Integrated Photonics and Nanophotonics Research and Applications (IPNRA)

Topical Meeting and Tabletop Exhibit

Collocated with
Slow and Fast Light Topical Meeting and Tabletop Exhibit (SL)

July 8-11, 2007

Hilton Salt Lake City Center
Salt Lake City, Utah, USA

Pre-Registration Deadline: June 6, 2007
Housing Deadline: June 14, 2007

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 Letter of Invitation section of this Web site for additional information.

Program Committee

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IPNRA 3: Modeling, Numerical Simulation, and Theory

Stefano Selleri, *Univ. degli Studi di Parma, Italy,* Chair
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Jiri Petracek, *Brno Univ. of Technology, Czech Republic*
Azizur Rahman, *City Univ., UK*
Frank Schmidt, *Konrad-Zuse-Sentrum fü r Informationstechnik Berlin, Germany*

IPNRA 4: Nanophotonic Devices and Applications

Michal Lipson, *Cornell Univ., USA*, Chair
Raymond Beausoleil, *HP Labs, USA*
Richard DeLaRue, *Univ. of Glasgow, Scotland*
Hans Peter Herzig, *Univ. de Neuchatel, Switzerland*
Ashok Krishnamoorthy, *Sun Microsystems Inc., USA*
Philippe Lalanne, *Inst. d'Optique, France*
Jung Shin, *Korea Inst. of Science & Technology, Korea*
Thomas Suleski, *Univ of North Carolina at Charlotte, USA*
Dries Van Thourhout, *Univ. Gent, USA*
Kuzumi Wada, *Univ. of Tokyo, Japan*

About Integrated Photonics and Nanophotonics Research and Applications

July 8 – 11, 2007

This year, the Integrated Photonics Research and Applications Topical Meeting and the Nanophotonics Topical Meeting have been combined. The meeting will cover all aspects of research in integrated photonics and nanophotonics, featuring innovative science and engineering results. Topics include active and compound semiconductor devices; dielectric waveguides and waveguide devices; modeling and numerical simulation; integrated diffractive optics; microphotonics; and the generation, detection, and transport of optical fields on the "nanoscale." Application areas within the scope of this meeting include telecommunications, information technology, optical computing, optical storage, displays, environmental monitoring, biomedical science and instrumentation, and quantum information processing and communication. Nanophotonics is on a scale ranging from individual atoms, molecules or their clusters, to that of subwavelength effective media and photonic crystals.

Integrated Photonics and Nanophotonics Research and Applications Meeting Topics

Silicon or Other Group IV Waveguide Photonics: Including SOI-based materials – active, light emitters or lasers isolation, amplifiers, passives, and complex circuits.

Active and Compound Semiconductor Devices: Active III-V semiconductor devices; compound semiconductor modulators; filters; switches; wavelength converters; VCSELs; planar amplifiers; photonic integrated circuits and optoelectronic integrated circuits; compound semiconductor WDM components; novel III-V quantum optoelectronic devices; III-V materials and processing for photonics; reliability advances and issues; and emerging packaging technologies.

Dielectric and Polymer Waveguides and Waveguide Devices: Integrated planar waveguides; polymer-based waveguide devices; active/passive integrated components; switches; variable optical attenuators; modulators; filters; integrated isolators and circulators; planar dispersion compensators; materials and fabrication technologies for photonic integrated circuits; characterization of linear and nonlinear optical waveguide devices; micro-machines and micro-optic components; parallel optical interconnects; reliability advances and issues; novel assembly and manufacturing techniques; and low-cost technology for polymer devices.

$LiNbO_3$ - and Other Metal-Oxide-Based Switches and Modulators: Ultrahigh-speed; low-$V\pi$; devices; integrated scanners; and new fabrication methods.

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; advances in computational algorithms, physics and coupled models for integrated photonic circuits.

Microphotonics: Simulation, modeling and experimental characterization of microcavity and other high confinement structures, waveguides, resonators, filters, add-drop integrated optical circuits, metallic and metallodielectric waveguides.

Inhomogeneous Materials (e.g., Composite Dielectrics, Semiconductors, Metals and Metallodielectrics): Anisotropic; dispersive; efficient light extraction; nonlinear optical materials; and dynamically configurable.

Nano-Engineered Devices for Generation, Transport, and Detection of Light: Resonators; light sources; quantum information; modulators; nano-MEMS; biophotonics; biological and chemical transducers and sensors; and efficient mode matching.

Nanofabrication Technology: Lithography techniques; growth and deposition approaches; self-organized methods; and etching.

Characterization Tools on the Nanoscale

Modeling and Simulation Tools

Photonic Crystals, Waveguides, and Fibers

Nanoscale Integration of Planar, Free-Space, and Mixed Subsystems

Integrated Photonics and Nanophotonics Research and Applications Invited Speakers

Optofluidic Technology, James Adleman; *Caltech, USA*

InP-Based Multi-Function Integrated Devices, Pietro Bernasconi; *Bell Labs, USA*

Hybrid Silicon Laser by Wafer Bonding, John Bowers; *Univ. of California at Santa Barbara, USA*

Linear and Nonlinear Propagation in Ring Microresonators, Jiri Ctyroky; *Inst. of Radio Engineering and Electronics, Czech Republic*

System Requirements for WDM Nano-Photonics, John E. Cunningham; *Sun Microsystems, USA*

Developments in Photonic Crystal Theory: Dynamics, Strong Correlation, and New Meta-Materials, Shanhui Fan; *Stanford Univ., USA*

Polymer Waveguides and Advances in Fabrication Techniques, Warren N. Herman; *Lab for Physical Sciences, USA*

Silicon Photonics for Biosensing Applications, Siegfried Janz; *Natl. Res. Council Canada, Canada*

InP-Based Monolithic Integration Technology, Charles Joyner; *Infinera, USA*

Semiconductor Photonic Integration for Advanced Telecom Applications, Takaaki Kakitsuka; *NTT Photonics Labs, Japan*

Electronic-Photonic Convergence: A Roadmap for Silicon Micro Electronics, Lionel Kimerling; *MIT, USA*

Electronically Driven Photonic Crystal Light Emitters, Yong Hee Lee; *KAIST, Republic of Korea*

Modeling Photonic Crystals by Dirichlet-to-Neumann Maps, Ya Yan Lu; *City Univ. of Hong Kong, Hong Kong*

Athermal AWGs for WDM-PON, Brian McGinnes; *Neophotonics Corp., USA*

40Gbps-Capable Integrated Wavelength Converter on InP, Yasunori Miyazaki; *Mitsubishi Electric Corp., Japan*

Integrated Optics: How Integrated? Salvatore Morasca; *Avanex, Italy*

Prospects of Silicon Photonics for Future VLSI Interconnects, Mario Paniccia; *Intel Corp., USA*

CMOS Electronic-Photonic Integration in a Foundry World, Sanjay Patel; *Bell Labs, Lucent Technologies, USA*

InP-PLC Multi-Chip Hybrid Integration Design and Assembly, Alistair J. Poustie; *Ctr. for Integrated Photonics, UK*

Wavefront Matching Waveguide: Principles and Design, Takashi Saida; *NTT Corp., Japan*

Micro- and Nanocavities for Microfluidic Spectroscopy, Axel Scherer; *Caltech, USA*

Planer Lightwave Circuit Integration with $LiNbO_3$, Takashi Yamada; *NTT Access Network Service Systems Labs, Japan*

TE/TM Wave Splitters Using Surface Plasmon Polaritons, Junji Yamauchi; *Faculty of Engineering, Hosei Univ., Japan*

Exhibitors to Integrated Photonics and Nanophotonics Research and Applications

Tabletop Exhibit:
July 9-11, 2007

Topical Meeting:
July 8-11, 2007

Tabletop exhibit space will be $970 for Corporate Members and $1020 for non-members and will include:

- **One complimentary registration list**
- **One complimentary technical registration and two exhibit personnel registrations**
- **One copy of the meeting's proceedings**

If you have questions about exhibiting at IPNRA/SL, please contact our exhibit sales staff at 202.416.1428 or exhibitsales@osa.org

Sponsorship Opportunities at IPNRA/SL

Increase your company's visibility among qualified attendees with a sponsorship at the event.

Current IPNRA/SL Sponsorship Opportunities include:

- **Coffee Break Sponsorships**
- **Reception Sponsorships**
- **Attendee Tote Bag Sponsorship**
- **Registration Material Inserts**
- **Advertising Signage Placements**

Plus other customizable promotional opportunities

To find out more about one of the sponsorship opportunities listed above or to discuss a customized IPNRA/SL promotional package or sponsorship, please contact Melissa Russell at 202.416.1957 or email exhibitsales@osa.org.

Program Agenda

	Alpine Ballroom	Grand Ballroom A	Grand Ballroom B	Alpine East
Sunday, July 8, 2007				
4:00 p.m. – 6:00 p.m.	Registration Open, 2nd Floor Foyer			
Monday, July 9, 2007				
7:00 a.m. – 5:00 p.m.	Registration Open, 2nd Floor Foyer			
8:15 a.m. – 8:30 a.m.	IPNRA/SL Opening Remarks			
8:30 a.m. – 10:00 a.m.	JMA ● Plenary I			
10:00 a.m. – 10:30 a.m.	Exhibits Open/Coffee Break, Grand Ballroom C			
10:30 a.m. – 12:00 p.m.	JMB ● Plenary II			
12:00 p.m. – 1:30 p.m.	Lunch (on your own)			
1:30 p.m. – 3:30 p.m.	SMA ● General Overview and Applications	IMA ● Active Waveguide Devices	IMB ● Modeling and Design of Photonic Crystals	
3:30 p.m. – 4:00 p.m.	Exhibits Open/Coffee Break, Grand Ballroom C			
4:00 p.m. – 5:15 p.m.	SMB ● Fundamental Limit and Image Delay (4:00 p.m. - 5:30 p.m.)	IMC ● Novel Devices	IMD ● Devices and Systems for Optical Interconnects	
Tuesday, July 10, 2007				
7:30 a.m. – 5:00 p.m.	Registration Open, 2nd Floor Foyer			
8:30 a.m. – 10:30 a.m.		ITuA ● Polymer Waveguides and Microrings	ITuB ● Modeling and Design of Plasmon and Photonic Devices	STuA ● Slow Light in Semiconductors
10:30 a.m. – 11:00 a.m.	Exhibits Open/Coffee Break, Grand Ballroom C			
11:00 a.m. – 12:30 p.m.		ITuC ● Hybrid Symposium Session I	ITuD ● On Chip Photonic Devices	STuB ● High-*Q* Cavity and Ring Resonators
12:30 p.m. – 2:00 p.m.	Lunch (on your own)			
2:00 p.m. – 4:00 p.m.		ITuE ● Group IV and Hybrid Photonic Devices	ITuF ● Modeling and Design of Resonant Devices	STuC ● Physics of Slow Light
4:00 p.m. – 4:30 p.m.	Exhibits Open/Coffee Break, Grand Ballroom C			
4:30 p.m. – 6:00 p.m.		ITuG ● Hybrid Integration Symposium II	ITuH ● Modeling and Design of Photonic Crystal Fibers	STuD ● Cold Atoms, Coherent Control of Slow Light
6:00 p.m. – 7:30 p.m.	Conference Reception & JTuA ● Joint Poster Session, Grand Ballroom C			

	Grand Ballroom A	Grand Ballroom B	Alpine East
Wednesday, July 11, 2007			
8:00 a.m. – 5:00 p.m.	Registration Open, 2nd Floor Foyer		
8:30 a.m. – 10:30 a.m.	IWA ● Integrated Optical Sensors	IWB ● Modeling and Design of Integrated Devices	SWA ● Slow Light in Optical Fibers and Waveguides
10:30 a.m. – 11:00 a.m.	Exhibits Open/Coffee Break, Grand Ballroom C		
11:00 a.m. – 12:30 p.m.	IWC ● Planer Lightwave Circuits	IWD ● Silicon Photonics	SWB ● Photonic Crystal Waveguides
12:30 p.m. – 2:00 p.m.	Lunch (on your own)		
2:00 p.m. – 4:00 p.m.	IWE ● Semiconductor Photonic Integrated Devices	IWF ● Photonic Crystals and Resonators	SWC ● Optical Fibers-Brillouin Scattering, Wavelength Conversion
4:00 p.m. – 4:30 p.m.	Exhibits Open/Coffee Break, Grand Ballroom C		
4:30 p.m. – 6:00 p.m.	IWG ● IPNRA Postdeadline Paper Session		SWD ● Slow and Fast Light Rump Session
6:00 p.m. – 6:15 p.m.	IPNRA Closing Remarks		SL Closing Remarks

Integrated Photonics and Nanophotonics Research and Applications Abstracts

• Sunday, July 8, 2007 •

2nd Floor Foyer
4:00 p.m. – 6:00 p.m.
Registration Open

• Monday, July 9, 2007 •

2nd Floor Foyer
7:00 a.m. – 5:00 p.m.
Registration Open

Alpine Ballroom
8:15 a.m. – 8:30 a.m.
IPNRA/SL Opening Remarks

JMA • IPNRA/SL Plenary I

Alpine Ballroom
JMA • IPNRA/SL Plenary I
8:30 a.m. – 10:00 a.m.
Gadi Eisenstein; Technion, Israel and *Nadir Dagli; Univ. of California at Santa Barbara, USA, Presiders*

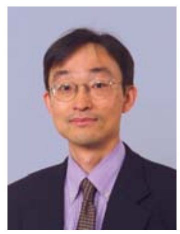
JMA1 • 8:30 a.m. **Plenary**

Active and Passive Coupled-Resonator Optical Waveguides, *Amnon Yariv; Caltech, USA.* I will describe the basic instructive approach to slow wave phenomena but emphasize those taking place in patterned optical structures which can be engineered and controlled. The basic mathematical similarity between electromagnetically induced transparency in atomic media and propagation in coupled cavity systems will be discussed as well as the role of optical amplification and nonlinear frequency conversion in slow light applications.

Amnon Yariv received the B.S., M.S., and Ph.D. degrees in electrical engineering from the University of California at Berkeley, in 1954, 1956, and 1958, respectively. In 1959, he joined Bell Telephone Laboratories, Murray Hill, NJ. In 1964, he joined the California Institute of Technology, Pasadena, as an associate professor of electrical engineering, becoming a professor in 1966. In 1980, he became the Thomas G. Myers Professor of Electrical Engineering and Applied Physics. In 1996, he became the Martin and Eileen Summerfield Professor of Applied Physics and Professor of Electrical Engineering. On the technical and scientific sides, he took part (with various coworkers) in the discovery of a number of early solid-state laser systems, in the original formulation of the theory of nonlinear quantum optics; in proposing and explaining mode-locked ultrashort-pulse lasers, GaAs optoelectronics; in proposing and demonstrating semiconductor-based integrated optics technology; in pioneering the field of phase conjugate optics; and in proposing and demonstrating the semiconductor distributed feedback laser. He has published widely in the laser and optics fields and has written a number of basic texts in quantum electronics, optics, and quantum mechanics. Yariv is a member of the American Academy of Arts and Sciences, the National Academy of Engineering, and the National Academy of Sciences.

JMA2 • 9:15 a.m. **Plenary**

Novel Optical Waveguide Devices and Its Application to Optical Communication, *Hiroshi Takahashi, Toshikazu Hashimoto, Yohei Sakamaki, Takashi Saida; NTT Photonics Labs, Japan.* The wavefront matching method provides a new way to obtain the optimum waveguide shape in planar lightwave circuit devices. This presentation reviews the principle behind the method and shows its usefulness with some experimental results.



