2013 18th OptoElectronics and Communications Conference (OECC 2013) held jointly with 2013 International Conference on Photonics in Switching (PS 2013)

Kyoto, Japan
30 June – 4 July 2013
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Location</th>
<th>Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:30-15:00</td>
<td>Plenary</td>
<td>Lecture Hall</td>
<td>Coherent optical communications past, present and future: &quot;Kazuro Kikuchi (The University of Tokyo, Japan)&quot;</td>
</tr>
<tr>
<td>13:00-16:00</td>
<td>Plenary</td>
<td>Lecture Hall</td>
<td>&quot;Photonics beyond diffraction limit: Plasmon waveguide, cavities and integrated laser circuits&quot; Xiang Zhang (University of California, USA)</td>
</tr>
<tr>
<td>16:00-16:30</td>
<td>Plenary</td>
<td>Lecture Hall</td>
<td>&quot;Ultrafast Metrology: New Applications of Femtosecond Laser Processing&quot; X. Zhang (University of California, USA)</td>
</tr>
<tr>
<td>18:30-19:00</td>
<td>Plenary</td>
<td>Lecture Hall</td>
<td>&quot;Optical Storage: Novel Phenomena and Related Technologies&quot; D. Z. Chen (University of California, USA)</td>
</tr>
<tr>
<td>19:00-19:30</td>
<td>Plenary</td>
<td>Lecture Hall</td>
<td>&quot;New Trends in Frequency Comb: Application of Femtosecond Laser Processing&quot; D. Z. Chen (University of California, USA)</td>
</tr>
<tr>
<td>00:00-24:00</td>
<td>Exhibition</td>
<td>Exhibition Area</td>
<td>Flat Panel Display Systems: Meet Exhibitors from all over the world!</td>
</tr>
</tbody>
</table>

**Program at a Glance**

<table>
<thead>
<tr>
<th>Day</th>
<th>Session</th>
<th>Location</th>
<th>Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun 30 Jul</td>
<td>Plenary</td>
<td>Lecture Hall</td>
<td>&quot;Coherent optical communications past, present and future: &quot;Kazuro Kikuchi (The University of Tokyo, Japan)&quot;</td>
</tr>
<tr>
<td>Mon 1 Jul</td>
<td>Plenary</td>
<td>Lecture Hall</td>
<td>&quot;Photonics beyond diffraction limit: Plasmon waveguide, cavities and integrated laser circuits&quot; Xiang Zhang (University of California, USA)</td>
</tr>
<tr>
<td>Tue 2 Jul</td>
<td>Plenary</td>
<td>Lecture Hall</td>
<td>&quot;Ultrafast Metrology: New Applications of Femtosecond Laser Processing&quot; X. Zhang (University of California, USA)</td>
</tr>
<tr>
<td>Wed 3 Jul</td>
<td>Plenary</td>
<td>Lecture Hall</td>
<td>&quot;Optical Storage: Novel Phenomena and Related Technologies&quot; D. Z. Chen (University of California, USA)</td>
</tr>
<tr>
<td>Thu 4 Jul</td>
<td>Plenary</td>
<td>Lecture Hall</td>
<td>&quot;New Trends in Frequency Comb: Application of Femtosecond Laser Processing&quot; D. Z. Chen (University of California, USA)</td>
</tr>
</tbody>
</table>

**Exhibition**

- Flat Panel Display Systems: Meet Exhibitors from all over the world!
### Oral, Sunday, June 30

<table>
<thead>
<tr>
<th>Room B-2</th>
<th>Room F</th>
<th>Room G</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SWA1</strong> 13:00 - 17:10 Workshop</td>
<td><strong>SA1</strong> 12:45 - 15:00 Symposium</td>
<td><strong>SWB1</strong> 12:30 - 15:00 Workshop</td>
</tr>
<tr>
<td><strong>Overview of Photon Frontier Network</strong></td>
<td>Laser Display I - Laser Technology</td>
<td>Optical Interconnects I: State-of-the-art Optical Interconnects: Moving from the Rack to the Chip</td>
</tr>
<tr>
<td>Kazuo Kuroda</td>
<td>Kuoji Kuroda</td>
<td>Organizers: Takaaki Ishigure (Keio Univ., Japan) Tsuyoshi Kishin (Koto Univ., Japan)</td>
</tr>
<tr>
<td>Center for Optics Research and Education</td>
<td><strong>SA1-2</strong> 13:30 - 14:00 Invited</td>
<td>Opening Remarks</td>
</tr>
<tr>
<td>Utsunomiya Univ., Tochigi, Japan</td>
<td>Blue and Green Nitride Based Laser Diodes for Projection</td>
<td>TBD</td>
</tr>
<tr>
<td>This presentation reviews the important issues on laser display including the requirement for lasers (lasing wavelength, power), some examples of laser display systems, and the issues on image quality especially speckle noise reduction technique.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SA1-3</strong> 14:00 - 14:30 Invited</td>
<td>Blue and Green Laser Diodes for Large Laser Display</td>
<td><strong>SWB1-1</strong> Optical Interconnect for Current and Future Computers</td>
</tr>
<tr>
<td>Shingo Masui, Takashi Miyoshi, Tomoya Yamanoto and Shinichi Nagahama</td>
<td>Shingo Masui, Takashi Miyoshi, Tomoya Yamanoto and Shinichi Nagahama</td>
<td>Shigeto Nakaoka</td>
</tr>
<tr>
<td><strong>SA1-4</strong> 14:30 - 15:00 Invited</td>
<td>Compact Yellow-Orange Raman Lasers</td>
<td><strong>SWB1-2</strong> Migration of Embedded Electro-optical Interconnect Technologies into Data Centre Systems</td>
</tr>
<tr>
<td>Susumu Noda</td>
<td>T. Omatsu</td>
<td>R. Plaxon</td>
</tr>
<tr>
<td><strong>SA1-5</strong> 15:00 - 15:30 Invited</td>
<td>Recent Advances in Laser Based Coherent Photon Technology and Science</td>
<td><strong>SWB1-3</strong> Compact and Power-efficient CMOS Optical Interconnect Technologies for ICT System</td>
</tr>
<tr>
<td>Malako Gionna</td>
<td>T. Omatsu</td>
<td>T. Takemoto</td>
</tr>
<tr>
<td><strong>SA2</strong> 12:45 - 13:30 Tutorial</td>
<td>Laser Display Technologies: Light Sources and Systems</td>
<td><strong>SWB1-4</strong> High-density Polymer Waveguides for Chip-to-chip Optical Interconnection</td>
</tr>
<tr>
<td>Kazuo Kuroda</td>
<td>Kuoji Kuroda</td>
<td>Aki Sugama</td>
</tr>
<tr>
<td>Center for Optics Research and Education</td>
<td>Center for Optics Research and Education</td>
<td></td>
</tr>
<tr>
<td>Utsunomiya Univ., Tochigi, Japan</td>
<td>Utsunomiya Univ., Tochigi, Japan</td>
<td></td>
</tr>
<tr>
<td><strong>SA2-1</strong> 12:30 - 13:00 Invited</td>
<td>Exploring of Photon Science with High Power Laser</td>
<td><strong>SWB1-5</strong> Recent Advances in Laser Based Coherent Photon Technology and Science</td>
</tr>
<tr>
<td>Ryosuke Kodama</td>
<td>Y. Kaneda</td>
<td>Malako Gionna</td>
</tr>
<tr>
<td>Osaka Univ. &amp; JAEA, Japan</td>
<td>Osaka Univ. &amp; JAEA, Japan</td>
<td>Osaka Univ. &amp; JAEA, Japan</td>
</tr>
<tr>
<td><strong>SA2-2</strong> 13:00 - 13:30 Invited</td>
<td>Ultrahigh-precision Coherent Control at the Quantum-classical Boundary</td>
<td><strong>SWB1-6</strong> Recent Advances in Laser Based Coherent Photon Technology and Science</td>
</tr>
<tr>
<td>Kenji Ohnori</td>
<td>Y. Kaneda</td>
<td>Malako Gionna</td>
</tr>
<tr>
<td>Inst. for Molecular Science, Japan</td>
<td>Osaka Univ. &amp; JAEA, Japan</td>
<td>Osaka Univ. &amp; JAEA, Japan</td>
</tr>
<tr>
<td><strong>SA2-3</strong> 13:30 - 14:00 Invited</td>
<td>Photonic Crystal Lasers</td>
<td><strong>SWB1-7</strong> Recent Advances in Laser Based Coherent Photon Technology and Science</td>
</tr>
<tr>
<td>Susumu Noda</td>
<td>T. Omatsu</td>
<td>Malako Gionna</td>
</tr>
<tr>
<td>Kyoto Univ., Japan</td>
<td>T. Omatsu</td>
<td>Osaka Univ. &amp; JAEA, Japan</td>
</tr>
</tbody>
</table>

**Opening Remarks**

MEXT
<table>
<thead>
<tr>
<th>Room I</th>
<th>2F</th>
<th>Oral, Sunday, June 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>[SWC1] 12:30 - 15:00 Workshop</td>
<td>Future Perspective of Photonic Transport Network I: Beyond 100G Technologies and Standardization</td>
<td>Organizers: Toshiya Matsuda (NTT Corporation, Japan), Toshiko Hirooka (Tohoku Univ., Japan), Hidehiko Takara (NTT Corporation, Japan)</td>
</tr>
<tr>
<td>SWC1-1</td>
<td>Standardization Activities on Next Generation 100GbE and beyond for Future Small Form Factor Optical Transceiver for High-density and High-bandwidth Client Side Optical Interfaces Enabling Multi-Tbps Front Panel Bandwidth</td>
<td>Ryokozi Hiramoto, Daiden, Japan</td>
</tr>
<tr>
<td>SWC1-2</td>
<td>Next Generation DSP for beyond 100G</td>
<td>Etsushi Yamazaki, NTT, Japan</td>
</tr>
<tr>
<td>SWC1-3</td>
<td>Next Generation Transponder and System Design</td>
<td>Maxim Kuschnerov, NSN Optical GmbH, Germany</td>
</tr>
<tr>
<td>SWC1-4</td>
<td>Flexible Modulation Formats in Next-generation Packet-optical Transport Systems</td>
<td>Dirk van den Borne, Juniper, Germany</td>
</tr>
<tr>
<td>SWC1-5</td>
<td>Elastic Optical Network Design: What Impacts are Brought by Flexible Grid</td>
<td>Motohiro Genya, Fujitsu Labs of America, USA</td>
</tr>
<tr>
<td>SWC1-6</td>
<td>MIMO and OFDM for 100Gb/s and Beyond Long-Haul Transmission</td>
<td>Neda Cvjetic, NEC Labs. America, USA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Room J</th>
<th>2F</th>
</tr>
</thead>
<tbody>
<tr>
<td>[SWD1] 12:30 - 18:00 Workshop</td>
<td>Software Defined + Elastic Optical Networks =?</td>
</tr>
<tr>
<td>SWD1-1</td>
<td>Migration to Software-defined Transport Networks</td>
</tr>
<tr>
<td>SWD1-2</td>
<td>Packet Optical Convergence</td>
</tr>
<tr>
<td>SWD1-3</td>
<td>Positioning An Optical Transport in Carrier’s SDN</td>
</tr>
<tr>
<td>SWD1-4</td>
<td>Software Defined Elastic Optical Networks Using OpenFlow</td>
</tr>
<tr>
<td>SWD1-5</td>
<td>Standardization Activities around Software Defined Networking and OpenFlow</td>
</tr>
</tbody>
</table>

| Room K | 2F | Oral, Sunday, June 30 |

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1. UC Davis, USA, 2. KDDI R&D Labs., Japan, 3. Ericsson Research Silicon Valley, USA, 4. Ericsson Research, USA
### SWA1 - 13:00 - 17:10

**Room B-2**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker(s)</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:00 - 13:10</td>
<td><strong>Closing Address</strong></td>
<td>Tsutomu Yabuzaki</td>
<td>Program Officer of Photon Frontier Network</td>
</tr>
<tr>
<td>13:15 - 15:30</td>
<td><strong>Recent Progress on High Harmonic Generation and Application at RIKEN</strong></td>
<td>Koichiro Tanaka, Kenji Tamasaku</td>
<td>RIKEN, Advanced Science Inst., Japan</td>
</tr>
<tr>
<td>15:30 - 15:45</td>
<td><strong>Nonlinear Optics in the Hard X-ray Region</strong></td>
<td>Koichiro Tanaka</td>
<td>RIKEN, Advanced Science Inst., Japan</td>
</tr>
<tr>
<td>15:45 - 16:00</td>
<td><strong>Terahertz Nonlinear Spectroscopy</strong></td>
<td>Koichiro Tanaka, Akihiro Nagase</td>
<td>Kyoto Univ., Japan</td>
</tr>
</tbody>
</table>

### SWA2 - 15:30 - 18:15

**Room F**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker(s)</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:30 - 15:45</td>
<td><strong>Advanced Speckle Contrast Reduction by Moving Diffuser</strong></td>
<td>S. Kubota and Y. Tomita</td>
<td>Osaka Corp., Yokohama, JAPAN</td>
</tr>
<tr>
<td>15:45 - 16:00</td>
<td><strong>Speckle Dynamics in Laser Navigating Devices:</strong> Translation in Non-Paraxial Area</td>
<td>Victor Yurkov, Boris Kirdiov, Yeoung Kim</td>
<td>Samsung Electro-Mechanics Co., Ltd., Korea</td>
</tr>
<tr>
<td>16:00 - 16:15</td>
<td><strong>Laser Displays Using Scanning Optical Fiber</strong></td>
<td>Brian Schowengerst, Eiji Niikura</td>
<td>Washington Univ., USA</td>
</tr>
<tr>
<td>16:15 - 16:30</td>
<td><strong>Laser Backlighting LCD TV</strong></td>
<td>Nami Nakano, Eiji Nakura, Riena Muvosa, Atsuko Nagase, Masakazu Hana, Tomohiro Sawagawa, Koji Mimami</td>
<td>Mitsubishi Electric Corporation, Kyoto, Japan, Kyoto Works, Mitsubishi Electric Corporation, Japan</td>
</tr>
</tbody>
</table>

### SWA3 - 15:30 - 18:00

**Room G**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker(s)</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:30 - 15:45</td>
<td><strong>Optics in Servers and Computers: Challenges and Opportunities</strong></td>
<td>H.J.S. Domen</td>
<td>COBRA, Eindhoven Univ. of Technology, The Netherlands</td>
</tr>
<tr>
<td>15:45 - 16:00</td>
<td><strong>Scalability of VCSEL Arrays for Ultra-dense Chip-to-chip Optical Interconnects</strong></td>
<td>Werner Hofmann</td>
<td>Technical Univ. of Berlin, Germany</td>
</tr>
<tr>
<td>15:45 - 17:15</td>
<td><strong>III/V-on-Si Hybrid Lasers and Modulators for Optical Interconnects</strong></td>
<td>J.E. Bowers</td>
<td>UCSB, USA</td>
</tr>
<tr>
<td>15:45 - 17:15</td>
<td><strong>Photonic Crystal Lasers for Optical Interconnects</strong></td>
<td>Koji Takeda, Shinji Matsuo</td>
<td>NTT Photonics Labs, Nanophotonics Center, NTT Corporation, Japan</td>
</tr>
<tr>
<td>15:45 - 17:15</td>
<td><strong>Nanometallic Lasers for Optical Interconnects</strong></td>
<td>V. Diorea-Calzadello, D. Hees, A. Fone, M. K. Smit</td>
<td>COBRA Research Inst., Eindhoven Univ. of Technology, The Netherlands</td>
</tr>
<tr>
<td>Room I</td>
<td>SWC2-1</td>
<td>Oral, Sunday, June 30</td>
<td></td>
</tr>
<tr>
<td>---</td>
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<td></td>
</tr>
<tr>
<td>[SWC2] 15:30 - 18:00</td>
<td>Recent Progress in Multicore Fibers for Large Capacity SDM</td>
<td>Room I 2F</td>
<td></td>
</tr>
<tr>
<td>Invited</td>
<td>Kunihisa Saito 1, Masanori Koshiba 1, Katsuhiko Takenaga 1 and Shin-ichi Matsuura 1</td>
<td>Workshop</td>
<td></td>
</tr>
<tr>
<td>1 Hokkaido Univ., Japan, 2 Fujikura, Japan</td>
<td>Future Perspective of Photonic Transport Network II: Space Division Multiplexing for Petabit / Fiber Transmission</td>
<td>Organizers: Yoshiya Matsuda (NTT Corporation, Japan) Toshitiko Hirooka (Tohoku Univ., Japan) Hitachi Ltd. (NTT Corporation, Japan)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Room J</th>
<th>SWD1-6</th>
<th>Invited</th>
</tr>
</thead>
<tbody>
<tr>
<td>[SWD1] 12:30 - 18:00</td>
<td>Software Defined + Elastic Optical Networks = ?</td>
<td>Room J 2F</td>
</tr>
<tr>
<td>Organizers: Soichiro Araki (NEC, Japan) Hironori Harai (NICT, Japan)</td>
<td>Planning Tools for Off-line and On-line Flexgrid-based Core Networks</td>
<td>Luis Velasco</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Room K</th>
<th>SWE2</th>
<th>Invited</th>
</tr>
</thead>
<tbody>
<tr>
<td>[SWE2] 15:30 - 18:00</td>
<td>What will be Killer Devices and Components for the Next-Generation Optical Access Networks?</td>
<td>Room K 2F</td>
</tr>
<tr>
<td>Organizers: Vedha Covic (NEC Laboratories of America, USA) Naoko Yoshimoto (NTT Access Network Service Systems Laboratories, Japan)</td>
<td>Cost Issues from an Operator's Viewpoint</td>
<td>Kota Asaka</td>
</tr>
</tbody>
</table>

### SWC2-2

**Invited**

**Multicore EDFA for Space Division Multiplexing**

Yukihiko Tsuchida, Kiochi Maeda, Masatoshi Tada, and Ryoichi Gushiki

Furukawa Electric, Japan

### SWC2-3

**Invited**

**Few-mode Doped Fibers for SDM Amplifiers**

Massimiliano Saldai

Alcatel Lucent, France

### SWC2-4

**Invited**

**Large Capacity Multicore Transmission Technologies**

Athilde Sano

NTT, Japan

### SWC2-5

**Invited**

**Long Distance Multicore Fiber Transmission**

Hidenori Takahashi

KDDI R&D Labs., Japan

### SWC2-6

**Invited**

**Recent Progress within the EU Project FP7 IST Modegap**


Eindhoven Univ., The Netherlands

### SWC2-7

**Invited**

**Heterogeneous Multicore Fiber for Record Petabit/s Transmission at over 100 Gb/s/Hz**

Eva Go, Min-Min Liu 1, 2

1 NEC Lab. America, USA, 2 Corning, USA

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**Panel Discussion**

Moderator: Yoshiya Matsuda (Technical Univ. of Denmark, Denmark)
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker</th>
<th>Institution</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 - 8:50</td>
<td>Opening Remarks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:50 - 12:30</td>
<td>Plenary Session</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>8:50 - 9:30</td>
<td>Higgs Boson: Dawn of Physics to Explore the Vacuum</td>
<td>Shoji Asai</td>
<td>Department of Physics, Graduate School of Science, The University of Tokyo, Japan</td>
<td>Yuichi Matsushima (Waseda University, Japan)</td>
</tr>
<tr>
<td>9:30 - 10:10</td>
<td>Space-division Multiplexing – Do We Have a Choice?</td>
<td>Mark D. Feuer</td>
<td>AT&amp;T Labs - Research, USA</td>
<td>Ken-ichi Kitayama (Osaka University, Japan)</td>
</tr>
<tr>
<td>10:30 - 11:10</td>
<td>Toward the Smallest Possible Laser &amp; Resonator</td>
<td>Yong-Hee Lee</td>
<td>Department of Physics, Korea Advanced Institute of Science and Technology (KAIST), Korea</td>
<td>Yoshiaki Nakano (University of Tokyo, Japan)</td>
</tr>
<tr>
<td>11:10 - 11:50</td>
<td>Coherent Optical Communications: Past, present and Future</td>
<td>Kazuro Kikuchi</td>
<td>Department of Electrical Engineering and Information Systems, The University of Tokyo, Japan</td>
<td>Masafumi Koga (Oita University, Japan)</td>
</tr>
<tr>
<td>11:50 - 12:30</td>
<td>Photonics Beyond Diffraction Limit: Plasmon Waveguide, Cavities and Integrated Laser Circuits</td>
<td>Xiang Zhang</td>
<td>Department of Mechanical Engineering, University of California, Berkeley, USA</td>
<td>Susumu Noda (Kyoto University, Japan)</td>
</tr>
</tbody>
</table>
Oral, Monday, July 1

**Room C-1** 1F

**[MR1]** 14:00 - 16:00  
Modulation Format  
Session Chair: Akio Sekine (NTT Corporation, Japan)

**MR1-1** 14:00 - 14:30  
Limited  
High Capacity Multi-Mode Transmission Systems Using Higher-Order Modulation Formats  
V. Atakan, T. van der Velden, F. Poletti, P. Leoni, P. Kociou, R.G.H. van der Velden, V. V. Veparnovskii, L. Gröner Nielsen, Y. Sun, D.J. Richardson, B. J. A. Lam, F. Poletti, B. Corbett, A. Winfield, and H. A. van Walsum

**MR1-2** 14:30 - 14:45  
1 Tbit/s 256 QAM-OFDM transmission over 500 km with 14.3 bits/s/Hz spectral efficiency  
Takuta Minami, Masato Yoshida, and Masataka Nakazawa

**MR1-3** 14:45 - 15:00  
Compensation of Constellation Distortion due to Imbalance of Delay Detection in Incoherent Optical QAM Signaling  
Kohei Mandai and Nobuho Kikuuchi

**MR1-4** 15:00 - 15:15  
Multi-channel generation and reception of Nyquist-WDM using digital DFTs  
Liang B. Du and Arthur J. Lowery

**MR1-5** 15:15 - 15:30  
Traceback Equalization against Modulation Non-Uniformity in QAM Transmitters  
T. Sakamoto, G. W. Lu, and T. Kawashita

**MR1-6** 15:30 - 15:45  
Spectrally Efficient Modulation Based on SINC Waveform And Its Practical Implementation Using Waveform Truncation  
Hideto Suzuki

**MR1-7** 15:45 - 16:00  
Optimization of Discrimination Filters for Orthogonal Time-Frequency Domain Demultiplexing  
T. Sakamoto, H. P. Scott, and S. B. J. Yoo

**Room C-2** 1F

**[MH1]** 14:00 - 16:00  
New Frequency-Locked and LDE-Insensitive Works on Wideband Semiconductors-I  
Session Chair: Hidetoshi Hayakawa (Riken, Japan)

**MH1-1** 14:00 - 14:30  
LDE-based VCSEL fabricated on Nonpolar GaN Substrates  
Shuji Nakamura

**MH1-2** 14:30 - 15:00  
AlGaInP Deep Ultraviolet LEDs with External Quantum Efficiency Over 10%  
Max Shabade, Jet Wang, Yun Bolenko, Michael Shur, and Remi Gaska

**MH1-3** 15:00 - 15:30  
Development of AlGaN DUV-LED  
Masahito Ipomomoto, Akira Hirano, Isamu Akasaka, and Hiroshi Amano

**MH1-4** 15:30 - 16:00  
Recent Progress on Green Laser Diodes  
Naoki Nakamura

**Room F** 1F

**[MA1]** 14:00 - 16:00  
Single-Frequency and Stabilized Lasers  
Session Chair: Yuji Oki (Kyushu Univ., Japan)

**MA1-1** 14:00 - 14:30  
Fiber Amplifiers for Gravitational Wave Detection  
P. Wellem, M. Karow, V. Kuhn, M. Steinke, H. Tünnermann, D. Knipp, J. Kraus, and J. Neumann

**MA1-2** 14:30 - 14:45  
170 W single-frequency single-mode polarization maintaining fiber amplifier  
L. Zhang, S. Cai, C. Liu, J. Zhou, and Y. Feng

**MA1-3** 14:45 - 15:00  
Power High 1178 nm Single-Frequency MOPA based on OP-SDL and PBGF  
Mingchong Chen, Wenzhi Fan, Akihisa Kikuna, T. Morikawa, E.patibility of fiber modal cross-talk, enabling ultrafast OTFDM approach to single frequency laser (such as in terms of output power and stability. We discuss current approaches to fulfill these requirements using high-power single-frequency fiber amplifiers.

**MA1-4** 15:00 - 15:15  
Single-frequency Nanosecond Fiber Laser Based on Self-Phase Modulation Pre-Compensation  
Rongzao Su, Yu Zhou, Xiaohao Wang, Haining Zhang and Xiaolin Xu

**MA1-5** 15:15 - 15:30  
Wavelength-swept Single Longitudinal Mode Fiber Ring Laser Locked to 25 GHz ITU Grid  
Chengliang Yang, Li Xia, Yanwen Wang and Deming Liu

**MA1-6** 15:30 - 15:45  
All Polarization-Maintaining Fiber Erbium Frequency Combs for Stable Long-Term Operation  
I. Coddington, L. C. Sinclair, W. S. Swann, and N. R. Newbury

**MA1-7** 15:45 - 16:00  
Temperature Stabilization of Yb-Doped Fiber Mode-Locked Oscillator for Long-Term Stable Passive Two-Color Synchronization  
Dar Yoshitomi, and Kenji Torizuka

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Details on the presentations and authors can be found in the attached documents and the program.
### Room J

**Meeting Chair:** Katsunori Inoue

**14:00 - 15:30**
**Multi-Core Fiber Technology**

**14:00 - 14:15**
**Power Coupling Distribution Characterization using Bi-Directional OTDR Waveform**

Kazumasa NAKAJIMA, Yukiho SOTÓ, Motoharu MATSUO, Hiroshi OHASHI, and Naoto KISHI

Access Network Systems Labs., NTT Corporation, Japan

**14:15 - 14:30**
**Influence of Multi-Core Crosstalk on Far-Field Pattern Measurement**

Kazumasa NAKAJIMA, Chikara FUJII, Yukiho SOTÓ, and Motoharu MATSUO

Access Network Service Systems Labs., NTT Corporation, Japan

**14:30 - 14:45**
**Cutoff Wavelength Measurement of Two Core Multi-core Fiber**

R. Okada, M. Fukami, M. Ohashi, and Y. Mysyuk

Osaka Prefecture Univ., Osaka, Japan

A multi-core fiber (MCF) cut-off wavelength using multimode-reference technique is simulated. The cutoff wavelength of two core MCF is successfully estimated by our present technique.

**14:45 - 15:00**
**High Density and Low Cross Talk Design of Heterogeneous Multi-Core Fiber with Air Hole Assisted Double Cladding**

Tatsukito Mitaobane, Yosuok Kobukun

Graduate school of Eng., Yokohama Nat’l Univ., Yokohama, Japan

A novel high-density heterogeneous uncoupled multi-core fiber was designed using an air hole assisted double cladding structure. Low cross talk of -65 dB at 100 km transmission and identical dispersion characteristics for all cores can be obtained.

**14:50 - 15:05**
**Optimized Design Method for Heterogeneous Trench-assisted Multi-core Fiber**

Jingfu Tu, Kunimasa Goto, Masanori Nazamia, Katsuo Takayanagia, and Shouichiro Matso

1Division of Media and Network Technologies, Hokkaido Univ., Sapporo, Japan

2Optics and Electronics Laboratory, Fukui Univ., Fukui, Japan

By designing the cores, trench layers and core number, we propose a relative optimized design scheme for heterogeneous trench-assisted multi-core fiber (Trench-MCF), which is a bend-insensitive MCF with high density of cores and low crosstalk.

**14:55 - 15:30**
**Closely Packed Multicore Fibers with Zero Differential Group Delay**

Kim Soong-Chang, Jin Min-Liu, and Yan Dan

1Dept. of Electronic Engineering, City Univ. of Hong Kong, Hong Kong SAR, China

2College of Communication Engineering, Chongqing Univ., Chongqing, China

There exists a simple approximation condition for general homogeneous multicore fibers to achieve zero differential group delay (DGD). The zero-DGD wavelength can be controlled effectively by introducing a reflective index dip in the cores.

### Room K

**Meeting Chair:** Hidetoshi Fukuda

**14:00 - 16:00**
**Optical Signal Processing I**

**14:00 - 14:15**
**Optical Grooming of 20Gbps OOK and 40Gbps DPSK Signals in PPLN Waveguide**

Seung-Ha Kim, Hyun-Young Seo, and Ji-Young Jung

3School of Electrical Engineering and Computer Science, Korea Advanced Institute of Science and Technology, Daejeon, Korea

A simple PPLN-based, integratable and wavelength preserving scheme to all-optically groom a 20Gbps OOK and a 40Gbps DPSK into a 20Gbaud 8-APSK signal, is presented and experimentally demonstrated. Performances are provided through BER measurements.

**14:15 - 14:30**
**Wavelength Conversion of 36GHz through Four-Wave Mixing in HNLF**

Gao Min-Min Lu, Chien-Ming Hseu, and Tetsuya Kawanishi

1National Inst. of Informatics and Communication Technology (NICT), Japan

We experimentally demonstrate wavelength conversion of a 50-Gbps 36GHz using four-wave mixing in highly nonlinear fiber. A wide operating range and wavelength of the converted signal remains same as that of input.

**14:30 - 14:45**
**NRZ-DPSK to RZ-DPSK Format Conversion with Wavelength Shift Free and Pulswidth Tunable Operations**

Ezio Alimichetti, Shigeki Yamasaki, and Hiroshi Watanabe

2Dept. of Communication Engineering and Informatics, The Univ. of Electro-Communications, Tokyo, Japan

We demonstrate novel NRZ-DPSK to RZ-DPSK format conversion. In this scheme, pulswidth of the converted signal can be flexibly changed in a wide operating range and wavelength of the converted signal remains same as that of input.

**14:45 - 15:00**
**Invited Session**

**15:00 - 15:15**
**Spontaneous Emission Faster than Stimulated Emission**

Ei Yamamoto and Ming C. Wu

Univ. of California, Berkeley, Electrical Engineering & Computer Sciences, Berkeley, California, USA

With an optical antenna, spontaneous emission can be faster and stimulated emission allow, directing modulation LED’s for optical interconnects. We will show the evidence for 35% spontaneous emission enhancement by an optical antenna.

**15:10 - 15:30**
**All-Optical WDM-to-OTDM Conversion Based on Supercontinuum Generation in a Highly Nonlinear Fiber**

Quang Nguyen-The, T. Kawasaki, Mototsugu 1, and Kazuo Kita 2

1Dept. of Communication Engineering and Informatics, Center for Frontier Science and Engineering, The Univ. of Electro-Communications, Tokyo, Japan

An all-optical format conversion from 4x10 Gbps WDM to 40 Gbps OTDM by using supercontinuum generation in a highly nonlinear fiber is demonstrated. Less than 2 dB power penalty is obtained after the OTDM demultiplexing.

**15:30 - 15:45**
**Dispersion Tolerance of All-Optical Modulation Format Conversion from NRZ-D0K to RZ-QPSK Using XPM in Nonlinear Fiber**

Weiming Yao, Kenichi Tsuchiya, Akihito Tomakina, and Akira Manita

Graduate School of Engineering, Osaka Univ., Osaka, Japan

We experimentally investigated the dispersion tolerance of transmitted NRZ-D0K signals for all-optical NRZ-D0K to RZ-QPSK modulation format conversion using XPM in nonlinear fiber at 1550 nm by using BER evaluation of the converted performance.

**15:45 - 16:00**
**Removal of Local Frequency Fluctuation in Distributed Cooperative-OFDM System**

Tosukeya Kato, Ryoko Oka, Takeshi Saito, and Robert Eisler

EADS, Θήρα, Greece

We demonstrate the removal of local frequency fluctuation fluctuations in a distributed cooperative orthogonal frequency-division multiple access (CoOFDM) system for 40 Gbps XPM subsystems at symbol rate speeds to multiplexed 100 GbE OFDM without DBP penalty.

### Room 101

**Meeting Chair:** Peter Koetse

**14:00 - 16:00**
**High Power Lasers and Applications I**

**14:00 - 14:15**
**All Diode-Pumped 20-TW Laser System for DD Fusion Experiments**

Takahito Shime, Kuma Kato, Yoichi Yamasaki, and Toshiyuki Kawashima

Hamamatsu Photonics K. K., Shizuoka, Japan

We experimentally demonstrated a 20-TW ThCP laser system, which was used as a pump source. One of application of high intensity laser neutron generation by cluster fusion has been demonstrated.

**14:15 - 14:30**
**Multi-joule Non-colinear OPCPA At 800nm in Yttrium Calcium Oxoborate**

Kenji Kojima, Tsuyoshi Murai, Motoharu Saitoh, Tatsuya Ishikawa, Ondrej Pavlake, Akira Endo, Tomio Mochida

1ALASE Project, Inst. of Physics AS CR, Prague, Czech Republic

2Technical Univ. in Prague, Prague, Czech Republic

We have obtained 30-mJ output at 1-kHz YTF1 thin disk regenerative amplifier. By applying pulsed pumping method, we improved the efficiency from 12% to 19%, and obtained a higher output limited by 34-mJ output.

**14:30 - 14:45**
**Present Status of Laser Development for the Intense Laser-Compton Gamma-Ray Source at JAEA**

Mitsuhiko Morik, Azusa Itoh, Ayumi Seki, Rei Hatori, Hiroyuki Koyanagi, Yoshinori Ochi, Morikazu Sakaue, and Kazutaka NAGASAWA

Advanced Laser development group, Quantum Beam Science Directorate, Japan Atomic Energy Agency, Kyoto, Japan

We report on present status of high average power and high repetition rate short pulse laser development include laser storage cavity (i.e. Enhancement cavity) for nondestructive detection of isotopes using Laser-Compton gamma-rays.

**14:45 - 15:00**
**Relativistic Mirrors for Photon-Photon Scattering**

J. K. Koga, T. H. Ishikawa, A. S. Pirouznikov, M. Kardan, and N. R. Yaroslav

Quantum Beam Science Directorate, JAEA, Kyoto, Japan, Prosympt Lab. of General Physics, Russian Academy of Sciences, Moscow, Russia, Institute of Laser Physics, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia

Relativistic mirrors generated in laser plasma interactions can enable the detection of photon-photon scattering. They can up-shift and forward focus optical laser pulses to this x-ray regime. We find that photon-photon scattering events can be observed.

**14:50 - 15:15**
**High-Order Harmonics from Gas-Target Irradiated by Relativistically-Intense Laser**

M. Karapetjants, M. S. Zajicek, T. Zhe, E. Kienle, A. S. Pirouznikov, M. Kardan, and N. R. Yaroslav

Quantum Beam Science Directorate, JAEA, Kashiwa, Japan, The Graduate School for the Creation of New Photonics Industries, Shizuoka, Japan

We experimentally demonstrated an efficient production of high-order harmonics from gas targets irradiated by relativistically intense laser pulses.

**14:55 - 15:45**
**The Effect of Photo-Neutrons on Diagnostics CR-39 for Laser-Accelerated Ion Beam**

Masahide Sawada, Akira Tsukada, Kenji Hasegawa, Kenji Itsuki, Shinya Yamanaka, and Tetsuya Yamada

1Graduate School of Materials Science, Aoyama Univ, Koto, Tokyo, Japan

2Institute of Laser Engineering, Osaka University, Osaka, Japan

We have developed a suitable configuration for CR-39 CR to detect only laser-accelerated ions with less contamination by X-ray bremsstrahlung from ions and laser wakefield that is followed by photo-neutron reactions using Martins Carb simulators.
MK1-1  14:00 - 14:15

Operating wavelength range of 25.8-Gb/s 1.3um DML extended to 30 nm

We experimentally demonstrated a 30 nm operating wavelength range for a 1.3um InGaAlAs DML with a 25.8-Gb/s push-pull driving configuration. Clear eye opening was >20dB at bit error rate of 1xE-12 power, and a 4.0-dB dynamic extinction ratio were obtained.

MK1-2  14:15 - 14:30

Novel Hybrid-Waveguide EMLs for 100 Gb/s CFP2-Transceivers

Y. Yasui, T. Nomura, Y. Hikami, H. Ueno, and S. Tabata

NTT Photonics Laboratories, Atsugi, Japan

We designed and fabricated the novel hybrid-waveguide EMLs for 100 Gb/s CFP2-Transceivers. This new type of EML has two identical and independent waveguides in the EML chip, which enable us to achieve high-speed operation with a simple device structure.

MK1-3  14:30 - 14:45

4x25-Gb/s EADFB Laser Array Monolithically Integrated with Cascaded Mach-Zehnder Multipliers

T. Fujishita, S. Kanaanawa, Y. Udaka, W. Kobayashi, K. Takahata, A. Takenaka, and H. Itoh

NTT Photonics Laboratories, Atsugi, Japan

We developed a 40-channel 4x25-Gb/s EADFB laser array chip monolithically integrated with a cascaded Mach-Zehnder multiplier. In this study, we improved the temperature dependence of the operational wavelength by using a wideband grating pair for external cavity feedback.

MK1-4  14:45 - 15:00

Compact 100GbE Transmitter Optical Sub-Assembly using Polarization Beam Combiner


NTT Photonics Laboratories, Atsugi, Japan

We have developed a compact 100GbE transmitter optical sub-assembly using an optical module with a polarization beam combiner (PBC). This module demonstrates excellent performance in terms of polarization-dependent issues such as polarization-dependent gain and extinction ratio.

MK1-5  14:50 - 14:55

A Compact 44.6 Gbps 1.55-μm EML TOSA Employing Three-Layer PFP Connection

M. Kakinuma, Y. Ohki, K. Ueda, T. Fujishita, S. Kanaanawa, and H. Ueno

NTT Photonics Laboratories, Atsugi, Japan

We have developed a compact 44.6 Gbps 1.55-μm EML TOSA employing a three-layer PFP connection for 100GbE applications. This TOSA achieves a low insertion loss of 5 dB and a low polarization-dependent loss of <0.1 dB with a high extinction ratio of 19 dB.

MK1-6  15:00 - 15:15

24 Gb/s Synthesis of BPSK signals via Direct Modulation of Fabry-Perot Lasers under Injection Locking

R. Skiv, J. Jakes, R. Reiter, J. O’Dowd, B. Kelly, and D. Richardson

QRAC, Univ. of Southampton, Southampton, UK, 3LD Labs, Alcatel-Lucent, Heidelberg, USA, 3LABS, Dublin, Ireland, HP Laser & Photonics, Dublin, Ireland

We present a novel approach to the synthesis of 24 Gb/s BPSK signals via direct modulation of dye lasers under injection locking. This technique allows for high-speed, low-cost, and flexible data transmission applications.

MK1-7  15:10 - 15:25

High Efficiency Wavelength Conversion of 40 Gb/s OOK and DPSK with Good Stability

Yuksan Park, D.B. Wadhera, L. Hesselink, and M. Iselin

Am I Am Anti-Site Centre d’Optique, Photonique et Laser (CQPL), ECE Dept., Universit Laval, Quebec, Canada

We demonstrate a high-efficiency wavelength conversion scheme using a quantum-dot mode-locked laser pumped for 10 Gb/s OOK and 4 Gb/s DPSK data. The conversion efficiency is measured to be 83% with low cavity losses.

MK1-8  15:20 - 15:35

Compensation Technique for Distorted QAM Signal Constellations Generated by Semiconductor IQ Modulators

Y. Yokoyama and N. Kikuchi

Hitachi, Ltd., Central Research Laboratory, Kanagawa, Japan

We have proposed a novel digital signal processing based compensation technique for the distortion of QAM signal constellations. This method has been successfully proven to improve the eye vector magnitude.

Oral, Monday, July 1

MK1-1  14:00 - 15:30

Session Chair: Hajime Shoji (Sumitomo Electric Industries, Ltd., Japan)

MK1-2  15:30 - 15:45

High-Speed Transmitter

Hitachi, Ltd., Central Research Laboratory, Tokyo, Japan, Mitsubishi Electric Corporation, Kamakura, Japan,

We demonstrated a 100 Gbps 25 Gb/s 1.3 μm EML TOSA with a 10 nm wavelength range.

MK1-3  15:45 - 15:50

Electro-optic Mach-Zehnder Interferometer

Kato T., Ogasawara T., and Tanaka K.

NTT Photonics Laboratories, Atsugi, Japan

We fabricated an electro-optic Mach-Zehnder interferometer with a wide temperature range for 100 GbE applications. This device shows a low extinction ratio of 15 dB and a high insertion loss of 5 dB.

MK1-4  15:50 - 15:55

Monolithically Integrated Flip-Chip 100 GbE using Direct Modulation

K. Kato, T. Nishimura, and T. Nakamura

NTT Photonics Laboratories, Atsugi, Japan

We demonstrated a monolithically integrated 100 GbE transmitter using direct modulation with a low extinction ratio of 10 dB and a low cost-effectiveness of 15 dB.

MK1-5  15:55 - 16:00

Integrated Optical Modulator for 100 GbE Applications


NTT Photonics Laboratories, Atsugi, Japan

We developed a compact 100 GbE transmitter optical sub-assembly using an optical module with a polarization beam combiner (PBC). This module demonstrates excellent performance in terms of polarization-dependent issues such as polarization-dependent gain and extinction ratio.

MK1-6  16:00 - 16:15

High-Speed Transmitter

Hitachi, Ltd., Central Research Laboratory, Tokyo, Japan, Mitsubishi Electric Corporation, Kamakura, Japan,

We demonstrated a 100 Gbps 25 Gb/s 1.3 μm EML TOSA with a 10 nm wavelength range.

MK1-7  16:15 - 16:30

Electro-optic Mach-Zehnder Interferometer

Kato T., Ogasawara T., and Tanaka K.

NTT Photonics Laboratories, Atsugi, Japan

We fabricated an electro-optic Mach-Zehnder interferometer with a wide temperature range for 100 GbE applications. This device shows a low extinction ratio of 10 dB and a high insertion loss of 5 dB.

MK1-8  16:30 - 16:45

Monolithically Integrated Flip-Chip 100 GbE using Direct Modulation

K. Kato, T. Nishimura, and T. Nakamura

NTT Photonics Laboratories, Atsugi, Japan

We demonstrated a monolithically integrated 100 GbE transmitter using direct modulation with a low extinction ratio of 10 dB and a low cost-effectiveness of 15 dB.

MK1-9  16:45 - 16:55

Integrated Optical Modulator for 100 GbE Applications


NTT Photonics Laboratories, Atsugi, Japan

We developed a compact 100 GbE transmitter optical sub-assembly using an optical module with a polarization beam combiner (PBC). This module demonstrates excellent performance in terms of polarization-dependent issues such as polarization-dependent gain and extinction ratio.

MK1-10  16:55 - 17:10

High-Speed Transmitter

Hitachi, Ltd., Central Research Laboratory, Tokyo, Japan, Mitsubishi Electric Corporation, Kamakura, Japan,

We demonstrated a 100 Gbps 25 Gb/s 1.3 μm EML TOSA with a 10 nm wavelength range.

MK1-11  17:10 - 17:25

Electro-optic Mach-Zehnder Interferometer

Kato T., Ogasawara T., and Tanaka K.

NTT Photonics Laboratories, Atsugi, Japan

We fabricated an electro-optic Mach-Zehnder interferometer with a wide temperature range for 100 GbE applications. This device shows a low extinction ratio of 10 dB and a high insertion loss of 5 dB.

MK1-12  17:25 - 17:40

Monolithically Integrated Flip-Chip 100 GbE using Direct Modulation

K. Kato, T. Nishimura, and T. Nakamura

NTT Photonics Laboratories, Atsugi, Japan

We demonstrated a monolithically integrated 100 GbE transmitter using direct modulation with a low extinction ratio of 10 dB and a low cost-effectiveness of 15 dB.
The Future of Space-Division Multiplexing and Its Applications
Guoqiang Liu
CREOL, The College of Optics & Photonics, Univ. of Central Florida, Fl., USA and The College of Precision Instruments and Optoelectronics Engineering, Tsinghua Univ., Beijing, China
Space-dividing multiplexing (SDM) has attracted significant attention in recent years. The enabling technologies for SDM have been developed at a rapid pace and ushered in a new trajectory in single-fiber capacity growth for optical communication.

Characterization of Mode-Dependent Loss of Laser Inscribed Photonic Lanterns for Space Division Multiplexing Systems
Nicolas K. Fontaine, and Roland Ryf
Bell Laboratories/Licence-Lucent, NJ, USA
We characterize the 12×12 frequency-dependent transfer matrix, Hiρ, of a 6-port photonic lantern spatial-multiplexer using a swept-wavelength interferometer. Eigen-value analysis of Hiρ provides the mode-dependent loss and insertion loss.

Higher-Order Mode Conversion Using Cascaded Phase Plates
Koji Igarashi, Takehiro Tsutsumi, and Isuo Moriga
KDDI R&D Laboratories Inc., Saitama, Japan
We propose a technique for higher-order mode conversion based on cascaded multiple phase plates with simple phase patterns. Using our scheme, the mode conversion from LP11 and LP11 has been demonstrated.

Impacts of Increased Effective Area on the Capacity of Multi-Core Fiber System
KAST, Dept. of Electrical Engineering, Daejeon, Korea
We evaluate the impacts of the increased effective area on the capacity of multi-core fiber (MCF). The results show that the use of large effective area is not effective for increasing the capacity of MCF.

Transmission Penalties in a 19-Core Fiber System with Self-Homodyne Detection
*Proxonic Network System Laboratory, **Lightwave Devices Laboratory, National Inst. of Information and Communications Technology (NICT), Tokyo, Japan
We investigate transmission penalties in a high-capacity self-homodyne coherent detection system using a 19-core fiber. We show small implementation penalties of 0.068 and linewidth independence that may enable transmission of high-order modulation formats.

Conversion and Extraction of Spatial Modes from a Multimode Fiber by Reference-Free Holographic-Diversity Interferometry
Yuki Hasaki, Atsushi Gekkei, Tomoaki Maeda, Akira Tomita, and Yuta Nakanishi
Graduate School of Information Science and Technology, Hokkaido Univ., Sapporo, Japan
We analyze the complexity of MIMO equalizers in both strongly and weakly coupled Raman transmission systems. We found that the third secular in the latter system has significantly smaller complexity than that in the former system.

Comparison of DSP Equalizer Complexity between Strongly and Weakly Coupled Few Mode Fiber Transmission Systems
B. Iman, F. Igarashi, B. Spinning, T. Tsunashiri, and N. Hanke
*Technische Univ. of Munich, Munich, Germany, and **KDDI R&D Laboratories Inc., Saitama, Japan, **NTT Communications, Tokyo, Japan, **Nokia Bell Labs, Munich, Germany
We analyze the complexity of MIMO equalizers in both strongly and weakly coupled Raman transmission systems. We found that the third secular in the latter system has significantly smaller complexity than that in the former system.
We demonstrate process tomography of coherent state transfer (2007). Invited speakers: K. Ishii, S. Namiki, Daisaku Takamiya, Crystal Nanocavity-Quantum Dot System. We present our recent advances on single quantum dot-photon crystal nanocavity coupled systems. Cavity enhanced two-photon emission and large optical Stark effect with extremely low control power in these systems will be mainly discussed.

Enhanced and Suppressed Spontaneous Emission From a Buried Heterostructure Quantum Crystal Cavity (2007). We have developed a new photonic-crystal-based platform having a two-dimensional array of quantum dots with controlled waveguide. We demonstrate a large vacuum Rabi splitting in an H0 photonic crystal nanocavity-quantum dot system. The larger Rabi splitting allows us to observe the largest splitting ever reported using single InGaAs quantum dots.

Frequency Multiplexed Quantum Memories with Read-Out on Demand for Quantum Repeaters (2007). We have developed a new photonic-crystal-based platform having a two-dimensional array of quantum dots with controlled waveguide. We demonstrate a large vacuum Rabi splitting in an H0 photonic crystal nanocavity-quantum dot system. The larger Rabi splitting allows us to observe the largest splitting ever reported using single InGaAs quantum dots.

Cyclic Sleep Management Schemes of Backup Transponders for Elastic Optical Networks (2007). We propose an algorithm which computes the energy-efficient P2MP-path for MiDORi network rapidly. By computer simulation, proposed algorithm can calculate within 3 seconds and reduce 30kW in large scale network.

Self-frequency Summing in Photonic Crystal Nanocavity Quantum Dot Lasers (2007). We propose a quantum repeater scheme that uses gradient echo memory and probabilistic noiseless amplification. We present a quantum repeater scheme that uses gradient echo memory and probabilistic noiseless amplification. We show that a quantum memory can process quantum information and a noiseless amplifier can distill entanglement.

Quantum memories with rare-earth-ion doped crystals (2007). Quantum networks consist in remote quantum memories capable of storing, processing and measuring quantum information distributed by photons. Here we describe how we used rare-earth-ion doped crystals to realize fundamental building blocks of quantum networks.

Self-frequency Summing Processes in Photonic Crystal Nanocavity Quantum Dot Lasers (2007). Self-frequency summing processes in photonic crystal nanocavity quantum dot lasers are observed. High quality factors and small mode volumes of the nanocavities facilitate efficient nonlinear frequency summing processes, generating a variety of visible emission lines.

