OAA/IPR

Optical Amplifiers and Their Applications

June 27–30, 2004

Integrated Photonics Research

June 30–July 2, 2004

Collocated Topical Meetings
and Tabletop Exhibits

Collocated with: IEEE/LEOS Workshop on Advanced Modulation Formats

Renaissance Parc 55 Hotel
San Francisco, California

Sponsored by: Optical Society of America
Technical Co-sponsor: IEEE/Lasers and Electro-Optics Society

OAA Program Committee

Organizing Committee
Jonathan A. Nagel, *AKA Tech. Solutions, USA*, **General Chair**
Shu Namiki, *Furukawa Electric Co. Ltd., Japan*, **General Chair**
Leo H. Spiekman, *The Netherlands*, **General Chair**
Jesper Moerk, *Tech. Univ. of Denmark, Denmark*, **Program Chair**
Masashi Onishi, *Sumitomo Electric Ind. Ltd., Japan*, **Program Chair**
Atul Srivastava, *Onetta, Inc., USA*, **Program Chair**

J. A. Abate, Lucent Tech., USA, **OSA Technical Group Representative**

1. Fiber and Active Waveguides
Morten Nissov, *Tyco Telecommunications, USA*, **Subcommittee Chair**
Takuya Aizawa, *Fujikura Ltd., Japan*
Gregory J. Cowle, *JDS Uniphase, USA*
Laurent Gasca, *Alcatel, France*
Dominique Hamoir, *MULTITEL, Belgium*
Clifford E. Headley, *OFS, USA*
Etsuko Ishikawa, *Fujitsu Lab. Ltd., Japan*
Li Qian, *Univ. of Toronto, Canada*
Karsten Rottwitt, *Technical Univ., Denmark*
Tadashi Sakamoto, *NTT Photonics Labs., Japan*
Michael V. Vasilyev, *Corning, Inc., USA*
Shinji Yamashita, *Univ. of Tokyo, Japan*

2. Semiconductor Devices and Functional Circuits
Hitoshi Kawaguchi, *Yamagata Univ., Japan*, **Subcommittee Chair**
Antonella Bogoni, *CNIT, Photonic Networks National Lab., Italy*
A. E. Kelly, *Univ. of Glasgow, UK*
Juerg Leuthold, *Lucent Technologies, Inc., USA*
Robert Manning, *University College Cork, UK*
Ken Morito, *Fujitsu Laboratories Ltd., Japan*
Geert I. Morthier, *Univ. of Ghent, Belgium*
Radha K. Nagarajan, *Infinera, USA*
Kevin Nishikata, *Japan*
Yasuo Shibata, *NTT Photonics Labs., Japan*

3. Networks and Systems
Peter M. Krummrich, *Siemens AG, Germany*, **Subcommittee Chair**
Sebastien Bigo, *Alcatel Corp. Res. Ctr., France*
Martin Birk, *AT&T Research, USA*
Chongcheng Fan, *Tsinghua Univ., China*
Kiyoshi Fukuchi, *NEC Corp., Japan*
Yutaka Miyamoto, *NTT Basic Res. Lab., Japan*
Rene Monnard, *Onetta, Inc., USA*
Stojan Radic, *Bell Labs., Lucent Tech., USA*
Katsuhiro Shimizu, *Mitsubishi Electric Corp., USA*
Balakrishnan Sridhar, *CIENA Corp., USA*
David V. Walker, *Nortel Networks, Canada*

About OAA

June 27–30, 2004

This topical meeting will provide an international forum for the most recent developments in optical amplifiers, including principles of operation, practical realization, design, photonic integration, optical systems and networks. All aspects of optical amplifier implementation from research to manufacturing will be discussed.

OAA Meeting Topics

Topics to be considered include:

Fiber and Active Waveguides
Planar waveguide amplifiers and sources, rare-earth doped fibers, Raman amplifiers, new fiber amplifiers and sources, nonlinear fiber-optic devices, materials and structures, design and fabrication, amplifier modeling and characterization, noise and linearity, active fiber-based integration.

- planar waveguide amplifiers and sources
- materials and structures
- rare-earth doped fibers
- design and fabrication
- Raman amplifiers
- amplifier modeling and characterization
- new fiber amplifiers and sources
- noise and linearity
- nonlinear fiber-optic devices
- active fiber-based integration

Semiconductor Devices and Functional Circuits
Semiconductor amplifiers, semiconductor pump lasers, wavelength converters, optical switches and processing elements, semiconductor photonic integrated circuits, planar elements and subsystems, sensors, noise dynamics novel (e.g., low dimensional) material systems.

- semiconductor amplifiers
- semiconductor photonic integrated circuits
- semiconductor pump lasers
- planar elements and subsystems
- wavelength converters

- sensors
- optical switches and processing elements
- noise dynamics novel (e.g., low dimensional) material systems

Networks and Systems
Multi-wavelength network applications, switched optical network applications, video and analog transport, subscriber-access networks, upgrade of existing systems, terrestrial and undersea transmission, soliton transmission, system-related analysis, nonlinear effects, field demonstrations/deployment experience.

- multi-wavelength network applications
- terrestrial and undersea transmission
- switched optical network applications
- soliton transmission
- video and analog transport
- system-related analysis
- subscriber-access networks
- nonlinear effects
- upgrade of existing systems
- field demonstrations/deployment experience

OAA 2004 Workshop: What is Next for Optical Amplifiers

Sunday, June 27, 2004, 2:00pm-5:00pm

Organizer: Atul Srivastava, Onetta Inc. asrivastava@onetta.com

During the bubble years, we witnessed tremendous progress in optical amplifiers (OA's). EDFAs advanced in bandwidth, power and architectural complexity. The amplification bandwidth was enhanced by the introduction of novel bands such as L-, S- and U-bands. Raman amplifiers reached practicability with the availability of high power 14xx pumps. These developments were aimed to satisfy the increasing demands on the capacity and longer reach of optical networks.

In the post-bubble era, there is a need to reassess the direction of research and development in OA's. There are signs that the networks are evolving from a linear, high capacity one to a more connected, two-dimensional architecture. The discussion on tradeoff between cost and performance continues to dominate the industry with balance tilted in favor of the cost. In this cost constrained environment, several of the attractive advances of the yesteryears may never be used.

This workshop aims to address the following key questions:

- How the metro and long-haul network architecture will evolve over next years?
- What innovations are needed in OA's to address the evolution in the networks?
- Will there be more/less complexity and functionality in OA's?
- Will the cost reduction trend continue or the cost/performance balance will shift towards performance?
- Which amplifiers will become a commodity soon?
- Are there new attractive OA technologies on the horizon?

Moderator:
Yan Sun, Onetta, USA

Panelists (presentation titles will be added as they are received):

To be announced, Martin Birk, *AT&T Research, USA*
To be announced, Peter M. Krummrich, *Siemens AG, Germany*
Raman amplifiers for future optical networks, Shu Namiki, *Furukawa Electric Co. Ltd., Japa*n
To be announced, Dhrupad Trivedi, *JDS Uniphase, USA*
To be announced, Paul Wysocki, *Consultant, USA*

IPR Speakers

Plenary Speakers

- **Convergence of optics and electronics**, Lionel Kimerling, *MIT, USA*
- **Applications of photonic crystals in integrated photonics**, Axel Scherer, *Caltech, USA*

Invited Speakers

The preliminary list of invited speakers for IPR includes:

1. Active and Compound Semiconductor Devices

- **InP-based photonic integration technology**, J. J. M. Binsma[1], Jan-Hendrik den Besten[2], Ronald G. Broeke[2]; [1]*JDS Uniphase, Netherlands*, [2]*COBRA, Eindhoven Univ. of Tech., Netherlands*. (IFB1)
- **Microdisk and microring lasers**, Daniel P. Dapkus, *Univ. of Southern California, USA.* (IWC1)
- **Semiconductor based advanced integrated devices for WDM networks**, Nobuhiro Kikuchi, Yasumasa Suzaki, Yasuo Shibata, Yuichi Tohmori; *NTT Photonics Labs., NTT Corp., Japan*. (IFB3)
- **Quantum dot lasers for high frequency systems**, Matthias Kuntz, D. Bimberg; *Technische Univ. Berlin, Germany*. (IThD4)
- **Self-pulsation and sub-harmonic optical injection locking beyond 200 GHz using multi-electrode DFB lasers**, Satoshi Nishikawa, Mitsunobu Gotoda, Tetsuya Nishimura, Yasunori Tokuda; *Mitsubishi Electric Corp., Japan*. (IThD1)
- **Ultrafast photoreceivers for various 40 Gb/s applications**, Andreas Umbach, Carsten Schramm, Christoph C. Leonhardt, Gerald Jacumeit, Jörg Honecker, Günter Unterbörsch; *u2t Photonics AG, Germany*. (IThB1)

2. Waveguides and Waveguide Devices

- **Reflective-based planar waveguide components**, Serge Bidnyk; *Enablence Inc., Canada*. (IThG1)
- **Electro-optic materials and devices for integrated photonics**, Larry Dalton[1], A. K.-Y Jen[1], B. H. Robinson[1], W. H. Steier[2]; [1]*Univ. of Washington, USA*, [2]*Univ. of Southern California, USA*. (IThC1)

- **Silica-on-silicon devices for inter- and intra-channel control in WDM systems**, Christopher Doerr, *Lucent Technologies, Bell Labs, USA*. (IThA1)
- **Integrated components using single-crystal thin-film $LiNbO_3$**, Tomoyuki Izuhara, *DuPont Photonics Technologies, USA.* (IFF1)
- **Hollow silicon waveguides for integrated optics: Design concepts and design criteria**, Michael Jenkins, M. E. McNie, A. F. Blockley, N. Price, J. McQuillan; *QinetiQ, UK*. (IFH1)
- **Reset-free integrated polarization controller using phase shifters**, Christi K. Madsen, Peter Oswald, Mark Cappuzzo, Evans Chen, Lou Gomez, Andrew Griffin, Annjoe Wong-foy, Ed Laskowski, A. Kasper; *Lucent Technologies, Bell Labs, USA*. (IFG1)
- **Silicon wire waveguides and their applications for microphotonics devices**, Hiroshi Fukuda[1], Tai Tsuchizawa[1], Koji Yamada[1], Toshifumi Watanabe[1], Mitsutoshi Takahashi[1], Jun-ichi Takahashi[1], Seiichi Itabashi[1], Tetsufumi Shoji[2]; [1]*NTT Microsystem Integration Labs.*, Japan, [2]*NTT West Corp., Japan*. (IWA1)

3. Modeling, Numerical Simulation and Theory

- **Bloch mode scattering matrix methods for modelling extended photonic crystal devices**, Lindsay Botten[1], A. A. Asatryan[1], T. N. Langtry[1], T. P. White[2], C. Martijn de Sterke[2], R. C. McPhedran[2]; [1]*Univ. of Tech., Australia*, [2]*Univ. of Sydney, Australia*. (IFE1)
- **Yee-mesh-based finite difference eigenmode analysis algorithms for optical waveguides and photonic crystals**, Hung-chun Chang, Chin-ping Yu; *Natl. Taiwan Univ., Taiwan Republic of China*. (IFE4)
- **Synthesis techniques for directional couplers as modulators and filters**, Anand Gopinath, Jaesang Oh, Ross Schermer, Kang-Hyun Baek, Desalegn Beraka; *Univ. of Minnesota, Duluth, USA*. (IThH1)
- **Design of optical circuits for dispersion compensation**, Koichi Takiguchi, *NTT Science and Core Technology Lab. Group, Japan*. (IFC1)
- **Accuracy issues in vectorial optical waveguide modeling**, David Yevick, *Univ. of Waterloo, Canada.* (IFA1)

4. Micro and Nano Photonics

- **Cross grid microring filter circuit - Versatile building block for filter synthesis**, Yasuo Kokubun, *Yokohama Natl. Univ., Japan.* (IThF1)

- **All-optical manipulation of light on a Silicon chip**, Michal Lipson, *Cornell Univ., USA*. (IFD1)
- **Multi-port PBG components in SOI photonic crystal slabs**, Masaya Notomi, A. Shinya, E. Kuramochi, S. Mitsugi; *NTT Basic Res. Labs., Japan*. (IWB4)
- **2D photonic crystal membrane surface operation micro-nano-scale photonic devices**, Christian Seassal, Jean Louis Leclercq, Pierre Viktorovitch, Xavier Letartre, Pedro Rojo-Romeo; *LEOM-CNRS, France*. (IFD4)
- **Ultra-high-Q (>100 million) micro-resonators on-a-chip and application to nonlinear optics, cavity QED and sensing**, Kerry Vahala, Tobias Kippenberg, Deniz Armani, Sean Spillane; *Caltech, USA*. (ITHF4)
- **Waveguiding in silicon photonic crystal slabs - Thrust toward ultradense optical integration**, Yurii Vlasov[1], S. McNab[1], N. Moll[2]; [1]*IBM, TJ Watson Res. Ctr., USA*, [2]*IBM Zurich Res. Lab., Switzerland*. (IWB1)

OAA Speakers

Plenary Speakers

- **Optical Networks: What's Next?** Rod Alferness, *Lucent Technologies, USA*
- **Optical Components for Metro Networking**, Rajiv Ramaswami, *Cisco Systems, Inc., USA*

Tutorial

- **Electronic compensation techniques for optical networks**, Nigel Jolley, *Nortel Networks, UK* (OWA3)

Invited Speakers

The preliminary list of invited speakers for OAA includes:

1. Fiber and Active Waveguides

- **Modeling and characterization of spectral hole burning in EDFAs**, Maxim Bolshtyansky, JDS Uniphase, USA. (OTuA1)

- **Erbium-doped holey fiber devices**, Taichi Kogure[1], Kentaro Furusawa[2], Tanya M. Monro[2], David J. Richardson[2]; [1]*Mitsubishi Electric Corp., Japan*, [2]*Optoelectronics Res. Ctr., Univ.of Southampton, UK.* (OMD4)
- **Quantum limits of optical amplification**, Prem Kumar, Renyong Tang, Paul Voss; *Northwestern Univ., USA.* (OTuA4)
- **Towards Er-doped Si nanocrystal sensitized microcavity lasers and amplifiers**, Alfred Polman[1,2], T. J. Kippenberg[1], B. Min[1], J. Kalkman[2], R. Walters[1], H. A. Atwater[1], K. J. Vahala[1]; [1]*Caltech, USA*, [2]*FOM-Institute AMOLF, Netherlands.* (OWC1)
- **Optical waveguide amplifiers using rare earth doped polymers**, E. Y. B. Pun, W. H. Wong, K. S. Chan; *City Univ. of Hong Kong, Hong Kong Special Administrative Region of China*. (OWC3)
- **Recent advances in carbon nanotube photonics**, S. Y. Set1, M. Jablonski[1], S. Yamashita[2]; [1]*Alnair Labs Corp., Japan*, [2]*The Univ. of Tokyo, Japan.* (OMD3)
- **High power narrow linewidth fiber lasers**, Christine Spiegelberg1, J. Geng[1], Y. Kaneda[1], Y. Hu[1], Shibin Jiang[1], N. Peyghambarian[2]; [1]*NP Photonics, Inc., USA*, [2]*Optical Sciences Ctr., Univ. of Arizona, USA.* (OMD1)

