The effect of hole leakage and Auger recombination on the temperature sensitivity of GaInAsSb/GaSb mid-infrared lasers

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Motivation

Absorption spectrum of some identified gases of interest.

- Air pollution monitoring
- Medical diagnostics
- Gas analysis

CW, RT MIR Lasers are required!!
Interband Lasers Studied

<table>
<thead>
<tr>
<th>λ (µm)</th>
<th>Ga</th>
<th>In</th>
<th>As</th>
<th>Sb</th>
<th>Barrier</th>
<th>strain</th>
<th>#QWs</th>
<th>Well width</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3</td>
<td>0.63</td>
<td>0.37</td>
<td>0.11</td>
<td>0.89</td>
<td>$\text{Al}<em>{0.33}\text{Ga}</em>{0.67}\text{As}<em>{0.03}\text{Sb}</em>{0.97}$</td>
<td>1.6%</td>
<td>2</td>
<td>11nm</td>
</tr>
<tr>
<td>2.6</td>
<td>0.57</td>
<td>0.43</td>
<td>0.14</td>
<td>0.86</td>
<td>GaSb</td>
<td>1.7%</td>
<td>1</td>
<td>10nm</td>
</tr>
</tbody>
</table>

- Reduced VB offset in the 2.6µm device.
Temperature Dependence of $J_{th}$

- In the 2.3µm devices have a $T_0$ of ~$59±3K$ in the temperature range of $200K ≤ T ≤ 300K$.
- In the 2.6µm devices $T_0$ values measured are $37±2K$ for $200K ≤ T ≤ 300K$.
- Lower $T_0$ at higher $T$ suggests, the presence of loss process.

$\frac{1}{T_0} = \frac{d \ln(I_{th})}{dT}$

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Loss mechanisms in MIR inter-band lasers

- Auger recombination
- Defects
- Carrier leakage
- IVBA (optical loss)
If optical loss ($\alpha$) is occurring, $T_0$ will continue to decrease as $T$ increases.

Temperature Dependence of $T_0$

$T_0 \sim T_0(I_{rad})$ at $T \leq 100K/130K$

- $T_0(2.3\mu m) \sim T_0(I_{Auger})$ at $T > 160K$

$T_0(2.6\mu m)$ decreases away from $T_0(I_{Auger})$ at $T \geq 160K$

$T_0$ values are calculated using the 3-point centred moving difference technique

- Reduced Auger at $T \leq 130K$, Increased Auger at $T \geq 130K$
- Optical loss ($\alpha$) sets in, at $T \geq 160K$ in the 2.6$\mu m$ device
Spontaneous emission ($L_{spon}$) measurements

- $I_{rad} \sim L_{spon}$ at threshold
- By measuring $J_{rad}$, other current paths in a diode laser can be deduced
- Through Z analysis, the dominant current path at various T ranges can be deduced

$$I = eV \left( An + Bn^2 + Cn^3 \right) + I_{leak}$$
Temperature dependence of $L_{spon}$ in EEL

- Poor Pinning of $L_{spon}$ in both devices.
- Indicates that carrier density increases above threshold.
- Degrades slope efficiency
Temperature dependence of $J_{th}$ ($J_{rad}$ and $J_{non-rad}$)

For the 2.3µm device:
- ~81% $J_{th}$ at RT is non-radiative
- ~40% of $J_{th}$ at 200K is non-radiative

For the 2.6µm device:
- ~96% $J_{th}$ at RT is non-radiative
- ~66% of $J_{th}$ at 200K is non-radiative
Z Analysis

- Measured Z suggests that Auger may be the dominant loss process in both devices at RT.

- In the 2.6µm device, Z>3 suggests that carrier leakage may be involved due to its reduced VB offset.
High pressure system using helium gas

- Hydrostatic pressure increases the bandgap of III-V semiconductors
- This reduces the probability of Auger recombination

Pressure cell was mounted inside a cryostat with variable temperatures from 80-300K
Pressure dependence measurement

- $J_{th}$ decreases with pressure by $\approx 25\%$ in the 2.3$\mu$m device at 5.5kbar.
- $J_{th}$ decreases with pressure by 46% in the 2.6$\mu$m device at 5.5kbar.

This indicates that Auger is the dominant loss process in both devices.
Increasing pressure reduces Auger and improves $T_0$ from 45K to $\sim$54K at 7.7kbar
Pressure dependence measurement

At a pressure of 5.5kbar, the 2.6µm device operates at 2.3µm

But 2.6µm device with 46% less Auger has $T_0$ of ~52K compared to the as-grown 2.3µm device $T_0$ of ~59K at RT

Even though leakage is occurring, the temperature sensitivity is mainly determined by Auger recombination.
Conclusions

- GaInAsSb/GaSb based MIR lasers investigated

- $J_{th}$ of devices is dominated by non radiative Auger recombination

- Reduced VB offset is a possible path for hole leakage. However, this has much less influence on $T_0$.

- Temperature sensitivity is mainly due to Auger recombination; reducing Auger will enhance device performance.
Thank YOU
2013 Conference on Lasers and Electro-Optics Europe and International Quantum Electronics Conference

Advance Programme

Munich ICM
International Congress Centre Munich, Germany
12 - 16 May 2013
www.cleoeurope.org

Sponsored by
- European Physical Society / Quantum Electronics and Optics Division
- IEEE
- The Optical Society
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Welcome to the 2013 Conference on Lasers and Electro-Optics Europe and the International Quantum Electronics Conference (hereafter CLEO®/Europe-IQEC 2013) at the World of Photonics Congress 2013

Following on from the very successful previous conferences held in Amsterdam (1994), Hamburg (1996), Glasgow (1998), Nice (2000) and Munich (2003, 2005, 2007, 2009, 2011), the General and Programme Chairs warmly welcome you to CLEO®/Europe-IQEC 2013 conference, which is being held in Munich from May 12 - 16, 2013. We extend a special welcome to postgraduate and PhD students attending, and we wish them every success, especially if this is their first participation in a major scientific conference.

The CLEO®/Europe-IQEC conference series has established a strong tradition as the largest, most comprehensive and prestigious gathering of optics and photonics researchers and engineers in Europe. With technical co-sponsorship provided by the European Physical Society (EPS), the Institute of Electrical and Electronics Engineers (IEEE) and the Optical Society (OSA), CLEO®/Europe and IQEC has a strong international presence in the complementary research areas of laser science, photonics and quantum electronics. More specifically, CLEO®/Europe emphasizes applied physics, optical engineering and applications of photonics and laser technology, whereas IQEC emphasizes basic research in laser physics, nonlinear optics and quantum optics.

This combination provides a unique forum to benefit from informative overviews and discuss recent advances in a wide spectrum of topics, from fundamental light-matter interactions and new sources of coherent light to technology development, system engineering and applications in industry, science and medicine. Over five days CLEO®/Europe-IQEC 2013 will showcase over 1400 technical contributions in the form of oral presentations (in parallel sessions) and posters from industry, university and research organizations drawn from countries around the world and will provide an unparalleled opportunity to bring together scientists, engineers and end-users of laser and photonics technology under the same roof. As in former years, the meeting will be complemented by LASER 2013 World of Photonics, the world’s largest tradeshow of laser and optical technology, which will provide researchers with the opportunity to see the latest developments in a very wide range of laser sources, optical and photonics products, and components.

CLEO®/Europe-IQEC is co-located with a number of smaller specialist conferences and topical meetings, including:
- ECBO - European Conferences on Biomedical Optics organised by The Optical Society (OSA) and SPIE,
- LIM 2013 - Lasers in Manufacturing organised by WLT-German Scientific Laser Society,
- Optical Metrology organised by SPIE Europe, together with a series of specialist conferences organised by the the European Optical Society (EOS).

All of the co-located conferences will share registration, allowing delegates to attend sessions of all the conferences.

Conference Structure and Technical Sessions

CLEO®/Europe-IQEC consists of a large number of technical presentations in a number of different formats:

A Plenary Talk is a broad-scope, 45 or 60-minute long talk given by a world-leading scientist and accessible to a general technical audience including conference attendees, exhibitors, and exhibit visitors. Plenary talks are not held in parallel with other sessions, allowing maximum possible attendance. In 2013, it is our pleasure to feature three plenary talks by Adolf Giesen (German Aerospace Center (DLR), Institute of Technical Physics, Stuttgart, Germany) who will discuss recent advances and future prospects for “Thin Disk Lasers”, Alain Aspect (Institut d’Optique, Palaiseau, France) who will discuss “Coherent Back Scattering and Anderson Localization of Ultra Cold Atoms” and Stefan W. Hell (Max Planck Institute for Biophysical Chemistry, Göttingen, Germany) who will discuss the topic of “Nanoscopy with Focused Light”.

Keynote Presentations (45 minute talk) and Tutorials (60 minute talk) are also given by the world leaders in particular technical areas, but are generally directed at a more specific audience, and are given in parallel with other sessions. Keynotes provide a survey of exciting recent developments, and Tutorials are particularly valuable for those unfamiliar with a field, allowing them to rapidly come up to speed.

An attractive feature of the CLEO®/Europe technical programme has been the Tech-Focus format. Tech-Focus sessions concentrate on selected photonics applications of industrial importance. CLEO®/Europe-IQEC 2013 features two Tech-Focus sessions on Fibre and Solid State Lasers: A Comparison from an Industrial Point of View jointly held with LIM 2013, which showcase this exciting field through presentations from leading academic and industrial researchers. Both sessions take place on Tuesday afternoon.

