hz to 1MHz) based on a novel high-power, low-loss semiconductor quantum-well gain medium.

CMA3 • 11:30 a.m.
Phase Coherence of Ti:Sapphire Optical Frequency Combs across Hundreds of Nanometers, *Qudsia Quraishi, Scott Diddams, Leo Hollberg; NIST, USA.* We demonstrate the scaling of the relative phase noise across hundreds of nanometers of spectra from stabilized Ti:Sapphire frequency combs. We show good agreement between the predicted and measured phase noise.

CMA4 • 11:45 a.m.
Sub-10 fs Residual Timing Jitter on a 10 GHz Optical Frequency Comb Generator, *Shijun Xiao, Leo Hollberg, Nathan Newbury, Scott Diddams; NIST, USA.* With a narrow linewidth seed laser, residual timing jitter on a 10 GHz optical frequency comb generator is reduced to 6 fs. We present analysis connecting spectral phase and laser linewidth to the timing jitter.

CMA5 • 12:00 p.m.
Dual-Frequency Laser at 1.5 µm for the Generation of High-Purity Microwave Signals, *Gregoire Pillet[1], Loic Morvan[1], Marc Brunel[2], Fabien Bretenaker[3], Daniel Dolfi[1], Marc Vallet[2], Jean-Pierre Huignard[1], Albert Le Floch[2]; [1]Thales Res. and Technology, France, [2]Inst. de Physique de Rennes, France, [3]Lab Aimé Cotton, Univ. Paris Sud, France.* We describe the stabilization of a dual-frequency laser on an external reference and on fiber delay lines. Low phase noise (-107 dBrad²/Hz at 10 kHz) beatnotes tunable from 2 to 6 GHz are demonstrated.

CMA6 • 12:15 p.m.
20 GHz Ultrashort Dual Wavelength Actively Mode-Locked Erbium-Doped Fiber Ring Laser, *Zhe Chen, Hongzhi Sun, Shaozhen Ma, Niloy K. Dutta; Univ. of Connecticut, USA.* We demonstrate a stable dual-wavelength actively mode-

locked erbium-doped fiber laser operating at 20GHz. We use a highly nonlinear fiber in the optical cavity. Simultaneous dual wavelength pulse trains with pulse widths ~1ps are achieved.

12:30 p.m.–2:00 p.m.
Lunch Break

CMB • Waveform Synthesis

Salons C/D
2:00 p.m.–4:00 p.m.
CMB • Waveform Synthesis
Daniel Dolfi; Thales Res. and Technology, France, Presider

CMB1 • 2:00 p.m. **Invited**
Optical Waveform Generation for Coherent High-Resolution Imaging, *Kevin W. Holman, David G. Kocher, Sumanth Kaushik; MIT Lincoln Lab, USA.* We have developed a time-multiplexed technique for controlling the amplitude and phase of the individual frequency components of a mode-locked laser to generate a precisely linear chirped waveform. We have demonstrated a 20-GHz, 1-us chirp.

CMB2 • 2:30 p.m. **Invited**
Pulse Shaping and Control of Optical and RF Phase, *Andrew Weiner; Purdue Univ., USA.* Applications of pulse shaping for control of optical and RF phase, including PMD equalization, manipulation of optical frequency combs, generation of arbitrary ultrawideband RF waveforms, and RF dispersion compensation, are discussed.

CMB3 • 3:00 p.m. **Invited**
High Resolution Optical Waveform Analysis, *Peter Andrekson; Chalmers Univ. of Technology, Sweden.* Techniques to analyze optical waveforms with high resolution are discussed. Emphasis is on all-optical sampling that offers picosecond resolution with excellent sensitivity as well as optical phase-sensitive and real time (Nyquist-limited) waveform capture capability.

CMB4 • 3:30 p.m.
Low-Insertion-Loss, In-Fiber, Dynamic Arbitrary Waveform Generation, *Yu Yeung (Kenny) Ho, Li Qian; Univ. of Toronto, Canada.* We present a low-loss, high-repetition-rate, dynamic waveform generation technique by independent phase and amplitude control of spectral lines in a continuous fiber. Several distinct waveforms are experimentally demonstrated by manipulating 5 lines.

CMB5 • 3:45 p.m.
Multi-Channel Running-Code OCDMA, *Shawn X. Wang[1], Gregory S. Kanter[2], Prem Kumar[1]; [1]Northwestern Univ., USA, [2]NuCrypt LLC, USA.* We report on an experimental investigation of a multi-channel running-code OCDMA system. The system utilizes double-pass acousto-optic-modulator pulse shapers to perform microsecond-scale spectral phase encoding/decoding.

Salon Foyer
4:00 p.m.–4:30 p.m.
Coffee Break

CMC • Components II

Salons C/D
4:30 p.m.–6:30 p.m.
CMC • Components II
Juerg Leuthold; Univ. of Karlsruhe, Germany, Presider

CMC1 • 4:30 p.m. **Invited**
Electro-Optic Modulators and Modulation for Enhanced LIGO and Beyond, *Volker Quetschke; Univ. of Florida, USA.* The Laser Interferometer Gravitational-Wave Observatory (LIGO) is currently undergoing an upgrade to improve its sensitivity. The laser power will increase to 30W, leading to stronger requirements on the modulators for avoiding losses and thermal lensing.