2. Semiconductor Devices and Functional Circuits

- **Optical signal processing using SOAs for packet switching,** Hercules Avramopoulos, *Natl. Technical Univ. of Athens, Greece.* (OTuB4)
- **Vertical cavity SOAs,** John Bowers, Univ*. of California at Santa Barbara, USA.* (OMB1)
- **1.3 µm GaInNAs semiconductor optical amplifier**, Jun-ichi Hashimoto[1,2], Kenji Koyama[1,2], Tsukuru Katsuyama[1,2], Yasuhiro Iguchi[1,2], Takashi Yamada[1,2], Shigenori Takagishi[1], Masashi Ito[1], Akira Ishida[1,2]; [1]*Sumitomo Electric Industries, Ltd., Japan*, [2]*OITDA, Japan*. (OMB4)
- **All-optical signal processing using ultra-long SOAs**, Hans-Peter Nolting, *Heinrich Hertz Inst., Germany.* (OTuB1)
- **High power pump laser**, Berthold Schmidt, Susanne Pawlik, Boris Sverdlov, Jürgen Müller, Nicolai Matuschek, Hans-Ulrich Pfeiffer, Norbert Lichtenstein, Arnaud Fily, Tomas Pliska, Stefan Mohrdiek, Christoph Harder; *Bookham (Switzerland) AG, Switzerland*. (OTuD1)

3. Networks and Systems

- **Optical amplifiers in undersea systems**, Stuart Abbott, *TYCO, USA.* (OMC1)

- **Low-cost optical monitoring for DWDM systems**, Glenn Bartolini, *Aegis Semiconductor, Inc., USA*. (OWB1)
- **Phase-sensitive amplification in long-haul communication systems**, Colin J. McKinstrie, Robert M. Jopson; *Lucent Technologies, Bell Labs, USA*. (OWB4)
- **Terabit-per-second transoceanic systems based on 40 Gbit/s prefiltered CS-RZ DPSK format**, Takehiro Tsuritani, *KDDI R&D Labs., Japan*. (OMC3)
- **High-speed optical signal processing using nonlinear fibers**, Shigeki Watanabe, F. Futami, R. Hainberger; *Fujitsu Lab. Ltd., Japan*. (OTuC1)
- **System trade-offs for different optical modulation formats**, Peter Winzer, R. J. Essiambre; *Lucent Technologies, Bell Labs, USA*. (OTuC4)

Publications

Conference Programs

The *Conference Program* is now available on the web. Authors submitting papers, past meeting participants, and current committee members were automatically notified by email when the Conference Program was available.

Technical Digests

The OAA and IPR *Technical Digests* will contain the camera-ready summaries of papers presented during the meeting. At the meeting, each registrant will receive their choice of either the OAA or IPR *Technical Digest* on CD-ROM. Extra CD-ROM copies can be purchased at the meeting for a special price of US$ 45.

Agenda

Explanation of Session Codes

The first letter of the code indicates the name of the meeting: OAA (O), IPR (I) and JOINT session (J). The second character designates the day of the week (Monday = M, Tuesday = Tu, Wednesday = W, Thursday = Th, Friday = F). The next character indicates the session within that particular day the talk is being given. Each day begins with a letter A and continues alphabetically. The number on the end of the code signals the position of the talk within the session (first, second, third, etc.).

For example, a session number OME4 would indicate that this paper was an OAA paper, being presented on Monday during the fifth session (E), and the fourth paper (4) presented in that session.

On This Page:

Sunday, June 27, 2004

Time	Event/Location
2:00 PM - 5:00 PM	**OSuA**, OAA Workshop: What is Next for Optical Amplifiers? *Parc Ballroom I*

Monday, June 28, 2004

Time	Event/Location
8:30 AM - 10:00 AM	**OMA**, OAA Plenary *Parc Ballroom I*
10:00 AM - 10:30 AM	Coffee Break *Parc Ballroom III*

10:30 AM - 12:00 PM	**OMB**, Novel SOA Devices and Structures *Parc Ballroom I*
12:00 PM - 1:30 PM	Lunch Break *On Your Own*
1:30 PM - 3:00 PM	**OMC**, Undersea Transmission *Parc Ballroom I*
3:00 PM - 3:30 PM	Coffee Break *Parc Ballroom III*
3:30 PM - 5:15 PM	**OMD**, Novel Fiber Devices *Parc Ballroom I*
5:30 PM - 7:00 PM	OAA Conference Reception *Parc Ballroom I*

Tuesday, June 29, 2004

Time	Event/Location
8:00 AM - 10:00 AM	**OTuA**, Optical Fiber Amplifiers *Parc Ballroom I*
10:00 AM - 10:30 AM	Coffee Break *Parc Ballroom III*
10:30 AM - 12:00 PM	**OTuB**, SOA-based All Optical Processing *Parc Ballroom I*
12:00 PM - 1:30 PM	Lunch Break *On Your Own*
1:30 PM - 3:00 PM	**OTuC**, High Speed Transmission and Optical Signal Processing *Parc Ballroom I*
3:00 PM - 3:30 PM	Coffee Break *Parc Ballroom III*
3:30 PM - 5:00 PM	**OTuD**, Lasers and Nonlinear Dynamics *Parc Ballroom I*
7:00 PM - 10:00 PM	OAA Rump Session *Parc Ballroom I*

Wednesday, June 30, 2004

Time	Event/Location
8:30 AM - 10:00 AM	Coffee Break *Parc Ballroom III*
8:30 AM - 10:00 AM	**JWA**, IPR Plenary *Parc Ballroom I*

10:30 AM - 12:00 PM	**IWA**, Silicon Microphotonics *Parc Ballroom II*
10:30 AM - 12:00 PM	**OWA**, System Impairments and Mitigation *Parc Ballroom I*
12:00 PM - 1:30 PM	Lunch Break *On Your Own*
1:30 PM - 3:00 PM	**IWB**, Photonic Crystal Waveguides *Parc Ballroom II*
1:30 PM - 3:00 PM	**OWB**, Amplifier Concepts and Power Management *Parc Ballroom I*
3:00 PM - 3:30 PM	Coffee Break *Parc Ballroom III*
3:30 PM - 5:00 PM	**IWC**, Ring Lasers and Wavelength Converters *Parc Ballroom II*
3:30 PM - 5:00 PM	**OWC**, Novel Amplifier Materials *Parc Ballroom I*
5:00 PM - 6:30 PM	**JWB**, Joint OAA/IPR Poster Session *Parc Ballroom III*

Thursday, July 01, 2004

Time	Event/Location
8:30 AM - 10:00 AM	**IThB**, Receivers and Novel Components *Parc Ballroom II*
8:30 AM - 10:00 AM	**IThA**, Advanced Silica-on-Silicon Devices *Parc Ballroom I*
10:00 AM - 10:30 AM	Coffee Break *Parc Ballroom III*
10:30 AM - 12:00 PM	**IThD**, High Speed Devices *Parc Ballroom II*
10:30 AM - 12:00 PM	**IThC**, Polymer-Based Waveguide Devices *Parc Ballroom I*
12:00 PM - 1:30 PM	Lunch Break *On Your Own*
1:30 PM - 3:00 PM	**IThE**, Silicon Waveguide Components *Parc Ballroom I*
1:30 PM - 3:00 PM	**IThF**, Microdisks and Resonators *Parc Ballroom II*
3:00 PM - 3:30 PM	Coffee Break *Parc Ballroom III*
3:30 PM - 5:00	**IThG**, Reflective-Based and Compact Devices

PM	*Parc Ballroom I*
3:30 PM - 5:00 PM	**IThH**, Design and Optimization Techniques and Applications *Parc Ballroom II*
5:00 PM - 6:30 PM	IPR Conference Reception *Parc Ballroom I*

Friday, July 02, 2004

Time	Event/Location
8:30 AM - 10:00 AM	**IFA**, Simulation Methods *Parc Ballroom I*
8:30 AM - 10:00 AM	**IFB**, Arrayed Waveguide Devices *Parc Ballroom II*
10:00 AM - 10:30 AM	Coffee Break *Parc Ballroom III*
10:30 AM - 12:00 PM	**IFC**, Design of Integrated Devices *Parc Ballroom I*
10:30 AM - 12:00 PM	**IFD**, Functional Microphotonic Devices *Parc Ballroom II*
12:00 PM - 1:30 PM	Lunch Break *On Your Own*
1:30 PM - 3:00 PM	**IFF**, Novel Waveguide Materials and Processes *Parc Ballroom II*
1:30 PM - 3:00 PM	**IFE**, Photonic Crystal Modeling *Parc Ballroom I*
3:00 PM - 3:30 PM	Coffee Break *Parc Ballroom III*
3:30 PM - 4:45 PM	**IFG**, Polarization Control Devices *Parc Ballroom I*
3:30 PM - 5:00 PM	**IFH**, Novel Waveguide Components *Parc Ballroom II*

■ Sunday
■ June 27, 2004

Location: Parc Ballroom Foyer

11:00 a.m. – 5:00 p.m.
Registration

Location: Parc Ballroom Foyer

12:00 p.m.
OAA Postdeadline Paper Deadline

Location: Parc Ballroom I

2:00 p.m. – 5:00 p.m.
OAA Workshop

What is Next for Optical Amplifiers?
Organizer: Atul Srivastava, Onetta Inc.
asrivastava@onetta.com.

During the bubble years, we witnessed tremendous progress in optical amplifiers (OA's). EDFAs advanced in bandwidth, power and architectural complexity. The amplification bandwidth was enhanced by the introduction of novel bands such as L-, S- and U-bands. Raman amplifiers reached practicability with the availability of high power 14xx pumps. These developments were aimed to satisfy the increasing demands on the capacity and longer reach of optical networks.

In the post-bubble era, there is a need to reassess the direction of research and development in OA's. There are signs that the networks are evolving from a linear, high capacity one to a more connected, two-dimensional architecture. The discussion on tradeoff between cost and performance continues to dominate the industry with balance tilted in favor of the cost. In this cost constrained environment, several of the attractive advances of the yesteryears may never be used.

This workshop aims to address the following key questions:

- How the metro and long-haul network architecture will evolve over next years?
- What innovations are needed in OA's to address the evolution in the networks?
- Will there be more/less complexity and functionality in OA's?
- Will the cost reduction trend continue or the cost/performance balance will shift towards performance?
- Which amplifiers will become a commodity soon?
- Are there new attractive OA technologies on the horizon?

■ Monday
■ June 28, 2004

Location: Parc Ballroom Foyer

7:30 a.m. – 5:00 p.m.
Registration

Location: Jurin Room

8:30 a.m. – 10:00 a.m.
OMA ■ Plenary Session

8:30 a.m.
Optical networks: What's next?
Rod Alferness; Lucent Technologies, USA.
The optical fiber amplifier has proven to be a truly disruptive technology. It has enabled scalable, ultra-low cost/unit bandwidth wavelength-division-multiplexed (WDM) transmission systems that underpin global communications and bring people around the world closer together. While slower than unreasonably expected during the telecom bubble and somewhat bittersweet, the evolution to flexible, WDM-based optical networks is also beginning with new national network builds and likely next-generation metro networks. At the same time, the telecom industry has gone through an unprecedented boom and bust cycle. So what are the next steps of optical network evolution? In this talk we will take stock of the current status of optical networks and consider some future scenario possibilities, as well as the role of the optical amplifier in each.

9:15 a.m.
Optical components for metro networking, *Rajiv Ramaswami; Cisco Systems, Inc., USA.*
Metro optical networks are evolving from pure TDM-based architectures to packet-oriented architectures providing more flexible transport options. New services are centered around thernet and fiber channel offerings. Transport options today include a combination of SONET/SDH, packet rings, and WDM. We will describe this evolution and focus specifically on the impact of these architectures on component technologies such as pluggable optical modules and a more flexible optical layer including intelligent amplifiers, reconfigurable optical add/drops and other related technologies.

Location: Parc Ballroom III
10:00 a.m. – 10:30 a.m.
Coffee Break

Location: Parc Ballroom I
10:30 a.m. – 12:00 p.m.
OMB ■ Novel SOA Devices and Structures
Radha Nagarajan; Infinera, USA, Presider.

OMB1 10:30 a.m. ►INVITED
Vertical cavity SOAs, *John Bowers; Univ. of California at Santa Barbara, USA.*
Abstract not available at this time.

OMB2 11:00 a.m.
Multiple wavelength amplification in a high power InAs/InP quantum dash optical amplifier operating at 1.55 µm, *Robert Alizon[1], Din Hadass[1], Visorian Mikhelashvili[1], Gad Eisenstein[1], Ruth Schwertberger[2], J.P. Reithmaier[2], Alfred Forchel[2], Michel Calligaro[3], Shailendra Bansropun[3], Michel Krakowski[3]; [1]Technion, Israel, [2]Univ. Wurzburg, Germany, [3]Thales Res. and Technology, France.*
We present a high gain, high saturation power, 1.55 µm InAs/InP quantum dash amplifier. The amplifier was used to demonstrate amplification with low cross talk of four WDM channels modulated at 2.5 and 10 Gbit/s.

OMB3 11:15 a.m.
Wavelength selection in MEMS tunable vertical-cavity SOAs, *Garrett D. Cole, Qi Chen, Staffan Bjorlin, Toshio Kimura, Shaomin Wu, Chad S. Wang, John E. Bowers, Noel C. MacDonald; Univ. of California at Santa Barbara, USA.*
We analyze the tuning characteristics of MEMS tunable vertical-cavity semiconductor optical amplifiers. Completed devices exhibit 10 dB device gain over an 11 nm tuning range.

OMB4 11:30 a.m. ►INVITED
1.3 µm GaInNAs semiconductor optical amplifier, *Jun-ichi Hashimoto[1,2], Kenji Koyama[1,2], Tsukuru Katsuyama[1,2], Yasuhiro Iguchi[1,2], Takashi Yamada[1,2], Shigenori Takagishi[1], Masashi Ito[1], Akira Ishida[1,2]; [1]Sumitomo Electric Ind., Ltd., Japan, [2]OITDA, Japan.*
GaInNAs-SOA was investigated. The peak chip gain of 14dB and 3-dB gain bandwidth of 49 nm were realized. Small dependence of gain on temperature and good dynamic response to 40 Gbps optical pulses were obtained.