Additionally three other sessions are jointly held with other co-located conferences:

Two sessions on “Biophotonics and Applications” jointly held with ECBO take place on Sunday afternoon.
A session on “Precision Processing in Micro to Nano Scale by Ultrafast Lasers” jointly held with LIM 2013 takes place on Tuesday morning.
another much appreciated feature of the CLEO®/Europe-IQEC meetings has been the special Symposia organized to anticipate and capture emerging fields by placing emphasis on fast developing, well defined topics. Five such symposia have been identified for CLEO®/Europe-IQEC 2013:

- JSI: Nuclear Photonics
- JSII: Photonics for Defence and Security
- JSIII: Dynamics of Random Waves and Extreme Events
- JSIV: Quantum Coherent Effects in Biology
- JSV: Superconducting Optics

CLEO®/Europe-IQEC 2013 will also present twelve Short Courses:

- The course on Frequency Combs and Applications will be presented by Thomas Udem (Max-Planck-Institut für Quantenoptik, Garching, Germany).
- The course on Fibre Amplifiers will be presented by Rüdiger Paschotta (RP Photonics Consulting GmbH, Bad Dürrheim, Germany).
- The course on Applications of Photonic Crystals will be presented by Thomas Krauss (University of St. Andrews, St. Andrews, United Kingdom).
- The course on High Harmonic Generation and Attosecond Science will be presented by John Tisch (Imperial College, London, United Kingdom).
- The course on Practical Quantum Optics will be presented by Gerd Leuchs (University of Erlangen, Erlangen, Germany).
- The course on Ultrafast Lasers and Applications will be presented by Frank Wise (Cornell University, Ithaca, United States).
- The course on Silicon Photonics will be presented by Dries Van Thourhout (Ghent University, Ghent, Belgium).
- The course on Ultrashort Pulse Characterisation will be presented by Selçuk Aktürk (Istanbul Technical University, Istanbul, Turkey).
- The course on Optical Parametric Oscillators will be presented by Majid Ebrahim-Zadeh (ICFO, Barcelona, Spain).
- The course on Optical Coherence Tomography: Technology and Applications will be presented by Wolfgang Drexler (Medical University Vienna, Vienna, Austria).
- The course on Laser Tweezers and Applications will be presented by Miles Padgett (University of Glasgow, Glasgow, United Kingdom).
- The course on Laser Beam Analysis, Propagation and Spatial Shaping Techniques will be presented by James R. Leger (University of Minnesota, Minneapolis, United States).

The conference will also have two postdeadline sessions scheduled for Wednesday evening, 15 May 2013 (18:45 to 20:15). The purpose of the postdeadline sessions is to give the audience the chance to listen to the latest breaking news at the conference, and is usually one of the most interesting events that certainly contributes to the great atmosphere that makes the CLEO®/Europe-IQEC conference a unique event.

We thank you all!
# Short courses at a glance (at additional cost)

<table>
<thead>
<tr>
<th>SUNDAY</th>
<th>MONDAY</th>
<th>TUESDAY</th>
<th>WEDNESDAY</th>
<th>THURSDAY</th>
</tr>
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<tbody>
<tr>
<td>ROOM 12</td>
<td>ROOM 22</td>
<td>ROOM A218</td>
<td>ROOM A221</td>
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<tr>
<td><strong>08:30</strong></td>
<td><strong>09:00</strong></td>
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<td><strong>10:00</strong></td>
<td><strong>10:30</strong></td>
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<tr>
<td>SH-10A</td>
<td>SH-8A</td>
<td>Short Course 10: Frequency Combs and Applications 1</td>
<td>Short Course 8: Fibre Amplifiers 1</td>
<td>SH-3A</td>
</tr>
<tr>
<td><strong>11:00</strong></td>
<td><strong>11:30</strong></td>
<td><strong>12:00</strong></td>
<td><strong>12:30</strong></td>
<td><strong>13:00</strong></td>
</tr>
<tr>
<td>COFFEE BREAK</td>
<td>SH-10B</td>
<td>Short Course 10: Frequency Combs and Applications 2</td>
<td>Short Course 8: Fibre Amplifiers 2</td>
<td>SH-8B</td>
</tr>
<tr>
<td><strong>13:00</strong></td>
<td><strong>13:30</strong></td>
<td><strong>14:00</strong></td>
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<td><strong>15:00</strong></td>
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<td>LUNCH BREAK</td>
<td><strong>14:30</strong></td>
<td><strong>15:00</strong></td>
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<td><strong>16:00</strong></td>
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<td><strong>14:30</strong></td>
<td><strong>15:00</strong></td>
<td><strong>15:30</strong></td>
<td><strong>16:00</strong></td>
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<tr>
<td>SH-4A</td>
<td>SH-9A</td>
<td>Short Course 12: Ultrafast Lasers and Applications 1</td>
<td>Short Course 11: Silicon Photonics 1</td>
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<td>SH-6A</td>
<td>Short Course 6: Practical Quantum Optics 1</td>
<td>SH-2A</td>
<td>Short Course 2: Optical Coherence Tomography: Technology and Applications 1</td>
<td>SH-7A</td>
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<td><strong>20:00</strong></td>
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# Sunday at a glance

## General Information

### Room Layout

<table>
<thead>
<tr>
<th>Room</th>
<th>Room 4A</th>
<th>Room 4B</th>
<th>Room 13A</th>
<th>Room 13B</th>
<th>Room 14A</th>
<th>Room 14B</th>
<th>Room 21</th>
<th>Room 22</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF/IE-1</td>
<td>IF-1</td>
<td>CC-1</td>
<td>CA-1</td>
<td>CB-1</td>
<td>CM-1</td>
<td>CD-1</td>
<td>CK-1</td>
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<tr>
<td>Ultrafast Electron Dynamics</td>
<td>Pulse Manipulation with Nonlinear Optics</td>
<td>Ultra Broadband and High Terahertz Fields</td>
<td>Nonlinear Frequency Conversion</td>
<td>Quantum Cascade Lasers and Long Wavelength Emitters I</td>
<td>Laser Ablation</td>
<td>Pulsed mid-IR Sources</td>
<td>Photonic Crystals</td>
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## COFFEE BREAK

**CF/IE-3**

<table>
<thead>
<tr>
<th>TIME</th>
<th>Session</th>
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<tbody>
<tr>
<td>09:00</td>
<td>Pulse Shaping and Characterization</td>
</tr>
<tr>
<td>09:30</td>
<td>Nonlinear Light Interactions in Quantum Systems</td>
</tr>
<tr>
<td>10:00</td>
<td>Terahertz Sources</td>
</tr>
<tr>
<td>10:30</td>
<td>Mid-IR-Lasers</td>
</tr>
<tr>
<td>11:00</td>
<td>Biophotonics and Applications I</td>
</tr>
<tr>
<td>11:30</td>
<td>Fibres and Components</td>
</tr>
<tr>
<td>12:00</td>
<td>Nonlinear Optics in Photonic Crystal Fibers</td>
</tr>
<tr>
<td>12:30</td>
<td>Novel Materials and Structures</td>
</tr>
<tr>
<td>13:00</td>
<td>Mapping Near Fields</td>
</tr>
</tbody>
</table>

## LUNCH BREAK

**CA, CC, CL, CM AND IF POSTER SESSION – HALL B0**

<table>
<thead>
<tr>
<th>TIME</th>
<th>Session</th>
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<tbody>
<tr>
<td>13:30</td>
<td>Pulse Shaping and Characterization</td>
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<tr>
<td>14:00</td>
<td>Nonlinear Light Interactions in Quantum Systems</td>
</tr>
<tr>
<td>14:30</td>
<td>Terahertz Sources</td>
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<tr>
<td>15:00</td>
<td>Mid-IR-Lasers</td>
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<tr>
<td>15:30</td>
<td>Biophotonics and Applications I</td>
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<tr>
<td>16:00</td>
<td>Fibres and Components</td>
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<tr>
<td>16:30</td>
<td>Nonlinear Optics in Photonic Crystal Fibers</td>
</tr>
<tr>
<td>17:00</td>
<td>Novel Materials and Structures</td>
</tr>
<tr>
<td>17:30</td>
<td>Mapping Near Fields</td>
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</table>

**COFFEE BREAK**

**CF/IE-4**

<table>
<thead>
<tr>
<th>TIME</th>
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<tr>
<td>16:30</td>
<td>High-energy Ultrafast Sources</td>
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<tr>
<td>17:00</td>
<td>Nonlinear Optical Interactions in Structured Materials</td>
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<tr>
<td>17:30</td>
<td>Terahertz Field Manipulation</td>
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<tr>
<td>18:00</td>
<td>Yb-Doped Lasers</td>
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<tr>
<td>18:30</td>
<td>Biophotonics and Applications II</td>
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<tr>
<td>19:00</td>
<td>Mode-locked Fiber Lasers</td>
</tr>
<tr>
<td>19:30</td>
<td>Nonlinear Imaging and Spectroscopy</td>
</tr>
<tr>
<td>20:00</td>
<td>Micro-nanostructured Optical Fibers</td>
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</table>
## Monday at a glance