CMC2 • 5:00 p.m.
Integrated Optical Modulator for a Spectral Coding of Optical Signals, *Alexander Shamray, Alexander Kozlov, Igor Ilichev, Mikhail Petrov; Ioffe Physico-Technical Inst., Russian Federation.* A novel integrated optical modulator based on the controllable Bragg grating was developed and fabricated. Modulator provides addition flexibility and possibility of using frequency modulation formats (FSK) in combination with spectral OCDMA encoding.

CMC3 • 5:15 p.m.
All-Optical Correlator for High-Speed OOK and DPSK Signals, *David F. Geraghty, Reza Salem, Mark A. Foster, Alex L. Gaeta; Cornell Univ., USA.* We describe a novel high-speed temporal correlator based on linear optical components. We demonstrate operation with 100-Gb/s OOK packets, and our modeling indicates that this system can also function with DPSK signals.

CMC4 • 5:30 p.m.
Frequency-Resolved Optical Gating on a Silicon Photonic Chip, *Mark A. Foster, Reza Salem, David F. Geraghty, Amy C. Turner, Michal Lipson, Alexander L. Gaeta; Cornell Univ., USA.* We implement frequency-resolved optical gating using four-wave mixing in CMOS-compatible silicon nanowaveguides and demonstrate sensitive characterization in the C-band for a 10-GHz train of 3.7-ps pulses.

CMC5 • 5:45 p.m.
Novel Phase Spectrum Measurement Method Based on Stimulated Brillouin Scattering, *Asier Villafranca[1], Javier*

Lasobras[1], Francisco Lopez[2], Rafael Alonso[1], Ignacio Garces[1]; [1]Univ. of Zaragoza, Spain, [2]Aragon Photonics SLU, Spain. A novel method to measure the phase spectrum of modulated optical signals based on stimulated Brillouin scattering is presented. Combined with power spectrum measurements, and through inverse Fourier transform, the time-domain information is recovered.

CMC6 • 6:00 p.m.
$\chi^{(2)}$ Evolution in Fiber during Prolonged Thermal Poling, *Jiawen Zhang, Li Qian; Univ. of Toronto, Canada.* We report a two-stage rise in the evolution of $\chi^{(2)}$ in a twin-hole fiber during thermal poling, suggesting a fast Na^+ migration and a slow H^+ injection, in accordance with our charge dynamics model.

CMC7 • 6:15 p.m.
80Gb/s XNOR Using a Four Wave Mixing Scheme in Highly Nonlinear Fibers, *Shaozhen Ma, Hongzhi Sun, Zhe Chen, Niloy K. Dutta; Univ. of Connecticut, USA.* 80 Gb/s All-optical XNOR has been demonstrated using four wave mixing scheme in highly nonlinear fibers. The nonlinear Schrodinger equations (NLS) describing the process in fibers has been simulate and solved using split-step Fourier method.

JMB • Joint Poster Session

Salon F
6:30 p.m.–8:00 p.m.
JMB • Joint Poster Session

JMB1
The Photoanisotropy and Photogirotropy in Compositions of Organic Dyes, *Valentina Shaverdova[1], Svetlana Petrova[1], Nino Obolashvili[2]; [1]Inst. of Cybernetics, Georgia, [2]Georgian Technical Univ., Georgia.* Several compositions of organic dyes, embedded in polymer matrix were created. Experimental results of investigation photoanisotropy and photogyrotropy in these compositions are presented. It was shown that they are polarize-sensitive in a wide spectral range.

JMB2
Polarization-Holographic Amplifier-Corrector of Optical Signals, *Vladimir Tarasashvili[1], Anna Purtseladze[1], Irakli Chaganava[2]; [1]Inst. of Cybernetis, Georgia, [2]Georgian Technical Univ., Georgia.* The possibility of applying the photoinduced anisotropy in dynamic polarization-sensitive media for the correction and amplifications of the laser radiation with a complex distribution of the polarization state over the wavefront is tested experimentally.

JMB3
Fundamentals of Spatial Coherence Modulation, *Rafael A. Betancur, Roman E. Castaneda; Univ. Nacional de Colombia, Colombia.* Fundamentals of phase and amplitude modulation of the coherence properties of an optical field have been stated from the standpoint of the second order theory. This methodology can be employed for designing arbitrary power distributions.

JMB4
A Full-Duplex Radio-over-Fiber Transport System, *Wen-I Lin, Ming-Huei Shyu, Chia Hsien Lee, Ardhendu Sekhar Patra, Hai-Han Lu; Natl. Taipei Univ. of Technology, Taiwan.* A full-duplex radio-over-fiber transport system based on two modes injection-locked Fabry-Perot laser diode is proposed and demonstrated. Good performance of BER was obtained over 40 km SMF transmission in our proposed systems.

JMB5
Radio-on-Hybrid WDM Transport Systems, *Wen-I Lin, Ming-Huei Shyu, Chia Hsien Lee, Ardhendu Sekhar Patra, Hai-Han Lu; Natl. Taipei Univ. of Technology, Taiwan.* A radio-on-hybrid wavelength-division-multiplexing transport system employing mutually injection-locked Fabry-Perot laser diodes is proposed and demonstrated. System performances evaluated by CNR, CSO, CTB, and BER for simultaneous transmission of CATV/LAN/ITS are improved.