12:00 p.m. – 1:30 p.m.
Lunch Break
Location: Parc Ballroom I
1:30 p.m. – 3:00 p.m.
OMC ■ Undersea Transmission
Peter M. Krummrich; Siemens AG, Germany, Presider.

OMC1 1:30 p.m. ►INVITED
Optical amplifiers in undersea systems, *Stuart Abbott; Tyco Telecommunications, USA.*
Optical amplifiers have played a defining role in the development of modern undersea transmission systems. This paper reviews the history, challenges, and solutions in using optical amplifier technology in the design of undersea transmission systems.

OMC2 2:00 p.m.
Performance recovery from pump failures in hybrid Raman/EDFA based systems, *Dmitri G. Foursa, Morten Nissov, Alexei N. Pilipetskii; Tyco Telecommunications, USA.*
The stability of hybrid Raman/EDFA systems in the presence of Raman pump failures is numerically investigated. A pump power management algorithm is proposed to significantly improve the system's recovery.

OMC3 2:15 p.m. ►INVITED
Terabit-per-second transoceanic systems based on 40 Gbit/s prefiltered CS-RZ DPSK format, *Takehiro Tsuritani; KDDI R&D Labs., Japan.*
Abstract not available at this time.

OMC4 2:45 p.m.
Simple channel power management for sparsely loaded broadband DWDM systems, *Georg Mohs, Vishal Gupta, Ralph B. Jander, M. Vaa, B. Bakhshi, Ekaterina A. Golovchenko, Stuart M. Abbott; Tyco Telecommunications, USA.*
Managing channel power in optically amplified systems is imperative when the system is loaded with only a fraction of its design capacity. We field-tested a simple technique that takes advantage of lightly loaded system properties.

Location: Parc Ballroom III
3:00 p.m. – 3:30 p.m.
Coffee Break

Location: Parc Ballroom I
3:30 p.m. – 5:15 p.m.
OMD ■ Novel Fiber Devices
Gregory Cowle; JDS Uniphase, USA, Presider.

OMD1 3:30 p.m. ►INVITED
High power narrow linewidth fiber lasers, *Christine Spiegelberg[1], J. Geng[1], Y. Kaneda[1], Y. Hu[1], Shibin Jiang[1], N. Peyghambarian[2]; [1]NP Photonics, Inc., USA, [2]Optical Sciences Ctr., Univ. of Arizona, USA.*
Compact, robust, single-frequency fiber lasers, emitting around 1.06 or 1.5 µm with up to several hundred mW power combine polarized output with very narrow linewidth of 1-3 kHz and fast frequency modulation up 10 kHz.

OMD2 4:00 p.m.
Multiwavelength 40 GHz pulse source based on saturated optical parametric amplifier, *David Dahan, Gadi Eisenstein; Technion, Israel.*
We present a novel multiwavelength 40 GHz pulse source employing high order FWM products of a saturated OPA. We demonstrate pulse width reduction with FWM order.

OMD3 4:15 p.m. ►INVITED
Recent advances in carbon nanotube photonics, *S. Y. Set[1], M. Jablonski[1], S. Yamashita[2]; [1]Alnair Labs Corp., Japan, [2]The Univ. of Tokyo, Japan.*
The ultra-fast optical nonlinear effects exhibited in single-walled carbon nanotubes have found several potential photonics application areas, amongst which the most practical application is for laser mode-locking. Pulsed lasers with pulse widths as short as 318fs and repetition rate up 10GHz have been realized using carbon nanotube mode-lockers.

OMD4 4:45 p.m. ►INVITED
Erbium doped holey fiber devices, *Taichi Kogure[1, 2], Kentaro Furusawa[2], Tanya M. Monro[2], David J. Richardson[2]; [1]Mitsubishi Electric Corp., Japan, [2]Optoelectronics Res. Ctr., Univ. of Southampton, UK.*
We fabricated an erbium-doped holey fiber, and demonstrate an all-fiber laser with ultra-low threshold (~0.5mW) and amplifier providing 47 dB of internal gain. Incorporating this amplifier within a ring-laser we demonstrate a tuning range over100nm.

Location: Parc Ballroom I
5:30 p.m. – 7:00 p.m.
OAA Conference Reception

■ Tuesday
■ June 29, 2004

Location: Parc Ballroom Foyer
7:30 a.m. – 5:00 p.m.
Registration

Location: Parc Ballroom I
8:00 a.m. – 10:00 a.m.
OTuA ■ Optical Fiber Amplifiers
Clifford E. Headley, III; OFS, USA, Presider.

OTuA1 8:00 a.m. ►INVITED
Modeling and characterization of spectral hole burning in EDFAs, *Maxim Bolshtyansky; JDS Uniphase, USA.*
Theoretical and numerical models of spectral hole burning in EDFA are developed. Spectral hole burning experiments are conducted to verify the dominant mechanism and the models. New characterization technique is suggested and demonstrated.

OTuA2 8:30 a.m.
Ultra-low nonlinearity EDFAs employing multi-mode EDF with effective mode area of 81um^2, *Tetsuya Haruna, Motoki Kakui, Masahiro Takagi, Masato Tanaka, Shinji Ishikawa; Sumimoto Electric Ind., Ltd., Japan.*
Employing the large A_{eff} EDFs that can maintain the single-mode operation, the four-wave-mixing cross-talk over L-band has been suppressed by 10dB compared with the conventional EDFs when the output signal power is set to +28dBm.

OTuA3 8:45 a.m.
EDFA gain and noise figure measurements at filter edges using a broadband source, *Sanjay Gupta, Li Qian; Univ. of Toronto, Canada.*
We report a low-cost, accurate EDFA gain and noise figure characterization method using a broadband ASE source and a transmission filter, by extracting the slope and intercept of output versus input power at filter edges. The required filter depth is 30dB.

OTuA4 9:00 a.m. ►INVITED
Quantum limits of optical amplification, *Prem Kumar, Renyong Tang, Paul Voss; Northwestern Univ., USA.*
Ideal phase-insensitive amplifiers have a 3dB noise figure at high gains. We show through theory and experiment that fiber parametric amplifiers do not reach this limit due to coupling of noise via the Raman effect.

OTuA5 9:30 a.m.
Demonstration of fiber optical parametric amplifier with widely tunable narrow gain spectra, *Kenneth K. Wong, Michel E. Marhic, Leonid G. Kazovsky; Stanford Univ., USA.*
By tuning the pump wavelength of a pulsed fiber OPA around 1540 nm we have observed a family of narrow gain spectra, some with bandwidth < 1 nm, tunable from 1325 nm to 1800 nm.

OTuA6 9:45 a.m.
High power-conversion-efficiency operation of discrete Raman amplifiers using high Raman gain fiber and its bandwidth dependence, *Atsushi Oguri, Yuki Taniguchi, Ryuichi Sugizaki, Takeshi Yagi, Shu Namiki; Fitel Photonics Lab., Furukawa Electric Co., Ltd., Japan.*
We investigate bandwidth dependence of power-conversion-efficiency for discrete Raman amplifiers using a high Raman gain fiber. The efficiency can be as high as 72% for a C+L-band booster amplifier, while 65% for a C-band amplifier.

Location: Parc Ballroom III

10:00 a.m. – 10:30 a.m.
Coffee Break

Location: Parc Ballroom I

10:30 a.m. – 12:00 p.m.
OTuB ■ SOA-based All Optical Processing

Antonella Bogoni; CNIT, Italy, Presider.

OTuB1 10:30 a.m. ►INVITED
All-optical signal processing using ultra-long SOAs, *Hans-Peter Nolting; Heinrich Hertz Inst., Germany.*
The fastswitching effects in a long SOA can be used to generate complementary pulses, which suppresses the pattern dependent carrier density fluctuations to overcome the speed limit of the conventional SOA, allowing new switching architectures.

OTuB2 11:00 a.m.
160 Gb/s SOA all-optical wavelength converter and assessment of its regenerative properties, *Juerg Leuthold, L. Möller, J. Jaques, S. Cabot, L. Zhang, P. Bernasconi, M. Cappuzzo, L. Gomez, E. Laskowski, E. Chen, A. Wong-Foy, A. Griffin; Lucent Technologies, Bell Labs, USA.*
We investigate the retiming and reshaping properties of a 160 Gb/s all-optical wavelength converter based on a semiconductor optical amplifier (SOA) gating delay interferometer (DI) configuration. 160Gb/s operation is performed with as little as -3.5dBm.

OTuB3 11:15 a.m.
Theoretical analysis of XGM wavelength conversion using reflective semiconductor optical amplifier, *Jeung-Mo Kang, Woo-Jin Shim, Hyuk-Choon Kwon, Tae-Young Kim, Sang-Kook Han; Yonsei Univ., Republic of Korea.*
We have analyzed theoretically in detail the wavelength conversion performance based on XGM of reflective SOA using dynamic TMM method. Wavelength conversion using reflective SOA shows improved performance in dynamics, extinction ratio and pulse shape.

OTuB4 11:30 a.m. ►INVITED
Optical signal processing using SOAs for packet switching, *Hercules Avramopoulos; Natl. Technical Univ. of Athens, Greece.*
We discuss the use of SOA-based interferometric gates for optical packet switching applications. Based on these modules, key signal processing functionalities required by a packet switched node are demonstrated directly in the optical domain.

12:00 p.m. – 1:30 p.m.
Lunch Break

Location: Parc Ballroom I
1:30 p.m. – 3:00 p.m.
OTuC ■ High Speed Transmission and Optical Signal Processing
Stojan Radic; Univ. of California at San Diego, USA, Presider.

OTuC1 1:30 p.m. ►INVITED
High speed optical signal processing using nonlinear fibers,
Shigeki Watanabe; Fujitsu Laboratories Ltd., Japan.
The possible applications of nonlinear fibers to optical signal processing are described. Ultra-fast optical signal processing using optical Kerr-effects in nonlinear fibers are promising technologies for future photonic networks. Steps for further improvements are also discussed.

OTuC2 2:00 p.m.
In-line regeneration of RZ-DPSK signals using four-wave mixing in a fiber,
Masayuki Matsumoto; Osaka Univ., Japan.
In-line signal regeneration using FWM in a fiber, which stabilizes amplitude while maintaining phase information carried by the signal, is analyzed. It is shown that RZ-DPSK quasi-linear transmission performance can be improved by the regenerator.

OTuC3 2:15 p.m.
90 x 42.7 Gb/s (3.6 Tb/s) WDM signal transmission with triple band in-line amplifiers, *Toshiya Matsuda, Takashi Kotanigawa, Akira Naka; NTT, Japan.*
We demonstrate in-line amplifier transmission using C and L-band EDFAs and U-band lumped Raman amplifiers. The triple band in-line amplifiers enable a 3.6 Tb/s WDM signal to be successfully transmitted over 240 km.

OTuC4 2:30 p.m. ►INVITED
System trade-offs for different optical modulation formats, *Peter Winzer, R. J. Essiambre; Lucent Technologies, Bell Labs, USA.*
We discuss criteria to select advanced optical modulation formats in order to mitigate impairments specific to various classes of fiber-optic communication systems.

Location: Parc Ballroom III
3:00 p.m. – 3:30 p.m.
Coffee Break

Location: Parc Ballroom I
3:30 p.m. – 5:00 p.m.
OTuD ■ Lasers and Nonlinear Dynamics
Juerg Leuthold; Lucent Technologies, Bell Labs, USA, Presider.

OTuD1 3:30 p.m. ►INVITED
High power pump laser, *Berthold Schmidt; Bookham Technology, USA.*
High power pump laser diodes at various wavelengths, mainly around 980 nm, are key elements in today's optical amplifier architectures. The status of Bookham's telecom-laser technology is reviewed and latest developments of transversal single- and multi-mode pump lasers are presented.

OTuD2 4:00 p.m.
Unifying mode-locking and self-pulsations in a laser with active feedback, *Stefan Bauer[1], Bernd Hüttl[1], Olaf Brox[1], Matthias Biletzke[1], Jochen Kreissl[1], Bernd Sartorius[1], Hans-Jürgen Wünsche[2]; [1]Fraunhofer-Inst. for Telecommunications, Germany, [2]Humboldt-Univ. zu Berlin, Germany.*
Lasers with active feedback are demonstrated to show self-pulsations and mode-locking. The different operation modes can be addressed via the driving currents. By experiments the different behavior of both pulsation types is demonstrated.

OTuD3 4:15 p.m.
8-channel DWDM multiplexer with integrated per-channel amplification on 100 GHz frequency grid, *Weiguo Yang[1], Dries Van Thourhout[2], Pietro Bernasconi[1], Liming Zhang[1], Barry I. Miller[1], Larry W. Stulz[1], Steven Cabot[1], Nick J. Sauer[1], Martin Zirngibl[1]; [1]Lucent Technologies, Bell Labs, USA, [2]Ghent Univ., Belgium.*
An 8-channel DWDM multiplexer with per-channel amplification is demonstrated. 10 dB, 3 dB, and 0 dB fiber-to-fiber gain is achieved using lensed fiber, cleaved fiber, and cleaved fiber array respectively. BER performance is also presented.

OTuD4 4:30 p.m.
Measurements of gain and index dynamics in quantum dash semiconductor optical amplifiers, *M. van der Poel[1], T. W. Berg[1], J. Mørk[1], D. Birkedal[1], V. Mikhelashvili[2], G. Eisenstein[2], R. Schwertberger[3], J. P. Reithmaier[3], A. Forchel[3], M. Calligaro[4], S. Bansropun[4], M. Krakowski[4]; [1]Technical Univ. of Denmark, Denmark, [2]Technion, Israel, [3]Univ. Wurzburg, Germany, [4]Thales Research and Technology, France.*
Ultrafast gain and index recovery of a 1.5um quantum dash amplifier after short pulse amplification is measured using pump-probe spectroscopy. The major part of the gain reduction is found to recover within a few picoseconds.

OTuD5 4:45 p.m.
Measurements and simulations of non-linear noise re-distribution in an SOA, *Filip Öhman[1], Bjarne Tromborg[1], Jesper Mørk[1], Andreas Aurelius[2], Anders Djupsjöbacka[2], Anders Berntson[2]; [1]COM, DTU, Denmark, [2]ACREO AB, Sweden.*
Measurements and statistical simulations demonstrate that a semiconductor optical amplifier (SOA) induces non-linear noise re-distribution with a strong power and bandwidth dependence.