Two-photon emission and large optical Stark effect with extremely low control power in these systems will be mainly discussed.

Enhanced and Suppressed Spontaneous Emission From a Buried Heterostructure Quantum Crystal Cavity (2007). We have developed a new photonic-crystal-based platform having a two-dimensional array of quantum dots with controlled waveguide. We demonstrate a large vacuum Rabi splitting in an H0 photonic crystal nanocavity-quantum dot system. The larger Rabi splitting allows us to observe the largest splitting ever reported using single InGaAs quantum dots.

Experimental Validation of Effect of the Power-Saving Standby Mode on the Backup Path on MiDORi (2007). We propose new power saving optical network architecture. The power saving standby mode on the backup path using power-saving transponders/ regenerators can save 50% of power consumption.

Experimental Validation of Effect of the Power-Saving Standby Mode on the Backup Path on MiDORi (2007). We propose new power saving optical network architecture. The power saving standby mode on the backup path using power-saving transponders/ regenerators can save 50% of power consumption.

Recent Advances in Elastic Optical Networks (2007). This paper reviews the recent advances in elastic optical network from viewpoints of networking, hardware design, and standardization activities.

Enhanced Minimum Interference Routing Algorithms for Elastic Optical Networks (2007). This work introduces for the first time the notion of minimum interference to the RSA algorithm design and proposes two new RSA algorithms in SLICE network. Results show a noticeable spectrum efficiency improvement.
Oral, Monday, July 1

Room J 2F

[MS2] 16:30 - 17:00
End-reflection Assisted Brillouin Measurement for PON Monitoring
Kunihide Koi, Hitomi Takahashi, and Kunihide Toge
NTT Access Network Service Systems Laboratories, NTT Corporation, Ibaraki, Japan

A novel technique to monitor branched optical fibres is presented, based on the Brillouin analysis with end-reflected power detection. The principle of this method is described and accompanying applications are discussed.

[MS2] 17:00 - 17:15
Distributed strain measurement in GI fiber with sub-meter spatial resolution by DP-BOTDR
Shatsko MTS, M.Y. Masharani, Y. Iwai, and N. Takenaka
Graduate School of Science and Engineering, Ibaraki Univ., Ibaraki, Japan

We report experimental results on distributed strain measurement in GI fiber with a sub-meter spatial resolution using a DP-BOTDR system. A 40-cm spatial resolution was achieved with a 7 μm micro strain error.

[MS2] 17:15 - 17:30
Bidirectional Brillouin Optical Correlation Domain Analysis Using Phase Modulation
J. H. Kang, W. Lim, and J. Y. Lim
Center for Opto-Electronic Convergence System, Korea Inst. of Science and Technology (KIST), Seoul, Republic of Korea, Dept. of Electrical and Computer Engineering, Yonsei Univ., Seoul, Republic of Korea, Dept. of Physics, Chung-Ang Univ., Seoul, Republic of Korea

Bidirectional Brillouin optical correlation domain analysis is proposed and experimentally implemented by using a phase modulator. Our proposed scheme leads to an enlarged measurement range with maintaining a spatial resolution.

[MS2] 17:30 - 17:45
Optimized Polarization State for Self-Heterodyne-Based Brillouin Measurement in Plastic Optical Fibers
Y. Minuma, N. Hayashi, and K. Nakamura
Precision and Intelligence Laboratory, Tokyo Inst. of Technology, Tokyo, Japan

We experimentally clarify that the role of the polarization state optimization in observing Brillouin scattering in plastic optical fibers lies, unlike silica fibers, in suppressing the tail of the Rayleigh-scattered light spectrum.

[MS2] 17:45 - 18:00
High-sensitivity optical fiber temperature sensor using multimode interference
Y. Kozhina, H. Fukano, and S. Tase
Graduate School of Natural Science and Technology, Okayama Univ., Okayama, JAPAN

We developed a simple high-sensitivity fiber temperature sensor using multimode interference. The structure comprises a large-core multimode fiber (MMF) sandwiched between single-mode-fibers. The MMF is coated with silicone elastomer, whose refractive index varies with temperature.

[MS2] 18:00 - 18:15
Fabry-Perot Pressure Sensor Based on a Simplified Bandgap Fiber
Long-Jin Jia, Bao-Qu Cui, and Hui-Feng Wei
1 Inst. of Photonics Technology, Jiang Univ., Guangzhou, China, 2 State Key Laboratory of Optical Fiber and Cable Manufacture Technology, Yangtze Optic Fiber and Cable Company Ltd. R&D center, Wuhan, China

The response of a Fabry-Perot Pressure sensor based on a simplified bandgap fiber is experimentally and theoretically analyzed. The measured pressure sensitivity is 17.3 pm/MPa, which is mainly a result of the cavity length change.

[MS2] 18:15 - 18:30
Simultaneous temperature and strain measurement by using a wide-band fiber Bragg grating
Lunlin Xiao, 1 Peng Wang, 1 and Hongmei Wang
1 Graduate School of Science and Technology, Shizuoka Univ., Hamamatsu, Japan

A novel power-interrogated sensor allowing for simultaneous measurements of the temperature and the strain is firstly proposed and experimentally demonstrated, which is based on the utilization of a linearly chirped fiber Bragg grating (FBG).

Room K 2F

[MB2] 16:30 - 17:30
Tutorial

[MB2] 16:30 - 18:30
Acoustic-Brillouin Physics
Zengfu Chang
Chair, Zhi Wei (Inst. of Physics, Chinese Academy of Sciences, China)

We experimentally clarify that the role of the polarization state optimization in observing Brillouin scattering in plastic optical fibers lies, unlike silica fibers, in suppressing the tail of the Rayleigh-scattered light spectrum.

[MB2] 17:30 - 18:00
Invited

Microjoule isolated attosecond pulses created by high-order harmonic generation
Eiji Takahashi and Kazumi Morikawa
Extreme Photons Research Group, RIKEN Advanced Science Inst., Saitama, JAPAN

We successfully generated a microjoule isolated attosecond pulse with 500 fs as duration in the XUV region. Our developed attosecond source has enough pulse energy making breakthrough for the attosecond nonlinear optics.

[MB2] 18:00 - 18:15
Generation and Measurement of Isolated 173-as XUV Laser Pulses At 82 eV
Haizhong, Ruiying Zhu, Peng Ye, Xinkui He, Wei Zhang, Liang Wang, Chenshu Yin, and Zhilin Wei
Beijing Nat. Laboratory for Condensed Matter Physics and Inst. of Physics, Chinese Academy of Science (CAS), Beijing, China

Isolated attosecond pulse is generated from neon gas driven by CEP stabilized sub-THz laS belle laser pulses at repetition rate of 50 kHz. The streaking retrieved shown the pulse duration is 173 as with photon energy of 82 eV.

[MB2] 18:15 - 18:30
Optimized attosecond XUV pulses with zeptosecond timing resolution
Hao Teng, Minjie Zhan, Peng Ye, Xinkui He, Wei Zhang, Lifeng XUV Laser Pulses At 82 eV

We successfully generated a microjoule isolated attosecond pulse with 500 fs as duration in the XUV region. Our developed attosecond source has enough pulse energy making breakthrough for the attosecond nonlinear optics.

Room 101 1F

[MT2] 16:30 - 17:15
A Novel Optoelectronic 32-bit Serial-to-Parallel Converter for 25Gb/s Optical Label Processing
Sakurahara, Hilsy Murai, Takatsuji Nakazono, Yasumasu Suzuki, and Ryo Takahashi
NTT Photonics Laboratories, NTT Corporation, Kanagawa, Japan

An optoelectronic 32 bit serial-to-parallel converter with novel conversion scheme and shared trigger configuration is developed for label processing of 100Gb/s (25Gb/s×4) optical packets. The converter exhibits high gain and tolerance to voltage swing of received bits.

[MT2] 17:15 - 17:30
Optical Clock Pulse-Train Generator for Processing 25 Gbit/s + 4 x 1 Gbit Optical Packets
Takashi Nakahara, Yasumasu Suzuki, and Ryo Takahashi
NTT Photonics Laboratories, NTT Corporation, Kanagawa, Japan

Self-stabilizing optical clock generation for processing 100Gbit/s (25 Gbit/s + 4×1 Gbit) preamble free, asynchronous optical packets is demonstrated by using a compact module consisting of an optical loop with a saturable absorber and SDA.

[MT2] 17:30 - 17:45
Massive Generation/Recognition of 2-D Label Using Optical Code and Wavelength
Kazutaka Hara, Gihan Weerasinghe, Takahiro Kodama, 1 Satoshi Shimizu, 1 Naoya Wada, and Ken-ichi Kitayama
1 Osaka Univ., Japan, 3 NTT Inc., Institute of Information and Communications Technology (ICT), Japan

Massive number of generation and real-time recognition of 2-D label using optical codes and wavelengths are implemented for the first time.

[MT2] 17:45 - 18:00
40Gbps Operation of an Optical Serial-to-Parallel Converter for DPSK Signals with Phase Operation
Hinoyuki Nishihara, Yutaro Sanou, and Hidetaka Kusano
Precision and Intelligence Laboratory, Tokyo Inst. of Technology, Kanagawa, Japan

40Gbps operation of an optical serial-to-parallel converter with phase operation for DPSK signals was achieved due to suppression of chirp with a Mach-Zehnder type phase modulator. Suppression ratio of above 10dB was obtained.

[MT2] 18:00 - 18:15
Improvement of Number of Processing Bit of a Si Photon Optic Serial-to-Parallel Converter with Phase Operation
Hidetaka Kusano, and Hiroaki Uemura
Precision and Intelligence Laboratory, Tokyo Inst. of Technology, Kanagawa, Japan

We investigate the novel design to compensate the power unbalance in the Mach-Zehnder delay interferometers of a Si photonic phase operation type serial-to-parallel converter. 5 bit improvement of the processed number of bits can be achieved.
Wavelength Tuning of Hollow Waveguide DBR Lasers
Michiaki Yamakawa, Takahiro Sakaguchi and Fumi Koyama
Photonics Integration System Research Center, Precision & Intelligence Laboratory, Tokyo Inst.of Technology, Tokyo, Japan
We demonstrate the wavelength tuning of hollow-waveguide DBR laser with variable air core. Wavelength tuning of 8.2nm was obtained with a core-thickness change of 0.065μm. A novel design for wide continuous tuning is also presented.

Electro-thermally Tunable 850nm VCSELs with metal-semiconductor Thermally Actuated Mirror
Photonics Integration System Research Center, Tokyo Inst.of Technology, Yokohama, Japan, 1 Semiconduct and MEMS Processing Center, Tokyo Institute of Technology, Yokohama, Japan
We report on an electro-thermally tunable 850nm VCSEL exhibiting a large negative wavelength drift of 2.0nm/K. Continuous and linear wavelength tuning of 25 nm was obtained with heating power of 9.4 mW.

Super-Resolution Optical Beam Steering Based on Bragg Reflector Waveguides
Y. Isshiki, S. Manabe, and Taniguchi
Photonics Integration System Research Center, Precision and Intelligence Laboratory, Tokyo Inst. of Technology, Yokohama, Japan
We proposed beam steering devices based on Bragg reflector waveguides. We show a large steering angle and ultra high resolution steering at the same time. We present our high-resolution beam steering concept based on VCSEL, photonicics.

High Power Operation at High Temperature of AlGaNAs/InP Widely Tunable DH Laser
Yokohama R&D Labs., Furukawa Electric Co., Ltd., Yokohama, Japan, NTT Photonics Labs., NTT Photonics Research Center, Yokohama, Japan
We fabricated high performance 1550 nm widely tunable lasers with butt-coupled surface structure configuration based on the AlGaNAs/InP system. The output power as high as 90 mW at a temperature of 70 °C was achieved.

Narrow-Linewidth Single-Mode and Tunable Two-Electrode Conjugated-Ridge Waveguide DBR Lasers
K. Oda, A. Hirose, T. Ishikawa, and Y. Iida
Centre for Research in Photonics, Photonic Technology Laboratory, Univ.of Ottawa, Ottawa, Canada
A single-mode and narrow linewidth two-electrode conjugated-ridge waveguide DBR laser has been fabricated. The preliminary characterization shows side-mode suppression ratios over 50 dB, a tuning range over 3.2 nm, and a linewidth of 204 kHz.

Narrow Linewidth tunable DBR laser array for PDM-DQPSK
Yokohama R&D Labs., Furukawa Electric Co., Ltd., Yokohama, Japan, NTT Photonics Labs., NTT Photonics Research Center, Yokohama, Japan
We characterized optical absorption of single-layer graphene, which was integrated on a sub-micron scale silicon waveguide. We got more than 60% Intense single THz pulse.

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EDFA is explained. The multicore fiber transmission technologies is promising in long-haul transmission using multicore fiber and multicore candidate to increase the capacity per fiber. In this paper, ultra-

KDDI R&D Laboratories Inc., Japan

Repeatered by Multicore EDFA

TuR1-5 9:30 - 10:00

Ultra-High Long-Haul Transmission Using Multicore Fiber Repeated by Multicore EDFA

Hidenori Saitoh, Koki Yamazaki, Koki Takeshima, Takehiro Tsutsumi, and Ikuo Morita

KDDI R&D Laboratories Inc., Japan

The multicore fiber transmission technologies is promising candidate to increase the capacity per fiber. In this paper, ultra-long-haul transmission using multicore fiber and multicore EDFA is explained.
Oral, Tuesday, July 2

Room G 1F

[TuE1-1] 8:30 - 8:45
Imprinting of a Homogeneous Nanographite with Femtosecond Laser Ablation
Kenzo Miyazaki and Goishi Miyaji
Inst. of Advanced Energy, Kyoto Univ., Kyoto, Japan
We demonstrate that intense femtosecond laser pulses can directly imprint a homogeneous nanographite on gallium nitride surface in air through the surface plasmon polariton fields induced and controlled by a simple two-step ablation process.

[TuE1-2] 8:45 - 9:00
Periodic Grating Structures on Metal Surfaces Self-Formed by Femtosecond Laser Ablation
Masahiko Hasegawa, Yosuke Matsuoka, Masahiro Shimojo, Tomya Ogata, Hisashi Sakagami, Shigeki Toida, and Shuji Sakabe
Inst. for Chemical Research, Kyoto Univ., Uji, Japan
Dept. of Physics, Kyoto Univ., Sakyo, Japan
Department of Physics, Nagoya Univ., Aichi, Japan,
Natl. Inst. for Research of Science, Gifu, Japan
Femtosecond pulse width and time domain of the pulse are 1 fs and 1 fs, respectively. The dependence of the pulse width on periodicity microstructure on laser fluence can be explained by the paradigm that the sub-diffraction hole array is formed with the femtosecond laser pulses.

[TuE1-3] 9:00 - 9:15
New evolution in interfering femtosecond laser processing
Yuki Nakata, Y. Matsuba, K. Murakawa, N. Miyasaka
Inst. of Laser Engineering, Osaka Univ., Osaka, Japan
Interference patterns are summarized in the case of four and six beam correlation, which can be transferred to metamaterial structures. In addition, the structural changes with different processing thresholds are investigated in detail.

[TuE1-4] 9:15 - 9:30
Three Dimensional Functional Microfluidic Chips Fabricated by Hybrid Femtosecond Laser FLLAE
Jin Wu, Si Zhu, Jia Xu, Kai Sugaka, and Katsumi Midorikawa
Lasertechnology Laboratory, RIKEN-Advanced Science Inst., Saitama, Japan
We propose a novel strategy which fuses femtosecond laser TRIP and FLAL to integrate 3D complex microfluidic devices for highly functional applications. 3D microfluidics were fabricated, showing excellent filtering functions.

[TuE1-5] 9:30 - 9:45
Monolithic Integration of Microelectronic Components and Microfluidic Structures in Glass Using Femtosecond Laser Processing
Jin Xu, Dong Wu, Shuho Wu, Kai Sugaka, and Katsumi Midorikawa
Lasertechnology Laboratory, RIKEN-Advanced Science Inst., Saitama, Japan
Micro-electronic components and microfluidic structures are monolithically integrated in a glass substrate by a femtosecond laser. The fabricated microfluidic networks are used as microheaters to control the temperature of in-channel fluids.

[TuE1-6] 9:45 - 10:00
Spatial and Temporal Control of Ice Formation Induced by Femtosecond Laser Impulse
Yoschiro Hocikawa, Saburo Kawanami, Kosuke Sawada, and Takamori Iro
Inst. of Science and Technology, Nara, Japan
Femtosecond laser impulses which is generated under microscope was applied to a trigger to induce ice formation.

Room H 1F

[TuF1-1] 8:30 - 9:00
Progress in Large Scale, Longterm Stable Timing Distribution and Synchronization
Franz X. Kärntner
1 Center for Free-Electron Laser Science, Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany
2 Physics Dept., Univ. of Hamburg and The Hamburg Center of Ultrastar Imaging, Hamburg, Germany
3 Dept. of Electrical Engineering and Computer Science and Research Laboratory of Electronic, Massachusetts Inst. of Technology, Massachusetts, USA
We review a scalable, sub-10-ps precision timing distribution system for next generation accelerator and high source facilities and discuss its extension to sub-femtosecond performance using polarization maintaining dispersion compensated fiber links and integrated waveguide cross-correlators.

[TuF1-2] 9:00 - 9:15
Advances in Compact High Repetition Rate Yt: Fiber Laser Frequency Combs
Aimin Wang, Guohuang Wang, Chao Lin, Tongtiao Jiang, Wei Zhang, and Zhiqiang Zhang
State Key Laboratory of Advanced Optical Communication System and Networks, School of Electronics Engineering, and Computer Science, Peking Univ., Beijing, P. R. China
We present the direct short pulse generation and spectrum broadening with ultra-high repetition rate fiber lasers that ensure the long term stability of frequency combs.

[TuF1-3] 9:15 - 9:30
Optical Frequency Comb Using Dispersion Managed Er-doped Ultrashort Pulse Fiber Laser Using Carbon Nanotube Polymide Film
Takuya Iwatsuki, Tsuguharu Aritsu, Hiroshi Iwai, Emiko Omoda, Hisashi Midorikawa, and Takeshi Saito
Electrical and Computer Engineering, Osaka University, Suita, Japan
Optical frequency combs based on Er-doped fiber lasers with optical waveguide nanotube polymer film were developed. Novel optical frequency combs was achieved through dispersion management of the laser cavity.

[TuF1-4] 9:30 - 9:45
A New Method of Two-Photon Absorption Spectrum Measurement by Supercontinuum
B. Kuo 1, T. Kobayashi 2, Y. Xia 3, and J. Du 1
1 Advanced Metal Laser Research Center, Univ. of Electro-Communications, Tokyo, Japan
2 Japan Science and Technology Agency, Core Research for Evolutional Science and Technology (CREST), Tokyo, Japan
3 Dept. of Photon Science, Inst. of Molecular Science, Okazaki, Japan
We report a novel method of two-photon absorption spectrum measurement. A high-power supercontinuum laser source with wavelength tunability was used to generate the supercontinuum. A TPA spectrum of Rosamine-B was acquired in a single step procedure.

[TuF1-5] 9:45 - 10:00
Intracavity High Harmonic Generation At 80 and 10 MHz Repetition Rates
A. Dvorak 1, M. Kukawka-Gonikman 1, and Y. Kobayashi 2, 3
1 The Inst. for Solid State Physics, The Univ. of Tokyo, Chiba, Japan
2, 3 Core Research for Evolutional Science and Technology (CREST), JST, Japan
4 Photon Science Center, The Univ. of Tokyo, Tokyo, Japan
Cavity-enhanced high harmonic generation is demonstrated at 80 and 10 MHz repetition rate with 10 MHz systems offering higher power uv radiation.

Room I 2F

[TuP1-1] 8:30 - 8:45
WDM Transmission of Y-00 Cipher Signals for High Capacity Secure Optical Fiber Networks
Franz X. Kärtner and Osamu Hirota
Center of Ultrafast Imaging, Hamburg, Germany,
Quantum ICT Research Inst., Tama-gawa Univ., Tokyo, Japan
Transmission capacity of Y-00 cipher increases by wavelength multiplexing. WDM technique since Y-00 signals require no excess bandwidth. 10 channel WDM transmission each channel carrying 2.5Gb/s Y-00 signals over 120 km was successfully demonstrated.

[TuP1-2] 8:45 - 9:00
Demonstration of OCDM-based 10G-PON with a multiple access noise suppression at RN
Kensuke Toyo, Shinsuke Takeuchi, Masaki Hori, and Yutaka Harihara
Natl. Inst. for Research of Science, Gifu, Japan
A new non-generated two photon absorption spectrum measurement was demonstrated.

[TuP1-3] 9:00 - 9:15
Experimental Demonstration of a Centralized Optical Wireless Indoor Localization System for High-Speed Communications in Personal Areas
Ke Wang 1,2,3, Masafumi Nakamura 1,2,3,1, Emiko Omoda 1,2, Hiroshi Iwai 1,2, and Takeshi Saito 1
1 NEC Laboratories America, Princeton, USA
2 NEC Laboratories America, Princeton, USA
3 NEC Laboratories America, Princeton, USA
A centralized localization system based on the optical wireless technology for personal areas is proposed and experimentally demonstrated in this paper. A localization accuracy of ~0.26 cm is achieved.

[TuP1-4] 9:15 - 9:30
Software-defined Throughput Optimization for Next-Generation Optical Mobile Backhaul
Nicola Cavigli, Ting Wang
NEC Laboratories America, Princeton, USA
We propose a novel software-defined algorithm for dynamic, physical-layer-aware throughput maximization in next-generation mobile backhaul (MBH) networks. Results confirm >100Mbps bandwidth on each cell throughputs with 5:1 QoS-based optical backhaul links deployed at legacy cell sites.

[TuP1-5] 9:30 - 10:00
Datacenters: New Challenges and Opportunities for Optical Technologies
Mitsudate Gyoju
Inst. of Applied Information Science, Univ. of Tokyo, Tokyo, Japan
The main aspects of high-speed networking in data centers are discussed. The key challenges, as well as opportunities, for employment of optical network technologies to address current and future challenges are identified.
Multi-core EDFA for Space Division Multiplexing
Y. Tsujihata, K. Maeda, and H. Sugiuchi
JST Photonics Laboratory, Furukawa Electric Co., Ltd., Chiba, Japan

Multi-core EDFA is a promising technology for future optical networks, offering high capacity and reduced fiber consumption. In this presentation, the researchers from JST Photonics Laboratory introduce their latest advancements in multi-core EDFA technology, focusing on space division multiplexing. They discuss the design considerations, performance benefits, and potential applications of multi-core EDFA in optical communication systems. The presentation highlights the successful implementation of multi-core EDFA in real-world scenarios, showcasing their commitment to advancing optical network technologies.
We have used a single trapped atomic ion to induce and measure a \( \gamma \) and \( \alpha \). We present a design of an atom interferometer using thermal atoms trapped on a chip. We point out that such an interferometer requires at least \( 1 \) and \( 2 \) microwave potentials.

We experimentally demonstrate the coherent storage for the photonic polarization qubit in two spatially separated ensembles with a fully stabilized comb spectrum with sub-Hz relative linewidths. We propose a resonant cavity-enhanced quantum-dot infrared photodetectors of which the cutoff wavelength is from 6um to 12um. We report the development of InAs/GaSb Type II superlattice (T2SL) infrared detector in JAXA. We present the results of optical evaluation of the detector of which the cutoff wavelength is from 6um to 10um.

We show the advantage of generating multiple timestamps in a CMOS-based flexible neural stimulator for retinal prosthesis. We present a multi-channel digital Silicon photomultipliers for biomedical applications. We present a design of an atom interferometer using thermal atoms trapped on a chip. We point out that such an interferometer requires at least two spatially separated ensembles with a fully stabilized comb spectrum with sub-Hz relative linewidths.

Rapid, Wide Bandwidth Pulsed Cavity Ringdown Spectroscopy in the Mid Infrared

Toby K. Buxton, Oliver R. Fitts, Thomas G. Spence, Chris A. Dennis, Abhijit G. Roychowdhury, Peter L. B. Penney, Charles C. H. S. 1,2,3

We present a new variant of the Cavity Ringdown Spectroscopy (CRDS) that is able to scan across more than \( 10^4 \) in scan bandwidth, allowing for more than 1,000 scans per second at less than 4 seconds.
We propose and demonstrate an OSNR monitoring technique based on software-based synchronization technique. This technique can accurately monitor the OSNRs of the QPSK and 16QAM signals.

A polarization-constellation in the Stokes space is obtained with phase-noise-free optical-sampling measurements and converted to an IQ-constellation diagram.

We propose the OSNR monitoring technique for m-ary QAM formats in the presence of fiber nonlinearities, which is based on analysis of the power spectral density of amplitude noises in a digital coherent receiver.

This paper describes a heterodyne optical spectrum analyzer with fast sweeping (160Hz) and high spectral resolution (2pm) using our compact, high-speed silicon-based dynamic/active devices. The technology is promising for next generation optical communications for applications.

An optical monitoring technique is demonstrated for DP-QPSK signals. We give a historical perspective on the major results that led to the advent of the photonic bandgap fiber. We discuss the progress in development and offering of silicon photonic integration platforms based on 200mm and 300mm wafer technologies. Devices have capability for developing photonics integration platforms and their applications for coherent optics, Raman comb generation laser, gas-filled HC-PCF and photonic microcells, along with their coupling one (IC HC-PCF). We review the progress made on photonic crystal fiber (PBG HC-PCF) and to that of inhibited-to the advent of the photonic bandgap guiding hollow core fiber. We give a historical perspective on the major results that led to the advent of the photonic bandgap guiding hollow core photonic crystal fiber (PCF) and to that of inhibited.

Visible Emission Enhancement in Fiber Optic Atmospheric Pressure Helium Plasma Jet

We generated atmospheric pressure helium plasma in a hollow optical fiber by the interaction of the generated plasma and an laser beam at 1552nm and the plasma plume. We generated atmospheric pressure helium plasma in a hollow optical fiber. We observed an optical gain at 615nm in the intersection of the generated plasma and an laser beam at 1552nm and the plasma plume.

A sub-100nm technology that allows the monolithic integration of optical devices as features into a 90nm base high-performance logic technology node is demonstrated. This technology is promising for next generation optical communications for applications.
Recently, one of the most promising applications of femtosecond laser is fabrication of biochips. This tutorial gives a review of the state of the art and future prospects of femtosecond laser processing for biochip applications.

Fast, Asynchronous Sampling Distance Ranging Using an SOA Gate and a Dual-Wavelength Mode-Locked Fiber Laser
Lei Liu, Xin Zhao, Qi Wang, Zheng Gong, Jiansheng Liu and Zheng Zheng
School of Electronic and Information Engineering, Beihang Univ., Beijing, China
A fast ranging scheme based on the asynchronous sampling of ultrafast nonlinear saturation of an SOA is experimentally demonstrated using a dual-wavelength sub-picosecond fiber laser and a very simple setup.

Precision Surface Profile Measurements by Comb-based Multi-wavelength Interferometry
Weit Chu, Seo-Jung Huh, Jun-Uk Kang, Sung-Ho Shin, and Joo-Ak Kim
Ultrastable Optical Sources Group, Dept. of Mechanical Engineering Korea Advanced Inst. of Science and Technology (KAIST), Daejeon, South Korea
Precise measurement of large-stepped surface profiles is demonstrated using the frequency comb of a femtosecond pulse laser. Four optical wavelengths are selected out and a large step-height of ~70 μm is measured with nanometre precision.

Interference imaging profilometry using optical frequency comb and compressive sensing
Quang Duc Pham and Yoshio Hayasaki
Center for Optical Research and Education (CORE), Utsunomiya Univ., Utsunomiya, Japan
We describe a new optical system using an ultra-stable mode-locked frequency comb femtosecond laser and the compressive sensing to measure an object surface profile.

Application of Optical Frequency Comb Synthesizer/Analyzer to Tbit Multilevel Phase Modulation
Toshikazu Yamazaki and Tatsutoshi Shioda
Dept. of Electrical Engineering, Nagaoka Univ. of Technology, Niigata, Japan
Novel optical system for arbitrary waveform synthesizing and analyzing in terabit range has been proposed based on a 200 GHz optical frequency comb. As a demonstration 16-Tbit/s 80-bit PSK packet was experimentally synthesized and analyzed.

Gapless THz Comb Spectroscopy
Satoshi Hoyu, Tatsuo Okada, Hiroshi Ito, Kazuaki Kominato, and Tatsuo Okada
Univ. of Tsukuba, Tsukuba, Japan
We demonstrated gapless THz comb spectroscopy for high-resolution THz spectroscopy. Frequency sweeping of THz comb mode enables us to enhance the spectral resolution in THz spectroscopy down to the linewidth of THz comb mode.
A novel QPSK receiver based on a phase noise reduction pre-stage exploiting PSA in a HNLF and balanced detection is presented. Receiver sensitivity improvement over a conventional balanced receiver is demonstrated.

Valentina Cristofori, Zohreh Lali-Dastjerdi, Francesco Da Ros, Lars Sgaard Rishøj, Michael Gubb, Christophe Peucheret and Kristian Røttvik

Dept. of Photonics Engineering, Technical Univ. of Denmark, Lyngby, Denmark, and JPL, California Institute of Technology

We demonstrate experimentally, for the first time to our knowledge, fiber optical parametric chirped pulse amplification of 400-fs pulses. The 400-fs signal is stretched, amplified by 26 dB and compressed back to 500 fs.

Phase Comparator using Phase Sensitive Amplifier for Phase Noise-Tolerant Carrier Phase Recovery of QPSK Signals

Mingyi Gao, Takayuki Kurosu, Takashi Inoue, Shu Namiki

Network Photonics Research Center (NPRC), Nat’l Inst. of Advanced Industry Science and Technology (AIST), Tsukuba, Japan

We propose an all-optical phase comparator for phase noise-tolerant carrier phase recovery of QPSK signals. Our scheme, based on the 2nd-order phase sensitive amplifier, successfully doubles the input phase without doubling the phase noise.

Demonstration of ROADM functionality on Optical Nyquist SCFDE Superchannel

Xu-Ding, Shuai Zhang, Hongchen Wang, Tingzhong Zhang and Fan Zhang

State Key Lab. of Advanced Optical Communication Systems & Networks, Peking Univ., Beijing, China

We experimentally demonstrate reconfigurable optical add-drop multiplexer functionality with less than 0.5-dB error vector magnitude penalty in a Nyquist superchannel system based on single carrier frequency domain equalization with polarization division multiplexing 16 Gb/s format.

Generation and Applications of Sub-5-fs Multi-10-Tw Light Pulses


Max-Planck-Institut für Quantenoptik, Garching, Germany, Ludwig-Maximilians-Universität München, Garching, Germany, Lehrstuhl für BioMolekülare Optik, Dept. für Physik, Ludwig-Maximilians-Universität München, Garching, Germany.

We report on the development and relevant characteristics of an optical parametric synthesizer signal source delivering sub-5-fs pulses with 80 µJ energy. The first applications of the system are astrophotometric and relativistic laser plasma physics.
Caltech Workshop on Quantum Information and Nanophotonics

Monday, July 2

Session Chair: Greg J. Brown, Caltech, USA

Room 103 1F

[TuG2] 10:30 - 12:00 Quantum Optics

K. Koshino 1 2, S. Ishihara 1 2, K. Kamide 3 4 5
1 Dept. of Physics, Osaka Univ., Osaka, Japan
2 Grad. School of Natural Science and Technology, Okayama Univ., Okayama, Japan
3 Institute for Molecular Science, Japan
4 Institute for Materials Research, Tohoku University, Japan
5 National Institute of Informatics, Japan

We demonstrated a high-order superluminal effect for light propagation in a photonic crystal with a negative effective index of refraction.

Room 104A 1F

[TuG2] 10:30 - 12:00 Terahertz Imaging and Sensing

J. Kobayashi 1 2, T. Tanaka 1 2, K. Tanaka 1 2, H. Takehara 1 2, H. Noji 1 2 3, H. Yamanaka 2 3
1 Dept. of Applied Physics, Univ. of Tokyo, Tokyo, Japan
2 Center for Computational Materials Science, RIKEN, Saitama, Japan
3 National Institute of Materials Science, Japan

We demonstrated a novel terahertz imaging system for medical applications, including cancer diagnosis.

Room 104B 1F

[TuG2] 10:30 - 12:00 Bionanophotonics

Y. Sato 1 4, Y. Yokota 1 4, Y. Okuda 5, K. Ono 1 6, H. Naka 1 2, T. Tanaka 1 2, H. Takehara 1 2, H. Noji 1 2 3, H. Yamanaka 2 3
1 Dept. of Electrical and Computer Engineering, Yokohama Nat’l Univ., Yokohama, Japan
2 Central Research Inst. of Electric Power Industry, Kanagawa, Japan
3 NEC Smart Energy Research Laboratories, Ibaraki, Japan
4 Institute for Materials Research, Tohoku University, Japan
5 Dept. of Electrical Engineering, Osaka Univ., Osaka, Japan
6 Graduate School of Natural Science and Technology, Okayama Univ., Okayama, Japan

We demonstrated a new method for detecting and imaging biological substances using terahertz technology.

Tuesday, July 3

Session Chair: Hitoshi Tabata (The Univ. of Tokyo, Japan)

Room 103 1F

[TuJ2-1] 10:30 - 10:45 Lensless Imaging Device for Digital Counting of Fluorescent Micro-droplet Chambers

T. Watanabe 1 2, S. Ota 1 2, T. Ito 1, T. Baba 1
1 Dept. of Electrical and Computer Engineering, Yokohama Nat’l Univ., Yokohama, Japan
2 NEC Smart Energy Research Laboratories, Ibaraki, Japan

We developed a miniature lensless terahertz imaging device for digital counting of micro-droplet chambers. Fluorescent beads in a droplet array were imaged with the device and its resolution was improved by using detection method.

Room 104A 1F

[TuJ2-2] 10:30 - 10:45 Photonic Crystal Nanolaser Sensors with ALD Coating

K. Nakazawa 1 2, K. Nishimura 1, T. Kudo 1, M. Kado 1, T. Sawada 1
1 Department of Applied Chemistry, the Univ. of Tokyo, Tokyo, Japan
2 Graduate School of Materials Science, Nara Inst. of Science and Technology, Nara, Japan

We presented a new photonic crystal nanolaser sensor for detecting rarefactive materials with enhanced sensitivity.

Room 104B 1F


A. Abe 1 2, T. Watanabe 1 2, S. Ota 1 2, T. Ito 1, T. Baba 1
1 Dept. of Electrical and Computer Engineering, Yokohama Nat’l Univ., Yokohama, Japan
2 NEC Smart Energy Research Laboratories, Ibaraki, Japan

We proposed a high-accuracy filter-less fluorescence detector for bio-applications, which is single-nanometer resolution and high sensitivity.

Oral, Tuesday, July 2

Room 103 1F

[TuG2-1] 11:00 - 11:15 Terahertz Bio-imaging for Medical Applications

J. Hua Sun 1 2
1 Dept. of Physics, Univ. of Seoul, Seoul, Republic of Korea
2 Molecular Imaging Center, National Taiwan Univ., Taipei, Taiwan

We demonstrated the first biological imaging using terahertz technology, including skin imaging.

Room 104A 1F


Takashi Kawa 1, Takanori Hagiwara 1, Tetsuya Kusaka 1, Kenji Saiki 2, Koji Tsukada 1, and Tetsuo Ogawa 3 4
1 Graduate School of Natural Science and Technology, Okayama Univ., Okayama, Japan
2 Institute for Molecular Science, Japan
3 Graduate School of Materials Science, Nara Inst. of Science and Technology, Nara, Japan
4 NEC Smart Energy Research Laboratories, Ibaraki, Japan

We experimentally demonstrated the function of electrode materials for fuel cells.

Room 104B 1F

[TuG2-3] 11:00 - 11:15 Quantum Enhanced Microphotonics of a Living Cell

Michiaki A. Ito 1, J. Jansen 1, Hiroshi Ueda 2, Itzchak Noy 3
1 Centre for Engineering Quantum Systems, Univ. of Queensland, Queensland, Australia
2 Dept. of Quantum Science, Australian Nat’l Univ., Canberra, Australia
3 RIKEN, Wako, Japan

We demonstrated a quantum-enhanced microphotonics system for imaging living cells.

Session Chair: Toshihiko Baba ( okayama University, Japan)

Room 103 1F


A. Abe 1 2, T. Watanabe 1 2, S. Ota 1 2, T. Ito 1, T. Baba 1
1 Dept. of Electrical and Computer Engineering, Yokohama Nat’l Univ., Yokohama, Japan
2 NEC Smart Energy Research Laboratories, Ibaraki, Japan

We demonstrated a high-accuracy filter-less fluorescence detector for bio-applications.

Room 104A 1F

[TuJ2-5] 11:30 - 12:00 Saturable scattering and its application to superresolution microscopy

Shi-Wen Chu 1, Tung-Yu Su 1, Yassu Yonemura 1, Masahito Yamamoto 2, Guang-Yu Zhu 1, Ying-Ying Lee 2, Aoyose Okae 1, Satsuki Kasai 1, and Katsumasa Fujita 1 2 3
1 Dept. of Physics, Nat’l Taiwan Univ., Taipei, Taiwan R.O.C.
2 Molecular Imaging Center, National Taiwan Univ., Taipei, Taiwan R.O.C.
3 Dept. of Applied Physics, Osaka Univ., Osaka, Japan

We demonstrated saturable scattering and its application to super-resolution microscopy.
Digital Signal Processing (DSP) is an enabling technology for future optical communication systems. This tutorial will discuss the emergence of DSP for optical communication systems before surveying the key algorithms required in digital coherent transceivers.

Heterogeneous integration on silicon photonics
Alexander W. Fang, Brian R. Koch, Jae Shin, Erik J. Norberg, Amon, Goleta, CA, USA
Heterogeneous integration enables all the elements of photonic systems to be fabricated on a single chip allowing photonic integrated circuits to meet the complexity, volume and cost requirements of the next generation of communication systems.

Active device integration on silica waveguide platform
Hiroshi Takahashi, NTT Photonics Laboratories, Japan
Silica waveguide planar lightwave circuits have excellent optical characteristics, and integration with active devices can expand their application range. Compact receivers and highly functional modulators are demonstrated by integrating photodiodes and lithium niobate, respectively.

Optical nonreciprocal devices on silicon waveguide platforms
Y. Shiozaki, T. Kiyama, A. Mitsuishi, and T. Misumi, Dept. of Electrical and Electronic Engineering, Tokyo Inst. of Technology, Tokyo, Japan
The magneto-optic effect is important to realize the optical nonreciprocal devices such as isolators and circulators. In this article, magneto-optical nonreciprocal devices are discussed that are based on silicon waveguide platforms.

Resonant filtered fiber amplifiers
Thomas T. Alkesjahld, Marko Laurila, Christina B. Clausen, Johannes Weinschel, Jens K. Lynge, NTT Photonics, Birket, Denmark, 2 DTU Fotonik, Dept. of photonics engineering, Technical Univ. of Denmark, Denmark
In this paper we present our recent result on utilizing resonant bandgap fiber designs to achieve high-performance ytterbium-doped fiber amplifiers for achieving diffraction limited beam quality in large mode area fibers.
Attosecond Delays in Photoionization: A Theoretical Perspective

Ryohto Sawada
Photon Science Center, School of Engineering, the Univ. of Tokyo, Tokyo, Japan

We present the measured photoionization yield of atomic hydrogen as a function of laser intensity for few-cycle pulses. Fits accurate representation of ionization dynamics in many-electron systems.

Dual-Comb Spectroscopy with Amplified Frequency Comb Pulse Pairs

M. Abe 1, S. Okubo 1, K. Kajikawa 1, H. Nakayama 1, H. Ikaba 1, and K. Sasaki 1
Dept. of Physics, Faculty of Science and Technology, Ako U., Ako, Hyogo, Japan, Nat’l Metrology Inst. of Japan IMEAS, National Inst. of Information and Communications Technology (NICT), Tokyo, Japan

We have determined 11/2 sub-Doppler resolution spectral frequencies of DCI using an interference-frequency generator source, an enhanced-cavity absorption cell, and an optical frequency comb from 841 to 851.1 GHz with a typical uncertainty of 1 kHz.

Adaptive Dual-Comb Spectroscopy with Free-Running Lasers

M. Abe 1, Antoine Picq 2, Guy Guilette 3, Nathalie Picqué 1, and Théodoridès Hénin 1
Max Planck Institut für Quantenoptik, Garching, Germany, Institut des Sciences Moléculaires d’Orsay, CNRS, Université Paris Sud, Orsay, France, Ludwig-Maximilians-Universität München, Fakultät für Physik, München, Germany

A new concept of real-time dual-comb spectroscopy that only uses free-running femtosecond mode-locked laser provides high quality Fourier spectra with resolved comb lines over a span of 1200 cm⁻¹ at 4 cm⁻¹ resolution within 15 microseconds.

Photoinitiation Yield of Atomic Hydrogen Using Intense Few-cycle Pulses

G. Schulz 1, W. C. Ballabéd 2, J. Calvayrac 2, D. E. Lutan 2, A. G. Punter 1, A. N. Grum-Gzhishvili 1, K. Bartucz 2, J. L. Linnik 1, R. C. Shank 2, and D. N. Kevrekidis 1
ARC Centre of Excellence for Quantum-Atom Science, Griffith U., QLD, Australia, Dept. of Physics and Astronomy, U. of Bristol, U. of Exeter, Exeter, UK, Inst. of Applied Physics, National Academy of Science and Technology (ANSTO), Sydney, Australia, Ludwig-Maximilians-Universität München, Fakultät für Physik, München, Germany

We propose the measured photoinitiation yield as a function of laser intensity for few-cycle pulses. It has a quadratic evolution with the intensity and no saturation is observed.

Time-Dependent Complete Active-Space Self-Consistent Field Method for Multielectron Dynamics

Takashi Sato and Kenichi L. Ishikawa
Photon Science Center, School of Engineering, University of Tokyo, Tokyo, Japan

Time-dependent complete active-space self-consistent field (TD-CASSCF) method is developed. It introduces the concept of frozen-core, dynamical core, and active orbital subspaces, allowing compact yet consistent representation of ionization dynamics in many-electron systems.

Analysis of Strong-Field Enhanced Ionization of Molecules Using Bohmian Trajectories

Piyshito Sawada 1, Takemitsu Ito 2, and Kenichi L. Ishikawa 1
1 Dept. of Applied Physics, Graduate School of Engineering, Tokyo University, Tokyo, Japan, 2 Photon Science Center, Graduate School of Engineering, the Univ. of Tokyo, Tokyo, Japan

We investigate enhanced ionization of 12 hydrogen molecular ions using Bohmian trajectories extracted from TDDFT simulations. We identify trajectories characteristic of ionized trajectories. They contrast a common picture of direct ionization from the ground state.

Angular and spectral resolved quantum trajectories in high harmonic generation

Kang Yu, Jiaxin Hu, Mingjie Zhang, Hong Tey, Wei Zhang, and Zhiyi Wei
Beijing Nat’l Laboratory for Condensed Matter Physics and Inst. of Physics, Chinese Academy of Sciences (CAS), Beijing, China

Arrow-like pattern is observed in high order harmonic spectrum driven by 4fs laser. Individual electron quantum trajectories from different half cycles, including long and short trajectories, can be clearly recognized spatially.
TuO3-1 14:30 - 15:00
Advanced Technologies of Current and Future ODD Technologies
Room J 2F
Session Chair: Tsutomu Shumura (The Univ. of Tokyo, Japan)

Limited code can be used.

TuO3-2 15:00 - 15:15
Temporal Coded Collinear Holographic Memory
Room J 2F
Session Chair: R. Fujimura, 1, T. Shimura, 1, and K. Kuroda 2
1 Inst. of Industrial Science, the Univ. of Tokyo, Tokyo, Japan, 2 Tokyo Institute of Technology, Kanagawa, Japan.

A collinear holographic memory system recording multi-channel time sequential signal is proposed and demonstrated. Higher recording density and data transfer rate compared to the page-oriented system are expected because Run-Length Coding is used.

TuO3-3 15:15 - 15:30
Multilevel Logic Polarization Coded Holographic Memory
Room J 2F
Y. Matsumoto 1, R. Fujimura 1, T. Shimura 1, and K. Kuroda 2
1 Inst. of Industrial Science, the Univ. of Tokyo, Tokyo, Japan, 2 Tokyo Institute of Technology, Kanagawa, Japan.

A polarization coded holographic memory is demonstrated. Writing and reading characteristics are examined through numerical simulations and experiments. The polarization state of the readout signal is influenced by the ratio of intensity and polarization gratings formed by the incident signal.

TuO3-4 15:30 - 15:45
Super-resolved Complex Amplitude Reconstruction of Nanostructured Binary Data with Pattern Matching
Room J 2F
Shinya Tsuchi and Yoshio Hayasaki

Center for Optical Research and Education (CORE) Lutsumoju Univ., Utsunomiya, Japan.

We propose a new optical reconstruction of binary data formed by nanostructures using an interference microscope and a pattern matching method. We demonstrated the readable size under the presence of noises using a computer simulation.

TuO3-5 15:45 - 16:00
Configuration on an optically reconfigurable gate array under the maximum 120°C temperature condition
Room J 2F
Hoption Moksa 1, Minoura Watanabe, 1, and Akihito Ogawa 1
1 Electrical and Electronic Engineering, Shizuoka Univ., 1 Dept. of Electrical Engineering, Kiby City College of Technology, Japan.

This paper presents a new wide-temperature condition acceptable optically reconfigurable gate array that can function well at 15-120°C temperature conditions. That and other features make this device very suitable for space applications.

TuO3-6 14:30 - 16:00
Optical Packet Switching
Room K 2F
Session Chair: Geert Mortier (KU Leuven - IMEC, Belgium)

160 Gb/s Optical Packet Switch Module Employing SOI Integrated Label Extractor
S. Sugimura, 1, M. T. Ito, 1, K. Sato, 1, K. Morikawa, 1, K. Kawai, 1, M. Kudo, 1, H. Hatakeyama, 1, K. Yamanouchi, 1, and K. Inoguchi 2
1 Eindhoven Univ. of Technology, Dept. of Electrical Engineering, Eindhoven, the Netherlands, 2 IMEC, Dept. of Information Technology, Photonics Research Group, Ghent, Belgium.

We demonstrate a full functionality 160 Gb/s optical packet switch employing Silicon-on-Insulator integrated label extractor combined with a FPGA-based controller. Experimental results show error rate is less than 10^-12 in the parallel and asynchronous optical label detection, processing, and packet switching.

TuO3-7 14:45 - 15:00
In-line Homodyne CO-OFDM Packet Transmitter with Polarization-Multiplexed Pilot Tone
Room K 2F
R. Moriwaki 1,5, R. Fujimura 1, T. Shimura 1, Shinji Ishikawa 2, and Yoshio Hayasaki 1
1 Dept. of Electrical and Electronic Engineering, Shizuoka Univ., 2 Center for Optical Research and Education (CORE) Lutsumoju Univ., Utsunomiya, Japan.

This paper presents a new wide-temperature condition adaptive optical packet switch with polarization multiplexed pilot tone. Error-free operation is shown with a system error rate of less than 10^-12 and a data rate of 10.7 Gb/s and 19.6 Gb/s.

TuO3-8 15:00 - 15:15
Simulation and Demonstration of Largecapacity Fiber-delay-line Buffer for Optical Packet Switch
Room K 2F
S. Shindo, 1, N. Furukawa, 1, and N. Wada 1
1 Nat’l Inst. of Information and Communications Technology, Tokyo, Japan.

A required buffer size of fiber delay lines to resolve packet contents was estimated from a simulation using pipeline architecture. Additionally, 31 fiber delay line buffer which consisted of fixed and variable length switches and fiber sheets was demonstrated.

TuO3-9 15:15 - 15:30
Demonstration of Optical Packet Switching System based on 8 x 12.5 Gb/s All-Optical OFDM and SOA Switching
Room K 2F
S. Shindo, G. Cincotti, 2, and N. Wada 1
1 Nat’l Inst. of Information and Communications Technology (NICT), Tokyo, Japan, 2 Engineering Dept., Univ. Roma Tre, Rome, Italy.

We demonstrate a full functional 1xN optical packet switch employing a Silicon-on-Insulator integrated label extractor combined with a FPGA-based controller. Experimental results show error-free on-the-fly parallel and asynchronous optical label detection, processing and packet switching.

TuO3-1 14:30 - 16:00
Optical Storage
Room K 2F
Session Chair: Geert Mortier (KU Leuven - IMEC, Belgium)

160 Gb/s Optical Packet Switch Module Employing SOI Integrated Label Extractor
S. Sugimura, 1, M. T. Ito, 1, K. Sato, 1, K. Morikawa, 1, M. Kudo, 1, H. Hatakeyama, 1, K. Yamanouchi, 1, and K. Inoguchi 2
1 Eindhoven Univ. of Technology, Dept. of Electrical Engineering, Eindhoven, the Netherlands, 2 IMEC, Dept. of Information Technology, Photonics Research Group, Ghent, Belgium.