Hiroshi Takahashi was born in Japan in 1963 and received bachelor and master degrees in electrical engineering from Tohoku University in 1986 and 1988, respectively. In 1988, he joined NTT Laboratories where he engaged in research on the design and fabrication of silica-based optical waveguide devices, including arrayed waveguide grating (AWG) wavelength multi/demultiplexers, for which he was awarded a Ph.D. in 1997 by Tohoku University. From 1998 to 2001, he was with NTT Electronics where he developed the first AWG multi/demultiplexer for commercial DWDM systems. He is currently a research group leader at NTT Photonics Laboratories and is working on a new optical waveguide design based on the wavefront matching (WFM) method and various kinds of waveguide circuits such as AWGs, Mach-Zehnder interferometer-based switches, reconfigurable optical add/drop multiplexing (ROADM) modules, dispersion compensators and optical CDMAs. He is also an adjunct lecturer at Yokohama National University and teaches optical fiber communication. From 2004 to 2005, he was the secretary of Optoelectronics Technical Committee at the Institute of Electronics, Information and Communication Engineers (IEICE) of Japan. Takahashi is a member of the IEICE, the Japan Society of Applied Physics (JSAP), and IEEE/LEOS.

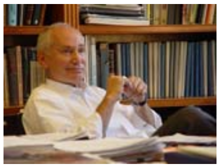
Grand Ballroom C
10:00 a.m. – 10:30 a.m.
Exhibits Open/Coffee Break

JMB • IPNRA/SL Plenary II

Alpine Ballroom
JMB • IPNRA/SL Plenary II
10:30 a.m. – 12:00 p.m.
William Steier; Univ. of Southern California, USA and *Shun Lien Chuang; Univ. of Illinois, USA, Presiders*

JMB1 ● 10:30 a.m. **Plenary**

Photonic Integration on Silicon ICs: Bridging the Last Micron, *Lionel C. Kimerling; MIT, USA.* Communication bandwidth, power dissipation and pin count have replaced transistor count and gate delay as the leading performance limiting factors for electronic systems. Electronic-Photonic synergy can extend the performance and functionality of the CMOS platform beyond traditional scaling methodologies. Solutions for architecture, circuits and scalability by monolithic photonic integration will be reviewed and evaluated.



Lionel C. Kimerling is the Thomas Lord Professor of Materials Science and Engineering at MIT. Kimerling is also the Director of the Materials Processing Center where he conducts an active research program in the structure, properties and processing of semiconductor materials, and he is Director of the MIT Microphotonics Center. He received his S.B. degree in Metallurgy and his Ph.D. in Materials Science in from the Massachusetts Institute of Technology. He was Head of the Materials Physics Research Department at AT&T Bell Laboratories until 1990, when he joined the faculty of MIT as Professor. Prior to joining AT&T, he served as Captain, USAF at the Solid State Sciences Laboratory of the Air Force Cambridge Research Laboratories. He has authored over 300 technical articles. Kimerling was the 1994 President of TMS/AIME (The Minerals, Metals and Materials Society). He is a Fellow of the American Physical Society, a Fellow of the AAAS, and a member of the National Center for Photovoltaics Advisory Board, NREL. He is the recipient of the 1995 Electronics Division Award of the Electrochemical Society, the 1996 MIT Perkins Award for Excellence in Graduate Advising, the 1997 Humboldt Senior Scientist Research Award, the 1999 John Bardeen Award of TMS, and the TMS Fellow Award in 2000. His research has had fundamental impacts on the understanding of the chemical and electrical properties of defects in semiconductors and in the use of this knowledge in materials processing and component reliability. His research teams have enabled the first long-lived telecommunications lasers, produced the first 1MB DRAM, developed semiconductor diagnostic methods such as DLTS, and pioneered silicon microphotonics.

JMB2 ● 11:15 a.m. **Plenary**

Slow Light in Bose-Einstein Condensates: A New Paradigm for Coherent Control, *Lene Vestergaard Hau; Harvard Univ., USA.* I will discuss slow and stopped light, and recent observations that a light pulse is extinguished in one atom cloud and then revived from a separate cloud, in a different location, and sent back on its way.

Lene Vestergaard Hau obtained her Ph.D. in theoretical condensed matter physics from the University of Aarhus in Denmark in 1991. That same year she joined the Rowland Institute for Science in Cambridge, Massachusetts, as a scientific staff member. Since 1999 she has been on the faculty at Harvard University and currently holds the Mallinckrodt Professorship of Physics and of Applied Physics. In 2001, Hau received the MacArthur Genius Award. In 1999, Hau's team at the Rowland Institute reported in *Nature* that they had slowed light to bicycle speed in a Bose-condensed atom cloud. Two years later they reported, also in *Nature*, how they had stopped a light pulse and then, several milliseconds later, let it loose again. Hau has worked in the fields of experimental and theoretical optical, atomic, and condensed matter physics, and her research has spanned studies of ultra-cold atoms and superfluid Bose-Einstein condensates, as well as channeling of relativistic MeV electrons and positrons in single crystals. The latter has involved the development of channeling radiation as a solid state probe of valence-electron and spin-magnetic densities and has included experiments at CERN, Brookhaven, and Lawrence Livermore National Laboratory.

12:00 p.m. – 1:30 p.m.
Lunch (on your own)

IMA • Active Waveguide Devices

Grand Ballroom A
1:30 p.m. – 3:30 p.m.
IMA ● Active Waveguide Devices
Maura Raburn; Infinera Corp., USA, Presider

IMA1 ● 1:30 p.m. **Invited**

Semiconductor Tunable Lasers Based on Integrated Waveguide Filters for Wavelength Routing Applications, *Takaaki Kakitsuka, Shinji Matsuo, Toru Segawa, Hiroyuki Suzuki; NTT Photonics Labs, Japan.* We present two types of tunable lasers with integrated waveguide filters; one using a ladder-type filter, the other using double-ring resonators. Their characteristics and applications to wavelength routing in photonic networks are described.

IMA2 ● 2:00 p.m.

Highly Efficient GaAs/AlGaAs Substrate Removed Nanowire Phase Modulators Based on Current Injection, *JaeHyuk Shin, Yu-Chia Chang, Nadir Dagli; Univ. of California at Santa Barbara, USA.* Highly efficient GaAs/AlGaAs nanowire phase modulators with drive voltage less than 0.1 V and phase shift efficiency π/mA have been realized. The modulator requires only 6.25 μW AC drive power for full modulation.

IMA3 ● 2:15 p.m.

Multi-Bounce Dual Grating Reflector for Internal Wavelength Locking of Laser Diodes, *Jason O'Daniel[1], Oleg Smolski[1], Eric Johnson[2]; [1]College of Optics and Photonics, CREOL and FPCE, Univ. of Central Florida, USA, [2]Univ. of North Carolina at Charlotte, USA.* This paper introduces a multi-bounce scheme based on a Dual Grating Reflector concept for integrated wavelength locking of broad stripe laser diodes.

IMA4 ● 2:30 p.m. **Invited**

InP-Based Multi-Function Integrated Optical Devices, *Pietro Bernasconi, A. Bhardwaj, C. R. Doerr, L. Zhang, N. Sauer, L. Buhl, W. Yang, D. T. Neilson; Bell Labs, USA.* We review a few recent examples of monolithically integrated devices comprising a variety of heterogeneous functional elements such as fast-tunable wavelength converters, amplified optical equalizers, and dispersion-managed electro-absorption modulators.

IMA5 ● 3:00 p.m. **Invited**

High-Speed Integrated Modulators and Receivers, *Karl-Otto Velthaus; Heinrich-Hertz-Inst., Germany.* Modulators and receivers are key components for high-speed transmission networks. This paper presents recent results at HHI for InP based MZ-modulators and receiver structures for serial high-speed and phase modulation formats.

Grand Ballroom C
3:30 p.m. – 4:00 p.m.
Exhibits Open/Coffee Break

IMB • Modeling and Design of Photonic Crystals

Grand Ballroom B
1:30 p.m. – 3:30 p.m.
IMB ● Modeling and Design of Photonic Crystals
Stefano Selleri; Univ. of Parma, Italy, Presider

IMB1 ● 1:30 p.m. **Invited**

Modeling Photonic Crystals by Dirichlet-to-Neumann Maps, *Ya Yan Lu[1], Jianhua Yuan[2], Shaojie Li[1]; [1]Dept. of Mathematics, City Univ. of Hong Kong, Hong Kong, [2]Dept. of Mathematics, Beijing Univ. of Posts and Telecommunications, Hong Kong.* The DtN map can be used to develop efficient numerical methods for analyzing photonic crystals. Boundary integral equation and multipole methods are used to construct DtN maps and computing band structures and transmission spectra.

IMB2 ● 2:00 p.m.

Band-Structure Analysis of 2-D Non-Diagonal Anisotropic Photonic Crystals by the Finite Element Method, *Sen-ming Hsu, Ming-mung Chen, Hung-chun Chang; Natl. Taiwan Univ., Taiwan.* A finite-element method based eigenvalue algorithm is developed to investigate the intrinsic effect of anisotropy on the construction of complete band structures for two-dimensional non-diagonal anisotropic photonic crystals. Analysis for the triangular lattice is demonstrated.

IMB3 ● 2:15 p.m.

Analysis of 2-D Photonic Crystals Involving Liquid Crystals Using the Finite-Difference Frequency-Domain Method, *Ming-mung Chen, Sen-ming Hsu, Hung-chun Chang; Natl. Taiwan Univ., Taiwan.* The finite-difference frequency-domain method is formulated for calculating band structures of 2-D photonic crystals involving anisotropic materials. The director of the liquid crystal is allowed to rotate in the plane of the unit cell.

IMB4 ● 2:30 p.m.

An E-Field Eigenvalue Method for Computing Waveguides and Photonic Band-Gap Properties, *Vitor M. Schneider, James A. West, Karl W. Koch; Corning, Inc, USA.* A new direct vectorial two-dimensional solution based on an eigenvalue method is implemented to analyze waveguides and photonic band-gap structures based on a simpler E-field formulation unlike the H-field formulation.

IMB5 ● 2:45 p.m.

Modal Solutions for Square and Circular Rod Photonic Crystals by the Finite Element Method, *B. M. A. Rahman[1], Arti Agrawal[1], Kenneth T. V. Grattan[1], S. S. A. Obayya[2]; [1]City Univ., UK, [2]Univ. of Wales, Swansea, UK.* Modal solutions for Photonic Crystal with circular and square shaped rods have been obtained using the Finite Element method. We compare the field distributions and effective indices with rod shape in the Photonic Crystal.

IMB6 ● 3:00 p.m. **Invited**

Developments in Photonic Crystal Theory: Nonlinearity, Strong Correlation, and Non-Maxwellian Meta-Materials, *Shanhui Fan, Xiaofang Yu, Jung-Tsung Shen, Jonghwa Shin; Stanford Univ., USA.* We show that photonic crystals can be used to control self-focusing and to induce strong-photon interaction. We also propose 3-D meta-materials that support non-Maxwellian effective fields.

Grand Ballroom C
3:30 p.m. – 4:00 p.m.
Exhibits Open/Coffee Break

IMC • Novel Devices

Grand Ballroom A
IMC ● Novel Devices
4:00 p.m. – 5:15 p.m.
Mehdi Asghari; Kotura Inc., USA, Presider

IMC1 ● 4:00 p.m.

Unidirectional Dual Grating Output Coupler, *Andrew Greenwell, Sakoolkan Boonruang, M. G. Moharam; College of Optics and Photonics, CREOL, Univ. of Central Florida, USA.* A novel all-dielectric unidirectional output coupler is presented and rigorously analyzed. Up to 96% substrate-side coupling is obtained over a wide range of grating properties. The device operation is very tolerant to structure parameters.

IMC2 ● 4:15 p.m.

High Efficiency Fiber-to-Waveguide Grating Couplers in Silicon-on-Insulator Waveguide Structures, *Gunther Roelkens, Jonathan Schrauwen, Dries Van Thourhout, Roel Baets; Ghent Univ., INTEC, Belgium.* High efficiency fiber-to-waveguide grating couplers were designed in SOI waveguide structures. 66% coupling efficiency can be obtained with a 3dB bandwidth of 85nm. Prototype fabrication reveals 2dB coupling efficiency improvement over standard grating coupler structures.

IMC3 ● 4:30 p.m.

Compact 90° Bends and Splitters for Silicon Rib Waveguides, *Yusheng Qian, Jiquo Song, Seunghyun Kim, Greg Nordin; Brigham Young Univ., USA.* We report the design, fabrication, and characterization of polymer-filled trench-based 90 degree bends and splitters for silicon rib waveguides. These are used to create compact splitter and bend networks for microcantilever array sensors.

IMC4 ● 4:45 p.m.
Low-Loss Compact Size Slotted Waveguide Mode Transformers, *Ning-Ning Feng, Rong Sun, Jurgen Michel, Lionel C. Kimerling; MIT, Microphotonics Ctr., USA.* We present various waveguide transformers that are capable of converting Gaussian-like waveguide modes to non-Gaussian-like slotted waveguide modes. The devices can achieve complete mode transformation within tens of micrometers with insertion loss less than 0.04dB.

IMC5 ● 5:00 p.m.
Integrated Optical Approaches to Millimeter-Wave Generation and Modulation, *Richard W. Ridgway, David W. Nippa, David J. Arft; Battelle, USA.* Two lithium niobate modulators and an arrayed waveguide grating are used to generate a millimeter-wave carrier at 94 GHz and to encode a 10 GB/s data stream onto the carrier for wireless data transport.

IMD • Devices and Systems for Optical Interconnects

Grand Ballroom B
IMD ● Devices and Systems for Optical Interconnects
4:00 p.m. – 5:15 p.m.
Steven Spector; MIT, USA, Presider

IMD1 ● 4:00 p.m. **Invited**
System Requirements for WDM Nano-Photonics, *John E. Cunningham; Sun Microsystems, USA.* Abstract unavailable.

IMD2 ● 4:30 p.m.
Narrow Bandpass MEMS-Tunable Filters Based on Phase Shifted Guided-Mode Resonance Structures, *Mehrdad Shokooh-Saremi, Robert Magnusson; Univ. of Connecticut, USA.* A MEMS-tunable narrow bandpass filter concept is presented. This filter is based on the phase shift effect between two gratings resulting from halving a broadband high reflector guided-mode resonance structure.

IMD3 ● 4:45 p.m. **Invited**
High-Speed Silicon Modulator for Future VLSI Interconnect, *Ansheng Liu[1], Ling Liao[1], Doron Rubin[2], Juthika Basak[1], Hat Nguyen[1], Yoel Chetrit[2], Rami Cohen[2], Nahum Izhaky[2], Mario Paniccia[1]; [1]Intel Corp., USA, [2]Intel Corp., Israel.* We demonstrate a silicon optical modulator capable of transmitting data at a bit rate up to 40 Gbps. Such a high-speed modulator enables integrated silicon photonic chips for future high data streams VLSI interconnect applications.

● Tuesday, July 10, 2007 ●

2nd Floor Foyer
7:30 a.m. – 5:00 p.m.
Registration Open

ITuA • Polymer Waveguides and Microrings

Grand Ballroom A
ITuA ● Polymer Waveguides and Microrings
8:30 a.m. – 10:30 a.m.
Greg Nordin; Univ. of Alabama at Huntsville, USA, Presider

ITuA1 ● 8:30 a.m. **Invited**
Polymer Waveguides and Advances in Fabrication Techniques, *Warren N. Herman, Y. Leng, V. Yun, W.-y. Chen, V. Van, T. Ding, L. Lucas, L. Li, E. Gershgoren, J. T. Fourkas, P.–t. Ho, J. Goldhar; Lab for Physical Sciences, Univ. of Maryland, USA.* We review our progress in fabricating polymer optical waveguides using three techniques: laser ablation and automatic dispensing, standard photolithography, and 3-D multiphoton absorption polymerization. Applications discussed include optical interconnects for PC boards and microring resonators.