Location: Parc Ballroom I
7:00 p.m. – 10:00 p.m.
Rump Session

■ Wednesday
■ June 30, 2004

Location: Parc Ballroom Foyer
7:30 a.m. – 5:00 p.m.
Registration

Location: Parc Ballroom I
8:30 a.m. – 10:00 a.m.
JWA ■ IPR Plenary Session

8:30 a.m.
Convergence of optics and electronics, *Lionel Kimerling; MIT, USA.*
Microphotonics is the optical implementation of microelectronic integrated circuits. The time evolution of this new technology platform is constrained by innovation, by development of a new fabrication infrastructure and by user acceptance of the new functionality. The two key target applications are 1) relief of the interconnection bottleneck that currently limits the speed of electronic systems; and 2) elimination of the optical-electronic-optical conversion that limits bandwidth at nodes in communications networks. A major challenge is integration of the diverse set materials that are currently used for optical components. Equally high barriers are the establishment of a standard platform for design and systems insertion, and of scalability for technology evolution. This talk will address the desirability and feasibility of monolithic integration of high performance waveguides, add/drop filters, modulators, amplifiers, sources and detectors with silicon electronics. The context for this analysis is a

Performance Figure of Merit = Information Capacity ÷(Power Dissipation x Area) that will provide the design rules for electronic-photonic partitioning; and a Scalability Figure of Merit = Performance ÷ Cost that must project 100x improvements every 10 years. A roadmap scheme will be used to highlight the coordination of the R&D timelines required to meet the projected performance needs of the emerging microphotonics technology platform.

9:15 a.m.
Applications of photonic crystals in integrated photonics, *Axel Scherer; Caltech, USA.*
Lithography and high refractive index contrast have enabled the radical miniaturization of photonic devices by orders of magnitude. Photonic crystals represent favorable geometries to connect these components, and we describe the design, fabrication and application of photonic crystal devices for integrated optics.

Location: Parc Ballroom III

10:00 a.m. – 10:30 a.m.
Coffee Break

Location: Parc Ballroom I

10:30 a.m. – 12:00 p.m.
OWA ■ System Impairments and Mitigation

Michael Vasilyev; Univ. of Texas at Arlington, USA, Presider.

OWA1 10:30 a.m.
Penalties induced by resonant noise enhancement and their mitigation in counter-pumped distributed Raman amplifiers, *Giovanni Sacchi[1], Simone Sugliani[1], Stefano Faralli[2], Gabriele Bolognini[2], Fabrizio Di Pasquale[2]; [1]CNIT, Italy, [2]Scuola Superiore Sant'Anna, Italy.*
We experimentally investigate optical noise figure and BER penalties induced by noise enhancement in counter-pumped distributed Raman amplifiers working in resonant conditions. An effective technique for performance improvement is suggested and demonstrated.

OWA2 10:45 a.m.
Transient gain dynamics in 1050/1550 nm dual-wavelength pumped TDFAs upon pump modulation, *Stefan R. Luthi, Mariana T. Carvalho, Anderson S. Gomes; Dept. de Física, Cidade Univ., Brazil.*
Signal response for modulation of 1050nm and 1550nm pump power is studied in a dual-wavelength pumped TDFA. Response times characteristic for the upper/lower amplification levels and critical dependence on the subsidiary/main pump ratio are observed.

OWA3 11:00 a.m. ◙ Tutorial
Electronic compensation techniques for optical networks, *Nigel Jolley; Nortel Networks, UK.*
The history of optical communications has been a continuous struggle against the limitations imposed by noise and dispersion. To date most of the solutions have relied on optical techniques to compensate or mitigate the impact of these limitations. Advances in the speed of electronic devices have now reached the point where it is feasible to implement electronic compensation of the effects of some optical distortions such as modal dispersion, chromatic dispersion and polarization mode dispersion. This talk will discuss the technology, architectures and approaches that can be used to implement electronic compensation and compare their performance with current optical solutions. The potential impact of these new technologies on optical amplifiers and optical networks will also be discussed.

12:00 p.m. – 1:30 p.m.
Lunch Break

Location: Parc Ballroom I

1:30 p.m. – 3:00 p.m.
OWB ■ Amplifier Concepts and Power Management

Rene Monnard; Onetta, Inc., USA, Presider.

OWB1 1:30 p.m. ►INVITED
Low-cost optical monitoring for DWDM systems, *Glenn Bartolini; Aegis Semiconductor, Inc., USA.*
We describe the structure, design parameters, and performance characteristics over life of low-cost tunable thin-film optical filters deployed in optical channel monitors, and analyze the benefits of integration into optical amplifiers designed for DWDM systems.

OWB2 2:00 p.m.
Ultra-wideband remotely-pumped EDF/DRA hybrid inline-repeater system using tellurite-based EDFs and 1500-nm pumping method, *Hiroji Masuda[1], Shoichiro Kuwahara[1], Hiroto Kawakami[1], Akira Hirano[1], Yutaka Miyamoto[1], Atsushi Mori[2], Tadashi Sakamoto[2]; [1]NTT Network Innovation Labs., Japan, [2]NTT Photonics Labs., Japan.*
A novel wideband remotely-pumped EDF/DRA hybrid inline-repeater system that offers the widest-to-be-reported 80-nm (1535-1615 nm) seamless gain-band and an OSNR improvement of 1.9 dB is constructed using tellurite-based EDFs and a 1500-nm pumping method.

OWB3 2:15 p.m.
Operation of lumped Raman fiber amplifier for fixed channel output power with channels up-grade and span loss variation, *Dominique Annie Mongardien, Sophie Borne, Catherine Martinelli, Laurence Lorcy, Dominique Bayart; Alcatel R&I, France.*
A tuning procedure is implemented in lumped Raman amplifier. Channel output power variation lower than 0.4dB is achieved for span loss variations of 9dB and up-grade from 1 to 160 channels.

OWB4 2:30 p.m. ►INVITED
Phase-sensitive amplification in long-haul communication systems, *Colin J. McKinstrie, Robert M. Jopson; Lucent Technologies, Bell Labs, USA.*
In recent years there has been a resurgence of interest in the use of phase-sensitive amplifiers in optical communication systems. We review research on parametric amplification and phase conjugation, and describe recent experiments with fiber parametric amplifiers in wavelength-division-multiplexed systems.

Location: Parc Ballroom III
3:00 p.m. – 3:30 p.m.
Coffee Break

Location: Parc Ballroom I
3:30 p.m. – 5:00 p.m.
OWC ■ Novel Amplifier Materials
Karsten Rottwitt; COM Ctr., Denmark, Presider.

OWC1 3:30 p.m. ►INVITED
Towards Er-doped Si nanocrystal sensitized microcavity lasers and amplifiers, *Alfred Polman[1,2], T.J. Kippenberg[1], B. Min[1], J. Kalkman[2], R. Walters[1], H.A. Atwater[1], K.J. Vahala[1]; [1]Caltech, USA, [2]FOM-Inst. AMOLF, Netherlands.*
An erbium-implanted toroidally shaped silica optical microcavity on Si is made using standard CMOS technology. Ultra-low threshold single-mode lasing is observed. Performance optimization using Si quantum dots as sensitizers for Er and applications in amplifiers are discussed.

OWC2 4:00 p.m.
Thulium-doped silica-fiber based S-band amplifier with increased efficiency by aluminum co-doping, *Basile Faure[1], Wilfried Blanc[1], Bernard Dussardier[1], Gérard Monnom[1], Pavel Peterka[2]; [1]LPMC, CNRS-UNSA, France, [2]IREE, Academy of Sciences, Czech Republic.*
Incorporation of alumina in silica Thulium-doped fiber amplifiers increases the 1470 nm luminescence quantum efficiency up to 7.7 percent. Gain up to 20 dB with 1 W of single wavelength 1050 nm-pump is predicted.

OWC3 4:15 p.m. ►INVITED
Optical waveguide amplifiers using rare earth doped polymers, *E. Y. B. Pun, W. H. Wong, K. S. Chan; City Univ. of Hong Kong, Hong Kong Special Administrative Region of China.*
Polymer materials offer many distinct properties, and many functional integrated optics devices have been demonstrated. In this talk, the recent progress of rare earth doped waveguide amplifiers using polymer materials will be described.

OWC4 4:45 p.m.
Raman gain properties of germania-based core silica fiber, *Valery Mashinsky[1], Vladimir Neustruev[1], Igor Bufetov[1], Alexey Shubin[1], Oleg Medvedkov[1], Alexander Rakitin[1], Eugeny Dianov[1], Alexey Guryanov[2], Vladimir Khopin[2], Mikhail Salgansky[2]; [1]Fiber Optics Res. Ctr. at the General Physics Inst., Russian Academy of Sciences, Russian Federation, [2]Inst. of Chemistry of High-Purity Substances, Russian Academy of Sciences, Russian Federation.*
Raman amplification in singlemode fiber with germania-based core and silica cladding was investigated for the first time. Very short efficient Raman lasers based on this fiber were developed in 1.1 and 1.6 µm spectral bands.

Location: Parc Ballroom III

5:00 p.m. – 6:30 p.m.
JWB ■ Joint OAA/IPR Poster Session

JWB1
100 nm broadband Raman amplification in NZ-DSF fiber with zero-dispersion wavelength around 1500 nm, *Xiang Zhou, Martin Birk; AT&T Labs-Research, USA.*
We demonstrated a novel method for broadband Raman amplification in NZ-DSF fiber with λ_0 around 1500 nm. The proposed method can effectively suppress pump-pump FWM effects and also improve the total noise performance.

JWB2
80 µm diameter Pr^{3+} -doped fluoride fiber for compact 1.3 µm band gain block, *Shinichi Aozasa, Koji Shikano, Makoto Yamada, Makoto Shimizu; NTT Photonics Lab., Japan.*
We developed 80 µm diameter Pr^{3+}-doped fluoride fiber that provides long-term reliability even with small packaging. We realized a compact 1.3 µm band gain block (70 x 40 x 15 mm) by using the fiber.

JWB3
21-line of multiple Brillouin Stokes incorporating a linear cavity of hybrid BEFL, *Mohammed H. Al-Mansoori, Borhanuddin M. Ali, Mohamad Khazani Abdullah, Mohd Adzir Mahdi; Photonics and Fiber Optic Systems Lab., Univ. Putra Malaysia, Malaysia*.
A new technique of producing multiple Brillouin Stokes was described utilizing a linear cavity of hybrid Brillouin/Erbium fiber laser. Twenty-one lines of multiple Brillouin Stokes with 10.88 GHz line spacing were obtained from this architecture.

JWB4
Crosstalk in parametric amplifers with orthogonal pumps, *Pei-fang Hu, Justin L. Blows; The Univ. of Sydney, Australia.*
We investigate the four-wave-mixing induced crosstalk in two-pump parametric amplifiers. We find that for the same signal gain the crosstalk is significantly less when the pumps have orthogonal, rather than parallel, linear polarization.

JWB5
Calculation of Raman gain when pumping with higher-order modes, *Ivo Flammer, Pierre Sillard; Alcatel Cable, France.*
Injecting Raman pump into higher-order modes (LP_{11} and LP_{02}) of SMF LEA, NZDSF and DCF, Raman gain is theoretically found to be 50%, 5% and 2% respectively, compared to injecting Raman pump into fundamental mode.

JWB6
Experimental validation of ASE reflection schemes for the design of a +20-dBm, single-pump, L-band EDFA, *Fabien Roy, Augustin Grillet, Jérémy Garbez, Guillaume Peigné, Domenico Giannone, Dominique Hamoir; Multitel ASBL, Belgium.*
Various ASE reflectors were implemented in two-stage L-band EDFAs to enable high-power single-pump amplification. We demonstrate that the behavior of the amplifier exhibits linearity, and use this property to validate an optimized band-reflector.

JWB7
Amplification without population inversion and optical switching through state-dependent alignment of molecules, *Alexander K. Popov[1], Vitaly V. Slabko[2,3]; [1]Univ. of Wisconsin-Stevens Point, USA, [2]Krasnoyarsk State Technical Univ., Russian Federation, [3]Inst. of Physics of Russian Academy of Sciences, SB, Russian Federation.*
Effective switching anisotropic molecules from strongly absorbing to amplifying state is shown to be possible without population inversion by dc or ac control electric fields. Suitable class of molecules and application in nanophotonics are outlined.

JWB8
SOA-based interferometric optical hard-limiter, *George T. Kanellos[1], Nikos Pleros[1], Chris Bintjas[1], Hercules Avramopoulos[1], George Guekos[2]; [1]Natl. Technical Univ. of Athens, Greece, [2]Swiss Federal Inst. of Technology Zurich, Switzerland.*
We present experimental and theoretical analysis of an optical hard limiter that uses SOA-based interferometers. Its operation relies on the deep saturation of SOA and it can suppress amplitude modulation in excess of 10 dB.

JWB9

Ultra-sharp optical decision characteristic from a laser diode integrated with a semiconductor optical amplifier, *Wouter D'Oosterlinck, Geert Morthier; Dept. of Information Technology, Ghent Univ., Belgium.*
An ultra-sharp optical decision characteristic is obtained from a semiconductor optical amplifier and a laser diode in a feedback scheme. The operation of the component is based on a flipping of the spatial hole burning.

JWB10

Noise properties of quantum dot optical amplifiers, *Alberto Bilenca, Gadi Eisenstein; Technion, Israel.*
We present a theoretical analysis of noise properties in linear and nonlinear quantum-dot amplifiers. Inhomogeneously broadened gain and fast population pulsation dynamics are highlighted. The results are consistent with published and measured saturation spectra.

JWB11

Impact of optical filters on pulse lifetime in fiber rings with frequency shifter and EDFA, *Katsumi Takano, Takayuki Yumoto, Kiyoshi Nakagawa; Yamagata Univ., Japan.*
Impact of optical filter response on pulse circulation limit in fiber ring with frequency shifter and EDFA is clarified. The results are applicable to optical packet buffers, wavelength converters, pulsed lightwave frequency sweepers with ring.

JWB12

Temporal and spectral dependence on polarization of the input signal in a semiconductor optical amplifier, *Brendan F. Kennedy[1], Pascal Landais[1], Louise Bradley[2], Severine Philippe[2], Miguel Martinez-Rosas[2]; [1]Dublin City Univ., Ireland, [2]Trinity College Dublin, Ireland.*
The polarization dependency of the instantaneous frequency variation and pulse width in a semiconductor optical amplifier is studied using second-harmonic generation frequency resolved optical gating. A reduction of the time-bandwidth product is measured.

JWB13

All-optical SOA-based 2R regeneration at 10 Gb/s in a MZI-configuration with one active arm, *Sam Verspurten, Jan De Merlier, Geert Morthier, Dries Van Thourhout, Roel Baets; INTEC/IMEC Ghent Univ., Belgium.*
Experimental results of 10Gb/s all-optical 2R-regeneration using a Mach-Zehnder Interferometer with one active arm and one transparent arm are presented. Feasibility up to 40 Gb/s is proven by simulations.

JWB14

Automatic control apparatus for optimizing the optical phase difference on MZI in SOA-based XPM wavelength converter, *Joo-Youp Kim, Jeung-Mo Kang, Sang-Kook Han; Optical Communication Lab. Dept. of Electrical and Electronic Engineering, Yonsei Univ., Republic of Korea.*
We have proposed and experimentally embodied the novel automatic control method for optimizing the optical phase difference on MZI in the SOA-based XPM wavelength converter through the electrical feedback and control process.