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<thead>
<tr>
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<th>Room</th>
<th>Session</th>
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<tbody>
<tr>
<td>08:30</td>
<td>1</td>
<td>CLEO/Europe 2013 Plenary Talk</td>
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<tr>
<td>09:00</td>
<td>1-2</td>
<td>Coffee</td>
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<tr>
<td>09:30</td>
<td>2</td>
<td>World of Photonics Opening with Plenary Talk</td>
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<tr>
<td>11:10</td>
<td>5-2</td>
<td>Novel Methods in Ultrafast Optics</td>
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<tr>
<td>11:30</td>
<td>1-2</td>
<td>Advances in Spectroscopy I</td>
</tr>
<tr>
<td>11:30</td>
<td>13A</td>
<td>Next Generation Transmission</td>
</tr>
<tr>
<td>11:30</td>
<td>13B</td>
<td>Strong Coupling</td>
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<tr>
<td>11:30</td>
<td>14A</td>
<td>Photon Pair Sources and Detectors</td>
</tr>
<tr>
<td>11:30</td>
<td>14B</td>
<td>Optical Parametric Oscillators</td>
</tr>
<tr>
<td>11:30</td>
<td>21</td>
<td>Microstructures for Energy and Sensing</td>
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<tr>
<td>11:30</td>
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<td>EXHIBITION AND LUNCH BREAK</td>
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<tr>
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<tr>
<td>13:30</td>
<td>6</td>
<td>Supercontinuum Generation and Filamentation</td>
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<tr>
<td>14:00</td>
<td>2-1</td>
<td>Frequency Combs</td>
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<tr>
<td>14:00</td>
<td>3-1</td>
<td>Applied Biophotonics</td>
</tr>
<tr>
<td>14:00</td>
<td>1-2</td>
<td>Quantum Photonics</td>
</tr>
<tr>
<td>14:00</td>
<td>12</td>
<td>Terahertz Quantum Cascade Semi-conductor Lasers</td>
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<tr>
<td>14:00</td>
<td>5-1</td>
<td>Modal Instabilities in Fibres</td>
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<td>14:00</td>
<td>5-2</td>
<td>Frequency Conversion based on Quadratic Nonlinearities</td>
</tr>
<tr>
<td>14:00</td>
<td>5-3</td>
<td>Quantum Coherent Effects in Biology I</td>
</tr>
<tr>
<td>14:00</td>
<td>5-4</td>
<td>Thin Films and Nanostructures</td>
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<tr>
<td>16:00</td>
<td>7</td>
<td>High Harmonic Generation</td>
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<td>16:30</td>
<td>2-2</td>
<td>Precision Measurements</td>
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<td>16:30</td>
<td>3-1</td>
<td>Structural Imaging</td>
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<td>16:30</td>
<td>1-2</td>
<td>Quantum Effects</td>
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<tr>
<td>16:30</td>
<td>12</td>
<td>Ultrafast Semiconductor Lasers I</td>
</tr>
<tr>
<td>16:30</td>
<td>5-1</td>
<td>Coherent Combining</td>
</tr>
<tr>
<td>16:30</td>
<td>5-2</td>
<td>New Devices for Frequency Conversion based on Quadratic Nonlinearities</td>
</tr>
<tr>
<td>16:30</td>
<td>5-3</td>
<td>Quantum Coherent Effects in Biology II</td>
</tr>
<tr>
<td>16:30</td>
<td>5-4</td>
<td>Photonic Nanowires - Materials and Applications</td>
</tr>
<tr>
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<tr>
<td>18:00</td>
<td>8</td>
<td>LASER WORLD OF PHOTONICS OPENING RECEPTION</td>
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<tr>
<td>19:00</td>
<td>9</td>
<td>ICM FOYER, GROUND FLOOR, CONGRESS CENTRE (END 22:00)</td>
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## Tuesday at a glance

<table>
<thead>
<tr>
<th>Time</th>
<th>Room 1</th>
<th>Room 4A</th>
<th>Room 4B</th>
<th>Room 11</th>
<th>Room 13A</th>
<th>Room 13B</th>
<th>Room 14A</th>
<th>Room 14B</th>
<th>Room 21</th>
<th>Room Einstein</th>
</tr>
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### COFFEE BREAK

- PL-3: IQEC 2013 Plenary Talk and Awards Ceremony

### EXHIBITION AND LUNCH BREAK

### CD, CE, CI, IC AND JSV POSTER SESSIONS – HALL B0

### COFFEE BREAK

- CD-10: Optical Devices for Data Processing
- IC-2: Ultracold Atoms: Clocks, Spins and Lattices
- CL-6: Mesoscopic Devices
- TF-2 / LIM: Fibre and Solid State Lasers: a Comparison from an Industrial Point of View II
- CB-6: Advanced Structures
- IB-4: Quantum Networking
- CA-7: High Energy Scaling Concepts
- CG-2: Ultrafast Dynamics in Attosecond Time Scale
- CE-6: Laser Materials

### CLEO®/EUROPE-IQEC CONFERENCE RECEPTION (END 23:00)
### Wednesday at a glance

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<th>ROOM 13A</th>
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<td>Advances in Optical Sensor Devices</td>
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<td>Rogue Waves and Soliton Dynamics</td>
<td>Fibre Laser Sources</td>
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### COFFEE BREAK

### EXHIBITION AND LUNCH BREAK

### CF/IE, CJ, II, JSII AND JSIII POSTER SESSIONS – HALL B0

### COFFEE BREAK

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**Thursday at a glance**

**ROOM INFORMATION**

- **Room 1**: CJ-9, Raman Effects in Fibre Sources
- **Room 4A**: II-3, Controlling and Harvesting Light with Plasmons
- **Room 4B**: CH-4, Metrology of Materials and Structures
- **Room 13A**: CK-7, Advanced Structures for Light Sources
- **Room 13B**: CB-7, Semiconductor Lasers for Optical Communications
- **Room 14A**: IB-5, Quantum Communication
- **Room 14B**: CF/IE-10, Ultrafast Spectroscopy
- **Room 21**: IA-7, Cavity-Opto Mechanics
- **Room 22**: CG-4, Ultrafast High Power Lasers
- **Room Einstein**: IH-3, Controlling Light Emission at the Nanoscale

**SESSIONS**

- **COFFEE BREAK**
- **EXHIBITION AND LUNCH BREAK**
- **CG, CH, IA, IG AND IH POSTER SESSIONS – HALL B0**
- **COFFEE BREAK**
- **CONFERENCE ENDS**
How to find the room?
A map locating the rooms can be found in the inner cover of the advance programme.

TALKS:
All talks take place in the congress centre (so called ICM) with the exception of the Einstein room (formerly B11) located in the exhibition hall B1.
To save space in the layout of the parallel sessions, all locations were abbreviated to the strict minimum such as “Room 1” instead of “Room 1, Ground Floor / 1st Floor, Congress Centre”. Below you will find the detailed locations of all the rooms:
Room 1, Ground Floor / 1st Floor, Congress Centre
Room 2, Ground Floor, Congress Centre
Room 3, Ground Floor, Congress Centre
Room 4a, Ground Floor, Congress Centre
Room 4b, Ground Floor, Congress Centre
Room 11, 1st Floor, Congress Centre
Room 12, 1st Floor, Congress Centre
Room 13a, 1st Floor, Congress Centre
Room 13b, 1st Floor, Congress Centre
Room 14a, 1st Floor, Congress Centre
Room 14b, 1st Floor, Congress Centre
Room 21, 2nd Floor, Congress Centre
Room 22, 2nd Floor, Congress Centre
Foyer ICM, Ground Floor, Congress Centre
Foyer ICM, 1st Floor, Congress Centre
Foyer ICM, 2nd Floor, Congress Centre
Hotel ICM, Ground Floor, Congress Centre
Foyer ICM, 2nd Floor, Congress Centre
Room Einstein (formerly B11), 1st Floor, Exhibition Hall B1*

SHORT COURSES:
Room 12, 1st Floor, Congress Centre
Room 22, 2nd Floor, Congress Centre
Room A218 & Room A221, 1st Floor, Exhibition Hall B0
(Access via west entrance)

POSTERS:
All CLEO/Europe-IQEC 2013 Posters take place in the Hall B0, Ground Floor, Congress Centre.

SHORT COURSES

<table>
<thead>
<tr>
<th>Short Course 10: Frequency Comb and Applications</th>
<th>Short Course 12: Ultrafast Lasers and Applications</th>
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<tbody>
<tr>
<td>Thomas Udern, Max-Planck-Institut für Quantenoptik, Garching, Germany</td>
<td>Frank Wise, Cornell University, Ithaca, USA</td>
</tr>
<tr>
<td>Sunday, 09:00 – 12:30 · Room 12</td>
<td>Tuesday, 14:00 – 17:30 · Room A218</td>
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<table>
<thead>
<tr>
<th>Short Course 8: Fibre Amplifiers</th>
<th>Short Course 7: Laser Tweezers and Applications</th>
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<tbody>
<tr>
<td>Rüdiger Paschotta, RP Photonics Consulting GmbH, Bad Dürrenheim, Germany</td>
<td>Miles Padgett, University of Glasgow, Glasgow, United Kingdom</td>
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<tr>
<td>Sunday, 09:00 – 12:30 · Room 22</td>
<td>Monday, 14:30 – 17:30 · Room A218</td>
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<thead>
<tr>
<th>Short Course 4: Applications of Photonic Crystals</th>
<th>Short Course 5: Laser Beam Analysis, Propagation and Spatial Shaping Techniques</th>
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<tbody>
<tr>
<td>Thomas Krauss, University of St. Andrews, St. Andrews, United Kingdom</td>
<td>James R. Leger, University of Minnesota, Minneapolis, United States</td>
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<td>Sunday, 14:30 – 18:00 · Room 12</td>
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<tr>
<th>Short Course 9: High Harmonic Generation and Attosecond Science</th>
<th>Short Course 6: Practical Quantum Optics</th>
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<tr>
<td>John Tisch, Imperial College, London, United Kingdom</td>
<td>Gerd Leuchs, University of Erlangen, Erlangen, Germany</td>
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<td>Monday, 14:30 – 18:00 · Room 12</td>
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<tr>
<th>Short Course 11: Silicon Photonics</th>
<th>Short Course 8: Fibre Amplifiers</th>
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<tr>
<td>Dries Van Thourhout, Ghent University, Ghent, Belgium</td>
<td>Rüdiger Paschotta, RP Photonics Consulting GmbH, Bad Dürrenheim, Germany</td>
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<td>Tuesday, 14:00 – 17:30 · Room A221</td>
<td>Sunday, 09:00 – 12:30 · Room 22</td>
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PL-1: CLEO/Europe 2013 Plenary Talk
Thin Disk Lasers
Adolf Giesen, Institute of Technical Physics, DLR, Stuttgart, Germany
Monday, 08:30 – 09:15 · Room 1

PL-2: World of Photonics Opening with Plenary Talk
Nanoscopy with Focused Light
Stefan W. Hell, Max Planck Institute for Biophysical Chemistry, Göttingen, Germany
Monday, 09:30 – 10:45 · Room 1
(Together with words of welcome)

PL-3: IQEC 2013 Plenary Talk and Awards Ceremony
Coherent Back Scattering and Anderson Localization of Ultra Cold Atoms
Alain Aspect, Laboratoire Charles Fabry, Institut d’Optique, Palaiseau, France
Tuesday, 10:30 – 12:30 · Room 1
(Together with award ceremonies)

TUTORIAL TALKS

Bill O’Neill, University of Cambridge, Cambridge, United Kingdom
Sunday, 11:00 – 12:00 · Room 14a

CL-1/ECBO: Biophotonics and Applications I (Session jointly held with ECBO)
Photoacoustic Tomography: Ultrasonically Breaking through the Optical Diffusion and Diffraction Limits
Lihong Wang, Washington University, St. Louis, MO, United States
Sunday, 14:30 – 15:30 · Room 13b
### Sessions at a Glance

<table>
<thead>
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<td>CG-2</td>
<td>Ultrafast Dynamics in Attosecond Time Scale</td>
<td>Attosecond Science and Technology (Paul Corkum, University of Ottawa, Ontario, Canada</td>
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<tr>
<td>II-4</td>
<td>Transformation Optics and Metamaterials</td>
<td>Geometry and Light: The Science of Invisibility (Ulf Leonhardt, Weizmann Institute of Science, Rehovot, Israel</td>
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<tr>
<td>IB-7</td>
<td>Fundamentals of Quantum Information and Quantum Information Tools</td>
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### How to read the Session Codes?