ITuA2 ● 9:00 a.m.
Integrated Optical Polymer Micro-Ring Sensors, *Bipin Bhola, William H. Steier; Univ. of Southern California, USA.* A new class of fiber-based polymer micro-ring sensors is demonstrated for measuring strain and acceleration based on the principle of measuring the change in resonant wavelength of the micro-ring resonator.

ITuA3 ● 9:15 a.m.
Fabrication and Characterization of Low-Loss Polymeric Waveguides and Micro-Resonators, *Jacob Scheuer; Tel Aviv Univ., Israel.* We realize low loss, single-mode polymer waveguides and microrings in SU-8 using E-beam lithography and demonstrate a simple approach for accurately extracting the propagation loss i and the coupling between the waveguide and the microring.

ITuA4 ● 9:30 a.m.
Time-Domain Characterization of Integrated Devices by Optical Coherence Pulsed Interferometry, *Francesco Morichetti[1,2], Andrea Melloni[2], Mario Martinelli[1,2]; [1]CORECOM, Italy, [2]Politecnico di Milano, Italy.* The complex amplitude of optical pulses is observed in time-domain by a novel interferometric technique, requiring no fast detection or synchronization. Pulse delay, envelope distortion and frequency chirp introduced by integrated ring resonators is measured.

ITuA5 ● 9:45 a.m.
Invariant Resonance Splitting in Stand-Alone Multiring Resonators, *Otto Schwelb; Concordia Univ, Canada.* Relations between coupling strength and resonator mode numbers that ensure invariant resonance splitting in stand-alone multiring resonators of diverse architectures are investigated analytically and numerically. The loss-insensitive splitting determines the bandwidth of the associated circuitry.

ITuA6 ● 10:00 a.m.
Design of Multilayer Optical Filters Using Linear Programming Based on Autocorrelation Sequences, *Mohamed A. Swillam, Mohamed H. Bakr, Xun Li; McMaster Univ., Canada.* A novel design approach of multilayer dielectric structures is proposed. The design problem is approximated as a linear programming by exploiting the autocorrelation sequence. Interior point methods are then utilized for efficiently solving the problem.

ITuA7 • 10:15 a.m.
3-D Tapered Waveguides in Volume Photopolymers, *Amy C. Sullivan, Robert R. McLeod; Univ. of Colorado, USA.* We demonstrate tapered waveguides written in volume photopolymers using a three-dimensional (3-D) direct-write lithography system. Cross sections of the tapered index profiles are measured using an optical diffraction tomography system.

Grand Ballroom C
10:30 a.m. – 11:00 a.m.
Exhibits Open/Coffee Break

ITuB • Modeling and Design of Plasmon and Photonic Devices

Grand Ballroom B
ITuB • Modeling and Design of Plasmon and Photonic Devices
8:30 a.m. – 10:30 a.m.
Andre Delage; Natl, Res. Council Canada, Canada, Presider

ITuB1 • 8:30 a.m.
Simulation of Surface Plasmon Polariton (SPP) Bragg Gratings by Complex Mode Matching Method, *Jian-wei Mu, Wei-ping Huang; McMaster Univ., Canada.* Surface plasmon polariton grating structures are simulated by complex mode matching method. Reflection, transmission and loss of the SPP modes by Bragg gratings are simulated and their dependence on key waveguide and grating parameters are investigated.

ITuB2 • 8:45 a.m.
Characterization of Surface-Plasmon Resonance Based Sensors for Biophotonic Applications, *Christos Themistos[1], Muttukrishnan Rajarajan[2], Azizur Rahman[2], Kenneth Grattan[2]; [1]Frederick Inst. of Technology, Cyprus, [2]City Univ., UK.* Finite element analysis based on the vector H-field formulation and incorporating the perturbation technique, is used to calculate the complex propagation characteristics of metal-coated dielectric waveguides for biophotonic applications.

ITuB3 • 9:00 a.m.
Surface Plasmon Resonance in a Few-Mode Waveguide: A Novel Detection Strategy, *Nelson Darío Gómez-Cardona, Jorge Alberto Gómez, Pedro Torres; Univ. Nacional de Colombia, Colombia.* A theoretical prediction of the surface plasmon resonance effect within the light distribution irradiated by a few-mode waveguide is presented. Then, a novel detection strategy to evaluate the SRP phenomenon is proposed.

ITuB4 • 9:15 a.m.
Particle Swarm Optimization: Principles and Application to the Design of Resonant Grating Devices, *Mehrdad Shokooh-Saremi, Robert Magnusson; Univ. of Connecticut, USA.* Particle swarm optimization (PSO) is an evolutionary, easy-to-implement and promising technique to design optical diffraction gratings. In this paper, design of guided-mode resonance (GMR) grating filters using PSO is reported.

ITuB5 • 9:30 a.m.
An Extremely Short Polarization Converter Using a Triangular Waveguide, *Junji Yamauchi, Masahiro Yamanoue, Hisamatsu Nakano; Faculty of Engineering, Hosei Univ., Japan.* A novel polarization converter in a buried waveguide is proposed. The polarization conversion length is found to be 2 microns with the insertion loss being less than 0.5 dB at a wavelength of 1.55 microns.

ITuB6 • 9:45 a.m.
Improving Design of Chirped Mirrors via Pulse Waveform Analysis, *Igor A. Sukhoivanov[1,2], Oleksiy V. Shulika[2], Sergiy O. Yakushev[2], Sergiy I. Petrov[2], Volodymyr V. Lysak[2,3], Alla V. Kublyk[2]; [1]Univ. Guanajuato, Mexico, [2]Natl. Univ. of Radio Electronics, Ukraine, [3]Gwangju Inst. of Science and Technology (GIST), Republic of Korea.* Model for CM optimization in terms of pulse data and/or mirror characteristics is developed. We found there are domains of stable and unstable compression under variation of layer number, which is unpredictable with present counterparts.

ITuB7 • 10:00 a.m. **Invited**
TE/TM Wave Splitters Using Surface Plasmon Polaritons, *Junji Yamauchi, Tomohide Yamazaki, Koji Sumida, Hisamatsu Nakano; Faculty of Engineering, Hosei Univ., Japan.* A branch-type TE/TM wave splitter and a TM-pass/TE-stop polarizer consisting of a thin metal film sandwiched with dielectric gratings are studied by the beam-propagation method and the finite-difference time-domain method.

Grand Ballroom C
10:30 a.m. – 11:00 a.m.
Exhibits Open/Coffee Break

ITuC • Hybrid Symposium Session I

Grand Ballroom A
ITuC • Hybrid Symposium Session I
11:00 a.m. – 12:30 p.m.
Mark Earnshaw; Lucent Technologies, USA, Presider

ITuC1 • 11:00 a.m. **Invited**
InP-PLC Multi-Chip Hybrid Integration Design and Assembly, *Alistair J. Poustie; Ctr. for Integrated Photonics, UK.* Photonic hybrid integration is an exciting approach to realise high performance optical modules at low cost. I describe the technology platform that allows multiple InP chips to be combined to create advanced optical circuits.

ITuC2 • 11:30 a.m. **Invited**
High-Speed Optical Functional Modulators Using Hybrid Assembly Technique with Silica-Based Planer Lightwave Circuits and $LiNbO_3$ Devices, *Takashi Yamada, Motohaya Ishii, Yohei Sakamaki, Shinji Mino, Akimasa Kaneko, Akihide Sano, Yutaka Miyamoto; NTT Photonics Labs, NTT Corp., Japan.* We review the configuration and performance of two optical modulators that employ the silica-PLC and LN phase modulator assembly technique. One is a 43-Gbit/s FSK modulator, and the other is an 86-Gbit/s DQPSK modulator.

ITuC3 • 12:00 p.m. **Invited**

Optofluidic Technology, *James Adleman[1], David A. Boyd[1], David G. Goodwin[1], Demetri Psaltis[1,2]; [1]Caltech, USA, [2]EPFL, Switzerland.* Optofluidics refers to adaptive systems that integrate optical and fluidic devices. Micro and nano-fluidics enable novel devices which introduce liquids into optical structures. We discuss recent optofluidic developments, including optically powered vapor pumps.

12:30 p.m. – 2:00 p.m.
Lunch (on your own)

ITuD • On Chip Photonic Devices

Grand Ballroom B
ITuD • On Chip Photonic Devices
11:00 a.m. – 12:30 p.m.
John E. Cunningham; Sun Microsystems, USA, Presider

ITuD1 • 11:00 a.m. **Invited**

Electronically Driven Photonic Crystal Light Emitters, *Hong-Kyu Park, Min-Kyo Seo, Sun-Kyung Kim, Seo-Heon Kim, Yong Hee Lee; KAIST, Republic of Korea.* Low threshold current 2-D slab photonic crystal lasers are reported. Two nondegenerate resonant modes with a central node are investigated. Highly-efficient photon out-coupling schemes will also be discussed.

ITuD2 • 11:30 a.m.

Quantum Metamaterials for Advanced Plasmonics and Strong Coupling, *Jonathan Plumridge, Edmund Clarke, Ray Murray, Chris Phillips; Imperial College London, UK.* We demonstrate a new "quantum metamaterial". It supports guided modes which combine the plasmonic field enhancement and optical coupling advantages of metals, with centimetre propagation distances, and which strong-couple to quantum transitions we design-in.

ITuD3 • 11:45 a.m.

Near-Infrared Photodetector Enhanced by an Open-Sleeve Dipole Antenna, *Liang Tang, Ekin Kocabas, Salman Latif, Ali K. Okyay, Dany Ly-Gagnon, Krishna C. Saraswat, David A. B. Miller; Stanford Univ., USA.* We present a dipole-antenna-enhanced Ge photodetector that shows 20 times photocurrent enhancement ratio between two orthogonal light polarizations at 1310 nm wavelength, and a spectral resonance characteristic of ~ half-wavelength antenna behavior.

ITuD4 • 12:00 p.m.

Ultra-Sensitive Thermo-Plasmonic Oscillations in Topologically-Defected Nano-Cylinders: Merging Photons and Electrons for Miniaturization of Fluidic Sensors, *Nikolaos J. Florous, Kunimasa Saitoh, Masanori Koshiba; Div. of Electronics and Information Engineering, Hokkaido Univ., Japan.* Using an accurate analysis based on the discrete-dipole-approximation, we show that the enhanced tuning of the localized plasmonic resonances in corrugated nano-cylinders can form the basis for the miniaturization of future nano-fluidic sensing systems.

ITuD5 • 12:15 p.m.

Thermal Stability of Reflection Multilayers on p-AlGaN/GaN Contact of Deep-UV Light Emitting Diodes, *M. Khizar[1,2], K. Acharya[1,2], M. Yasin Akhtar Raja[1,2]; [1]Dept. of Physics and Optical Sciences, Univ. of North Carolina at Charlotte, USA, [2]Ctr. for Optoelectronics and Optical Communications, Univ. of North Carolina at Charlotte, USA.* Thermal stability of reflection layer (Ni/Au/Al/Ti/Au) on p-AlGaN/GaN of deep-UV flip chip LEDs has been studied. We observed that at 280°C for 45 s, bonding temperature has no degradation effect on device forward voltage.

12:30 p.m. – 2:00 p.m.
Lunch (on your own)

ITuE • Group IV and Hybrid Photonic Devices

Grand Ballroom A
ITuE • Group IV and Hybrid Photonic Devices
2:00 p.m. – 4:00 p.m.
Karl-Otto Velthaus; Heinrich-Hertz-Inst., Germany, Presider

ITuE1 • 2:00 p.m. **Invited**

Germanium Quantum-Well Photonic Devices on Silicon, *David A. B. Miller; Stanford Univ., USA.* We discuss the recent observation of quantum-confined Stark effect electroabsorption in germanium quantum wells grown on silicon substrates, and the implications for high-performance optical modulators and integrated optoelectronics on silicon chips.

ITuE2 • 2:30 p.m.

Waveguide-Integrated Ge Photodetectors on Si for Electronic and Photonic Integration, *Jifeng Liu[1], Donghwan Ahn[1], Ching-yin Hong[1], Mark Beals[1], Lionel C. Kimerling[1], Jurgen Michel[1], Jian Chen[1], Franz X. Kaertner[1], Andrew Pomerene[2], Daniel Carothers[2], Craig Hill[2], James Beattie[2], Kun-yii Tu[3], Young-Kai Chen[3], Sanjay Patel[3], Mahmoud Rasras[3], Alice White[3], Douglas Gill[3]; [1]MIT, USA, [2]BAE Systems, USA, [3]Bell Labs, Lucent Technologies, USA.* We demonstrate waveguide-integrated Ge p-i-n photodetectors on Si with vertical coupling and butt-coupling schemes. A responsivity of >1.0 A/W around 1550 nm and a bandwidth of several GHz were achieved in both cases.

ITuE3 • 2:45 p.m.

Responsivity and Transient Response of 1.5 µm-Infrared Si Photodiodes Fabricated in a CMOS Line, *Michael W. Geis[1], Steven J. Spector[1], Matthew E. Grein[1], Robert T. Schulein[1], Jung U. Yoon[1], Donna M. Lennon[1], Fuwan Gan[2], Franz Kaertner[2], Theodore M. Lyszczarz[1]; [1]MIT Lincoln Lab, USA, [2]MIT, USA.* CMOS-compatible, Si waveguide photodiodes, exhibit responsivity of 0.33 to 21 A W^{-1} and have transient response from <12 to 16 ps when exposed to 1.5-µm radiation. The diode's characteristics depend upon processing and bias voltage.

ITuE4 • 3:00 p.m. **Invited**

Advances, Challenges and Opportunities in Silicon Photonics, *Tom Koch; Lehigh Univ., USA.* Recent advances in silicon photonics will be discussed, along with key technical challenges that could significantly impact or enable new applications. This includes a brief summary of a NSF-Sponsored Workshop: Very Large Scale Photonic Integration.

ITuE5 ● 3:30 p.m.
Compact Carrier Injection Based Mach-Zehnder Modulator in Silicon, *Steven Spector[1], Matthew E. Grein[1], Robert T. Schulein[1], Michael W. Geis[1], Jung U. Yoon[1], Donna M. Lennon[1], Fuwan Gan[2], Franz X. Kaertner[2], Theodore M. Lyszczarz[1]; [1]MIT Lincoln Lab, USA, [2]MIT, USA.* CMOS-compatible, PIN diode Mach-Zehnder modulators have been fabricated. The devices operate at 10 GHz with a modulation depth of 25% at an input power of 100 mW. Compensated frequency response is flat to 5 GHz.

ITuE6 ● 3:45 p.m.
Hybrid Polymer/Fiber Waveguide for Electric Field Sensing, *Josh Kvavle[1], Eric K. Johnson[1], Richard H. Selfridge[1], Stephen M. Schultz[1], Richard Forber[2], Wen Wang[2], De Yu Zang[2]; [1]Brigham Young Univ., USA, [2]IPITEK, USA.* An electric field sensor is fabricated by etching the core of a D-Shaped fiber and depositing PMMA/DR1 which forms a hybrid Electro-Optic core. The device demonstrates sensitivity < 100 V/m at a frequency of 2.9Ghz.

Grand Ballroom C
4:00 p.m. – 4:30 p.m.
Exhibits Open/Coffee Break

ITuF • Modeling and Design of Resonant Devices

Grand Ballroom B
ITuF ● Modeling and Design of Resonant Devices
2:00 p.m. – 4:00 p.m.
Andrea Melloni; DEI, Italy, Presider

ITuF1 ● 2:00 p.m. **Invited**
Micro- and Nanocavities for Microfluidic Spectroscopy, *Axel Scherer; Caltech, USA.* Abstract unavailable.