JWB15

All-optical control signal generation to drive optical gates for packet switching applications, *Leontios A. Stampoulidis[1], Konstantinos Yiannopoulos[1], Marios Kalyvas[1], George Theophilopoulos[1], Hercules Avramopoulos[1], George Guekos[2]; [1]Natl. Technical Univ. of Athens, Greece, [2]Swiss Federal Inst. of Technology, Switzerland.*
We present a technique to generate control signals to power optical gates for packet switching. The technique employs a Fabry-Perot filter and a Semiconductor Optical Amplifier and is tested at 10 and 40 GHz.

JWB16

Optimal placement of DGE controlled amplifier in long haul transmission line, *Maxim Bolshtyansky, Alexey Turukhin, Paul Bollond, Yihong Cheng, Enrico Gonzales; JDS Uniphase, USA.*
Optimal placement of a DGE controlled amplifier is studied for a sample transmission link. Self-controlled and link-controlled cases, which are differentiated by location of the flattened channel power spectra, are investigated analytically and experimentally.

JWB17

WDM-PON downstream system with a single to multi-wavelength converter using FP-LD, *Hyuk-Choon Kwon, Jeong-Mo Kang, Tae-Young Kim, Sang-Kook Han; Optical Communication Lab., Yonsei Univ., Republic of Korea.*
We have proposed and experimentally demonstrated a novel WDM-PON downstream system including a single to multi-wavelength converter as broadcasting function. The downstream transmission of 2.5Gbps and broadcasting transmission of 622Mbps are performed over 33.6km.

JWB18

Analysis of optimal pre-emphasis in ultra-long-haul transmission systems, *Michael Vasilyev; Univ. of Texas at Arlington, USA.*
By simple calculations, we show that, in presence of nonlinearities, the optimum pre-emphasis techniques correspond to either same OSNR or same nonlinear phase-shift for all channels, yielding flat spectrum near the middle of the link.

■ Wednesday
■ June 30, 2004

Location: Parc Ballroom Foyer

7:30 a.m. – 5:00 p.m.
Registration

Location: Parc Ballroom I

8:30 a.m. – 10:00 a.m.
JWA ■ IPR Plenary Session

8:30 a.m.
Convergence of optics and electronics, *Lionel Kimerling; MIT, USA.*
Microphotonics is the optical implementation of microelectronic integrated circuits. The time evolution of this new technology platform is constrained by innovation, by development of a new fabrication infrastructure and by user acceptance of the new functionality. The two key target applications are 1) relief of the interconnection bottleneck that currently limits the speed of electronic systems; and 2) elimination of the optical-electronic-optical conversion that limits bandwidth at nodes in communications networks. A major challenge is integration of the diverse set materials that are currently used for optical components. Equally high barriers are the establishment of a standard platform for design and systems insertion, and of scalability for technology evolution. This talk will address the desirability and feasibility of monolithic integration of high performance waveguides, add/drop filters, modulators, amplifiers, sources and detectors with silicon electronics. The context for this analysis is a Performance Figure of Merit = Information Capacity ÷(Power Dissipation x Area) that will provide the design rules for electronic-photonic partitioning; and a Scalability Figure of Merit = Performance ÷ Cost that must project 100x improvements every 10 years. A roadmap scheme will be used to highlight the coordination of the R&D timelines required to meet the projected performance needs of the emerging microphotonics technology platform.

9:15 a.m.
Applications of photonic crystals in integrated photonics, *Axel Scherer; Caltech, USA.*
Lithography and high refractive index contrast have enabled the radical miniaturization of photonic devices by orders of magnitude. Photonic crystals represent favorable geometries to connect these components, and we describe the design, fabrication and application of photonic crystal devices for integrated optics.

Location: Parc Ballroom III

10:00 a.m. – 10:30 a.m.
Coffee Break

Location: Parc Ballroom II

10:30 a.m. – 12:00 p.m.
IWA ■ Silicon Microphotonics
Steven Spector; MIT, USA, Presider

IWA1 10:30 a.m. ►INVITED
Silicon wire waveguides and their applications for microphotonics devices, *Hiroshi Fukuda[1], Tai Tsuchizawa[1], Koji Yamada[1], Toshifumi Watanabe[1], Mitsutoshi Takahashi[1], Jun-ichi Takahashi[1], Seiichi Itabashi[1], Tetsufumi Shoji[2]; [1]NTT Microsystem Integration Labs., Japan, [2]NTT West Corp., Japan.*
We report our recent progress in a Si wire waveguides, which promises size reduction and high-density integration of optical circuits. The application to functional devices and their nonlinear optical effects are also discussed.

IWA2 11:00 a.m.
Submicrosecond, submilliwatt, silicon on insulator thermooptic switch, *Michael W. Geis, Steven J. Spector, Theodore M. Lyszczarz; MIT Lincoln Lab., USA.*
This is the first report of a thermal Mach-Zehnder switch with directly heated waveguides, having a switching time <1 μs and a switching power of 0.1 to 5.5 mW.

IWA3 11:15 a.m.
Optical bistability on silicon microphotonics, *Vilson R. Almeida, Michal Lipson; Cornell Univ., USA.*
We demonstrate optical bistability on a silicon-based integrated optical device. Hysteresis curves and modulation measurements show bistable modulation depth of 10 dB and sub-microsecond time response.

IWA4 11:30 a.m.
Spontaneous Raman scattering in a silicon wire waveguide, *Jerry I. Dadap, Jr.[1], Richard L. Espinola[1], Richard M. Osgood, Jr.[1], Sharee J. McNab[2], Yurii A. Vlasov[2]; [1]Columbia Univ., USA, [2]IBM T.J. Watson Res. Ctr., USA.*
We report spontaneous Raman scattering at 1550nm in an SOI strip waveguide with cross-sectional area 0.1μm^2. The tight optical confinement permits efficient Raman conversion for small coupled pump powers (1435nm) of <50mW.

IWA5 11:45 a.m.
Tunable electro-optic modulator on silicon-on-insulator substrates using ring resonators, *Sameer S. Pradhan, Vilson R. Almeida, Carlos A. Barrios, Michal Lipson; Cornell Univ., USA.*
We propose a tunable electro-optic modulator using ring resonators on silicon-on-insulator substrate. Optical modulation is achieved using free carrier injection. A steady state on-off ratio of 90% at 775MHz is achievable with the proposed scheme.

Location: Parc Ballroom Foyer
12:00 p.m.
IPR Postdeadline Paper Deadline

12:00 p.m. – 1:30 p.m.
Lunch Break

Location: Parc Ballroom II
1:30 p.m. – 3:00 p.m.
IWB ■ Photonic Crystal Waveguides
Thomas Krauss; Univ. of St. Andrews, UK, Presider.

IWB1 1:30 p.m. ►INVITED
Waveguiding in silicon photonic crystal slabs—Thrust toward ultradense optical integration, *S. McNab[1], N. Moll[2], Yurii Vlasov[1]; [1]IBM, TJ Watson Res. Ctr., USA, [2]IBM Zurich Res. Lab., Switzerland.*
We will review the latest results on development of submicron silicon-on-insulator waveguiding structures – photonic crystals (PhC) and single-mode strip waveguides.

IWB2 2:00 p.m.
Photonic crystal channel guide Y-junction beam splitter based on an AlGaAs/GaAs epitaxial structure, *Edilson A. Camargo[1,2], Richard M. De La Rue[1]; [1]Univ. of Glasgow, UK, [2]Inst. Tecnológico de Aeronáutica - CTA/CAPES, Brazil.*
We report an experimental realization of a PhC beam-splitter operating at 1.5 µm. The device structure integrates bends and a Y-junction - and uses different PhC filling factors to enhance the single-mode transmission band.

IWB3 2:15 p.m.
Transmission measurement of tapered single line defect photonic crystal waveguide, *Aimin Xing, Marcelo Davanco, Danniel J. Blumenthal, Evelyn L. Hu; Dept. of Electrical and Computer Engineering, Univ. of California at Santa Barbara, USA.*
Two-dimensional single-line defect Photonic Crystal (PC) waveguides were fabricated and characterized by optical transmission measurements. Different PC-waveguide tapers were investigated for coupling to access ridge waveguides; ~10-dB coupling efficiency enhancement was observed over un-tapered waveguides.

IWB4 2:30 p.m. ►INVITED
Multi-port PBG components in SOI photonic crystal slabs, *Masaya Notomi, A. Shinya, E. Kuramochi, S. Mitsugi; NTT Basic Res. Labs., Japan.*
Recent progress on various components consisting of PBG waveguides and resonators in SOI photonic-crystal slabs are reviewed. We have achieved significant improvement in loss for waveguides and Q for resonators. By combining these PBG waveguides and resonators, we have designed and fabricated several multi-port devices, such as resonant-tunneling filters, and channel-drop filters.

Location: Parc Ballroom III
3:00 p.m. – 3:30 p.m.
Coffee Break

Location: Parc Ballroom II

3:30 p.m. – 5:00 p.m.

IWC ■ Ring Lasers and Wavelength Converters

Yoshiaki Nakano; Univ. of Tokyo, Japan, Presider.

IWC1 3:30 p.m. ►INVITED
Microdisk and microring lasers, *Daniel Dapkus; Univ. of Southern California, USA.*
Abstract not available at this time.

IWC2 4:00 p.m.
Integrated passively modelocked InGaAsP ringlasers with active-passive integration, *Yohan Barbarin[1], E. A. J. M. Bente[1], M. J. R. Heck[1], J. H. den Besten[1], G. Guidi[1], M. K. Smit[1], J. J. M. Binsma[2]; [1]COBRA / OED Group, Eindhoven Univ. of Technology, Netherlands, [2]JDS Uniphase, Netherlands.*
Integrated modelocked ring lasers with fundamental repetition rates of 35 and 26Ghz were fabricated in InGaAsP using active-passive integration. First measurements shows pulses down to 1.2ps width can be produced.

IWC3 4:15 p.m.
Quantum well intermixing for monolithic integration: A demonstration of novel widely-tunable 10Gb/s transmitters and wavelength converters, *James W. Raring, Erik J. Skogen, Leif A. Johansson, Matt N. Sysak, Jonathon S. Barton, Milan L. Masanovic, Larry A. Coldren; Univ. of California at Santa Barbara, USA.*
Wavelength-agile InGaAsP/InP photonic integrated circuits were fabricated using a quantum well intermixing processing platform. 10Gb/s operation was achieved with widely-tunable laser/modulator transmitters and optoelectronic wavelength converters in the 1550 nm range.

IWC4 4:30 p.m.
The influence of gain and phase dynamics in the integrated GS-SOA on the switching performance of the monolithically integrated GS-MZI, *Tolga Tekin, Michael Schlak, Christian Schmidt, Colja Schubert; Fraunhofer Inst. for Telecommunications, Heinrich-Hertz-Inst., Germany.*
We determined the dynamic gain-/phase response of integrated GS-SOAs and analyzed the dependence of switching performance on the switching scheme by using the monolithically integrated GS-MZI.

IWC5 4:45 p.m.
Saturable absorber based micro-cavity for broadband wavelength conversion,
Alexandre Shen[1], Jean Decobert[1], Jean Landreau[1], Francis Poingt[1], Odile Legouezigou[1], Lionel Legouezigou[1], Frédéric Pommereau[1], Bruno Thédrez[1], David Massoubre[2], Guy Aubin[2], Jean-Louis Oudar[2]; [1]Alcatel, France, [2]LPN-CNRS, France.
Saturable absorber comprised inside a suited micro-cavity has been fabricated and characterized through a dynamic wavelength conversion experiment. Wavelength conversion is observed within a 40nm bandwidth, and is effective within a 15nm bandwidth.

Location: Parc Ballroom III

5:00 p.m. – 6:30 p.m.

JWB ■ Joint OAA/IPR Poster Session

JWB19
Optical bandwidth of Mach-Zehnder interferometer wavelength converters,
Rabah Hanfoug, L. M. Augustin, J. J. G. M. van der Tol, R. G. Broeke, M. K. Smit; Eindhoven Univ. of Technology, Netherlands.
Comparison of optical bandwidth of a SOA-MZI using 1x2 input couplers to one with 2x2 input couplers is presented. The simulation shows that wider bandwidth can be obtained in case where 2x2 couplers are used.

JWB20
Polymer film to prevent intermixing, *Walter J. Zubrzycki[1], G. A. Vawter[1], G. M. Peake[1], T. Hargett[1], C. Alford[1], B. Salters[1], S. D. Mukherjee[1,2]; [1]Sandia Natl. Lab., USA, [2]Linkoping Univ.- ITN, Sweden.*
We present a new surface treatment that controls selective area quantum well intermixing. A CHF_3/O_2 plasma in an RIE system is used to form a polymer on localized areas that prevents intermixing.

JWB21
Traveling wave electrode structure for polymer modulators, *Desalegn B. Bereka, Anand Gopinath; Univ. of Minnesota, USA.*
Velocity matching is achieved using a capacitively loaded stripline approach for high-speed electro-optic polymer modulator.

JWB22

Optimization for low-loss arrayed-waveguide gratings, *Kenneth A. McGreer, Calvin K. Ho, Jane C. Lam, Liang Zhao, Hao Xu, Nizar S. Kheraj; Neophotonics, USA.*
Experimental data show AWGs in which the insertion loss versus wavelength within one free spectral range follow a fourth order polynomial. Relationships among the coefficients of the polynomial are used to simplify the optimization process.

JWB23

On-chip spot-size converter using a two-step lateral taper for efficient coupling to InP-based photonic integrated circuits, *Fang Wu, Valery I. Tolstikhin, Adam Densmore, Serge Grabtchak; MetroPhotonics Inc., Canada.*
Two-step lateral tapering is proposed as a means for waveguide mode shaping for improved fiber coupling without compromising the waveguide design. Using this technique, on-chip spot-size converters integrated with shallow etched InP-based waveguides are reported.

JWB24

Direct-write waveguides in volume photopolymers, *Robert R. McLeod, Amy C. Sullivan, Matthew Grabowski; Univ. of Colorado, USA.*
Photopolymers developed for holographic data storage have good optical quality in millimeter-thick films, very low shrinkage and large index change. We show that these materials will support single-mode waveguides created via three-dimensional direct-write lithography.

JWB25

Integrated thin film heater and sensor with arrayed waveguide gratings, *Ming Yan, Jason Weaver, Calvin Ho, Xu Hao, Wen Li, Thomas Tarter; NeoPhotonics Corp., USA.*
Localized temperature control of multiple arrayed waveguide gratings (AWG) on single chip using integrated thin film heater and sensor is designed and characterized with 2 picometer center wavelength accuracy to ITU grid.