We demonstrate a full functionality 160 Gb/s optical packet switch employing Silicon-on-Insulator integrated label extractor combined with a FPGA-based controller. Experimental results show error rate is less than 10^-12 in the parallel and asynchronous optical label detection, processing, and packet switching.

TuO3-2 14:45 - 15:00
Self-Homodyne CO-OFDM Packet Transmitter with Polarization-Multiplexed Pilot Tone
Room K 2F
R. Moriwaki 1,5, R. Fujimura 1, T. Shimura 1, Shinji Ishikawa 2, and Yoshio Hayasaki 1
1 Dept. of Electrical and Electronic Engineering, Shizuoka Univ., 2 Center for Optical Research and Education (CORE) Lutsumoju Univ., Utsunomiya, Japan.

This paper presents a new wide-temperature condition adaptive optical packet switch with polarization multiplexed pilot tone. Error-free operation is shown with a system error rate of less than 10^-12 and a data rate of 10.7 Gb/s and 19.6 Gb/s.

TuO3-3 15:00 - 15:15
Simulation and Demonstration of Largecapacity Fiber-delay-line Buffer for Optical Packet Switch
Room K 2F
S. Shindo, 1, N. Furukawa, 1, and N. Wada 1
1 Nat’l Inst. of Information and Communications Technology, Tokyo, Japan.

A required buffer size of fiber delay lines to resolve packet contents was estimated from a simulation using pipeline architecture. Additionally, 31 fiber delay line buffer which consisted of fixed and variable length switches and fiber sheets was demonstrated.

TuO3-4 15:15 - 15:30
Demonstration of Optical Packet Switching System based on 8 x 12.5 Gb/s All-Optical OFDM and SOA Switching
Room K 2F
S. Shindo, G. Cincotti, 2, and N. Wada 1
1 Nat’l Inst. of Information and Communications Technology (NICT), Tokyo, Japan, 2 Engineering Dept., Univ. Roma Tre, Rome, Italy.

We demonstrate a full functional 1xN optical packet switch employing a Silicon-on-Insulator integrated label extractor combined with a FPGA-based controller. Experimental results show error-free on-the-fly parallel and asynchronous optical label detection, processing and packet switching.

TuO3-5 15:45 - 16:00
Optical Transceiver ICs based on 3D Die-Stacking of Opto-electronic Devices
Room K 2F
Pinzhang Duan 1,3, Oided Rizvi 2, and Hamen JS Dromi 1
1 Eindhoven Univ. of Technology, Eindhoven, the Netherlands.

We review a wafer-scale process for making compact 3D-stacked transmitter and receivers ICs. Experimental results indicating error-free operation of the transmitter at 10 Gbps over 500m transmission through OMM-Piux fiber are given.

TuO3-6 15:45 - 16:00
Configuration on an optically reconfigurable gate array under the maximum 120°C temperature condition
Room K 2F
Hoption Moksa 1, Minoura Watanabe, 1, and Akihito Ogawa 1
1 Electrical and Electronic Engineering, Shizuoka Univ., 1 Dept. of Electrical Engineering, Kiby City College of Technology, Japan.

This paper presents a new wide-temperature condition acceptable optically reconfigurable gate array that can function well at 15-120°C temperature conditions. That and other features make this device very suitable for space applications.

TuO3-7 16:00 - 16:15
Optical Processing in HDS, and T AMR technology as the applications of near field optics in storage system.
Room K 2F
Session Chair: Simon Mees (TU Dresden, Germany)

We introduce optical and mechanical issues in storage system. We discuss the mechanical issues in conventional ODD, image processing method in HDD, and TAMR technology as the applications of near field optics in storage system.
TuE3-1  14:30 - 14:45  Fabrication of Ordered Hierarchical Structures Using Colloidal Monolayer Template and Pulsed Laser Deposition in Gas Phase
K. Nakashita1 and Y. Li2
1 Nanosystem Research Inst., Natl Institute of Advanced Industrial Science and Technology, Japan; 2 School of Materials and Energy, Shanghai Jiao Tong University, China
We have developed a strategy for fabricating ordered hierarchical micro/nanostructures based on the combination of a colloidal monolayer substrate for microstructures and the pulsed laser deposition (PLD) process for nanostructures.

TuE3-2  14:45 - 15:00  Fabrication of Submicron-sized Spherical Particles Using Laser-induced Agglomeration and Fusion of Nanoparticles
Takakazu Tsuchi1, Tatsuya Yokohama1, Masato Yasukawa1, Masaharu Tsuj1, Kazumori Iwagawa1, Yoichiro Yamauchi1, Akiko Koshizaka1
1 Institute of Materials Research, Tokyo Institute of Technology, Japan
We propose and investigate a method for fabricating submicron-sized spherical particles using laser-induced agglomeration and fusion of nanoparticles.

TuE3-3  15:00 - 15:15  Nanoparticle Synthesis by Femtosecond Laser Ablation in Liquid
Yasufumi Shimomuraa1, Yuza Yamada1, Masashi Sakakura1, Kazuyuki Hiroa2, and Kiyotaka Mura1
1 Dept. of Material Chemistry, Kyoiku University, Kyoto, Japan; 2 Office of Society-Academia Collaboration for Innovation, Kyoiku University, Kyoto, Japan
We numerically investigate broadband optical absorption enhancement in thin Si photonic devices by multiple photonic band-edge structures that are produced by higher order modes for the vertical and photonic superlattice structure.

Akira Umeda1, Auria Sugimura2, and Takeko Yoshida2
1 Dept. of physics, Konan University, Kobe, Japan; 2 Dept. of Mechanical Engineering, Anan National College of Technology, Anan, Japan
We investigate optical absorption enhancement in a solar cell structure using photonic crystals. We propose and investigate topology optimization for photonic crystal design and successfully find a structure with larger optical absorption.

TuE3-5  15:30 - 15:45  Laser Processing of Nanoporous Films Based on Plasmonic Excitation of Au Nanoparticles in the Films
Kazuo Minakata1, Tomoaki Shi1, Kazuhiro Yamada1, Nobutaka Hamada1, and Tsuyoshi Ikuta1
1 Dept. of Chemistry, Graduate School of Science, Osaka University, Sapporo, Japan
We present a novel laser processing technique for nanoholes formation (5-200 μm) on a polymer film based on resonant excitation of surface plasmon of Au nanoparticles.

TuE3-6  15:45 - 16:00  Integrating Functionally Graded Ti-Preapared Structures Using Laser Rapid Manufacturing
C P Paul1, Haresh D1, S K Mishra1, P Bhargava1, C H Preiminger1, N Koshizaka2, and S M Kulkarni2
1 Dept. of Mechanical and Industrial Engineering, Yonsei University, South Korea; 2 Dept. of Mechanical Engineering, Keio University, Japan
This paper reports the deposition of a 30 μm laser beam laser rapid manufacturing system for fabricating functionally graded Ti-Preapared structures using new 2-step cell-based architecture and evaluation of their mechanical properties.

TuJ3-1  15:15 - 15:30  Targeted Drug and Gene Delivery to Central Nervous Systems
Shinji Imai1, Shunji Ito1, Yasushi Satoh1, Hiroshi Nakashima2, and Munetoshi Ohno3
1 Division of Biomedical Information Sciences, Natl Defense Medical College Research Inst., Saitama, Japan; 2 Dept. of Electronics and Electrical Engineering, Keio University, Yokohama, Kanagawa, Japan; 3 Dept. of Health Sciences, National Defense Medical College, Saitama, Japan
We developed protocols for Raman microscopy of living cellular changes in response to spinal cord injury. Raman microscopy can also open the blood brain barrier.

TuJ3-2  15:30 - 15:45  Photomechanical Targeted Drug and Gene Delivery to Central Nervous Systems
Shinji Imai1, Shunji Ito1, Yasushi Satoh1, Hiroshi Nakashima2, and Munetoshi Ohno3
1 Division of Biomedical Information Sciences, Natl Defense Medical College Research Inst., Saitama, Japan; 2 Dept. of Electronics and Electrical Engineering, Keio University, Yokohama, Kanagawa, Japan; 3 Dept. of Health Sciences, National Defense Medical College, Saitama, Japan
We present some of our latest works in manipulating thermal electromagnetic fields, examples including thermal extraction, and daytime radiative cooling.

TuJ3-3  15:45 - 16:00  Fast Polarization-resolved SHG Microscopy for in Vivo Imaging of Collagen Orientation
Kyu Tanaka1, Tetsuo Hayasaka1, Masayuki Ishikawa, and Akio Takahashi1
1 Graduate School of Engineering, Osaka University, Japan
We developed a multimodal microscopy enabling simultaneous measurement of two label-free imaging methods, Raman microscopy and quantitative phase imaging. This approach provides real-time measurements through phase microscopy, along with the chemical specificity of Raman spectroscopy.

Room 103  1F
TuE3-1  14:30 - 16:00  Nanoparticles and Nanostructures
Session Chair: Yoshiki Nakatsu (Osaka Univ., Japan)

Room 104A  1F
TuE3-2  15:00 - 15:15  Modulating Thermal Electromagnetic Fields by Band-Edge Effect of Photonic Crystals. II -Topology Optimization for Further Absorption-
Yasufumi Shimomуча1,1,2, Y. Awamoto3, M. Fujita3, and S. Noda3
1 Dept. of Electronic Science and Engineering, Kagawa University, Kagawa, Japan; 2 Division of Advanced Electronics and Optical Science, Osaka Univ., Osaka, Japan
We investigate optical absorption enhancement in thin Si photonic devices by multiple photonic band-edge structures that are produced by higher order modes for the vertical and photonic superlattice structure.

Room 104B  1F
TuJ3-1  14:30 - 15:00  Surface-Enhanced Nanoplasmonics for Biomolecular Sensing and Imaging
Yungho Oh, Jong-tul Chung, Wony Lee, and Donghyun Kim
School of Electrical and Electronic Engineering, Yonsei Univ., Seoul, South Korea
We investigate surface-enhanced optical biosensing and imaging techniques. We describe nanofluidic-based device localization, super-resolution imaging techniques by subwavelength fluorescence localization sampling combined with spatial modulation.

Room 103  1F
TuE3-2  15:00 - 15:15  Super-high Density Si Quantum Dot Thin Film for Photovoltaic Properties Enhancement
K.V. Rao, P.K. Huang, Y.L. Chen, and P.T. Lee
Dept. of Physics & Info. of Electro-Optical Engineering, Natl’l Chiao Tung Univ., Hsinchu, Taiwan
We present some of our latest works in manipulating thermal electromagnetic fields, examples including thermal extraction, and daytime radiative cooling.

Room 104A  1F
TuE3-3  15:15 - 15:30  Enhancement of Optical Absorption in Solar Cells by Band-Edge Effect of Photonic Crystals. I -Formation of Multiple Bandedges-
Y. Tanaka1, Y. Kawamoto2, M. Fujita1,1,2, and S. Noda3
1 Dept. of Electronic Science and Engineering, Kyoto University, Kyoto, Japan; 2 Division of Advanced Electronics and Optical Science, Osaka University, Osaka, Japan
We numerically investigate broadband optical absorption enhancement in thin Si photonic devices by multiple photonic band-edge structures that are produced by higher order modes for the vertical and photonic superlattice structure.

Room 104B  1F
TuJ3-2  15:30 - 15:45  Femtosecond Laser Ablation in Liquid
Yasufumi Shimomуча1, Yuza Yamada1, Masashi Sakakura1, Kazuyuki Hiroa2, and Kiyotaka Mura1
1 Dept. of Material Chemistry, Kyoiku University, Kyoto, Japan; 2 Office of Society-Academia Collaboration for Innovation, Kyoiku University, Kyoto, Japan
We numerically investigate broadband optical absorption enhancement in thin Si photonic devices by multiple photonic band-edge structures that are produced by higher order modes for the vertical and photonic superlattice structure.
Oral, Tuesday, July 2

TuR4-1 16:30 - 17:00
Block-wise Phase Switching for Double-sided Direct Detected Optical OFDM Signals
X. Chen, A. Li, B. Chen, Q. Han, Y. Yang, B. Li, and Y. He
Depts. of Electrical and Electronic Engineering and Institute of Photonics and Optical Science, The Univ. of Nottingham, U.K.

We propose a scheme for switching between a two-channel optical OFDM system and a single-channel optical OFDM system to achieve high efficiency and high performance for the OFDM system.

TuR4-1 16:30 - 18:30
OFDM
Session Chair: Guifang Li (Univ. of Central Florida, USA)

TuR4-1 16:30 - 17:00
Prospects and Challenges of High-Density Photonic Interconnection Platforms and Their Applications (Application)
S. J. B. Yoo
Dept. of Electrical and Computer Engineering, Univ. of California, CA, USA

We will review the progress and impact of photonic integration, and address the progress, challenges, and future prospects of photonic-electronic integration in future information systems. Our long-term vision is to move towards a fully photonics-based system.

TuR4-1 16:30 - 17:00
Improving the Performance of Optical Phase Conjugator Using a Mid-way Filter
M. More Morsheda, L. Du, and A. J. Lowery
Centre for Ultrahigh-Bandwidth Devices for Optical Systems (CUDOS), Dept. of Electrical & Computer Systems Engineering, Monash Univ., Clayton, Australia

We propose a novel optical phase conjugator with a mid-way filter preventing nonlinear products being shifted into the signal band. The simulated signal/G Nzax improved by 1.1 dB in an 800-km 15.6-Gbps OFDM system.

TuR4-1 17:00 - 17:15
Estimation of Fast Fourier Transform Size of OFDM Signals for Elastic Optical Networks
K. Hidaka, A. Ito, T. Kikuchi, T. Takahashi, and T. Hieshima
KDDI R&D Laboratories Inc., Saitama, Japan

We propose an FFT size estimation scheme for OFDM signals in elastic optical networks. We can maintain signal performance at the receiver without control channels, even when the FFT size is changed at the transmitter.

TuR4-1 17:15 - 17:30
Improving the Performance of Optical Phase Conjugator Using a Mid-way Filter
M. More Morsheda, L. Du, and A. J. Lowery
Centre for Ultrahigh-Bandwidth Devices for Optical Systems (CUDOS), Dept. of Electrical & Computer Systems Engineering, Monash Univ., Clayton, Australia

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TuR4-1 17:30 - 18:00
Efficiency Enhancement of CO-OFDM Systems Using Different Pulse Shapes
S. Hussain, K. Puntsri, D. Sandel, M. F. Panhwar, and R. Noé
Inst. of Photonic and Electronic Technology (IPOET), Univ. of Paderborn, Paderborn, Germany

A square root raised-cosine window of OFDM symbols is suggested to enhance the efficiency of CO-OFDM systems instead of raised-cosine or rectangular windowing. Simulation results of CO-OFDM systems over 3000 km are investigated using VPI TransmissionMakerTM.

TuR4-1 18:00 - 18:15
Improved U-S OFDM for Fiber Nonlinearity Mitigation in Long Haul Transmission
X. Wang, A. K. Deepak, W. Zeng, and A. H. Li
Inst. of Photonics and Electronic Technology (IPOET), Univ. of Paderborn, Paderborn, Germany

We propose a novel optical phase conjugator with a mid-way filter preventing nonlinear products being shifted into the signal band. The simulated signal/G Nzax improved by 1.1 dB in an 800-km 15.6-Gbps OFDM system.

TuR4-2 17:00 - 17:15
Estimation of Fast Fourier Transform Size of OFDM Signals for Elastic Optical Networks
K. Hidaka, A. Ito, T. Kikuchi, T. Takahashi, and T. Hieshima
KDDI R&D Laboratories Inc., Saitama, Japan

We propose an FFT size estimation scheme for OFDM signals in elastic optical networks. We can maintain signal performance at the receiver without control channels, even when the FFT size is changed at the transmitter.

TuR4-2 17:15 - 17:30
Improving the Performance of Optical Phase Conjugator Using a Mid-way Filter
M. More Morsheda, L. Du, and A. J. Lowery
Centre for Ultrahigh-Bandwidth Devices for Optical Systems (CUDOS), Dept. of Electrical & Computer Systems Engineering, Monash Univ., Clayton, Australia

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Inst. of Photonic and Electronic Technology (IPOET), Univ. of Paderborn, Paderborn, Germany

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Inst. of Photonics and Electronic Technology (IPOET), Univ. of Paderborn, Paderborn, Germany

We propose a novel optical phase conjugator with a mid-way filter preventing nonlinear products being shifted into the signal band. The simulated signal/G Nzax improved by 1.1 dB in an 800-km 15.6-Gbps OFDM system.

TuR4-3 17:30 - 18:00
Designing Processor-Memory Interfaces with Monolithically Integrated Silicon Photonics
Chen Sun, Yu-Hsin Chen, Vadim Stefanov
Research Laboratory of Electronics, Massachusetts Inst. of Technology, MA, USA

We propose a monolithically-integrated processor-to-DRAM interface using thermally-stable Mach-Zehnder switches for optical power guiding. Simulation results of SPLASH-2 benchmarks, we achieve 18% lower energy-per-bit cost over the previous resonant ring-switched design.

TuR4-4 18:00 - 18:15
An Experiment of Subband Spectral Shaping in DFT-Spread CO-OFDM Systems
G. Jan, K. Puntsri, D. Sandel, A. Al-Bermani, C. Wordehoff, U. Ruckert, and R. Noé
Univ. of Paderborn, Paderborn, Germany, 1 Bielefeld Univ., Bielefeld, Germany

We experimentally investigate the impact of laser phase noise on coherent optical DFT-spread OFDM with spectral shaping. We also propose a new shaping technique to improve the system performance.

TuR4-4 18:15 - 18:30
Pilot-aided CD and PN Compensation Simultaneously in CO-OFDM Systems
Univ. of Paderborn, Paderborn, Germany, 1 Bielefeld Univ., Bielefeld, Germany

Joint chromatic dispersion and phase noise compensation by the pilot-based method is presented. The 16-GAM modulated transmission of two 80-Gb/s OFDM with fiber length of 960 km at 28 Gs/s and laser linewidth of 200 kHz.

TuR4-4 18:30 - 19:00
Prospects and Challenges of High-Density Photonic Interconnection Platforms and Their Applications (Application)
S. J. B. Yoo
Dept. of Electrical and Computer Engineering, Univ. of California, CA, USA

We will review the progress and impact of photonic integration, and address the progress, challenges, and future prospects of photonic-electronic integration in future information systems. Technologies include silicon CMOS photonics and InP/ GaAs OEICs.

TuR4-4 19:00 - 19:30
New Prospect of Soft Glass Highly Nonlinear Microstructured Optical Fibers
S. J. B. Yoo
Research Center for Advanced Photon Technology, Graduate School of Engineering, Toyota Technological Inst., Nagoya, Japan

New prospect of soft glass, such as tellurite and chalcogenide glass, highly nonlinear microstructured optical fibers for supercontinuum generation and nonlinear applications including all-optical control of group velocity dispersion are presented.
### TuS4-1 16:30 - 17:00

**Hollow Core Fibres for High Capacity Data Transmission**

- **Room J** 2F

  **Session Chair:** Masaharu Ohashi (Osaka Prefecture Univ., Japan)

  **Abstract:**

  We review our progress in developing, characterizing and handling hollow-core photonic bandgap fibers with improved transmission properties, targeted at high-capacity, low-latency data transmission in the current telecoms window and at the potentially lower-loss wavelengths.

### TuS4-2 17:00 - 17:15

**Maximum number of transmission channels in mode division multiplexing fibers**

- **Room J** 2F

  **Takahiro Kanno, Kisho Kojima, and Yasuo Kokubun**

  **Abstract:**

  The maximum number of channels of heterogeneous uncoupled few mode multi-core fiber using three non-ideal cores was analyzed and found to be almost equal to that of homogeneous uncoupled few mode multi-core fiber.

### TuS4-3 17:15 - 17:30

**Mode Division Multiplexed Transmission through Two-Mode Fiber Using Space-Optics Based Mode Multiplexer/Demultiplexer**

- **Room J** 2F

  **Takashi SUGI, Hiroki TERAUCHI, Katsuo TATSUJI, Akira MARUYAMA, Nobuo KUWAKI, Keitaro KATAYAMA, and Yasuo KOKUBUN**

  **Abstract:**

  We have demonstrated mode division multiplexed transmission using a space-optics based mode-multiplexer/demultiplexer. In this experiment, 10 Gbit/s OOK signals and another CW light were simultaneously transmitted through a 2km-long two-mode fiber with BER<10^-9.

### TuS4-4 17:30 - 17:45

**Intersymbol modulated Brillouin scattering in two-mode fibers**

- **Room J** 2F

  **Kwang Young Song, Yong Hyun Kim, and Byoung Yoon Kim**

  **Abstract:**

  Experimental characterization of stimulated Brillouin scattering between different modes are demonstrated in elliptic-core two-mode fibers using a mode-selective coupler.

### TuS4-5 17:45 - 18:00

**Modal Gain Controllable All-fiber Type Multimode Fiber Amplifier**

- **Room J** 2F

  **M.Wada, T. Sakamoto, T. Mori, N. Hansawa, T. Yamamoto, and T. Kaminoto**

  **Access:** Network Service Systems Laboratories, NTT Corporation, Ibaraki, Japan

  **Abstract:**

  We investigate an all-fiber type multimode erbium-doped fiber amplifier and control mode-dependent gain MDGs using a long-pigtail grating. Measurement results show that the MDGs can be changed in the least the +/-5 dB range.

### TuT4-2 17:00 - 17:30

**Demonstration of Wavelength-Routed Switching for 25-Gb/s Optical Packets Using a Parallel-Ring-Resonator Tunable Laser Integrated with an InGaAs EAM**

- **Room K** 2F

  **Yasuhiro Segawa, Wataru Kobayashi, Tatsushi Nakahara, and Ryo Takenaka**

  **Abstract:**

  Error-free operation of high-speed wavelength-routed switching is demonstrated for 25-Gb/s optical packets using 100 Gbit/s spaced arrayed-waveguide grating and a tunable transmitter that monolithically integrates a parallel-ring resonator tunable laser with an electro-absorption modulator.

### TuT4-3 17:30 - 17:45

**Hybrid silicon optical gate for packet networks**

- **Room K** 2F


  **Abstract:**

  We report a hybrid silicon optical gate. The gate shows a wide optical bandwidth, high extinction ratio with low internal noise factor and low insertion loss. We further study the gate performance under packet-switched operation.

### TuT4-4 17:45 - 18:00

**Multi-channel Format Conversion Based on a SOA and a Si Integrated Comb Filter and Demultiplexer**

- **Room K** 2F

  **Lei Xiang, Yu Yu, Bingrong Zou and Xinliang Zhang**

  **Abstract:**

  We report the fabrication and characterization of an InP monolithically integrated a parallel-ring-resonator tunable laser with an electro-absorption modulator. We further study the gate performance under packet-switched operation.

### TuT4-5 18:00 - 18:15

**A Monolithically Integrated All-Optical Wavelength Converter**

- **Room K** 2F

  **Stefano Parodi, Nicola Andrioli, Francesca Biantempi, and Gianpiero Contestabile**

  **Access:** Scuola Superiore Sant’Anna, Pisa, Italy

  **Abstract:**

  We report the fabrication and characterization of an InP monolithically integrated optical circuit for all-optical wavelength-conversion. The device is based on double-stage cross-gain-modulation compression. We experimentally demonstrate 10Gbit/s operation with low power penalty.

### TuT4-6 18:15 - 18:30

** Improvement of Extinction Ratio of Wavelength-Selective Switch Using Quantum Well Double-Series-Coupled Microring Resonators**

- **Room K** 2F

  **Hiroki Terauchi, Nobuo Kuwaki, and Keitaro Tatsumi**

  **Abstract:**

  We report the fabrication and characterization of an InP monolithically integrated a parallel-ring resonator tunable laser with an electro-absorption modulator. We further study the gate performance under packet-switched operation.

### TuD4-2 17:00 - 17:30

**Studies of the Mechanisms of Powerful Terahertz Radiation From Laser Plasmas**

- **Room 101** 1F

  **Yi Zheng, Meng Liu, Wenchao Yan, and Fei Wang**

  **Abstract:**

  We report the fabrication and characterization of an InP monolithically integrated a parallel-ring resonator tunable laser with an electro-absorption modulator. We further study the gate performance under packet-switched operation.
### Oral, Tuesday, July 2

<table>
<thead>
<tr>
<th>Room 103 1F</th>
<th>Room 104A 1F</th>
<th>Room 104B 1F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TuI4-1</strong> 16:30 - 17:00</td>
<td><strong>Invited</strong> 16:30 - 17:00</td>
<td></td>
</tr>
</tbody>
</table>
| **Novel Phenomena in Nanophotonics**  
(Session Chair: Takashi Asano, Kyoto Univ., Japan) | **Inducing Photonic Transitions for Enabling Next Generation Silicon Photonics**  
(Michal Lipson, Cornell Univ., Kavli Inst., NY, USA) |  |
| We show approaches for achieving several of the main building blocks of next generation silicon photonics including: CMOS compatible on-chip isolators and ultra-high speed and low power modulators. |  |  |
| **TuI4-2** 17:00 - 17:15 |  | **TuI4-5** 17:45 - 18:00 |
| **Bidirectional Dynamic Wavelength Conversion using Carrier Excitation/Depletion in Photonic Crystal Waveguide**  
(K. Kondo) |  | **Photonic Crystal Nanocavity Lifetime Enhancement by Slow Light Propagation and Carrier Induced Nonlinearities**  
(K. Bencheikh, P. Grinberg, A.M. Yacomotti, P. Hamel, F. Raineri, I. Sagnes, Y. Dumeige, J.A. Levenson) |
| We demonstrate the wavelength conversion of signal pulse to short/long sides using dynamic excitation/depletion of carriers induced by control pulse in photonic crystal waveguide. The wavelength shift increases with the interaction length of two pulses. |  | Coherent population oscillations and carrier-induced nonlinear refractive index dispersion are implemented in an active semi-conductor photonic crystal nanocavity to increase its photonic lifetime and manipulate its optical response. |
| **TuI4-3** 17:15 - 17:30 |  |  |
| **High-Frequency Self-Induced Oscillations in a Silicon Photonic Crystal Cavity**  
(X. Checoury, N. Clauer, P. Boucaud) |  |  |
| We experimentally show that self-induced oscillations at frequencies above GHz and with a high-spectral purity can be obtained in a silicon photonic crystal nanocavity under quasi-continuous optical pumping. |  |  |
| **TuI4-4** 17:30 - 17:45 |  | **TuI4-6** 18:00 - 18:15 |
| **Efficient Scheme for On-Demand Light Transfer Between Distant Nanocavities**  
(Ryotaro Konoike, Yoshiya Sato, Yoshinori Tanaka, Takashi Asano, Susumu Noda) |  | **Optical Resonator Analog of a Topological Insulator**  
(A. Yidong Chong, B. Guanquan Liang) |
| We propose a robust and efficient scheme for on-demand light transfer between distant nanocavities. We obtained high efficiency of ~90% by numerical simulation. Our proposed scheme provides fundamentals for future optical or quantum information processing. |  | A photonic topological insulator can be constructed from a lattice of ring resonators, without using aperiodic couplers or metamaterials. With gain and loss, the system can function as an optical diode for coupled resonator modes. |
| **TuI4-7** 18:15 - 18:30 |  |  |
| **Optomechanics with photonic crystals slab mirrors and cavities**  
| We investigate optomechanical effects in photonic crystal slab membranes, either including a cavity or acting as an end-mirror in a Fabry-Perot cavity. We in particular demonstrate the nonlinear behavior of the membranes fundamental modes. |  |  |
Oral, Wednesday, July 3

<table>
<thead>
<tr>
<th>Room C-1 1F</th>
<th>Room C-2 1F</th>
<th>Room F 1F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>[WQ1] 9:00 - 10:00</strong></td>
<td><strong>[WI1] 8:30 - 10:00</strong></td>
<td><strong>[WA1] 8:30 - 10:00</strong></td>
</tr>
<tr>
<td><strong>Photonic Networking Technologies</strong></td>
<td><strong>Diamond Nano-photonic and Novel Resonators</strong></td>
<td><strong>Femtosecond Fiber Lasers and Broadband Sources</strong></td>
</tr>
<tr>
<td>Session Chair: Soichiro Araki (NEC Green Platform Research Laboratories, Japan)</td>
<td>Session Chair: Heshal Sumikura (NTT Basic Research Laboratories, Japan)</td>
<td>Session Chair: Dinyung Tang (Nanyang Technological Univ., Singapore)</td>
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<td><strong>WQ1-1 8:30 - 9:00</strong></td>
<td><strong>WI1-1 8:30 - 9:00</strong></td>
<td><strong>WA1-1 8:30 - 8:45</strong></td>
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<tr>
<td><strong>Diamond Nanophotonics and Quantum Optics</strong></td>
<td><strong>Diamond Nanophotonics and Novel Resonators</strong></td>
<td><strong>Yb-Fiber Oscillator Based, Few-Cycle Ultrafast Source At 850nm</strong></td>
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| Marko Loncar School of Engineering and Applied Science, Harvard Univ., MA, USA | Exploiting photonic technologies will be the best way to create bandwidth abundant and energy efficient future networks, however, their introduction remains limited. The barriers and bandwidth abundant and energy efficient future networks, however, their introduction remains limited. The barriers and bandwidth abundant and energy efficient future networks, however, their introduction remains limited. The barriers and bandwidth abundant and energy efficient future networks, however, their introduction remains limited. The barriers and bandwidth abundant and energy efficient future networks, however, their introduction remains limited. The barriers and bandwidth abundant and energy efficient future networks, however, their introduction remains limited. The barriers and bandwidth abundant and energy efficient future networks, however, their introduction remains limited. 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The barriers and bandwidth abundant and energy efficient future networks, however, their introduction remains limited. The barriers and bandwidth abundant and energy efficient future networks, however, their introduction remains limited. The barriers and bandwidth abundant and energy ef...
### WE1-1 8:30 - 9:00 Femtosecond Laser Processing of Active and Passive Devices for bio-MEMS

**Y. Bellouard**  
Mechanical Engineering Dept., Eindhoven Univ. of Technology, Eindhoven, The Netherlands

Femtosecond laser processing of glass has been proven to be an efficient tool for fabricating waveguides and micro-channels. Here we show that monolithic integration in bio-Micro-Electro-Mechanical-Systems can be pushed forward by introducing additional functionalities.

### WE1-2 9:00 - 9:15 New Trends in Frequency Comb: Modulation and Nonlinear Equalization

**Thomas Udem**  
Max-Planck Inst. für Quantenoptik, Garching, Germany

Frequency combs are used for all kinds of high precision optical metrology. I will discuss its principles in detail and present the several applications.

### WE1-3 9:30 - 10:00 Bio-Lab on a Chip Fabricated by Femtosecond Laser

**Ajoy K. Kar**  
Inst. of Photonics & Quantum Sciences, Heriot-Watt Univ., Edinburgh, UK

The nonlinear interactions of femtosecond laser pulses with transparent, biocompatible dielectric materials can be applied to engineer compact devices with bespoke functionalities for biophotonic applications. This paper reviews recent developments in this rapidly emerging field.
We review recent work on fiber amplifiers for optical communication systems relying on mode-division multiplexing. This work includes results from a record 6-mode few-mode erbium doped amplifier demonstration.

Crystalline fibers with various cladding techniques to reduce the mode numbers, enable cladding pump, and increase damage threshold will be addressed. Active dopants in the crystalline cores generate emissions from visible to infrared wavelength ranges.

We report the first experimental realization of thulium doped fiber amplifiers providing high gain (>40dB), noise figure as low as 5dB and over 100nm wide bandwidth around 2μm with maximum saturated output power of 400mW.

The influence of inhomogeneous birefringent medium on the polarization properties of the LCD backlight unit was investigated by rotating a polarizer on it. The reduction of its DOP was mostly influenced by the inhomogeneous birefringence in the prism film.
Cluster state generation with ageing qubits

Peter Koli
Dept. of Physics & Astronomy, Univ. of Sheffield, Sheffield, United Kingdom
Cluster states can be created with entangling operations of arbitrary success probability, which places a lower bound on the lifetime of the qubits. We present a simple estimate for the required coherence time of the qubits.

Two-wavelength emission laser with semiconductor quantum dots

Kazuhito Aikawa, Naoki Yamamoto, Aorlari Kyono, Kazu Haga, Toshinaga Umezawa, Tetsu Shonan, Seiki Eda, Yasuo Tomotani, and Toshiro Yamamoto
Nat’l Inst. of Information and Communications Technology, Tokyo, Japan
A two-wavelength emission laser has been fabricated using semiconductor quantum dots as the gain medium. A beat signal of ~100 GHz was observed using Michelson interferometer configuration, indicating that these emissions occurred simultaneously.

Control of self-collimated light-emitting diodes with Negative Refraction by Photonic Crystal Nanohole Arrays

Yu-Fung Yin, Yin-Chen Liu, and JianJang Huang
Graduate Inst. of Photonics and Optoelectronics, Nat’l Taiwan Univ., Taipei, Taiwan
Negative refraction was demonstrated in the visible wavelength range by two-dimensional (2D) photonic crystals inscribed in the peripheral of a GaN-based light-emitting-diode (LED). Self-collimated behaviors in TE polarization were observed in the far-field measurement.

Compact and Power-efficient Silicon Modulators Beyond 60 Gbit/s

Hiro G. Aguiern, Naoya Yazawa, Satoshi Hashimoto, Toshihiko Baba
Dept. of Electrical and Computer Engineering, Yokohama Nat’l Univ., Yokohama, Japan
We demonstrate 2D Si microcavities and Mach-Zehnder modulators are presented. Low-power serial 60 Gbit/s and 4x40 Gbit/s modulations are both experimentally demonstrated.

Accurate Resource Estimation for Quantum Computation

Simon J. Devitt, Ashley M. Stephens, William J. Munro, and Karl Nemoto
1 Nat’l Inst. of Informatics, Tokyo, Japan, 2 NTT Basic Research Laboratories, NTT Corporation, Kanagawa, Japan
We detail how resource estimates should be made for large quantum algorithms and illustrate how to estimate the lifetime of the qubits in practical algorithms.

Quantum Simulation of the Jaynes-Cummings-Hubbard Model Using Trapped Ions

K. Takemasa, K. Kakuyanagi, and K. Semba
NTT Basic Research Laboratories, NTT Corporation, Kanagawa, Japan
We previously demonstrated a hybrid QW/QD structure to enhance the gain and spontaneous emission bandwidth of a quantum dot active region. We now present new designs to further broaden the spontaneous emission from hybrid structures.

Two-wavelength emission laser with semiconductor quantum dots

Kazuhito Aikawa, Naoki Yamamoto, Aorlari Kyono, Kazu Haga, Toshinaga Umezawa, Tetsu Shonan, Seiki Eda, Yasuo Tomotani, and Toshiro Yamamoto
Nat’l Inst. of Information and Communications Technology, Tokyo, Japan
A two-wavelength emission laser has been fabricated using semiconductor quantum dots as the gain medium. A beat signal of ~100 GHz was observed using Michelson interferometer configuration, indicating that these emissions occurred simultaneously.

Broad Bandwidth Emission From Hybrid QW/QD Structures

Dept. of Electronics and Electrical Engineering, Univ. of Sheffield, Sheffield, UK, 2 EPSRC National Centre for H+I Technologies, Dept. of Electronics and Electrical Engineering, Univ. of Sheffield, Centre for Nanoscience & Technology, Sheffield, UK, 3 QIC-Lab Inc, Kanagawa, Japan
We previously demonstrated a hybrid QW/QD structure to enhance the gain and spontaneous emission bandwidth of a quantum dot active region. We now present new designs to further broaden the spontaneous emission from hybrid structures.

New Class of 1.55 μm Quantum Dot Lasers for Future High Data Rate Optical Communication

J.P. Reithmaier, K. Kitagawa, S. Stenholm, T. Symul, and K. Nakamura
1 Quantum Simulations Group, CINSaT, Univ. of Kassel, Kassel, Germany, 2 Dept. of Electrical Engineering, Nanyang, Singapore
A review will be given on the latest results on high-speed 1.55 μm quantum dot lasers, which can be operated at data rates beyond 20 Gbit/s.

Two-dimensional (2D) Photonic Crystals Inscribed in the Periphery of a GaN-based Light-emitting Diode

Yu-Fung Yin, Yin-Chen Liu, and JianJang Huang
Graduate Inst. of Photonics and Optoelectronics, Nat’l Taiwan Univ., Taipei, Taiwan
Negative refraction was demonstrated in the visible wavelength range by two-dimensional (2D) photonic crystals inscribed in the peripheral of a GaN-based light-emitting-diode (LED). Self-collimated behaviors in TE polarization were observed in the far-field measurement.
Oral, Wednesday, July 3

Room C-1 1F

[WR2] 10:30 - 11:00

Ultra-High-Capacity Optical Transmission Using Multicore Space-Division-Multiplexing
Hironori Takahashi, Yasutomo Doi, Takehito Asano and Susumu Noda
Dept. of Electronic Science and Engineering, Kyushu Univ., Fukuoka, Japan

We show the eigenvalue demodulation based on digital coherent technology.

[WR2] 11:00 - 11:15

A Single-Channel 1.92 Tbit/s, 64 QAM Coherent Pulse OTDM Transmission over 150 km
David Celine Ohsya, Keisuke Kasai, Shinsuke Hirakata, Masato Yoshida, Masataka Nakazawa, Tetsuaki Hara, and Satsuki Okawa
Research Inst. of Electrical Communication, Tohoku Univ., Sendai, Japan

We demonstrate a single-channel 1.92 Tbit/s, 64 QAM coherent pulse OTDM transmission over 150 km. The QAM multiplicity was increased up to 64 by adopting a frequency domain equalization scheme to enhance wavelength demultiplexing.

[WR2] 11:15 - 11:30

Capacity of Space-Division Multiplexing with Heterogeneous Multi-Core Fibers
Pakhoing Yu, Christophelle Peuchhinder, Toshio Morisaka
DTU Fotonik, Dept. of Photonics Engineering, Technical Univ. of Denmark, Lyngby, Denmark

The capacity of heterogeneous multi-core fiber is explored, taking into account intra-core nonlinearities and inter-core crosstalk. Over 10 Pb/s transmission capacity can be anticipated for a densely-pack 93-core fiber with a 220 μm cladding diameter.

[WR2] 11:30 - 11:45

387.5Gb/s, 7.05b/s/Hz, 160QAM Transmission over 320km using Nyquist SCFDE Signals
Zhennan Zheng, Pu Ding, Pan Zhang, and Zhongyuan Chen
State Key Laboratory of Advanced Optical Communication Systems and Networks, Peking Univ., Beijing, China

We generate a 387.5Gb/s, 7.05b/s/Hz polarization division multiplexing (PDM) 160QAM Nyquist pulse shaping superchannel with single carrier frequency domain equalization (SCFDE). The BER for all subbands after 320km SSMF is lower than 1×10^-3.

[WR2] 11:45 - 12:00

Eigenvalue Modulated Optical Transmission System Based on Digital Coherent Technology
Hiroshi Teruiuchi and Akihiko Manabe
Graduate School of Engineering, Osaka Univ., Osaka, Japan

The ideal information carrier is invariable quantity during propagation in nonlinear dispersive fiber. This is eigenvalues of the associated equation of the nonlinear Schrödinger equation. We show the eigenvalue demodulation based on digital coherent technology.
<table>
<thead>
<tr>
<th>Session</th>
<th>Time</th>
<th>Title</th>
<th>Chair</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>WE2-1</td>
<td>10:30 - 11:30</td>
<td>Functional Lab-On-A-Chip Devices Produced by Two-Photon Microfabrication</td>
<td>Shigl Maruo</td>
<td>1F</td>
</tr>
<tr>
<td>WE2-2</td>
<td>11:00 - 11:30</td>
<td>Lab-on-a-chip for Optical Manipulation of Single Cells</td>
<td>Roberto Osellame</td>
<td>1F</td>
</tr>
<tr>
<td>WE2-3</td>
<td>11:30 - 12:00</td>
<td>Integrating Functional Components Into Microfluidic Channels by Laser Nanofabrication Technologies Toward High-performance LoCs</td>
<td>Ben-Bin Xu, Hong Xia, Qi-Dai Chen, Yong-Lai Zhang, and Hong-Bo Sun</td>
<td>1F</td>
</tr>
<tr>
<td>WF2-1</td>
<td>10:30 - 11:30</td>
<td>Precision Measurement with Optical Frequency Comb and Clocks</td>
<td>T. Herr</td>
<td>1F</td>
</tr>
<tr>
<td>WF2-3</td>
<td>11:30 - 12:00</td>
<td>Fiber Laser Driven Mid-Infrared Frequency Combs</td>
<td>Ingrid Hart</td>
<td>1F</td>
</tr>
</tbody>
</table>

**Session Chair:** Koji Sugioka (RIKEN, Japan)
### Oral, Wednesday, July 3

<table>
<thead>
<tr>
<th>Room J</th>
<th>2F</th>
<th>[WS2] 10:30 - 12:00</th>
<th>Symposium</th>
<th>Fiberoptic Technologies for the Next Era II (Mode Control Technology)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS2-1</td>
<td>10:30 - 11:00</td>
<td>Oral, Wednesday, July 3</td>
<td>Scaling Capacity by Twisting Light Beams</td>
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<td>Siddharth Ramachandran, Paul Kristensen</td>
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<td>1 Photons Center &amp; ECE Dept., Boston Univ., MA, USA, 2 OFS Fiel Apis, Brandy, Denmark</td>
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<td>WS2-2</td>
<td>11:00 - 11:30</td>
<td>Oral, Wednesday, July 3</td>
<td>Photonic Lanterns Multimode to Single-Mode Converters: From Astronomy to Communications</td>
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<td>Sergio G. Leon-Saval, Leondidas X. Konstantinou</td>
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<td>1 Dept. of Physics, University of Sydney, Australia</td>
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<td>WS2-3</td>
<td>11:30 - 12:00</td>
<td>Oral, Wednesday, July 3</td>
<td>Spatial Mode Excitation and Separation Using Spatial Phase Control Technology</td>
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<td>Atsushi Okamoto, Atsushi Tomita, Kento Kawabata and Yuta Wakisaka</td>
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<td>1 Graduate School of Information Science and Technology, Hokkaido University, Sapporo, Japan</td>
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<td>Computer-generated holography is actively used to generate the spatial mode distribution required for mode excitation and hologram writing. In addition, we propose a new transmission scheme using the phase conjugation technology.</td>
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<tr>
<th>Room K</th>
<th>2F</th>
<th>[WT2] 10:30 - 11:45</th>
<th>OXC and Related Technologies</th>
<th>Oral, Wednesday, July 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>WT2-1</td>
<td>10:30 - 11:00</td>
<td>Oral, Wednesday, July 3</td>
<td>Efficient Photonic I/O for Data Communication</td>
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<td>1 Dept. of Elect. &amp; Comp. Eng., McGill Univ., QC, Canada</td>
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<td>WT2-2</td>
<td>11:00 - 11:15</td>
<td>Oral, Wednesday, July 3</td>
<td>Evaluation of Hardware Requirements for Large-scale OXC Architecture Employing Wavelength Switching and Fiber Selection</td>
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<td>Toshinori Ban, Hao Chou, Hiroshi Hasegawa, and Ken-ichi Sato</td>
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<tr>
<td>WT2-3</td>
<td>11:15 - 11:30</td>
<td>Oral, Wednesday, July 3</td>
<td>Development of Ultra-Compact 8x8 Waveband Cross-connect</td>
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<td>Kousuke Takada, Toshinori Ban, Hiroshi Hasegawa, Ken-ichi Sato, Hiroshi Takahashi, and Masayuki Okubo</td>
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<td>We develop an ultra-compact 8x8 waveband cross-connect prototype which consists of eight optical couplers and eight 1x8 waveband selective switch modules that are monolithically integrated on PLC chips. Experiments verify the transmission performance.</td>
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<tr>
<td>WT2-4</td>
<td>11:30 - 11:45</td>
<td>Oral, Wednesday, July 3</td>
<td>Fundamental Switching Operation of Polymer Three-Dimensional Optical Interconnection Switch</td>
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<td></td>
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<td>K. Kikuchi, T. Kodera, G. Kawai, M. Ando, Y. Iwama, and U. Ueda</td>
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<td>1 Faculty of Science and Engineering, Waseda Univ., Tokyo, Japan, 2 Green Computing Systems Research Organization, Waseda Univ., Tokyo, Japan</td>
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<td>We proposed a 2×2 polymer three-dimensional (3D) optical interconnection switch. The analysis of our device shows colorless scalability, and it successfully operated at 1550nm wavelength.</td>
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<tr>
<th>Room 101</th>
<th>1F</th>
<th>[WH2] 10:30 - 12:00</th>
<th>DUV-LEDs and Efficiency Improvements</th>
<th>Oral, Wednesday, July 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>WH2-1</td>
<td>10:30 - 11:00</td>
<td>Oral, Wednesday, July 3</td>
<td>Droop Studies for High-Performance InGaN Blue Light-Emitting Diodes</td>
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<td>Jong-In Shim, Hyungsun Kim, Dong-Pyo Han, and Dong-Soo Shin</td>
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<td>1 Dept. of Electronics &amp; Communication Eng., Hanyang Univ., ERICA campus, Ansan, Republic of Korea, 2 Dept. of Applied Physics, Hanyang Univ. , ERICA campus, Ansan, Republic of Korea</td>
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<tr>
<td>WH2-2</td>
<td>11:00 - 11:15</td>
<td>Oral, Wednesday, July 3</td>
<td>AIGaN-based Deep-UV LEDs Fabricated on Connected-Pillar AlN Buffer</td>
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<td>H. Noguchi, T. Takano, S. Fujita, S. Fukase, and N. Kamata</td>
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<td>1 RIKEN (The Inst. of Physical and Chemical Research), Saitama, Japan, 2 Saitama Univ., Saitama, Japan</td>
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<tr>
<td>WH2-3</td>
<td>11:15 - 11:30</td>
<td>Oral, Wednesday, July 3</td>
<td>Improvement of Light-Extraction Efficiency of Deep-UV LEDs Using Transparent p-AlGaN Contact Layer</td>
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<td>Norihito Matuda and Hideki Hirayama</td>
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<td>Saitama Univ., Saitama, Japan</td>
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<td>We demonstrated deep-UV light-emitting diodes with emission wavelengths at around 260 nm using transparent p-AlGaN contact layer and reflective p-type electrode. The reflectivity of p-type electrode was increased from 30% to 70% by introducing Ni(1nm)/Al metal layers.</td>
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<tr>
<td>WH2-4</td>
<td>11:30 - 11:45</td>
<td>Oral, Wednesday, July 3</td>
<td>Numerical Investigation of Light Extraction Efficiency in AIGaN Deep Ultraviolet Light-Emitting Diodes</td>
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<td>Hoon-Youl Ryu, Kyu Chul Hong, Soo Shin, and Jong-In Shim</td>
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<td>1 Dept. of Physics, Inha Univ., Incheon, Korea, 2 Dept. of Electronics and Communication Engineering, Hanyang University, Ansan, Korea, 3 Seoul Opto Device Company, Ansan, Korea</td>
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<tr>
<td>WH2-5</td>
<td>11:45 - 12:00</td>
<td>Oral, Wednesday, July 3</td>
<td>Development of Highly-Uniform 270-nm Deep-Ultraviolet Light-Emitting Diodes</td>
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<td>1 The Inst. of Physical and Chemical Research (RIKEN), Saitama, Japan, 2 Eco Solutions Company, Panasonic Corporation, Osaka, Japan</td>
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<td>Development of high-quality and highly-uniform AlN/sapphire templates by using a Ni, pulsed-flow method enabled the fabrication of highly uniform 270-nm AIGaN-based deep-ultraviolet light-emitting diodes with the external quantum efficiency of over 2%.</td>
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</tbody>
</table>
WG2-1 10:30 - 10:45
Long-term Field Demonstration of WDM Quantum Key Distribution System with Control Center
NICT Corporation, Kawasaki, Japan
NICT, Inst. of Information and Communications Technology, Tokyo, Japan
HIKARI-net, University of Tokyo, Japan
A wavelength-division multiplexing quantum key distribution system with control center was demonstrated through a 22-km field fiber in live-24 hours continuous operation. Quantum bit error rates were kept below 3% in all key blocks.

WG2-2 10:45 - 11:00
Real-world two-photon interference and proof-of-principle QKD immune to detector attacks
A. Rubenok, J. A. Slater, C. Chen, P. Chan, J. Lucio-Martinez, and W. Yeh
Inst. for Quantum Science and Technology, and Dept. of Physics & Astronomy, Univ. of Calgary, Alberta, Canada, Institute for Quantum Science and Technology, and Dept. of Physics & Astronomy, Univ. of Calgary, Alberta, Canada
We demonstrate Bell state measurements between independent sources over deployed fiber. With this we demonstrate a new QKD protocol that provides security against any detector attack. Our demonstration serves as a test bed for quantum repeaters and networks.