ITuF2 ● 2:30 p.m.
Interlaced Coupled-Cavity Waveguide Platform for Silicon Photonics, *Ashutosh R. Shroff[1], Philippe M. Fauchet[2]; [1]Inst. of Optics, Univ. of Rochester, USA, [2]Dept. of Electrical and Computer Engineering, Univ. of Rochester, USA.* Slow-light devices are receiving significant interest in integrated photonics. We present a multi-channel platform with bandwidth above 400 Gbits/s at group velocities below 0.004c. Channel tunability makes it attractive for active devices and bio-sensing applications.

ITuF3 ● 2:45 p.m.
Standing-Wave Model Based on Modes of Cold Cavity for Simulation of Laser Diodes, *Yanping Xi, Xun Li, Wei-Ping Huang; McMaster Univ., Canada.* A standing-wave model based on mode expansion of "cold" cavities is proposed and presented for simulation of laser diodes. The model is validated against the well-established traveling-wave model and shown to be more efficient.

ITuF4 ● 3:00 p.m. **Invited**
Linear and Nonlinear Propagation in Ring Microresonators, *Jiří Čtyroký, Tomáš Lauerman; Inst. of Photonics and Electronics ASCR, v.v.i., Czech Republic.* Principles of vectorial modeling tools for microresonators, a bend mode solver and a method for modeling the ring-to-waveguide coupler, are reviewed. Novel algorithm for modeling nonlinear pulse propagation in microresonator-based devices is described.

ITuF5 ● 3:30 p.m.
Quality Factors of Non-Ideal Micro Pillars, *Torben R. Nielsen, Niels Gregersen, Bjarne Tromborg, Jesper Mørk; COM•DTU, Denmark.* The influence of fabrication-induced imperfections and material absorption on the quality factor of a micro-cavity pillar is studied numerically. The dependence on side-wall inclination, selective underetch and intrinsic loss is quantified.

ITuF6 ● 3:45 p.m.
Micro-Cavity Resonator Optimization Using Particle Swarm Optimization, *Jeremiah D. Brown[1], Eric G. Johnson[2]; [1]Univ. of Central Florida, CREOL, USA, [2]Univ. of North Carolina at Charlotte, Ctr. for Optoelectronics, USA.* Particle swarm optimization is used to design the geometry of micro-cavity optical resonators to obtain high q-factors at desired resonances. The quality factor and resonant frequency of the cavity are evaluated using eigenmode analysis.

Grand Ballroom C
4:00 p.m. – 4:30 p.m.
Exhibits Open/Coffee Break

ITuG • Hybrid Integration Symposium II

Grand Ballroom A
ITuG ● Hybrid Integration Symposium II
4:30 p.m. – 6:00 p.m.
Jurgen Michel; MIT, USA.

ITuG1 ● 4:30 p.m. **Invited**
Integrated Optical Amplifiers on Silicon Waveguides, *John Bowers[1], Hyundai Park[1], Ying-hao Kuo[1], Alexander W. Fang[1], Richard Jones[2], Mario J. Paniccia[2], Oded Cohen[3], Omri Raday[3]; [1]Univ. of California at Santa Barbara, USA, [2]Intel Corp., USA, [3]Intel Corp., Israel.* We present a hybrid silicon evanescent amplifier utilizing a wafer-bonded structure of silicon waveguide and AlGaInAs quantum wells. Chip gain of 13 dB with power penalty of 0.5 dB at 40 Gb/s data amplification is demonstrated.

ITuG2 ● 5:00 p.m. **Invited**
CMOS Electronic-Photonic Integration in a Foundry World, *Sanjay Patel; Bell Labs, Lucent Technologies, USA.* Abstract unavailable.

ITuG3 ● 5:30 p.m.
Optimization of Electrically Pumped Microdisk Lasers Integrated with a Nanophotonic SOI Waveguide Circuit, *Joris Van Campenhout[1], Pedro Rojo Romeo[2], Philippe Regreny[2], Christian Seassal[2], Dries Van Thourhout[1], Lea Di Cioccio[3], Jean-Marc Fedeli[3], Roel Baets[1]; [1]Ghent Univ., Belgium, [2]Inst. des Nanotechnologies de Lyon, France, [3]CEA LETI-Minatec, France.* Electrically-injected continuous-wave lasing was achieved in InP-based microdisks coupled to a sub-micron silicon-on-insulator waveguide, with 0.6 mA threshold current and up to 7 μW coupled output power. We present strategies to improve the device performance.

ITuG4 ● 5:45 p.m.
Continuous-Wave Lasing from DVS-BCB Heterogeneously Integrated Laser Diodes, *Günther Roelkens, Dries Van Thourhout, Roel Baets; Ghent Univ., INTEC, Belgium.* Continuous-wave lasing from heterogeneously integrated laser diodes, bonded using DVS-BCB adhesive bonding, is presented. An integrated heat sink structure and reduction of the power dissipation resulted in room-temperature continuous-wave lasing with 1.9mW maximum output power.

Grand Ballroom C
6:00 p.m. – 7:30 p.m.
Conference Reception

ITuH • Modeling and Design of Photonic Crystal Fibers

Grand Ballroom B
ITuH ● Modeling and Design of Photonic Crystal Fibers
4:30 p.m. – 6:00 p.m.
Hugo H. Figueroa; Univ. Estadual de Campinas, Brazil, Presider

ITuH1 ● 4:30 p.m.
Influence of the Cross-Section Geometry on Hollow-Core Bragg Fiber Guiding Properties, *Matteo Foroni[1], Federica Poli[1], Davide Passaro[1], Annamaria Cucinotta[1], Stefano Selleri[1], Jesper Lægsgaard[2], Anders Bjarklev[2]; [1]Univ. of Parma, Italy, [2]COM•DTU, Technical Univ. of Denmark, Denmark.* The cross-section geometry influence on hollow-core Bragg fiber guiding properties is numerically investigated. As in experimental measurements, surface modes interrupt the regularity of the transmission window, shifted to longer wavelengths as the bridge width increases.

ITuH2 ● 4:45 p.m.
Fluidic Sensors Based on Photonic Crystal Fiber Gratings: An Emerging Technology for Realizing Ultra-Low Thermo-Responsive Sensing Platforms, *Nikolaos J. Florous, Kunimasa Saitoh, Shailendra Varsheney, Masanori Koshiba; Div. of Electronics and Information Engineering, Hokkaido Univ., Japan.* We propose the use of photonic crystal fiber gratings (PCFGs) as fluidic sensors. The thermo-optical sensitivity response of PCFG-based sensors is found to be superior in comparison to conventional fiber Bragg gratings.

ITuH3 ● 5:00 p.m.
THz Frequency Radiation in Silver/Polystyrene(PS) Coated Hollow Glass Waveguides, *Christos Themistos[1], B. M. Azizur Rahman[1], Muttukrishnan Rajarajan[1], Kenneth T. V. Grattan[1], James A. Harrington[2], Bradley Bowden[2], Oleg Mitrofanov[3]; [1]City Univ., UK, [2]Rutgers Univ., USA, [3]Bell Labs, Alcatel-Lucent, USA.* Finite element analysis is used to calculate the complex propagation characteristics of silver/polystyrene (PS) coated hollow glass waveguides for the THz frequency radiation. Camera images of mode profiles are presented and compared with simulated results.

ITuH4 ● 5:15 p.m.
Air-Core Waveguides for Terahertz Signals, *Chin-ping Yu, Hung-chun Chang; Natl. Taiwan Univ., Taiwan.* The finite-difference frequency-domain method is adopted for analysis of air-core THz waveguides formed by Teflon rods. The guiding mechanism is found to be based on ARROW model and well confined guided THz-field can be obtained.

ITuH5 ● 5:30 p.m.
Characterization of the Single Mode Operation of PCF Using Finite Element Method, *B.M. Azizur Rahman, A.K.M. Saiful Kabir, Kejalakshmy Namassivayane, Muttukrishnan Rajarajan, Ken Grattan; City Univ., UK.* Finite element based full vectorial modal solution approach has been developed to determine effective index of space filling mode, cutoff of fundamental and second order guided modes, identifying single mode operation of photonic crystal fibers.

ITuH6 ● 5:45 p.m.
Space-Mapping Based Optimization for Fiber-Optic Transmission Systems, *Dong Yang, Shiva Kumar; Dept. of ECE, McMaster Univ., Canada.* A two-stage space-mapping technique is used for optimization of fiber-optic transmission system performance. The computation effort can be significantly reduced by using space mapping technology compared with the traditional direct optimization without losing much accuracy.

Grand Ballroom C
6:00 p.m. – 7:30 p.m.
Conference Reception

JTuA • Joint Poster Session

Grand Ballroom C
JTuA ● Joint Poster Session
6:00 p.m. – 7:30 p.m.

JTuA1
Slow Light in Quantum Dot Semiconductor Laser for Photonic RF Phase Shifter, *P. C. Peng[1], J. N. Liu[2], C. T. Lin[2], H. C. Kuo[2], J. H. Chen[2], S. C. Wang[2], S. Chi[2,3], J. Y. Chi[4]; [1]Dept. of Applied Materials and Optoelectronic Engineering, Natl. Chi Nan Univ., Taiwan, [2]Dept. of Photonics and Inst. of Electro-Optical Engineering, Natl. Chiao-Tung Univ., Taiwan, [3]Dept. of Electrical Engineering, Yuan-Ze Univ., Taiwan, [4]Opto-Electronics and System Lab, Industrial Technology Res. Inst., Taiwan.* We demonstrate a phase shifter based on slow light in a quantum dot vertical-cavity surface-emitting laser. The phase change with the frequency ranging from 10 to 20 GHz is achieved.

JTuA2
Observation of Band Structure and Reduced Group Velocity Area in SOI 2-D Planar Photonic Crystals, *Nicole A. Paraire, Yassine Benachour, Laurent Nevou; CNRS, Universite Paris Sud, France.* We report experimental band structure determination for several 2-D photonic crystals etched in SOI, using diffractive optics techniques. This allows fast characterization of devices and location of reduced group velocity areas suitable for nonlinear observations.

JTuA3
Limitations on Nonlinear Pulse Propagation in Coupled-Resonator Waveguides, *Vishnupriya Govindan, Steve Blair; Univ. of Utah, USA.* Under the constraint of fixed pulse distortion, the nonlinear response of coupled-resonator slow light waveguides fails to improve with increasing number of resonators, even though improvement in bandwith-delay product is obtained.

JTuA4
Influence of Group Velocity on Roughness Losses for 1-D Periodic Structures, *Jaime García, Alejandro Martínez, Javier Martí; Valencia Nanophotonics Technology Ctr., Spain.* Slow-wave structures do not only provide benefits. One of their most important problems is the increase of roughness losses when group velocity decreases. This dependence has been theoretically studied for some 1-D periodic structures.

JTuA5
Slow Light Propagation for High Optical Information Density in Active Photonic Lattices, *Spilios Riyopoulos; SAIC, USA.* Evanescent field coupling in coupled micro- and nano-laser cavity arrays supports optical modulation waves propagating near the sound speed. The possibility of achieving high information density with near unity delay-time to pulse-time ratio is addressed.

JTuA6
Broad-Bandwidth Slow Light in Multi-Line Brillouin Gain Spectrum, *Yongkang Dong, Zhiwei Lu, Qiang Li; Inst. of Opto-Electronics, Harbin Inst. of Technology, China.* We present a method to achieve broad-bandwidth and flat-top gain spectrum through overlapping multi-line Brillouin gain spectrum with a phase modulator, achieving a Brillouin gain bandwidth of ~ 330 MHz.

JTuA7
Physical Properties of InN for Optically Controlling the Speed of Light, *Fernando B. Naranjo[1], Miguel González-Herráez[1], Héctor Fernández[2], Javier Solis[2], Eva Monroy[3]; [1]Photonics Engineering Group, Electronics Dept., Univ. of Alcala, Spain, [2]Optics Inst., CSIC, Spain, [3]Equipe Mixte CEA-CNRS-UJF, Nanophysique et Semiconducteurs, DRFMC/SP2M/PSC, France.* We report on $|\chi(3)|$ and population grating lifetime measurements performed on thick InN samples. We study the possibility of using InN for slow light applications considering linear and non-linear absorption near band-gap wavelengths (~1500 nm).

JTuA8
Low Distortion Fast Light in an Optical Fiber Using Stimulated Brillouin Scattering, *Luc Thévenaz[1], Sanghoon Chin[1], Miguel Gonzalez-Herraez[2]; [1]Ecole Polytechnique Federal de Lausanne, Switzerland, [2]Dept. of Electronics, Univ. of Alcalá de Henares, Spain.* We demonstrate experimentally a novel approach for fast light generation based on a wideband compound spectral resonance using stimulated Brillouin scattering. The pulses experience fast light with extremely reduced distortion and small amplitude change.

JTuA9
Slow Light of Gb/s Bit Streams via Stimulated Brillouin Scattering in Non-Uniform Optical Fibers, *Vladimir Kalosha, Liang Chen, Xiaoyi Bao; Dept. of Physics, Univ. of Ottawa, Canada.* Slow-light effect in fibers with distance-depending Brillouin frequency provides large, optically controlled delay of picosecond pulses with a little shape distortion, when Brillouin frequency variation along the fiber corresponds to the whole pulse spectrum.

JTuA10
Slow-Light Soliton Stability with Respect to Atomic Relaxation, *Ilya Vadeiko[1], Andrei Rybin[2], Alan Bishop[3]; [1]Physics Dept., McGill Univ., Canada, [2]Univ. of Information Technologies, Mechanics and Optics, Russian Federation, [3]Los Alamos Natl. Lab, USA.* We solved the problem of slow-light soliton dynamics in the presence of strong spontaneous emission of excited atoms. We have demonstrated that the damping of the soliton is strongly suppressed due to the nonlinear interaction.

JTuA11
Study of Brillouin Active Fiber Ring as an Effective Slow Light Device, *Chung Yu[1], Christopher Horne[1], Yongkab Kim[2]; [1]North Carolina A&T State Univ., USA, [2]Wonkwang Univ., Republic of Korea.* This letter presents experimental data on the superior performance in SBS gain and linewidth of the fiber ring and their potential enhancement of time delay in slow light fiber devices.

JTuA12
Reduction of Light Propagation by Spectral Burning Hole in an Optical Fiber, *Yundong Zhang, Wei Qiu, Jianbo Ye, He Tian, Nan Wang, Hao Wang, Ping Yuan; Harbin Inst. of Technology, China.* The authors observed a spectral burning hole and slowdown of light propagation by population oscillation technique in an Erbium-doped optical fiber. Measured bandwidth of the hole was about 55 Hz. Group velocity was 2.186×10^3m/s.

JTuA13
Flat and Offset Band Edges in Multi-Mode Fibers with Superstructure Bragg Gratings, *Andrey A. Sukhorukov[1], C. Martijn de Sterke[2]; [1]Australian Natl. Univ., Australia, [2]Univ. of Sydney, Australia.* We show that, in a conventional fiber with a superstructure Bragg grating designed for mode mixing, the dispersion at band-gap edge can be made quartic, or the band-edges may appear for non-zero wave vectors.

JTuA14
Photonic Crystal Waveguides: 2-D Numerical Modeling, *Ivan Richter, Milan Šiňor, Pavel Kwiecien; Czech Technical Univ. in Prague, Czech Republic.* Photonic crystal waveguides are modeled in various configurations, in two-dimensional geometry, including rectangular, chessboard, circular building blocks of rectangular and triangular grids, both of direct and inverse type. Mode matching and FDTD techniques are used.