The following pages are the abstracts of the papers which will be presented at CLEO/Europe-IQEC 2013.

All CLEO/Europe sessions are on a white background and have a code which begins with a C.

All IQEC sessions are on a shaded background and have a code that begins with an I.

**Exceptions as mentioned below are on a dark background:**
- Short courses referenced with a SH
- Plenary talks referenced with a PL
- Tech-focus sessions (jointly held with the LIM conferences) referenced with a TF
- CLEO/Europe-IQEC joint symposia referenced with a JS.
- The ECBO-CLEO/Europe joint sessions referenced with CL-1/ECBO and CL-2/ECBO
- CF/IE sessions as being joint sessions of CLEO/Europe-IQEC
- CLEO-LIM joint session on Precision Processing in Micro to Nano Scale by Ultrafast Lasers referenced with CM-3/LIM

### Oral Presentations

Oral presentations have a code made up of three parts, e.g.

- **CD-1.1** TUE (Invited) 09:00
  - The first part indicates the Conference, the topic title, the session title and the placement of the presentation within the session, e.g.

### Poster Presentations

Poster presentations have a code made up of two parts, e.g.

- **ID-P.1** MON 13:30
  - The second part indicates the day on which the poster presentation takes place (same abbreviations as for the orals). All posters are displayed per topic according their reference numbers over the conference days (see days at a glance).
### Sessions at a Glance

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<td>Light Beam Propagation in Disordered and Periodic Systems High-Resolution Imaging with Scattered Light</td>
<td>Zürich, Switzerland</td>
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<td>CM-1</td>
<td>Laser Ablation</td>
<td>Mid-IR-Lasers Mid-IR Solid-State Lasers for Spectroscopy and Metrology Applications Gianluca Galzerano, Istituto di Fotonica e Nanotecnologie - CNR, Milano, Italy</td>
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<td>IF-1</td>
<td>Pulse Manipulation with Nonlinear Optics</td>
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<td>IH-2</td>
<td>Heat and Energy Control Broadband Management of Light Using Nanophotonics for Solar and Thermal Applications</td>
<td>Porto, Portugal</td>
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<td>CF/IE-1</td>
<td>Ultrafast Electron Dynamics Strong-field Photoemission of Electron Pulses from Sharp Metallic Tips Claus Ropers, Göttingen University, Göttingen, Germany</td>
<td>Novel Materials and Structures</td>
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<td>CK-1</td>
<td>Photonic Crystals Ultra-Narrowband Nonlinear Wavelength Conversion Using Coupled Photonic Crystal Nanocavities Nobuyuki Matsuoka, NTT Basic Research Laboratories &amp; Nanophotonics Center, Atsugi, Japan</td>
<td>Terahertz Sources THz Emission from Intrinsic Josephson Junctions in High Tc Superconductors for Imaging Applications Kazuo Kadokawa, University of Tsukuba, Tsukuba, Japan</td>
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<td>CF/IE-2</td>
<td>CEP Control and Attosecond Phenomena Generation of Gigawatt-scale Isolated Attosecond Pulses Eiji Takashiki, RIKEN, Wako, Japan</td>
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<td>CC-3</td>
<td>Terahertz Sources Room-Temperature Terahertz Generation Using Vertical-External-Cavity Surface-Emitting Lasers Martin Koch, Philippus-Universität Marburg, Marburg, Germany</td>
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<td>CA-3</td>
<td>Yb-Doped Lasers Solid State Cryocoolers: Developments and Prospective</td>
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<td>CL-2/ECBO</td>
<td>Biophotonics and Applications II (Session jointly held with ECBO) Noninvasive Fluorescence Imaging through Strongly Scattering Jacopo Bertolotti, University of Twente, Enschede, The Netherlands &amp; University of Florence, Florence, Italy</td>
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<td>CA-4</td>
<td>Nonlinear Imaging and Spectroscopy Label Free Nonlinear Imaging in Microscopy and Endoscopy Hervé Rigneault, Université Aix-Marseille, Marseille, France</td>
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<td>CL-2/ECBO</td>
<td>Biophotonics and Applications II (Session jointly held with ECBO) Combination of Optical Micromanipulation with Raman Spectroscopy for Cell Sorting Christoph Kraft, Institute of Photonic Technology, Jena, Germany</td>
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<td>CD-4</td>
<td>Nuclear Photonics Nuclear Photonics with Extreme Gamma-ray Sources Chris P.J. Barty, Lawrence Livermore National Laboratory, CA, United States</td>
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### GENERAL INFORMATION

**Invited Talks**

**IF-1**
- Pulse Manipulation with Nonlinear Optics
- Broadband Deep-Ultraviolet Femtosecond Pulse Generation by Third-order Nonlinear Optical Processes in Thin Media
  - Helders Crespo, University of Porto, Porto, Portugal
  - Sunday, 09:00 – 09:30 · Room 4a

**CD-1**
- Pulsed mid-IR Sources Nonlinear Optics with High Power Femtosecond Mid-infrared Pulses
  - Danill Kartashov, Technical University, Vienna, Austria
  - Sunday, 09:00 – 09:30 · Room 14b

**CB-1**
- Quantum Cascade Lasers I
- Recent Progress on Single-mode Quantum Cascade Lasers
  - Borislav Hinkov, ETH Zürich,
  - Sunday, 14:30 – 15:00 · Room 4b
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<td>CI-1</td>
<td>Next Generation Transmission 400G/1T Superchannels Enabling Next Generation Optical Communications</td>
<td>Senthumadhavan, Chandra Sekhar and Xiang Liu, Alcatel-Lucent Bell Labs, Holmdel, United States</td>
<td>Monday, 11:00 – 11:30 - Room 4b</td>
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<td>JS1-2</td>
<td>Nuclear Photonics Nuclear Processes and Nuclear Decay Modifications in Plasmas</td>
<td>Vincent Méot, CEA/DAM Ile de France, Arpajon, France</td>
<td>Monday, 11:30 – 12:00 - Room 2</td>
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<td>IA-1</td>
<td>Strong Coupling Quantum Networks based on Single Atoms in Optical Cavities</td>
<td>Stephan Ritter, Max-Planck-Institut für Quantenoptik, Garching, Germany</td>
<td>Monday, 12:00 – 12:30 - Room 13a</td>
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<td>CE-1</td>
<td>Semiconductor Materials and Devices Nano-scale Characterization of Semiconductors Using Helium Temperature Scanning Transmission Electron Microscopy Cathodoluminescence</td>
<td>Jürgen Christen, Otto-von-Guericke-University, Magdeburg, Germany</td>
<td>Monday, 12:00 – 12:30 - Room Einstein</td>
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<td>JSIV-1</td>
<td>Quantum Coherent Effects in Biology I Quantum Coherence Explored at the Level of Individual Light-Harvesting Complexes</td>
<td>Scott Papp, NIST, Boulder, United States</td>
<td>Monday, 15:30 – 16:00 - Room 4a</td>
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<td>ID-2</td>
<td>Frequency Combs Microresonator Frequency Combs</td>
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<td>JSIV-2</td>
<td>Quantum Coherent Effects in Biology II Robust Design Principles for Quantum Enhanced Excitation Transport</td>
<td>Andreas Buchleitner, Albert-Ludwigs-University, Freiburg in Brisgau, Germany</td>
<td>Monday, 16:30 – 17:00 - Room 21</td>
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<td>CE-3</td>
<td>Photonic Nanowires - Materials and Applications III-V and III-Nitride Nanowires for LED Applications</td>
<td>Lars Samuelson, Nanometer Structure Consortium at Lund University, Lund, Sweden</td>
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<td>CL-3</td>
<td>Applied Biophotonics Super Resolution Imaging of Single DNA-Protein Interactions</td>
<td>Win Peterman, Vrije University, Amsterdam, The Netherlands</td>
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<td>CL-4</td>
<td>Structural Imaging Imaging Molecular Organization of Cell Membranes and Proteins Assemblies using Polarimetric Fluorescence Microscopy</td>
<td>Sophie Brasselet, Fresnel Institute, Marseille, France</td>
<td>Monday, 17:00 – 17:30 - Room 4b</td>
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<td>CB-3</td>
<td>Ultrafast Semiconductor Lasers I Optical Frequency Combs using Ultrafast Diode Lasers: Techniques and Applications</td>
<td>Peter J. Delfyett, CREOL, The College of Optics and Photonics, Orlando, FL, United States</td>
<td>Monday, 17:30 – 18:00 - Room 13b</td>
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<td>CD-8</td>
<td>New Guiding Phenomena Electro-optic Routing of Spatial Solitons in Nematic Liquid Crystals</td>
<td>Armando Piccardi, University Roma Tre, Rome, Italy</td>
<td>Tuesday, 08:30 – 09:00 - Room 1</td>
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<td>JSV-1</td>
<td>Superconducting Optics Superconducting Single Photon Detectors</td>
<td>Sae Woo Nam, NIST, Boulder, United States</td>
<td>Tuesday, 08:30 – 09:00 - Room 4a</td>
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<td>CM-3/LIM</td>
<td>Precision Processing in Micro to Nano Scale by Ultrafast Lasers (Session jointly held with LIM) Welding of Glass/Glass and Si/Glass Using Ultrashort Laser Pulses</td>
<td>Isamu Miyamoto, Osaka University, Osaka, Japan</td>
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<td>IB-2</td>
<td>Integrated Quantum Photonics and Simulation Quantum Simulation with Integrated Photonics</td>
<td>Fabio Sciarrino, Sapienza Università di Roma, Rome, Italy</td>
<td>Tuesday, 08:30 – 09:00 - Room 14a</td>
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<td>IG-1</td>
<td>Synchronization Dynamics and Optomechanical Self-organization Synchronization of N Coupled Dipoles: from Anderson to Dicke</td>
<td>Robin Kaiser, INLN, Valbonne, France</td>
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<td>CI-2</td>
<td>Integrated Circuits Low Energy Consumption and High Speed Germanium-Based Optoelectronic Devices</td>
<td>Laurent Vivien, Université Paris Sud, Orsay, France</td>
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<td>CM-3/LIM</td>
<td>Precision Processing in Micro to Nano Scale by Ultrafast Lasers (Session jointly held with LIM) Delocalization of Focused Intense Ultra-short Laser Pulses in Air and Transparent Solids</td>
<td>Vitaly Konov, General Physics Institute, Moscow, Russia</td>
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<td>JSV-1</td>
<td>Superconducting Optics</td>
<td>Producing Correlated Photons Using Superconducting Circuits</td>
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<td>Göran Johansson, Chalmers University of Technology, Gothenburg, Sweden</td>
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<td>CM-3 / LIM</td>
<td>Precision Processing in Micro to Nanoscale by Ultrafast Lasers</td>
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<td>monochrome Displays</td>
<td>Finer Features Faster</td>
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<td>Georg von Freymann, University of Kaiserslautern, Kaiserslautern, Germany</td>
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<td>Florian Marquardt, University of Erlangen-Nuremberg, Erlangen, Germany</td>
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<td>Fibre and Solid State Lasers: a Comparison from an Industrial</td>
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<td>Point of View I</td>
<td>Trapped Ions for Simulating</td>
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<td>Interacting Spins</td>
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<td>IB-3</td>
<td>QIP with Light and Matter</td>
<td>Christian Roos, University of Innsbruck, Innsbruck, Austria</td>
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<td>TF-2</td>
<td>Fibre and Solid State Lasers: a Comparison from an Industrial</td>
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<td>Point of View II</td>
<td>Looking Inside the Recollision Process</td>
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<td>Nirit Dudovich, Weizmann Institute, Rehovot, Israel</td>
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<td>IB-4</td>
<td>Quantum Networking</td>
<td>Quantum Networks Enabled by Quantum Optics</td>
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<td>Jeff H. Kimble, California Institute of Technology, Pasadena, United States</td>
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<td>TF-3</td>
<td>Optical Materials and Plasmonics</td>
<td>Optical Gain in Metamaterials and Plasmonic Systems:</td>
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<td>Stimulated Emission</td>
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<td>CE-5</td>
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<td>M.A. Noginov, Norfolk State University, Norfolk, VA, United States</td>
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<td>Laser Materials</td>
<td>Engineering of Refractive Index and Doping Level of KY, Gd, Lu, Yb</td>
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<td>(WO4)2 Layers for a Cladding-side-pumped Channel Waveguide Laser</td>
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<td>Markus Polliau, University of Twente, Enschede, The Netherlands</td>
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<td>TF-5</td>
<td>Optical Devices for Data Processing</td>
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**Sessions at a Glance**