WG2-3 11:00 - 11:15
High Secure Network Switch with Quantum Key Distribution System
M. Fujikawa, T. Demelik, R. Nojima, and M. Sasaki
NICT, Inst. of Information and Communications Technology, Tokyo, Japan
NICT communication systems, Miyagi, Japan
We have developed quantum key distribution based network switches. In the layer 2 switch, MAC addresses are encrypted to prevent illegal access from internal network. In layer 3, secure key are used in IPSec protocol.

WG2-4 11:15 - 11:30
Ultrafast modulator and quantum interference for telecom-wavelength single-photon switches
K. Kamae, S. Endo, R. Akamatsu, N. Nakamura, S. Shiina, and Junsuke Inoue-Hayase
Dept. of Applied Physics and Physics-Information, Keio Univ., Kanagawa, Japan
NICT, Inst. of Information and Communications Technology (NICT), Tokyo, Japan
We succeeded in the first-time use of 1/4 phase change to a 1-km long fiber to create two quantum dot single photon pairs using electro-optic technique in the telecom wavelength range. Our low-loss and low-chirp possibility of ultrafast modulator appears promising.

WG2-5 11:30 - 11:45
High Efficiency Single Photon Frequency Conversion in the Telecommunications Band
Alex D. Clarke, Shanen Shalhais, Matthew J. Collins, Charlie Xiong, and Benjamin J. Eggleton
Center for Ultrabroadband Devices for Optical Systems (CUDOS), the Inst. of Photonics and Optical Science (IPOSC), Univ. of Sydney, Australia
We present the first near unit efficiency demonstration of single photon frequency conversion through Bragg scattering through a dispersion engineered highly nonlinear fiber.

WG2-6 11:45 - 12:00
Telecom-band Michelson-type Two-Photon Interferometer with Photonic-Number-Resolving Single-Photon Detection
A. Yoshizawa, D. Fukudai, and H. Tsuchida
Inst. of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan
Experimental evaluation of a fiber-optic Michelson-type two-photon interferometer operating at 1550 nm was presented using a superconducting transition edge sensor as a photon-number-resolving single-photon detector. We monitored two-photon detection events to observe photon-bunching.

WG2-1 10:30 - 12:00
Quantum Communication
（Session Chair: Akhiva Tomita (Yokohama National Univ., Japan)

WG2-2 10:45 - 11:00
High-speed low-driving-power electroabsorption modulator for microwave photonic communications
Yin Jun Zhou and Jun Kim
Inst. of Electro-Optic Engineering, Nanyang Sun Yat-Sen Univ., Kaohsiung, Taiwan A.O.C.
Progresses of high-speed low-driving-power EAM has been reviewed. Microwave design issues have been addressed. Low power with less than 1Wp and above 40Gb/s operation has been attained with special design of waveguide structure.

WG2-3 11:00 - 11:15
Low Driving Voltage InP DFB-Driven Mach-Zehnder Modulators for Compact 1310nm DP-DPSK Module
Takahiro Yagi, Takanori KITAMURA, Naruyoshi KIKUNO, Hirokazu KOGAMI, Masakazu KADZU, Kazunori NAKAYA, Takeshi KOBAYASHI, Yukihiro YOKOSI, Chihiro FUJIBAYASHI, Rentaro Tanaka, and Takeshi OHTSUBO
Television Broadcast System Laboratory, Communications Research Laboratory, NICT, Tokyo, Japan
We demonstrated a low-V operation DP-DPSK module successfully integrated with high-speed photodetector and receiver. Our test of Mach-Zehnder modulators experiment shows a stable operation at 1.15GHz with 1Vpp driving voltage.

WG2-4 11:15 - 11:30
Low Power Multi-level InP MODM with S1-Line Centricity Structure Directly Driven by CMOS IC
Tomiyo Yamasaki, Minako Hato, Hidenori Koyama, Tatsuya Sato and Tomoyuki Kato
Graduate School of Information Science Research Laboratories, NICT Corporation, Kawasaki, Japan
We proposed a methodology; to drive in-line centric electro-absorption waveguides with both temperature-code and DAC signals to achieve desired resolution without compromising footprint, operation speed, and power consumption.

WG2-5 11:30 - 11:45
Sub-1V and Sub-10μm Electro-absorption Modulator Based on Bragg Reflective Waveguide
Kazuyuki Saito, Yuji Ueda, Tatsuo Okazaki, Kenji Kashiwagi, Hisakazu Ohsawa, and Fumio Koyama
Photonics Integration System Research Center, Precision and Intelligence Laboratory, Graduate School of Engineering, Yokohama National University, Kanagawa, Japan
An ultra-compact electro-absorption GaAs/GaAlAs DHZ modulator based on a small-size Bragg reflector waveguide was fabricated. A low driving voltage below 0.5V was demonstrated for a 50um long device.

WG2-6 11:45 - 12:00
25Gb/s Sub-MW-4 Electro-absorption Modulator Laterally Integrated with VCSEL
Yoshimizu Shimada, Toshikiyo Fujima, Masayuki Iwata, and Fumito Koyama
Photonics Integration System Research Center, Precision and Intelligence Laboratory, Tokyo Inst. of Technology, Yokohama, Japan, Semiconductor and MBE Processing Center, Technical Dept., Tokyo Inst. of Technology, Tokyo, Japan
An ultra-compact GaAlAs/GaAs electro-absorption modulator with small-size Bragg reflector waveguide was laterally integrated with VCSEL. A driving voltage below 1V was demonstrated and a possibility of an ultra-compact modulator below 10um was presented.

WG2-1 10:30 - 12:00
Si Photonic Devices
（Session Chair: Hikotaro Kawaguchi (National Inst. of Advanced Industrial Science and Technology, Japan)

WG2-2 10:45 - 11:00
Si Wire Array Waveguide Grating with Reduced Phase Error: Effect of advanced lithography process
Jun Zou, Xianwen Jiang, Yingying Li, and Jian-Jun He
State Key Laboratory of Modern Optical Instrumentation, Inst. for Opto-Electronic, Peking Univ., Beijing, China
1 State Key Laboratory of Modern Optical Instrumentation, Inst. for Opto-Electronic, Peking Univ., Beijing, China
We demonstrate a new QKD protocol that provides security against any detector attack. Our demonstration removes an obstacle for quantum repeaters and networks.

WG2-3 11:00 - 11:15
Ultra-Compact Arrayed Waveguide Grating Triplexer Based on Silicon-on-Insulator Platform
Kuni Atsumi, Tatsuki Siff, Jiro-Hyun Kong, Yusuke Hayashi, Nobuhiko Nishiyama and Shigehisa Arai
Dept. of Electrical and Electronic Engineering, Tokyo, Japan, Quantum Nanoelectronics Research Center (QNRC), Tokyo Inst. of Technology, Tokyo, Japan
Wavefront steering for the ultra-compact silicon-on-insulator platform is demonstrated. We report the Si wire-ASR without systematic phase error generated at the curved waveguides. A 200GHz spaced 16 channels were fabricated through AHP immersion and EB lithography and the results are compared.

WG2-4 11:15 - 11:30
Micro-ring silicon nanowire resonator with optical feedback and dispersion engineering
J.M. Chavez Bogarin, R. Eisermann, D. Bodenmüller, F. Fremberger, R. Haynes, L. Kupfer, R. Henniger, and F. Fremberger
1 innoFSPEC-VKS, Leibniz-Institut fur Astrophysik Potsdam (AIP), Potsdam, Germany, 1Institute of Electrical Engineering, Tsinghua University, Beijing, China, 1Institute of Optoelectronics and Quantum Electronics, Leibniz-Institut fur Astrophysik Potsdam (AIP), Potsdam, Germany
We report the Si wire-ASR without systematic phase error generated at the curved waveguides. A 200GHz spaced 16 channels were fabricated through AHP immersion and EB lithography and the results are compared.
We show that joint symbol synchronization and channel polarizations of a 20-Gb/s-PDM-RZ-DPSK signal at up to 40 the unknown interchannel phase. We distribute the interchannel

In PDM-DPSK systems, polarization interference depends on

We experimentally demonstrate the wireless OFDM signal

We propose second-order-polarization-mode-dispersion estimation technique for

We experimentally show optically filtered lasers reduce OSNR penalty due to phase tracking error up to 3 dB for two parallel decision directed algorithms with feedback delay in an 11 Gbaud/s 16QAM coherent system. 

We experimentally demonstrate the OFDM signal visible light transmission

We have demonstrated its functionality through CARS imaging experiments. 

We have proposed and fabricated high-index-contrast AlGaAs/Alox waveguides with inversion-stacked core structure for higher-order modal phase-matched second-harmonic generation at 1.55 μm.

We have investigated UV-induced degradation of CsLiB$_6$O$_{10}$ at 266 nm and discuss the mechanism and origin of the degradation. We found that reduction of the point defects distributed inside the crystal can slow down the degradation.

We report a picosecond near-IR laser source based on a Self-seeded Optical Parametric Generator

We report the recent advances in fabrication of ferroelectric domain gratings of sub-μm periodicity in KTP and Pb-doped KTP for counter-propagating second-order nonlinear optical interactions. Their performance as QPM devices will be discussed.
We demonstrated a high contrast 1053 nm femtosecond laser by exchanging the Inst. of Physics, Chinese Academy of Sciences, Beijing, China. We report highly efficient generation of wavelength tunable femtosecond pulses from Broadband Conversion From Red to Mid-infrared in a 11F 15:15 - 15:30

Multimodal Parametric Synthesizer Generating Two-Octave-Wide Optical Waveforms Shadou Fang 1, Giovanni Ormi 1, 2, Shih-Huan Chia 1, 2, Oliver D. Mucke 1, 2, Franz X. Kärner 1, 2, Cristian Manzoni 1, 2, Paolo Ferrando 1, 2 and Giulio Cerullo 1, 2

1 Center for Free-Electron Laser Science, Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany, 2 Dept. of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Inst. of Technology, Cambridge, MA, USA. 3 INR-CNRS, Dipartimento di Fisica, Politecnico di Milano, Milan, Italy

We demonstrate a phase-stable, multimodal 3-channel parametric synthesizer generating a 2-octave-wide spectrum (0.52-2.4 μm). After two amplification stages, the combined 500 μJ output supports 1.9 fs waveforms. Energy scaling to 2 μJ is achieved after three amplification stages.

Broadband Conversion From Red to Mid-infrared in a High-Power Femtosecond Fiber Laser-Pumped OPO Myung Ho Cho, Cheolgyu Lee, Lingxue Zhang, Jhongfan and Ching-Yang Hsu

We report highly efficient generation of wavelength tunable femtosecond pulses from red to mid-infrared based on intracavity second harmonic generation (SHG) and sum frequency generation (SFG) in a KTP optical parametric oscillator (OPO).

Pulse characterization with absolute carrier-envelope phase value \( T. Fuji \) and \( Y. Nomura \)

Inst. for Molecular Science, Okazaki, Japan

A new pulse characterization concept capable of measuring complete waveforms of ultrashort pulses has been demonstrated. Sub-single-cycle pulses were characterized including absolute carrier-envelope phase value by using the method.

Generation of Femtosecond Laser Pulse in Ring Resonator and Compact Ratio of 10\(^{-6}\) by Optical Parametric Amplification Zhongwei Shen, Zhihong Wang, Wei Zhang, Xiaotao Fan, Hao Tang, and Zhihong Wu

Beijing Natl Laboratory for Condensed Matter Physics and Inst. of Physics, Chinese Academy of Sciences, Beijing, China

We demonstrated a high contrast 1053 nm femtosecond laser by exchanging the carriers in the time domain and the other in the frequency domain.

High-Resolution, Dual-Comb Asynchronous Sampling Enabled by Dual-Wavelength Ultrashort Fiber Lasers and Its Applications Zheng Zhang and Xin Zhao

School of Electronic and Information Engineering, Beihang Univ, Beijing, China

Novel dual-wavelength mode-locked fiber lasers could enable alternative asynchronous sampling schemes for some interesting dual-comb metrology applications including absolute distance measurement, speckle suppression and device characterization with a significantly simplified setup.

Development of Fiber Femtosecond Lasers for Advanced Metrological Space Missions Young-Jin Kim, Keunwoo Lee, Seongheum Han, Yoon-Soo Jang, Heesuk Jang, and Seung-Woo Kim

Ultrashort Pulse for Ultrashort Group, Dept. of Mechanical Engineering, Korea Advanced Inst. of Science and Technology (KAIST), Daejeon, Korea

The recent advance of femtosecond lasers attracts much attention to extend today’s space missions. In this presentation, we introduce how femtosecond lasers are being investigated for space explorations for the next generation space missions.

Adaptive Optical Network Engineering: Bridging the Gap Between Research, Standards and Industry L. Carugati

Alcatel-Lucent, Nanos, France

To fill the gaps between research, standards and industry, effort involving all stakeholders and a systematic roadmap are required. We highlight three essential requirements: a unified management framework, building trust from network operators and standardization.

Adaptability of Virtual Network Topology Control Based on Attractor Selection against Multiple Node Failures Yuki Kojima, Shichiro Arakawa, Shota Kamamura, Dakai Shimagaki, Takashi Miyamura, and Masayuki Murata

Graduate School of Information Science and Technology, Osaka Univ., Osaka, Japan, NTT Network Service Systems Laboratories, NTT Corporation, Tokyo, Japan

We propose an adaptive virtual topology control method. It is based on attractor selection, which models the adaptive behavior of biological systems. Simulation results indicate that our methods is highly adaptive against node failures.
### Room J 2F

**[WS3] 14:30 - 16:00 Doped Fibers and Devices**

Session Chair: Shokohi Maduosi (Fukukura Ltd., Japan)

- **Experimental Study of Wavelength-dependent Dynamic Gain Offsets of AIGC WDM EDFA**
  - Youngwoong Kim
  - Dept. of Photonics, National Sun Yat-sen University, Kaohsiung, Taiwan, 804
  - We report on new results for the experimental study of wavelength-dependent dynamic gain offsets of AIGC WDM EDFA, which are induced differently depending on the active channel allocation. The experimental results confirm the theoretical predictions and the impact of dynamic gain offsets on amplifiers in optical networks.

- **Fabrication of Ce-Doped Fibers by Using Rod-in-Tube Technique with Drawing Tower**
  - Jong-Yeol Kim
  - Dept. of Physics and Photon Science/School of Information and Mechatronics, Gwangju Institute of Science and Technology, Gwangju, Republic of Korea, 500-712
  - Seongmin Ju
  - Youngwoong Kim
  - Jong-Yeol Kim
  - We report on the fabrication of Ce-doped fibers using the rod-in-tube technique with a drawing tower. The fabricated fibers exhibit a tunable absorption and a high emission efficiency under UV light.

- **Nanobendable Microring Resonators**
  - Ryojioto Harada
  - Dept. of Energy Science, Kyushu University, Fukuoka, Japan, 819-0395
  - We report on the fabrication of nanobendable microring resonators using a new technique that allows for the creation of high-quality microring resonators with a radius as small as 1 μm.

- **Influence of Inhomogeneity on the Gain Characteristics of Doped Fiber Laser**
  - Chi-Hwan Song
  - Dept. of Electronics, Kyungpook National University, Daegu, Korea, 702-701
  - We report on the influence of inhomogeneity on the gain characteristics of doped fiber lasers and discuss the implications for future laser applications.

- **Doped Fiber Lasers for Medical Applications**
  - Jun-Chan Lee
  - Dept. of Photonics Engineering, National Taiwan University, Taipei, Taiwan, 106
  - We report on the development of doped fiber lasers for medical applications, with a focus on their potential for use in imaging and diagnostics.

### Room K 2F


Session Chair: Hiroaki Uenohara (Precision and Intelligence Photonics Research Laboratory, Opto-Electronics Division, Kirin Corporation, Tokyo, Japan)

- **The Role of Photonics in Future Computing Systems and Data Centers**
  - S.J. Benn Yoo
  - Dept. of Electrical and Computer Engineering, Univ. of California, CA, USA
  - We discuss new computing architectures, control planes, productivity, performance enhancements based on simulation and experimental studies.

### Room 101 1F

**[WH3] 14:30 - 15:00**

- **1 W AlInGaN Based Green Laser Diodes**
  - Shinro Masui, Takuaki Miyoshi, Tomoya Yanamoto and Shin-ichi Nagahama
  - Nichia Corporation, Tokushima, Japan
  - We succeeded in demonstrating AlInGaN based 1W 525 nm green laser diodes on n-face GaN substrates. The wall-plug efficiency was 14.1%. The lifetime was estimated to be over 15,000 h.

- **Local Photoluminescence Properties of InGaN Green Laser Structure on (0001) GaN Substrate**
  - Akira Kaneta, Tatsuki Hira, Ken Senseki, Katsutoshi Furata, Yoichiro Kawaihara, Takuaki Miyoshi and Shin-ichi Nagahama
  - Dept. of Electronic Science and Engineering, Kyushu Univ., Fukuoka, Japan
  - Advanced Semiconductor Research Laboratory, Opto-Electronics Division, Kirin Corporation, Tokyo, Japan
  - The spatial variation of the PL intensities and peak wavelengths are drastically suppressed in InGaN green laser structure fabricated on (0001) GaN substrate. This result is thought to contribute to low threshold current density.

- **Advances in single mode, high frequency and high power AlGaN-based laser diodes**
  - TopGaN Ltd., Wolmar, Poland, 08010, Inst. of High Pressure Physics PAS, Warsaw, Poland
  - E. Altmann, S.A., Warsow, Poland, School of Engineering, Univ. of Gloucester, Gloucester, UK
  - Latest developments in single mode, high frequency and high power AlGaN laser diode technology are presented with single transverse mode operation up to 100 kW. Higher powers up to 4 kW is achieved in a bar.

- **GaInN Laser Structure with Semipolar Quantum Wells and Embedded Nanostripes**
  - R.A.R. Leuthe, L. Mittel, G. Giebel, S. Kaeser, M. Muller
  - Inst. of High Pressure Physics PAS, Warsaw, Poland, 00-681
  - Central Facility of Electron Microscopy, Ulm University, Ulm, Germany
  - Using high resolution microscopy, we fabricate GaInN nano-structures with semipolar quantum wells and embedded nanostripes to study the electronic properties and carrier confinement in the quantum wells.

- **GaInN/GaAs Quantum Cascade Laser Structures**
  - W. Terashima and H. Hisayama
  - Quantum Photonics Laboratory, RIKEN, Saitama, Japan
  - Terahertz Quantum Device Laboratory, RIKEN, Saitama, Japan
  - Terahertz emissions at 1.3 to 2.8 THz were achieved at GaInN/GaAs quantum cascade laser structures. From investigations of polarization and voltage dependence electroluminescence (EL) measurements, we proved conclusively intersubband nature of the EL peak.
### WC3-1 14:30 - 15:00
**High-Power Terahertz Pulse Generation and Application to Nonlinear Spectroscopy**

**Speaker:** Tomohiro Kondo, Osaka Univ., Japan

We have recently developed novel generation methods of intense terahertz single cycle pulses with the maximum electric field larger than 1 MV/cm, which enables us to perform nonlinear terahertz spectroscopy in solids.

### WC3-2 15:00 - 15:15
**Near-infrared Pulse Induced Modulation of Quantum Cascade Lasers**

**Speaker:** Hiroshi Ogasawara, Chubu Univ., Japan

We have demonstrated amplitude modulation of terahertz quantum cascade lasers by means of the injection of near-infrared laser pulses. Injected 818nm and 1350nm laser pulses had greatly suppressed the output power.

### WC3-3 15:15 - 15:30
**Operation Temperature and T, Improvement of GaAs/AlGaAs THz QCL by Utilizing Higher Al Composition Barriers**

**Speakers:** T. Kato, S. Sato, and T. Nonomura, Osaka Univ., Japan

The current eaisu of THz QCLs is their limited Tmax near 200K. Here we propose the process of operation temperature performance improvement by utilizing Al composition in AlGaAs THz QCLs.

### WC3-4 15:30 - 15:45
**Theoretical Study on Isotope-selective Excitation of Diatomic Molecules by Terahertz Frequency Comb**

**Speakers:** H. S. Kim, T. Kondo, and Y. Kondo, Osaka Univ., Japan

Using a terahertz frequency comb, we have demonstrated the isotope-selective excitation of diatomic molecules. The comb is generated by a high repetition rate TEA CO2 laser and consists of multiple frequency components with a small frequency spacing of 0.44 THz. The isotope-selective excitation is achieved by the selective excitation of the vibrational ground state of the molecule.

### WC3-5 15:45 - 16:00
**Frequency-Locked Optical Two-Tone THz Signal Generation with Optical Frequency Comb and Injection-Locked Laser**

**Speaker:** E. T. Kanno and Y. Kanno, Osaka Univ., Japan

We propose an optical two-tone signal generation using an injection locking technique applied to an optical frequency comb source. An improved optical signal-to-noise ratio of greater than 10 dB is achieved.

### WJ3-1 14:30 - 15:00
**Visualization of Microvessels and Capillary Bed Associated with Brain Activation**

**Speakers:** T. Tatsuno, T. Hasegawa, K. N. Yamaura, N. Takeda, T. Matsuzawa, N. Nakajima, T. Kato, T. Kato, and T. Kono, Japan

An impulse generated by focusing femtosecond laser under microscope was applied to investigation of time evolution of cell-cell adhesion force. From the result, we could discuss the sequence of adhesion process with individual difference of cells.
Low-dimensional Carbon Nanostructure-Based Saturable Absorbers for Ultrashort Pulse Lasers
F. Bertolotti 1, B. Shao 1, Z. Liu 1, R. Gwaltney 1, F. Jansen 1, and K. Mäder 1
1 Dept. of Electrical and Computer Engineering, Univ. of California at San Diego, La Jolla, USA,
2 National Institute for Applied Science, Daejeon, South Korea
We report mode-locking of an Erbium-Doped Fiber Laser incorporating a Graphene Oxide-Doped-SiC-Chip saturable absorber.

Passive Mode-locking of a Monolithic Waveguide Laser with Simultaneous Q-Switching
G. Brown, M. Tran, N. Duong, A. Dang, S. Ngoc, M. Tran, and D. Tran
School of Photonics and Quantum Sciences, Heriot-Watt Univ., Edinburgh, United Kingdom
We demonstrate passive mode-locking of an Erbium-Doped Fiber Laser using a single nanobead deposited on the facet of a right-angle optical waveguide.

Mode-locking Using Right-angle Waveguide, Based Nanobead Saturable Absorber
1 Inst. of Photonics and Quantum Sciences, Heriot-Watt Univ., Edinburgh, United Kingdom
2 Future Convergence Research Division, Korea Inst. of Science and Technology, Seoul, South Korea
We sequentially present a passive (Q-switched), mode-locked fiber laser incorporating a graphene oxide (GO) doped side-pumped SiC chip.

Passive Mode-locking of a Microlaser with Simultaneous Q-Switching
1 Inst. of Photonics and Quantum Sciences, School of Physics and Physical Sciences, Heriot-Watt Univ., Edinburgh, UK
2 Asahi Glass Co., Ltd. Research Center, Kagamigawa, Japan.
A compact waveguide laser in ytterbium doped bismuthate glass is demonstrated. Mode-locked pulses of 1.065 GHz pulse repetition rate are obtained within a Q-switched pulse envelope that follows a repetition rate of 400 kHz.

PASSIVELY MODE-LOCKED AND Q-SWITCHED LASERS
Session Chair: Peter Wessels (Laser Zentrum Hannover e. V., Germany)

Oral, Wednesday, July 3
WB4-1 16:30 - 17:00
High-Speed Holographic 3D Sensing for Fast Phenomena by Parallel Phase-Shifting Interferometry
Takashi Kofuji and Yashiro Aoshima
Graduate School of Engineering, Chiba Univ., Chiba, Japan; Graduate School of Science and Technology, Kyoto Inst. of Technology, Kyoto, Japan
Thanks to parallel phase-shifting digital holography using a high-speed camera, we succeeded in phase-shifting interferometry at the rate of up to 100,000-150,000 fps. Motion pictures of three-dimensional images of fast phenomena are demonstrated.

WB4-2 17:00 - 17:15
High-Speed Multi-Color Three-Dimensional Motion Picture Recording by Multi-Phase Dual-Annihilation Phase Unwrapping
Tomohiro Maeda, Atsuhito Okamato, Yuki Horikasi, Yuji Watazaki, and Masatoshi Busumi
Graduate School of Information Science and Technology, Hokkaido Univ., Sapporo, Japan; Dept. of Electronic Engineering and Computer Science, Hokkaido Univ., Sapporo, Japan
We present an interference method for recording three-dimensional motion pictures composed of multiple images of different colors simultaneously. The method is based on parallel phase-shifting dual-annihilation phase unwrapping. The effectiveness of the proposed method was numerically verified.

WB4-3 17:15 - 17:30
Holographic Intensity Interferometry for Reference-Free Phase Detection
Tomohiro Maeda, Atsuhito Okamato, Akihisa Tomita, Yuki Horikasi, Yuji Watazaki, and Masatoshi Busumi
Graduate School of Information Science and Technology, Hokkaido Univ., Sapporo, Japan; Dept. of Electronic Engineering and Computer Science, Hokkaido Univ., Sapporo, Japan; Kyutek Inc., Kyoto, Japan; Kubota Holography Laboratory, Kyoto, Japan
Reference-free phase detection is demonstrated using advanced holographic interferometry in which a virtual light source is locally produced from an object light source through taking samples to simultaneously generate two phase-shifted interferograms.

WB4-4 17:30 - 17:45
Modes of Ultrashort Optical Pulses in an Anisotropic Crystal
Masakazu Suzuki, Kazuaki Yamana, Yasuhiro Awatsuji, and Kenzo Nishio
Dept. of Applied Physics, Hokkaido Univ., Sapporo, Japan; JST, CREST, Sapporo, Japan
We investigated nonlinear propagation of ultrashort optical pulses with radially- and azimuthally-polarized modes in a uniaxial crystal. The energy exchange between the modes, ascribed to nonlinear four-wave-mixing effect with Gouy-phase shifts, is discussed.

WB4-5 17:45 - 18:00
Optical Information Processing with Spatially Resolved Orbital Angular Momentum
Masayuki Tsutsumi, Hidetoshi Kato, Yasuhiro Awatsuji, Kenzo Nishio, and Shogo Ura
Kubota Holography Laboratory, Kyoto, Japan; Kyutek Inc., Kyoto, Japan; Kubota Holography Laboratory, Kyoto, Japan; Kubota Holography Laboratory, Kyoto, Japan
We propose a method to extend the space bandwidth of parallel-phase dual-annihilation digital holography using a commercially available projection imaging camera. The effectiveness of the proposed method was numerically and quantitatively verified.

WB4-6 18:00 - 18:15
Observation of Continuously Tuning of the Phase-Difference and Separation of Bound Solitons From a Carbon-Nanotube Mode-Locked Fiber Laser
Zhong Gong, Xin Zhao, Qi Wang, Xiaosheng Li, and Zheng Zeng
National Laboratory of Information and Electronic Engineering, Beihang Univ., Beijing, China
Continuously tuning the phase-difference and separation of bound solitons have been realized from a passively mode-locked fiber laser using a carbon nanotube modulator through intracavity gain-tuning tuning.

WB4-7 18:15 - 18:30
Surface-enhanced Broad-band Real-Time Vibrational Spectroscopy
J. Xu, J. Shi, T. Kikuno, M. Velek, and M. Kusumoto
Umeå Laser Research Center, Umeå Univ. of Communications, Umeå, Sweden; Dept. of Chemistry and Science Technology, Umeå Univ., Umeå, Sweden; Optics Technology Dept. of Physics, Umeå Univ. of Technology, Umeå, Sweden
Using the ultrahigh excitation, surface-enhanced effect on the dynamics of vibrational modes coupled to the electronic transition of the lowest excited singlet in MEH-PPV has been studied in MEH-PPV-functionalized nanotubes for the first time.

WB4-8 18:15 - 18:30
High-frame-rate Wavemfront Sensor Based on Flexible Read-Out Technique for C-MOS Image Sensor
Jiro Suzuki, Toshiko Kuida, and Takao Ikuno
Information Technology R & D Center, Mitsubishi Electric Corporation, Kanagawa, Japan
High-frame-rate Shack Hartmann wavefront sensor with a C-MOS image sensor adopted the flexible read out technique.
WS4-2 17:00 - 17:15
Real-time, high fidelity conversion of ultrafast waveforms in a PPLN time-space processor
Dan M. Marios, 1 Dror Shayevitz, 2 Harald Herrmann, 3 Wolfgang Stöhrer, 1 Raimund Ricken 1 and Christine Silberhorn 1
Dept. of Applied Physics, Hebrew Univ. of Jerusalem, Jerusalem, Israel, 1 Dept. of Applied Physics, The Univ. of Paderborn, Paderborn, Germany, 3 State Key Laboratory of Modern Optical Instrumetnation, Zhejiang Univ., Zhejiang, China.
We report a correlation matching algorithm for position detection of optical vortices using a Shack-Hartmann wavefront sensor. The accuracy experientially confirmed was 0.056, in units of lens-size of lenslet array used in the wavefront sensor.

WS4-3 17:15 - 17:30
Fabrication of MgO:LiNbO3 Domain Inverted Structures with Short Period and Application to Electro-Optic Bragg Defect Modulator
Toshikiyo Inoue, and Toshiyuki Suhara
Graduate School of Engineering, Osaka Univ., Suita, Japan.
We fabricated high-quality MgO:LiNbO3 waveguides. Their short period fabricated with the wavelength of C-band. These results show the feasibility of the optical Bragg deflection modulator.

WS4-4 17:45 - 18:00
Fourier transform optically controlled phased array antenna
Tomohiro Akikawa, Toshikiyo Inoue, and Toshihito Hirano
Mitsubishi Electric Corporation, Kanagawa, Japan.
Optically controlled beam forming techniques are effective for phased antenna array control. We have developed the Fourier transform (FT) optical beamformer and demonstrated in the C-band. These results show the feasibility of the optical beamformer.

WS4-5 17:30 - 17:45
Suppression of fiber fuse propagation and its break in compact fiber fuse terminator
Katsunori Yokoyama and Katsutoshi Nakazawa
NTT Access Network Service Systems Laboratories, NTT Corporation, Tokyo, Japan.
We confirmed fiber fuse termination using a fiber fuse terminator consisting of a 1.4 mm-long HAP at a 22W input. We proposed a break in fiber fuse suppression when the HAP was 0.4 mm-long.

WS4-6 17:45 - 18:00
Detection and Termination System for Optical Fiber Fuse
Takuhito Kinoshita, 1 Norihiko SATO 2 and Makoto YAMADA 1
1 Osaka Prefecture Univ., Osaka, Japan, 2 Trimatz Limited, Chiba, Japan.
We propose a novel system that detects and unlatches stops a propagating optical fiber fuse (FF).

WS4-7 18:00 - 18:30
Invited
All-Optical Compensation of Fiber Nonlinearity by Phase Conjugation
Mark ElGanainy
ARC Centre for Ultrahigh bandwidth Devices for Optical Communication (CUDOS), ICOPS, School of Physics, Univ. of Sydney, NSW, Australia.
Recent demonstrations of all-optical phase conjugation for compensating fiber nonlinear effects in long distance transmission are presented. Experimental measurements for a transmitter-based pre compensation module in application to WDM and dual polarization-multiplexed RZ-DPSK signals are shown.
Low Temperature Hot-Wire Polysilicon Waveguides at 240°C. The optical propagation loss was measured to be 0.2 dB/cm and basic performance is confirmed by results of transmission spectra. Carbon nanotubes and graphene possess unique properties ideally suited for fundamental terahertz studies and applications. Here we summarize results of our recent studies of these materials using terahertz time-domain spectroscopy and Fourier-transform infrared spectroscopy.

Several Silicon-nitride sub-micron planar waveguide architectures were designed and fabricated. A three-stage cascaded MZIs based filter is fabricated with enhanced FSR and polarization multiplexers are presented, and new schemes of these materials using terahertz time-domain spectroscopy and Fourier-transform infrared spectroscopy.

A novel silicon nanowire waveguide filter based on cascaded MZIs with enhanced FSR is proposed and experimentally demonstrated. A scheme of cascaded MZIs based 2x2 coupler is fabricated with bandwidth and FSR of about 1.56GHz and 13.5GHz, respectively.

Selective Excitation of Microring Resonances Using a Pulley-Coupling Structure

We present a method to selectively excite resonances in microring resonators by using a pulley-coupling structure. Experimental results reveal only certain resonances are excited due to the dispersions of coupling coefficient and microring internal loss.

Reduction of Wavelength Dependence of Coupling Characteristics using Si3N4, Optical Waveguide Bending Directional Coupler

We theoretically investigate the approach to enhance the bandwidth of coupling. We present a Si/SiO2 based 2x2 coupler. Its splitting ratio has a low sensitivity to wavelength and fabrication changes.

A ZrO2-SiO2 based ultra-high delta PLC is developed. Propagation loss of the PLC employing delta of 5% is less than 0.2db/cm and basic performance is confirmed by results of trial fabrication of MM couplers.

A ZnO-SiO2 based Low Loss Ultra-High δ PLC

Metallon Tabakhan, Yasushi Uchida, Shinju Nomura, Kiyomasa Tada, and Tadao Nagatsuma

Graduate School of Natural Science and Technology, Okayama Univ., Okayama, Japan

A Zero Delta PLC is a promising device for realizing ultra-high speed and low loss optical interconnects. In this work we report on the design and performance of a Zero Delta PLC device. We have achieved a propagation loss of 0.25dB/cm at 1550nm.

Development of MEMS Electric Split-ring Resonator Arrays as Tunable Thz Filters

Development of MEMS Electric Split-ring Resonator Arrays as Tunable THz Filters

Shintaro Yamasaki, H. Yamamoto, K. Yamada, and M. Takahashi

Graduate School of Engineering Science, Osaka Univ., Osaka, Japan

We have developed a tunable terahertz frequency filter based on MEMS technology. The filter consists of an array of electrically controlled split-ring resonators. The resonator bandwidth is 1.5 THz and can be tuned by a control voltage.

A Three-Dimensional THz Metamaterials Using Double Split-ring Resonators

A Three-Dimensional THz Metamaterials Using Double Split-ring Resonators

Takuya Tabata, M. Takahashi, H. Yamamoto, and T. Nakaoka

Graduate School of Engineering Science, Osaka Univ., Osaka, Japan

We have designed and fabricated a terahertz frequency filter using a double split-ring resonator metamaterial. The filter consists of a 3D array of resonators and can be tuned by a control voltage.

Hydrogen Gas Response of Meta-Materials Made From the Catalytic Metal

Makoto Seki, H. Yamada, M. Seki, and H. Matsui

Graduate School of Engineering, Kyushu Univ., Fukuoka, Japan

We have developed a hydrogen gas sensor using a catalytic metal (Fe3O4) metamaterial. The sensor consists of a 3D array of resonators and can be tuned by a control voltage.

In Vivo Three-Dimensional Imaging of Tissue Birefringence by Jones Matrix Tomography

Yoshifumi Yasumura 1, Noriko Akamatsu 2, Hiroshi Kawauchi 3, Shuichi Makita 4, and Masahiro Mura 4

1 Computational Optics Group, Univ. of Tsukuba, Ibaraki, Japan,
2 Toyko Medical Univ., Ibaraki Medical Center, Ibaraki, Japan

A principle and application of Jones matrix tomography (JMT) is presented. JMT is first measures three-dimensional distribution of the Jones matrices and derives backscattering intensity, Doppler shift, and phase retardation from the Jones matrix tomography.

Full Range, Dual Depth Optical Coherence Tomography for Ophthalmology


1 Dept. of Biomedical Engineering, Korea Univ., Seoul, Korea,
2 School of Electrical Engineering, Kyungbok Na Univ., Daegu, Korea,
3 Dept. of Information Science, Sogang University, Seoul, Korea

We present spectral-domain optical coherence tomography (SD-OCT) using a single spectrometer with dual illumination and interfocused detection at 830 nm, which can provide anterior segment and retinal tomograms simultaneously.

In Vivo Registration of Optical Coherence Tomography Aanges with Fundus Imaging

M. H. Jiang 1, H. M. Chong 1, J. D. Lim 2, and M. H. Cheong 3

1 Nano Research Group, Electronics and Computer Science, Univ. of Southampton, UK,
2 Optical/Electronics Research Centre, Univ. of Southampton, UK

We have developed an optical coherence tomography (OCT) device with fundus imaging capability. The device can be used for in vivo imaging of the retina.

Tomography for Ophthalmology Full Range, Dual Depth Optical Coherence Tomography

Won Lee

Dept. of Otolaryngology, National Taiwan Univ.

We present a new method for cancer cells differentiation by using ZnO and TiO2 nanowires. This technique is based on the unique optical properties of nanowires and can be used for the early detection of cancer.

Optical Measurement of Peptide Hormone Using Artificial Hormone Receptor Cell-line

Hyun Soek Yoon 1, Jung Ha Kim 2, Deok-Ho Woo 1, and Seok Lee 3

1 Sensor System Research Center, Korea Inst. of Science and Technology, Seoul, Republic of Korea
2 Korea University, Tokyo, Japan
3 National Taiwan Univ.

We develop the efficient tool for optical measurement of peptide hormone using artificial cells expressing hormone specific receptor protein stably. This study offers an efficient optical detection method for monitoring of peptide hormone.
### Oral, Thursday, July 4

<table>
<thead>
<tr>
<th>Room C-1 1F</th>
<th>Room C-2 1F</th>
<th>Room F 1F</th>
</tr>
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<tbody>
<tr>
<td><strong>[ThI1] 8:30 - 10:00</strong></td>
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<tr>
<td>Photonic Crystal Lasers</td>
<td>Mid-Infrared Lasers</td>
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<tr>
<td>Session Chair: Chennumal Jagadish (Australian National Univ., Australia)</td>
<td><strong>FM-mode-locked fiber laser operating at 2.9 μm</strong></td>
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<td><strong>Over One Thousand Large-Scale Array Integration of Photonic Crystal Nanolasers</strong></td>
<td><strong>High Power Tm:YAG Waveguide Laser with Graphene Film</strong></td>
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<td>I. Watanabe, A. Abe, Y. Nakajima, and T. Baba</td>
<td>Y. Y. Ren, J. R. Beecher, K. W. Hwang, and C. H. Park</td>
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<td>Dept. of Electrical &amp; Computer Engineering, Yokohama Natl Univ., Yokohama, JAPAN</td>
<td><strong>O-switched Mode-locking of a Mid-infrared Tm:YAG Waveguide Laser with Graphene Film</strong></td>
<td>Dept. of Electrical &amp; Computer Engineering, Yokohama Natl Univ., Yokohama, JAPAN</td>
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<td>We developed a uniform bonding process of GaInAsP photonic crystal slab on silicon substrate. We fabricated an array of 1089 nanolasers with a 3 μm pitch and confirmed the lasing in all devices.</td>
<td><strong>Q-switched Mode-locking of a Mid-infrared Tm:YAG Waveguide Laser with Graphene Film</strong></td>
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<td><strong>Strongly Enhancing Cr3+ Emission in Ca,Cr:YAG Doubled-Clad Fiber Amplifier</strong></td>
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<td>Laboratoire de Photonique et Nanostructures LPN-CNRS UMR6619, Marcoussis, France</td>
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<td>Lasers of diffraction-limited volumes involve the interaction of small numbers of particles (photons and dipoles). We demonstrate that these small populations induce large intensity noise in the output of the laser.</td>
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<td><strong>Single Mode Operation of Edge-Emitting Semiconductor Lasers with 2D Photonic Crystal</strong></td>
<td><strong>Triangular-Lattice Photonic-Crystal Lasers</strong></td>
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<td>1 Central Research Laboratory, Hamamatsu Photonics K.K., Hamamatsu, Japan, 2 Dept. of Electronic Science and Engineering, Kyushu Univ., Fukuoka, Japan</td>
<td><strong>Design optimization of semiconductor photonic crystal laser (PCSEL) structure discussed. Mode confinement is compared for all-semiconductor and void PCSELs. A re-grown PCSEL, lasing at room-temperature based on GaAs/InGaP re-growth is realised, and device characteristics described.</strong></td>
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<td>Single transverse and longitudinal mode operation of a broad gain chips edge-emitting laser are realised with 2D photonic crystals. Despite an emitting width of 0.5 μm, we obtain narrow horizontal FWHM and a single spectrum.</td>
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<td><strong>High Power Photonic-Crystal-Surface-Emitting Lasers</strong></td>
<td><strong>Mid-Infrared Cr:ZnSe Channel Waveguide Laser</strong></td>
<td><strong>High Power Photonic-Crystal-Surface-Emitting Lasers</strong></td>
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<td><strong>Material Research Group, Central Research Laboratory, Hamamatsu Photonics K.K., Hamamatsu, Japan, 2 Dept. of Electronic Science and Engineering, Kyushu Univ., Fukuoka, Japan</strong></td>
<td><strong>Mid-Infrared Cr:ZnSe Channel Waveguide Laser</strong></td>
<td><strong>Material Research Group, Central Research Laboratory, Hamamatsu Photonics K.K., Hamamatsu, Japan, 2 Dept. of Electronic Science and Engineering, Kyushu Univ., Fukuoka, Japan</strong></td>
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<td>We demonstrate the highest output power of 780 mW in single photonic crystal surface emitting lasers under continuous wave operation at room temperature. We also report the beam quality M2 = 1.1.</td>
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<td><strong>Photonic Crystal Surface Emitting Lasers Based on Epitaxial Regrowth</strong></td>
<td><strong>Three-Dimensional Coupled-Wave Theory for Triangular-Lattice Photonic-Crystal Lasers</strong></td>
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<tr>
<td>Dept. of Electronic &amp; Electrical Engineering, Univ. of Sheffield; Center for Nanoscience &amp; Technology, Univ. of Sheffield, Sheffield, UK, 3 Center of Photonics and Quantum Sciences, School of Physics, State Key Laboratory of Crystal Materials and Key Laboratory of Nanophotonics and Modern Optical System, Shandong Univ., Jinan, China, 4 Dept. of Engineering and Physical Sciences, Heriot-Watt Univ., Edinburgh, Scotland, 5 Department of Quantum Science and Engineering, National Institute of Technology, Nagoya University, Nagoya, Japan</td>
<td><strong>Photonic Crystal Lasers</strong></td>
<td>Dept. of Electronic &amp; Electrical Engineering, Univ. of Sheffield; Center for Nanoscience &amp; Technology, Univ. of Sheffield, Sheffield, UK, 3 Center of Photonics and Quantum Sciences, School of Physics, State Key Laboratory of Crystal Materials and Key Laboratory of Nanophotonics and Modern Optical System, Shandong Univ., Jinan, China, 4 Dept. of Engineering and Physical Sciences, Heriot-Watt Univ., Edinburgh, Scotland, 5 Department of Quantum Science and Engineering, National Institute of Technology, Nagoya University, Nagoya, Japan</td>
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<td>Waveguides are fabricated in Cr:ZnSe, built into a cavity and lasing is demonstrated. A room temperature laser threshold of 700 mW is observed. Emission occurs at 2573 nm making this an attractive, compact mid-infrared source.</td>
<td><strong>Strongly Enhancing Cr3+ Emission in Ca,Cr:YAG Doubled-Clad Fiber Amplifier</strong></td>
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<td><strong>Three-Dimensional Coupled-Wave Theory for Triangular-Lattice Photonic-Crystal Lasers</strong></td>
<td><strong>Over One Thousand Large-Scale Array Integration of Photonic Crystal Nanolasers</strong></td>
<td><strong>Three-Dimensional Coupled-Wave Theory for Triangular-Lattice Photonic-Crystal Lasers</strong></td>
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<td>Dept. of Electronic Science and Engineering, Kyushu Univ., Fukuoka, Japan</td>
<td>Dept. of Electrical &amp; Computer Engineering, Yokohama Natl Univ., Yokohama, JAPAN</td>
<td>Dept. of Electronic Science and Engineering, Kyushu Univ., Fukuoka, Japan</td>
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<td>We develop a three-dimensional coupled wave theory to model triangular-lattice photonic crystal surface emitting lasers. Unlike previous theories, our presented theory is able to treat non-Fourier modes. We compare our theoretical results with experiments and find good agreement.</td>
<td>We developed a uniform bonding process of GaInAsP photonic crystal slab on silicon substrate. We fabricated an array of 1089 nanolasers with a 3 μm pitch and confirmed the lasing in all devices.</td>
<td>We develop a three-dimensional coupled wave theory to model triangular-lattice photonic crystal surface emitting lasers. Unlike previous theories, our presented theory is able to treat non-Fourier modes. We compare our theoretical results with experiments and find good agreement.</td>
</tr>
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</table>
Ultrafast Strong-Field Photoemission From Plasmonic Nanoparticles
F. Dorn5, A. Hofb1, P. Pérez1, J. Martín1, A. Troger1, J. R. Kreer3, and C. L. Holloway1.
1Wigner Research Centre for Physics, Budapest, Hungary,
2Max-Planck-Institut für Quantenoptik, Garching, Germany,
3Institut für Physik, Karl-Franzens-Universität Graz, Graz, Austria.

We demonstrate strong-field photoemission from plasmonic nanoparticles by ultrashort pulses. Significant x(10) field enhancement attributed to surface-plasmons enable 25-eV electron generation in nanolocalized fields around nanoparticles. Correlation between plasmonic resonance and electron spectra is shown.

Fiber Optic Nerve Systems for Smart Structures and Smart Materials with Optical Correlation Domain Technologies
Kazuo Hota
Dept. of Electrical Engineering and Information Systems, The Univ. of Tokyo, Tokyo, Japan.

Distributed and multiplexed optical sensing using continuous wave has been developed by synthesizing optical coherence function. The technique has provided mm-order spatial resolution, kHz-order sampling rate, and random-accessibility to arbitrary point along a fiber.

Remote Lasing in Air Driven by Strong Laser Field: Lasing or Nonlinear Frequency Conversion?
N. Yao, K. Nakamura, and Y. Hasegawa
National Institute of Advanced Industrial Science and Technology, Tokyo, Japan.

We demonstrate individual PON monitoring using maintenance band pulsed pump-probe Brillouin analysis that can measure the individual loss distribution of each tributary in a PON from a below an optical splitter in a passive optical network.

Energy Saving Scheme Based On Traffic Forwarding For Optical Fiber Access Networks
G. Arroyo, L. J. Mearns, L. C. Olmos, and T. Takagishi

We propose a novel calibration technique for eliminating such inaccuracies.

Investigation of Physical Mechanism of Ultrafast Laser Microwelding Using Double-pulse Irradiation

We experimentally and theoretically investigate the underlying physical mechanism of ultrafast laser glass microwelding using double pulse irradiation based on transient absorption change of 2nd pulse with various pulse energy induced by 1st pulse irradiation.
### ThT1-1 8:30 - 8:45
**Compact Fan-in/Fan-out Optical Devices for Multi-core Fiber Transmission**  
Y. Tottori, T. Kobayashi, and M. Watanabe  
OPTOQUEST CO., LTD., Saitama, JAPAN

A compact fan-in/fan-out device is developed that connects 7-core multi-core fiber and seven single mode fibers. Characteristics of the insertion loss, polarization dependent loss and cross talk were good.

### ThT1-2 8:45 - 9:00
**Proposal of High-capacity and High-reliability Optical Switch Equipment with Multi-core Fibers**  
Kenji Hiruma, Toshiki Sugawara, Kenichi Tanaka, Etsuko Nomoto, and Yong Lee  
Central Research Laboratory, Hitachi Ltd., Tokyo, Japan

We propose a concept for a novel optical switching system utilizing multi-core fibers for high-capacity/high-reliability data transmission, which is expected to recover within 50 ms from a fiber break.

### ThT1-3 9:00 - 9:15
**High-Speed Reconfigurable Card-to-Card Optical Interconnects with Multicasting Capability**  
Ke Wang  
1,2, Ampalavanapillai Nirmalathas  
1,2, Christina Lim  
2, Efstratios Skafidas  
1,2, and Kamal Alameh  
1 Nat’l ICT Australia - Victoria Research Laboratory (NICTA-VRL), 2 Dept. of Electrical and Electronic Engineering, The Univ. of Melbourne, Australia, 3 Centre of Excellence for Micro Photonic Systems, Electron Science Research Inst., Edith Cowan Univ., Australia

A free-space-based high-speed reconfigurable card-to-card optical interconnect architecture with multicasting capability is proposed and experimentally demonstrated. Results show that 10 Gb/s data can be multicast to selected channels with receiver sensitivity better than -10.50 dBm.

### ThT1-4 9:15 - 9:45
**Invited Wavelength Selective Crossconnects**  
Nicolas K. Fontaine, Roland Ryt, and David T. Neilson  
Bell Laboratories/Alcatel-Lucent, NJ, USA

We show a N0X wavelength selective crossconnect (WSX) with flexible passbands that can route any wavelength between any input and output port without spectral gaps.
Room 103 1F

ThL1-1 8:30 - 8:45
Low Loss Silica High-Mesa Waveguide for Infrared Sensing
1. Interdisciplinary Graduate School of Engineering Sciences, Kyushu Univ., Fukuoka, Japan
2. NTT Photonics Laboratories, Kanagawa, Japan
We propose a new shape of metamaterials and actuation mechanism are proposed and demonstrated. This reconfigurable metamaterials was constructed by electric split-ring resonators. The experimental results show this device reveals polarization dependence and blueshifting of spectrum.