JTuA15
Ultra-Fast Polarization Conversion with a Filtered Pattern-Independent Semiconductor Optical Amplifier, *Claudio Crognale[1], Vittorio Ricchiuti[1], Stefano Caputo[2], Sante Saracino[3]; [1]Technolabs S.p.A., Italy, [2]SMD Elettronica, Italy, [3]Siemens S.p.A., Italy.* A new optical gain pattern-dependence suppression method in Semiconductor Optical Amplifiers (SOAs) has been applied to an optically filtered SOA-based architecture to perform the all-optical polarization conversion of an ultra-fast data-stream without any pattern-dependence.

JTuA16
Bragg Reflector Waveguide Based on Thin Film Barium Titanate, *Zhifu Liu, Pao-Tai Lin, Bruce W. Wessels; Northwestern Univ., USA.* Bragg reflector waveguide was fabricated from $BaTiO_3$ thin film using low pressure nano-lithography. Its transmission spectrum around 1.55 μm shows a 40% change over a 6 nm range. Velocity phase matching condition is discussed.

JTuA17
A One-Dimensional Photonic Crystal Rib Waveguide, *Jeremy J. Goeckeritz, Steve Blair; Univ. of Utah, USA.* We introduced a new type of 1-D PC rib waveguide (PCRW). Simulations of the structure showed an extremely wide photonic band gap. Furthermore, the loss can be controlled by increasing the waveguide height.

● Wednesday, July 11, 2007 ●

2nd Floor Foyer
8:00 a.m. – 5:00 p.m.
Registration Open

IWA • Integrated Optical Sensors

Grand Ballroom A
IWA ● Integrated Optical Sensors
8:30 a.m. – 10:30 a.m.
Alistair J. Poustie; Ctr. for Integrated Photonics, UK, Presider

IWA1 ● 8:30 a.m. **Invited**
Silicon Waveguide Photonics for Biosensing Applications, *Siegfried Janz, A. Densmore, D.-x. Xu, P. Waldron, J. Lapointe, G. Lopinski, T. Mischki, P. Cheben, A. Delâge, B. Lamontagne, J. H. Schmid; Natl. Res. Council Canada, Canada.* We present recent theoretical and experimental results on silicon photonic wire evanescent field (PWEF) sensors that show such PWEF sensors have the highest response to bulk index change as well as surface molecular adsorption.

IWA2 ● 9:00 a.m.
Photonics-Enabled Microcantilever Arrays for Sensor Applications, *Gregory P. Nordin, Jong W. Noh, Yusheng Qian, Jiquo Song, Seunghyun Kim; Brigham Young Univ., USA.* We report the design, fabrication, and characterization of differential waveguide splitters for transduction of microcantilever motion for sensor applications. Our approach is scalable to permit hundreds to several thousand microcantilevers on a single chip.

IWA3 ● 9:15 a.m.
Monitoring of Volatile Organic Compounds Using a Surface Relief D-Fiber Bragg Grating and a Polydimethylsiloxane Layer, *Tyson L. Lowder, John D. Gordon, Stephen M. Schultz, Richard H. Selfridge; Brigham Young Univ., USA.* We use a surface relief fiber Bragg grating with a polydimethylsiloxane layer as a volatile organic compound chemical sensor. Sensitivity of ~4000 ppm is demonstrated of dichloromethane in a gas state.

IWA4 ● 9:30 a.m.
Integrated Hollow-Core Waveguides Made by Sputter Deposition, *Yue Zhao[1], Evan J. Lunt[1], Dongliang Yin[2], Holger Schmidt[2], Aaron R. Hawkins[1]; [1]Brigham Young Univ., USA, [2]Univ. of California at Santa Cruz, USA.* A new fabrication method for hollow core waveguides based on sputter deposition is demonstrated. Arched-core waveguides were constructed on silicon with a low-temperature sacrificial etching technique that lends itself to high-volume production.

IWA5 ● 9:45 a.m.
Spectral Behavior and Guided-to-Surface Mode Transition of Arch-Shaped Hollow-Core Waveguides, *Matteo Foroni, Federica Poli, Annamaria Cucinotta, Stefano Selleri; Univ. of Parma, Italy.* Arch-shaped hollow-core waveguides have been studied, providing TE and TM dispersion and confinement loss curves in the wavelength range 600-1000 nm. The transition from guided to surface mode is described.

IWA6 ● 10:00 a.m.
Improved Sensing Performance of D-Fiber/Planar Waveguide Couplers, *Richard Gibson, Josh Kvavle, Richard Selfridge, Stephen Schultz; Brigham Young Univ., USA.* Improvements in wavelength selective coupling is demonstrated between the core of a D-shaped optical fiber and a multimode planar waveguide. A comb filter with transmission dips of -20dB, and linewidths of 0.25nm is demonstrated.

IWA7 ● 10:15 a.m.
Low Loss SOI-Based High-Mesa Waveguides Fabricated Using Neutral Loop Discharge (NLD) Plasma Etching for Compact Breath-Sensing System, *Satoshi Yano, Kosuke Kameyama, Kiichi Hamamoto; Interdisciplinary Graduate School of Engineering Sciences, Kyushu Univ., Japan.* SOI-based Si/SiO_2 high-mesa waveguide has been fabricated by using neutral loop discharge (NLD) plasma etching. Significant loss reduction of about 50%, resulted in 0.3dB/cm propagation loss, has been achieved.

Grand Ballroom C
10:30 a.m. – 11:00 a.m.
Exhibits Open/Coffee Break

IWB • Modeling and Design of Integrated Devices

Grand Ballroom B
IWB ● Modeling and Design of Integrated Devices
8:30 a.m. – 10:30 a.m.
Presider to Be Announced

IWB1 ● 8:30 a.m. Invited
Integrated Optics: How Integrated? *Salvatore Morasca; Avanex, Italy.* Abstract unavailable.

IWB2 ● 9:00 a.m.
Reliable Simulation on the Performance of InGaAsP Optical Quantum-Well Electroabsorption Modulator, *Dong Kwon Kim, David S. Citrin; Georgia Tech, USA.* Accurate and reliable simulation of performance of InP-based QW-EAM's was executed, which yielded essentially identical results to experimental data. Subsequently, asymmetric double quantum wells are predicted to enhance slope efficiency by more than 300 %.

IWB3 ● 9:15 a.m.
Design and Simulation of Silicon-Based p-i-n Carrier Injection Electro-Optical Waveguide Modulators, *Shaowu Chen[1], Danxia Xu[2], Xiaoguang Tu[1], Xuejun Xu[1], Ross McKinnon[2], Siegfield Janz[2], Jinzhong Yu[1]; [1]Inst. of Semiconductors, Chinese Acad. of Sciences, China, [2]Inst. for Microstructural Sciences, Natl. Res. Council of Canada, Canada.* This paper presents the simulation results of a forward biased carrier injection silicon p-i-n modulator with improved structure, fast response time (rise time of 0.663ns and a fall time of 0.249ns) can be achieved.

IWB4 ● 9:30 a.m.
BPM Based Efficient Sensitivity Analysis Exploiting the Adjoint Variable Method, *Mohamed A. Swillam, Mohamed H. Bakr, Xun Li; McMaster Univ., Canada.* An adjoint variable method is proposed for efficient sensitivity analysis using BPM. The computational cost of estimating the gradient is less than one extra BPM simulation. The obtained sensitivities match well the accurate central differences.

IWB6 ● 10:00 a.m.
Coupling Characteristics between Strongly Guiding Waveguides Stacked Laterally, *Junji Yamauchi, Noriyuki Shibuya, Hisamatsu Nakano; Faculty of Engineering, Hosei Univ., Japan.* Laterally stacked waveguides are investigated using the full-vectorial beam-propagation method. For rectangular cores, the polarization is converted with the interference between two even (or odd) supermodes.

IWB7 ● 10:15 a.m.
Phase-Sensitive All-Optical Switching with Ultra-Low Control Power Using Silicon-Wire Directional Coupler, *Vladimir S. Grigoryan; Northwestern Univ., USA.* A phase-sensitive all-optical switching in a 4 mm long silicon-wire directional coupler with the control power of 10 μW is demonstrated in a numerical experiment. The switching speed is limited by the carrier lifetime.

Grand Ballroom C
10:30 a.m. – 11:00 a.m.
Exhibits Open/Coffee Break

IWC • Planer Lightwave Circuits

Grand Ballroom A
IWC ● Planer Lightwave Circuits
11:00 a.m. – 12:30 p.m.
Dan-Xia Xu; Natl. Res. Council of Canada, Canada, Presider

IWC1 ● 11:00 a.m. Invited
Athermal AWGs for WDM-PON, *Brian McGinnis; Neophotonics, USA.* We review WDM-PON and its requirements for athermal AWG's. Athermal AWG's are commercially available today that can meet the requirements of a variety of WDM-PON designs and provide a cost-efficient and robust critical component.

IWC2 ● 11:30 a.m.
Experimental Study of Ultra-Low Power Consumption Thermo-Optic Silica-on-Silicon Switches, *Mark Earnshaw; Alcatel Lucent, USA.* We present a study of ultra-low power thermo-optic waveguide switch designs. Through optimization we achieved under 25mW power consumption for standard index-contrast silica-on-silicon material with reduced polarization dependent switching performance.

IWC3 ● 11:45 a.m.
Compact 64 Channel, 100GHz VMUX with Low-Power, Fast Attenuators, *Mark Earnshaw, C. Bolle, M. A. Cappuzzo, E. Chen, L. Gomez, A. Wong-Foy; Bell Labs, Alcatel-Lucent, USA.* We have developed high-index-contrast designs for monolithic integration of a 64 channel, VMUX in a compact die. We reduced the VOA power consumption to 20mW and increased the switching speed to 0.5mS by electrical overdriving.

IWC4 ● 12:00 p.m.
Signal Transmission from VCSEL in Thin-Film-Waveguide WDM Optical Interconnects Board, *Shogo Ura[1], Kouji Shinoda[1], Chikara Ito[1], Daisuke Nii[1], Kenzo Nishio[1], Yasuhiro Awatsuji[1], Kenji Kintaka[2]; [1]Kyoto Inst. of Technology, Japan, [2]Natl. Inst. of Advanced Industrial Science and Technology, Japan.* Diverging light from vertical cavity surface emitting laser was coupled by free-space-wave add/drop multiplexer consisting of focusing grating coupler and distributed Bragg reflector into thin-film waveguide and was transmitted with 1 Gbits/s NRZ signal.

IWC5 ● 12:15 p.m.
Novel Technique to Predict Reliability of Bragg Gratings Inscribed in Germania-Doped Silica Waveguides, *Rajesh Joseph[1], Balaji Srinivasan[1], Nirmal Viswanathan[2]; [1]IIT Madras, India, [2]Univ. of Hyderabad, India.* We compare the results of ITA and ICA on Bragg gratings for predicting the reliability. A novel aspect of our work is the gathering of ITA data within the ICA routine.

12:30 p.m. – 2:00 p.m.
Lunch (on your own)

IWD • Silicon Photonics

Grand Ballroom B
IWD • Silicon Photonics
11:00 a.m. – 12:30 p.m.
Michal Lipson; Cornell Univ., USA.

IWD1 • 11:00 a.m. **Invited**
Ultrasmall and Wideband Polarization Rotator Based on Silicon Wire Waveguides, *Hiroshi Fukuda, Koji Yamada, Tai Tsuchizawa, Toshifumi Watanabe, Sei-ichi Itabashi; Nippon Telegraph and Telephone Corp., Japan.* We propose an ultrasmall and wideband polarization rotator consisting of a short silicon wire and an off-axis silicon oxinitride waveguide. The simulated extinction ratio is found to be over 20 dB for the C-band.

IWD2 • 11:30 a.m.
Oxygen-Ion Implantation of SOI Microring Resonators for High-Speed All-Optical Switching Applications, *Michael Först[1], Jan Niehusmann[1], Tobias Plötzing[1], Heinrich Kurz[1], Jens Bolten[2], Thorsten Wahlbrink[2], Christian Moormann[2]; [1]RWTH Aachen Univ., Inst. für Halbleitertechnik, Germany, [2]Advanced Microelectronic Ctr. Aachen, AMO GmbH, Germany.* Ultrafast carrier-induced all-optical switching is demonstrated in an oxygen-ion implanted silicon-on-insulator microring. A reduced free carrier lifetime of 55 ps facilitates optical switching in the 1.55 μm range at modulation speeds larger than 5 Gbit/s.

IWD3 • 11:45 a.m.
Efficient, Broadband Amplification and Frequency Conversion on Silicon Chip, *Alexander Gaeta; Cornell Univ., USA.* By carefully engineering the dimensions of nanowaveguide structures in Silicon, we demonstrate highly efficient, broad-band parametric amplification and frequency conversion on-chip via four-wave mixing.

IWD4 • 12:00 p.m.
Optical Regeneration in a Silicon Waveguide, *Reza Salem, Mark A. Foster, Amy C. Turner, David F. Geraghty, Michal Lipson, Alexander L. Gaeta; Cornell Univ., USA.* We demonstrate optical regeneration by nonlinear spectral broadening in a silicon nanowaveguide followed by spectral filtering in a ring resonator. Power transfer function of the device is measured showing 6-W operating peak power.

IWD5 • 12:15 p.m.
Single Row SOI-Based Photonic Crystal/Photonic Wire Micro-Cavities with Medium Q-Factor and High Transmission, *Antonio Samarelli[1], Ahmad R. Md Zain[2], Marco Gnan[2], Harold Chong[2], Marc Sorel[2], Richard M. De La Rue[2], Paola Frascella[1], Caterina Ciminelli[1], Mario N. Armenise[1]; [1]Politecnico di Bari, Italy, [2]Univ. of Glasgow, UK.* We present the results of a study of tapered hole structures for realising medium quality-factor (Q-factor), high-transmission photonic crystal/photonic wire micro-cavities. Q-factors of more than 3,000 and transmission of 80% have been simultaneously achieved.

12:30 p.m. – 2:00 p.m.
Lunch (on your own)

IWE • Semiconductor Photonic Integrated Devices

Grand Ballroom A
IWE • Semiconductor Photonic Integrated Devices
2:00 p.m. – 4:00 p.m.
Yoshiaki Nakano; RCAST, Univ. of Tokyo, Japan, Presider

IWE1 • 2:00 p.m. **Invited**
InP-Based Monolithic Integration Technology, *Charles Joyner, Fred A. Kish, Radhakrishnan Nagarajan, Masaki Kato, Jacco L. Pleumeekers, Atul Mathur, Peter W. Evans, Damien J. H. Lambert, Sanjeev Murthy, Sheila K. Mathis, Johan Baeck, Mark J. Missey, Andrew G. Dentai, Randal A. Salvatore, Richard P. Schneider, Mehrdad Ziari, Jeffrey S. Bostak, Timothy Butrie, Vincent G. Dominic, Mike Kauffman, Richard H. Miles, Matthew L. Mitchell, Alan C. Nilsson, Stephen C. Pennypacker, Rory Schlenker, Robert B. Taylor, Huan-Shang Tsai, Michael F. Van Leeuwen, Jonas Webjorn, Michael Reffle, David G. Mehuys, David F. Welch; Infinera, USA.* Low FIT monolithically integrated components with device counts exceeding 50 discrete components are in commercial use. We will present results showing that device counts exceeding 240 discrete components for an individual integrated chip are practical.