- **TF-1**: Fibre and Solid State Lasers: a Comparison from an Industrial Point of View I (Session jointly held with LIM)
  - Fabrication and Market Segments for Ultra-High Brightness Direct Diode Lasers
  - Wolfgang Gries, Direct Photonics Industries GmbH, Berlin, Germany
  - Tuesday, 14:30 – 15:00 - Room 13a

- **IB-3**: QIP with Light and Matter Trapped Ions for Simulating Interacting Spins
  - Christian Roos, University of Innsbruck, Innsbruck, Austria
  - Tuesday, 14:30 – 15:00 - Room 14a

- **IB-4**: Quantum Networking Quantum Networks Enabled by Quantum Optics
  - Jeff H. Kimble, California Institute of Technology, Pasadena, United States
  - Tuesday, 16:00 – 16:30 - Room 13a

- **TF-2**: Fibre and Solid State Lasers: a Comparison from an Industrial Point of View II (Session jointly held with LIM)
  - Ultrafast Solid State Laser with High Pulse Energy - New Applications
  - Hans Amler, Photon Energy GmbH, Ottensen, Germany
  - Tuesday, 16:30 – 17:00 - Room 13a

- **CA-7**: High Energy Scaling Concepts
  - The Opportunity of High Average and High Peak Power Lasers
  - John Collier, Rutherford Appleton Laboratory, Chilton, United Kingdom
  - Tuesday, 16:30 – 17:00 - Room 14b

- **IC-2**: Ultracold Atoms: Clocks, Spins and Lattices
  - Holger Mueller, University of California, Berkeley, United States
  - Tuesday, 17:00 – 17:30 - Room 4a

- **TF-2**: Fibre and Solid State Lasers: a Comparison from an Industrial Point of View II (Session jointly held with LIM)
  - Ultrafast Fiber Lasers and Bulk Lasers for Material Processing - A Comparison
  - Norman Hodgson, Coherent Inc., Santa Clara, CA, United States
  - Tuesday, 17:00 – 17:30 - Room 13a
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<td>Photonics for Defence and Security: Spectroscopy Imaging and Detection of Hazardous Substances</td>
<td>Kumar Patel, Pranalytica Inc., Santa Monica, CA, United States</td>
<td>Wednesday, 08:30 – 09:00 · Room 13b</td>
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<td>II-1</td>
<td>Quantum and Graphene Plasmonics</td>
<td>Javier Aizpurua, Materials Physics Center (CSIC-UPV/EHU) and DIPC, Donostia-San Sebastián, Spain</td>
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<td>IA-5</td>
<td>Non-Classical Light: Biological Measurement beyond the Quantum Limit</td>
<td>Michael Taylor, University of Queensland, Brisbane, Australia</td>
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<td>JSII-2</td>
<td>Photonics for Defence and Security: Coherent Sources</td>
<td>Peter Schunemann, BAE Systems Inc., Nashua, NH, United States</td>
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<td>CM-5</td>
<td>Material Processing with Shaped Laser Beams</td>
<td>Antonin Borot, Laboratoire d’Optique Appliquée, ENSTA ParisTech, Ecole</td>
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<td>JSIII-1</td>
<td>Light Emission and Propagation in Random Media</td>
<td>Hui Cao, Yale University, New Haven, CT, United States</td>
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<td>CK-6</td>
<td>Plasmonic Nanostructures and Applications</td>
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<td>JSIII-2</td>
<td>Rogue Waves and Soliton Dynamics</td>
<td>Claudio Conti, Università Sapienza, Rome, Italy</td>
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<td>CH-4</td>
<td>Metrology of Materials and Structures</td>
<td>Nathan R. Newbury, NIST, Boulder, CO, USA</td>
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<td>CH-6</td>
<td>Optical Sensor Applications</td>
<td>Tolga Bagci, QUANTOP, Niels Bohr Institute, Copenhagen, Denmark</td>
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<td>CB-7</td>
<td>Semiconductor Lasers for Optical Communications</td>
<td>Martijn Heck, University of California, Santa Barbara, United States</td>
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<td>CB-9</td>
<td>High Efficiency/High Brightness Semiconductor Lasers</td>
<td>Peter Nordlander, Rice University, Houston, United States</td>
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<td>IH-4</td>
<td>Quantum Nanophotonics</td>
<td>Mete Atature, University of Cambridge, Cambridge, United Kingdom</td>
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<td>CH-5</td>
<td>Advances in Spectroscopy II</td>
<td>Rashid Zia, Brown University, Providence, United States</td>
<td>Thursday, 09:00 – 09:30 · Room 13b</td>
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<td>CB-7</td>
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<td>CJ-11</td>
<td>Special Fibres</td>
<td>Fethah Benabid, University of Limoges, Limoges, France and University of Bath, Bath, UK</td>
<td>Thursday, 14:00 – 14:30 · Room 1</td>
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<td>CG-6</td>
<td>FEL and High Photon Energy Science</td>
<td>Robin Santra, Center for Free-Electron Science, DESY, Hamburg, Germany</td>
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<td>CH-6</td>
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<td>Tolga Bagci, QUANTOP, Niels Bohr Institute, Copenhagen, Denmark</td>
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### TECH FOCUS SESSIONS

| TF-1 | Fibre and Solid State Lasers: a Comparison from an Industrial Point of View I | Session jointly held with LIM |
| TF-2 | Fibre and Solid State Lasers: a Comparison from an Industrial Point of View II | Session jointly held with LIM |

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### GENERAL INFORMATION

- **TF-1** Integrated Photonic Devices
  - Integrated Photonic Devices for Optical Communications
  - Mike J. Wale, Oclaro Technology Ltd., Towcester, United Kingdom
  - Room 13a, Tuesday, 15:00 – 15:30

- **CF/IE-12** Mid Infrared and Terahertz Phenomena
  - Imaging ultrafast nanoscale dynamics with a THz-pulse-coupled STM
  - Tyler Cocker, University of Alberta, Edmonton, Canada
  - Room 13a, Tuesday, 15:00 – 15:30

- **CF/IE-13** Charge Dynamics in Solids
  - Ultrafast Electronic Charge Dynamics in Solids Mapped by Femtosecond X-ray Diffraction
  - Thomas Elsaesser, Max-Born Institute, Berlin, Germany
  - Room 13a, Tuesday, 15:00 – 15:30

### CLEO®/Europe 2013 SESSIONS

- **CB-1** Quantum Cascade Lasers and Long Wavelength Emitters I
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-2** Quantum Cascade Lasers and Long Wavelength Emitters II
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-3** Ultrafast Semiconductor Lasers I
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-4** Ultrafast Semiconductor Lasers II
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-5** Dynamics and Chaos in Semiconductor
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-6** Advanced Structures
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-7** Semiconductor Lasers for Optical Communications
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-8** Semiconductor Vertical Cavity Surface Emitting Lasers
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-9** High Efficiency/High Brightness Semiconductor Lasers
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-10** Disk and Mid-Infrared Semiconductor Lasers
  - Room 13a, Tuesday, 15:00 – 15:30