JMB6
Optical Path Difference Determination by Means of Coherence Degree Measurement, *Maximino L. Arroyo Carrasco, Diana Rodríguez Méndez, Marcela M. Méndez Otero, Israel Severiano Carrillo; BUAP, Mexico.* We measure the optical path difference of two interfering beams by means of the coherence degree determination with Photo Electro-Motive Force based detectors. This technique makes possible profile, thickness and index of refraction measurements.

JMB7
Withdrawn

JMB8
Digital Post-Equalization of Intrachannel Nonlinearities in Coherent DQPSK Transmission Systems, *Yan Gao, Fan Zhang, Liang Dou, Zhangyuan Chen, Anshi Xu; Peking Univ., China.* Digital post-equalization of intrachannel nonlinearities in coherent DQPSK systems is numerically studied. The simulation results show that the simplified channel inversion method is efficient in simultaneous compensation of intrachannel nonlinearities and chromatic dispersion.

JMB9
Improved Receiver Sensitivity by Using an Injection-Locked Laser and Double-Pass EDFA Scheme, *Ricardo A. P. Gomes, Reginaldo Silva, Aldario C. Bordonalli; State Univ. of Campinas - UNICAMP, Brazil.* This work investigates a coherent receiver that uses a single-facet optical injection-

locked semiconductor laser embedded into a doubled-pass EDFA. Consequently, receiver sensitivity as low as -65 dBm is possible with this low noise combined scheme.

JMB10-JMB33 can be found in the Slow Light abstracts.
JMB34-JMB41, JMB81 can be found in the IPNRA abstracts.
JMB42-JMB80 can be found in the ICQI abstracts.

NOTES

• Tuesday, July 15 •

Atrium Foyer
7:30 a.m.–5:00 p.m.
Registration Open

JTuA • Joint Plenary Session II

Salon E
8:00 a.m.–10:00 a.m.
JTuA • Joint Plenary Session II

8:00 a.m.
Slow Light Plenary
Electro-Optic Modulation of Photons and Biphotons, *Stephen E. Harris; Stanford Univ., USA.*

8:40 a.m.
ICQI Plenary
Entanglement, Information Processing and Decoherence in Trapped Atomic Ions, *David J. Wineland; NIST, USA.*

9:20 a.m.
COTA Plenary
Coherence Cloning and Phase Controlled Apertures Using Optical Phase-Lock Loops, *Amnon Yariv; Caltech, USA.*

Salon Foyer
10:00 a.m.–10:30 a.m.
Coffee Break

CTuA • Imaging I

Salons C/D
10:30 a.m.–12:30 p.m.
CTuA • Imaging I
Frank Hanson; SPAWAR Systems Ctr. San Diego, USA, Presider

CTuA1 • 10:30 a.m. **Invited**
Long Range ID Using Sub-Aperture Array Based Imaging, *Paul McManamon; Exciting Technology LLC, USA.* The Air Force needs decision quality long range ID, but radar does not provide this capability. Laser radar provides high quality ID, but conformal aperture approaches are needed for next generation Air Force aircraft.

CTuA2 • 11:00 a.m.
Laser Radar and Quantum States of Light, *Mark A. Rubin, Sumanth Kaushik; MIT Lincoln Lab, USA.* We examine proposals to employ squeezed states and NOON states, novel quantum states of light, in laser radar. We find that the use of these states does not yield enhanced performance.

CTuA3 • 11:15 a.m. **Invited**
Laser and Lidar Technology Development for Highly Accurate Vertical Profiles of Vector Wind Velocity from Earth Orbit, *Michael J. Kavaya; NASA Langley Res. Ctr., USA.* We report progress, challenges, plans and our wish list for enabling a coherent-detection, 2-micron, pulsed, Doppler lidar system to measure winds from space.

CTuA4 • 11:45 a.m. **Invited**
Digital Holography of Total Internal Reflection, *M. K. Kim, W. M. Ash; Univ. of South Florida, USA.* Phase front of light in TIR is modulated by presence of object on the surface. Digital holography reconstructs the modulated phase front, to image the interface between the TIR surface and biological cells on it.

CTuA5 • 12:15 p.m.
Mueller Matrix Microscopy, *Mircea Mujat, Nick Iftimia, Dan R. Ferguson, Dan X. Hammer; Physical Sciences Inc., USA.* We describe here a new imaging technique, Mueller matrix microscopy, for investigating the anisotropic properties of the refractive index in biological samples. The system's capabilities are demonstrated first on mica.

12:30 p.m.–2:00 p.m.
Lunch Break

CTuB • Imaging II

Salons C/D
2:00 p.m.–4:00 p.m.
CTuB • Imaging II
Zhongping Chen; Univ. of California at Irvine, USA, Presider

CTuB1 • 2:00 p.m. **Invited**
Guiding Laser Thermal Therapy with Optical Frequency Domain Imaging, *Ben Vakoc; Massachusetts General Hospital, Harvard Univ., USA.* Laser thermal therapy seeks to coagulate limited volumes of diseased tissue while leaving neighboring healthy tissue unharmed. The role of coherent imaging technologies in guiding and monitoring this coagulation process is described.