IWE2 • 2:30 p.m. **Invited**
40Gbps-Capable Integrated Wavelength Converter on InP, *Yasunori Miyazaki[1,2], Kazuhisa Takagi[1,2], Keisuke Matsumoto[1,2], Toshiharu Miyahara[1,2], Satoshi Nishikawa[1,2], Tatsuo Hatta[1,2], Toshitaka Aoyagi[1,2], Kuniaki Motoshima[1,2]; [1]Mitsubishi Electric Corp., Japan, [2]Optoelectronic Industry and Technology Development Association (OITDA), Japan.* The dimensions of the bulk InGaAsP SOA active region were optimized for fast gain recovery in polarization-independent SOA-MZI all-optical wavelength converters for full C-band 40Gbps-NRZ operation.

IWE3 • 3:00 p.m.
Measurement of the Wavelength Dispersion of the Photoelastic Response in InGaAsP/InP MQW Structures, *Huiling Wang[1], Marcel G. Boudreau[2], Daniel T. Cassidy[1]; [1]McMaster Univ., Canada, [2]Bookham Inc., Canada.* The photoelastic response versus wavelength, has been measured for InGaAsP multiple quantum well structures by analyzing changes in the material absorption spectrum and the corresponding index of refraction owing to an externally applied uniaxial load.

IWE4 • 3:15 p.m.
Modulation in InAs Quantum Dot Waveguides, *Bakiye I. Akca[1], Aykutlu Dana[1], Atilla Aydinli[1], Marco Rossetti[2], Lianhe Li[2], Andrea Fiore[2], Nadir Dagli[3]; [1]Bilkent Univ., Turkey, [2]Inst. of Quantum Electronics and Photonics, Ecole Polytechnique Fédérale de Lausanne EPFL, Switzerland, [3]Univ. of California at Santa Barbara, USA.* Modulation in molecular beam epitaxy grown self-assembled InAs quantum dot waveguides have been studied at 1500 nm as a function of wavelength and voltage. Enhanced electro-optic coefficients compared to bulk GaAs were observed.

IWE5 ● 3:30 p.m. Invited
Micro and Nano Lasers for Digital Photonics, *Martin T. Hill; Eindhoven Univ. of Technology, Netherlands.* The small size, low-power and high-speed of nano-lasers make them an attractive nonlinear element for digital photonics. Further miniaturization of lasers below the diffraction limit is required before digital photonics can compete with electronics.

Grand Ballroom C
4:00 p.m. – 4:30 p.m.
Exhibits Open/Coffee Break

IWF • Photonic Crystals and Resonators

Grand Ballroom B
IWF ● Photonic Crystals and Resonators
2:00 p.m. – 4:00 p.m.
Mario Paniccia; Intel Corp., USA, Presider

IWF1 ● 2:00 p.m.
Micropore and Nanopore Features on Integrated Hollow Waveguides, *Matthew R. Holmes[1], Mikhail Rudenko[2], Tao Shang[1], Holger Schmidt[2], Aaron Hawkins[1]; [1]Brigham Young Univ., USA, [2]Univ. of California at Santa Cruz, USA.* We demonstrate the fabrication of micropore and nanopore features directly over the core of hollow antiresonant reflecting optical waveguides (ARROWs). Pores of specific size allow controlled access to test media.

IWF2 ● 2:15 p.m.
Spontaneous Emission ß-Factors in Photonic Crystal Waveguides: Towards Single-Mode LED, *Guillaume Lecamp, Christophe Sauvan, Philippe Lalanne, Jean-Paul Hugonin; Inst. d'Optique, France.* We theoretically study light emission in photonic crystal waveguides and show that remarkably large spontaneous emission rates into the fundamental guided mode (beta factor >95%) can be obtained over a 40-nm-large spectral interval at 950nm.

IWF3 ● 2:30 p.m.
Silicon Pedestal Ultra-High *Q* Microdisk Resonators: A Novel Device Architecture to Suppress Thermal Instability and Enable Active Integration, *Mohammad Soltani, Siva Yegnanarayanan, Qing Li, Ali Adibi; Georgia Tech, USA.* Silicon-on-insulator microdisk resonators with two structures of disk-on-oxide and disk-on-silicon-pedestal are fabricated and compared. Pedestal architecture exhibits a dramatic improvement in the thermal resistance, thereby, increasing the threshold for thermal instability. Experimental Q~$3x10^6$ is observed.

IWF4 ● 2:45 p.m.
Linear and Nonlinear Control of Polarization State Using Microring Resonators, *Gennady Shvets, Chris Fietz; Univ. of Texas at Austin, USA.* Polarization conversion between linear, circular and elliptic light can be accomplished with an on-chip dielectric microring resonator. At high intensities, hysteresis makes the polarization of the transmitted light dependent on its history.

IWF5 ● 3:00 p.m.
"Infinite" 2-D Photonic Crystals for the Near-Infrared, *Jacson W. Menezes[1,2], Edmundo S. Braga[1], Lucila H. D. Cescato[2]; [1]Faculdade de Engenharia Elétrica e Computação, UNICAMP, Brazil, [2]Inst. de Fisica "Gleb Wataghin," DFMC, UNICAMP, Brazil.* In this work we propose and demonstrate a simple holographic technique that allows the fabrication of "infinite" 2-D Photonic Crystals for the near infrared region of the spectrum.

IWF6 ● 3:15 p.m.
Room-Temperature Low-Threshold GaAs/InGaAs Photonic Crystal Laser, *Hatice Altug[1], Dirk Englund[2], Jelena Vuckovic[2]; [1]Boston Univ., USA, [2]Stanford Univ., USA.* We demonstrate GaAs-photonic-crystal laser that can operate at room-temperature with ultra-low-threshold power. These advances are achieved by passivating structures to reduce nonradiative surface recombination loses, which we show as important as Q for threshold determination.

IWF7 ● 3:30 p.m.
Mapping the Field Distribution of a Photonic Crystal Resonator Using Transmission SNOM, *Wico C. L. Hopman, Kees O. van der Werf, René M. de Ridder; Univ. of Twente, Netherlands.* We show that transmission SNOM (T-SNOM) can be used for imaging optical intensity distributions in a photonic crystal resonator with a resolution better than 100 nm. Two alternatives are explored: contact and tapping mode operation.

IWF8 ● 3:45 p.m.
Fabrication of Large Area Polymer-Based 3-D Photonic Crystals, *Peng Yao[1], Shouyuan Shi[1], Ahmed Sharkawy[2], Eric Kelmelis[2], Dennis W. Prather[1]; [1]Univ. of Delaware, USA, [2]EM Photonics, USA.* Polymer based photonic crystals are ideal candidates for applications relying on engineering the dispersive properties of those periodic structures. We present a process for fabricating arbitrary large area 3-D photonic crystal structures in polymers.

Grand Ballroom C
4:00 p.m. – 4:30 p.m.
Exhibits Open/Coffee Break

IWG • IPNRA Postdeadline Paper Session

Grand Ballroom A
IWG ● IPNRA Postdeadline Paper Session
4:30 p.m. – 6:00 p.m.
William Steier; Univ. of Southern California, USA.

Grand Ballroom A
IPNRA Closing Remarks
6:00 p.m. – 6:15 p.m.

Slow and Fast Light Abstracts

• Sunday, July 8, 2007 •

2nd Floor Foyer
4:00 p.m. – 6:00 p.m.
Registration Open

• Monday, July 9, 2007 •

2nd Floor Foyer
7:00 a.m. – 5:00 p.m.
Registration Open

Alpine Ballroom
8:15 a.m. – 8:30 a.m.
IPNRA/SL Opening Remarks

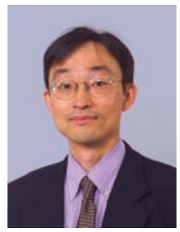
JMA • IPNRA/SL Plenary I

Alpine Ballroom
JMA • IPNRA/SL Plenary I
8:30 a.m. – 10:00 a.m.
Gadi Eisenstein; Technion, Israel and *Nadir Dagli; Univ. of California at Santa Barbara, USA, Presiders*

JMA1 • 8:30 a.m. **Plenary**
Active and Passive Coupled-Resonator Optical Waveguides, *Amnon Yariv; Caltech, USA.* I will describe the basic instructive approach to slow wave phenomena but emphasize those taking place in patterned optical structures which can be engineered and controlled. The basic mathematical similarity between electromagnetically induced transparency in atomic media and propagation in coupled cavity systems will be discussed as well as the role of optical amplification and nonlinear frequency conversion in slow light applications.

Amnon Yariv received the B.S., M.S., and Ph.D. degrees in electrical engineering from the University of California at Berkeley, in 1954, 1956, and 1958, respectively. In 1959, he joined Bell Telephone Laboratories, Murray Hill, NJ. In 1964, he joined the California Institute of Technology, Pasadena, as an associate professor of electrical engineering, becoming a professor in 1966. In 1980, he became the Thomas G. Myers Professor of Electrical Engineering and Applied Physics. In 1996, he became the Martin and Eileen Summerfield Professor of Applied Physics and Professor of Electrical Engineering. On the technical and scientific sides, he took part (with various coworkers) in the discovery of a number of early solid-state laser systems, in the original formulation of the theory of nonlinear quantum optics; in proposing and explaining mode-locked ultrashort-pulse lasers, GaAs optoelectronics; in proposing and demonstrating semiconductor-based integrated optics technology; in pioneering the field of phase conjugate optics; and in proposing and demonstrating the semiconductor distributed feedback laser. He has published widely in the laser and optics fields and has written a number of basic texts in quantum electronics, optics, and quantum mechanics. Yariv is a member of the American Academy of Arts and Sciences, the National Academy of Engineering, and the National Academy of Sciences.

JMA2 • 9:15 a.m. **Plenary**
Novel Optical Waveguide Devices and Its Application to Optical Communication, *Hiroshi Takahashi, Toshikazu Hashimoto, Yohei Sakamaki, Takashi Saida; NTT Photonics Labs, Japan.* The wavefront matching method provides a new way to obtain the optimum waveguide shape in planar lightwave circuit devices. This presentation reviews the principle behind the method and shows its usefulness with some experimental results.



Hiroshi Takahashi was born in Japan in 1963 and received bachelor and master degrees in electrical engineering from Tohoku University in 1986 and 1988, respectively. In 1988, he joined NTT Laboratories where he engaged in research on the design and fabrication of silica-based optical waveguide devices, including arrayed waveguide grating (AWG) wavelength multi/demultiplexers, for which he was awarded a Ph.D. in 1997 by Tohoku University. From 1998 to 2001, he was with NTT Electronics where he developed the first AWG multi/demultiplexer for commercial DWDM systems. He is currently a research group leader at NTT Photonics Laboratories and is working on a new optical waveguide design based on the wavefront matching (WFM) method and various kinds of waveguide circuits such as AWGs, Mach-Zehnder interferometer-based switches, reconfigurable optical add/drop multiplexing (ROADM) modules, dispersion compensators and optical CDMAs. He is also an adjunct lecturer at Yokohama National University and teaches optical fiber communication. From 2004 to 2005, he was the secretary of Optoelectronics Technical Committee at the Institute of Electronics, Information and Communication Engineers (IEICE) of Japan. Takahashi is a member of the IEICE, the Japan Society of Applied Physics (JSAP), and IEEE/LEOS.

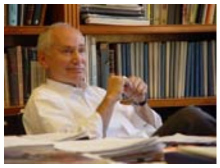
Grand Ballroom C
10:00 a.m. – 10:30 a.m.
Exhibits Open/Coffee Break

JMB • IPNRA/SL Plenary II

Alpine Ballroom
JMB • IPNRA/SL Plenary II
10:30 a.m. – 12:00 p.m.
William Steier; Univ. of Southern California, USA and *Shun Lien Chuang; Univ. of Illinois, USA, Presiders*

JMB1 • 10:30 a.m. **Plenary**

Photonic Integration on Silicon ICs: Bridging the Last Micron, *Lionel C. Kimerling; MIT, USA.* Communication bandwidth, power dissipation and pin count have replaced transistor count and gate delay as the leading performance limiting factors for electronic systems. Electronic-Photonic synergy can extend the performance and functionality of the CMOS platform beyond traditional scaling methodologies. Solutions for architecture, circuits and scalability by monolithic photonic integration will be reviewed and evaluated.



Lionel C. Kimerling is the Thomas Lord Professor of Materials Science and Engineering at MIT. Kimerling is also the Director of the Materials Processing Center where he conducts an active research program in the structure, properties and processing of semiconductor materials, and he is Director of the MIT Microphotonics Center. He received his S.B. degree in Metallurgy and his Ph.D. in Materials Science in from the Massachusetts Institute of Technology. He was Head of the Materials Physics Research Department at AT&T Bell Laboratories until 1990, when he joined the faculty of MIT as Professor. Prior to joining AT&T, he served as Captain, USAF at the Solid State Sciences Laboratory of the Air Force Cambridge Research Laboratories. He has authored over 300 technical articles. Kimerling was the 1994 President of TMS/AIME (The Minerals, Metals and Materials Society). He is a Fellow of the American Physical Society, a Fellow of the AAAS, and a member of the National Center for Photovoltaics Advisory Board, NREL. He is the recipient of the 1995 Electronics Division Award of the Electrochemical Society, the 1996 MIT Perkins Award for Excellence in Graduate Advising, the 1997 Humboldt Senior Scientist Research Award, the 1999 John Bardeen Award of TMS, and the TMS Fellow Award in 2000. His research has had fundamental impacts on the understanding of the chemical and electrical properties of defects in semiconductors and in the use of this knowledge in materials processing and component reliability. His research teams have enabled the first long-lived telecommunications lasers, produced the first 1MB DRAM, developed semiconductor diagnostic methods such as DLTS, and pioneered silicon microphotonics.

JMB2 • 11:15 a.m. **Plenary**

Slow Light in Bose-Einstein Condensates: A New Paradigm for Coherent Control, *Lene Vestergaard Hau; Harvard Univ., USA.* Slow and stopped light and recent observations that a light pulse is extinguished in one atom cloud and then revived from a separate cloud, in a different location, and sent back on its way.

Lene Vestergaard Hau obtained her Ph.D. in theoretical condensed matter physics from the University of Aarhus in Denmark in 1991. That same year she joined the Rowland Institute for Science in Cambridge, Massachusetts, as a scientific staff member. Since 1999 she has been on the faculty at Harvard University and currently holds the Mallinckrodt Professorship of Physics and of Applied Physics. In 2001, Hau received the MacArthur Genius Award. In 1999, Hau's team at the Rowland Institute reported in *Nature* that they had slowed light to bicycle speed in a Bose-condensed atom cloud. Two years later they reported – also in *Nature* – how they had stopped a light pulse and then, several milliseconds later, let it loose again. Hau has worked in the fields of experimental and theoretical optical, atomic, and condensed matter physics, and her research has spanned studies of ultra-cold atoms and superfluid Bose-Einstein condensates, as well as channeling of relativistic MeV electrons and positrons in single crystals. The latter has involved the development of channeling radiation as a solid state probe of valence-electron and spin-magnetic densities and has included experiments at CERN, Brookhaven, and Lawrence Livermore National Laboratory.

12:00 p.m. – 1:30 p.m.
Lunch (on your own)

SMA • General Overview and Applications

Alpine Ballroom
1:30 p.m. – 3:30 p.m.
SMA • General Overview and Applications
Connie J. Chang-Hasnain; Univ. of California, USA, Presider

SMA1 • 1:30 p.m. **Invited**

Progress in Applications Using Slow Light Technology, *Jay Lowell[1], Enrique Parra[2]; [1]DARPA, USA, [2]Booz Allen Hamilton Inc., USA.* This talk outlines the DARPA Slow Light program. Fundamental application classes are mentioned, and the scientific motivation for each developed to indicate overall goals, prospects for technology development, and insertion into specific devices.

SMA2 • 2:00 p.m. **Invited**

Slow Light, Fast Light, and Backwards Light: Fundamentals and Applications, *Robert W. Boyd; Univ. of Rochester, USA.* Recent advances in slow-light research are reviewed. Special emphasis is placed on the possibility of extreme propagation conditions, such as backwards propagation.