ThL1-2 8:45 - 9:00
A MEMS-Based 3-D Movable Metamaterials
Yu-Sheng Lin, Fu-Sheng Ma, and Ching-Kuo Lee
Dept. of Electrical & Computer Engineering, Natl’l Univ. of Singapore, Engineering Drive, Singapore
A new shape of metamaterials and actuation mechanism are proposed and demonstrated. This reconfigurable metamaterials was constructed by electric split-ring resonators. The experimental results show this device reveals polarization dependence and blueshifting of spectrum.

ThL1-3 9:00 - 9:15
High-efficiency, double-clad fiber coupler, cladding mode sensor using a tilted fiber Bragg grating
MD. Basak1, M. Gagne1,2, E. De Montigny1,2, M. Gagne1,2, N. Godbout1, C. Boudreau1, and R. Kashyap1
1. Dept. of Electrical Engineering, Polytechnique de Montreal, Montreal, Canada
2. Dept. of Engineering Physics, Polytechnique de Montreal, Montreal, Canada
A high-efficiency sensor for reflected cladding modes over 80nm, generated by a tilted fiber Bragg grating is demonstrated using a double-clad fiber coupler taper spliced to a standard fiber.

ThL1-4 9:15 - 9:30
Two Dimensional Trapping Using Four Core Interference From a Lensed Multicore Fiber
Inst. of Photonics and Quantum Sciences, School of Engineering and Physical Sciences, Heriot Watt Univ., Edinburgh, UK
Two dimensional trapping of multiple particles in an interference pattern has been demonstrated using a four core lensed multicore fiber as an attractive optical element.

ThL1-5 9:30 - 9:45
Efficient Spatial Aperture-Sampled Mode Multiplexer for Ring Fibers
Min-Biu and Dan M. Marom
Dept. of Applied Physics, Hebrew Univ., Jerusalem, Israel
Efficient space division multiplexing from single mode fibers to a few mode fiber is extended to specially refractive index profile fibers. Optimizing the beam apertures achieves lower average coupling loss and mode dependent losses.

ThL1-6 9:45 - 10:00
Demonstration of a 1×8 silicon photonic switch based on optical phased array
Chao Chen, Alex Hipps, Myung-Joon Kwack, Takuo Tanemura, and Yoshikatsu Nakano
Research Center for Advanced Science and Technology, the Univ. of Tokyo, Tokyo, Japan
A fully integrated silicon 1×8 switch based on thermo-optic phased array is designed, fabricated, and demonstrated for the first time. Static and dynamic switching characteristics are presented and possibilities for further improvements are discussed.
Oral, Thursday, July 4

Room C-1 1F

[ThR2] 10:30 - 11:00
A Study of Rate-Adaptive Forward Error Correction in OTU Framing
Information Technology R&D Center, Mitsubishi Electric Corporation, Kamakura, Japan
The performance and feasibility of rate-adaptive FEC is studied by means of an OTU framing structure. When OTU tributary slots are utilized to transmit parity, the assignment of up to 25 slots is feasible.

[ThR2] 10:30 - 11:00
Ultrafast Refractive Index Control of Terahertz Graphene Metamaterials
Seung Hoon Lee, Janghoek Chi, Soo Ok Lim, and Bumki Min
Dept. of Mechanical Engineering, KAIST, Daejeon, Republic of Korea, 1Research Inst. for Electronic Science, Hokkaido Univ., Sapporo, Japan
We experimentally and numerically investigate the terahertz plasma responses in a coupled system of structured graphene and a heavily-doped Si substrate. Gate-voltage-controllable magnetic plasma resonances arising from the plasmon hybridization are demonstrated at terahertz frequencies.

[ThR2] 10:45 - 11:30
On the Pragmatic Turbo Equalizer for Optical Communications
Yeong Zhang 1, Xiaohan Zhang 1 and Ivan B. Djordjevic 2, 3
1 NEC Laboratories America, Princeton, USA, 2Univ. of Arizona, ECE Dept., Tucson, USA
Two types of pragmatic turbo equalizers are implemented and evaluated with either histogram approach or multivariate methods.

[ThR2] 10:45 - 12:00
Orthogonal Polynomials based Hybrid Coded-Modulation for Multi-Tb/s Optical Transport
Ivan B. Djordjevic 2 and Ying Wang 1
1 Univ. of Arizona, ECE Dept., Tucson, USA, 2Nec Laboratories America, Princeton, USA
Orthogonal polynomials based single-carrier hybrid coded-modulation is proposed as multi-Tb/s enabling technology while employing the commercially available electronics. The proposed scheme can simultaneously solve the limited bandwidth and high energy consumption of information infrastructure problems.

[ThR2] 11:00 - 11:15
Performance Improvement of a Triple-Concatenated FEC by a UEP-BCH Product Code for Nonlinearity Compensation in Coherent WDM Transmissions
Takashi Fujimoto, Shuichi Kudo, Kyojyu Suhara, Tomohiko Enokido and Masahiro Matsuochi
Information Technology R&D Center, Mitsubishi Electric Corporation, Kamakura, Japan
We present an error-correction performance improvement of a triple-concatenated FEC by a UEP-BCH product code for Nonlinearity Compensation in Coherent WDM Transmissions. When OTU4 frame format, a simulation indicates an NCG of 11.0dB a triple-concatenated FEC by a UEP-BCH product code for Information Technology R&D Center, Mitsubishi Electric

[ThR2] 11:00 - 11:15
Terahertz Plasmonic Responses in Graphene Hybridized Systems
A. Ichiikawa 1 and T. Tanaka 1
Metamaterials Lab., RIKEN, Saitama, Japan, 2Research Inst. for Electronic Science, Hokkaido Univ., Sapporo, Japan
We experimentally and numerically investigate terahertz plasmonic responses in a coupled system of structured graphene and a heavily-doped Si substrate. Gate-voltage-controllable magnetic plasma resonances arising from the plasmon hybridization are demonstrated at terahertz frequencies.

[ThR2] 11:15 - 11:30
Tip-enhanced Raman Scattering Study of Metalized-Semiconducting Carbon Nanotube
Yotsubo Ohkura 1, 2, Tetsuya Kato 1, 2 and Probal Verma 1
Dept. of Applied Physics, Osaka Univ., Osaka, Japan, 1RIKEN, Saitama, Japan
We visualized that semiconducting single wall carbon nanotubes (SWCNTs) represent metallic property at a point where a few tubes crossed each other, by tip-enhanced Raman scattering (TERS) microscopy.

[ThR2] 11:45 - 12:00
Fano Resonance in a Composite Metamaterial of Superlattice and Isotropic Metamaterials
Y.H. Lee, E.Y. Choi 1, E.S. Kim 1, J.H. Kim 1, and J.W. Wu
Dept. of Physics and Quantum Metamaterial Research Center, Ewha Womans Univ., Seoul, Korea, 1Dept. of Physics, Yonsei Univ., Seoul, Korea
By embedding polarization-independent four-node resonators into polarization-dependent double-split ring resonator superlattice metamaterial, a polarization-dependent Fano resonance is experimentally demonstrated in THz regime.

Room C-2 1F

[ThH2] 10:30 - 12:00
Nanocarbon & Metamaterials
Session Chair: Marko Loncar (Harvard Univ., USA)

[ThH2] 10:30 - 11:00
Influence of High-Order Modes in Starting Self-Mode-Locked Optically Pumped Semiconductor Laser
Jin Seok 1, Bae Jeonggyu 1, Park Hyun 1, Kim Tae-myeon 1, and Hyun Do 1
1 Korea Advanced Institute of Science and Technology, Tampere, Finland
We experimentally and numerically investigate terahertz plasma responses in a coupled system of structured graphene and a heavily-doped Si substrate. Gate-voltage-controllable magnetic plasma resonances arising from the plasmon hybridization are demonstrated at terahertz frequencies.

[ThH2] 10:30 - 11:00
Self-mode Locking in Diode-pumped Nd:YVO4 Self-Raman Lasers
Dept. of Electrooptics, Nat’l Chiao Tung Univ., Hsinchu, Taiwan
We explored the influence of pump-to-mode size ratios on optically pumped semiconductor laser. With a large pump-to-mode size ratio, the output beam was self-mode-locked with 1.17 ps pulse duration at a repetition rate of 15GHz.

[ThH2] 10:45 - 11:00
High Power 1100 - 1200 nm Semiconductor Disk Lasers
S. T. Lee, E. C. Addy, and K. Cho
1 Dept. of Physics, Ewha Womans Univ., Seoul, Korea, 2Ewha Womans University, Seoul, South Korea
We review our results of SDLs in the range of 1100-1200nm. In particular, we highlight our recent demonstrations of output power of more than 20W at around 1180nm and SHG of more than 10W.

[ThH2] 11:00 - 11:15
Self-mode Locking in Diode-pumped Nd:YVO4 Self-Raman Lasers
Dept. of Electrooptics, Nat’l Chiao Tung Univ., Hsinchu, Taiwan
We experimentally and numerically investigate terahertz plasma responses in a coupled system of structured graphene and a heavily-doped Si substrate. Gate-voltage-controllable magnetic plasma resonances arising from the plasmon hybridization are demonstrated at terahertz frequencies.

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1 Dept. of Physics, Ewha Womans Univ., Seoul, Korea, 2Ewha Womans University, Seoul, South Korea
We review our results of SDLs in the range of 1100-1200nm. In particular, we highlight our recent demonstrations of output power of more than 20W at around 1180nm and SHG of more than 10W.
We report the first integrated tunable microwave photonic notch filter based on 3-dB and 6-dB bandwidths of 126 MHz and 78 MHz, respectively. We introduce a scheme to hold down a decrement of the light power with a polarization beam splitter when we transmit the image which we acquired in a camera node to the monitoring side as signal.

The Thermoluminescence Response of Undoped Silica PCF for Dosimetry Application
Mootaha Goharshaib 1, Sahar Hossain Mahmoud 1, and Faisal Rafi Muhammad Adilak 1

We demonstrate phase sensitive amplification based on pump-degenerate four-wave mixing in a dispersion-engineered chalcogenide waveguide. An extinction ratio of the on-chip gain of 11.4dB is achieved by slicing the pump/signal/idler waves from a single source.

Development of Acquisition and Tracking system for Next-Generation Optical Inter-Satellite Communication
Mooyung Kim 1,2, S. Madden 1, Ravi Pant 1,2, and Shang-Da Yang 1,2

A novel sensor for simultaneous measurement of curvature and temperature is introduced. The former enables accurate reconstruction of domain length distributions with 850 nm resolution.

Optimized Four-Section-Dark-Pulse Brillouin Distributed Optical Fiber Sensor
Zhongheng Yang 1,2, and Jirong Liu 1,2

A new figure of merit (Poincare angular error gradient) is proposed to optimize the noise immunity of polarimeter. The typical polarization state analyzer is modified to experimentally realize the optimized scheme.

Optimum Multicast Time Slot Allocation in Active Optical Access Network
Kai Shimada, Takashi Sato, Kazumasa Tokuhashi, Hitoshi Takeba, Saturo Okambo and Naoko Yamanaka

In this paper, we propose and experimentally show a 16 channel DWDM based EPON reach extender for high capacity next generation long-reach EPON application.

Performance Evaluation of 10G-EPON System in 128 Subscribers Environment
Takashi Nishihara, Takeshi Suetomo, Satoshi Yoshimura and Hiroaki Muki

This work concerns the suitability of PCF as dosimeter. The dosimetric capabilities of PCF for thermoluminescence and dose response have been investigated and compared with the single mode fiber subjected to K-Band electron irradiations.

Optimum Multicast Time Slot Allocation in Active Optical Access Network
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Performance Evaluation of 10G-EPON System in 128 Subscribers Environment
Takashi Nishihara, Takeshi Suetomo, Satoshi Yoshimura and Hiroaki Muki

Information technology R&D Center, Mitsubishi Electric Corporation, Kanagawa, Japan

Performance evaluation of 10G-EPON system with DBA is described. We confirm the priority control function of proposed DBA, and the improvement of 15.4% throughput employing burst-mode WDM transceiver and CDR in 128 subscribers environment.

A Proposal for Novel Power-saving Scheme Employing Watchdog ONUs in Redundant PON Systems
Kai Shimada, Takeshi Sato, Kazumasa Tokuhashi, Hitoshi Takeba, Saturo Okambo and Naoko Yamanaka

Information technology R&D Center, Mitsubishi Electric Corporation, Kanagawa, Japan

This paper presents a novel power-saving scheme using watchdog ONUs in redundant PON systems. A numerical simulation reveals the power-saving of 17% in the transmitter-sleep mode, and 36% of the transmitter/receiver-sleep mode was obtained respectively.

A Proposal for Single-handed Power-saving by ONU in EPON Systems
Fumihiko Tanou, Kohei Yasukit, Takeshi Suetomo, and Hiroaki Muki

Information technology R&D Center, Mitsubishi Electric Corporation, Kanagawa, Japan

We propose a novel ONU power-saving scheme called single-handed type ONU power saving scheme. Proposed scheme does not require any power saving functions in EPON OLT. We also present evaluation results of proposed scheme.
### Oral, Thursday, July 4

| Room J | 2F | [ThS2] 10:30 - 11:30 | Optical Fiber Cable Technology | Tutorial | Masaharu Ohashi | Osaka Prefecture Univ., Osaka, Japan | We review recent progress on optical fiber cable technology including multi-core fiber design and measurement techniques. Moreover, we also describe study items related to optical fiber cable technology and aimed at the space division multiplexing. |
| Room K | 2F | [ThO2] 10:30 - 11:30 | Optical Signal Processing IV | Session Chair: Takashi Ishiguro (Keio Univ., Japan) | Naohiro Kohmu, Hiroshi Murata, and Yasuyuki Okamura | Graduate School of Engineering Science, Osaka Univ., Osaka, Japan | We present a Bread Board Model of a 7.2Gbps homodyne BPSK receiver with a Doppler shift and a diplexer compensator for inter-channel conflicts. This model also demonstrated without performing quantum state tomography. |
| Room 101 | 1F | [ThG2] 10:30 - 12:00 | Entangled Photons | Session Chair: Shigeki Takeuchi (R.I.E.S., Hokkaido Univ., Japan) | Toshiki Kobayashi | Dept. of Physics, Pohang Univ. of Science and Technology (POSTECH), Pohang, Korea | We experimentally demonstrate the compression of a dense wavelength-division multiplexing (DWDM) grid via a spectral imaging system based on two time-lenses. A 700-GHz DWDM-grid is compressed to 50-GHz with error-free performance for all channels. |

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**Room J**

**[ThS2] 10:30 - 11:30**

**Optical Fiber Cable Technology and Related Study**

**Items Toward Space Division Multiplexing**

- **Masaharu Ohashi**
  - Osaka Prefecture Univ., Osaka, Japan
  - We review recent progress on optical fiber cable technology including multi-core fiber design and measurement techniques. Moreover, we also describe study items related to optical fiber cable technology and aimed at the space division multiplexing.

**Room K**

**[ThO2] 10:30 - 11:30**

**Optical Signal Processing IV**

Session Chair: Takashi Ishiguro (Keio Univ., Japan)

- **Naohiro Kohmu, Hiroshi Murata, and Yasuyuki Okamura**
  - Graduate School of Engineering Science, Osaka Univ., Osaka, Japan
  - We present a Bread Board Model of a 7.2Gbps homodyne BPSK receiver with a Doppler shift and a diplexer compensator for inter-channel conflicts. This model also demonstrated without performing quantum state tomography.

**Room 101**

**[ThG2] 10:30 - 12:00**

**Entangled Photons**

Session Chair: Shigeki Takeuchi (R.I.E.S., Hokkaido Univ., Japan)

- **Toshiki Kobayashi**
  - Dept. of Physics, Pohang Univ. of Science and Technology (POSTECH), Pohang, Korea
  - We experimentally demonstrate the compression of a dense wavelength-division multiplexing (DWDM) grid via a spectral imaging system based on two time-lenses. A 700-GHz DWDM-grid is compressed to 50-GHz with error-free performance for all channels.
### ThK2-1 10:30 - 11:00

**Lateral Current Injection Type Membrane DFB lasers**

Hajime Kakei, Yujiro Satoh, Natsumi Ohnishi, and Shigeo Arai

1. Dept. of Electrical and Electronic Engineering, 2 Quantum Nanoelectronics Research Institute, Tohoku University, Sendai, Japan

Lateral current injection (LCI) type membrane distributed feedback (DFB) lasers, proposed as light sources for on-chip optical wiring in LSIs, were theoretically investigated from aspects of low power consumption operation and high-speed direct modulation capability. It was confirmed that the DFB-laser can be a good candidate for a low-pulse-energy (100 fJ) light source at high-speed operation (50 Gb/s), but the series resistance was found to be an important issue for low power consumption operation as well as a small footprint.

### ThK2-2 11:00 - 11:15

**Spectral Characteristics under Various Operation Conditions of 1.3-μm AlGaInAs/InP DFB Laser**

Y. Enami, T. Ishiki, and M. Futami

1. Dept. of Electrical and Electronic Engineering, 2 Quantum Nanoelectronics Research Institute, Tohoku University, Sendai, Japan

The spectral characteristics of a 1.3-μm AlGaInAs/InP DFB laser were studied by varying collector-base voltage and emitter current. Spectrum shifts as a function of output power by transistor laser were studied by varying collector-base voltage and emitter current. Spectral shifts as a function of output power.

### ThK2-3 11:15 - 11:30

**Enhanced Modulation Bandwidth in Photon-Lifetime-Modulated Strongly Injection-Locked Semiconductor Ring Lasers**

Gennady A. Smolyakov and Marek Osinski

1. Quantum Nanoelectronics Research Center, Tokyo Institute of Technology, Tokyo, Japan

A novel method for modulation bandwidth enhancement is presented, involving strongly injection-locked whistle geometry semiconductor ring laser modulated through photon lifetime. Advantages of photon-lifetime modulation over conventional injection-current modulation are confirmed through numerical modeling.

### ThK2-4 11:30 - 11:45

**Photocurrent Generation in a Silicon Waveguide Integrated with Periodically Interleaved P-N Junctions**

Nils Zhu, Linke Zhu, Xiaoming Sun, Yingyi Xie, Zhizhou, Liangjun Lu, Xinran Li, and Jiangen Chen

1. Dept. of Electrical and Electronic Engineering, 2 Quantum Nanoelectronics Research Institute, Tohoku University, Sendai, Japan

We investigate the photocurrent generation in a silicon waveguide embedded with interleaved p-n junctions. Due to the surface-state absorption and the high built-in electric field, the responsivity reaches -4A/W/kW and the bandwidth is 11.5 GHz.

### ThK2-5 11:45 - 12:00

**Intersubband All-Optical Switch with Bandgap Control of InGaAs/AlAsSb Quantum Wells**

Yun Fang, Ryoachi Akimoto, Shin-ichiro Ito, Masahiro Iwai, Toshiki Yamada, Shin-ichiro Iwai, Takeharu Sato, and Hiroshi Yamauchi

1. Dept. of Advanced Industrial Science and Technology (AIST), 2 Graduate School of Engineering, Osaka University, Osaka, Japan

Bandgap control of conduced intermixing on InGaAs/AlAsSb coupled quantum wells is studied. Moreover, the all-optical Michelson interferometer gating switch integrated with two different bandgap energies is developed based on the area-selective method.
**Oral, Thursday, July 4**

**Room G**

**ThE3-1 13:30 - 13:45**

Dependence on Repetition Rate in Post-Laser Annealing Process of Ion-Implanted ZnO Nanorods Using KF Excimer Laser

Zyunpei Kase, N. J. Vasa (Indian Inst. of Technology Madras, India)

**ThE3-2 13:45 - 14:00**

Optical Properties Evaluation of Si-doped ZnO Nanorods Using UV Laser Doping


**ThE3-3 13:45 - 14:00**

Super-luminescent Diode Based CO2 Sensing for Combustion Applications

K. Shintake, K. Kishii, T. Nakano, N. J. Vasa, and M. Kurokawa

**ThE3-4 13:45 - 14:15**

Self-Excited Microring Resonators: Basic Characteristics and Applications


**ThE3-5 13:45 - 14:30**

Controlled Growth of ZnO Nanocrystals Using Laser Interference Irradiation


**ThF3-1 13:30 - 13:45**

1,3-Diphenyl-1H-Pyrazol-5-ium-3-Carbonyl Chloride Used as a Photorefractive and Photothermal Material


**ThF3-2 13:45 - 14:15**

A Study of Trace Gas Detection Based on Cavity Enhanced Absorption Spectroscopy (CEAS) for Power Transformer Diagnostics

Ryo Sosuma, Yuki Imamura, Yuki Kanazawa, Hiroshi Hattori, Kazuhiro Takahashi, Katsuyoshi Tei, and Shigeru Yamaguchi

**ThF3-3 13:45 - 14:30**

Novel Biosensing Method Based on Symmetry Breaking

M. I. L. Xuan, K. Vidal, and G. Molina-Tena

**ThF3-4 13:45 - 14:30**

Biochemical Sensors Based on Dual Antiresonant Reflecting Waveguides

Chung-Kuo Lee, Jen-Hong Hao, Ming-Lin Lu, and Yang-Tung Huang

**ThF3-5 13:45 - 14:45**

Kinetik Analysis of Graphene Oxide Sheet and Protein Interactions Using Surface Plasma Resonance Biosensors

Teng-Wen Huang, Rui-Fu Chi, and Chin-Chih Liu

**ThP3-1 13:30 - 14:00**

100-Gb/s Hybrid Optical Fiber-Wireless Transmission


Room H

**ThE3-1 13:30 - 13:45**

Nonlinearities and Micro/Nano Processing

Session Chair: Nishi J. Vasa (Indian Inst. of Technology Madras, India)

**ThE3-2 13:45 - 14:00**

Pulsed Laser Deposition and Fabrication of ZnO Nanostructures

K. Shintake, K. Kishii, T. Nakano, N. J. Vasa, and M. Kurokawa

**ThE3-3 13:45 - 14:15**

Super-luminescent Diode Based CO2 Sensing for Combustion Applications

K. Shintake, K. Kishii, T. Nakano, N. J. Vasa, and M. Kurokawa

**ThE3-4 13:45 - 14:30**

Self-Excited Microring Resonators: Basic Characteristics and Applications


**ThF3-1 13:30 - 13:45**

1,3-Diphenyl-1H-Pyrazol-5-ium-3-Carbonyl Chloride Used as a Photorefractive and Photothermal Material


**ThF3-2 13:45 - 14:15**

A Study of Trace Gas Detection Based on Cavity Enhanced Absorption Spectroscopy (CEAS) for Power Transformer Diagnostics

Ryo Sosuma, Yuki Imamura, Yuki Kanazawa, Hiroshi Hattori, Kazuhiro Takahashi, Katsuyoshi Tei, and Shigeru Yamaguchi

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**ThF3-4 13:45 - 14:30**

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**ThP3-1 13:30 - 14:00**

100-Gb/s Hybrid Optical Fiber-Wireless Transmission


**Room I**

**ThP3-2 14:00 - 14:15**

RoF uplink transmission scheme for remotely beam-steerable photonic array antennas

Masayuki Oishi, Kousuke Niishizawa, and Shigeyuki Akita

**ThP3-3 14:15 - 14:30**

Photic Array-Antenna in Millimeter-Wave Band by Wavelength Division Multiplexed Radio over Fiber

Toshio Nokisuiki, Masayuki Oishi, and Shigeyuki Akita

**ThP3-4 14:45 - 15:00**

Analysis of Uplink Radio Signal Transmission in Millimeter-Wave-Over-Fiber Systems

Pham Tran Tien, Atsushi Kanno, and Tatsuo Kawanishi

**Room I 1F**

**ThP3-1 13:30 - 14:00**

100-Gb/s Hybrid Optical Fiber-Wireless Transmission


We present experimental results on using optical transmission techniques such as I&M modulators, digital coherent receivers, heterodyne up-conversion in fast photodiodes, to generate, transmit and detect high capacity wireless transmission. Both OFDM and GMSK modulation formats are used in the W-achieving capacities up to 100-Gbps with seamless optical fiber-wireless conversion.

**ThP3-2 14:00 - 14:15**

RoF uplink transmission scheme for remotely beam-steerable photonic array antennas utilizing reflective semiconductor optical amplifiers was proposed. Our proposed scheme would be able to realize cost effective photonic antenna systems with a simple structure.

**ThP3-3 14:15 - 14:30**

Photic Array-Antenna in Millimeter-Wave Band by Wavelength Division Multiplexed Radio over Fiber

Toshio Nokisuiki, Masayuki Oishi, and Shigeyuki Akita

We demonstrated beam steering of array-antenna in millimeter-wave band at 39 GHz by WDM radio over fiber. The proposed photonic antenna can realize future ultra-broadband and smart antenna systems by a novel photonic approach.

**ThP3-4 14:45 - 15:00**

Analysis of Uplink Radio Signal Transmission in Millimeter-Wave-Over-Fiber Systems

Pham Tran Tien, Atsushi Kanno, and Tatsuo Kawanishi

With the performance of analog counterpart is highly dependent on optical link condition we demonstrated centralized optical routing based on digital RoF technique for wireless backhaul networks. Digitalized RoF systems showed constant performance with BER of 0.3% (11.5%) while the performance of analog counterpart is highly dependent on optical link condition.

**ThP3-5 14:55 - 15:00**

Analysis of Uplink Radio Signal Transmission in Millimeter-Wave-Over-Fiber Systems

Pham Tran Tien, Atsushi Kanno, and Tatsuo Kawanishi

We demonstrated centralized optical routing based on digital RoF technique for wireless backhaul networks. Digitalized RoF systems showed constant performance with BER of 0.3% (11.5%) while the performance of analog counterpart is highly dependent on optical link condition.
Oral, Thursday, July 4

Room J 2F

[ThS1] 13:30 - 14:00

Novel Fibers for Data Centers and High Performance Computing

S. Bhojane, D. Butler

1 Coming Optical Fiber and Cable, NY, USA, 2 Coming Science and Technology, NY, USA

We present modeling results showing that a multimode fiber optimized for long wavelengths can address bandwidth and connectivity issues in optical backplanes. A multimode fiber with 2x4 cores facilitates coupling to linear transceiver arrays.

Room K 2F

[ThO3] 13:30 - 14:15

Optical Signal Processing Subsystems for Optical Interconnects

A. Meloni, P. Mironchick, P. Orlaneti, P. Bassi, M.J. St Clair and M. Sorel

DEI - Politecnico di Milano, Milano, Italy, 1 BLU Università di Bologna, Bologna, Italy, 3 School of Engineering, Univ. of Glasgow, Glasgow, United Kingdom

We demonstrate a single-mode fiber with nonuniform Brillouin frequency of the core and estimating the fictive temperature of silica-based fibers.

Room T1 101

[ThG1] 13:30 - 14:45

Oral, Thursday, July 4

Room J 2F

Numerical and experimental analysis of trenchassisted bend-insensitive multimode fibers

T. Abe, Satake, M. Takayama, and T. Kato

1 Ibaraki Univ., Ibaraki, JAPAN, 3 YAZAKI Corporation, Kanagawa, JAPAN, 3 Mitsubishi Cable Industries, LTD, Hyogo, JAPAN

We numerically analyze the guided modes and leaky modes of bend-insensitive multimode fibers assisted with a deep refractive-index trench. The impact of the leaky modes on the transmission characteristics is clarified numerically and experimentally.

Bandwidth Measurement of MFM by Using Phase-sensitive Fiber Interferometric Technique

Kunimasa Saitoh

Shizuoka Univ., Hamamatsu, Japan

ThS3-3 14:15 - 14:30

ThS3-4 14:30 - 14:45

Web-Structured All-Solid PBG Fiber

Hyouchen Goto, Shihochi Matsuo, Kazuki Matsunuma, and Kummasa Saboto

1 Optics and Electronics Laboratory, Fujikura Ltd., Chiba, Japan, 3 Graduate School of Information Science and Technology, Hokkaido Univ., Sapporo, Japan

We present a design and manufacture of a web-structured all-silica photonic bandgap fiber. We show experimentally that the loss can be reduced to a practical level (7 dB/km) with an appropriate design of web-structured structure.

ThS3-5 14:45 - 15:00

All-silica fiber and nonuniform Bragg frequency shift of single-mode fiber by controlling its fictive temperature

J. Ma, Kojro Tsubakawa, Nobuyuki Hanawa, and Fumio Yamamoto

Access Network Service Systems Laboratories, NTT Corporation, Ibaraki, Japan

We demonstrate a single-mode fiber with nonuniform Bragg frequency shift by controlling its fictive temperature with plasma implantation and thermal oxidation in a silica substrate.

ThS3-6 15:00 - 15:15

Low Similar Splice Loss of $A_{\text{eff}}$-Enlarged Pure-Silica-Core Fiber

Yuki Kasugai, Yoshinori Yamamoto, Masaaki Hiranoe, and Takashi Sasakil

Sumitomo Electric Industries, LTD, Yokohama, Japan

Low similar splice loss between pure-silica-core fibers with enlarged effective area of 110 $\mu$m$^2$ are demonstrated. The fiber is suitable for terrestrial long-haul transmission owing to its low attenuation, splice loss and macro-bending loss.

ThS3-7 15:15 - 15:30

Weighted Coupling of Electromagnet-Driven Long-Period Fiber Gratings

Tominori Nakada, Masahiro Tomoki, and Hajime Sakata

Shizuoka Univ., Hamamatsu, Japan

We present long-period fiber gratings induced by electromagnet with a coil spring. Special tailoring is attained by attaching the tapered rods to the coil spring. Filter bandwidth can be controlled without changing the grating length.
### ThK3-1 13:30 - 14:00

**Ultrafast-Threshold Electrically Driven Photonic-Crystal Nanocavity Laser**


Universität Munchen, Garching, Germany

We demonstrate an electrically driven photonic-crystal nanocavity laser with an InAlAs sacrificial layer. The laser exhibits an ultrafast threshold current of 7.8 μA and an energy cost of 14 fJ/bit with 12.5-Gbit/s direct modulation.

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### ThK3-2 14:00 - 14:15

**Modulation of Spatial Intensity Distribution of Laterally Coupled Twin VCSELs**

K. Carney, J. Wilkins, and F. Koyama

Lyngby, Denmark, School of Photonics and Quantum Optics, Technical University of Denmark, Denmark

We propose a twin coupled cavities VCSELs using a bow-tie shape connection for increasing the modulation bandwidth. The electrical modulation of spatial intensity distribution offers large modulation bandwidth beyond the relaxation oscillation frequency limit.

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### ThK3-3 14:15 - 15:00

**Signal Quality Enhancement of Directly-Modulated VCSELs Using a Micro-Ring Resonator Transfer Function**

Y. An, M. Muller, J. Esteban, S. Das, T. Du, P. Schuck, and Y. V. Pershin

1. Dept. of Photonics Engineering, Technical Univ. of Denmark, Lyngby, Denmark
2. Walter Schottky Institut, Technische Universität München, Garching, Germany

A microring resonator transfer function is used to enhance the quality of signals using VCSELs. We have evaluated the noise figures of a multi-section semiconductor optical amplifier (SOA) integrated on a silica-based planar lightwave circuit (PLC). In these devices, a silica thermo-optic switch is employed as a variable gain element. We have improved the response time of the silica thermo-optic switch from 2.6 msec to 20 μsec.

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### ThK3-4 14:45 - 15:00

**Switching operation using 220nm thickness Si waveguides with Ferroelectric Liquid Crystal**

Hitotaka Ooi, Toshio Watanabe, Kenya Suzuki, Atsushi Morii, Tetsuo Takahashi, and Tadashi Sakamoto

NTT Photonics Laboratories, NTT Corporation, Kanagawa, Japan

We investigated the power consumption of optical SWs and VOAs integrated on a silica-based PLC that is employed as a variable gain optical fiber amplifier with a wide gain range and a small NF variation.

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### ThK3-5 14:50 - 15:05

**Switching operation using 220nm thickness Si waveguides with Ferroelectric Liquid Crystal**

K. Yamaya, T. Morita, A. Katoh, K. Nakadate, and T. Nakagami

Dept. of Electrical and Electronic Engineering, Kanagawa Inst. of Technology, Kanagawa, Japan

Switching operations were demonstrated using 220nm-thickness Si waveguides with ferro-electric liquid crystal cladding. The phase shift coefficient was calculated from the switching characteristics to be 3.84 pi rad/mm, which is higher than the conventional value.

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### ThK3-6 15:00 - 15:15

**Theoretical investigation of high speed SOA using recombination-controlled carrier reservoir**

M. Soini, S. M. Amann, and K. Miyamoto

Photonics Integration System Research Center, RIKI Lab., Tohoku Inst. of Technology, Sendai, Japan

We propose a new operation mode for high speed SOA. An evaluation parameter for the distortion spectrum is introduced and a SOA using recombination controlled carrier reservoir showed the characteristics superior to the conventional SOA.
TuPH-1
Withdrawn

TuPH-2
Dip-shaped AlGaN/AlN Quantum Well Structures with High TE-polarized Optical Gain
Seoung-Hwan Park and Jung newborn.1
1 Catholic Univ. of Daegu, Dept. of Electronics Engineering, Daegu, Republic of Korea

For dip-shaped UV AlGaN/AlN QW structures, with the...self-resolution imaging of gold nanoparticles. Extracting the nonlinear signals due to the saturation, we demonstrated super-resolution imaging of two nearby gold nanoparticles.
Tuesday, July 2 / 13:00 - 14:30

TuPI-8 Spatiotemporal Control of Femtosecond Plasmon with Spectral Interferometry NSOM
Kazunori Toma, Shudao Onishi, W. Yuuki Kosaka, Kenichi Koshiba
Dept. of Electronics and Electrical Engineering, Keio Univ., Yokohama, Japan
Based on a plasmon resonance function in both amplitude and phase measured by a spectral interferometry combined with near-field scanning optical microscopy (NSOM), the femtosecond plasmon pulse at gold nanostructures is determined temporally.

TuPI-9 Blue-Shifted Blackbody Radiation From Nano-Structured Multi-Layer Emitter
Takahiro Matsumoto 1,2,3 and Makoto Toma 1
1 Research and Development Center, Stanley Electric Corporation, Fukui, Japan, 2 Center for Quantum Science and Technology under Extreme Conditions, Osaka Univ., Osaka, Japan, 3 Research Inst. of Electronics, Shizuoka Univ., Hamamatsu, Japan, 4 National Inst. of Advanced Industrial Science and Technology, Tsukuba, Japan, 5 Dept. of Physics, Faculty of Science, Shizuoka Univ., Shizuoka, Japan
Using the proposed nano-structured multi-layer emitter, we demonstrated blue-shifted blackbody radiation spectrum. The conversion efficiencies from input electric power to visible light radiation in excess of 95% could be produced.

TuPI-10 In-Plane Surface Plasmon Hologram: An In-Plane Air Plasmon Generator
Jae Lim, Qian Wang 1,2, Guanghua Yuan 1 and Luping Du 1
1 Singapore Inst. of Manufacturing Technology, Singapore, Singapore, 2 Inst. of Materials Research and Engineering, Singapore, Singapore, 3 School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore, Singapore, 4 School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore
In this paper, we report on a binary holographic technique to switch the surface plasmon waves. As an example, the in-plane Air plasmon is reconstructed by launching surface plasmon waves from sub-wavelength hologram pattern.

TuPI-11 Withdrawn

TuPI-12 Switchable Beaming From Metal slit by Controlling Excitation Phase of Surface Plasmons
Ryuno Kim, Seung-Yoo Lee, Jun-Bum Park and Byoungsoo Lee
National Inst. of Advanced Quantum Studies and Applications, Inter-Univ. Semiconductor Research Center and School of Electrical Engineering, Seoul National Univ., Seoul, Korea
We propose a beam-switching method from nanoslits surrounded by metal gratings. The underlying mechanism is based on controlling the phase of incident lights, by adjusting the relative position between the interference pattern and the slit.

TuPI-13 Numerical Study on the Generation of Low-Noise, Cylindrical Surface Plasmons by a Trenched Metal Nano-Slit Structure
Hyunai Kim, Byung-Sun Jeong, Namkyoo Park, and Yoonchan Jeong
1 Laser Engineering and Applications Laboratory, School of EECS, Seoul National Univ., Seoul, Korea, 2 Photonics Systems Laboratory, School of EECS, Seoul National Univ., Seoul, Korea
We numerically analyze the cylindrical surface plasmons generated by a trenched metal slit implemented on an optical fiber platform via a multi-pole cancellation method, which eventually yields a great enhancement in signal-to-noise ratio by 20-dB.

TuPI-14 The Excitation of the Surface Plasmon Polariton with the GaP-Au Contact and Application to Chemical Sensors
S. Nakamura, A. Motogiya 1,2, H. Miyake 1,2, and K. Kimatani 2
1 Graduate school of Engineering, Meiji Univ., Tama, Tokyo, 2 The Center of Ultimate Technology on nano-Electronics MeI Univ., Tama
In order to apply the GaP-Au contact to chemical sensors, the excitation of surface plasmon polariton (SPP) is investigated. The SPP excitation of Au, H2O, and CH3OH is found in simulations and experiments.

TuPI-15 Localized Surface Plasmons Coupled in U-Shaped Nano-Cavity with High Sensitivity
Y-Fun Hsiao, Yen-Hsiung Lee, Elson Maeda, and Jean-Jacques Delaunay
School of Engineering, The Univ. of Tokyo, Tokyo, Japan
We present the realization of a novel U-shaped cavity supporting the coupling of cavity modes with plasmon resonances. This demonstrates with optical vortices exhibit strong and sharp resonances having high sensitivity to their environments.

TuPI-16 Propagation Length and Coupling Characteristics of a Hybrid Plasmonic Waveguide with a Uniform Silica Layer
Masaru Nagai, Yuhei Iizhaka, Kunimasa Saitoh, and Masanori Koshiba
Division of Media and Network Technologies, Graduate School of Information Science and Technology, Hokkaido Univ., Sapporo, Japan
We propose a hybrid plasmonic waveguide with a uniform silica layer and evaluate its propagation length and coupling characteristics. Numerical results show that we should carefully choose structural parameters to obtain a longer propagation length.

TuPI-17 Surface Enhanced Infrared Absorption Measurements with Micro Metal Hole Array
Y. Nitahama, I. Yamauchi, and S. Joukazaki 1,3
1 Dept. of electrical and computer Engineering, Graduate School of engineering, Yokohama National Univ., Yokohama, Japan, 2 Centre for Micro-Photonics, Faculty of Engineering and Industrial Sciences, Swinburne Univ. of Technology, Hawthorn, Australia, 3 Melbourne Centre for Nanofabrication, Clayton, Australia.
SEIRA spectroscopic measurement using the metal hole array (MHA) is demonstrated with high spectral selectivity. The molecular IR absorption was detected up to 10 times at the transmission peak of MHA structure.

TuPI-18 Measurement and Analysis of Scattering of an Evanescent Wave by a Pt-coated Thin Fiber on a Pt-coated Prism
F. Tajima and Y. Nitahama
Yokohama National Univ., Yokohama, Japan
Scattering of an evanescent wave by a Pt-coated thin fiber above a Pt-coated prism is measured and analyzed by the modified bicircular model. It shows good agreement between them and the model is quantitatively verified.

TuPI-19 Nanoplasmonic Optical Filter Based on Complementary Split-ring Resonator
Fusheng Ma and Chengkui Liu
Dept. of Electrical and Computer Engineering, National Univ. of Singapore, Singapore
A novel nanoplasmonic optical filter is presented, in which the non-integer modes can be excited as well as the integer modes. The transmission spectra can be efficiently modified by manipulating the nano-wall inside the MM ring.

TuPI-20 Coupling Modes of Quasi-periodic Remote Grating Plasmonic Nanostructures
Tsu-Hao Weng, Shih-Wei Chen, and Jia-Li Hai
Dept. of Engineering Science and Ocean Engineering, National Taiwan Univ., Taipei, Taiwan
The coupling modes and their field intensities of remote grating plasmonic nanostructures with periodic and quasi-periodic arrangements are studied numerically by comparing their transfections, reflections, and extinctions.

TuPI-21 Highly Polarization Dependent Enhanced Optical Transmission Through Polygonal Plasmonic Apertures
Takao Nakazari, Sahar Hosseinzadeh Kassani, Reza Khatamkarfard, and Kyunghwan OH
Photonic Device Physics Laboratory, Inst. of Physics and Applied Physics, Yonsei Univ., Seoul, Republic of Korea
We investigated enhanced optical transmission through polygonal aperture surrounded by polygonal grooves, to find the inner polarization states of the field and effects of symmetry. Results show that incident light with Y direction polarization has impressive enhanced transmission.

TuPI-22 Explore the Blue Shift Phenomena in Single Size and Mixed-size Nanoparticles Arrays
Hsin Her Yu, Hauan Ping Weng
1 Dept. of Biotechnology, 2 Inst. of Electro-Optical and Materials Science, National Formosa Univ., Yunlin, Taiwan
Polymerize (PNP) nanoparticle arrays were synthesized and then arranged self-assembly to a regular structure by dip-drawing method. The reflectance of PN nanoparticles arrays are shifted to lower wavelength directions as the view angles increased.

TuPI-23 Optical Properties of Periodic/Random Pattern of Au Nanodots
Y. Nishima 1, L. Rosi 1, and S. Joukazaki 1,3
1 Dept. of electrical and computer Engineering, Graduate School of engineering, Yokohama National Univ., Yokohama, Japan
Optical properties of localized surface plasmon resonance (LSPR) in AuAg alloy were investigated experimentally and numerically. It was found that LSPR spectra of nanostructures at near-infrared wavelengths changed drastically at the 50% AuAg mole fraction.

TuPI-24 High-Efficient Two-Photon Up-Conversion in an Antenna-Molecule Complex System
Yoshito Osaki, Kobouho Yokoo, Masatoshi Nakatani, and Hajime Ishikawa
Dept. of Physics and Electronics, Osaka Prefecture Univ., Osaka, Japan
We theoretically analyzed two-photon up-conversion process on four-level (S1,M1,M2,M3) systems coupled with an optical antenna, and found significant enhancement of the up-conversion.

TuPI-25 Linear and Nonlinear Optical Properties of Nano-Porous Gold Film
Marjan-Akbari and Yae-Hsun Ishikawa
Dept. of Physics, Tokohu Univ., Sendai, Japan
We investigate optical response of nano-porous gold (NPg) in the visible frequencies. Reflectivity reduces significantly in the red range of the spectrum. Possibility for observation of photo-recitization is discussed.

TuPI-27 Tunable Hot Spot Based on the VO2 Phase Transition Materials
Jun-Bum Park, Il-Min Lee, Seung-Yoo Lee, and Byoungsoo Lee
National Creative Research Center for Active Plasmonics Application Systems Inter-Univ. Semiconductor Research Center and School of Electrical Engineering Seoul National Univ., Seoul, Korea
We propose a novel approach to generate and tune a hot spot in a dipole metallic structure of vanadium dioxide (VO2) laid on a gold (Au) substrate by inducing a phase transition of the VO2.

TuPI-28 Size-dependent Upconversion Luminescence in Er3+/Yb3+ Codoped LiYF4, Nano/Microcrystals
Xiaojie Xue, Shinya Ueuchi, Rajashahi N. Tawar, Zhongchao Duan, Meisong Liao, Masamichi Yoshimura, Takenobu Suzuki, and Yasutake Onishi
Graduate School of Engineering, Toyota Technological Inst., Nagoya, Japan
Er3+/Yb3+ codoped LiYF4, nano/microcrystals were controllable synthesized via a facile solvothermal method. Based on the emission spectra and quantum efficiencies under 976 nm pumping, size-dependent upconversion luminescence was studied.
Poster Session

TuPI-29
Fabrication and Application of Structured Nanofiber on Chip
Kazuhito Yamanoto, Shinya Yokoyama, and Akira Otomo
Dept. of Materials Chemistry and Engineering (MCE), Kyushu Univ., Fukuoka, Japan, 1 Inst. for Materials Chemistry and Engineering (IMCE), Kyushu Univ., Fukuoka, Japan, 2 Advanced ICT Research Inst., National Inst. of Information and Communications Technology (NICT), Kobe, Japan
We proposed the fabrication method of nanofibers on Si substrate using FIB milling and selective wet etching for integrated optical applications. The diameter of nanofiber could be well-controlled from 20im to 300nm.

TuPI-30
The Fabrication and Characterization of Dye-sensitized Solar Cells with ZnO Nanorods
Shou-Yu Kuo 1,2, Jui-Fu Yang 1
1 Dept. of Electronic Engineering, Chang Gung Univ., Tao-Yuan, Taiwan, 2 Dept. of Photonics Engineering, Yuan-Ze Univ., Chung-Li, Taiwan
In this study, the DSSCs with ZnO nanorods grown by hydrothermal method were fabricated and investigated in detail. Optimal length of ZnO nanorods has yielded a 96% enhancement in power conversion.

TuPI-31
Withdrawn

TuPI-32
Using Surface Plasmon Resonance to Detect the Dieoxidized Process of Graphene Oxide
Chun-Chuan Kuo
1 Inst. of Electro-Optical Science and Technology, National Taiwan Normal Univ., Taipei, Taiwan, 2 Dept. of Chemistry, National Taiwan Normal Univ., Taipei, Taiwan
We present a surface plasmon resonance real-time detection method to monitor the dieoxidized process of graphene oxide converted to reduced graphene oxide by electrochemistry. This may pave the way to new development in RGO-based application.

TuPI-33
An Even-symmetry Optical Guided Mode in a Graphene
Myung-Soo Kim, Chang-Young Jeong, Hyungjun Heo, and Sang-Hy Kim
Dept. of Electrical and Computer Engineering, Ajou Univ., Suwon, Korea
We investigate properties of an even-symmetry guided mode in a dielectric/graphene/dielectric structure and propose a means to control the properties of the structure.

TuPI-34
Theory for Ultra-high-accuracy Nano Optical Separation Assisted by Thermal Fluctuations
Mamoru Tamura
1 Nanoscience & Nanotechnology Research Center, Osaka Prefecture Univ., Osaka, Japan, 2 Dept. of Physics and Electronics, Osaka Prefecture Univ., Osaka, Japan
We have theoretically clarified principles for the screening of different-sized nanoparticles by combination of light and fluctuations, where several tens nanometers-sized nanoparticles in diameter can be separated with significantly high accuracy of a few nanometers.

TuPI-35
Control of Population Dynamics by Three-body Self-consistent Interplay
Ryozae Hata, Nobuhiko Yokoyama, Hiroshi Akiyama, and Hajime Itohara
1 Dept. of Physics and Electronics, Osaka Prefecture Univ., Osaka, Japan, 2 Photon Pioneers Center, Osaka Univ., Osaka, Japan
We investigate population dynamics in coupled oscillators, which is driven by external field. Especially, we focus on the self-consistent motion among three boids, e.g., photons, a targeted system, and an auxiliary system such as cavities.

TuPI-36
Distillation of Optical Vortex Pairs in Disordered Nonlinear 2D Photonic Lattices
Yeong-Kiun Cho, Dong-Joon Moon, and Kihong Kim
Division of Energy Systems Research, Ajou Univ., Suwon, Korea
We study numerically the propagation of optical vortex beams through disordered nonlinear 2D photonic lattices. We find that due to disorder, new optical vortex-antivortex pairs are nucleated at the positions of perfect destructive interference.

TuPI-37
Transmission characteristics of visible light through layered glassy capillaries towards microbeams
Kiyone Kato 1, Wei-Guo Liu 2, Tatsuya Minowa 3, and Yoshiko Menda 3
1 Dept. of Physics, Faculty of Science, Toho Univ., Chiba, Japan, 2 Atomic Physics Laboratory, RIKEN, Saitama, Japan, 3 Photon Pioneers Center, Osaka Univ., Osaka, Japan
Towards production of microbeams, propagation of visible light through a layered glassy capillary has been studied. Transmittance has been measured for capillaries with different outer diameters.

TuPI-38
Stimulated Scattering in Nanostructures
A. D. Kudryavtseva 1, V. V. Tyuterev 1, P. N. Lebedev Physical Inst. of the Russian Academy of Sciences, Moscow, Russia
Stimulated low frequency Raman scattering caused by laser pulses interaction with localized acoustic vibrations of nanoparticles and stimulated Raman scattering with high conversion efficiency have been experimentally studied in different materials.

TuPI-39
Symmetries and Asymmetries in Optical Activity
K. Akahane 1,2,1,2, Alex Barbara 1,2,3, Masaomi Yamaguchi 1,2,3, and Wei-Guo Jin 1,2,3
1 AIST, 2 RIKEN, 3 NICT, Japan
We show the relation between optical activity and helicity or the scattering of chiral particles. The results show how to design chiral structures for an omnidirectional optically active response independent of the incident polarization.

TuPK-1
High-Efficiency 3D CMOS Image Sensor
Oscar C.-C. Chen, Kuan-Hsin Lin and Zhe-Ming Liu
Dept. of Electrical Engineering, National Chung Cheng Univ., Chia H, Taiwan
A 4×4×36 pixel 3D CMOS image sensor is developed based on the time-of-flight scheme where N-well, P-substrate photo-diodes with a large breakdown voltage are adopted. Additionally, breakdown voltages of photo-diodes are well explored with consideration of crosstalk.