CTuB2 • 2:30 p.m. **Invited**
CARS Microscopy, *Sunney Xie; Harvard Univ., USA.* Coherent Anti-Stokes Raman Scattering microscopy is a label-free imaging technique using molecular vibration as a contrast mechanism. Recent advances have enabled orders of magnitude improvement in sensitivity, enabling a wide range of applications.

CTuB3 • 3:00 p.m. **Invited**
***In vivo* Three-Dimensional Optical Coherence Tomography Using Fourier Domain Mode-Locked Laser,** *Yu Chen; Univ. of Maryland, USA.* We have developed an endoscopic OCT system based on an FDML laser. *In vivo* three-dimensional imaging at 100 kHz with 9 × 7 µm

(transverse by axial) resolution is demonstrated in the rabbit gastrointestinal tract.

CTuB4 • 3:30 a.m. **Invited**

Applications of Highly Coherent Femtosecond Fiber Lasers, *Nathan R. Newbury; NIST, USA.* Coherent, broadband fiber lasers produce pulse trains with <1 femtosecond relative timing uncertainty and <1 mHz relative frequency uncertainty. These sources can advance many applications including optical frequency metrology, ranging LIDAR, and broadband molecular spectroscopy.

Salon Foyer
4:00 p.m.–4:30 p.m.
Coffee Break

CTuC • Analog Photonics

Salons C/D
4:30 p.m.–6:30 p.m.
CTuC • Analog Photonics
Y. K. Chen; Bell Labs, Alcatel-Lucent, USA, Presider

CTuC1 • 4:30 p.m. **Invited**

A High Dynamic Range Coherent Optical RF Digital Receiver, *Thomas Clark, Michael Dennis; Applied Physics Lab, Johns Hopkins Univ., USA.* Coherent optical techniques—capitalizing on linear electro-optic phase encoding, quadrature detection and DSP—are applied to analog signal transport with unprecedented linearity. Applications, results, and directions for future work will be discussed.

CTuC2 • 5:00 p.m.

Time-Sampled Linear Optical Phase Demodulation, *Leif A. Johansson, Colin Sheldon, Anand Ramaswamy, Mark Rodwell; Univ. of California at Santa Barbara, USA.* Time-sampled optical phase demodulation is proposed, based on heterodyne detection of a phase modulated signal, digital frequency division and measurement of the timing of zero-crossings using an XOR-gate. 30dB improvement in intermodulation terms is measured.

CTuC3 • 5:15 p.m.

Optical Phase Demodulation of a 10GHz RF Signal Using Optical Sampling, *Anand Ramaswamy, Leif A. Johansson, Jonathan Klamkin, Darko Zibar, Larry A. Coldren, Mark J. Rodwell, John E. Bowers; Univ. of California at Santa Barbara, USA.* For the first time we demonstrate sampling downconversion of a 10GHz phase modulated optical signal using an integrated coherent receiver with feedback. At a downconverted frequency of 100 MHz we measure 19dB improvement in SIR.

CTuC4 • 5:30 p.m.

En-Decoding in the Optical Phase Domain in the Design of ADC's, RF Amplifiers/Filters and Antenna Links, *Geert J. Wyntjes, John J. Atkinson, David Rall; Visidyne, Inc., USA.* Discuss the advantages of linear angle, phase encoding between pairs of optical carriers, beams, and its recovery through interferometry in the same domain for, in the design of RF amplifiers/filters, analog-to-digital converters, and antenna links.

CTuC5 • 5:45 p.m.

Improvement of CSO/CTB Performance Based on Fabry-Perot Etalon, *Wen-I Lin, Ming-Huei Shyu, Chia Hsien Lee, Ardhendu Sekhar Patra, Hai-Han Lu; Natl. Taipei Univ. of Technology, Taiwan.* We proposed and demonstrated an externally modulated NTSC 77-channel EDFA-repeated system employing Fabry-Perot etalon at the receiving site to improve system performance. Good performance of CNR, CSO, and CTB were achieved over 100-km SMF transmission.

CTuC6 • 6:00 p.m.

CATV/ROF Transport Systems Based on -1 Side Mode Injection-Locked and Optoelectronic Feedback Techniques, *Wen-I Lin, Ming-Huei Shyu, Chia Hsien Lee, Ardhendu Sekhar Patra, Hai-Han Lu; Natl. Taipei Univ. of Technology, Taiwan.* A CATV/ROF transport system with side mode injection-locked and optoelectronic feedback techniques is proposed and demonstrated. Good performances of CNR, CSO, and CTB were obtained for CATV band; BER values were achieved for ITS application.

CTuC7 • 6:15 p.m.

Coherent Optical Transponder at Femto-Watt Light Levels, *John Dick[1], Meirong Tu[1], Kevin M. Birnbaum[1], Dmitry V. Strekalov[1], Nan Yu[1], Ertan Salik[2]; [1]JPL, USA, [2]California State Polytechnic Univ., USA.* We investigated two schemes for coherent optical transponder at extremely low light levels. Optical phase locking at femtowatt levels has been demonstrated and characterized. We also discuss an alternative "injection seeded" approach, and ranging experiments.