SMA3 • 2:30 p.m. **Invited**

The Emergence of Electromagnetically Induced Transparency, *Peter E. Toschek; Univ. Hamburg, Germany.* Attempts of manipulating atoms being excited in light absorption instigated the spectroscopy of saturation. It prompted the discovery of quantum interference, the "dark" resonance, where the absorber turns transparent. These roots of EIT are outlined.

SMA4 • 3:00 p.m. **Invited**

Electromagnetically Induced Coherent Backscattering: Concepts and Experiments, *Marlan O. Scully[1,2], Yuri Rostovtsev[1], Hebin Li[1], Vladimir Sautenkov[1]; [1]Inst. for Quantum Studies, Texas A&M Univ., USA, [2]Princeton Inst. for the Science and Technology of Materials and Dept. of Mechanical and Aerospace Engineering, Princeton Univ., USA.* We demonstrate a coherent backward wave oscillation using forward propagating fields. This is achieved by using an ultra-dispersive medium. The physics has much in common with propagation of ultraslow light. Experimental progress will be discussed.

Grand Ballroom C
3:30 p.m. – 4:00 p.m.
Exhibits Open/Coffee Break

SMB • Fundamental Limit and Image Delay

Alpine Ballroom
SMB ● Fundamental Limit and Image Delay
4:00 p.m. – 5:30 p.m.
Alan Willner; Univ. of Southern California, USA, Presider

SMB1 ● 4:00 p.m.
Fundamental Limit to Delay-Bandwidth Product in One-Dimensional Linear Optical Structures, *David A. B. Miller; Stanford Univ., USA.* This delay-bandwidth product is shown to be bounded essentially by the maximum available relative dielectric constant times the length of the structure in wavelengths, and is otherwise independent of structure design and dielectric constant spectrum.

SMB2 ● 4:15 p.m. Invited
Optimal Atomic and Photonic Resonances for Slow Light Propagation, *Jacob B. Khurgin; Johns Hopkins Univ., USA.* Abstract unavailable.

SMB3 ● 4:45 p.m. Invited
Storing Light on Chip: Breaking the Delay-Bandwidth Limit, *Michal Lipson; Cornell Univ., USA.* Abstract unavailable.

SMB4 ● 5:15 p.m.
All Optical Delay of Images Using Slow Light, *Ryan Camacho, Curtis Broadbent, I. Ali-Khan, John Howell; Univ. of Rochester, USA.* The amplitude and phase of images are preserved in a slow light medium. The S/N ratio is sufficiently small to use very low light levels and preserve the images leading to quantum image storage.

● Tuesday, July 10, 2007 ●

2nd Floor Foyer
7:30 a.m. – 5:00 p.m.
Registration Open

STuA • Slow Light in Semiconductors

Alpine East
STuA ● Slow Light in Semiconductors
8:30 a.m. – 10:30 a.m.
Hailin Wang; Univ. of Oregon, USA, Presider

STuA1 ● 8:30 a.m. Invited
Quantum Optics Experiments with Semiconductor Nanostructures, *Chris Phillips; Imperial College London, UK.* We use semiconductor nanostructures, to demonstrate coherent optical effects previously seen only in atomic vapours. We show, for the first time in a solid, optical gain without population inversion, and light slowed down to ~c/40.

STuA2 ● 9:00 a.m.
THz Tunable Slow Light and Fast Light of Ultrashort Pulses in Semiconductor Optical Amplifiers, *Bala Pesala[1], Forrest G. Sedgwick[1], Alexander V. Uskov[1], Connie Chang-Hasnain[1], Tony H. Lin[2]; [1]Univ. of California at Berkeley, USA, [2]Calmar Optcom Inc., USA.* Electrically tunable delays and advances for 600fs pulses are achieved using ultra-fast nonlinearities in SOAs. Feasibility of cascading multiple SOAs to achieve higher delays is confirmed using a novel scheme that uses a single SOA.

STuA3 ● 9:15 a.m.
Scaling Law for Fast Light in Cascaded Semiconductor Optical Amplifiers, *Piotr K. Kondratko, Hui Su, Shun Lien Chuang; Univ. of Illinois at Urbana-Champaign, USA.* Fast light with scaling law using cascaded quantum-well semiconductor optical amplifiers is demonstrated and modeled. Delay-bandwidth and frequency tuning are achieved by varying the number of amplifiers or coupling amplifier-to-amplifier attenuation.

STuA4 ● 9:30 a.m.
Pulse Propagation near Exciton Resonance: Anomalous Transition between Slow and Fast Light, *Yan Guo, Susanta Sarkar, Hailin Wang; Univ. of Oregon, USA.* We report experimental studies of optical pulse propagation near an exciton resonance in an optically thick GaAs quantum well. The studies are aimed at understanding an anomalous transition between regimes of slow and fast light.

STuA5 ● 9:45 a.m.
Increase of Fractional Advance in THz-Bandwidth Fast Light by Pulse Chirping in an SOA, *Forrest G. Sedgwick[1], Bala Pesala[1], Jui-Yen Lin[1], Connie Chang-Hasnain[1], Tony Lin[2]; [1]Univ. of California at Berkeley, USA, [2]Calmar Optcom, Inc., USA.* We propose a novel technique to improve fast light in semiconductor optical amplifiers. By chirping input pulses, experimentally measured advance increases 1.5 ps. The fractional advance can be increased twofold by recompressing the output pulses.

STuA6 ● 10:00 a.m.
Large Microwave Phase Shift and Small Distortion in an Integrated Waveguide Device, *Filip Öhman[1], Salvador Sales[2], Yaohui Chen[1], Enrique Granell[2], Jesper Mørk[1]; [1]COM•DTU Dept. of Communications, Optics and Materials, Denmark, [2]Dept. de Comunicaciones, ITEAM Res. Inst., Univ. Politécnica de Valencia, Spain.* We have obtained a tunable phase shift of 150 degrees in an integrated semiconductor waveguide by optimizing the interplay of fast and slow light effects. Furthermore, the distortions imposed by device nonlinearities have been quantified.

STuA7 ● 10:15 a.m.
All-Optical Delay Line Using Semiconductor Cavity Solitons, *Francesco Pedaci[1], Stéphane Barland[1], Emilie Caboche[1], Patrice Genevet[1], Massimo Giudici[1], Jorge Tredicce[1], Thorsten Ackemann[2], Andrew J. Scroggie[2], Willie J. Firth[2], Gian-Luca Oppo[2], Giovanna Tissoni[3], Roland Jaeger[4]; [1]Inst. Non Linéaire de Nice, France, [2]SUPA, Dept. of Physics, Univ. of Strathclyde, UK, [3]INFM-CNR, Italy, [4]Ulm Photonics, Germany.* A novel approach to all-optical delay line based on lateral drift of cavity solitons in semiconductor micro-resonators is experimentally demonstrated. Delay-bandwidth product obtained compares well with the ones obtained in "slow-light" based delay lines.

Grand Ballroom C
10:30 a.m. – 11:00 a.m.
Exhibits Open/Coffee Break

STuB • High-*Q* Cavity and Ring Resonators

Alpine East
STuB ● High-*Q* Cavity and Ring Resonators
11:00 a.m. – 12:30 p.m.
Michal Lipson; Cornell Univ., USA, Presider

STuB1 ● 11:00 a.m. **Invited**
Optical Pulse Trapping by Ultra-High *Q* Nanocavity, *Susumu Noda; Kyoto Univ., Japan.* Abstract unavailable.

STuB2 ● 11:30 a.m.
Universal Parameters for the Design of Flat-Band Finite-Size Coupled Resonator Optical Waveguides, *Siva Yegnanarayanan, Qing Li, Mohammad Soltani, Ali Adibi; Georgia Tech, USA.* Systematic design rules for finite-size CROW are developed using direct correspondence to ladder-type LC circuits. Silicon-on-Insulator CROW with flat-band spectrum and excellent group- delay response is experimentally demonstrated.

STuB3 ● 11:45 a.m.
Loss-Tuning of Coupled-Resonator Delay Lines Allows Light-Stopping of Large Bandwidth Signal, *Sunil Sandhu, Michelle L. Povinelli, Shanhui Fan; Stanford Univ., USA.* We introduce a novel light-stopping process using dynamic loss tuning. The system allows a ~1THz bandwidth signal to be delayed for ~12ps. We present an analysis of the system during the dynamic loss tuning.

STuB4 ● 12:00 p.m.
Simultaneous Fast and Slow Light on a Chip Using Microring Resonators, *Christopher Fietz, Gennady Shvets; Univ. of Texas at Austin, USA.* Two orthogonal light polarizations in a waveguide coupled to microring resonators can propagate as fast and slow light. Which one is fast (slow) is determined by input polarization and the number of resonators.

STuB5 ● 12:15 p.m.
Form-Birefringent Slow Light Optical Limiter, *Yang Cao, John O. Schenk, Thomas J. Suleski, Michael A. Fiddy; Univ. of North Carolina, USA.* We discuss multilayer devices based on subwavelength form-birefringence to slow light, that enhance electric field strengths and induce index changes that modify the bandgap. Design considerations, fabrication processes and initial results are discussed.

12:30 p.m. – 2:00 p.m.
Lunch (on your own)

STuC • Physics of Slow Light

Alpine East
STuC ● Physics of Slow Light
2:00 p.m. – 4:00 p.m.
Robert W. Boyd; Univ. of Rochester, USA, Presider

STuC1 ● 2:00 p.m. **Invited**
Slow Light by Slow Waves: Plasmonics for Light Halting, *Meir Orenstein; Technion, Israel.* Abstract unavailable.

STuC2 ● 2:30 p.m. **Invited**
Slow Light by Persistent Spectral Hole Burning, *Aleksander Rebane; Montana State Univ., USA.* We survey pulse reshaping by propagation through narrow spectral transmission features in optically dense, inhomogeneously broadened persistent spectral hole burning medium. Maximum group delay versus pulse distortion is analyzed and compared to time-space holography.

STuC3 ● 3:00 p.m. **Invited**
Light Storage Using Gradient Stark Echoes, *Matthew Sellars[1], A. L. Alexander[1], J. J. Longdell[2], G. Hétet[3], P. K. Lam[3]; [1]Res. School of Physical Sciences and Engineering, Australian Natl. Univ., Australia, [2]Dept. of Physics, Univ. of Otago, New Zealand, [3]ARC COE for Quantum-Atom Optics, Australian Natl. Univ., Australia.* Aquantum memory for light using optical gradient echoes is proposed. The scheme uses only two atomic levels and the recalled pulse propagates forward. In preliminary experiments efficiencies in excess of 10% have been observed.

STuC4 ● 3:30 p.m. **Invited**
Slow Light: Underlying Controversies, *V. Zapasskii[1], G. G. Kozlov[1], E. B. Aleksandrov[2]; [1]V. A. Fock Inst. of Physics, St. Petersburg State Univ., Russian Federation, [2]A. F. Ioffe Physical-Technical Inst., Russian Acad. of Sciences, Russian Federation.* We show that some experimental observations on 'slow' and 'fast' light can be interpreted in terms of simple models of classical nonlinear optics without attracting the idea of steep-dispersion-based modification of group velocity of light.

Grand Ballroom C
4:00 p.m. – 4:30 p.m.
Exhibits Open/Coffee Break

STuD • Cold Atoms, Coherent Control of Slow Light

Alpine East
STuD ● Cold Atoms, Coherent Control of Slow Light
4:30 p.m. – 6:00 p.m.
Lene Vestergaard Hau; Harvard Univ., USA, Presider

STuD1 ● 4:30 p.m. **Invited**
Confinement of Cold Atoms Inside Hollow-Core Photonic Bandgap Fiber, *Vlatko Balić, M. Bajczy, A. Zibrov, V. Vuletic, M. D. Lukin; Harvard/MIT Ctr. for Ultracold Atoms, USA.* We describe recent progress in our experiment that uses a combination of magnetic trapping and a red-detuned optical dipole trap to transfer cold rubidium atoms into the hollow-core photonic bandgap fiber.

STuD2 • 5:00 p.m.
Temporal Compression of Laser Pulses by Coherent Control: Experimental and Theoretical Studies, *Roberto Buffa[1], Stefano Cavalieri[2], Lorenzo Fini[2], Emilio Ignesti[1], Emiliano Sali[2], Marco V. Tognetti[1]; [1]Univ. di Siena, Italy, [2]Univ. di Firenze, Italy.* We present our most recent theoretical results on a temporal compression technique based on electromagnetically-induced transparency. An experiment aimed to provide a first proof-of-principle demonstration of the process is also described.

STuD3 • 5:15 p.m.
Slow Light for Studying Quantum Weak Values, *Shubhrangshu Dasgupta[1], Girish S. Agarwal[2]; [1]Univ. of Toronto, Canada, [2]Oklahoma State Univ., USA.* We show how the quantum mechanical "weak values" can be realized using the ideas of slow light pulses. The measurements can also change light propagation from subluminal to superluminal.

STuD4 • 5:30 p.m.
A New Beating Experiment Using Biphotons Generated from a Two-Level System, *Jianming Wen[1], Morton H. Rubin[1], Shengwang Du[2]; [1]Physics Dept., Univ. of Maryland, USA, [2]Stanford Univ., USA.* A new beating experiment is proposed based on biphotons created from a two-level system in the resonant-pumping case. Both slow-light and fast-light effects play the role as of path-length difference in the original Franson interferometer.

STuD5 • 5:45 p.m.
Trojan Wavepacket Pulses with Slow Light in Media with Time and Space Dependent Refraction, *Matt K. Kalinski; Utah State Univ., USA.* Using the formalizm of so-called Wave Function of Photon in strongly refractive time dependent dielectric medium we show that the light trapping in the form of stable nondispersing wavepackets is possible on circular orbits.

Grand Ballroom C
6:00 p.m. – 7:30 p.m.
Conference Reception

JTuA • Joint Poster Session

Grand Ballroom C
JTuA • Joint Poster Session
6:00 p.m. – 7:30 p.m.

JTuA1
Slow Light in Quantum Dot Semiconductor Laser for Photonic RF Phase Shifter, *P. C. Peng[1], J. N. Liu[2], C. T. Lin[2], H. C. Kuo[2], J. H. Chen[2], S. C. Wang[2], S. Chi[2,3], J. Y. Chi[4]; [1]Dept. of Applied Materials and Optoelectronic Engineering, Natl. Chi Nan Univ., Taiwan, [2]Dept. of Photonics and Inst. of Electro-Optical Engineering, Natl. Chiao-Tung Univ., Taiwan, [3]Dept. of Electrical Engineering, Yuan-Ze Univ., Taiwan, [4]Opto-Electronics and System Lab, Industrial Technology Res. Inst., Taiwan.* We demonstrate a phase shifter based on slow light in a quantum dot vertical-cavity surface-emitting laser. The phase change with the frequency ranging from 10 to 20 GHz is achieved.

JTuA2
Observation of Band Structure and Reduced Group Velocity Area in SOI 2-D Planar Photonic Crystals, *Nicole A. Paraire, Yassine Benachour, Laurent Nevou; CNRS, Universite Paris Sud, France.* We report experimental band structure determination for several 2-D photonic crystals etched in SOI, using diffractive optics techniques. This allows fast characterization of devices and location of reduced group velocity areas suitable for nonlinear observations.

JTuA3
Limitations on Nonlinear Pulse Propagation in Coupled-Resonator Waveguides, *Vishnupriya Govindan, Steve Blair; Univ. of Utah, USA.* Under the constraint of fixed pulse distortion, the nonlinear response of coupled-resonator slow light waveguides fails to improve with increasing number of resonators, even though improvement in bandwith-delay product is obtained.