### CLEO®/Europe 2013 SESSIONS

- **CB-1** Quantum Cascade Lasers and Long Wavelength Emitters I
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-2** Quantum Cascade Lasers and Long Wavelength Emitters II
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-3** Ultrafast Semiconductor Lasers I
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-4** Ultrafast Semiconductor Lasers II
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- **CB-5** Dynamics and Chaos in Semiconductor
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- **CB-6** Advanced Structures
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- **CB-7** Semiconductor Lasers for Optical Communications
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-8** Semiconductor Vertical Cavity Surface Emitting Lasers
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-9** High Efficiency/High Brightness Semiconductor Lasers
  - Room 13a, Tuesday, 15:00 – 15:30

- **CB-10** Disk and Mid-Infrared Semiconductor Lasers
  - Room 13a, Tuesday, 15:00 – 15:30
Sessions at a Glance

**CD-10** Optical Devices for Data Processing
   Tuesday, 16:00 – 17:30 · Room 1

**CD-11** Application of Solitons
   Wednesday, 14:00 – 15:30 · Room 1

**CD-12** Solitons and Nonlinearly Driven Self-organization
   Wednesday, 16:00 – 17:30 · Room 1

**CE** OPTICAL MATERIALS, FABRICATION AND CHARACTERIZATION

**CE-1** Semiconductor Materials and Devices
   Monday, 11:00 – 12:30 · Room Einstein

**CE-2** Thin Films and Nanostructures
   Monday, 14:30 – 16:00 · Room Einstein

**CE-3** Photonic Nanowires - Materials and Applications
   Monday, 16:30 – 18:00 · Room Einstein

**CE-4** Optical Fibres and Waveguides
   Tuesday, 08:30 – 10:00 · Room Einstein

**CE-5** Optical Metamaterials and Plasmonics
   Tuesday, 14:00 – 15:30 · Room Einstein

**CE-6** Laser Materials
   Tuesday, 16:00 – 17:30 · Room Einstein

**CE-7** Nonlinear Materials
   Wednesday, 08:30 – 10:00 · Room Einstein

**CE-8** Lithium Niobate - Fabrication and Characterization
   Wednesday, 10:30 – 12:00 · Room Einstein

**CE-9** Functional Optical Materials
   Wednesday, 14:00 – 15:30 · Room Einstein

**CF/IE** ULTRAFAST SCIENCE AND TECHNOLOGY (JOINT TOPIC AREA WITH IQEC 2013)

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**CF/IE-12** Mid Infrared and Terahertz Phenomena
   Thursday, 14:00 – 15:30 · Room 14b

**CF/IE-13** Charge Dynamics in Solids
   Thursday, 16:00 – 17:30 · Room 14b

**CG** HIGH-FIELD LASER PHYSICS AND ATTOSECOND TECHNOLOGIES

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<td>CG-3</td>
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<td>CG-4</td>
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**CH** OPTICAL SENSING AND METROLOGY

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**CH-3** Advances in Optical Sensor Devices
   Wednesday, 16:00 – 17:15 · Room 4b

**CH-4** Metrology of Materials and Structures
   Thursday, 08:30 – 10:00 · Room 4b

**CH-5** Advances in Spectroscopy II
   Thursday, 10:30 – 11:45 · Room 4b

**CH-6** Optical Sensor Applications
   Thursday, 14:00 – 15:30 · Room 4b

**CH-7** Frontiers of Optical Sensing
   Thursday, 16:00 – 17:15 · Room 4b

**CI** OPTICAL TECHNOLOGIES FOR COMMUNICATIONS AND DATA STORAGE

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**CJ** FIBRE AND GUIDED WAVE LASERS AND AMPLIFIERS

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<tr>
<td><strong>CM</strong></td>
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<td><strong>CM-1</strong></td>
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<td><strong>CM-8</strong></td>
<td>Laser Processing from Polymers to Fibres</td>
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<td><strong>IB</strong></td>
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**CLEO®/Europe 2013 Topics**

### CA - Solid-state Lasers
Advances in solid-state lasers: novel solid-state lasers and amplifiers; high-power and high-energy lasers; power-scalable laser architectures, solid-state micro-chip and nanolasers; random lasers; pulse generation; short wavelength lasers; mid-infrared lasers; tunable lasers; intracavity wavelength conversion; upconversion lasers; thermal effects and their mitigation, beam quality characterization; linewidth reduction and wavelength tuning techniques; amplitude and frequency stability; novel pump sources and pumping configurations; laser resonator design; spectroscopic characterization of solid-state gain media; advanced laser crystals and glasses; laser characterization and modeling, novel solid-state lasers for system applications.

**CHAIR:** David Burns, University of Strathclyde, Glasgow, United Kingdom

### CB - Semiconductor Lasers
New technology, devices and applications; semiconductor optical amplifiers; modeling of semiconductor lasers and optical amplifiers; novel characterization techniques; vertical (extended) cavity surface emitting lasers; optically-pumped semiconductor lasers, photonic crystal semiconductor lasers, micro-cavity lasers; quantum dot/dash lasers; semiconductor ring lasers; short wavelength lasers: blue and green; near-infrared long wavelength lasers; mid-infrared and far-infrared semiconductor lasers; quantum cascade lasers and THz lasers; high power and high brightness lasers; short-pulse generation, mode locking; functional applications: switching, clock recovery, signal processing; semiconductor lasers in integrated photonic circuits; nonlinear dynamics of semiconductor lasers: optical feedback, coupled lasers, optical injection, spatial and temporal instabilities, synchronization, multimode dynamics, chaos.

**CHAIR:** Guido Giuliani, Università di Pavia, Pavia, Italy

### CC - Terahertz Sources and Applications
Sources for generating terahertz (far- infrared) radiation in the approximate range from 200 GHz to 10 THz. These sources can be based on various physical principles, including ultrafast time-domain systems, direct generation using terahertz lasers, and sources based on nonlinear optical mixing; applications using terahertz radiation for sensing, spectroscopy and imaging; advances in terahertz communications; new terahertz measurement techniques and instrumentation, including advances in imaging configurations, detector technologies, and terahertz optical components and waveguides; and terahertz optical measurements using surface plasmons, near-field effects, photonic crystals and metamaterials, and nonlinear optics; and terahertz imaging and modeling of plumes, turbulent air, or gaseous flows.

**CHAIR:** Jérôme Faist, ETH - Institute for Quantum Electronics, Zürich, Switzerland

### CD - Applications of Nonlinear Optics
Novel applications of nonlinear optical phenomena and new devices; nonlinear frequency conversion for the UV, visible and IR; telecommunications applications and all-optical switching; all-optical delay lines and slow light; optical parametric devices such as optical parametric amplifiers and oscillators; nonlinear optics in waveguides and fibres, including photonic crystal structures and microstructured optical fibres; quasi-phased matched materials and devices; novel nonlinear materials and structures; stimulated scattering processes and devices; optical solitons and their applications; optical limiting; spatial and spatio-temporal nonlinear processes including filamentation; electro-optic and Kerr devices in crystals and semiconductors; Raman based devices including amplifiers and lasers; nonlinear probing of surfaces; multi-photon imaging and coherent Raman microscopy.

**CHAIR:** Ulf Peschel, University of Erlangen-Nuremberg, Erlangen, Germany

### CE - Optical Materials, Fabrication and Characterization
Fabrication of optical materials; new crystalline and glass laser materials in bulk, fiber and waveguide geometry; micro- and nano-fabrication and engineering techniques; optical characterization of laser and nonlinear materials, micro-structured fiber and photonic crystal waveguides, micro- and nano-crystalline materials, single defect centres, quantum wells, quantum wires and quantum dots, nano-tubes and nano-needles, innovative organic materials.

**CHAIR:** Stefan Kück, Physikalisch-Technische Bundesanstalt, Braunschweig, Germany

### CF/IE - Ultrafast Science and Technology
Femtosecond and picosecond pulse generation from solid state, fiber and waveguide sources; mode-locked and Q-switched lasers; few-cycle optical pulses; ultrashort-pulse semiconductor laser and devices; ultrafast parametric and nonlinear optical conversion; ultrashort-pulse mid-IR and THz radiation; pulse compression; super-continuum generation; dispersion compensation; ultrafast electro-optics; pulse-shaping; carrier-envelope effects; ultrafast characterization methods and measurement techniques, ultrafast optoelectronic systems and devices; applications of ultrafast technology, femtosecond pulse filamentation and applications. This topical area will also feature papers on fundamentals of ultrafast nonlinear processes and ultrafast spectroscopy in physics, chemistry, and biology; coherent control using femtosecond pulses; ultrafast microscopic techniques; electro-optic sampling; femtochemistry; ultrafast x-ray experiments and attosecond phenomena.

**CHAIR:** Giulio Cerullo, Politecnico di Milano, Milano, Italy

### CG - High-field Laser Physics and Attosecond Technologies
Laser and parametric chirped-pulse amplification; generation, compression, carrier-envelope phase (CEP) stabilization and characterization of Petawatt pulses; CEP and light waveform synthesis metrology; strong field ionization and attosecond XUV/ x-ray pulse generation; generation of high brightness attosecond pulses; probing of non-linear and ultrafast dynamics by intense free-electron laser pulses; optimal control of ultrafast non-linear processes; time-resolved Auger spectroscopy, XUV/soft x-ray spectroscopy, interferometry and microscopy; time-resolved Coulomb explosion imaging; strongly coupled electron-nuclear dynamics in molecules; attosecond and femtosecond electron diffraction imaging of molecular structures; dynamics in fixed-in-space molecules; ultrafast electron dynamics in bulk media, nanostructures and quantum-confined structures; probing of surface electron dynamics and physiochemical processes via time-resolved UPS/soft XPS; time-resolved XAS, XANES & EXAFS; femtosecond-laser-produced plasmas; relativistic nonlinear optics; laser-driven particle acceleration.

**CHAIR:** Matthias Kling, Max Planck Institute, Garching, Germany

### CH - Optical Sensing and Metrology
Optical sensing and metrology allow for inspection of a wide range of objects, from the macroscopic to the nanometric scale. This topical area
focuses on recent progress in all aspects of optical sensing and metrology, particularly in new photonic sensor technologies and applications. Papers are solicited on the following and related topics: new trends in optical remote sensing; fiber sensors using conventional and photonic crystal fibers; active multispectral and hyperspectral imaging; sensor multiplexing; novel spectroscopic techniques, applications and systems; optical precision metrology; novel measurement methods and devices based on interferometry; holography; diffractometry or scatterometry; critical dimension metrology; virtual metrology; multiscale surface metrology; UV and DUV microscopy; resolution enhancement technologies in microscopy; inverse problems; adaptive optics; phase retrieval.