Salon F
6:30 p.m.–8:00 p.m.
Conference Reception

• Wednesday, July 16 •

Atrium Foyer
7:30 a.m.–5:00 p.m.
Registration Open

CWA • Coherent Communications I

Salons C/D
8:00 a.m.–10:00 a.m.
CWA • Coherent Communications I
Hamid Hemmati; JPL, USA, Presider

CWA1 • 8:00 a.m. **Invited**
Coherent Communication in Optical Free-Space and Fiber Networks, *Vincent Chan; MIT, USA.* This paper addresses coherent optical detection in the context of free-space optical networks in the presence of atmospheric turbulence and multi-user interference. We discuss how many of these techniques can be applied to fiber networks.

CWA2 • 8:30 a.m. **Invited**
Multi-Carrier or Single-Carrier Transmission: An Optical Debate, *William Shieh, Xingwen Yi; Dept. of Electrical and Electronic Engineering, Univ. of Melbourne, Australia.* Coherent optical OFDM has promise for being an attractive modulation format for future 100 Gb/s transmission systems. In this presentation, we revisit the long-standing debate on the superiority between OFDM and single-carrier frequency-domain equalization.

CWA3 • 9:00 a.m. **Invited**
Performance of Synchronous or Nonsynchronous Receivers Using Atmospheric Compensation Techniques, *Aniceto Belmonte[1,2], Joseph M. Kahn[2]; [1]Dept. of Signal Theory and Communications, Technical Univ. of Catalonia, Spain, [2]Stanford Univ., USA.* We present recent studies on the impact of phase and amplitude fluctuations on free-space links using either synchronous or nonsynchronous detection. We compare options for atmospheric compensation, including conjugate and non-conjugate adaptive optics.

CWA4 • 9:30 a.m.
The FWM Impairment in Coherent OFDM Compounds on a Phased-Array Basis over Dispersive Multi-Span Links, *Moshe Nazarathy[1], Jacob Khurgin[2], Rakefet Weidenfeld[1], Yehuda Meiman[3], Pak Cho[3], Reinhold Noe[4], Isaac Shpantzer[3]; [1]Technion, Israel, [2]Johns Hopkins Univ., USA, [3]Celight Inc., USA, [4]Univ. Paderborn, EIM-E, Germany.* We develop a novel all-analytic model of FWM generation over dispersive coherent OFDM long-haul links, leading to a new multispan phased-array effect. The nonlinear FWM impairment may be mitigated by destructive interference of intermodulation products.

CWA5 • 9:45 a.m.
Withdrawn

Salon Foyer
10:00 a.m.–10:30 a.m.
Coffee Break

CWB • Coherent Communications II

Salons C/D
10:30 a.m.–12:45 p.m.
CWB • Coherent Communications II
Kazuro Kikuchi; Dept. of Frontier Informatics, Univ. of Tokyo, Japan, Presider

CWB1 • 10:30 a.m. **Invited**
Digital Compensation of Linear and Nonlinear Impairments in Coherent Optical Receivers, *Ezra Ip, Alan P. T. Lau, Daniel J. F. Barros, Joseph M. Kahn; Stanford Univ., USA.* We study digital backpropagation for compensating linear and nonlinear impairments in single-mode fiber. We reduce computational complexity by increasing the spatial step size. We evaluate the effects of sampling rate and dispersion map on performance.

CWB2 • 11:00 a.m. **Invited**
Digital Self-Coherent Detection and Mitigation of Transmission Impairments, *Xiang Liu; Bell Labs, Alcatel-Lucent, USA.* We review the techniques used in digital self-coherent detection for improvement of receiver sensitivity, recovery of multi-level phase and amplitude modulated signals, and mitigation of transmission impairments. Comparisons with digital coherent detection are also discussed.

CWB3 • 11:30 a.m.
Experimental Demonstration of Distributed Impairment Compensation for High-Spectral Efficiency Transmission, *Gilad Goldfarb, Michael G. Taylor, Guifang Li; College of Optics and Photonics, CREOL and FPCE, Univ. of Central Florida, USA.* Distributed impairment compensation for dispersion and nonlinear effects is demonstrated experimentally in the OWDM (channel spacing equal to symbol rate) environment and for transmission distances over 1000 km.

CWB4 • 11:45 a.m.
Frequency Estimation and Compensation for Coherent QPSK Transmission with DFB Lasers, *Sebastian Hoffmann[1], Timo Pfau[1], Olaf Adamczyk[1], Christian Wördehoff[1], Ralf Peveling[1], Mario Porrmann[1], Reinhold Noé[1], Suhas Bhandare[2]; [1]Univ. of Paderborn, EIM-E, Germany, [2]Discovery Semiconductors, Inc., USA.* We present a hardware-efficient combined frequency and phase estimator. It is capable of tracking phase noise of 10 GBaud optical QPSK transmission systems with DFB lasers and frequency mismatch up to 0.8 GHz.

CWB5 • 12:00 p.m.
Self-Coherent Differential Transmission with Decision Feedback–Phase Noise Impairments, *Yuval Atzmon, Moshe Nazarathy; Technion, Israel.* The BER performance of self-coherent receivers is analytically evaluated for the first time, accounting for (i) linear (ii) non-linear (SPM/XPM) (iii) laser phase noises. Longer decision-feedback memory ameliorates the impact of (i),(ii) while enhancing (iii).