JTuA4
Influence of Group Velocity on Roughness Losses for 1-D Periodic Structures, *Jaime García, Alejandro Martínez, Javier Martí; Valencia Nanophotonics Technology Ctr., Spain.* Slow-wave structures do not only provide benefits. One of their most important problems is the increase of roughness losses when group velocity decreases. This dependence has been theoretically studied for some 1-D periodic structures.

JTuA5
Slow Light Propagation for High Optical Information Density in Active Photonic Lattices, *Spilios Riyopoulos; SAIC, USA.* Evanescent field coupling in coupled micro- and nano-laser cavity arrays supports optical modulation waves propagating near the sound speed. The possibility of achieving high information density with near unity delay-time to pulse-time ratio is addressed.

JTuA6
Broad-Bandwidth Slow Light in Multi-Line Brillouin Gain Spectrum, *Yongkang Dong, Zhiwei Lu, Qiang Li; Inst. of Opto-Electronics, Harbin Inst. of Technology, China.* We present a method to achieve broad-bandwidth and flat-top gain spectrum through overlapping multi-line Brillouin gain spectrum with a phase modulator, achieving a Brillouin gain bandwidth of ~ 330 MHz.

JTuA7
Physical Properties of InN for Optically Controlling the Speed of Light, *Fernando B. Naranjo[1], Miguel González-Herráez[1], Héctor Fernández[2], Javier Solis[2], Eva Monroy[3]; [1]Photonics Engineering Group, Electronics Dept., Univ. of Alcala, Spain, [2]Optics Inst., CSIC, Spain, [3]Equipe Mixte CEA-CNRS-UJF, Nanophysique et Semiconducteurs, DRFMC/SP2M/PSC, France.* We report on $|\chi(3)|$ and population grating lifetime measurements performed on thick InN samples. We study the possibility of using InN for slow light applications considering linear and non-linear absorption near band-gap wavelengths (~1500 nm).

JTuA8
Low Distortion Fast Light in an Optical Fiber Using Stimulated Brillouin Scattering, *Luc Thévenaz[1], Sanghoon Chin[1], Miguel Gonzalez-Herraez[2]; [1]Ecole Polytechnique Federal de Lausanne, Switzerland, [2]Dept. of Electronics, Univ. of Alcalá de Henares, Spain.* We demonstrate expeimentally a novel approach for fast light generation based on a wideband compound spectral resonance using stimulated Brillouin scattering. The pulses experience fast light with extremely reduced distortion and small amplitude change.

JTuA9
Slow Light of Gb/s Bit Streams via Stimulated Brillouin Scattering in Non-Uniform Optical Fibers, *Vladimir Kalosha, Liang Chen, Xiaoyi Bao; Dept. of Physics, Univ. of Ottawa, Canada.* Slow-light effect in fibers with distance-depending Brillouin frequency provides large, optically controlled delay of picosecond pulses with a little shape distortion, when Brillouin frequency variation along the fiber corresponds to the whole pulse spectrum.

JTuA10
Slow-Light Soliton Stability with Respect to Atomic Relaxation, *Ilya Vadeiko[1], Andrei Rybin[2], Alan Bishop[3]; [1]Physics Dept., McGill Univ., Canada, [2]Univ. of Information Technologies, Mechanics and Optics, Russian Federation, [3]Los Alamos Natl. Lab, USA.* We solved the problem of slow-light soliton dynamics in the presence of strong spontaneous emission of excited atoms. We have demonstrated that the damping of the soliton is strongly suppressed due to the nonlinear interaction.

JTuA11
Study of Brillouin Active Fiber Ring as an Effective Slow Light Device, *Chung Yu[1], Christopher Horne[1], Yongkab Kim[2]; [1]North Carolina A&T State Univ., USA, [2]Wonkwang Univ., Republic of Korea.* This letter presents experimental data on the superior performance in SBS gain and linewidth of the fiber ring and their potential enhancement of time delay in slow light fiber devices.

JTuA12
Reduction of Light Propagation by Spectral Burning Hole in an Optical Fiber, *Yundong Zhang, Wei Qiu, Jianbo Ye, He Tian, Nan Wang, Hao Wang, Ping Yuan; Harbin Inst. of Technology, China.* The authors observed a spectral burning hole and slowdown of light propagation by population oscillation technique in an Erbium-doped optical fiber. Measured bandwidth of the hole was about 55 Hz. Group velocity was 2.186×103m/s.

JTuA13
Flat and Offset Band Edges in Multi-Mode Fibers with Superstructure Bragg Gratings, *Andrey A. Sukhorukov[1], C. Martijn de Sterke[2]; [1]Australian Natl. Univ., Australia, [2]Univ. of Sydney, Australia.* We show that, in a conventional fiber with a superstructure Bragg grating designed for mode mixing, the dispersion at band-gap edge can be made quartic, or the band-edges may appear for non-zero wave vectors.

JTuA14
Photonic Crystal Waveguides: 2-D Numerical Modeling, *Ivan Richter, Milan Šiňor, Pavel Kwiecien; Czech Technical Univ. in Prague, Czech Republic.* Photonic crystal waveguides are modeled in various configurations, in two-dimensional geometry, including rectangular, chessboard, circular building blocks of rectangular and triangular grids, both of direct and inverse type. Mode matching and FDTD techniques are used.

JTuA15
Ultra-Fast Polarization Conversion with a Filtered Pattern-Independent Semiconductor Optical Amplifier, *Claudio Crognale[1], Vittorio Ricchiuti[1], Stefano Caputo[2], Sante Saracino[3]; [1]Technolabs S.p.A., Italy, [2]SMD Elettronica, Italy, [3]Siemens S.p.A., Italy.* A new optical gain pattern-dependence suppression method in Semiconductor Optical Amplifiers (SOAs) has been applied to an optically filtered SOA-based architecture to perform the all-optical polarization conversion of an ultra-fast data-stream without any pattern-dependence.

JTuA16
Bragg Reflector Waveguide Based on Thin Film Barium Titanate, *Zhifu Liu, Pao-Tai Lin, Bruce W. Wessels; Northwestern Univ., USA.* Bragg reflector waveguide was fabricated from $BaTiO_3$ thin film using low pressure nano-lithography. Its transmission spectrum around 1.55 μm shows a 40% change over a 6 nm range. Velocity phase matching condition is discussed.

JTuA17
A One-Dimensional Photonic Crystal Rib Waveguide, *Jeremy J. Goeckeritz, Steve Blair; Univ. of Utah, USA.* We introduced a new type of 1-D PC rib waveguide (PCRW). Simulations of the structure showed an extremely wide photonic band gap. Furthermore, the loss can be controlled by increasing the waveguide height.

● Wednesday, July 11, 2007 ●

2nd Floor Foyer
8:00 a.m. – 5:00 p.m.
Registration Open

SWA • Slow Light in Optical Fibers and Waveguides

Alpine East
SWA ● Slow Light in Optical Fibers and Waveguides
8:30 a.m. – 10:30 a.m.
Daniel Gauthier; Duke Univ., USA, Presider

SWA1 ● 8:30 a.m. **Invited**
Fundamental Limits and Recent Advances in Slow and Fast Light Systems Based on Optical Parametric Processes in Fibers, *Evgeny M. Shumakher, Amnon Willinger, Gadi Eisenstein; Technion, Israel.* We describe a comprehensive model which predicts fundamental limits for slow light using narrow band parametric amplification. It includes Raman contribution to phase matching and fiber birefringence. Exemplary experiments confirming the model are also described.

SWA2 ● 9:00 a.m.
Slow Light with Opto-Acoustic Gap Solitons, *Richard S. Tasgal[1], Y. B. Band[1], Boris A. Malomed[2]; [1]Depts. of Chemistry and Electro-Optics, Ben Gurion Univ., Israel, [2]Dept. of Interdisciplinary Studies, Faculty of Engineering, Tel Aviv Univ., Israel.* Optical gap solitons can couple to acoustic waves through electrostriction, giving rise to ``gap-acoustic'' solitons (GASs). We show that supersonic GASs are unstable, which results in changes in speed, and ultimately very slow (subsonic) light.

SWA3 ● 9:15 a.m.
Photon Tunneling through Evanescent Gaps and Bandgaps, *Sergey V. Polyakov[1,2], David Papoular[3], Daniel Josell[4], Paul Lett[1,3], Colin McCormick[3], Alan Migdall[1,2]; [1]Joint Quantum Inst., Univ. of Maryland, USA, [2]Optical Technology Div., NIST, USA, [3]Atomic Physics Div., NIST, USA, [4]Metallurgy Div., NIST, USA.* We investigate photon tunneling times in regions of evanescent propagation and compare them to tunneling times in bandgaps with even and odd numbers of layers, which yield measurably different tunneling times.

SWA4 ● 9:30 a.m. Invited
Slow-Light Techniques in Optical Waveguides, *Alexander Gaeta; Cornell Univ., USA.* Abstract unavailable.

SWA5 ● 10:00 a.m. Invited
Optical Nanofibers for Manipulating Atoms and Photons, *Kohzo Hakuta; Univ. of Electro-Communications, Japan.* We show how subwavelength-diameter silica-fibers, "optical nanofibers," can open new perspectives for manipulating atoms and photons. We explore atom/photon interaction around a nanofiber using laser-cooled Cs-atoms. Spontaneous emission, single-atom trapping, and electromagnetically-induced tansparency are discussed.

SWB • Photonic Crystal Waveguides

Alpine East
SWB ● Photonic Crystal Waveguides
11:00 a.m. – 12:30 p.m.
Presider to Be Announced

SWB1 ● 11:00 a.m. Invited
Controlled Slowlight in Photonic Crystals, *Toshihiko Baba[1,2], D. Mori[1], T. Kawasaki[1], S. Kubo[1], H. Sasaki[1]; [1]Yokohama Natl. Univ., Japan, [2]CREST, Japan Science and Technology Agency, Japan.* Anomalous dispersion which generates slow light can be flexibly designed in photonic crystals, so that a delay and bandwidth are balanced and higher order dispersion is suppressed. Such slow light is demonstrated in photonic crystal waveguide devices.

SWB2 ● 11:30 a.m.
Optical Analogue to Electromagnetically Induced Transparency in Photonic Crystals, Simulation and Experiments, *Jun Pan, Sunil Sandhu, Yijie Huo, Michelle L. Povinelli, Martin M. Fejer, Shanhui Fan, James S. Harris; Stanford Univ., USA.* We design an optical analogue to electromagnetically-induced transparency in photonic crystal slabs. A simulated transmission spectrum exhibits a narrow transparency resonance, while experiments demonstrate cavity-waveguide coupling in a two-cavity structure.

SWB3 ● 11:45 a.m.
Optical Jitter and Pulse Distortion in High Bit-Rate, Slow-Light Mach-Zehnder Interferometers, *Ashutosh R. Shroff[1], Philippe M. Fauchet[2]; [1]Inst. of Optics, Univ. of Rochester, USA, [2]Dept. of Electrical and Computer Engineering, Univ. of Rochester, USA.* Slow-light waveguides formed by photonic crystal coupled-cavities can be used to reduce the size of integrated MZI switches. We demonstrate that in these devices optical jitter causes significant pulse distortion at bit-rates above 100 Gbits/s.

SWB4 ● 12:00 p.m.
Slow-Light Switching in Nonlinear Bragg-Grating Couplers, *Sangwoo Ha, Andrey A. Sukhorukov, Yuri S. Kivshar; Australian Natl. Univ., Australia.* We reveal that nonlinear waveguide couplers with phase-shifted Bragg gratings can be used to perform power-controlled switching of slow-light pulses between the output ports, combined with the delay control and suppression of dispersion-induced pulse broadening.

SWB5 ● 12:15 p.m.
Slow Light in Tapered Negative-Refractive-Index Waveguides, *Kosmas Tsakmakidis, Ortwin Hess; Advanced Technology Inst., School of Electronics and Physical Sciences, Univ. of Surrey, UK.* We analytically demonstrate that a lightwave propagating along an adiabatically tapered left-handed waveguide can efficiently be brought to a complete standstill, while allowing for more than 90% in-coupling from an ordinary dielectric waveguide.

SWC • Optical Fibers- Brillouin Scattering, Wavelength Conversion

Alpine East
SWC ● Optical Fibers- Brillouin Scattering, Wavelength Conversion
2:00 p.m. – 4:00 p.m.
Jesper Moerk; Technical Univ. of Denmark, Denmark, Presider

SWC1 ● 2:00 p.m. Invited
Progress on Stopped Light and Large-Delay Slow Light in Optical Fibers, *Daniel Gauthier; Duke Univ., USA.* Recently, slow light was achieved in room temperature optical waveguides, which is accelerating the transition of this technique to applications. This paper reviews recent progress in obtaining large optically-controllable slow-light delays.

SWC2 ● 2:30 p.m.
Multi-Functional All-Optical Tunable Delay Line Combined with Wavelength Converter, *Takashi Kunihiro, Tomochika Kanou, Shoichiro Oda, Akihiro Maruta; Graduate School of Engineering, Osaka Univ., Japan.* We propose a novel multi-functional all-optical tunable delay line with wavelength converter using soliton self-frequency shift and filtering supercontinuum spectrum. We experimentally demonstrate a temporal shift of 15.6ps and wavelength conversion in 1525-1565nm range.

SWC3 ● 2:45 p.m.
Adjusting the Brillouin Spectrum in Optical Fibers for Slow and Fast Light Applications, *Thomas Schneider, R. Henker, K. U. Lauterbach, M. Junker; Deutsche Telekom AG, Germany.* We discuss the tailoring of the Brillouin spectrum by the superposition of different Stokes and anti-Stokes resonances. With this method it is possible to overcome the slow light bandwidth limitation and to enhance pulse delays.

SWC4 ● 3:00 p.m.
Single-Sideband Modulation and Variable Delay of GHz-Wide Analog Signals Generated via Stimulated Brillouin Scattering, *Avi Zadok, Avishay Eyal, Moshe Tur; Tel Aviv Univ., Israel.* Single-sideband and variable delay of GHz-wide, linear frequency modulated signals are demonstrated, using stimulated Brillouin scattering in fiber. Distortion is minimized using precise chirp control of the broadened pump. Results are attractive for optical beam-forming.

SWC5 ● 3:15 p.m.
Self-Advanced Propagation of Light Pulse in an Optical Fiber Based on Brillouin Scattering, *Sanghoon Chin[1], Miguel Gonzalez-Herraez[2], Luc Thévenaz[1]; [1]Ecole Polytechnique Federal de Lausanne, Switzerland, [2]Dept. of Electronics, Univ. of Alcala de Henares, Spain.* We propose a novel method to realize self-induced fast light and signal advancement with no distinct pump source in optical fibers, based on stimulated Brillouin scattering. This scheme will be helpful for real application systems.

SWC6 ● 3:30 p.m. Invited
Application of Fast Light to Enhancing the Bandwidth-Sensitivity Product of a Gravitational Wave Detector, *Selim M. Shahriar, G. S. Pati, M. Salit, K. Salit; Northwestern Univ., USA.* A Fast-Light based White Light Cavity can be used to enhance the bandwidth-sensitivity product for gravitational-wave detection. Here, we demonstrate such a system in a meter-long ring-cavity using bi-frequency Raman gain in the intra-cavity medium.

SWD • Slow and Fast Light Rump Session

Alpine East
SWD ● Slow and Fast Light Rump Session
4:30 p.m. – 6:00 p.m.
Gadi Eisenstein; Technion—Israel Inst. of Technology, Israel, Presider

Alpine East
SL Closing Remarks
6:00 p.m. – 6:15 p.m.

Key to Authors and Presiders

(bold denotes Presider or Presenting Author)