CHAIR: Tomas Nasilowski, Military University of Technology (MUT), Warsaw, Poland

CI - OPTICAL TECHNOLOGIES FOR COMMUNICATIONS AND DATA STORAGE
Fibre devices including dispersion compensating and nonlinear fibres, fibre propagation and polarization effects, fibre amplifiers and fibre lasers, fibre gratings and fibre grating-based devices; semiconductor devices for generation, processing and detection of optical signals including laser sources, detectors and modulators; performance monitoring devices, switches, picosecond and femtosecond pulse sources; optical components for enabling WDM and OTDM systems including filtering and switching devices; digital signal processing and coding techniques; communication and access networks; optical sub-systems including clock recovery techniques, packet/burst switching subsystems, advanced modulation formats, subcarrier-multiplexing, receivers for coherent detection, radio-over-fiber and microwave photonic technologies, optical regeneration, switching and frequency conversion; optics in storage area networks, optical delays and buffering, holographic and 3D optical data storage, near-field recording and super-resolution, photorefractives.

CHAIR: Stefan Wabnitz, Università di Brescia, Brescia, Italy

CJ - FIBRE AND GUIDED WAVE LASERS AND AMPLIFIERS
Waveguide and fibre laser oscillator and amplifiers including novel waveguide and fibre geometries; power scaling of waveguide and fibre lasers - including beam combination techniques (for both pump and signal beams) and new waveguide coupling approaches; upconversion lasers; nonlinear effects in waveguides and fibres - including nonlinear frequency conversion and pulse generation and compression; advances in fibre waveguide materials; fabrication techniques for doped waveguide and fibre devices; active microstructured fibre and waveguide laser devices; novel waveguide and fibre sources for industrial applications.

CHAIR: Thomas Schreiber, Fraunhofer Institute for Applied Optics and Precision Engineering IOF, Jena, Germany

CK - MICRO- AND NANO-PHOTONICS
The intensive research nowadays being carried out in the area of nanostructured materials for photonic applications has branched in many directions but keeps a common goal. This is learning and profiting from the novel phenomena occurring when light is created, transported and detected in environments where either dimensionality or size are reduced and, in particular, when light-matter interaction occurs in regions smaller than or similar to the wavelength of light. This trend has earned the term nanophotonics. Such a vast field includes but is not restricted to periodic or quasi-periodic nanostructures (photonic crystals), plasmonic and metamaterial devices; integrated optics; optical MEMS; materials aspects and fabrication techniques, including inorganic/organic nano-layers/wires, nanocrystals in periodic structures and single molecules; issues related to order/disorder in nanostructured materials; and applications tending to the integration into photonic devices for biology, lighting, communication, sensing and energy efficiency.

CHAIR: Valerio Pruneri, ICF-I The Institute of Photonic Sciences and ICREA, Castelldefels, Barcelona, Spain

CL - BIOPHOTONICS AND APPLICATIONS
This topic area addresses emerging concepts in biophotonics: single particle/molecule detection and tracking; spatio-temporal manipulation of light fields for biomedicine; enhanced linear and non linear excitation and detection; micro-fluidics, optofluidics and micro-optics; new optical probes for local measurements – including organic and inorganic nanoparticles, electric fields and temperature measurements; New routes and modalities for optical detection in biophotonics: non linear processes; spectroscopy; holography, adaptive optics, phase conjugation time reversal etc; physics of optical phenomena in biological media: scattering; coherence; polarization; symmetry and invariance. Advanced light sources and geometries for microscopy, phototherapy, surgery, biomedicine etc.

CHAIR: Kishan Dholakia, University of St. Andrews, St. Andrews, Fife, United Kingdom

CM - MATERIALS PROCESSING WITH LASERS
Fundamentals of laser-materials interactions: phase transformation, chemical reactions, diffusion processes, ablation; analytical and numerical mathematical modelling; high-power laser-materials processing: welding, cutting, surface treatment; laser ablation; thin-film growth: PLD, LCVD; direct write techniques: MAPLE, LIFT, near-field techniques; 2D and 3D micro/nano structuring; plasma related processes; laser assisted nanosynthesis; fundamentals and applications of femtosecond micromachining; ultrafast laser processing: volume modification, index engineering; laser-assisted manufacturing.

CHAIR: Boris Chichkov, Laser Zentrum Hannover, Hannover, Germany

IQEC 2013 Topics

IA - QUANTUM OPTICS
This topical area will feature papers on multimode and mesoscopic quantum optics; single photon emission and absorption; quantum light sources and applications; nonlocality and quantum interference; squeezing and entanglement; quantum correlations and measurement; quantum optics in circuits and cavities; quantum coherence; slow light and quantum memories; quantum imaging and quantum lithography.

CHAIR: Axel Kuhn, Oxford University, Oxford, United Kingdom

IB - QUANTUM INFORMATION, COMMUNICATION, AND SIMULATION
This topical area will highlight recent innovations in all areas of the field, from algorithm and protocol development to experimental implementations of quantum computers and quantum communication systems. Of special interest are results in quantum simulations, quantum key distribution, quantum logic gates, entanglement distribution and distillation, conversion of information between static and flying qubits, and quantum memories. In addition, novel platforms, devices and materials for quantum information processing, such as integrated devices, nano-mechanics, ion-trap arrays, superconducting
structures, quantum dots and cavity QED based quantum gates will be covered.

**CHAIR:** Christine Silberhorn, Universität Paderborn, Paderborn, Germany

**IC - ULTRACOLD QUANTUM MATTER**
This topical area will feature papers on recent developments in few- and many-body phenomena with ultracold quantum gases of atoms and molecules. These will include: quantum simulation of strongly correlated systems with artificial gauge fields, frustration, disorder and impurities; out-of-equilibrium many-body phenomena; superfluidity and thermodynamics in Bose and Fermi systems; dipolar physics with atoms and molecules; Efimov physics; quantum atom interferometry; controllable multiparticle entanglement; hybrid systems.

**CHAIR:** Giovanni Modugno, LENS / Department of Physics, University of Florence, Florence, Italy

**ID - PRECISION METROLOGY AND FREQUENCY COMBS**
This topical area will deal with the ultimate limitations of measurement precision as imposed by the nature of quanta. It will feature papers on precision interferometry and spectroscopy, novel methods of laser spectroscopy, tests of fundamental symmetries, quantum metrology, definition of basic units, and the constancy of fundamental constants.

**CHAIR:** Ekkehard Peik, Physikalisch-Technische Bundesanstalt (PTB) Braunschweig, Germany

**IE/CF - ULTRAFast SCIENCE AND TECHNOLOGY (JOINT TOPIC AREA with CLEO*/EUROPE- IQEC 2013 TOPICS)**
Femtosecond and picosecond pulse generation from solid state, fiber and waveguide sources; mode-locked and Q-switched lasers; few-cycle optical pulses; ultrashort-pulse semiconductor lasers and devices; ultrafast parametric and nonlinear optical conversion; ultrashort-pulse mid-IR and THz radiation; pulse compression; super-continuum generation; dispersion compensation; ultrafast electro-optics; pulse-shaping; carrier-envelope effects; ultrafast characterization methods and measurement techniques, ultrafast optoelectronic systems and devices; applications of ultrafast technology, femtosecond pulse filamentation and applications. This topical area will also feature papers on fundamentals of ultrafast nonlinear processes and ultrafast spectroscopy in physics, chemistry, and biology; coherent control using femtosecond pulses; ultrafast microscopic techniques; electro-optic sampling; femtochemistry; ultrafast x-ray experiments and attosecond phenomena.

**CHAIR:** Giulio Cerullo, Politecnico di Milano, Milan, Italy

**IF - FUNDAMENTALS OF NONLINEAR OPTICS**
This topical area will feature papers on nonlinear optical phenomena including frequency conversion, wave mixing, parametric processes, electromagnetic induced transparency, lasing without inversion, slow light and dark states, temporal and spatial solitons, novel nonlinear optical materials and nano-structures, nonlinear optical fibers, media with extreme nonlinear properties, nonlinear imaging, nonlinear manipulation and characterization of short pulses.

**CHAIR:** Sophie Brasselet, Fresnel Institute, Marseille, France

**IG - DYNAMICS, SOLITONS AND SELF-ORGANIZATION**
This topical area features papers on the formation of self-organized spatio-temporal structures in optical systems. Topics include a large variety of phenomena such as nonlinear dynamics, pattern formation and dissipative solitons, beam filamentation, instabilities, synchronization, complex behaviour, and extreme events. Applications of these phenomena in, for example, information processing, chaos control and optical communication are also considered. Systems of interest encompass single active or passive photonic devices as well as coupled systems and networks, including novel optical systems such as polariton condensates, quantum dot lasers, microlasers, photonic crystal microcavities, optomechanical systems.

**CHAIR:** Thorsten Ackemann, University of Strathclyde, Glasgow, United Kingdom

**II - LIGHT-MATTER INTERACTIONS AT THE NANO-SCALE**
This topical area will feature papers on all the aspects of light-matter interaction at the nanoscale including single photon emitters (quantum dots, NV centers) and related physics (nanoantennas, microcavities), strong coupling, non-linear optics at the nanoscale, photovoltaics, sources and detectors at the nanoscale, optical forces (optical tweezers at nanoscale, Casimir and Casimir-Polder forces) and radiative heat transfer at the nanoscale.

**CHAIR:** Jean-Jacques Greffet, Institut d’Optique, Palaiseau, France

**JSI - JOINT SYMPOSIUM ON NUCLEAR PHOTONICS**
The recent development of high intensity lasers, very brilliant y or ion beams and coherent x-ray sources opens new perspectives for nuclear physics studies in extreme conditions. Nuclear properties in presence of a very high electromagnetic field or the study of nuclear reaction, excitation, deexcitation rates in hot and dense plasmas are new domains of investigation. They are of prime importance in particular for the population of isomeric states and element synthesis in astrophysics, and for the issue of energy storage in nuclei. The aim of this symposium is to bring together theorists and experimentalists from different related areas such as direct laser-driven interactions, half-life modifications in plasmas, atomic effects in nuclear excitation and decay, UHI-driven particle sources and coherent X-ray sources.