CWB6 • 12:15 p.m.
Fading Mitigation in Homodyne RZ-QPSK via Delay-Diversity Transmission, *Pak S. Cho, Yehuda Meiman, Geof Harston, Yaakov Achiam, Isaac Shpantzer; CeLight, Inc., USA.* Turbulence-induced fading in free-space transmission of optical RZ-QPSK can be mitigated in homodyne detection via delay-diversity. A SNR gain of 2.6 dB is obtained using orthogonal polarizations with delay comparable to the turbulence correlation time.

CWB7 • 12:30 p.m.
Coherent Detection of DQPSK for Tolerance to Coherent Crosstalk, *Anjali Agarwal, Paul Toliver, Tom Banwell, Ronald Menendez, Janet Jackel, Shahab Etemad; Telcordia Technologies, USA.* Coherent crosstalk is a significant challenge in OCDM/A systems especially for high spectral efficiency coherent implementations. We study its impact on DQPSK with coherent detection. An improvement in performance is seen over direct detection.

12:30 p.m.–2:00 p.m.
Lunch Break

CWC • Coherent Communications III

Salons C/D
2:00 p.m.–4:15 p.m.
CWC • Coherent Communications III
Keang-Po Ho; Inst. of Communication Engineering, Taiwan, Presider

CWC1 • 2:00 p.m. **Invited**
40 Gb/s Coherent WDM Modems, *Kim Roberts; Nortel Networks, Canada.* Continuous real-time measurements of coherent 46 Gb/s transmission with Dual Polarization QPSK. Digital compensation is used for dispersion and polarization effects, with little performance degradation created by 150 ps of rapidly varying 1st-order PMD.

CWC2 • 2:30 p.m. **Invited**
Beyond 100-Gb/s Optical Transmission Based on Coded Modulation and Coherent Detection, *Ivan B. Djordjevic; Univ. of Arizona, USA.* We present several two-dimensional and three-dimensional coded-modulation schemes enabling optical transmission well beyond 100-Gb/s, using commercial components operating at 40-Giga-symbols/s. The coded-modulation schemes include: bit-interleaved coded-modulation, multilevel-coding, and coded-OFDM; all three based on LDPC codes.

CWC3 • 3:00 p.m. **Invited**
Digital Coherent Communication Algorithms and Architectures, *Isaac Shpantzer; CeLight Inc., USA.* Digital coherent communications in fiber optic or free-space can be implemented in scalar time-domain or vectored frequency-domain. The key algorithms, architecture, VLSI design complexity and performance tradeoffs will be highlighted.

CWC4 • 3:30 p.m.
Dual-Threshold Receiver for 1550nm Homodyne QPSK Quantum Key Distribution System, *Qing Xu[1], Manuel Sabban[1], Philippe Gallion[1], Francisco Javier Mendieta[2]; [1]Ecole Natl. Supérieure des Télécommunications, France, [2]CICESE, Mexico.* We present a dual-threshold balanced homodyne receiver for QPSK QKD system in which the strong reference is time-multiplexed with the weak signal pulses in optical fiber, we also report its experimental BER and post-detection efficiency.

CWC5 • 3:45 p.m.
Coherent Performance Monitoring for Telecom Signals, *Jungmi Oh, Misha Brodsky, Lynn E. Nelson, G. Cadena, Mark D. Feuer; AT&T Labs, USA.* We show how interferograms of modulated telecom signals can be used to monitor signals degradation in real networks. In particular, reliable measurements of extinction ratio and OSNR are demonstrated for various modulation schemes.

CWC6 • 4:00 p.m.
Signal-Phase Variation Induced by an Amplitude Limiter Using Saturation of a Fiber-Optic Parametric Amplifier, *Masayuki Matsumoto; Osaka Univ., Japan.* Generation of phase variation in an amplitude limiter using saturation of parametric amplification in fiber is analyzed. Phase noise of output signals induced by input amplitude noise both of signal and pump is quantified.

Key to Authors and Presiders

(**Bold** denotes Presider or Presenting Author)

2008 OSA Summer Optics & Photonics Congress Update Sheet and Addendum

Additional Authors

CMA2 — *Paul W. Juodawlkis[1], Jason L. Plant[1], Fred J. O'Donnell[1], Leo J. Missaggia[1], Robin K. Huang[1], Joseph P. Donnelly[1], John B. Schlager[2], William Swann[2], Nathan R. Newbury[2], Sangyoun Gee[3], Sarper Ozharar[3], Franklyn Quinlan[3], Peter J. Delfyett[3]; [1]MIT Lincoln Lab, USA, [2]Natl. Inst. of Standards and Technology, USA, [3]CREOL, Univ. of Central Florida, USA.*

SWC2 — *Alfredo Rossi[1], S. Combrié[1], Q. V. Tran[1], C. Husko[1], G. Vadalà[1], P. Hamel[2], R. Gabet[2], Y. Jaouën[2], A. Parini[3], Y. Gottesman[3], F. Raineri[4]; [1]Thales Res. and Technology, France, [2]GET/Telecom Paris, France, [3]Inst. Natl. des Télécommunications, France, [4]Lab de Photonique et de Nanostructures, France.*

JMB1 — This poster will be presented by *Irakli Chaganava; Georgian Technical Univ., Georgia.*