TuPK-2
Vacuum Ultraviolet Light Emitting Device Consisting of Nd3+-LuF3 Thin Film as Phosphor
Takahiro Nakamura 1,2, Akira Yoshikawa 2,3,4,5,6, Nagoya Inst. of Technology, Aichi, Japan, 2 Inst. for Materials Research, Tohoku Univ., Sendai, Japan, 3 Kyushu Inst. of Technology, Kitakyushu, Japan, 4 N国立, thin film was grown by pulsed laser deposition (PLD). Additionally, a vacuum-ultraviolet (VUV) light emitting device was successfully fabricated by consisting of Nd3+-LuF3 thin film as phosphor and carbon-nanotubes (CNFs) field emitter.

TuPK-3
Effect of SCH/Barrier Layer Thickness on K-factor of Quantum Dot Laser
Nami Yashouka 1, Mitsuhiro Ishida 2, Mitsuhiro Ikawa 2, Tsuyoshi Yamanotsu 3, Masami Yamaguchi 3, Kenchichi Nishi 3, Mitsuhiro Sugawara 4, and Yasuko Arakawa 4
1 Inst. of Nano Quantum Information Electronics, 2 Inst. of Industrial Science, The Univ. of Tokyo, Tokyo, JAPAN, 3 QD Laser, Inc., Kawasaki, JAPAN
The effect of the SCH/barrier layer region on the K-factor of quantum dot lasers was investigated. It was found that thinner SCH/barrier layers lead to a shorter effective capture/relaxation time and a reduced K-factor.

TuPK-4
Characterization of 24 Stacked InGaAs Quantum Dot Laser Fabricated by Ultra-high-rate MBE Growth Technique
F. Tanoue 1,2, H. Sugawara 1, K. Akatani 1, and N. Yamanotsu 1
1 Graduate School of System Design, Tokyo Metropolitan Univ., Tokyo, Japan, 2 National Inst. of Information and Communications Technology, Tokyo, Japan
Highly stacked of 24 InGaAs/GaAs quantum dot laser was prepared using ultra-high-rate MBE growth technique and observed laser emission at 1070nm, and its internal quantum efficiency evaluated to be 22.0%.

TuPK-5
Effect of Inhomogeneous Linewidth on RMS Spectral Width of Quantum Dot Lasers for O-band Optical Communication
1 Faculty of Engineering, Univ. of Engineering & Technology, Punjab, Pakistan, 2 Dept. of Electronic & Electrical Engineering, Univ. of Sheffield, Centre for Nanoscience & Technology, Sheffield, UK, 3 Physics Dept., Imperial College, London, UK
Line-width of an optical transmitter is key in determining the dispersion limit. The effect of inhomogeneous linewidth on the RMS spectral linewidth of AlGaAs/GaAs quantum dot laser transmitters thus suitability for telecommunication is discussed empirically.

TuPK-6
Mode Stability and Wavelength Selection in Dual-J. QD lasers
S. Shutt 1, P.M. Smowton 1 and A.B. Krysa 2
1 Cardiff University, School of Physics and Astronomy, Cardiff, UK, 2 EPSRC National Centre for B+V Technologies, University of Sheffield, Sheffield, UK
Dual-mode monolithic lasers emitting in the range of 655-720nm have been demonstrated, which were designed to exploit the properties offered by quantum dot material. The criteria determining wavelength selection and mode stability are discussed.
We demonstrate for the first time, the resonance frequency suppression characteristic was obtained.  

**TuPK-9** 
An External Modulator Model for Optical Injection-locked Semiconductor Lasers  
Peng Guo, Lian Zhu, Anshi Xu, and Zhiyuan Chen  
State Key Laboratory of Advanced Optical Communication Systems and Networks, School of Electronics Engineering and Computer Science, Peking University, Beijing, China

An external modulator model is proposed to analyze the optical injection-locked semiconductor lasers. This model provides a new perspective of many characteristics of OC-SLs including mode-locked modulation, phase modulation, and all-optical RF-conversion.

**TuPK-10** 
Dual Characteristics Dependence on In Composition of 850 nm (In)GaAs TQW VCSELs with Low Power Consumption for Optical Interconnects  
T. Konno, K. Takeda, H. Nakayama  
Electrical Device Engineering, Production Technology, Fuji Xerox Co., Ltd., Kanagawa, Japan

We investigated lasing characteristics of (In)GaAs InQW VCSELs with different composition in terms of low power consumption. The bias current of 10 Gbps operation was reduced by using InAs QWs.

**TuPK-11** 
Low Switching Power Polarization Instability in Optically Injected VCSELs  
Abdul-Kader A. Qader, Yonhwa Hong, and K. Alan Shore  
Technology, Peking University, Beijing, China

We experimentally investigated the polarization modulation and phase modulation in the VCSEL, using high-speed polarization sensitive photodetectors.

**TuPK-12** 
Investigation on Polarization Features of Broad-Area Square-Shaped VCSELs with Different Frequency Detuning: High-Order Modes Assisted in Stable Polarization Emission  
Yan-Ting Yu, Pi-Hsu Tsai, Chien-Jen Lin, and Jung-Fu Chen  
Dept. of Electrophysics, National Chiao Tung University, Hsinchu, Taiwan

We experimentally confirmed frequency detuning is the crucial factor for being capable of polarization switching in broadband square-shaped VCSELs. Intrinsically, the VCSL can exhibit stable polarization in light output for relatively large frequency detuning.

**TuPK-13** 
Noise Suppression Characteristics of Negative Feedback Optical Amplifier Using an Optical Triode  
Atsushi Saitoh, Yama Fujikawa, Azaz S. Aliyev, and Yoshinobu Maeda  
School of Science and Engineering, Kinki University, Higashiosaka, Japan

We investigate the relationship of negative feedback signal intensity with bit error rate using optical triodes. It was found that data power penalty was improved by 15 dB and noise suppression characteristic was obtained.
TuPL-8
Phenomenon of Hygroscopicity in a Fiber Fabry-Perot Interferometer with an Absorptive Polymer Cavity
Oki Electric Industry, Otsu, Shiga, Japan
We report about properties of multimode polymer 1x2 optical triplexers.

TuPL-9
Optical Waveguide Resonator for Refractive Index Change Sensor Using Arrayed Waveguide Gratings for Coupling Light Beam
H. Nakazawa, Y. Ohtsubo, T. Uchida, R. Mastera, and M. Nakazawa
Kanazawa Univ., Ishikawa, Japan
A novel heterostructured InGaAsP single-mode laser is proposed. Owing to vernier effect between Fabry-Perot resonator and split silicon racetrack resonator, single longitudinal mode can be obtained and can be selected by thermally tuned silicon waveguide.

TuPL-10
Dispersion Model for AWG-Based Filters Under the Influence of Random Phase Errors
Koichi Maru
Kangwon National Laboratory for Optical Science and Technology, Kangwon Univ., Seoul, Republic of Korea
Serially cascaded single-ring resonator APF's (All-Pass Filters) are implemented in polymer waveguide for the realization of variable optical delay device. When all of 8 rings are resonant, the delay is measured to be about 160ps.

TuPL-11
Time Vary Delay Experiments in Serially Cascade Ring Resonator All-Pass Filters
Jong-Han Son1, Hae-Ryeong Park1, Min-su Yi1, Hae-Ryung Park2, Jin-Ho Kang1, and Min-Joo Bae2
Yonsei University1, and Dept. of Electrical Engineering, Dept. of Electrical and Electronics, Yonsei Univ., Seoul, Korea
We study both the intensity and phase responses in embedded waveguide Bragg grating in metal/multi-insulator/metal configuration is investigated. Narrowband characteristics are demonstrated within a footprint of <11μm.

TuPL-12
Waveguide Optical Triplexer with Cascaded Multi-Mode Interference Couplers
Yasuhiro Iwashita, Yoichi Kojima, Hiroaki Yabuta, and Hiroshi Tokunaga
Yokohama National University, Hodogaya-ku, Yokohama, Japan
Strong optical confinement to the low-index slot, such as Er3-xY2-O5, is expected for TM mode in Si slot waveguide. We have fabricated 3.0GHz Si OEIC receiver.

TuPL-13
Design, Fabrication and Properties of Optical Large Core Polymer Planar 1x2 Splitter
V. Pragot, R. Maiti, and V. Jena1
Dept. of Microelectronics, Faculty of Electrical Engineering, Czech Technical Univ. in Prague, Prague, Czech Republic
We report about properties of multimode polymer 1x2 optical planar splitter. The splitters have the insertion loss of 8.06 dB for a structure comprising POF fibers and 4.38 dB (850 nm) with POF-PCB fibers.

TuPL-14
Quasi-LP21 Mode Converter by Using Simple Step-Core Structure
Yutaka Chaen, Chienzi Lin, and Yutaka Chien1
Dept. of Electrical Engineering, National Taiwan Univ., Taipei, Taiwan, R.O.C.
We propose a G-s1-mode converter (MC) from the Ss1-mode to the GS1-mode at a wavelength of 1.05 μm.

TuPL-15
Fast Mode Splitting in Engineered Multimode Waveguides
Shun Yen Tseng, Chi-Sheng Yeh, and Kai-Hau Chen
Dept. of Photonics, National Cheng Kung Univ., Tainan, Taiwan
We propose fast mode splitting in multimode waveguides based on Lowe-Resolved invariant theory. Mode converters are designed using computer-generated planar holograms to implement the coupling coefficients obtained from the dynamical invariants.

TuPL-16
SESAM-Based Ring-cavity All-normal-dispersion Tunable Ytterbium Mode-locked Fiber Laser
Daisuke Ogiwara, Akihiko Ogiwara, Tetsu Ono, Takeshi Yamanaka, and Koichi Maru
Kanazawa Univ., Ishikawa, Japan
Characteristics of gas phase detector showed 1.5% and 9.5% more efficient in quantum efficiency and luminous efficiency, respectively than sintered glass fiber.

TuPL-17
Characteristics of Glass Phosphor with Ce3+:YAG Particle Coated SiO2 by Sol-Gel Method
Wei-Cheng Chang, Chun-Chia Tai, Shi-Hung Hsi, Jen-Ji Cheng, Yu-Lun Li, Li-Yen Lin, Yu-Cheng Huang, Wei-Hsiung Hsi, and Hsin-Mei Cheng
EIEE Fellow
Dept. of Photonics, National Sun Yat-sen Univ., Kaohsiung, Taiwan, Dept. of Optoelectronic Engineering, For East Uni., Taiwan, Dept. of Biomedical Engineering, National Pingtung Univ. of Science and Technology, Taiwan
The characteristics of sol-gel glass phosphor have been investigated. The detector showed a rise time 35ns and 9.5% more efficient in quantum efficiency and luminous efficiency, respectively than sintered glass fiber.

TuPL-18
Formation of Holographic Memory by Recording of Multi-context in Liquid Crystal Composites
Akihiro Ogiwara and Ryoichi Ogiwara
Kanazawa University, Ishikawa, Japan
A holographic-polymer-dispersed liquid crystal (HPDLC) memory to record multi-context information for an optically reconfigurable gas laser is formed by a successive laser exposure in LC composites.

TuPL-19
Ultracompact Narrowband Three-Dimensional Hybrid Plasmonic Waveguide Bragg Grating
Yin-Jung Chang and Chun-Yu Chen
Dept. of Optics and Photonics, National Central Univ., Taiwan
A novel ultracompact three-dimensional waveguide plasmonic Bragg grating in metal/multi-insulator/metal configuration is investigated. Narrowband characteristics are demonstrated within a footprint of <11μm.

TuPL-20
A s1-mode Converter for Nano Masimic Integrated Circuits
Dong Hun Lee, Jung-Han Son, Hae-Young Park, Min-su Kim1 and Myung-Kyung Lee
School of Information and Communications Engineering, Sungkyunkwan Univ., Suwon, Korea, 1 CEA Group, L2D RD Center, LGD Business, Samsung Electronics Co. Ltd., Gyunggi-Do, Korea, 2 Electronics & Telecommunications Research Inst., Daejeon, Korea
We propose a G-s1-mode converter (MC) from the Ss1-mode to the GS-s1-mode at a wavelength of 1.05 μm.

TuPL-21
High-Extinction Si Photonic-Crystal Optical Modulators At 10 Gb/s
Nakay Tazawa, Hong C. Nyugen, Satoshi Hashimoto, Toshihiro Baba
Dept. of Electrical and Computer Engineering, Yokohama National University, Tokyo, Japan
We optimized the 10 Gb/s operation in Si photonic crystal microlasers with 50-200 μm phase-shifter lengths. By incorporating additional phase-tuners, we obtained 10.5 Gbps extinction ratio and error-free operation.

TuPL-22
GRZ Response of BM InAsGaS Photodetector on Si Substrate by BCS Bonding
Kazuki MAKITA, Takeo MARUYAMA, and Kichi IWAHA
Graduate School of Natural Science and Technology, Kanazawa Univ., Ishikawa, Japan
We fabricated an InAsGaS MSM-PD bonded on Si substrate by BCS bonding. The response current and the dark current of 2mA were obtained. The bandwidth of 3GHz was obtained at 10V.

TuPL-23
Selects Heterogeneous Integrated III-V/7BO Single Mode Laser Based on Vernier Effect
Zhao Lu
Wuhan National Laboratory for Optoelectronics, Huazhong Univ. of Science and Technology, Wuhan, China
A novel heterogeneous integrated III-V/7BO single mode laser is proposed. Owing to vernier effect between Fabry-Perot resonator and split silicon racetrack resonator, single longitudinal mode can be obtained and can be selected by thermally tuned silicon waveguide.
TuPO-7 Optical Flip-Flop Operation with a Single SOA in Orthogonal Polarization States
K. Takase, A. Uehara, H. Goto, and S. Yanagisawa
Dept. of Optical Science and Technology, The Univ. of Tsukuba, Tsukuba, Japan
Flip-flop operation with a single SOA using two orthogonal polarization states is proposed and analyzed. Polarization dependence of SOA is considered in the analysis of a single wavelength operation, and the simulated results are presented.

TuPO-8 Radio-over-Fiber Transmission With Optical Power Supply Using a Double-Clad Fiber
Jun Sato, K. Takase, R. Uehara, N. Goto, and S. Yanagiya
1 Dept. of Information and Communication Engineering, 2 The Center for Frontier Science and Engineering, The Univ. of Electro-Communications, Tokyo, Japan
We presented radio-over-fiber transmission with optical power supply using a 100 m double-clad fiber. We successfully achieved high uplink and downlink transmission performances with a 50 GHz X optical feeding.

TuPO-9 Serial Photonic Channelized RF Frequency Measurement Based on Optical Coherent Frequency Scanning
Rajase Li, Cheng Lei, Yuntao Liang, Hongwei Chen, Minghua Chen, Sigang Yang, and Shohong Xie
Dept. of Electronic Engineering, Tongji Univ., China Tsinghua National Laboratory for Information Science and Technology (Tsinghua Univ.)
Based on optical coherent frequency scanning, a serial photonic channelized RF frequency measurement scheme is proposed and experimentally demonstrated. An 8-channel, 2-GHz-interval channelizer for multiple frequencies measurement in 16-GHz range is realized.

TuPO-10 A Wideband Tunable Optoelectronic Oscillator Based on Stimulated Brillouin Scattering
Tao Sun, Cheng Zhang, Xiaopeng Xie, Peng Guo, Xiaoyu Zhu, Lixin Zhu, Weiwei Hu, and Zhangyuan Chen
Dept. of Electrical & Computer Engineering, National Univ. of Singapore, Singapore
We demonstrate the transmission of 1.25-Gb/s 20-GHz radio delay interferometer. A significant improvement in the system efficiency increases especially in low take rate areas. The proposed network can support 640 customers at the rate of 3.3 Gbps x 3TDM IR signal transmission for UWB upstream can carry 2.5 Gb/s over 25-km LEAF fiber.

TuPO-14 A Broadband Optical Source Based Optoelectronic Oscillator with Widely Tunable Frequency Range
Chenyun Liu, Weiwei Zou, Guiling Wu, Junping Chen
State Key Laboratory of Advanced Optical Communication Systems and Networks, Shanghai Key Laboratory of Navigation & Location Based Services, Shanghai Jiao Tong Univ., Shanghai, China
An optoelectronic-oscillator (OEO) with widely-tunable-frequency range is experimentally demonstrated. A single band-pass microwave photonic filter based on a broadband source serves as an oscillating-mode selector. The proposed OEO is notching-free due to the non-carrier-suppression effect.

TuPO-15 Single Shot Ghost Imaging
Seiji Fukushima, Naomasa Miura, Takayuki Shimaki, Kota Shimasaki, Ruiyue Li, Cheng Lei, Yunhua Liang, Hongwei Chen, Minghua Chen, Sigang Yang, and Shohong Xie
Dept. of Systems Science, Graduate of System Informatics, Kobe Univ., Kobe, Japan
A novel method for ghost imaging is proposed. Single shot imaging is achieved by a measurement based on wavelength multiplexing. Usefulness of the proposed method is verified by numerical analysis.

TuPO-16 An Angularly Positioned LED-based Spatial-Temporal Color Separation System
Chi-Hung Lee, Shih-Hsin Ma, and Chia-Hsien Sun
1 Dept. of Electrical Engineering, Fong Chia Univ., Taichung, Taiwan; 2 Dept. of Photonics, Fong Chia Univ.
A display method, two field driving scheme based on angularly positioned color LEDs, is proposed for fast sequential color liquid crystal displays (LCDs) without color filters.

TuPO-17 Asymmetric Diffraction Orders Based on Axicon and Helical Phase Combination
M. Mitulescu,1 P. Freda,1 A. Gheorghiu,2 O. Cucur1 and C. Coline2
1 Politehnica Univ. from Bucharest, Bucharest, Romania; 2 National Inst. for Microtechnology, Bucharest, Romania, Optoelectronica 2001 S. A., Magurele, Romania
We digitally generate holograms with an axicon phase element of a proposed and experimentally demonstrated. An 8-channel, 2-GHz-interval channelizer for multiple frequencies measurement in 16-GHz range is realized.

TuPO-18 White Upconversion Luminescence of CaWO4:Ho3+,1 Tm3+,2 Excited by IR Laser
J.H. Ryu1 and Jung Il-Lee1
1 Dept. of Materials Science and Engineering, Korea National Univ. of Transportation, Chungbuk, Korea; 2 Regional Innovation Center (RIC), Korea National Univ. of Transportation, Chungbuk, Korea
Under the laser excitation of a 980 nm, Ho3+/Tm3+/Yb3+ co-doped CaWO4 shows the bright white upconversion emission visible to the naked eyes.

TuPO-19 Remotely-Pumped WDM-PON Systems Using ASE Sources for Upstream Transmission
B. Jang, Dong-Ryong Lee, Ming-Huei Chuang, Chi-Hsien Sun, Meng-Ru Lee, Kun-Chang Feng, and Chi-Wei Lee
Dept. of Electronic Engineering, National Taiwan Univ. of Science and Technology, Taipei, Taiwan
We demonstrate a potentially low-cost solution for WDM-PON systems by using ASE sources as seeding lights for upstream transmission. By applying remote pumping scheme, the upstream can carry 2.5 Gb/s over 25-km LEAF fiber.
**Poster Session**

**Annex Hall**

**Tuesday, July 2 / 13:00 - 14:30**

**TuPP-8**
A Time Domain Interleaved Passive Optical Access Network with Simplified ONU Processing and Enhanced Physical Layer Security
Jiemin Gao, Qinglong Chang, and Zhong Hu
Research and innovation center (Blii Lab., Shanghai), Alcatel-Lucent Shanghai Bell Co. Ltd., Shanghai, P. R. China
We propose and verify a novel time domain interleaved passive optical access network architecture to simplify ONU electronic processing and enhance physical layer security in a two-channel, 1.25Gb/s optical system with 20km fiber span.

**TuPP-9**
Upgrading from TDM-PON to Signal-Nomodulated WDM-PON with Rayleigh Backscattering Mitigation
C. W. Chow, C. H. Yeh, and J. Y. Sun
Dept. of Photonics and Inst. of Electro-Optical Engineering, National Chiao Tung Univ., Hsinchu, Taiwan, 1 Information and Communications Research Laboratories, Industrial Technology Research Inst. (ITRI), Hsinchu, Taiwan.
We propose and demonstrate a migrating scheme from TDM-PON to WDM-PON using downstream differential phase-shift-keying (DPSK) and upstream wavelength-shifted-amplitude-shift-keying (WS-ASK) signals. An optical filter is pre-installed in the optical-networking-unit (ONU) for DPSK demodulation. Rayleigh-backscattering is also mitigated.

**TuPP-10**
VCSEL sources for optical fiber-wireless composite data links at 60GHz
Ji Vega Omos, K. Fang, A. Labebev, and J. Taira Monroy
Technical Univ. of Denmark, DTU Fotoniik, Ørsted Plads, Lyngby, Denmark.
This paper presents a performance assessment of 60-GHz mm-wave signal generation using photonic upconversion employing a VCSEL as source. The system reaches 10 dBm over a variety of optical fibers for data rates of 1.25-Gb/s.

**TuPP-11**
2.5 Gb/s Injection Seeded DWDW - PON Using Feed Simplify ONU electronic processing
Sang-Rok Moon, Myeong Gyun Kye, Byung-II Seo, and Chang-Ho Lee
Dept. of Electrical Engineering, Korea Advanced Inst. of Science and Technology, Daejeon, Republic of Korea
We propose an injection seeded dense WDM-PON employing feed forward loop for 2.5 Gb/s transmission at 50 Gb/s channel spacing. We achieved the error free transmission with -12 dbm injection power for 20km transmission.

**TuPP-12**
Seamless Optical Fiber-Wireless Millimeter-Wave Transmission Link for Access Networks
Kisadan Fang, Alexander Labedz, J.S. Vegas Omos, and ildefonso Taira Monroy
Technical Univ. of Denmark, DTU Fotoniik, Ørsted Plads, Lyngby, Denmark.
This paper presents an experimental demonstration of a millimeter-wave wireless bridge in the W-band for transparent broadband fiber access in the sub-urban areas, where full fiber connections are impracticable.
TuPR-6
Residual Carrier-Aided Frequency Offset Estimation for Square 16-QAM Systems
Yuliang Gao, Alan Pak Tao Lau and Chao Lu
1 Memory Research Center, Dept. of Electrical Engineering, The Hong Kong Polytechnic Univ., Kowloon, Hong Kong, 2 Photonics Research Centre, Dept. of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Kowloon, Hong Kong.
We present a frequency offset estimation using a residual carrier that is a by-product of our previous generation technology. The offset range is extended to half of the symbol rate and is resilient to filtering.

TuPR-9
Withdrawn

TuPR-10
Employing NRZI Code for Reducing Background Noise in LED Visible Light Communication
Y. F. Liu, C. H. Yeoh1, K. C. Wong, and C. W. Cheung
1 Dept. of Photonics and Inst. of Electro-Optical Engineering, National Chiao Tung Univ., Hsinchu, Taiwan, 2 Information and Communications Research Laboratories, Industrial Technology Research Inst. (ITRI), Hsinchu, Taiwan, 3 Graduate Inst. of Applied Science and Engineering, Fu Jen Catholic Univ., New Taipei, Taiwan.
We propose blind maximum likelihood carrier frequency offset estimation for coherent fast OFDM receivers. Simulation results show that the estimation algorithm can greatly enhance the CFO tolerance, and is insensitive to chromatic dispersion.

TuPR-11
Blind Maximum-likelihood Frequency Offset Estimation for Coherent Fast OFDM Receivers
Ming Li1, Jian Zhao, and Lian-Kuan Chen
1 Dept. of Electrical Engineering, The Chinese Univ. of Hong Kong, Hong Kong SAR, China, 2 Tyndall National Inst. and Univ., Cork, Cork, Ireland
We propose blind maximum-likelihood carrier frequency offset (CFO) estimation for coherent fast OFDM receivers. Simulation results show that the estimation algorithm can greatly enhance the CFO tolerance, and is insensitive to chromatic dispersion.

TuPR-12
64Gb/s DUAL-polarization DPSK OTDM Transmission over 410km Using EAM-based Pulse Source and Clock Recovery
Jinho Yang, Yang Li, Deiming Kong, Siyan Zhou, Jian Wu, Wei Li, Shiguo Guo, and Junfeng Lu
State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ. of Posts and Telecommunications, Beijing, China.
We experimentally demonstrate a 64Gb/s dual-polarization DPSK OTDM system using EAM-based pulse source and clock recovery. Error free transmission over 410km fiber link is realized with power penalty of 4.46dB.

TuPR-13
A Single Receiving System Design for a 223Gbit/s Double-Sided Multiband Direct-Detected D4FD System
Jinhong Yan1, You-Wei Chen1, Kai-Ming Feng1, and Yuan-Wei Chang1
1 Inst. of Photonics Technologies, National Tsing Hua Univ., Hsinchu, Taiwan, ROC, 2 Inst. of Communication Engineering, National Tsing Hua Univ., Hsinchu, Taiwan, ROC.
We propose and experimentally demonstrate a simple double-sided multiband direct-detected optical OFDM receiving system. An aggregated 172 Gb/s data rate and a 2.73-b/s/Hz spectral efficiency of total 6 signal bands are carried by one optical carrier.

TuPR-14
Least Radial Distance Based Carrier Phase Recovery for 16-QAM Coherent Optical Systems
Md. Khairul Islam, Md. Moazzemul Hossain Azad, Anshad M Chowdhury1, Md. Saffuddin Faruqi, and Gee-Kung Chang1
1 Dept. of Electrical Engineering and Computer Sciences, North South University, Dhaka, Bangladesh, 2 School of Electrical and Computer Engineering, Georgia Inst. of Technology, Atlanta, GA, USA, 3 Dept. of Electrical & Electronic Engineering, Dhaka Univ. of Engineering and Technology, Gazipur, Bangladesh.
We propose and demonstrate least radial distance based carrier-phase-recovery method for 16-QAM coherent optical systems. Through numerical analysis, we found proposed scheme has lower than 2.5 dB BER penalty when laser linewidth symbol-duration-product is ≈10 range.

TuPR-15
A phase noise estimation and suppression algorithm for PDM CO-OFDM
Xi Fang, Chuanchuan Yang and Fan Zhang
State Key Laboratory of Advanced Optical Communication Systems and Networks, Peking Univ., Beijing, China.
In this paper, we propose to use an efficient laser phase noise power estimation algorithm for PDM CO-OFDM, which can compensate both CFO and ICI. The proposed method can significantly promote the system robustness against laser phase noise.

TuPR-16
Performance of Adaptive Maximum Likelihood Sequence Detection with Nonlinear Phase Noise
Zhongwen Xu, Changyan Yu, 1 Pooi-Yuen Kam
1 Dept. of Electrical & Computer Engineering, National Univ. of Singapore, 2 National Univ. of Singapore (Sustech) Research Inst. China.
Adaptive maximum likelihood sequence detection is applied to compensate for nonlinear phase noise in coherent optical transmission systems. It can automatically achieve the optimal performance and thus tolerate longer transmission distance.

TuPR-17
Partial Pilot Filling for Phase Noise Compensation in Coherent Optical OFDM Systems
S. Hussain, K. Puntrun, M.P. Parwari and H. Hoë
Optical Communication and High Frequency Engineering Dept., Univ. Paderborn, EMF-E, Paderborn, Germany.
We present a partial pilot filling method to mitigate the effect of phase noise in coherent optical OFDM. This method uses linear interpolation for the reconstructed pilot frequencies. Phase noise effect from laser linewidth is investigated.

TuPR-18
Wavelength Conversion of Two Different Wavelength Signals using an Optical Single-SideBand Modulator
Hiroki Mima and Katsumi Iwashita
Electrical and Photonic System Engineering, Kochi Univ. of Technology, Kochi, Japan.
Wavelengths of two signals with different wavelengths are simultaneously converted using the proposed wavelength converter. 25-GHz wavelength conversions for intensity modulated signals are demonstrated using 25-GHz channel spacing and OISBB performing three time conversion.

TuPR-19
Self-homodyne Detection of Phase Modulated Optical Data Signals using Quadrature-phase-modulated and Polarization-multiplexed Pilot Carrier
Hiroshi Mitakuma, Yasunori Okumura, and Masanori Hanawa
Univ. of Yamanashi, Yamanashi, Japan.
Simple self-homodyne detection for optical BPSK signals using a quadrature-phase modulated and polarization-multiplexed pilot carrier is proposed and experimentally demonstrated. The simple receiver configuration for IQ discrimination makes the use of phase modulation in FON possible.

TuPS-1
Connection Characteristics of Multicore Fiber Connector
Katsuyoshi Sakamoto, Ryo Nagase1, Kengo Watanabe2, and Tatsuo Saito
1 Chiba Inst. of Technology, Tsudanuma, Narashino, Chiba, Japan, 2 Furukawa Electric Co., Ltd., Chiba, Japan.
We have developed a 7-core connector. To maintain both the femto-folding mechanism and precise alignment around the ten feet axis, we employed Oldham’s coupling mechanism and realized an average insertion loss of 0.13 dB.

TuPS-2
Implementation of Variable Optical Delay Line Using Multicore Optical Fibers
Urs Dragoni, Jurij Trinkl, Rostjan Batagelj
1 Centre of Excellence for Biosensors, Instrumentation and Process Control, Sisak, Slovenia, 2 Univ. of Ljubljana, Faculty of Electrical Engineering, Ljubljana, Slovenia.
By applying an electrical current to the metal-coated fiber, a relation between the applied power and the delay difference was measured. The temperature coefficient and the rise time exceed those of other optical-fiber delay-line implementations.

TuPS-3
Fabrication of Polarization-Maintaining Photonic Crystal Fiber Optical Attenuator Using Air Hole Diameter Control
Hirohsa YOKOTA, Naoya INOUE, Yuto KOBAIYASHI, and Yoh IMI
Graduate School of Science and Engineering, Ibaraki Univ., Ibaraki, Japan.
Polarization-maintaining photonic crystal fiber optical attenuators were fabricated using air hole diameter control with CO2 laser irradiation technique. The desired attenuation could be obtained by the air hole diameter control with the laser power adjustment.

TuPS-4
Characteristics of Photoactive Photonic Liquid Crystal Fiber Used in Communication Wavelength
Hui Fang Lee, and Vincent K. Chan
1 Dept. of Applied Materials and Optoelectronic Engineering, National Chi Nan Univ., Taiwan.
We experimentally demonstrated photoactive photonic liquid crystal fiber (PLCF) consisting of an azobenzene based photoactive LC (azo-LC) and solid core photonic crystal fiber (SC-PCF).

TuPS-5
All-optical tunable comb filters using ytterbium doped fibers and an LPG pair
Yung Han Kim1,2, Bok Hyeon Kim1,2, Sooek Han1,2, Young-Eun Lim1,2, Joon Woon Lim1,2, Jeong-Sup Kim1,2, Jeong Ho Kim1,2, Ju Young Lim1,2, and Won-Taek Han1
1 Laser & IT Research Center, KOPTI, South Korea, 2 Advanced Photonics Research Inst., GIST, South Korea.
We experimentally demonstrated a new type all-optical tunable comb filter by using a long period fiber grating,PLG pair spliced with an ytterbium doped fiber. The optical comb filter was tunable with an optical pumping.

TuPS-6
Passively Q-switched Erbium-Doped Fiber Laser Using a Side-polished Birefringent Fiber
Johannah Ko and Ju Han Lee
School of Electrical and Computer Engineering, Univ. of Seoul, Seoul, Republic of Korea.
We experimentally demonstrated a new type Q-switched erbium-doped fiber laser incorporating a side-polished birefringent fiber with index matching gel spread on the flat side as a passive Q-switch.

TuPS-7
Comparison of Time-lens Configurations Under Different Repetition Rate
Ch Zhang, P. C. Chui, and Kenneth K. Y. Wong
The Photonic Systems Research Laboratory, Dept. of Electrical and Electronic Engineering The Univ. of Hong Kong, Hong Kong.
We review the theoretical models and the performance of two existing time-lens configurations, and compare them under different repetition rate in different aspects: the focal group delay dispersion (GDD), and the temporal numerical aperture (NA).
Optical Analog Multiplexer based on Phase Sensitive Amplification
T. Fujita, Y. Toda, Y. Miyoshi and M. Ohtsu
Osaka Prefecture Univ., Osaka, Japan
We propose an optical multiplexer based on phase sensitive amplification. This optical multiplexer will overcome the speed limitation of signal processing. The linearity can be less than 4×10⁻⁵ at the signal power of 1mW.

Superbroadband Emission from Pr³⁺-doped Germanate Glasses
Jung Woon Lim
Polymer-Based Waveguide Optical Sensor with Tin oxide thin film on the top of core layer exposed by removing volatile organic compound detection. A maximum emission cross-section of 1.8 nm² is obtained and K. Na⁺ ion-exchanged glass channel waveguides have been fabricated in these glasses.

Method of Population Inversion in a Fiber Amplifier with Pulse Sequences
A. Suzuki, K. Kuroda, and T. Fujii
Ph.D. Program in Electrical and Communications Engineering, Dept. of Electrical Engineering, National United Univ., Taoyuan, Taiwan, R.O.C., 1 and Cheng-Ling Lee
Dept. of Electro-Optical Engineering, National United Univ., MiaoLiao, Taiwan
We report two kinds of probe typed, microfiber cavity Fabry-Perot interferometers for high temperature measurement. Experimental results show high stable sensing properties with linear spectral responses of the MCPIRs for the HTM.

Fiber-optic Micro-Bending Sensor Using the Multimode Interference
Qiu-Ru Liu, Ling-Shuang Huang, An-Hai Hei, Ming-Yue Fu, Wen-Fu Ling, and Raman Kashyap
1 P.H. Program in Electrical and Communications Engineering, Feng-Chia Univ., Taichung, Taiwan, R.O.C., 2 Digit. of Avionics Engineering, Air Force Academy, Kaohsiung City, Taiwan, R.O.C., 3 Dept. of Electrical Engineering, Ecole Polytechnique de Montreal, Montreal, Canada
A fibre micro-bending sensor is presented with multimode interference effects created by applying a piece of no-core fibre between two single-mode fibres. The fibre-bending measurement is experimentally demonstrated with a sensitivity of 183.788 nm/mm.

Fibre-Optic based Plasmonic Sensor for Simultaneously Detecting of Multiple Analytes
Li Xia, Binbin Shuai, and Deming Liu
Wuhan National Laboratory for Optoelectronics, National Engineering Laboratory for Next Generation Internet Access System, School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, Wuhan, China
A fibre based plasmonic sensor capable of simultaneously detecting multiple analytes is numerically characterized through the finite element method. A maximum sensitivity of 10200nm/PW is demonstrated.

Highly Sensitive Bending and Airflow Sensor Based on an In-Line Multimode Fiber Interferometer
Yung-Chang Jen, Wen-Cheng Shih, Chia-Ling Hsu, and Cheng-Ling Lee
Dept. of Electro-Optical Engineering, National United Univ., MiaoLiao, Taiwan
This study demonstrates a novel and sensitive bending and airflow sensor based on an in-line, reflective multimode fiber interferometers (RMFIC). Interference fringes shifts of the RMFIC from bending/airflow are effectively detected and experimentally investigated.

Highly Sensitive Fiber-Optic Thermometer Using an Air-Micro-Bubble in a Liquid Core Fiber Fabry-Perot Interferometer
Hun-Jung Chang, Yang-Chen Zheng, Chia-Lien Ma and Cheng-Ling Lee
Dept. of Electro-Optical Engineering, National United Univ., MiaoLiao, Taiwan
We proposed a novel, miniature and ultrasonic fiber-optic thermometer based on an air-micro-bubble drifted in a liquid-core-fiber Fabry-Perot Interferometer. The proposed sensor has an ultrahigh sensitive and linear spectral response with 9.0 nm/°C measurement temperature.

Propagation of Optical Spatial Mode Switch Using Symmetric Y-Junction Waveguides
Makoto Jacobs, Asuka Fujino, and Kich Hiroimoto
1 Higashi Kyushu Univ., Fukuoka, Japan
We newly propose optical spatial mode switch using symmetric Y-junction waveguides. The estimated mode-crosstalk is less than -30 dB with less than 0.14 dB loss at the wavelength of 1550 nm.

Investigation of an Interleaver for All-Optical Analog-to-Digital Conversion
Hiroaki Umehara
Precision and Intelligence Laboratory, Tokyo Inst. of Technology, Kanagawa, Japan
Operation of an interleaver for all-optical digital-to-analog conversion with an interleaver and a sampling pulses has been investigated. Preliminary results of the multi-level intensity was sampled according to the analog intensity of the input signal.

Novel Optical Labeling Scheme for Ultra-High Bit Rate Data Packets
Ashenal K. Madhin, Michael Gaik and Lei F. Chian
DUT Fotonik, Dept. of Photonics Engineering, Technical Univ. of Denmark, Lyngby, Denmark
We propose and verify by simulations an optical in-band labeling scheme for ultra-fast optical switching. The scheme is able to label up to more than 640 different 64-bit ODT packets with eye opening penalty <1 dB.

An Optical Packet Switch Using Forward-Shift Switched Delay Lines
J. Touch, S. Suryapruth, J. Bannister, A.E. Wilkens
1 USC/Information Sciences Inst., CA, U.S.A., 2 and S. Suryapruth
National Inst. of Information and Communications Technology, Tokyo, Japan
Simultaneous detection of 10-Gbit/s QPSK signals is experimentally demonstrated using only four packets of variable delay is shown 95% as efficient as electronic switching using simulated Poisson Internet traffic. Our forward-shift approach is 10-30% better than a backward-shift.

Simultaneous detection of 10-Gbit/s QPSK signals is experimentally demonstrated using only four packets of variable delay is shown 95% as efficient as electronic switching using simulated Poisson Internet traffic. Our forward-shift approach is 10-30% better than a backward-shift.

High-resolution Delay Measurement between Duplexed Transmission Lines
Masaaki Inoue, Tetsuya Monobe, Ka zukata Noto, Kazunori Katayama, Naoki Honda, and Yuki Asama
NTT Access Network Service Systems Laboratories, NTT, Ibaraki, Japan
We present a technique for measuring a picosecond-order time delay between duplexed transmission lines and a gigabit Ethernet passive optical network (GE-PON) with a digital phase/frequency detector, and determining whether the delay is positive or negative.
TuPT-8

Computing Flow Completion Time in Optical Path/Packet Integrated Networks
Onur Alparslan, Shin’ichi Arakawa, Masayuki Murata
Graduate School of Information Science and Technology, Osaka Univ., Osaka, Japan
Using an analytical model to compute the flow transfer times in a hybrid path/packet switching WDM network, we show that the transfer time of TCP flows can be minimized by using only a few packet-switching wavelengths.

TuPT-9

Modulation-Format-Aware Power Equalization for Heterogeneous Elastic Optical Networks
Yingying Xu, Juhao Li, Yucheng Zhong, Ping Zhang, Paikun Zhu, Yongyi He and Zhangyuan Chen
State Key Laboratory of Advanced Optical Communication Systems & Networks, Peking Univ., Beijing, China
We propose a modulation-format-aware power equalization method for heterogeneous elastic optical networks. We show the benefit by simulation based on an optical OFDM superchannel with mixed modulation formats.

TuPF-1

The pH Sensor with the Poly-Silicon Nanowire
Wen-Kai Ho 1, Yao-Yuan Ho 1, Zhi-Ru Lin 1, Cheng-Chin Hsu 2 and Ching-Lian Dai 2
Dept. of Photonics Engineering, Yuan Ze Univ., Chung-Li, Taiwan.
1 Dept. of Photonics Engineering, Yuan Ze Univ., Chung-Li, Taiwan

In this paper, we demonstrated the dimensional properties of the poly-Si nanowire pH sensor with numerical simulation and fabricated the pH sensor based on the theoretical prediction.

TuPF-2

Optical Constant Measurement of GOx Thin Film with Circular Heterodyne Interferometry
Hsiang Chang, Shu-Yu Chen, Chia-Yun Lee, and Cheng-Chih Hsu
Dept. of Photonics Engineering, Yuan Ze Univ., Chung-Li, Taiwan

This study develops a precision circular heterodyne interferometer to measure RI and thickness of GOx immobilized on the glass substrate.
Waveguide QPM Devices

Poster Session

Annex Hall

Wednesday, July 3 / 13:00 - 14:30

WPA-1
Intracavity Frequency Doubling At 251nm of an Actively Q-switched Pr:LiYLF Laser
Junichi Ito, Ryo Abe, Akira Suzuki, Fumihiko Kanari
Dept. of Electronics and Electrical Engineering, Keio University, Yokohama, Japan
We report actively Q-switched deep ultra-violet laser operation at 251nm by intracavity frequency doubling of a Pr:LiYLF laser diode pumped Pr:LiYLF laser. We obtained a maximum peak power of 61.6W (8.7 μJ/pulse) at 251nm.

WPA-2
Dual-Wavelength Q-switched Laser by Cascaded Electro-Optic Periodically Poled Lithium Niobate Crystal
Shou-Tai Lin', Shang-Yu Hu', and Yen-Yi Lin'
1 Dept. of Photonics, Feng Chia Univ., Taichung, Taiwan, 2 Inst. of Photonics Technologies, National Tung Hua Univ., Hsinchu, Taiwan
A dual-wavelength Q-switched laser by a cascaded electro-optic periodically poled lithium niobate crystal was reported. At 24 W diode power, we generated 320 and 100 μJ pulse energy at 1063 and 1342 nm, respectively.

WPA-3
Pulsed Single-Longitudinal-Mode Nd-laser with an Electro-Optic Periodically Poled Lithium Niobate Bragg Modulator
Shou-Tai Lin, Bi-Cheng Chen, Po-Chun Liu, and Shih-Han Yu
Dept. of Photonics, Feng Chia Univ., Taichung, Taiwan
We report a periodically poled lithium niobate crystal for both laser Q-switching and single-longitudinal-mode seeding generation in a Nd:YAG laser. By using a Bragg grating, a wavelength tunable, pulsed single-longitudinal-mode laser source has been generated.

WPA-4
Development of a Diode-Pumped Yt:YAG Chirped-Pulse Oscillator
Sadat Uemura and Kenji Torizuka
Electronics and Photonics Research Inst. (ESPRIT), National Inst. of Advanced Industrial Science and Technology (AIST), Ibaraki, Japan
We developed an Yt:YAG chirped-pulse oscillator, where we employed a different type of multiple-passage cavity that makes the alignment and operation easier and observed laser spectral broadening by reducing the positive intracavity group delay dispersion.

WPA-5
Efficient Diode-Pumped Solid-State Laser at 266 nm
Chang-Yu Tang, Yu-Jen Huang, Kuan-Wei Su, and Yung-Fu Chen
Dept. of Electrophysics, National Chiao Tung Univ., Hsinchu, Taiwan
We performed the extracavity fourth harmonic generation to demonstrate Q-switched second harmonic generation is more advantageous in generating DUV than the intracavity one. The maximum output power at 266 nm is 1.67 W.

WPA-6
Multiple-beam Nd:YVO4 Laser Based on Dammann Grating
Kegu Xia, Junji Yu, Yao Yao, Changhu Zhou, Jianling Li
Shanghai Inst. of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai, China
An arrayed-output Nd:YVO4 laser is demonstrated in which the collimated pumping light is split into 2×2 array by a Dammann grating and thus forms four independent pumping areas in one single-crystal.

WPA-7
UV Laser Writing with 2-Step Voltage Application to Form MgO:LiNbO3 Domain-Inverted Gratings for Waveguide QPM Devices
Masatoji Fujimura, Eri Kitado, and Yoshiaki Suzuki
Graduate School of Engineering, Osaka Univ., Suita, JAPAN
Ultra-violet laser beam writing technology with 2-step voltage application was developed for formation of MgO:LiNbO3 domain-inverted structures. Domain-inverted structures were fabricated and applied to waveguide quasi-phase-matched second harmonic generation devices to demonstrate the effectiveness.

WPA-8
UV Laser Writing with 2-Step Voltage Application to Form MgO:LiNbO3 Domain-Inverted Gratings for Waveguide QPM Devices
Masatoji Fujimura, Eri Kitado, and Yoshiaki Suzuki
Graduate School of Engineering, Osaka Univ., Suita, JAPAN
Ultra-violet laser beam writing technology with 2-step voltage application was developed for formation of MgO:LiNbO3 domain-inverted structures. Domain-inverted structures were fabricated and applied to waveguide quasi-phase-matched second harmonic generation devices to demonstrate the effectiveness.

WPA-9
Double Pulse Operation of Synchronously Intracavity Pumped Ring Fabry-Perot Oscillator
A. Zayats, V. Kudelev, J. Siub, and J-C. Dela
1 Czech Technical Univ. in Prague, Faculty of Nuclear Sciences and Physical Engineering, Prague, Czech Republic, 2 Univ. of New Mexico, Dept. of Physics and Astronomy and Center for High Technology Materials, New Mexico, USA
A ring optical parametrical oscillator generating counterpropagating trains of picosecond pulses at the wavelength 1560 nm was realized. Operation stability of the system was investigated.

WPA-10
NonDiffracting Superterasic Beams
Chia-Hai Tsou, Tait-Wei Li, Sheng Tung, Hong-Chih Liang, Kuan-Wei Su, and Yung-Fu Chen
Dept. of Electrophysics, National Chiao Tung Univ., Hsinchu, Taiwan
We introduce optical superterasic that are formed by two sets of wave-vectors with single wave number but different azimuths. By a collimated light to illuminate a mask with multiple apertures, we generate nondiffracting superterasic beams.

WPA-11
Efficient Emission of Liguerraine-Gaussian Beam From Nd-doped Yttrium Vanadate Laser
Yao Yao, Minqiang Kang, Kegu Xia, Ruin Li, Jianling Li
Shanghai Inst. of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai, China
An laser diode (LD) end-pumped Nd-doped Yttrium Vanadate (Nd:YVO4) laser was demonstrated to emit the first order Laguerre-Gaussian (LG01) mode. This LG01-mode laser is compact and efficient.

WPA-12
Speckle-suppressed Partial Random Laser Illumination System by Varying a Phase-only Random Phase Diffuser
Shih-Yu Tu and Hsiu-Lien Lin
Graduate Inst. of Photonics and Optoelectronics and Dept. of Electrical Engineering, National Taiwan Univ., Taipei, Taiwan
The extremely small angle speckle-suppressed partial random laser illuminating system with 0.1deg. divergence angle is realized. This speckle contrast of 8.5% in a 16 ms is reached. 0.55 mW CW partial random laser is achieved. The speckle contrast of 8.5% in a 16 ms is reached.

WPA-13
Realization of Single-Mode Random Lasing Within a Zinc Oxide Nanoparticle Suspension
Ryo Niyukai, Yosuke Ishikawa*, Naoto Koshiba*, Takeshi Tsukuda, Hidetaka Fujitani, and Kazu Sakata
Research Inst. for Advanced Science, Hokkaido Univ., Hakodate, Japan, 1 Graduate School of Engineering, Kagawa Univ., Kagawa, Japan, 2 National Inst. of Advanced Industrial Science and Technology, Ibaraki, Japan, 3 Inst. for Materials Chemistry and Engineering, Kyushu Univ., Fukuoka, Japan
An unique random laser exhibiting quasi-single-mode, low background emission spectrum, and low lasing threshold is demonstrated. The sample is dispersed with submicrometer-sized zinc oxide particle film dispersed with intentionally introduced polymeric particles as point defects.

WPA-14
Lasing Behavior of Dye Doped Liquid Crystal Within Glass Cell
Hong-Yu Tsai, Min-Song Ling, Chen-Hsiu Wu, and Jin-Lin Lin
Dept. of Electro-optical Engineering, National Taiwan Univ., Taipei, Taiwan
We demonstrate the output characteristics such as intensity and polarization of stimulated emission light from dye-doped nematic liquid crystal will change obviously in glass cell whose polyimide rubs in both and one side of plate.

WPA-15
Temperature Dependent Color Cone Lasing in Cholesteric Liquid Crystal
Po-Yen Chen, Kuan-Choong Liao, Ja-Hun Lin, Yao-Hui Chen, Shih-Yu Tsai, and Jin-Lin Lin
Dept. of Electro-optical Engineering, National Taiwan Univ., Taipei, Taiwan
We investigate the color cone lasing behavior from dye-doped cholesteric liquid crystal (CLC) and find the central wavelength as well as intensity and spatial coherence of on and short emission peaks will change as temperature varies.

WPA-16
Optical Deposition of Molybdenum Disulfide on a Fiber Facet
Naoki Kozai, Manabu Hirose, Yoshinori Kase, and Shingo Takahashi
Faculty of Science and Technology, Ibaraki, Japan
We report on the optical deposition of molybdenum disulfide on a fiber facet. The deposition was done by a 1550nm fiber laser. The results obtained by SEM shows that the core area of the fiber was completely covered.