JWB26

Single-mode polymer optical waveguides fabricated by electron beam direct writing, *Chih-Wei Hsu[1], Way-Seen Wang[1], Hsuen-Li Chen[2], Wen-Chi Chao[2]; [1]Inst. of Electro-Optical Engineering and Dept. of Electrical Engineering, Natl. Taiwan Univ., Taiwan Republic of China, [2]Natl. Nano Device Lab., Taiwan Republic of China.*
Single-mode optical waveguides using benzocyclobutene are fabricated by electron beam direct writing. The measured propagation losses for TE and TM polarizations at 1.55μm are 0.82dB/cm and 0.9dB/cm, respectively. Moreover, directional couplers are made for comparison.

JWB27

Optical waveguides on Nd:YVO_4 formed by ion beam implantation, *Gloria V. Vázquez[1], María E. Sánchez-Morales[1], Heriberto Márquez[2], Jorge Rickards[3], Rebeca Trejo-Luna[3]; [1]Ctr. de Investigaciones en Óptica, Mexico, [2]Dept. de Óptica, CICESE, Mexico, [3]Inst. de Física, UNAM, Mexico.*
Optical waveguides are formed on Nd:YVO_4 by either proton or carbon implantation. Refractive index profiles with a low index barrier are obtained and spectroscopic properties are presented.

JWB28

Low-loss silicon rich silicon nitride waveguides for high density integrated optics, *Hugh T. Philipp, Karin N. Andersen, Winnie E. Svendsen, Haiyan Ou; COM, Denmark.*
Amorphous silicon rich silicon nitride high-index contrast waveguides are characterized and shown to have low curvature loss. Ultra small microring resonators with large free spectral ranges are demonstrated as well as a channel dropping filter.

JWB29

Trenches for building blocks of advanced planar components, *Haiyan Ou, Karsten Rottwitt; COM Ctr., Denmark.*
Fabrication of trenches across silica on silicon waveguides is demonstrated. These are etched deep into the substrate and their widths are varied between 24 and 100 μm. Measurements and predictions of insertion loss are shown.

JWB30

Dependence of performance of a waveguide spectral encoding/decoding system on its planar element parameters, *Cooper D. Babich[1], James F. Young[1], Chau-Han Lee[2], Yung Jui Chen[2]; [1]Dept. of Electrical and Computer Engineering, Rice Univ., USA, [2]Dept. of Computer Science and Electrical Engineering, Univ. of Maryland, Baltimore County, USA.*

Modeling of an integrated waveguide spectral encoder/decoder shows that bit error rates of 10^{-9} are generally possible with current fabrication tolerances, but that code lengths longer than 24-bits require tighter tolerances for some device parameters.

JWB31

The design of a weakly guided multimode interference device in three dimensions using a genetic algorithm, *Brian R. West, Seppo Honkanen; Optical Sciences Ctr., Univ. of Arizona, USA.*

We discuss the use of a genetic algorithm in designing a weakly guided multimode interference (MMI) device. Lateral and transverse mode distributions are accounted for, in order to properly describe devices fabricated by ion exchange.

JWB32

Parabolic equation approach for calculating wave propagation properties of multilayer 3D optical waveguide, *Hidenori Nagai, Yoshiaki Neishi, Takaharu Hiraoka, Tetsuo Anada; Kanagawa Univ., Japan.*

The validity and accuracy of parabolic equation method is given for multilayered 3D optical waveguides with different refractive indices. The propagation properties of polarization-maintaining waveguides and antiresonant reflecting optical waveguides are investigated through numerical examples.

JWB33

Time-domain analysis of widely tunable sampled grating DFB laser diode, *Soohyun Kim, Youngchul Chung; Kwangwoon Univ., Republic of Korea.*

A widely tunable SG(Sampled Grating)-DFB laser diode is successfully analyzed using split-step time domain model and it is demonstated that the simple tuning and high output power operation could be possible.

JWB34

Design issues for directional coupler-based optical microring filters on InP waveguides, *C. Themistos[1], Muttukrishnan Rajarajan[1], B. M. A. Rahman[1], K. T. V. Grattan[1], K. Kalli[2], M. Komodromos[3]; [1]City Univ., UK, [2]Higher Technical Inst., Cyprus, [3]Frederick Res. Ctr., Cyprus.*

The characterization of optical microring resonator-based optical filter on InP waveguides, using the finite element-based beam propagation approach is presented here. Design issues, such as, coupling, wavelength dependence, power and field evolution have been investigated.

JWB35

Imaginary-distance BPM simulation of a light-guiding metal line, *Jun Shibayama, Tomohide Yamazaki, Junji Yamauchi, Hisamatsu Nakano; Hosei Univ., Japan.*

Two- and three-dimensional light-guiding structures composed of a metal on a dielectric substrate are analyzed using the imaginary-distance BPM. Dispersion characteristics are investigated as a function of metal thickness and width.

JWB36

Nonlinear effects in passive ring-resonator-coupled lasers, *Zhixi Bian[1], Ali Shakouri[1], Bin Liu[2]; [1]School of Engineering, Univ. of California at Santa Cruz, USA, [2]Dept. of Electrical and Computer Engineering, Univ. of California at Santa Barbara, USA.*

We investigate maximum output power and modulation speed of passive ring-resonator-coupled lasers in the presence of nonlinear optical absorption and refraction. A detailed numerical analysis in time domain is presented.

JWB37

1-D omnidirectional reflectors for visible, near infra red, *Manish Deopura; MIT, USA.*

Tin sulfide-silica multilayers are fabricated and characterized for optical and nano-mechanical properties. Multilayers act as 1-D photonic band-gap omnidirectional reflector for visible and near infra red wavelength.

■ Thursday
■ July 1, 2004

Location: Parc Ballroom Foyer

7:30 a.m. – 5:00 p.m.
Registration

Location: Parc Ballroom I

8:30 a.m. – 10:00 a.m.
IThA ■ Advanced Silica-on-Silicon Devices

Richard Osgood; Columbia Univ., USA, Presider.

IThA1 8:30 a.m. ►INVITED
Silica-on-silicon devices for inter- and intra-channel control in WDM systems, *Christopher Doerr; Lucent Technologies, Inc., USA.*
Silica-on-silicon devices can be mass-produced and non-hermetically packaged, promising the low cost needed for high-functionality optical control devices. We cover both inter-channel control devices, such as wavelength-selective cross connects, and intra-channel control devices, such as general optical equalizers.

IThA2 9:00 p.m.
Reconfigurable Optical Add-Drop Multiplexer (ROADM) with full add and drop path crossconnect, *Mark Earnshaw, M. Cappuzzo, E. Chen, L. Gomez, A. Griffin, E. Laskowski, A. Wong-Foy; Bell Labs., USA.*
We demonstrate a high-performance, monolithic reconfigurable optical add-drop multiplexer (ROADM) with integrated add and drop optical crossconnects and per-channel gain equalization.

IThA3 9:15 a.m.
On-chip multichannel power monitoring by using phase modulation and fast fourier transform technique, *Xiao Lin, Yu Sun, Gary M. Carter, Li Yan; Univ. of Maryland, Baltimore County, USA.*
We demonstrate an on-chip power monitoring method based on a channelized dynamic gain equalizer filter. Multichannel signal powers can be monitored simultaneously by fast Fourier transform, while phase modulation does not induce penalty on data.

IThA4 9:30 a.m.
High performance variable optical attenuator multiplexer filter (VMUX), *Mark Earnshaw, M. Cappuzzo, E. Chen, L. Gomez, A. Griffin, E. Laskowski, A. Wong-Foy; Bell Labs., USA.*
We report progress on fully integrated variable optical attenuator multiplexers (VMUXs). We show substantial performance improvements, notably very low loss and PDL, and the realization of extremely compact designs in high delta silica-on-silicon.

IThA5 9:45 a.m.
Integrated variable optical delay lines using high index contrast waveguide, *Mahmoud S. Rasras, Christi K. Madsen, Mark A. Capuzzo, Evans Chen, Louis Gomez, Edward J. Laskowski, Andrew Griffin, Annjoe Wong-Foy, Sanjay Patel, Arman Gasparyan, Jane D. Le Grange, Albin Kasper; Lucent Technologies, Bell Labs, USA.*
Wide-tunable-range optical delay lines are demonstrated in high index contrast waveguides. This device integrates tunable allpass filters, for continuous delay tuning, with cascaded fixed delay waveguides enabling coherent switching and tuning ranges up to *2.56ns*.

Location: Parc Ballroom II

8:30 a.m. – 10:00 a.m.
IThB: Receivers and Novel Components

Joe Campbell; Univ. of Texas at Austin, USA, Presider

IThB1 8:30 a.m. ►INVITED
Ultrafast photoreceivers for various 40 Gb/s applications, *Andreas Umbach, Carsten Schramm, Christoph C. Leonhardt, Gerald Jacumeit, Jörg Honecker, Günter Unterbörsch; u²t Photonics AG, Germany.*
The application of 40 Gbit/s in the optical network will require different types of photoreceivers. Single-ended and differential receivers with up to 1000 V/W conversion gain are presented. Balanced detectors for DPSK modulation formats show superior results for long-haul transmission.

IThB2 9:00 a.m.
An 8 x 25 GHz polarization-independent integrated multi-wavelength receiver,
Mahmoud Nikoufard, X. J. M. Leijtens, Y. C. Zhu, J. J. M. Kwaspen, E. A. J. M. Bente, M. K. Smit; Eindhoven Univ. of Technology, Netherlands.
In this paper, we present an eight-channel polarization independent multiwavelength receiver which comprises an AWG demultiplexer monolithically integrated with eight twin-waveguide pin-photodetectors.

IThB3 9:15 a.m.
A monolithic evanescent field spore detector,
Daniel A. Cohen, Chad S. Wang, Jill A. Nolde, Dan D. Lofgreen, Larry A. Coldren; Univ. of California at Santa Barbara, USA.
We demonstrate a monolithically integrated particle sensor based on evanescent field scattering, well suited for use with affinity assays for pathogen recognition. Single micron sized particles may be detected, representative of spores and small bacteria.

IThB4 9:30 a.m.
Optical signal routing device designed with compound semiconductor heterostructure,
Hironori Tsukamoto, Thomas D. Boone, Jerry M. Woodall; Yale Univ., USA.
A concept of novel semiconductor optical signal routing device is proposed for short-distance optical communication. We show that the optical signals can be spatially delivered to output-fibers by biasing AlGaAs/GaAs heterostructure device instead of micromirrors.

IThB5 9:45 a.m.
Monolithic-integrated optical gain competition inverter, *G. Allen Vawter, Charles Alford, Greg Peake, Florante Cajas, Betty Salters, Joel Wendt, Walt Zubrzycki; Sandia Natl. Lab., USA.*
A monolithic integrated optical inverter is demonstrated. The device uses the gain competition effect to switch off an etched-facet diode laser under side optical injection from and integrated master laser and semiconductor optical amplifier.

Location: Parc Ballroom III

10:00 a.m. – 10:30 a.m.
Coffee Break

Location: Parc Ballroom I

10:30 a.m. – 12:00 p.m.
IThC ■ Polymer-Based Waveguide Devices

Louay Eldada; DuPont Photonics Technologies, USA, Presider.

IThC1 10:30 a.m. ►INVITED
Electro-optic materials and devices for integrated photonics, *Larry R. Dalton[1], A. K.-Y. Jen[1], B. H. Robinson[1], W. H. Steier[2]; [1]Univ. of Washington, USA, [2]Univ. of Southern California, USA.*
Theoretically-inspired material design paradigms have permitted the electro-optic(EO) coefficients of organic materials to be increased to 200 pm/V(at telecommunication wavelengths). Materialshave been used to fabricate a variety of device structures including conformal and flexible devices.

IThC2 11:00 a.m.
Silica waveguide electrooptic modulator employing push-pull electrodes, *Richard W. Ridgway, David W. Nippa, Steven Risser, Vincent McGinniss; Optimer Photonics, Inc., USA.*
An unpoled electrooptic material is used as the cladding on a silica waveguide interferometer to form an optical modulator operating at microwave frequencies. Two electrodes in a push-pull configuration are shown to increase modulation depth.

IThC3 11:15 a.m.
Ultrahigh index contrast planar polymeric strictly non-blocking 1024x1024 cross-connect switch matrix, *Junichiro Fujita, Tomoyuki Izuhara, Antonije Radojevic, Reinald Gerhardt, Louay Eldada; DuPont Photonics Technologies, USA.*
We report on the first 1024×1024 switch designed in a planar lightwave circuit, enabled by the 30% refractive index contrast achievable in our buried-channel polymer waveguides. We present architectures, design considerations, and implementation schemes.

IThC4 11:30 a.m.
Implementation of a tunable notch filter using a thermo-optic long-period grating,
Min-Suk Kwon, Sang-Yung Shin; Dept. of Electrical Engineering, Korea Advanced Inst. of Science and Technology, Republic of Korea.
We propose a tunable notch filter using a thermo-optic long-period grating. The grating is generated and controlled thermo-optically. The attenuation of the notch filter is adjustable. Making it with thermo-curable polymers, we demonstrate its feasibility.

IThC5 11:45 a.m.
Optical PCB using waveguide-embedded backplane, *Keun Byoung Yoon, In-Kui Cho, Seong Ho Ahn, Hee Kyung Sung; Electronics and Telecommunications Res. Inst., Republic of Korea.*
A practical optical PCB was demonstrated using waveguide-embedded optical backplane and optical slots for board-to-board interconnection. The polymer waveguide was formed by hot embossing and embedded following conventional lamination processes being used for electrical PCBs.

Location: Parc Ballroom II

10:30 a.m. – 12:00 p.m.
IThD ■ High Speed Devices

Mario Dagenais; Quantum Photonics Inc., USA, Presider.

IThD1 10:30 a.m. ►INVITED
Self-pulsation and sub-harmonic optical injection locking beyond 200 GHz using multi-electrode DFB lasers, *Satoshi Nishikawa[1,2], Mitsunobu Gotoda[1,2], Tetsuya Nishimura[1,2], Yasunori Tokuda[1,2]; [1]Mitsubishi Electric Corp., Japan, [2]OITDA, Japan.*
We report ultra-high frequency pulsation DFB lasers with effects of phase shift gratings. Self-pulsation and sub-harmonic optical injection locking beyond 200 GHz were experimentally verified for devices designed by numerical simulations.

IThD2 11:00 a.m.
Small-footprint, high-efficiency, integrated transmitters for high-speed optical interconnect applications, *Erik J. Skogen, Chad S. Wang, James W. Raring, Gordon B. Morrison, Larry A. Coldren; Univ. of California at Santa Barbara, USA.*
Short-cavity InGaAsP/InP DBR lasers with integrated SOA and EAM were fabricated using a quantum well intermixing processing platform. >10mW output power and 17.5% wall-plug efficiency was achieved at 30mA. EAM extinction was >15dB at -4V.