Updated Titles

CWB1 — **Compensation of Chromatic Dispersion and Nonlinearity Using Simplified Digital Backpropagation**
CWC1 — **Real-Time 46 Gb/s Coherent System**
IMC7 — **Dispersion Engineering in Silicon Photonic Wires Using Thin Si_3N_4 Conformal Dielectric Coating**
QMA2 — **Decoherence and Entanglement for Quantum Critical Baths**
QWD2 — **Electromagnetically-Induced Transparency and Squeezed Light**
QWD3 — **Qubus Computation and Its Applications to Hybrid Quantum Repeaters**
STuA1 — **Novel Chirp and Compensate Scheme to Enhance Fast Light in a Semiconductor Optical Amplifier**
STuA2 — **Negative Refraction in a Semiconductor Metamaterial in the Mid-Infrared**
JMB35 — **Chirped Multilayer Mirror Based on Silicon Nitride (Si_3N_4) with Air-Gap Interlayers**
JMB67 — **Simulation of the Quantum Decoherence Effect for $^{79}Br^{85}Rb$**

Updated Papers

CTuA6 • 12:30 p.m.–1:00 p.m. (Invited)
Quantitative Phase Imaging of Cells and Tissues, *Gabriel Popescu; MIT, USA.* We developed novel imaging techniques for quantifying optical phase shifts produced by cells and tissues with unprecedented accuracy. This approach provides information about structure and dynamics at the nanometer and millisecond scales, with broad range of biomedical applications, including cell membrane dynamics, cell growth, and tissue diagnosis.

CWA5 • 9:45 a.m.
Optical Interconnects for Petaflops Supercomputers, *Hirsch Mandelberg; Lab for Physical Sciences, Univ. of Maryland, USA.* We discuss the requirements for an optical interconnect system capable of providing the multi-petabit/sec bandwidth, operating in a cryogenic-to-room-temperature environment, necessary for a petaflops supercomputer based on Josephson junction processors and memory.

A full summary of paper CWA is attached.

Updated Presiders

CTuB — *Yu Chen; Univ. of Maryland, USA.*

New Presiders to be announced on-site: CMB, CMC, CWB, CWC, IMB, ITuC, IWA, IWD, QMB, SMB, STuA, STuC

Withdrawals

QMA2, SMA5, JMB53, JMB75

Optical Interconnects for Petaflops Supercomputers

Hirsch I. Mandelberg
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Abstract: A new program has been initiated for the development of the technologies necessary to construct a petaflops supercomputer based on Josephson junction processors and memory. The requirements for an optical interconnect system capable of providing the necessary multi-petabit/sec bandwidth, operating in a cryogenic-to-room-temperature environment, will be discussed, along with some of the options being considered.

1. Superconducting Technology Assessment

The challenges to extending the delivered computing capabilities of semiconductor technology through Moore's Law, while manageable in the short term, may prove difficult or possibly impractical in the long term. Even now, the complex interplay of power and performance is resulting in significant changes in previous trends. Clock rates of commodity microprocessors are flattening even as multi-core chips are emerging as the norm for next generation systems. While conventional wisdom has dictated an assumption of continued adherence to the pure CMOS tradition of the last decade and more, the supercomputing community must consider the possibility of alternative technologies, at least in combination with more conventional devices. New architecture structures and programming models may also need to be considered to exploit the potential of such advances.

A panel of superconducting experts was challenged by the National Security Agency to do an independent assessment of the future of Rapid Single Flux Quantum (RSFQ) superconductor circuits to address the 2010-2015 petaflops system challenges of the high end user community. RSFQ logic exhibits operational properties in terms of performance and power that now positions it as a potential future leader among alternative digital technologies to augment semiconductor components in hybrid systems. But it is also challenged by lack of maturity and commercial market as well as its reliance on extreme operational temperature regimes. RSFQ technology may deliver clock rates in excess of an order of magnitude greater than that of the corresponding semiconductor logic and with dramatically reduced power requirements. Nonetheless, in spite of decades of research and experience with small fabrication lines, it has not managed to challenge the prevailing semiconductor technologies. However, the increasing difficulties to sustaining current level of growth in density and performance of CMOS within practical power constraints may change this. Critical issues of technology and architecture and how RSFQ may contribute effectively to future supercomputing next decade were considered. Six major areas were addressed: 1) superconductor technology, 2) micro-architecture using RSFQ, 3) hybrid memory systems, 4) system architecture incorporating superconductor components, 5) interconnects and system input/output and 6) system integration. The results of this study were reported at Supercomputing 2005 [1], and are available online [2].

2. Optical Input/Output Requirements

In petaflops-scale computer systems, the processor to memory and processor to processor data rates are enormous; the estimated bidirectional bandwidth requirement is 32 Petabits/s. The use of RSFQ digital circuits with clock frequencies exceeding 50 GHz imposes challenges resulting from the increasing differential between memory cycle time and processor clock. Reduced time-of-flight (TOF) latency motivates the use of cryogenic memory close to the processor. Providing the required bandwidth between room-temperature electronics and the cryogenic RSFQ processor elements requires careful engineering of the balance between the thermal load on the cryogenics and the number, type, bandwidth, and active elements of the lines providing input/output (I/O). The major interconnection, data communication, and I/O needs of a petaflops-scale system based on cryogenic RSFQ technology are: 1) high throughput data input to the cryogenic processors and/or memory at 4 K, 2) high throughput output from the 4 K operating regime to room-temperature system elements such as secondary and archival storage, and 3) communication between processor elements within the 4 K processing system at data rates commensurate with the processor clock rate.