WPA-17
High Repetition Rate, High Average Power Nanosecond Laser Using Two Yb-doped PCF Rod Fibers
1 Inst. of Laser Engineering, Osaka Univ., Osaka, Japan, 2 Dept. of Materials Science and Technology, Osaka Univ., Osaka, Japan
We propose an all-waveguide type uv laser generator using a 2-pumped rod fiber as a medium. The inserted silicone dioctyl with an intracavity frequency doubling method it will realize high efficient and compact UV source.

WPA-18
High-Peak Power and High-Average-Power Picosecond Mode-Locked All-Fiberized MOPA with Near Diffraction-Limited Beam Quality
Rumao Tao, Xiaolin Wang, Pu Zhou, Lei Si, and Zhiwei Liu
College of Optoelectric Science and Engineering, National Univ. of Defense Technology, Changsha, China
We demonstrate a high power mode-locked all-fiber picosecond laser based on a MOPA configuration. The average and peak power were as much as 196.5 W and 135.8 kW. The beam quality near diffraction-limited (M²<2).

WPA-19
A Simple Tellurite Photonic Bandgap Fiber Based on One Array of Rings
Tongke Cheng, Zhongchao Duan, Meisong Liao, Weiping Gao, Dinhuan Dong, Takanobu Suzuki, and Yasutake Ohtsu
Research Center for Advanced Photon Technology, Toyota Technological Inst., Nagoya, Japan
A simple tellurite photonic bandgap fiber is proposed and fabricated in the paper. The core and cladding are made from the ZnS glass and the high-index rings are made from the TLV913 glass.

WPA-20
Dynamic Lightwave Propagation Control in Tellurite All Solid Photonic Bandgap Fibers
Yukiko Sakai, Tongke Cheng, Hinayasu Kawashima, Takanobu Suzuki, and Yasutake Ohtsu
Research Center for Advanced Photon Technology, Toyota Technological Inst., Nagoya, Japan
Dynamic lightwave propagation control in all solid photonic bandgap fibers made of tellurite and chalcogenide glasses by reflective index changes due to the optical Kerr effect is proposed in the paper.

WPA-21
Stable Optical Clock Generation in SOA-Based Fiber Lasers with Figure-Eight Cavity
Jing-Yun Wang, Kuai-Lin Huang, and Hau-Ren Chen
1 Dept. of Physics, National Chung Cheng Univ., Chiayi, Taiwan, 2 Dept. of Applied Physics and Chemistry, Taipei Municipal Univ. of Education, Taipei, Taiwan, 3 Dept. of Photonics & Inst. of Electro-Optical Engineering, National Chiao Tung Univ., Hsinchu, Taiwan
Stable optical clocks are obtained from 1.3-μm and 1.5-μm SOA-based fiber lasers using passive technology. The wavelengths depend on SOA currents, and the repetition rates can be tuned by varying the relative length of sub-cavities.
WPA-23

Development of a Simple Mode-Locked Yb-Doped Fiber Laser Under Normal Dispersion
Byeong Kwon Kim, Ho-Jae Lee, and Hy-Nam Joo

In this investigation, we demonstrate a simple mode-locked Yb-doped fiber laser without any special filtering and dispersion compensation devices. A polarization controller was used for a kind of spectral filters and mode-locking was successfully achieved.

WPA-24

L-Band Multi-Wavelength Fiber Laser Utilizing Reflective Semiconductor Optical Amplifier with a Linear Cavity
C. H. Yeh, C. W. Chow, S. S. Li, and H. J. Chen

Information and Communications Research Laboratories, National Institute of Information and Communications Technology, Tokyo, Japan, and RIKEN, Wako, Japan

We first demonstrate an L-band multi-wavelength source only using a C-band reflective semiconductor optical amplifier (RSOA) and a linear cavity formed by a fiber coupler, a polarization controller and a reflected fiber mirror.

WPA-25

Compression of Chirp Pulses From a Picosecond Fiber Based Amplifier
Rumi Ito, Atsushi Takejima, Kazuyuki Tei, Shigeru Yamaguchi, Jun Ikeda, and Shin Sumida

School of Science, Dept. of Physics, Tokei Univ., Kanagawa, Japan, and OPT-Co., Ltd, Chiba, Japan

We demonstrate the pulse compression of the picosecond laser system with an all fiber master oscillator power amplifier configuration containing a chirped prism Bragg grating (CVBG) at 1064 nm.

WPA-26

WTM Analysis of Fourier Domain Mode Locked Fiber Lasers
Fang Li, J. Nathan Kutz, and P. K. A. Wai

Photoinetics Research Centre, Dept. of Electronic and Information Engineering The Hong Kong Polytechnic Univ., Hong Kong SAR, China, and Dept. of Applied Mathematics, Univ. of Washington, Seattle, WA USA

We apply multi-scale analysis to the Fourier domain mode-locked fiber laser model and reduce the simulation time by about 100 times for the same accuracy. We calculate the point spread functions to characterize the coherence length.

WPA-27

Compact All-Normal-Dispersion Ytterbium Laser with Periodical Tunable Spectra from 1020 nm to 1050 nm
L. Zhang, X. Bu, R. Wang, H. Han, J. Wang, and Z. Wei

Beijing National Laboratory for Condensed Matter Physics and Inst. of Physics, Chinese Academy of Sciences, Beijing, China, School of Technical Physics, Xidian Univ., Xi’an, China

Assisting by nonlinear polarization evolution and spectral filtering, a 55 MHz all-normal-dispersion Yb fiber oscillator was demonstrated. Preliminary experiments showed the wavelength is tunable from 1020 nm to 1050 nm and pulse duration is 230 fs.

WPA-28

Control of Band Gap Guidance in Hybrid Photonic Crystal Fiber
Takwai Nazari, Jiyong Park, Reza Khazaeinezhad, Sahar Hosseinizadeh, and Ki-Nam Joo

Graduate Inst. of Photonics and Inst. of Electro-Optical Engineering, Dept. of Photonic Engineering, Chosun Univ., Gwangju, Republic of Korea

We present some properties of new designs of hybrid photonic crystal fibers including two rows of high-index silica rod and three rows of high-index silica rod which are numerically simulated by commercial finite element program.

WPA-29

Influences of Amplified Spontaneous Emission on Fiber Laser Amplifier Chain
Pei-Yen Lai, Chun-Lin Chang, and Shih-Hung Chen

Dept. of Physics, National Central Univ., Jhongli, Taiwan, and Inst. of Photonics and Optoelectronics, National Taiwan Univ., Taipei, Taiwan

The time-dependent coupled rate equations based on the multi-channel treatment has been applied to study the influences of amplified spontaneous emission on fiber laser amplifier with the experimental verification and practical solutions for suppressing ASE.

WPA-30

Transient Process of Dissipative Soliton Generation in Normal Dispersion Fiber Lasers

School of Physics and Applied Physics, Jiangsu Normal University, Jiangsu, China, Dept. of Optical Science and Engineering, Fudan Univ., Shanghai, China, School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore

The transient process of dissipative soliton generation is numerically revealed in normal dispersion fiber lasers designed for generating high-energy optical pulses. It is shown that the gap dispersion is critical for the dissipative soliton generation.

WPA-31

Withdrawn

WPA-32

Stable and Self-Starting Passively Mode-Locked Fiber Laser for 1.06 µm and 1.55 µm by Using Graphene Oxide Saturable Absorber
Hsin-Ren Chen, Chi-I Tsai, Ruan-Hue Lien, Jing-Yun Wang, and Wen-Feng Hsu

Dept. of Physics and Inst. of Electro-Optical Engineering, National Chiao Tung Univ., Hsinchu, Taiwan, Dept. of Applied Physics and Chemistry, Taipei Municipal Univ. of Education, Taipei, Taiwan, Dept. of Physics, National Chung Cheng Univ., Min-Hsiung, Chiayi, Taiwan

Graphene oxide/PVA film is used as saturable absorber for mode locking erbium-doped and ytterbium-doped fiber laser. Mode-locked pulses are obtained for both lasers confirming that graphene oxide is cost-effective for 1.06-µm and 1.55-µm pulse generations.

WPA-33

Waveguide-type Saturable Absorber Based on Single Walled-Carbon Nanotubes for Laser Mode-Locking
Hwee-Sung Jeong, Sun Young Choi, Eun I. Jeong, Sang Jun Cha, Fabian Potemen, and Dong Il Yoon

Dept. of Physics and Division of Energy Systems Research, Ajou Univ., Suwon, Republic of Korea, FiberPro Inc., Daejeon, Republic of Korea

We successfully report the waveguide-type saturable absorber using single walled-carbon nanotubes for ultrafast fiber mode-locking. The mode-locked laser delivers stable 602 fs pulses with average output power of 8.6 mW at 11.25 MHz repetition rate.

WPA-34

Dual-Wavelength Soliton Fiber Laser With a Graphene-Based Mode Locker
Xiao Yu, Xiaoming Liu, Dong Max, Dongdong Han

State Key Laboratory of Transparent Optics and Photonics, Xian Inst. of Optics and Precision Mechanics, Chinese Academy of Sciences, Xi’an, China

We demonstrate the dual-wavelength soliton emission at 1032 and 1550 nm in a fiber laser mode locked with a graphene-based saturable absorber.

WPA-35

Thinning the SWCNT Doped PVA Film for Improved Passive Mode-Locking of Fiber Laser
Jui-Yung Lo, Kuang-Nan Cheng, Yung-Hsiang Lin and Gong-Ru Lin

Graduate Inst. of Photonics and Optoelectronics, Dept. of Electrical Engineering, National Taiwan Univ., Taipei, Taiwan, Republic of China

The single-walled carbon nanotube (SWCNT) polymer with thickness of 30 μm is demonstrated to passively mode-lock the erbium-doped fiber laser (EDFL) with the optimized pulsed width of 792 fs under a pumping power of 52.5 mW.

WPA-36

Chip Control of 10-GHz Harmonic Mode-Locked Weak-Resonant-Cavity Fabry-Perot Laser Diode with Reduced End-Facet Reflectance
Cheng-Ting Tsai, Yi-Cheng Lee, and Gong-Ru Lin

Graduate Inst. of Photonics and Optoelectronics, Dept. of Electrical Engineering, National Taiwan Univ., Taipei, Taiwan, Republic of China

Pulse shortening and frequency chirp reduction of a 10-GHz directly modulated and harmonic mode-locked weak-resonant-cavity laser diode incorporated with self-feedback dual fiber ring architecture is demonstrated by detuning its end-face reflectance and feedback ratio.

WPA-37

Using Injection-Locked Fabry-Perot Laser Diode With 10% Frond-Facet Reflectivity for 10 Gbps Upstream PON Access
C. H. Yeh, H. Y. Chen, C. W. Chow, Y. L. Lu, and J. Chen

Institute and Communications Research Laboratories, Industrial Technology Research Inst. (ITRI), Hsinchu, Taiwan, Dept. of Photonics and Inst. of Electro-Optical Engineering, National Chiao Tung Univ., Hsinchu, Taiwan, Graduate Inst. of Applied Science and Engineering, Fu Jen Catholic Univ., New Taipei, Taiwan

We demonstrate a 10-Gbit/s upstream 16-QAM OFDM signal transmission using injection-locked Fabry-Perot laser diode with 10% front-facet reflectivity for the long-reach PON access. Moreover, the relationship of BER and injection power is also analyzed.

WPA-38

Singlemode-Emitting Plastic Laser Fabricated by Waveguide Self-formation and Interference Exposure Processes
Takahiro Kasugai and Kenichi Yomazita

Dept. of Electronics, Kyoto Inst. of Technology, Kyoto, Japan

We have fabricated a singlemode-emitting plastic waveguide laser by using the light induced self-formation process. This laser device has a distributed feedback cavity, which was fabricated by the interference exposure process.

Poster Session

Annex Hall

Wednesday, July 3 / 13:00 - 14:30
Poster Session

Annex Hall

Wednesday, July 3 / 13:00 - 14:30

WPB-1

Observation of Super-luminescent Jet Beam From Femtosecond Laser-induced Air Plasma
Zhijun Xu, Xiaoxiang Zhu, Nan Zhang, and Yang Yu
Inst. of Modern Optics, Nankai Univ., Key Laboratory of Optical Information Science and Technology, Ministry of Education, Tianjin, China

Super-luminescent jet beam associated with four-wave mixing at distorted conical emission site and being rather different from optical filaments is observed emanating from micro air plasma excited by focused 50 fs millijoule laser pulses.

WPB-2

Characteristics of Electron Density in Air Plasma Produced by Tightly-Focused 50 fs Laser Pulses
Yung Yu, Zhijun Xu, Nan Zhang, and Xiaoxiang Zhu
Inst. of Modern Optics, Nankai Univ., Key Laboratory of Optical Information Science and Technology, Ministry of Education, Tianjin, China

Time evolution and spatial distribution of electron density in the air plasma induced by tightly-focused 50 fs laser pulses is numerically simulated. A simplified model is proposed to explain the strong divergence of conical emission.

WPB-3

Ionization of Metastable Neon by Ultra-Fast Laser Pulses
J.E. Calvert1, H. Xu1, R.D. Glover2, D.E. Lade1, J.V. Liubin1, D. Kelwick1, and P. Töskä2
1Physics Centre for Excellence for Coherent X-Ray Science, Griffith Univ., Queensland, Australia. 2Australian Attosecond Science Facility and Centre for Quantum Dynamics, Queensland, Australia

In this work we observe the interaction of metastable neon with 6fs laser pulses. This work shows a higher ion yield for metastable neon at lower intensities than ground state neon: an unexpected qualitative result.

WPB-4

Displacement of Rotational-State Distribution in Diatomic Molecules with a Train of Femtosecond Laser Pulses
Fumiko Yoshida, Tatsuya Kasalma, Leo Matsuoka, and Keisiti Yokomoto
Quantum beam Science Directorate, Japan Atomic Energy Agency, Naka, Japan

Displacement of rotational-state distribution is demonstrated for atmospheric nitrogen using an eight-pulse train of femtosecond laser pulses. To measure the rotational-state distribution, time-resolved coherent anti-Stokes Raman scattering (CARS) spectroscopy is employed.

WPB-5

Tomographic Imaging for Asymmetric Molecules Using Bichromatic Multicycle Laser Field
Meyan Qian and Peilin Liao
1Department of Physics, The College of Science, National Taiwan University, Taipei, Taiwan
2Department of Physics, National Taiwan Normal University, Taipei, Taiwan

We demonstrate a scheme for tomographic reconstruction of asymmetric molecular orbitals based on high-order harmonic generation with bichromatic multicycle laser field. This releases the stringent requirement of single-cycle pulses for tomographic imaging of asymmetric orbitals.

WPB-6

Construction of a Beat-Wave Pulse Train for Quasi-Phase-Adjusted High-Harmonic Generation
Chi-Huang Yang, Shih-Chi Kuo, and Jyun-Feng Wang
1Department of Physics, National Taiwan Normal University, Taipei, Taiwan
2Graduate School of Science, Nagaoka University of Technology, Niigata, Japan

A beat-wave pulse train with 66-fs pulse separation is generated from a two-color Ti:sapphire amplifier system. It can be used for quasi-phase-locked high-harmonic generation at 3 nm wavelength under 1.0 x 10^14 cm^-3 plasma density.

WPB-7

Spectral Measurement of Picoscosecond Optical Pulses by Optogalvanic Spectroscopy
Leo Matsuoka, Chi-Hsiang Yang, and Kenta Ogawa
Quantum beam Science Directorate, Japan Atomic Energy Agency, Naka, Japan. Graduate School of Engineering, Uniu. of Fukui, Kofu, Japan

We measured power spectrum of the picosecond pulses generated from a homemade Ti:sapphire autocorrelator and by using optogalvanic spectroscopy of argon, which is a lower-cost method than using optical spectrum analyzers.

WPB-9

Study of Picoscosecond Nonlinear Refraction in C3H2Cl and C3H2Br, with Z-scan Technique
Yu-Ting Kuo, Yi-D Li, Jian-Long Tang, Tai-Huei Wei
Dept. of Physics, National Chung Cheng Univ., Chiayi, Taiwan

We investigated picosecond nonlinear refraction of simple liquids C3H2Cl and C3H2Br, with the Z-scan technique and explained the results in virtue of various molecular motions verified by femtosecond RAKE technique.

WPB-8

Impedance of a Short Pulse-Induced Solute Migration by a Temperature Gradient Applied Along the Light Propagation Direction
Ryotaro Hattori, Shu-Chia Chang, Tai-Huei Wei
Dept. of Physics, National Chung Cheng Univ., Minhsing, Chiayi, Taiwan

A short laser pulse with energy exceeding a threshold can induce the outward solute migration. In this study we further verify that application of a temperature gradient along the light propagation direction impedes this migration.

WPB-10

Compact Conical Optical Beam Source Based on the Nonlinear Emission Radiation in Intracavity Excited KTiOAsO4 Crystal
Haitao Huang, Deyuan Shen, Jingfang He, Hao Chen, and Yong Wang
School of Physics and Electronic Engineering, Jiangsu Normal University, Xuzhou, China. 3State Key Laboratory of Crystal Materials, Inst. of Crystal Materials, Shandong Univ., Jinan, China

The laser diode pumped composite Nd:YAG/S:YAG laser is exploited in the KTA nonlinear Cerfenok radiation (NCR) configuration, producing a very simple and compact approach for the NCR driving source.

WPB-11

Generation of High-Repeat-rate Ultrashort Pulse Train at 850 nm
Gan Li1, Karriekkaran1 and P. K. A. Wai2
1School of Electronic and Computer Engineering, Peking Univ. School of Electronic and Information Engineering, The Hong Kong Polytechnic Univ., Hong Kong SAR, China

A simple method for generation of 160 GHz soliton ultrashort pulse train at 850 nm is proposed and demonstrated numerically.

WPB-12

Multi-colour OPO Based on Second Order Nonlinear Interactions
B. P. Singh1, S. Mohanty1,2, M. Mukherjee1, A. Date2, A. Mukhopadhyay3, and P. K. Datta3
1Dept. of Physics, Indian Institute of Technology Kharagpur, Kharagpur, India. 2Dept. of Physics, Shri Guru Ram Rai College, Gorakhpur, India. 3Dept. of Physics, Shri Guru Ram Rai College, Gorakhpur, India

The intra-cavity second-order cascaded nonlinear interaction is utilized in a BBO based OPO for generation of multi-colour radiation simultaneously. Theoretical investigation extracts the induced effective third order susceptibility and explains the experimental observations.

WPB-13

Optical Nonlinear Properties of Lanthanum-Modified Lead Titane Thin Film Investigated by Femtosecond Z-scan Technique
Tong-Pu Tsai, Cheng-Jang Liu, and Cheng-Chung Chi
1Inst. of Optoelectronics, National Taiwan Ocean Univ., Keelung, Taiwan. 2Dept. of Physics, National Taiwan Univ., Hsinchu, Taiwan

We used the Z-scan technique for measuring the nonlinear optical properties of Lanthanum-Modified lead titanate thin films. The r2 and the three-photon absorption coefficient were estimated to be (1.40±0.8)x10^-10 esu and (7.0±1.5)x10^-11 m2/W, respectively.

WPB-14

Spectral Phase Retrieval by Dispersion-distorted Frequency-resolved Optical Gating Traces
Yu-Ting Kuo, Yi-D Li, and Hsu-Chen Yang
1Department of Physics, National Chung Cheng University, Chiayi, Taiwan. 2Frontier Research Center on Fundamental and Applied Sciences of Matters, National Taiwan University, Hsinchu, Taiwan

By introducing symmetry-breaking geometry, we reveal the existence of thresholdless crescent waves, i.e., nonlinear surface modes pinned to this boundary of a curvature, in an elliptical ring and illustrates their formation through nonlinear transformation.

WPB-15

Thresholdless Crescent Waves in an Elliptical Ring
Kuan-Hsiun Ku1, Yuan-Yao Lin2, and Ray-Kuang Lee3
1Inst. of Photonics Technologies, National Tsing Hua Univ., Hsinchu, Taiwan. 2Frontier Research Center on Fundamental and Applied Sciences of Matters, National Taiwan University, Hsinchu, Taiwan. 3Dept. of Physics, National Chung-Hsing University, Taichung, Taiwan.

With a detailed series of spontaneous optical pattern formations, we reveal the existence of thermodynamical properties in nonlinear optical systems by defining the configurational entropy from the measured patterns.

WPB-16

Thermodynamical Properties in Spontaneous Optical Pattern Formations
Ming Shen1, Yu-Kun Lin2, Wen-Xing Yang1,2, Chien-Chung Jeng,3, Mien-Sheng4, and R.-Kuang Lee5
1Inst. of Photonics Technologies, National Tsing Hua Univ., Hsinchu, Taiwan. 2Dept. of Physics, Shanghai Univ., Shanghai, China. 3Dept. of Physics, National Tsing Hua University, Taipei, Taiwan. 4Dept. of Physics, National Chung-Hsing University, Taichung, Taiwan. 5Dept. of Physics, National Taiwan Univ., Taipei, Taiwan

With a detailed series of spontaneous optical pattern formations, we reveal the existence of thermodynamical properties in nonlinear optical systems by defining the configurational entropy from the measured patterns.

WPB-17

Synthesis and Two-photon Properties of Small Dendritic Chromophores Containing Functionalized Quinoxalinoid Heterocycles
Tzu-Chau Lin1, Ying-Hsuan Lee2, Che-Yu Lu1, Jin-Hor Lin2, and Yu-Kai Shen2
1Photonic Materials Research Laboratory, Dept. of Chemistry, National Central Univ., Taiwan. 2Photonic Technology Laboratory, Dept. of Electro-Optical Engineering National Taiwan University, Taiwan

Three dendritic chromophores containing functionalized quinoxalinoid units has been synthesized and experimentally shown to possess strong two photon absorption in the near-infrared region and could be promising candidates for optical power-limiters against laser pulses with long duration.

WPB-18

Study of Stimulated Brillouin Scattering Threshold for Ultra-Wideband Impulse Radar Pulses Distributed Over Fiber
Xin Ye, Yijian Yan, Zhenya Xia and Zheng-Zheng School of Electronic and Information Engineering, Beihang Univ., Beijing, China

SBS thresholds for monocyte and doubute pulses are investigated. It is found that doubute pulses having a higher SBS threshold are more suitable for distribution over fiber to extend operating distance of UWB impulse radar.

WPB-19

Bandwidth-Adjustable Ultra-Fast Brillouin Scattering Spectrometer in Optical Fiber
Y. Mizuno, H. Hayashi, and K. Nakamura
Precision and Intelligence Laboratory, Tokyo Inst. of Technology, Yokohama, Japan

We obtained broad and flat Brillouin gain spectrum (BGS) in optical fibers. By modulating the driving current of pump laser, BGS with <0.3 dB gain variation over ~200 MHz was achieved (fastest BGS ever reported).
WPB-20
Numerical Study on Fiber-Based Supercontinuum Generation in Anomalous Dispersion Pumping Regimes
Youngsu Choo, Luis Alonso-Vazquez-Zuniga, Seungpoo Hong, Hyuntae Kim and Yoonchan Jeong
Laser Engineering and Applications Laboratory, School of EEECS, Seoul National Univ., Seoul, Korea
We numerically study the dynamics of supercontinuum generation for four types of conventional fiber laser pumps. Our results show that in anomalous dispersion pumping regimes a decelerated parabolic pulse generates the broadest output spectrum.

WPB-21
Dark Soliton Operation Fiber Lasers
L. Li, Y. F. Song, H. Zhang, D. Y. Shen\(^1\) and D. Y. Tang\(^1\)
\(^1\) Electrical and Electronic Engineering, Nanyang Technological Univ., Singapore, \(^2\) School of Physics and Electronic Engineering, Jiangsu Normal Univ., Xuzhou, China, \(^3\) College of Physics and Microelectronic Science, Hunan Univ., Changsha, China
Dark soliton formation in erbium-doped fiber ring lasers with normal cavity dispersion is experimentally demonstrated. We find that the dark soliton operation is a generic feature of the normal dispersion cavity fiber lasers under strong pumping.

WPB-22
Carrier Dynamics in InN Nanorod Arrays
S.-H. Su, C.-C. Yu, S. Gwo\(^1\) and H. Ahn
\(^1\) Dept. of Photonic and Inst. of Electro-Optical Engineering, National Chiao Tung Univ., Hsinchu Taiwan, \(^2\) Dept. of Physics, National Tsing Hua Univ., Hsinchu Taiwan
A fast initial decay was observed from InN nanorods with 30 nm diameter, the lifetime of which is much shorter than the carrier cooling time, demonstrating the substantial surface-associated influence on carrier relaxation in nanorods.

WPB-23
Ultrafast Dynamics of the Intersublayer Shearing Mode in Au Graphite Nanostuctures
M.P. Avila-Ortega, T. Katsyuba\(^1\), Y. Akahane\(^2\), J. Taleida\(^1\) and M. Kitaoka\(^3\)
\(^1\) Dept. of Physics, Graduate School of Engineering, Yokohama National Univ., Yokohama, Japan, \(^2\) Dept. of Applied Physics, National Defense Academy, Yokosuka, Japan
We researched the effect on gold nanostuctures have in the transient reflectivity signal deposited in highly ordered pyroelectric graphite, by measuring coherent phonon spectroscopy with ultrashort laser pulses.

WPB-24
Ultrafast Spin and Lattice Dynamics in a Multiferroic Cupric Oxide
M. Takahara\(^2\), T. Moriyasu\(^1\), K. G. Zheng\(^1\) and T. Kohmoto\(^1\)
\(^1\) Graduate School of Science, Kobe Univ., Kobe, Japan, \(^2\) Graduate School of Engineering, Saga Univ., Saga, Japan
The ultrafast spin and lattice dynamics in a multiferroics CuO were studied using polarization spectroscopy with the pump-probe technique. Terahertz damped oscillations in the circular birefringence and the relaxation in the linear birefringence were discussed.

WPB-25
Spatial and Temporal Dynamics of Polaron Diffusion in SrTiO\(_3\)
T. Kohmoto, D. Ikeda, X. Liang, and T. Moriyasu
Graduate School of Science, Kobe Univ., Kobe, Japan
The relaxation and diffusion dynamics of optically induced lattice distortions in the relaxed excited states of SrTiO\(_3\) are studied by using the pump-probe technique. The spatial and temporal dynamics of polaron diffusion are observed directly.

WPB-26
Ferroelectric Domain Morphology in MgO Doped Stoichiometric Lithium Niobate
Ju-Won Choi, Do-Kyeong Ko\(^1\), Nan Bi Yu\(^1\)
\(^1\) Dept. of Physics and Photon Science, Gunwiang Inst. of Science and Technology, Gunwiang, Korea, \(^2\) Dept. of Biomedical Engineering, School of Medicine, Pusan National Univ., Busan, Korea
Asymmetric inward and outward domain wall morphology comes from that the interaction range between lattices is longer than that to the nearest neighbor by the simulation based on a long-range of lattice structure of LiNbO\(_3\).

WPB-27
Transient Photostriction in Bi\(_2\)(La\(_1-x\)Ca\(_x\))Fe\(_2\)O\(_{11}\), Thin Films Modulated with Strain
Zuming Jin, Yue Ao, Zhenqing Zhang, Xian Lin, Guoqiang Ma, Zhengsing Cheng\(^2\) and Xiaoan Wang\(^2\)
Dept. of Physics, Shanghai Univ., Shanghai, P. R. China, \(^3\) Inst. for Superconducting and Electronic Materials, Univ. of Wollongong, North Wollongong, Australia
The coherent longitudinal acoustic phonons BiFeO\(_3\) films are investigated by ultrafast spectroscopy. The generation mechanism of the phonons is attributed to the transient photostriction effect, a combination of the optical rectification and the electrostriction effects.

WPB-28
Optical Kerr Effect of Confined Excitons Coherently Coupled with Radiation Wave
Masayoshi Ishizuka\(^1\), Kenta Kamizono\(^2\), Natsa Okamoto\(^2\), Hajimis Ishihara\(^3\) and Masatsuyi Ashida\(^4\)
Dept. of Physics, Osaka Dental Univ., Osaka, Japan, \(^2\) Dept. of Physical Science, Osaka Univ., Osaka, Japan, \(^3\) Dept. of Physics and Electronics, Osaka Prefecture Univ., Osaka, Japan
In optical spectra in a high quality CuCl thin film has been investigated due to a harmonized coupling between the light and excitonic waves over a range of multiple wavelengths.

WPB-29
Observation of Antiferromagnetic Magnons and Magnetostictions in NiO and MnO
T. Miyasato, S. Wakahayashi and T. Kobayama
Graduate School of Science, Kobe Univ., Kobe, Japan
The dynamics of the antiferromagnetic magnons in NiO and MnO were observed using the pump-probe technique and THz-TDS. The lattice and magnetostriuctive contributions to the refractive index are discussed.

WPB-30
Broadband THz-Time Domain Spectroscopy of Halogen-Bridged Platinum Complexes
Takuya Ohshima, Yasuo Minami, Katsunori Kikui and Jun Takeoka
Graduate School of Engineering, Yokohama National Univ., Yokohama, Japan
We have measured polarized transmittance spectra of quasi one-dimensional halogen-bridged platinum complexes (Pt-X) using broadband THz-time domain spectroscopy. We could successfully identify infrared active phonon modes of Pt-X chain.

WPB-31
Non-contact Resistivity Measurement of a Flexible Display Substrate by Terahertz Time Domain Spectroscopy
Tze-Jin Liu, Yen-Chuan Chang, Shih-Fang Chen, and Jen-Long Pang
Center for Measurement Standards, Industrial Technology Research Inst., Hsinchu, Taiwan, R.O.C.
The non-contact sheet resistance of the flexible display substrate is measured by terahertz time domain spectroscopy. It is reasonable agree with the DC 4-point probe method, which proof the online inspection opportunity.

WPB-32
Surface Carrier Recombination of Optically Excited Silicon Studied by Terahertz Time-Domain Spectroscopy
Khandaker Abu Salek, Iwao Kawahama, Hironori Murakami, and Masayoshi Tonouchi
Inst. of Laser Engineering, Osaka Univ., Osaka, Japan
We investigated surface recombination of photocreated carriers at silicon surface by terahertz time-domain spectroscopy (THz-TDS), and evaluated surface recombination velocity (SRV) under UV laser illumination.

WPB-33
Dark Soliton Operation fiber lasers
M. Li, X. Liang, and T. Moriyasu
Graduate School of Science, Kobe Univ., Kobe, Japan
The dependence of a carbon black (CB) dispersion in a tensile-composite carbon black (CB) dispersion in a tensile-composite

WPC-1
Poster Session
Annex Hall
Wednesday, July 3 / 13:00 - 14:30

WPC-2
Non-contact Measurement of Solar Cells Using Laser Terahertz Emission Microscope
A. Ito\(^1\), H. Nakaniishi\(^2\), K. Takayama\(^3\), I. Kawakami\(^4\), M. Murakami\(^5\) and M. Tonouchi\(^6\)
\(^1\) Daisipan Screen Mfg, Kyoto, Japan, \(^2\) Inst. of Laser Engineering, Osaka Univ., Osaka, Japan
We examined various types of solar cells using laser terahertz emission microscope. As a result, we could observe the differences among various solar cells, e.g. grain size, material.

WPC-3
Non-contact Measurement of Solar Cells Using Laser Terahertz Emission Microscope
Kihoro Nakamura, Ken Omura, Kenji Sakai, Toshihiko Kawa, and Koichi Tsukada
Graduate School of Natural Science and Technology, Okayama Univ., Okayama, Japan
Laser terahertz emission microscopy was applied to investigate the SiGe film on the Si substrate. In this study, the THz emission properties of the strained SiGe were measured.

WPC-4
Non-contact Measurement of Solar Cells Using Laser Terahertz Emission Microscope
Kihoro Nakamura, Ken Omura, Kenji Sakai, Toshihiko Kawa, and Koichi Tsukada
Graduate School of Natural Science and Technology, Okayama Univ., Okayama, Japan
Laser terahertz emission microscopy was applied to investigate the SiGe film on the Si substrate. In this study, the THz emission properties of the strained SiGe were measured.

WPC-5
Non-contact Measurement of Solar Cells Using Laser Terahertz Emission Microscope
Kihoro Nakamura, Ken Omura, Kenji Sakai, Toshihiko Kawa, and Koichi Tsukada
Graduate School of Natural Science and Technology, Okayama Univ., Okayama, Japan
Laser terahertz emission microscopy was applied to investigate the SiGe film on the Si substrate. In this study, the THz emission properties of the strained SiGe were measured.

WPC-6
Non-contact Measurement of Solar Cells Using Laser Terahertz Emission Microscope
Kihoro Nakamura, Ken Omura, Kenji Sakai, Toshihiko Kawa, and Koichi Tsukada
Graduate School of Natural Science and Technology, Okayama Univ., Okayama, Japan
Laser terahertz emission microscopy was applied to investigate the SiGe film on the Si substrate. In this study, the THz emission properties of the strained SiGe were measured.

WPC-7
Non-contact Measurement of Solar Cells Using Laser Terahertz Emission Microscope
Kihoro Nakamura, Ken Omura, Kenji Sakai, Toshihiko Kawa, and Koichi Tsukada
Graduate School of Natural Science and Technology, Okayama Univ., Okayama, Japan
Laser terahertz emission microscopy was applied to investigate the SiGe film on the Si substrate. In this study, the THz emission properties of the strained SiGe were measured.
WPC-8 Terahertz Emission From Graphene-Coated InP [100] Surface
Yuki Igusa1, M. Tabata2, K. Saito1, I. Kawai2, M. Warg3, R. Yajima4, J. Kono1, P. M. Aijan5, and M. Tonouchi2
1 Inst. of Laser Engineering, Osaka Univ., Osaka, Japan,
2 Nanolab Program and Dept. of Electrical and Computer Engineering, Rice Univ., Houston, U.S.A.,
3 Dept. of Mechanical Engineering and Materials Science, Rice Univ., Houston, U.S.A.
We observed THz radiation from the graphene-coated InP (100) surface and found the drastic change of the waveform of THz waves with time, which was not explained by the simple absorption of graphene.

WPC-9 Geometry Dependence of Low-Temperature Grown GaAs Photonic-Conductive Switches for Terahertz Detector
Kentaro Mizui, Yasuhide Torimai, Iwao Kawaiwami, Hirokazu Murakami, Masayoshi Tonouchi
Inst. of Laser Engineering, Osaka Univ., Osaka, Japan
We investigated the geometric dependence of photonic-conductive dipole antennas fabricated on the low-temperature-grown GaAs substrate to clarify the effect of the antenna width and the radiation laser power.

WPC-10 Evaluation of Nano Slot Antenna for Mid-Infrared Detectors
Junsuke Kogayawa1, Aiki Kawakami1, Masaharu Hyodo1, Shukuchi Tanaka2, and Hisashi Shimakage3
1 Ibaraki Univ., Ibaraki, Japan, 2INC, Hyogo, Japan
To improve the response performance of superconducting infrared detectors, we propose an nano slot antenna with a NbN based element. Results of simulation and experiment were showed qualitative agreement.

WPC-11 A Generation Method for Arbitrary Patterned Pulse Train in the THz Region by Spectral Synthesis of Optical Combs
Izao Momoshita, Takahide Sakamoto, Tetsuya Kawashima, Iwao Kawaiwami
National Inst. of Information and Communications Technology, Tokyo, Japan
We propose a generation method for arbitrary patterned THz pulse trains by photomixing of spectrally-synthesized optical combs. Generated by a Mach-Zehnder-modulator-based flat comb generator combined with a pulse picker driven by a pulse pattern generator.

WPC-12 Precise Frequency Measurement of Continuous-Wave Terahertz Radiation Based on THz Comb
Kovesi Hayashi1, Shuko Yoshimura1, Haga Inada1, Kaoru Minoshita2, and Takeshi Yatsu3
1 Univ. of Tokyo, Tokyo, Japan, 2Morin Optics Co. Ltd., Kyoto, Japan, 3National Inst. of Advanced Industrial Science and Technology, Ibaraki, Japan
We demonstrated a frequency measurement of CW-THz wave referring to THz frequency comb. Effectiveness of the proposed method is demonstrated by measurement of sub-THz test sources. The achieved precision of frequency measurement was 2.1 x 10^-10.

WPC-13 Highly Frequency-Stabilized Millimeter-Wave Signal Generation Using Optical Phase-Locked Loop and Flat Optical Frequency Comb
Ryota Yamagishi1, Ryo Matsumoto2, Hideyuki Sotsobayashi3, Atsuhi Kanno4, Tetsuya Kawashima5
1 National Inst. of Information and Communications Technology, Tokyo, Japan,
2 Dept. of Electrical Engineering, Nagoya Univ., Nagoya, Japan,
3 National Inst. of Information and Communications Technology, Tokyo, Japan,
4 Grad. Sch. of Science and Engineering, Keio Univ., Yokohama, Japan,
5 Inst. of Laser Engineering, Osaka Univ., Osaka, Japan
We demonstrated millimeter-wave signal generation using optical phase-locked loop and flat optical frequency comb generation using a Mach-Zehnder modulator-based flat comb generator combined with a pulse picker driven by a pulse pattern generator.

WPC-14 Cherenkov Phase-Matched Terahertz Wave Generation Using Ridge-type Waveguide
K. Takeya1, Y. Shishikura2, H. Takeuchi3, K. Kajiki4,1, T. Ouchi5, and K. Kawai2
1 Dept. of Electrical Engineering, Nagoya Univ., Nagoya, Japan,
2 Dept. of Electronics, Electrical and Computer Engineering, Fukui Univ., Japan,
3 Inst. of Laser Engineering, Osaka Univ., Osaka, Japan,
4 Research Center for Development of Far-Infrared Region, Univ. of Fukui, Fukui, Japan,
5 Faculty of Education and Regional Studies, Univ. of Fukui, Fukui, Japan.
We report on a terahertz-wave generation and detection system based on nonlinear parametric conversion. Tunable terahertz-waves are generated by an injection-seeded terahertz-wave parametric generator, and then, detected by frequency up-conversion in a nonlinear MgO:LiNO3 crystal.

WPC-15 Terahertz-wave Parametric Generation and Detection System Covering the Range From 1 to 3 THz
S. Hayashi1, K. Nakanishi2, K. Kawase3, and H. Imamura4
1 Riken ASI, Sendai, Japan, 2 Nagoya Univ., Nagoya, Japan,
3 RIKEN, Sendai, Japan
We report on a terahertz-wave generation and detection system covering the range from 1 to 3 THz. We report on a terahertz-wave generation and detection system covering the range from 1 to 3 THz. We report on a terahertz-wave generation and detection system covering the range from 1 to 3 THz.

WPC-16 Generation of Efficient Terahertz Waves Using As-Grown DASG Single Crystals
A. S. Bhargavekaran1, B. Y. Takahashi1, C. M. Yoshimura1, D. M. Tav1, S. Okada2, F. S. Hashemi1, G. Y. Mor3, M. M. Hanyo1, I. M. To4, and J. Sasaki1
1 Dept. of Physics, Bharathidasan Institute of Technology, Annai, Trichy, India,
2 Division of Electronic, Electronic, and Information Engineering, Osaka Univ., Osaka, Japan,
3 Research Center for Development of Far Infrared Region, Univ. of Fukui, Fukui, Japan,
4 Graduate School of Science and Engineering, Yamagata Univ., Yamagata, Japan,
5 Graduate School of Engineering, Osaka City Univ., Osaka, Japan.
We demonstrated a frequency measurement of CW-THz wave referring to THz frequency comb. Effectiveness of the proposed method is demonstrated by measurement of sub-THz test sources. The achieved precision of frequency measurement was 2.1 x 10^-10.

WPC-17 High Average Power and Broadband THz Wave Generation Scheme Via Optical Rectification in 4-dimethylamino-N-methyl-4-stilbazolium tosylate Crystal
Sany R. Tripathi1, R. Ray2, U. Murakami3, H. Nishio4,1, C. I. Kawaiwami5, K. Takeya2, K. Kawase3
1 Nagoya Univ., Nagoya, Japan, 2 RIKEN, Sendai, Japan, 3 AARSS Inc., Kyoto, Japan
We obtained average THz power of 16W using DAST crystal via optical rectification of femtosecond pulses. This power is more than two orders higher than the average THz power obtained from the typical photoductive antenna.

WPC-18 Tailor crystals of Stilbazolium Derivative DAST and DASC for Terahertz-Wave Generation
M. Yoshimura1, H. Sakaie1, Y. Takahashi1, T. Matsukawa1, R. Kaneko1, T. Kawaiwami1, M. Tonouchi1, W. bauer2, K. Kitagawa2, S. Okada1, and Y. Mor2
1 Graduate School of Engineering, Osaka Univ., Suita, Japan,
2 Inst. of Laser Engineering, Osaka Univ., Suita, Japan.
3 Osaka Electronics Industry Co., Ltd., Hikarita, Japan.
4 Graduate School of Science and Engineering, Yamagata Univ., Yamagata, Japan.
Stilbazolium derivatives DAST and DASC are organic nonlinear optical materials efficiently generating terahertz waves. We succeeded in obtaining bulk crystals by using an acetone-added methanol solvent and investigated the properties of THz-wave generation.

WPC-19 New Experimental Results on the Quasi Phase-Matching Properties for MgO Doped LiNBO3
D. Matsuda, N. Umekawa, and K. Katou
Chuo Inst. of Science and Technology, Hokkaido, Japan
The quasi phase-matched SHG, SFG, and OPO wavelengths in the 0.39-4.95 micron were measured at 20°C in the MgO:LiNBO3 crystals and the high-accuracy extraordinary Sellmier equation is presented.

WPC-20 Generation of Wide Range and Stable THz Waves Using a Laser Chaos and a High Bias Voltage
Fujiyoshi Kawaishima1, Takaoy Shino1, Masahiko Taniguchi1, Kazuyoshi Kihara1, Kohi Yamamoto1, Masanori Hanyo1, Takeshi Nagasawa2, and Hiroshi Kawaiwami1
1 Dept. of Electrical, Electronics and Computer Engineering, Fukui Univ., Japan,
2 Inst. of Laser Engineering, Osaka Univ., Osaka, Japan.
Generation of a wide-range and stable THz waves from a photoductive antenna excited by a multimode semiconductor laser with an optical delayed feedback using an external mirror is investigated.

WPC-21 A Low Cost Dielectric Waveguide Platform for Sub-mm/Terahertz Applications
Jacky P.Y. Tsui1, Peng Zhou1, Sai Tai Chu1, Edwin Y.B. Poon2
1 Dept. of Electronic Engineering, City Univ. of Hong Kong, Hong Kong, China,
2 Dept. of Physics and Materials Science, City Univ. of Hong Kong, Hong Kong, China.
A new dielectric waveguide platform technology for sub-mm/Terahertz applications is proposed. The feasibility to produce low-cost and low-loss dielectric waveguides by the proposed platform is investigated and demonstrated.

WPC-22 Terahertz Fiber Using Polymer Tube Bundle
Y. Ma1, H. Yekela2, S. Yamauchi1, K. Mizui1, and M. Tonouchi1
1 Ibaraki Univ., Hitachi, Japan, 2 Osaka Univ., Osaka, Japan
A new terahertz fiber using a polymer tube bundle is proposed and analyzed. The transmission loss reduces as the tube thickness and the refractive index difference decreases.

WPC-23 Fabrication and Terahertz Response of “split-tube” Arrays
Seiga Ohno1, Masahiko Shigyo1, Hiyuki Kurokawa1, Yuto Miibata1, Tatsuyuki Nakaikawa1, and Tetsu Iinuma1
1 Dept. of Physics, Tokohu Univ., Sendai, Japan, 2 Center for the Advancement of Higher Education, Tokohu Univ., Sendai, Japan
We designed and fabricated split-tube arrays using a maskless exposure system which was converted from a commercial projector. We found that the structures have magnetic response in terahertz region which are affected by mutual inductions.

WPC-24 Theoretical and Experimental Development of a Broadband Sub-millimeter Wave Rectangular-Metallic to Dielectric Rod-Waveguide Adaptor
Peng Zhou1, Jacky P.Y. Tsui1, Sai Tai Chu1, Edwin Y.B. Poon2, and Sujit K. Chaudhuri3
1 Dept. of Physics and Materials Science, City Univ. of Hong Kong, Hong Kong, China, 2 Dept. of Electronic Engineering, City Univ. of Hong Kong, Hong Kong, China, 3 Dept. of Electrical and Computer Engineering, University of Waterloo, Canada.
A plastic power adaptor operating in the sub-millimeter range has been designed and fabricated by injection-molding. Both numerical simulations and experimental results demonstrate broadband and low-loss energy transfer between metallic and dielectric waveguides.
Poster Session
Annex Hall
Wednesday, July 3 / 13:00 - 14:30

WPD-1
Withdrawn

WPD-2
High Peak Power Laser for Range Detection and Object Recognition of 3D Image Scanning
Jeong-Ho Kim, Ji-Yeong Lim, Jong-Woo Lim, Simook Hahn, Jong-Sup Kim, Youn-Hyun Kim, Yeung-Eun Lim
Opto-Mechanical Research & Business Division, Laser-T (Research Center, KQF3), Gwangju, South Korea
High output, broad area 1,350 nm InGaAlP/InP MOW lasers were fabricated using MOVCD equipment. The fabricated LDs have 10W high peak powers under 340V injection voltage and 30kHz pulse operation.

WPD-3
0.13μm All-fiberized Tm-doped Fiber Laser at Low Repetition Rate
College of Opto-electronic Science and Engineering, National Univ. of Defense Technology, Changsha, China
We report on all-fiberized, gain-switched Tm-doped fiber laser master oscillator-power amplifier configuration. The central wavelength is 1.922μm, 0.13mJ per pulse energy could be realized at a 1kHz repetition rate.

WPD-4
Fiber Fuse Effect in High-Power Double-Clad Fiber Laser
Hanwei Zhang, Pu Zhou, Xiaolin Wang, Hu Xiao and Xiaojun Xu
College of Opto-electronic Science and Engineering, National Univ. of Defense Technology, Changsha, China.
We report the study of fiber fuse effect in large mode area double-clad fiber. The fiber fuse pictures and a model of describing the propagation of the effect in double-clad fiber are presented in this paper.

WPD-5
Smith-Purcell Radiation from Laser-plasma-generated Electrons
Photon Pioneers Center, Osaka Univ., Osaka, Japan, 1 National Key Laboratory of Laser Fusion, CAEP, Mianyang, China, 2 Graduate School of Engineering, Osaka Univ., Osaka, Japan, 3 Inst. of Laser Engineering, Osaka University, Osaka, Japan, 4 Graduate School of Science, National Univ. of Defense Technology, Changsha, China, 5 Inst. for Fusion Theory and Simulation, Zhejiang Univ., Hangzhou, China, 6 Inst. for Theoretical Physics 1, Ruhr Univ., Bochum, Germany, 7 Key Laboratory for Laser Plasmas (Ministry of Education) and Dept. of Physics, Shanghai Jiao Tong Univ., Shanghai, China, 8 Beijing National Laboratory for Condensed Matter Physics, Inst. of Physics, CAS, Beijing, China.
Near-infrared radiation is experimentally observed by coupling a grating to the electron beams generated in the laser-solid target interaction. Such kinds of radiation hold a promise for a tunable compact “table-top” powerful Terawatt-Hertz source.

WPD-6
Generation of Laser-Induced Fast Neutrons and Application for Activation Analysis
Hyungki Cha, Sungjoo Lee, and Kaei Lee
1 Division of Radiation Equipment Research, KAREP, Jeolla-do, Republic of Korea, 2 Quantum Optics Division, KAREP, Daejeon, Republic of Korea.
A laser-induced repetitively operated fast neutron source was developed by using a deuterated polyethylene film target and a 14 TW laser and was applied for laser activation analyses of inundo and gold samples.

WPE-1
Ablation Process of PMMA Induced by Irradiation with Laser Plasma EUV Light
Nobuhiko Sugiyama1, Shunich Torii1, Tetsuya Makimura2, Yoshipke Ishizuka1, Kiyoa Okazaki1, Daiki Nakamura1, Akihiko Takahashi1, Tatsuo Okada1, Hiroki Naito1, Koichi Murakami1
1 Inst. of Applied Physics, Univ. of Tsukuba, Ibaraki, Japan, 2 Graduate School of Information Science and Electrical Engineering, Kyushu Univ., Fukuoka, Japan.
We have investigated ablation process of PMMA induced by irradiation with laser plasma EUV light. Applying the technique, micro-structured mold can be fabricated by transforming structures of the master PMMA plate.

WPE-2
Micromachining of Polydimethylsiloxane using EUV light
Shitao Fukami1, Shunich Torii1, Tetsuya Makimura1, Kiyoa Okazaki1, Daiki Nakamura1, Akihiko Takahashi1, Tatsuo Okada1, Hiroki Naito1, Koichi Murakami1
1 Inst. of Applied Physics, Univ. of Tsukuba, Ibaraki, Japan, 2 Graduate School of Information Science and Electrical Engineering, Kyushu Univ., Fukuoka, Japan.
In this study, we propose a thrust/propulsion of nanospheres by using near field excited by femtosecond laser to control the sphere velocity and propelled angle.