IThD3 11:15 a.m.
Substrate removed low drive voltage GaAs/AlGaAs semiconductor electro-optic phase modulators, *Jae Hyuk Shin, Shaomin Wu, Nadir Dagli; Univ. of California at Santa Barbara, USA.*
Substrate removed phase modulators in bulk GaAs with drive voltage 3.7 V-cm were fabricated. Good agreement between the measured and simulated values opens the possibility of realizing high speed modulators with very low drive voltages.

IThD4 11:30 a.m. ►INVITED
Quantum dot for lasers for high frequency systems, *Matthias Kuntz; Technische Univ. Berlin, Germany.*
5 Gb/s error free data transmission across 4 km fiber as well as 20 GHz hybrid and 35 GHz passive mode-locking of (InGa) As quantum dot (QD) lasers on GaAs substrates emitting at 1.3 µm are reported.

12:00 p.m. – 1:30 p.m.
Lunch Break

Location: Parc Ballroom I

1:30 p.m. – 3:00 p.m.
IThE ■ Silicon Waveguide Components

Christi K. Madsen; Bell Labs., USA, Presider.

IThE1 1:30 p.m.
Integrated magnetooptical device designs in Garnet/Silicon-on-Insulator waveguides, *Richard L. Espinola, Tomoyuki Izuhara, Ming-Chun Tsai, Richard M. Osgood, Jr.; Columbia Univ., USA.*
We present a new structure using a garnet film bonded on silicon-on-insulator waveguides. Experimental data, obtained at λ=1.55µm using a hybrid fiber-optic/SOI-Garnet test setup, show large nonreciprocal phase shift. Integrated isolators on SOI are proposed.

IThE2 1:45 p.m.
Tunable Bragg grating filters in SOI waveguides, *Ling Liao, Ansheng Liu, Song Pang, Mario J. Paniccia; Intel Corp., USA.*
We present a thermally tunable Bragg grating filter based on silicon-on-insulator (SOI) technology. The grating's periodic refractive index modulation is achieved with alternating regions of single-crystalline silicon and polycrystalline silicon (polySi).

IThE3 2:00 p.m.
Phase-matching and nonlinear optical processes in silicon waveguides, *Dimitrios Dimitropoulos, Varun Raghunathan, Ricardo Claps, Bahram Jalali; Dept. of Electrical Engineering, Univ. of California at Los Angeles, USA.*
Phase matching in silicon waveguides is studied in the context of the recently demonstrated parametric-Raman wavelength conversion. We show that phase matching leading to efficient conversion can be achieved using birefringence to cancel material dispersion.

IThE4 2:15 p.m.
Tunable waveguide based external cavity laser using a silicon/poly-silicon Bragg grating, *Richard Jones[1], Mario J. Paniccia[1], Scott Merritt[2]; [1]Intel Corp., USA, [2]Covega Corp., USA.*
A tunable external cavity laser is described based on butt coupling a semiconductor gain chip to a Bragg grating fabricated on silicon-on-insulator. The novel Bragg grating is formed between crystalline and polycrystalline silicon.

IThE5 2:30 p.m.
Hybrid multi-mode/single-mode waveguides for low loss, *Steven J. Spector, Michael W. Geis, Donna Lennon, Richard C. Williamson, Theodore M. Lyszczarz; MIT Lincoln Lab., USA.*
We have demonstrated a technique for achieving low loss in silicon waveguides by using wide sections in the straight paths with narrow sections in the turns. The overall loss achieved was approximately 0.3 dB/cm.

IThE6 2:45 p.m.
Improved digital optical switching using carrier injection induced reconfigurable waveguides, *S. Ng[1], S. Abdalla[1], B. Syrett[1], P. Barrios[2], A. Delâge[2], I. Golub[2], J. J. He[2], S. Janz[2], W. R. McKinnon[2], P. Poole[2]; [1]Carleton Univ., Canada, [2]Inst. for Microstructural Sciences, Natl. Res. Council Canada, Canada.*
A compact 1x2 InGaAsP/InP waveguide digital optical switch with electrically reconfigurable output waveguide arms is demonstrated. The carrier injection device exhibits better than 20 dB isolation and 3 nanosecond time response.

Location: Parc Ballroom II

1:30 p.m. – 3:30 p.m.
IThF ■ Microdisks and Resonators

John D. O'Brien; Univ. of Southern California, USA, Presider.

IThF1 1:30 p.m. ►INVITED
Cross grid microring filter circuit - Versatile building block for filter synthesis, *Yasuo Kokubun; Yokohama Natl. Univ., Japan.*
The recent progress in the development of vertically coupled microring filters is summarized. The precise control technique of center wavelength and some examples of filter response synthesis utilizing the cross grid topology are introduced.

IThF2 2:00 p.m.
Vertically coupled microdisk resonators on silicon-on-insulator platform using SIMOX 3-D sculpting, *Prakash Koonath, Tejaswi Indukuri, Bahram Jalali; Dept. of Electrical Engineering, Univ. of California at Los Angeles, USA.*
Vertically coupled microdisk resonator structures have been synthesized on Silicon utilizing a modified Separation by Implantation of Oxygen (SIMOX) technique. Resonances are observed with Q values of 6300 and free spectral range of 5.4 nm.

IThF3 2:15 p.m.
ARROW-based Gires-Tournois interferometer, *Ilya Golub, Eli Simova; Natl. Res. Council, Canada.*
A novel design of Gires-Tournois interferometer (GTI) based on lateral ARROW (antiresonant reflective optical waveguide) is proposed and studied. The device can be used to control dispersion in communication systems.

IThF4 2:30 p.m. ►INVITED
Ultra-high-Q (>100 million) micro-resonators on-a-chip and application to nonlinear optics, cavity QED and sensing, *Kerry Vahala, Tobias Kippenberg, Deniz Armani, Sean Spillane; Caltech, USA.*
A new chip-based microcavity capable of Q factors as high as 500 million is reviewed. Applications of these structures are examined including demonstrations of fiber-coupled Raman oscillators having microWatt level threshold powers.

Location: Parc Ballroom III

3:00 p.m. – 3:30 p.m.
Coffee Break

Location: Parc Ballroom I

3:30 p.m. – 5:00 p.m.
IThG ■ Reflective-Based and Compact Devices

Siegfried Janz; Natl. Res. Council Canada, Canada, Presider.

IThG1 3:30 p.m. ►INVITED
Reflective-based planar waveguide components, *Serge Bidnyk; Enablence Inc., Canada.*
Novel architectures for the design of DWDM optical components based on planar reflective grating devices are presented. The performance of reduced footprint 100-GHz-period comb filters and interleavers with various spectral response shapes is described.

IThG2 4:00 p.m.
Planar waveguide gratings with controlled polarization properties and adjustable strength, *Dale G. Fried, James Foresi, Jean-Francois Viens, Tairan Wang, Gokhan Ulu; Clarendon Photonics, USA.*
We explain and demonstrate a method for controlling polarization properties of planar waveguide gratings, and a robust technique for adjusting grating strength that is tolerant to fabrication errors and does not perturb other optical parameters.

IThG3 4:15 p.m.
Low refractive index contrast waveguide 90 degree bends and a ring resonator design using hybrid photonic crystal and conventional waveguide structures, *Seunghyun Kim, Jingbo Cai, Jianhua Jiang, Gregory P. Nordin; Univ. of Alabama in Huntsville, Nano and Micro Devices Lab., USA.*
Ultracompact high efficiency 90 degree waveguide bends are achieved by hybrid integration of limited photonic crystal regions composed of air holes. A new ring resonator configuration using hybrid PhC and CWG structures is followed.

IThG4 4:30 p.m.
Extremely small AWG demultiplexer fabricated on InP by using a double-etch process, *Yohan Barbarin, X. J. M. Leijtens, E. A. J. M. Bente, C. M. Louzao, J. R. Kooiman, M. K. Smit; COBRA / OED Group, Netherlands.*
A compact low-loss 4x4 AWG demultiplexer with a channel spacing of 400GHz is presented. The device size is reduced to only 230x330μm². Measured insertion losses are less than 5dB and the crosstalk is below -12dB.

IThG5 4:45 p.m.
Self-aligned total internal reflection mirrors with very low loss, *Doo Gun Kim, Cem Ozturk, Jae Hyuk Shin, Jong Chang Yi, Nadir Dagli; Univ. of California at Santa Barbara, USA.*
We designed, fabricated and characterized total internal reflection mirrors on InGaAsP/InP using a self aligned process with two etch steps. Experimental results show that additional loss per mirror is 0.71 ± 0.06 dB.

Location: Parc Ballroom II

3:30 p.m. – 5:00 p.m.
IThH ■ Design and Optimization Techniques and Applications

Azizur B. Rahman; City Univ., UK, Presider.

IThH1 3:30 p.m. ►INVITED
Synthesis techniques for directional couplers as modulators and filters, *Jaesang Oh, Ross Schermer, Kang-Hyun Baek, Desalegn Beraka, Anand Gopinath; Univ. of Minnesota at Duluth, USA.*
The various synthesis techniques of directional couplers with variable coupling is discussed to obtain specific responses as modulators and filters.

IThH2 4:00 p.m.
Optimization of deeply-etched antireflective waveguide terminators by space mapping technique, *Gui-Rong Zhou, Xun Li, Ning-Ning Feng; Dept. of Electrical and Computer Engineering, McMaster Univ., Canada.*
A space mapping optimization technique is applied to the design of the deeply-etched antireflective (AR) waveguide terminators. An optimal design is obtained with only six iterations of FDTD simulation.

IThH3 4:15 p.m.
Modeling of realistic air-core photonic band-gap fibers, *Kunimasa Saitoh[1], Niels A. Mortensen[2], Masanori Koshiba[1]; [1]Hokkaido Univ., Japan, [2]Crystal Fibre A/S, Denmark.*
We investigate the guided modes in the recently reported realistic low-loss air-core photonic band-gap fiber through a finite-element approach. We find that surface modes have a significant impact on fiber characteristics.

IThH4 4:30 p.m.
A novel approach for endlessly single-mode photonic crystal fiber design, *Arismar C. Sodre, Jr.[1], Kleber Z. Nobrega[2], Fabrizio Di Pasquale[1], Hugo E. Hernandez-Figueroa[2]; [1]Scuola Superiore Santanna, Italy, [2]UNICAMP, Brazil.*
We propose an original and simple geometry for endlessly single-mode photonic crystal fibers. Numerical results, based on a full-vectorial finite element analysis, point out single-mode operation for wavelengths greater than 100 nm.

IThH5 4:45 p.m.
Binary radially-chirped Bragg and graded-index Fresnel fibre lenses for singlemode fibre to photonic crystal coupling, *Michael C. Parker[1], Makiko Hisatomi[1], Stuart D. Walker[2]; [1]Fujitsu Lab. of Europe Ltd., UK, [2]Univ. of Essex, UK.*
Binary radially-chirped Bragg and graded-index Fresnel fibre lens couplers are compared. With 41μm focal length, and 2.3 average refractive index, a radially-chirped Bragg fibre lens reduces spot-size from 4.5μm to 600nm incurring 0.4dB loss.

5:00 p.m. – 6:30 p.m.
IPR Conference Reception

■ Friday
■ July 2, 2004

Location: Parc Ballroom Foyer

8:00 a.m. – 5:00 p.m.
Registration

Location: Parc Ballroom I

8:30 a.m. – 10:00 a.m.
IFA ■ Simulation Methods
G. R. Hadley; Sandia Natl. Labs., USA, Presider.

IFA1 8:30 a.m. ►INVITED
Accuracy issues in vectorial optical waveguide modeling, *David Yevick; Dept. of Physics, Univ. of Waterloo, Canada.*
This talk summarizes recent results obtained with Tao Lu, Henghua Deng, Derek Dumas and Magnus Wik on the application of finite difference, finite element and boundary element methods to polarized electric fields in optical waveguides.

IFA2 9:00 a.m.
Time domain integral equation; 3D Model, *A. Y. Al-Jarro[1], P. Sewell[1], T. M. Benson[1], A. G. Nerukh[2]; [1]George Green Inst. for Electromagnetics Res., Univ. of Nottingham, UK, [2]Kharkov Natl. Univ. of Radio Electronics, Ukraine.*
A full vector 3D numerical algorithm derived from a time domain integral equation model of the behavior of light in time varying media is presented for the first time.

IFA3 9:15 a.m.
An efficient time domain reflective beam propagation method for analysis of optical waveguide devices, *Ning-Ning Feng, Wei-Ping Huang; Dept. of Electrical and Computer Engineering, McMaster Univ., Canada.*
An efficient time-domain reflective beam propagation method (TD-RBPM) is presented for the analysis of time domain optical pulse propagation and reflection in waveguide structures with multiple discontinuities.

IFA4 9:30 a.m.
ADI schemes for time-domain simulation of 2-D photonic structures, *Ya Yan Lu; Dept. of Mathematics, City Univ. of Hong Kong, Hong Kong Special Administrative Region of China.*
A fourth order unconditionally stable ADI method for the wave equation is developed. The method is only twice more expensive than the second order ADI methods, but a much larger step size can be used.

IFA5 9:45 a.m.
Graphical design of directional coupler devices, *Ross T. Schermer, Anand Gopinath; Univ. of Minnesota, USA.*
A graphical method of solving the first-order coupled mode equations is discussed and demonstrated, which provides a simple, intuitive approach to designing optical devices based on the directional coupler.

Location: Parc Ballroom II
8:30 a.m. – 10:00 a.m.
IFB ■ Arrayed Waveguide Devices
Larry Coldren; Univ. of California at Santa Barbara, USA, Presider.

IFB1 8:30 a.m. ►INVITED
InP-based photonic integration technology, *J. J. M. Binsma[1], Jan-Hendrik den Besten[2], Ronald G. Broeke[2]; [1]JDS Uniphase, Netherlands, [2]COBRA, Eindhoven Univ. of Technology, Netherlands.*
An InP-based photonic integration technology platform is described and results are presented for photonic integrated circuits fabricated using this platform.

IFB2 9:00 a.m.
An InP-based photonic integrated beamformer for phased-array antennas, *F. M. Soares[1], F. Karouta[1], E. Smalbrugge[1], M. K. Smit[1], J. J. M. Binsma[2], J. Lopez[3], A. Enard[3], N. Vodjdani[3]; [1]COBRA, Eindhoven Univ. of Technology, Netherlands, [2]JDS Uniphase, Netherlands, [3]Thales Res. & Technology, France.*
An InP-based integrated beamformer for beamsteering of a four-element Phased-Array Antenna has been designed, fabricated and characterized. This beamformer consists of an AWG, 14 high-speed MZI switches, and 9 delaylines integrated on a single compact chip.