While RSFQ processors allow construction of a compact (~1 m^3) processing unit, a superconductor petaflops-scale computer is a very large machine, on the scale of tens of meters, with high data bandwidth requirements. For example, a particular architecture may require more than half a million data streams at 50 Gbps each between the superconductor processors and room-temperature memory. One potential solution is to use optical interconnect technologies.

The main issue to be dealt with is the electrical power requirement for communicating from the 4K environment to room temperature considering the currently achievable refrigeration efficiency of 0.1%. For example, using a figure of 3mW/GHz achieved using VCSELS [3] would require 30 kW in the cryogenic environment, or 30 MW of power if the VCSELs were at 4K. This does not include power for interface amplifiers to go from RSFQ circuit output voltages of 5 mV to that needed to drive the VCSELs. This compares to 4 MW for the entire RSFQ processor. This power level arises from 4096 separate processors each dissipating about 1 watt at 4K. One envisioned solution to this is to generate the photons at room temperature, and modulate them at an intermediate temperature (30K-40K) with a refrigeration efficiency of 2%, which is electrically connected to the 4K processor. This is shown in Figure 1.

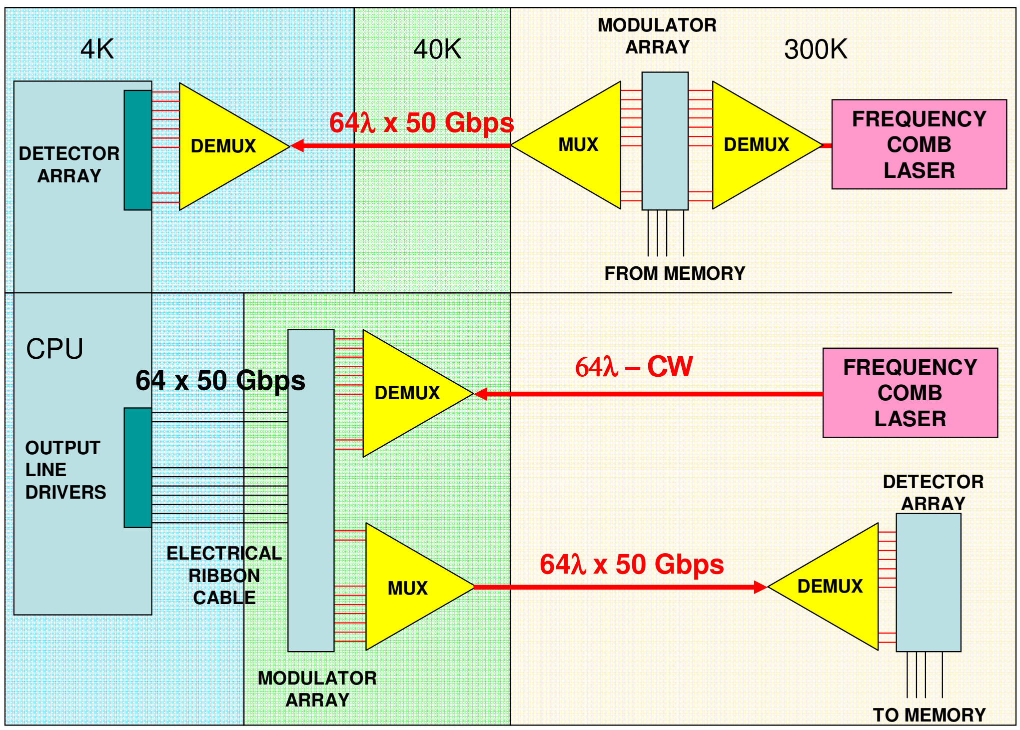

Figure 1: A 3 fiber, 64 wavelength, 50 Gbps DWDM System for bidirectional transmission totaling 6.4 Tbps between each of 4096 superconductor processors at 4K and mass memory at 300K**.**

Low power can be achieved in a number of ways. One is to reduce the voltage levels required to drive the low temperature operation modulators. Another is to use high order modulation techniques to reduce the operating frequency of each modulator, and thereby the drive voltage required. While this increases the number of modulators, it improves the spectral efficiency, and reduces the overall power. This also opens other options, which will be discussed. It should be noted that with the short distances involved, transmission impairments are not an issue and coherent optical receivers are greatly simplified.

3. References

[1] T. Sterling, M. Dorojevets, B. Smith, T. Van Duzer, A. Silver "Superconducting Technology Assessment Panel Session", Super Computers 2005, Seattle, WA, November 12-18, 2005

[2] www.nitrd.gov/pubs/nsa/sta.pdf

[3] C. Kromer, G. Sialm, C. Berger, T. Morf, M.L. Schmatz, F. Ellinger, D. Erni, G-L Bona, H. Jackel, "A 100 mW 4/spl times/10Gb/s transceiver in 80-nm CMOS for high density optical interconnects", IEEE Journal of Solid State Circuits, **23**, 2667-2679 (2005).