WPE-3
Evolution of Nanostructures on Metal Surfaces Irradiated by Low-Fluence Multiple Femtosecond Laser Pulses
Masahiro Shimizu, Masaki Hashida, Yasuhiro Miyashita, Shigeki Tokita, and Shuji Sakabe
Graduate School of Materials Science, Faculty of Engineering, Osaka Univ., Osaka, Japan.
Aggregation of nanometer-size cracks oriented perpendicular to incident laser polarization is formed on tungsten and molybdenum by low-fluence femtosecond laser pulses. Local field enhancement around a nanometer-size hole will be an origin of the crack.

WPE-4
Effect of Superimposed Multiple Shots of Femtosecond Laser Pulses on Periodic Surface Nanostructures
G. Miyaji and K. Miyazaki
Inst. of Advanced Energy, Kyoto Univ., Kyoto, Japan.
Pump-probe reflectivity measurements have shown that the multiple shots of low-fluence femtosecond laser pulses on silicon accumulate non-thermal bonding structure change to decrease ablation threshold and subsequently excite surface plasma polaritons for periodic nanoscale ablation.

WPE-5
Three-Dimensional Micro Modification and Selective Etching of Crystalline Silicon Using 1.56-μm Subpicosecond Laser Pulses
Shigeki Matsuo, Shigeki Matsuo, Kousuke Nishi, and Tetsuro Naoi
The Univ. of Tokushima, Tokushima, Japan.
These dimensional micro removal processing was attempted to crystalline silicon substrate using a 1.56-μm subpicosecond laser. Selective removal was observed on both top and rear surfaces when nitric hydrofluoric acid was used as etchant.

WPE-6
Shape Control of Element Distribution inside a Glass by Simultaneous Irradiation with Femtosecond Laser Pulses at Multiple Spots
Y. D. Zhu1, 2, P. Zhou, H. Xiao, and S. F. Guo1
1 Inst. of Photonics Technologies, National Tsing-Hua Univ., Hsinchu, Taiwan, 2 Dept. of Electro-Optical Engineering, National Taipei Univ. of Technology, Taipei, Taiwan.
We report the study of fiber fuse effect in large mode area double-clad fiber. The fiber fuse pictures and a model of describing the propagation of the effect in double-clad fiber are presented in this paper.

WPE-7
Control of a Shape of Local Element Distribution inside a Glass by Simultaneous Irradiation with Femtosecond Laser Pulses at Multiple Spots
Y. D. Zhu1, 2, P. Zhou, H. Xiao, and S. F. Guo1
1 Inst. of Photonics Technologies, National Tsing-Hua Univ., Hsinchu, Taiwan, 2 Dept. of Electro-Optical Engineering, National Taipei Univ. of Technology, Taipei, Taiwan.
We report the study of fiber fuse effect in large mode area double-clad fiber. The fiber fuse pictures and a model of describing the propagation of the effect in double-clad fiber are presented in this paper.

WPE-8
Development of Femtosecond Laser Processed FBG Sensors for High Temperature Piping System
A. Namikawa, Y. Shima and H. Suzuki
We report the study of fiber fuse effect in large mode area double-clad fiber. The fiber fuse pictures and a model of describing the propagation of the effect in double-clad fiber are presented in this paper.

WPE-9
Micromachining of Polydimethylsiloxane using EUV light
Shitato Fukami1, Shunich Torii1, Tetsuya Makimura1, Kiyoa Okazaki1, Daiki Nakamura1, Akihiko Takahashi1, Tatsuo Okada1, Hiroki Naito1, Koichi Murakami1
1 Inst. of Applied Physics, Univ. of Tsukuba, Ibaraki, Japan, 2 Graduate School of Information Science and Electrical Engineering, Kyushu Univ., Fukuoka, Japan, 3 Graduate School of Health Science, Kyushu University, Fukuoka, Japan, 4 ISC, National Inst. of Advanced Industrial Science and Technology (AIST), Ibaraki, Japan
In this study, we propose a thrust/propulsion of nanospheres by using near field excited by femtosecond laser to control the sphere velocity and propelled angle.

WPE-10
Control of microstructures by two interfered femtosecond laser pulses using biprism
Y. Okada, T. Sato, K. Takeshi, and M. Ohno
1 Nagoya Inst. of Technology, Aichi, Japan, 2 AIST SEIKO CO., LTD, Aichi, Japan.
Periodic microgrooves on Si water induced by interfered femtosecond laser pulses using biprism are reported. Shape of microstructures is controlled by laser fluence, scanning numbers, and base angle of biprism. Tribological property changes by microgrooves.

WPE-11
Pattern Writing in a Liquid-Crystal-Monomer Mixture Using Two-Photon Polymerization
Chandren P. Jana, Kuo-Chu Hsiao, Yu-Chi Lin, Ja-Hon Lin, and Ray-Kuang Lee
1 Inst. of Photonics Technologies, National Tsing-Hua Univ., Hsinchu, Taiwan, 2 Univ. E-O Services Inc., Chung-Li, Taiwan.
In this study, we proposed a thrust/propulsion of nanospheres by using near field excited by femtosecond laser to control the sphere velocity and propelled angle.

WPE-12
Fabrication of Spherical-Shaped Submicron Particles of ZnO Using Laser-induced Melting of Submicron-sized Source Materials
Yasutaka Higashib, Takayuki Taji, Masaharu Taji, Hideki Fujisawa, Rishi Ishikawa, Naoto Kozakazi
1 Inst. of Materials Chemistry and Engineering, Kyushu Univ., Fukuoka, Japan, 2 Research Inst. for Electronic Science, Hokkaido Univ., Hokkaido, Japan, 3 Dept. of Advanced Materials Science, Faculty of Engineering, Kagawa Univ., Kagawa, Japan.
We report the study of fiber fuse effect in large mode area double-clad fiber. The fiber fuse pictures and a model of describing the propagation of the effect in double-clad fiber are presented in this paper.

WPE-13
Luminescence and Lifetime Properties of Nd3+/La3+, Thin Films Grown by Pulsed Laser Deposition
Naoki Yoda, Naoki Miyake, Shin-ichi Ono, Kohei Yamanaka, Yoshinori Shimji, Nobukiyo Sakuruki, Yuui Yokota, Takayuki Yanagita, and Akira Yoshikawa
1 Nagoya Inst. of Technology, Aichi, Japan, 2 Inst. of Laser Engineering, Osaka Univ., Osaka, Japan, 3 Inst. for Materials Research, Tohoku Univ., Sendai, Japan, 4 Kyushu Inst. of Technology, Kitakyushu, Japan.
Nd3+/La3+ thin films were grown by pulsed laser deposition. Photoluminescence spectra revealed a dominant peak at 1730nm with a decay time of 8.2 ns, which is similar to the results obtained from bulk Nd3+ crystal.

Poster Wednesday, July 3
**Poster Session**

Annex Hall

**Wednesday, July 3 / 13:00 - 14:30**

**Poster WPF-14**

**3D Microfabrication in YAG Crystals by Direct Laser Writing and Chemical Etching**

Debaditya Choudhury, Anirban Maldekar, Lynn Paterson, Daniel Jaquet and Jay K. Kol

Inst. of Photonics & Quantum Sciences, Heriot-Watt Univ., Edinburgh, UK; Dept. of Chemistry, Manipal Institute of Technology, Manipal, India; University of Massachusetts Lowell, USA; IMEC-UNH, USA; and MIR, India

We have grown Ce-doped fluorescent YAG crystals by direct laser writing and chemical etching. These crystals exhibit excellent optical properties and high thermal stability, making them suitable for various applications in the fields of laser physics and solid-state physics.

**Poster WPF-15**

**Optical Properties of Ce-doped YAG Crystals**

Nobuhiko Sarukura, Kato, and Tatsuo Okada

Inst. for Materials Research, Tohoku Univ., Sendai, Japan

We have investigated the optical properties of Ce-doped YAG crystals using absorption and luminescence spectroscopy. The results indicate that the crystals exhibit high luminescence efficiency and good thermal stability, making them potential candidates for optical device applications.

**Poster WPF-16**

**A Compact Dual-wavelength Optical Head for Photo-lithography**

Yuan-Chin Lee, K. Wada, Y. Hono, T. Hashii, Y. Yamagami, T. Matsuyama, and K. Nakamura

Dept. of Electrical and Electronic Engineering, Tokyo Univ. of Agriculture and Technology, Tokyo, Japan

We have developed a compact dual-wavelength optical head for photo-lithography. The device is capable of emitting two wavelengths simultaneously and has been successfully tested in a practical application.

**Poster WPF-17**

**A Wavelength-scanning Surface Plasmon Microscopy for Detection of a Bubble Layer**

Kayo Watanahe and Koji Matsuura

Dept. of Electrical and Electronic Engineering, Toyama Univ., Toyama, Japan

We have developed a wavelength-scanning surface plasmon microscopy for the detection of bubble layers in optical materials. Our technique allows for the precise detection of bubble layers in various materials, including those used in optical devices.

**Poster WPF-18**

**Measurement of Carbon Dioxide Concentration by Fiber Loop Ring Down Spectroscopy for Telemetering**

Hiroshi Morisawa, Yuki Fukuushima, Takumi Yonekura, and Tomoaki Shimizu

Dept. of Electrical and Electronic Engineering, Tokyo Univ. of Agriculture and Technology, Tokyo, Japan

We have developed a fiber loop ring down spectroscopy technique for the measurement of carbon dioxide concentration in the atmosphere. Our method allows for real-time monitoring of CO2 levels with high accuracy.

**Poster WPF-19**

**Fiber Evanescent Wave Spectroscopy of Acetylene Molecules with the Optical Microfiber Taper**

K. U. Huang, T. Lin, C. C. Chou, and C. W. Wu

Dept. of Photonics, Feng Chia Univ., Taichung, Taiwan, ROC

We have demonstrated a fiber evanescent wave spectroscopy technique for the detection of acetylene molecules. Our method utilizes an optical microfiber taper and shows potential for applications in gas detection and chemical analysis.

**Poster WPF-20**

**Distributed Optical Fiber Sensors**

Jin Huang, Samuele Lilliu, and Airán Ródenas

Graduate School of Engineering, Niigata Univ., Japan

We have developed a distributed optical fiber sensor system for monitoring temperature and strain in real-time. Our technique allows for high-resolution measurements and has potential applications in various fields, including structural health monitoring and industrial control systems.
WPF-17 Non-mechanical Scanning Laser Doppler Velocimeter with Directional Discrimination Using Single Transmission Path
Takahito Hata and Koichi Umi
Dept. of Reliability-based Information Systems Engineering, Graduate School of Engineering, Kagawa Univ., Kagawa, Japan
A non-mechanical axial scanning laser Doppler velocimeter (LDV) with directional discrimination using a single transmission path is proposed. The axial scan and directional discrimination has been demonstrated experimentally using a sensor probe setup.

WPF-18 Wafer Metrology Based on Combined Optical Interferometry
Young Giwan Kim, Yong Bum Seo, and Ki-Nam Joo
Dept. of Photonic Engineering, Chosun Univ., Gwangju, Republic of Korea
In this presentation, we report a simple combined interferometer with box coherence scanning interferometry and spectrally-resolved interferometry using NIR SDL to measure both side surface and thickness profiles of a Si wafer at once.

WPF-19 Shape Variation of Brillouin-Gain Spectrum Caused by Sinusoidal-like Strain Distribution
Yoshiki Hayashi and Hiroshi Nara
Mie Univ., Mie Prefecture, Japan
Shape variation characteristics of the Brillouin gain spectrum caused by sinusoidal-like strain distribution, which is a typical non-uniform strain distribution produced in a ring structure, are clarified through numerical calculation and experiments.

WPF-20 Cross-polar Fiber Sensor for Reflective Index Measurement Based on Localized Surface Plasma Resonance
Seung Jun Park , Chae Leong To, Hae Gui Baek, Yong Ho Kim, Joo Bleeom Eom, Young Tae Lee, and Byoeng Ho Lee 1, 2
1 School of Information and Communications, GIST, Gwangju, South Korea
2 Dept. of Medical System Engineering, GIST, Gwangju, South Korea
Fiber-optic based localized surface plasma resonance sensor has been developed for the measurements of reflective index (RI).

WPF-21 Development of Dual Laser Triangulation Measurement Device Applied on Petal Thickness Inspection
Kuang-Chy Lee, Jin-Shiang Yang, Hsin Her Yu
Graduate Institute of Automatic Engineering, 1 Dept. of Electrical Engineering, National Formosa Univ., Yunlin, Taiwan
We presented a 10 m remote measurement based on the algorithm of reflectivity-height transformation by use of a commercial telescope and a parallagram prism for thickness, depth, and profile measurements.

WPF-22 Terahertz Remote Measurements by Use of a 3-D Telescope
Ming-Hung Chiu and Yan-Sin Chen
Dept. of Electro-Optical Engineering, National Formosa Univ., Yunlin, Taiwan
We presented a 10 m remote measurement based on the algorithm of reflectivity-height transformation by use of a commercial telescope and a parallagram prism for thickness, depth, and profile measurements.

WPF-23 Minimization of Spectral Phase Errors in Spectrally Resolved Interferometry
A. Jeong You 1, B. Ki-Nam Joo
1 INTEKPLIS Co., Daegu, Republic of Korea
2 Dept. of Photonic Engineering, Chosun Univ., Gwangju, Republic of Korea
We introduce and verify an iterative least squared phase shifting method, inherently insensitive to any types of phase shifting errors, to calculate the spectral phase in PS-SPR.

WPF-24 Spatial and Temporal Dynamics of Thermal and Carrier Diffusions in Clathrate Compounds
T. Watanabe, T. Moriyasu, K. Okamura, K. Suekuni, T. Onishi, T. Takahata, and T. Komoto
Graduate School of Science, Kobe Univ., Kobe, Japan
Graduate School of Advanced Sciences of Matter, Hiroshima Univ., Hiroshin-Hiroshima, Japan
The direct observation of the spatial and temporal dynamics of lattice and carrier diffusions in clathrate compounds are demonstrated by a pump-probe experiment. The effect of the ratting motion on the thermal diffusion is discussed.

WPF-25 Non-destructive and Non-contact Thickness Measurement for Optically Opaque Samples by Optical Fiber Heterodyne Interferometry System
Jongyoun Eom, Saegun Jun Park, Yong Ho Kim, Byoeng Ho Lee 1
Dept. of Medical System Engineering, Gwangju Inst. of Science and Technology, Gwangju, Republic of Korea
"School of Information and Communications, Gwangju Inst. of Science and Technology, Gwangju, Republic of Korea
We demonstrate a scheme of non-destructive and non-contact thickness measurement by using the fiber-induced acoustic pressure wave with a compact optical fiber heterodyne interferometer, we could measure the thickness of an opaque or metallic sample.

WPF-26 Assessment of Reconstructed Method of Absorber in Scattering Medium Using Intensity Ratio
Toshikho Yamaoki, Kouichi Nitta, Osamu Matoba
Kobe Univ., Kobe, Japan
For the reconstruction of absorber embedded in a homogeneous scattering medium, a backprojection method using intensity ratio is evaluated numerically. The proposed method uses the intensity ratio between an object medium and a reference medium.

WPF-27 Deep Walls Microscaffold Characterization Using Digital Holographic Microscopy
M. Minakata, T. Lu, K. C. Pippescu, A. Matsui, A. Kusano, M. Dreisse, E. J. Scarti
University of Dortmund, Dortmund, Germany
Polymer microscaffolds with deep walls have been fabricated for the reconstruction of absorber embedded in a homogeneous scattering medium, a backprojection method using intensity ratio is evaluated numerically. The proposed method uses the intensity ratio between an object medium and a reference medium.

WPF-28 Experimental Evaluation of Depth of Focus by MTF in Digital Holographic Microscopy
Kazuhiko Tsuaya, Kouichi Nitta, Osamu Matoba, and Yasuhiro Akiyama
1 Kobe Univ., Kobe, Japan
2 Kyoto Inst. of Technology, Kyoto, Japan
3 National Inst. of Inform. and Communications Tech., Daejeon, South Korea
4 Korea Research Inst. of Standard and Science (KRISS), Daejeon, South Korea
The gamma ray induced behavior of a saturable absorber was tested by pump-probe experiment, which reveals that the modulation depth and saturation fluence vary from 6-to-3 % and 45-105 μJ/μm 2, after gamma-ray exposure of ~100 krad.

WPF-29 Influence of Spatial Coherence Degree in Fluorescence Digital Holography
Kazuhiko Tsuaya, Kouichi Nitta, Osamu Matoba, and Yasuhiro Akiyama
1 Kobe Univ., Kobe, Japan
2 Kyoto Inst. of Technology, Kyoto, Japan
3 National Inst. of Inform. and Communications Tech., Daejeon, South Korea
4 Korea Research Inst. of Standard and Science (KRISS), Daejeon, South Korea
The gamma ray induced behavior of a saturable absorber was tested by pump-probe experiment, which reveals that the modulation depth and saturation fluence vary from 6-to-3 % and 45-105 μJ/μm 2, after gamma-ray exposure of ~100 krad.

WPF-30 Uncertainty Budget of PD’s Frequency Response Measurement Using Heterodyne Technique
K. Nagata, T. Kawanishi, M. Ameya, S. Kurokawa, and Y. Okawa
1 National Inst. of Inform. and Communications Tech., Tokyo, Japan
2 National Inst. of Advanced Industrial Science and Technology, Ibaraki, Japan
3 Tensai Ltd., Chiba, Japan
4 National Inst. of Inform. and Communications Tech., Daejeon, South Korea
5 Korea Research Inst. of Standard and Science (KRISS), Daejeon, South Korea
We define and validate an iterative least squared phase shifting method, inherently insensitive to any types of phase shifting errors, to calculate the spectral phase in PS-SPR.
WP-1 Magneto-optical double resonance of a single NV center in diamond for photon-spin state transfer
Nakio Nishio, Hiroki Kojima, Naotomi Abe, Yasuyoshi Matsuura, Koichi Edamatsu
Research Inst. of Electrical Communication, Tohoku Univ., Sendai, Japan.
We demonstrate magneto-optical double resonance of a single NV center in diamond for quantum media conversion between a photon and an electron or a nuclear spin via resonant photo-absorption.

WP-2 Optical WGMs The Tuning and Mechanical Modes in a PDMS Double-Stem Resonator
Ranjipal Madhurya1, Yong Yang 2, Jonathan M Ward 3, and Sashikanth Shankar 4
1 Light-Matter Interactions Unit, OIST Graduate Univ., Okinawa, Japan, 2 Physics Dept., Univ. College Cork, Cork, Ireland, 3 The tuning of optical WGMs is observed in a stretchable PDMS microresonator, demonstrating sensitivities as high as 0.13 mJ/nm. The structure also provides the possibility of observing mechanical modes with frequencies in kHz range.

WP-3 High-resolution Quantum Optical Coherence Tomography by Broadband Parametric Fluorescence
Masayuki Okano1, Ryo Okamoto2, Akira Tanaka2, Shutoh Umeda3, and Shigeki Takeuchi2
1 Research Inst. for Electronic Science, Hokkaido Univ., Sapporo, Japan, 2 The inst. of Scientific and Industrial Research, Osaka Univ., Osaka, JAPAN, 3 Graduate School of Engineering, Nagoya Univ., Nagoya, JAPAN.
Quantum optical coherence tomography (QOCT) can achieve high-resolution imaging with dispersion tolerance by virtue of quantum entanglement. We demonstrate advantages of high-resolution QOCT by comparison with classical optical coherence tomography.

WP-4 Adaptive Quantum State Estimation of Mixed States Using Photons
Satoshi Oyama1, Minae Itofuji1, Ryo Okamoto2, Koichi Yamagata2, Akiyoshi Fujikawa1, and Shigeki Takeuchi2
Adaptive quantum state estimation of mixed state inputs is experimentally demonstrated. The theoretically predicted different behavior of the convergence of the estimated value is experimentally demonstrated. The theoretically predicted different behavior of the convergence of the estimated value is experimentally demonstrated. The theoretically predicted different behavior of the convergence of the estimated value is experimentally demonstrated.

WP-5 Broadband Frequency Correlated Photon Pairs Using a Chirped-QPM Device
Akira Tanaka1, Ryo Okamoto2, Hwong Hong Lim1, Shyntu Sinha Subashchandran1, Masayuki Okano1, Laban Zhang2, Lin Kang3, Jian Chen4, Peiheng Wu2, and Shigeki Takeuchi2
1 Inst. for Optics, Information and Photonics, Univ. of Erlangen-Nürnberg, Erlangen, Germany, 2 National Inst. of Materials Science, Tsukuba, Japan, 3 Research Inst. of Superconductor Electronics (RISE), School of Electronic Science and Engineering, Nanyang Univ., Nanyang, Singapore, 4 Central Research Laboratory, Hamamatsu Photonics, K.K., Hamamatsu, Japan.
We report the observation of the broadband frequency correlation of two-photon states to date via parametric down conversion using chirped QPM device. The two-photon correlation in time domain can be compressed to 3:5 cycles.

WP-6 Sum-frequency-Photon Generation From an Entangled Photon Pair
Yu Eto1, Masayuki Okano1, Akira Tanaka1, Shyntu Sinha Subashchandran1, Ryo Okamoto2, Hwong Hong Lim1, Laban Zhang2, Lin Kang3, Jian Chen4, and Shigeki Takeuchi2
1 Inst. for Optics, Information and Photonics, Univ. of Erlangen-Nürnberg, Erlangen, Germany, 2 National Inst. of Materials Science, Tsukuba, Japan.
We report sum-frequency-photon generation from an entangled photon pair, which is an important step toward the realization of photon pairs with ultra-short (monocycle) temporal correlation.

WP-7 Release-recupal Experiment on Cold 87Rb Atoms with an Optical Nanofiber Probe
Ravi Kumar1, Laura Russell2, Vihbrti Bharath Tiwar3 and Ole Niel Chorlott4
1 Oklahoma Inst. of Science and Technology, Oklahoma, Japan, 2 Physics Dept., Univ. College Cork, Cork, Ireland, 3 Laser Physics Applications Section, Centre for Advanced Technology, Indore, India.
An optical nanofiber (ONF) has been used to measure the temperature of cold 87Rb atoms in a magneto-optical trap by release-recupel method. Integration of the ONF with cold atoms is useful for quantum technologies.

WP-8 Manipulation of Self-arranged Dielectric Particles Using Optical Nanofibers
All Michaela1,2, Mary Frazier3, Eugen Prei1, Viet Giang Truong1, and Ole Niel Chorlott4
1 Light-Matter Interactions Unit, OIST Graduate Univ., Okinawa, Japan, 2 Physics Dept., Univ. College Cork, Cork, Ireland, 3 Photonics Institute, Austrian Academy of Science, Austria, 4 Energy Research Inst., Ministry of Science and Technology, Korea.
Propagation properties of single and chains of particles with well-separated distance between particles in the evanescent field surrounding a nanofiber were studied. Interference of counter-propagating beams is demonstrated, useful for directional propulsion and positional control.

WP-9 WDM Polarization-Entanglement by Cascaded Optical Nonlinearities in a PPLN Waveguide
Shin Arakawa and Hihtoh Muri
Corporate R&D Center, Oki Electric Industry Co., Ltd., Saitama, Japan.
We report generation of wavelength-multiplexed polarization-entangled photon-pairs by cascaded optical nonlinearities (sum-frequency-generation and parametric down-conversion) in a period-doubled UNLIGOs waveguide device. The visibilities higher than 98% were achieved for all the evaluated wavelength channels.

WP-10 Radially and Azimuthally Polarized Non Paraxial Bessel Beams
M. Drighotti, and A. Aileo1
1 Max Planck Inst. for the Science of Light, Erlangen, Germany, 2 Inst. for Optics, Information and Photonics, Univ. of Erlangen-Nürnberg, Erlangen, Germany.
We present a method for the realization of cylindrically polarized non-paraxial beams by constructing exact vector solutions of Maxwell’s equations from scalar Bessel beams and combining them together by analogy with the paraxial case.

WP-11 Sub-Rayleigh Imaging with Incoherent Light
Joo-En Oh1, Young-Wook Cho1, Yi-Lu Wu1, Hwan Seok Cho1, Giuliano Scarsi1, and Yoan-Hee Kim2
1 Dept. of Physics, Pohang Univ. of Science and Technology (POSTECH), Pohang, Korea, 2 Harvard Medical School and Weisman Center for Photomedicine, Massachusetts General Hospital, MA, USA.
We demonstrate sub-Rayleigh limit imaging of an object via speckle illumination. Imaging beyond the Rayleigh limit is achieved by illuminating the object with pseudothermal light. An object image is reconstructed from the second-order correlation measurement.

WP-12 Modulation Transfer Spectroscopy for D2 Transition Line of Rubidium
Heung-Ryoul Noh and Sang Eon Park1
1 Chonnam National Univ., Gwangju, Korea, 2 Korea Research Inst. of Standards and Science, Daejeon, Korea.
When a frequency-modulated pump beam overlaps with a probe beam, new modulated probe beams are generated via nonlinear interaction with atoms. We observed this phenomenon for D2 line of 87Rb and compared with calculated results.

WP-13 Self-Rotation of Elliptically Polarized Light in Doppler-Broadened Rubidium
Eui Hyun Cha, Jong Min Park, and Heung-Ryoul Noh
We present an experimental and theoretical study of the self-rotation for elliptically polarized light in Doppler-broadened rubidium in upper hyperfine transition of 87Rb and 88Rb. The experimental results were compared with the calculated results.

WP-14 Combination Method of Atom Trap and Time-of-Flight Mass Spectrometer for Ca Isotope Analysis
Kei Ho-Hoon Ko1, Riu Hi-Hong1, Yonghee Kim1, Lim Lee1, Taek-Soo Kim1, Hyun-Min Park1, Dan-Sik Park2, Yong-Ho Cha1, Gwo Ki3, and Gye-Hung Jeong3
The combination method of the atom trap and the time-of-flight mass spectrometer is demonstrated using calcium atom. The design of the acceleration unit is introduced and the isotope selective characteristics of the systems are discussed.

WP-15 Quantum Communication Utilizing Cavity-based Quantum Devices
Kee Nemo1, A. Stephens1, S. Devith1, M. Evert1, J. Schmiedmayer2, M. Trappe2, E. Saro2, Y. Matsuzaki2, A. SalToh1, K. Harrison1, W. J. Munro3
1 National Inst. of Informatics, Tokyo, Japan, 2 Vienna Center for Quantum Science and Technology, Atom Institute, Vienna, Austria, 3 NTT Basic Research Laboratories, NTT Corporation, Kanagawa, Japan.
Photons play a central role in performing communication tasks with quantum information. In this paper, we present several quantum repeater schemes, their implementation and compare the advantages and disadvantages of each.

WP-16 Flexible Nonlinearity in an Antenna-coupled Double Quantum Dot
Nobutaka Yoshioki and Hajime Ishihara
Dept. of Physics and Electronics, Osaka Prefecture Univ., Osaka, Japan.
We theoretically investigate nonlinear excitations in a double quantum dot (DQD). It is found that a flexible and strong nonlinearity of the excitations in the coupled system caused by quantum interferences.

WP-17 Compact Experimental Apparatus for Producing High Repetition Rate 87Rb Bose Einstein Condensation on Atom Chip
D. J. Kim, H.-K. Kim, Y.-J. Moon, and J. B. Kim
Dept. of Physics Education, Korea National Univ. of Education, Chung-Buk, Korea.
We construct a compact experimental apparatus for producing a high repetition rate ultra cold 87Rb based on an external atom chip. In this system, we successfully produce Bose-Einstein condensation (BEC) with about 5 sec repetition period.

WP-18 Observation of Interferometric Structure in Fluorescence From Thiophene/Phenylene Co-Oligomer Crystal
H. Mizuno1, H. Katsuki1, H. Yanagi1, S. Fasak1, S. Hotta1, and K. Ohnori1
1 Nara Inst. of Science and Technology, Nara, Japan, 2 Electronics and Photonics Research Inst., National Inst. of Advanced Industrial Science and Technology, Ibaraki, Japan.
We report interferometric structures in fluorescence from a thin slab crystal of 5,5´-bis(4´-methoxybiphenyl-4-yl)-2,2´-bithiophene. These structures observed in the relative delay time with 10 ps between double pulses were discussed in terms of coherent dynamics.
Poster Session
Wednesday, July 3 / 13:00 - 14:30

Annex Hall

WPG-19
Development of a Surface Electrode Trap for Two-Dimensional Ion Lattice
T. Tanaka, K. Suzuk, and S. Urabe
Graduate School of Engineering Science, Osaka Univ., Osaka, JAPAN
We report a surface electrode trap which enables two-dimensional ion lattice. Calcium ion lattice has been observed by adjusting the trapping potential. Such trap could be applied for quantum simulation of coupled spin systems.

WPG-20
Highly Efficient Light Collecting Devices Utilizing a Nanofiber Tip
Sho Chonese, Shinya Kato, and Takao Aoki
School of Advanced Science and Technology, Waseda Univ., Tokyo, Japan
We have performed numerical simulations of light collecting devices utilizing a silica nanofiber tip. Up to 39% of light from a point dipole source can be coupled to the fundamental guided mode of the nanofiber.

WPG-21
Optical Control of Microwavability by Mechanical Nonlinearity Under Environmental Fluctuations
Nguyen Duy Vu and Takuya Ida
Nanoscience and Nanotechnology Research Center, Osaka Prefecture Univ., Osaka, Japan, Dept. of Physics and Electronics, Osaka Prefecture Univ., Osaka, Japan
Nonlinear dynamics of an optical microcavity-based oscillator are studied under the self-consistent radiation pressure and environmental fluctuations. Vibration amplitude is significantly suppressed with the negative optical rigidity and effective suppression arising from higher mechanical modes.

WPG-22
Environment of Success Probability by Squeezed Light in Weak Value Amplification for Single-Photon-Level Nonlinearity
F. Matsukawa, A. Tomita, and A. Okamoto
Graduate School of Information Science and Technology, Hokkaido Univ., Sapporo, Japan
We propose the use of a squeezed coherent light probe in weak value amplification of single photon nonlinearity. It improves the success probability more than tenfold without the degradation of the error probability.

WPG-23
Withdrew

WPG-1
Absorption of Cervical Dentin with a Nanosecond Pulsed Laser at a Wavelength of 858 Micrometer: Relationship Between Selectivity and Hardness
Graduate School of Engineering, Osaka Univ., Osaka, Japan, Dept. of Chemistry, Osaka Dental Univ., Osaka, Japan, Graduate School of Frontier Biosciences, Osaka Univ., Osaka, Japan
The Center for Advanced Medical Engineering and Informatics, Osaka Univ., Osaka, Japan
Relationship between ablation depth and hardness in a nanosecond dentin with a nanosecond pulsed laser at a wavelength of 858 μm was investigated for the selective removal of dental caries under minimally invasive dentistry.

WPG-2
Femtosecond Pumping of e6FP Transfected Human Embryonic Kidney Cells
M. D. Macleod, D. Choudhury, L. Paterson, R. R. Duncan, and A. K. Kar
Inst. of Photonics and Quantum Sciences, School of Engineering and Physical Sciences, Heriot Watt Univ., Edinburgh, UK, Inst. of Biological Chemistry, Biophysics and Bioengineering, School of Engineering and Physical Sciences, Heriot Watt Univ., Edinburgh, UK
An investigation was made of femtosecond pumping of a cell using a human embryonic kidney (HEK293) cells transfected with enhanced green fluorescent protein.

WPG-3
Dependence of the Photobleaching of Fluorescent Proteins on the Repetition Rate of Femtosecond Light Pulses
Kosuke Tojo, Hiroki Takashashi, and Akira Suda
Dept. of Physics, Faculty of Science and Technology, Tokyo Univ. of Science, Tokyo, Japan
We investigate the photobleaching of fluorescent proteins as function of pulse interval, chirp, and pulse energy of the repetitively excited light pulses and find out that the photobleaching occurs via one-photon excited state absorption of the bleached state.

WPG-4
2D Simultaneous Spatial and Temporal Focusing as a Fast-Scanning Two-Photon Excited Fluorescence Microscopy
Aoi Nakamura, Kyousan Song, Kenichi Hirokawa, and Fumihiko Hamada
Dept. of Electronics and Electrical Engineering, Keio Univ., Yokohama, Japan
I propose a two-dimensional simultaneous spatial and temporal focusing (2STF) microscopy employing a VIPA and a grating, which can improve both axial resolution and background noise compared to 1-D STF microscopy.

WPG-5
Ultrafast Excitation of Quantum Dots with a Fibre Laser for Deep Tissue Imaging
Centre For Quantum Dynamics, Griffith Univ., Nathan Old, Australia, Dept. of Glycobiology, Griffith Univ., Southport, Australia
Fluorescence from three photon absorption was observed in CdSe quantum dots excited with ultrashort pulses from a telecom band Eritum fibre laser. Reduced scattering at longer wavelengths makes this approach interesting for deep tissue imaging.

WPG-6
Withdrew

WPG-7
Real-Time Detection of Protein Kinase A Activity by a Si-Based ARROW-B SPR Biosensor
Hsin-Feng Hsu, Yuan-Chang Chang, Chien-Chih Lin, Jong-Wen Lin, Huei-Jyuan Pan, and Zheng-Wen Lin
Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan, Inst. of Biophotonics, National Yang-Ming Univ., Taipei, Taiwan, Biophotonics & Molecular Imaging Research Center (BMIRC), National Yang-Ming Univ., Taipei, Taiwan
We measured the membrane roughness of neuroblastoma cells by non-interferometric wide-field optical profilometry. We found that the peptide related to Alzheimer’s disease, Amyloid-beta 42, reduces membrane roughness, but direct current electrical fields recover this effect.

WPG-8
Characterization of Photoacoustic Signal of Plasmonic Gold Nanoparticles
Miyako Ishihara, Takeshi Hirasawa, Ryota Sato, Shinya Okawa, Yoshinari Teranishi
1 Dept. of Medical Engineering, National Defense Medical College, Saitama, Japan, 2 Inst. for Chemical Research, Kyoto Univ., Kyoto, Japan
We performed a comprehensive photoacoustic measurement of various gold nanoparticles to design exogenous imaging agents for enhancing the contrast. The photoacoustic signal intensities were sensitive to the shape and size of the gold nanoparticles.

WPG-9
Laser-Assisted Control of Protein Adsorption for Dynamically Arranging Viable Cells
Kazunori Okano, A. Matsumi, Y. YasuoMizawa, M. Hasegawa, Y. Ohkubo, T. Kato, K. Kakimoto, F. Matsuoka, A. Tomita, and A. Okamoto
Graduate School of Information Science and Technology, Hokkaido Univ., Sapporo, Japan
We propose the use of a squeezed coherent light probe utilizing a silica nanofiber tip. Up to 39% of light from a point dipole source can be coupled to the fundamental guided mode of the nanofiber.

WPG-10
Cell Migration Guidance by Using Optical Micropatterns
Jan-Long Yao, De-Han Lu, Yu-Ching Hsu, and Chau-Hwang Lee
1 Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan, 2 Inst. of Biophotonics, National Yang-Ming Univ., Taipei, Taiwan, 3 Biophotonics & Molecular Imaging Research Center (BMIRC), National Yang-Ming Univ., Taipei, Taiwan
We used static and dynamic optical micropatterns to guide the migration of adherent cells. With 0.2 W/cm² intensity and a 2.8 μm pattern speed, 70% of the tested cells were guided along an optical pattern.

WPG-11
Optical Measurement on Membrane Roughness of Neuroblastocty Cells Treated with Amyloid-b Peptide and Electric Fields
1 Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan, 2 Inst. of Biophotonics, National Yang-Ming Univ., Taipei, Taiwan, 3 Biophotonics & Molecular Imaging Research Center (BMIRC), National Yang-Ming Univ., Taipei, Taiwan
We measured the membrane roughness of neuroblastoma cells by non-interferometric wide-field optical profilometry. We found that the peptie related to Alzheimer’s disease, Amyloid-beta 42, reduces membrane roughness, but direct current electrical fields recover this effect.

WPG-12
Identification of Malignant Melanoma by Three-dimensional Single-cell Tomography
Nai-Chia Cheng, Chien-Chih Lin, Song-Sheng Tsai, Ming-Yi Lin, Shang-Lung Huang, and Ding-Wei Huang
1 Inst. of Photonics and Optoelectronics, National Taiwan Univ., Taipei, Taiwan, 2 Dept. of Physics, National Dong Hwa Univ., Hualien, Taiwan, 3 Dept. of Dermatology, National Taiwan University Hospital and College of Medicine, National Taiwan University, Taipei, Taiwan
Discriminating melanoma cells from keratocytes and fibroblasts by ultrahigh-resolution optical coherence tomography was demonstrated. 20 features were acquired from volume images. 97% sensitivity and 94% specificity for melanoma cells were achieved by linear discriminant analysis.

WPG-13
Simultaneous measurement of the mental-sweating dynamics of a few tens of sweat glands by OCT
Masato Ohmi, and Yuki Wada
Graduate School of Medicine, Osaka Univ., Osaka, Japan
We demonstrate the dynamic OCT analysis of mental sweating of a few tens of eccrine sweat glands. The dynamical analysis of mental sweating for sound stimuli is permitted by the time-sequential en-face OCT images.
WPJ-14
GPU Accelerated Correlation Mapping OCT for Real-Time Imaging of Microvasculature
Yuuki Watanabe, Hiroshi Numazawa, and Dai Kamiyama
Graduate School of Science and Engineering, Yamagata Univ., Yonezawa, Japan
We developed GPU(Graphics Processing Unit) processing to display correlation mapping OCT images in real-time. A display rate of 91 frames per second for processed images (1024 FFT size x 512 lateral A-scans) was achieved.

WPJ-15
Reflectance Images using 5 mm Graded-Index Multimode Fiber
Manabu Sato¹, Takahiro Kanno¹, Syoutarou Ishihara¹, Hiroshi Suto¹, Toshiko Takahashi² and Izumi Nishidate²
¹ Graduate School of Science and Engineering, Yamagata Univ., Yamagata, Japan, ² Graduate School of Bio-Applications & Systems Engineering, Tokyo Univ. of Agriculture and Technology
The imaging condition and magnifications were measured using graded index multimode fiber with diameter of 140 μm and length of 5 mm. Reflectance images of weed surface were measured to show cell shapes.

WPJ-16
Estimation of Scattering Coefficient in CW Reflectance Measurement for Noninvasive Triglyceride Evaluation
Kazuya Inaga¹, Takeshi Namita¹, Toshihiro Sakurai², Hitoshi Chiba², and Koichi Shimazu²
¹ Graduate School of Information Science and Technology, Hokkaido Univ., Sapporo, JAPAN, ² Faculty of Health Sciences, Hokkaido Univ., Sapporo, JAPAN
For noninvasive measurement of the triglyceride in the blood, a technique was developed to estimate the scattering coefficient of a turbid medium from the backscattered intensity at two different points on the human body surface.

WPJ-17
Effect of Probe Arrangement on Reconstruction of Optical Brain Function Imaging
Kazuki Kurihara¹, Hiroshi Kawaguchi¹, Takayuki Obata², Hiroshi Ito³, and Eiji Okada⁴
¹ Dept. of Electronics and Electrical Engineering, Keio Univ., Yokohama, Japan, ² Molecular Imaging Center, National Inst. of Radiological Sciences, Chiba, Japan
The effect of probe arrangements on optical brain function imaging is evaluated. The high-density probe arrangements, in which the distance between neighboring probe pairs is less than 10 mm can effectively improve the reconstructed image.
### PD1b-2 16:12 - 16:24
**World’s Fastest Real-time Line Scan Microscopic Imaging System with 1GHz Frame Rate**
Fangjian Xing, Hongwei Chen, Minghua Chen, Sigang Yang, Hongchen Yu, and Shizhong Xie
Tsinghua National Laboratory for Information Science and Technology (THList), Dept. of Electronic Engineering, Tsinghua Univ., China

We experimentally demonstrate a line scan microscopic imaging system with 1-D frame rate of 1 GHz, which dramatically exceeds the records before. This technique has potential to capture fast process, especially non-repetitive transient phenomena.

### PD1b-3 16:24 - 16:36
**Record 11 dB Phase Sensitive Amplification in Sub-millimeter Silicon Waveguides**
Y. Zhang, C. Husko, J. Schröder, S. Lefrancois, I. Rey, T. Krauss, and B. J. Eggleton
1CUDOS, School of Physics, Univ. of Sydney, Australia, 2SUPA, School of Physics and Astronomy, Univ. of St. Andrews, UK, 3School of Physics, Univ. of York, UK

We demonstrate phase sensitive amplification (PSA) in a 196μm silicon slow-light photonic crystal with an extinction ratio of 11dB. This record smallest phase sensitive amplifier is also the first demonstration of PSA in a photonic crystal.

### PD1b-4 16:36 - 16:48
**Quantum Key Distribution over a 60-dB Channel Loss Using SSPD with Ultralow Dark Count Rate**
Hiroyuki Shibata, Toshimori Honjo, and Kaoru Shimizu
1NTT Basic Research Laboratories, NTT Corporation, Japan, 2NTT Nanophotonics Center, NTT Corporation, Japan, 3NTT Secure Platform Laboratories, NTT Corporation, Japan

We present the first quantum key distribution (QKD) experiment over 60 dB channel loss, which is equivalent to 300 km of fiber. We use the differential phase shift QKD protocol and ultra-low dark count SSPDs.
### Thursday, July 4

#### Room 510

**Post Deadline Paper (PDP) Joint**

**Session Chair:** Akihiko Kasukawa (Furukawa Electric Co., Ltd., Japan)  
**Time:** 16:00 - 17:00

| PD2-1 | 16:00 - 16:12 | **A Silicon Receiver for 100 Gb/s PDM-DQPSK Signals**  
F. Gambini¹, S. Faralli¹, A. Malacarne¹, G. Meloni¹, G. Berrettini², G. Contestabile², L. Poti¹, and J. Klamkin²³  
¹CNIT Photonic Networks National Lab., Italy, ²Scuola Superiore Sant’Anna, Italy, ³Boston Univ., USA  
We demonstrate a monolithically-integrated silicon photonic receiver for 100 Gb/s PDM-DQPSK signals. The device is realized with a 2D grating coupler, four Mach-Zehnder delay interferometers with phase shifters and four germanium balanced photodetectors. |
| PD2-2 | 16:12 - 16:24 | **High-speed Direct Modulation Beyond 29GHz of 980nm Transverse Coupled Cavity VCSEL**  
Hamed Dalir and Fumio Koyama  
Photonics Integration System Research Center, Tokyo Inst. of Technology, Japan  
A novel concept for the modulation-bandwidth enhancement of VCSELs using transverse-coupled-cavity scheme is proposed, which enables us to tailor the modulation-transfer function. The 3dB-bandwidth is increased by a factor of 3 far beyond the relaxationoscillation frequency. |
| PD2-3 | 16:24 - 16:36 | **In-line Phase-sensitive Amplifier for QPSK Signal Using Multiple QPM LiNbO3 Waveguide**  
Masaki Asobe¹², Takeshi Umeki¹, Hirokazu Takenouchi¹ and Yutaka Miyamoto³  
¹NTT Photonics Labs, NTT Corporation, Japan, ²NTT Network Innovation Labs., NTT Corporation, Japan, ³Tokai Univ., Japan  
The carrier phase of a QPSK signal is recovered using multistage frequency mixing in a multiple quasi-phasematched LiNbO3. QPSK signal regeneration is demonstrated in a PPLN-based PSA for the first time. |
| PD2-4 | 16:36 - 16:48 | **Fabrication of Silicon Reflection-Type AWGs with Distributed Bragg Reflectors**  
Katsunari Okamoto and Kenzo Ishida  
AiDi Corporation, Japan  
Silicon reflection-type arrayed waveguide gratings (AWGs) with -20dB crosstalk are experimentally demonstrated for the first time to our knowledge. The AWG has 14 output channels with 400GHz channel spacing and a footprint of 230x530 μm². The minimum on-chip loss of 3.0 dB is achieved by using a second-order distributed Bragg reflector (DBR) facet. |
| PD2-5 | 16:48 - 17:00 | **Demonstration of a Photonic Integrated Mode Coupler with 3.072Tb/s MDM and WDM Transmission over Few-Mode Fiber**  
Haoshuo Chen¹, Vincent Sleiffer¹, Bradley Snyder², Maxim Kuschnerov², Roy van Uden¹, Yongmin Jung³, Chigo Okonkwo¹, Oded Raz¹, Peter O’Brien⁵, Hugo de Waardt¹, and Ton Koonen¹  
¹Cobra Inst., Eindhoven Univ. of Technology, The Netherlands, ²Tytndal National Inst., Univ. College Cork, Ireland, ³Coriant GmbH & Co. KG, Germany, ⁴Optoelectronics Research Centre, Univ. of Southampton, UK  
We demonstrate 3.072Tb/s (6 spatial-andpolarization modes x 4 WDM x 128-Gb/s 16QAM) transmission over 30km few-mode fiber by employing a photonic integrated mode coupler, which utilizes push-pull and center launch for exciting LP_{11} and LP_{01} modes through mode-profile match. |
### PD3-1  16:00 - 16:12  First Optical Nyquist Filtering of 10G OOK for OFDMA λ-overlays on 40km and 1:128 split PON  
Akihiro Tanaka, Neda Cvijetic, and Ting Wang  
NEC Laboratories America  
We demonstrate the first OLT-side optical Nyquist filtering of legacy 10G OOK signals, doubling both the reach and split ratios of dynamic >10Gb/s OFDMA λ-overlays for mobile backhaul over PON, without any ONU-side optics upgrades.

### PD3-2  16:12 - 16:24  Transmission and Pass-Drop Operations in All-Optical Elastic Network using Nyquist OTDM-WDM up to 2x344 Gbaud/channel  
Hung Nguyen Tan, Takashi Inoue, Takayuki Kurosu, and Shu Namiki  
National Inst. of Advanced Industrial Science and Technology (AIST), Japan  
We propose a highly efficient, fully elastic alloptical network based on Nyquist OTDM-WDM, and demonstrate the transmission and pass-drop operations of multi-granular signals from 43Gbaud to dual-polarization 344Gbaud over 320-km SLA-IDF with four WSS nodes.

### PD3-3  16:24 - 16:36  First Demonstration of Real-time All-Optical Software-Defined Intra-Data Center Star Network Using OFDM and Burst Switching  
Philip N. Ji, Dayou Qian,1 Karthik Sethuraman,1 Jungiang Hu,1 Yoshiaki Aono,1 Tsutomu Tajima,2 William Blainey,2 and Ting Wang1  
1NEC Laboratories America, Inc. USA, 2NEC Corporation of America, USA, 3Converged Network Division, NEC Corporation, Japan  
We demonstrate the first real-time high-capacity star OFDM-based all-optical intra-data center network using burst switching and OpenFlow-based software-defined networking. It offers efficient flexible bandwidth multivendor any-to-any switching and hitless in-service upgrade.

### PD3-4  16:36 - 16:48  Optical Phase Conjugation for Nonlinearity Compensation of 1.21-Tb/s Pol-Mux Coherent Optical OFDM  
Monir Morshed1, Liang B. Du1, Benjamin Foo1, Mark D. Pelusi1, and Arthur J. Lowery1  
1Centre for Ultrahigh bandwidth Devices for Optical Systems (CUDOS), Dept. Electrical & Computer Systems Engineering, Monash Univ., Australia, 2CUDOS, School of Physics, Univ. of Sydney, Australia  
We experimentally demonstrate mid-span spectral inversion for fiber nonlinearity compensation of a 1.21-Tb/s polarization multiplexed coherent optical OFDM system. For 800-km link, the nonlinear threshold was improved by 2.8 dB. To our knowledge, this is the first demonstration of all-optical nonlinearity compensation of a dual polarization coherent optical OFDM system.

### PD3-5  16:48 - 17:00  31 Tb/s Transmission over 7,200 km Using 46 Gbaud PDM-8QAM with Optimized Error Correcting Code Rate  
M. Salsi1, A. Ghazisaeidi1, P. Tran1, Rafael Rios Muller1, L. Schmaler1, J. Renaudier1, H. Mardoyan1, P. Brindel1, G. Charlet1, S. Bigo1  
1Alcatel-Lucent Bell Labs, France, 2Alcatel-Lucent Bell Labs, Germany  
We present a transmission experiment over transoceanic distance using multi-level modulation format and an error correcting code optimized for 200 Gb/s channel rate. A record capacity is obtained using 155 channels over C+L bands.

### PD3-6  17:00 - 17:12  3 MDM × 8 WDM × 320-Gb/s DP-32QAM Transmission over a 120km Few-Mode Fiber Span Employing 3-Spot Mode Couplers  
Haoshuo Chen1, Vincent Sleiffer1, Roy van Udën1, Chigo Okonkwo1, Maxim Kuschnirov1, Frans Huijskens1, Lars Grüner-Nielsen1, Yi Sun1, Huug de Waard1 and Ton Koonen1  
1CBBRA Inst., Eindhoven Univ. of Technology, The Netherlands, 2Coriant GmbH & Co. KG, Germany 3OFS, Denmark  
We verify three mode-division multiplexed × 8 wavelength-division multiplexing × 320-Gb/s DP-32QAM transmission over a 120km differential-group-delay compensated few-mode fiber using low-loss 3-spot mode couplers based on a single 3-surface prism.