IFB3 9:15 a.m. ►INVITED
Semiconductor-based advanced integrated devices for WDM networks, *Nobuhiro Kikuchi, Yasumasa Suzaki, Yasuo Shibata, Yuichi Tohmori; NTT Photonics Lab., NTT Corp., Japan.*
Semiconductor monolithic integration is a key technology for realizing various functional WDM devices. In this paper, our monolithically integrated devices, which are the WDM channel selector and the WDM modulator, are reviewed.

IFB4 9:45 a.m.
Integration of semiconductor optical amplifiers with an arrayed waveguide grating demultiplexer by MOVPE selective area growth, *Abdullah Al Amin, Xueliang Song, Kenji Sakurai, Masakazu Sugiyama, Yoshiaki Nakano; Univ. of Tokyo, Japan.*
We integrated an InP-based demultiplexer with quantum-well semiconductor amplifiers using a single-step growth process. Using an arrayed mask for elective growth, 140nm shift of bandgap wavelength was achieved. We measured characteristics of the versatile device.

Location: Parc Ballroom III
10:00 a.m. – 10:30 a.m.
Coffee Break

Location: Parc Ballroom I
10:30 a.m. – 12:00 p.m.
IFC ■ Design of Integrated Devices
T. M. Benson; Univ. of Nottingham, UK, Presider.

IFC1 10:30 a.m. ►INVITED
Design of optical circuits for dispersion compensation, *Koichi Takiguchi; NTT Photonics Lab., NTT Corp., Japan.*
A method for synthesizing lattice-form waveguide devices for adaptive optical filtering is described. The characteristics of several useful kinds of chromatic dispersion compensators designed by this method and fabricated by silica waveguide technology are reported.

IFC2 11:00 a.m.
Directional-coupler-type polarization splitters using multilayer thin-film waveguides, *Junji Yamauchi, Yuji Kamei, Hisamatsu Nakano; Hosei Univ., Japan.*
The beam-propagation method based on Yee's mesh is employed to demonstrate polarization splitting properties of a directional coupler composed of multilayer thin-film waveguides. A short device length of 270 μm is achievable.

IFC3 11:15 a.m.
Study of polarization splitter/combiner in high index contrast Bragg reflector waveguides, *Eli Simova, Andre Delâge, Ilya Golub; Natl. Res. Council, Canada.*
A study on the optimum design of a novel polarization splitter/combiner based on Bragg reflector waveguides in high-index contrast material is presented. Numerical simulations with 3D semivectorial BPM and 2D modesolver demonstrate the device performance.

IFC4 11:30 a.m.
Design of polarization filter using vertical coupler, *Chee-Wei Lee, Mee-Koy Chin; Nanyang Technological Univ., Singapore.*
We present a systematic design for a compact polarization filter with mode-size transformer, by using tapered *resonant vertical coupler* with a transfer region that includes only the resonant width for the desired polarization.

IFC5 11:45 a.m.
Polarization maintaining semiconductor waveguides, *Azizur B. Rahman[1], Tiparatna Wongcharoen[2], Wanne Boonthittanont[1], Salah S. Obayya[3]; [1]City Univ., UK, [2]Bangkok Univ., Thailand, [3]Brunel Univ., UK.*
A novel optical waveguide with a layered core, which supports only a single polarization state, is optimized by adjusting the layer compositions and its expected performance is reported by using rigorous numerical methods.

Location: Parc Ballroom II
10:30 a.m. – 12:00 p.m.
IFD ■ Functional Microphotonic Devices
John D. O'Brien; Univ. of Southern California, USA.

IFD1 10:30 a.m. ►INVITED
All-optical manipulation of light on a Silicon chip, *Michal Lipson; Cornell Univ., USA.*
We demonstrate passive and active light manipulation on Silicon using compact strong light confining structures. We show high coupling efficiency between nano- and micron-size waveguides as well as all-optical switching using low energy pump pulses.

IFD2 11:00 a.m.
Low switching energy saturable absorber device for 40Gbit/s networks, *David Massoubre[1], J. L. Oudar[1], H. Choumane[1], G. Aubin[1], J. C. Harmand[1], A. Shen[2], J. Decobert[2], J. Landreau[2], B. Thédrez[2]; [1]CNRS/LPN, France, [2]Alcatel, France.*
All-optical regeneration devices based on semiconductor microcavity have been designed with different numbers of quantum wells inside. The switching energy is strongly dependent of the quantum well number.

IFD3 11:15 a.m.
Design and fabrication of diffractive optical elements using the sub-wavelength scale pillar array structure, *Masakatsu Hakamata, Hiroyuki Tsuda; Keio Univ., Japan.*
The diffractive optical element using the sub-wavelength scale pillar array structure is proposed. Fresnel lens with the focal length of 20mm using this structure is designed and fabricated. We estimate the characteristics of this lens.

IFD4 11:30 a.m. ►INVITED
2D photonic crystal membrane surface operation micro-nano-scale photonic devices, *Pierre Viktorovitch, Jean Louis Leclercq, Xavier Letartre, Pedro Rojo-Romeo, Christian Seassal; LEOM-CNRS, France.*
The physical concepts and tools for the extension of 2D Photonic Crystal to out of plane surface operation are presented. The case of the vertical emission Bloch Mode Micro-laser, formed in a 2D Photonic Crystal InP membrane, bonded onto silica on silicon, is emphasized.

12:00 p.m. – 1:30 p.m.
Lunch Break

Location: Parc Ballroom I

1:30 p.m. – 3:00 p.m.

IFE ■ Photonic Crystal Modeling

Susan Hagness; Univ. of Wisconsin, USA, Presider.

IFE1 1:30 p.m. ►INVITED

Bloch mode scattering matrix methods for modeling extended photonic crystal devices, *Lindsay Botten[1], A. A. Asatryan[1], T. N. Langtry[1], T. P. White[2], C. Martijn de Sterke[2], R. C. McPhedran[2]; [1]Univ. of Technology, Australia, [2]Univ. of Sydney, Australia.*

A rigorous semi-analytic approach to the modelling of coupling, guiding and propagation in complex microstructures embedded in photonic crystals is presented. The method, based on Bloch modes and generalized Fresnel coefficients, is outlined and a variety of applications of the design tool are presented.

IFE2 2:00 p.m.

Frequency-dependent finite-element time-domain analysis of metal-dielectric composite nanostructures, *V. F. Rodríguez-Esquerre[1], Masanori Koshiba[1], H. E. Hernández-Figueroa[2]; [1]Div. of Electronics and Information Engineering, Hokkaido Univ., Japan, [2]Dept. of Microwave and Optics, School of Electrical and Computer Engineering, Unicamp, Brazil.*

An efficient time-domain algorithm based on the finite-element method for the analysis of metal-dielectric nanostructures is presented. This approach uses the slowly wave variation approximation and includes the dispersion effects and losses by recursive convolution.

IFE3 2:15 p.m.

Finite-element method for nonlinear periodic optical waveguides and its application to photonic crystal circuits, *Takeshi Fujisawa, Masanori Koshiba; Hokkaido Univ., Japan.*

A finite-element method is newly formulated for the analysis of nonlinear periodic optical waveguides.Various PC waveguide structures are analyzed and their nonlinear modal properties are presented.

IFE4 2:30 p.m. ►INVITED

Yee-mesh-based finite difference eigenmode analysis algorithms for optical waveguides and photonic crystals, *Hung-Chun Chang, Chin-ping Yu; Natl. Taiwan Univ., Taiwan Republic of China.*

Eigenvalue equations for solving full-vector modes of optical waveguides are formulated using Yee-mesh-based finite difference algorithms. The effect of dielectric interface treatment on numerical accuracy is examined. The formulations are also applied to photonic crystal band diagram calculation.

Location: Parc Ballroom II

1:30 p.m. – 3:00 p.m.

IFF ■ Novel Waveguide Materials and Processes

Y. Chen; Univ. of Maryland, Baltimore County, USA, Presider.

IFF1 1:30 p.m. ►INVITED

Integrated components using single-crystal thin-film $LiNbO_3$, *Tomoyuki Izuhara; DuPont Photonics Technology, USA.*

Crystal ion slicing (CIS) can be used to fabricate single-crystal, microns-thick complex-oxide thin-films for fundamentally new integrated optic devices and structures. Here we describe the technology and device applications using CIS lithium niobate thin-films.

IFF2 2:00 p.m.

Buried planar and channel waveguides in sapphire and Ti:sapphire by proton implantation, *Laetitia Laversenne[1], Patrik Hoffmann[1], Markus Pollnau[1], Paul Morretti[2]; [1]Swiss Federal Inst. of Technology, Switzerland, [2]Claude Bernard-Lyon1 Univ., France.*

Buried, stacked planar, and channel waveguides fabricated by proton implantation into sapphire are demonstrated for the first time. The good control of implantation parameters is promising to achieve active integrated optics devices Ti^{3+}: sapphire.

IFF3 2:15 p.m.

Crystalline waveguides with exceptionally large electro-optic coefficients, *Michael W. Geis, Steven J. Spector, Theodore M. Lyszczarz; MIT Lincoln Lab., USA.*

By using graphoepitaxy single-crystal waveguides and Mach-Zehnder modulators have been fabricated in the electro-optic material DAST. These modulators have a sensitivity of 10 V mm, 5 to 10 times that of $LiNbO_3$ Mach Zehnder devices.

IFF4 2:30 p.m.
Low loss waveguides and embedded Bragg gratings in As_2Se_3 chalcogenide glass, *Nakeeran Ponnampalam[1], Ray G. DeCorby[1], Hue T. Nguyen[1], Prabhat K. Dwivedi[1], Chris J. Haugen[1], Jim N. McMullin[1], Robert M. Bryce[2], Safa O. Kasap[3]; [1]TRLabs Edmonton, Canada, [2]Ctr. for Nanoscale Physics, Canada, [3]Univ. of Saskatchewan, Canada.*
Shallow rib waveguides were fabricated in arsenic-triselenide chalcogenide glass by direct patterning with ultra-violet light. The Fabry-Perot method was used to measure the propagation loss. Preliminary characterization of holographically defined embedded Bragg gratings is presented.

IFF5 2:45 p.m.
Integrated combiner based on self-switching in quantum dots, *Evgeni A. Patent, J. J. G. M. van der Tol, P. R. A. Binetti, Q. Gong, Y. S. Oei, R. Nötzel, J. E. M. Haverkort, P. J. van Veldhoven, J. H. Wolter, M. K. Smit; Eindhoven Univ. of Technology, Netherlands.*
We demonstrate all-optical switching in quantum dots. The switching is studied in an integrated optical combiner circuit. This Mach-Zehnder interferometric device is aimed to avoid an unwanted 3-dB loss, fundamental in passive optical splitters.

Location: Parc Ballroom III
3:00 p.m. – 3:30 p.m.
Coffee Break

Location: Parc Ballroom I
3:30 p.m. – 4:45 p.m.
IFG ■ Polarization Control Devices
Mark Earnshaw; Lucent Technologies, Bell Labs, USA, Presider.

IFG1 3:30 p.m. ►INVITED
Reset-free integrated polarization controller using phase shifters, *Christi K. Madsen, Peter Oswald, Mark Cappuzzo, Evans Chen, Lou Gomez, Andrew Griffin, A. Kasper, Ed Laskowski, L. Stulz, Annjoe Wong-Foy; Bell Labs., USA.*
A reset-free polarization controller is proposed using silica-on-silicon waveguides and thermo-optic phase shifters that avoids the need for tunable polarization mode converters. A rotating quarter-wave-plate analog with an integrated polarimeter is demonstrated as a proof-of-concept.

IFG2 4:00 p.m.
Ultra-short waveguide polarization converter using a sub-wavelength grating, *Jingbo Cai, Jianhua Jiang, Gregory P. Nordin; Univ. of Alabama in Huntsville, USA.*
We proposed a new approach for realizing ultra-short waveguide polarization converter by employing form birefringence sub-wavelength air trench gratings slanted etched across waveguide. A rigorous and efficient design approach and a design example are presented.

IFG3 4:15 p.m.
Tuning the modal birefringence in waveguide devices, *Siegfried Janz, Pavel Cheben, Dan Dalacu, Andre Delâge, Boris Lamontagne, Marie-Josee Picard, Dan-Xia Xu, Winnie Ye; Natl. Res. Council Canada, Canada.*
We describe two new techniques for tuning local effective index birefringence in waveguides. Theoretical and experimental results for birefringence tuning using cladding stress in SOI, and form birefringence in silica and SOI waveguides are presented.

IFG4 4:30 p.m.
Polarization rotating waveguides in silicon on insulator, *Chris Brooks[1], Paul E. Jessop[1], Henghua Deng[2], David O. Yevick[2], Garry Tarr[3]; [1]McMaster Univ., Canada, [2]Univ. of Waterloo, Canada, [3]Carleton Univ., Canada.*
Polarization rotating waveguides based on a novel asymmetric geometry have been fabricated in the silicon on insulator material system. The fabrication process and preliminary results will be presented.

Location: Parc Ballroom II
3:30 p.m. – 4:30 p.m.
IFH ■ Novel Waveguide Components
Presider
Daniel Dapkus; Univ. of Southern California, USA, Presider.

IFH1 3:30 p.m. ►INVITED
Hollow silicon waveguides for integrated optics: Design concepts and design criteria, *R. Michael Jenkins, M. E. McNeil, A. F. Blockly, N. Price, J. McQuillan; QinetiQ Ltd., UK.*
Standard MEMS processes facilitate low-loss hollow waveguides (< 0.1dB/cm) and alignment slots for discreet components in silicon substrates. Designs concepts and design criteria for optical modules based on this new hybrid integration technology are described.

IFH2 4:00 p.m.

Compact arrowhead arrayed waveguide grating using v-bend optical waveguides, *Takanori Suzuki, Yutaka Shibata, Kenichi Masuda, Hiroyuki Tsuda; School of Integrated Design and Engineering, Graduate School of Science and Technology, Keio Univ., Japan.*
8-ch, 40 GHz-spacing, compact arrowhead arrayed waveguide grating using v-bend optical waveguides with elliptic integrated mirrors is proposed and fabricated. Its size is one-tenth of the conventional one.

IFH3 4:15 p.m.

Optical waveguide device for demultiplexing of free space waves from guided waves, *Kenji Kintaka[1], Junji Nishii[1], Junpei Ohmori[2], Yoshitaka Imaoka[2], Masaaki Nishihara[2], Shogo Ura[2], Ryohei Satoh[3], Hiroshi Nishihara[4]; [1]Natl. Inst. of Advanced Industrial Science and Technology, Japan, [2]Kyoto Inst. of Technology, Japan, [3]Osaka Univ., Japan, [4]The Univ. of the Air, Japan.*
Optical waveguide demultiplexer for wavelength-Div.-multiplexing chip-to-chip optical interconnecting board was fabricated by integration of guided-mode-selective focusing grating couplers and different-mode-coupling distributed Bragg reflectors. Two-channel demultiplexing with 5-nm wavelength spacing was demonstrated.