Topics include:
- Nuclear physics in laser induced plasma (excitation processes in plasma, effect of high temperatures on transmutation)
- Nuclear physics in laser fields (laser-driven excitations and review of nuclear experiments which can be carried out at XFEL)
- Nuclear physics with monoenergetic g-beams (review of experiments which can be carried out at Compton backscattering facilities)
- Techniques and facilities of UHI-driven particle beams, brilliant monoenergetic g-beams, coherent X-ray sources for nuclear physics.
- NEET and NEEC and the inverse processes with possible applications to gamma ray lasers.

**Joint CLEO*/EUROPE-IQEC 2013 TOPICS**
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Frantisek Tolar, Czech University of Technology, Prague, Czech Republic  
Jesper Mork, Technical University of Denmark, Lyngby, Denmark

JSII - Joint Symposium on Photonics for Defence and Security  
Today, worldwide security is significantly affected by the increasing globalization and the emergence of new military and non-military threats. Low-intensity conflicts, asymmetric warfare, peacekeeping missions in urban theaters, border security, and the continued rise in terrorism. All this has created a need for new and innovative technical solutions where photonics are playing, and will continue to play, a key role. Optical sensing is now extending from the UV, through the visible, to the terahertz frequency range, offering novel imaging systems with increased discrimination capabilities, and spectroscopic techniques that can help characterize suspicious materials. Laser systems have evolved which enable three-dimensional imaging, directed infrared countermeasures, and other new defense concepts. This symposium will focus on novel and improved techniques and applications of photonics for security and defence. It aims at bringing together engineers and scientists from academia, industry, and government from around the world to exchange results and ideas in this field.

Topics include:
Active imaging, range gated flash imaging systems and applications, three dimensional imaging, hyper spectral, multispectral and polarimetric imaging. Automated target detection and identification. Enabling laser and focal plane arrays technologies. Light detection and ranging, incoherent and coherent LIDAR, laser velocimetry, vibrometry and profilometry. Obstacle detection and landing aid applications. 3D scanning. LIDAR-RADAR concepts, i.e., RF modulated waveforms. Enabling technologies, such as eye-safe fiber laser with arbitrary waveforms capability, novel semiconductor lasers, advanced detectors, and non-mechanical beam steering. Spectroscopic techniques for sensing biological and chemical species, including time resolved fluorescence, absorption, Raman, and LIBS spectroscopy. Detection and imaging of illegal substances, and in vapor phase, in liquids, and as solid traces. Hidden objects detection. Stand-off detection of improvised explosive devices and antipersonnel mines. Dedicated laser and detector technologies from the UV to the THz range. Directed energy applications such as infrared countermeasures and laser weapon concepts. Infrared laser sources incl. high power solid-state and fiber lasers developments. Incoherent and coherent beam combining concepts. Propagation and turbulence effects mitigation. Beam directors and adaptive optics. Femtosecond lasers and associated effects, e.g., filamentation and remote plasma generation.

CO-CHAIRS:
Eric Lallier, Thales Research and Technology, Palaiseau, France  
Jerry Meyer, Naval Research Labs, USA  
Joachim Wagner, Fraunhofer IAF, Freiburg, Germany

JSIII - Joint Symposium on Dynamics of Random Waves and Extreme Events  
There has been significant recent development in the observation and understanding of random waves and extreme event dynamics. However, the range of topical areas covering this field is extremely broad, from meteorology over optics to ultracold matter. The aim of this symposium is to present the recent progress in this field by bringing together experts from different areas such as dynamics of linear and nonlinear random waves, random surface waves, optical turbulences, instabilities in lasers cavities, pattern formation in liquid crystals, temporal extreme events in optical fibers and waveguides, as well as spatial extreme events in bulk media or rogue waves in Bose-Einstein condensates.

CO-CHAIRS:
Goery Genty, Tampere University of Technology, Tampere, Finland  
Stefan Skupin, Max Planck Institute, Dresden, Germany

JSIV - Joint Symposium on Quantum Coherent Effects in Biology  
This topical area will deal with the existence and potential importance of quantum coherence in biological processes. It will include: vibrational and electronic coherence in ultrafast light-activated processes; spin effects on magnetosensitivity; ultra-high time-resolution transient absorption and ultrafast multidimensional spectroscopy; theoretical predictions on the importance of quantum coherence in biology.

CO-CHAIRS:
Philipp Kukura, University of Oxford, Oxford, United Kingdom  
Marcus Motzkus, University of Heidelberg, Heidelberg, Germany

JSV - Joint Symposium on Superconductive Optics  
This joint symposium highlights the growing role of superconductive materials and circuits in quantum optics. It will focus on the development of quantum circuits based on superconducting materials. These circuits provide an ideal playground for exploring atomic physics and quantum optics with microwave photons as well as a scalable blueprint for quantum computing. The symposium will also explore the wide ranging applications of superconducting detectors in quantum optics and quantum information, highlighting high performance superconducting technologies for infrared single photon detection, and implementations in applications such as quantum key distribution, quantum metrology and quantum information processing.

Co-Chairs:  
Franco Nori, RIKEN Advanced Science Institute, Saitama, Japan  
Robert Hadfield, Heriot-Watt University, Edinburgh, United Kingdom

Topics
Joint Sessions
CLEO®/Europe and ECBO:

Two sessions on Biophotonics and Applications (CL-1/ECBO and CL-2/ECBO) to be presented on Sunday afternoon are jointly organised by CLEO®/Europe (CL committee) and ECBO.

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CIC nanoGUNE Donostia - San Sebastian, Spain

Jiri Homola,
Czech Academy of Sciences, Prague, Czech Republic

Satoshi Kawata,
RIKEN, Osaka, Japan

Wolfgang Parak,
Philips University of Marburg, Marburg, Germany

Din Ping Tsai,
National Taiwan University, Taipei, Taiwan

Pol Van Dorpe,
IMEC, Leuven, Belgium

Cleo®/Europe - IQEC 2013
JOINT SYMPOSIUM COMMITTEE

JSI - JOINT SYMPOSIUM ON NUCLEAR PHOTONICS
CO-CHAIRS:
Franch Gobet,
Centre Etudes Nucléaires, Bordeaux, France

Ken Ledingham,
University of Strathclyde, Glasgow, United Kingdom

JSII - JOINT SYMPOSIUM ON PHOTONICS FOR DEFENCE AND SECURITY
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Thales Research and Technology, Palaiseau, France

Jerry Meyer,
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JSIII - JOINT SYMPOSIUM ON DYNAMICS OF RANDOM WAVES AND EXTREME EVENTS
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Tampere University of Technology, Tampere, Finland

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JSIV - JOINT SYMPOSIUM ON QUANTUM COHERENT EFFECTS IN BIOLOGY
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University of Oxford, Oxford, United Kingdom

Marcus Motzkus,
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JSV - JOINT SYMPOSIUM ON SUPERCONDUCTING OPTICS
CO-CHAIRS:
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RIKEN Advanced Science Institute, Saitama, Japan

Robert Hadfield,
University of Glasgow, Glasgow, United Kingdom
The CLEO®/Europe-IQEC 2013 technical programme features 1423 presentations. These include 3 plenary, 5 tutorial, 8 keynote, 78 invited and 6 tech-focus talks. The conference also features 764 oral contributions and 559 poster presentations. Two postdeadline sessions (18 oral talks) are also added.

Conference Dates

CLEO®/Europe-IQEC 2013 will be running from Sunday 12 May, 9:00 to Thursday 16 May, 17:30.

2013 LASER World of PHOTONICS Opening with Plenary Talk

The official LASER World of PHOTONICS opening will take place right after the CLEO®/Europe plenary talk on Monday 13 May, beginning from 9:30, Room 1.

The ceremony will start with a couple of welcome addresses and will be followed by a Plenary Talk. 2013 will mark the 40th anniversary of the LASER World of PHOTONICS. Messe Munich will honour the exhibitors of the first event.

Time schedule:

09:30 – 10:00  Welcoming by Norbert Bargmann, Deputy CEO of Messe München International.

10:00 – 10:45  Plenary Talk on “Nanoscopy with Focused Light” by Stefan W. Hell, Max Planck Institute for Biophysical Chemistry, Göttingen, Germany.

Prizes and Awards

A series of Prize and Award ceremonies will take place during the Plenary session scheduled Tuesday 14 May from 10:30 to 12:30, Room 1.

During this session Alain Aspect, Institut d’Optique, Palaiseau, France will present a plenary talk on “Coherent Back Scattering and Anderson Localization of Ultra Cold Atoms”.

The following Prizes and Awards will be presented:

- 2013 Awards of the European Physical Society – Quantum Electronics and Optics Division:
  - (2) Quantum Electronics Prizes.
  - (2) Fresnel Prizes.

See EPS-QEOD Prize Ceremony brochure.

- EPS Emmy Noether Distinction for Women in Physics
- OSA Fellow Awards
- DPG/OSA Herbert Walther Award.

See programme in the parallel sessions.

Poster Sessions

Posters are a major attraction and provide an intimate interaction between the presenter and the viewer. To allow participants to see as many posters as possible, all CLEO®/Europe-IQEC 2013 posters will be displayed in the Hall B0 (ground floor) next to the ICM centre. The conference will feature 5 poster sessions taking place from Sunday to Thursday after lunchtime. There will be no oral presentations during this time.

Poster time schedules:

- **Sunday**: 13:30 - 14:30 (topics CA, CC, CL, CM and IF)
- **Monday**: 13:30 - 14:30 (topics CB, CK, IB, ID and JSIV)
- **Tuesday**: 13:00 - 14:00 (topics CD, CE, CI, IC and JSIII)
- **Wednesday**: 13:00 - 14:00 (topics CF/IE, CJ, II, JSII and JSIII)
- **Thursday**: 13:00 - 14:00 (topics CG, CH, IA, IG and IH)

All authors are requested to display posters on their allocated boards on the morning of their assigned poster day. In order to present their work and answer questions, they are requested to be present in the vicinity of their poster during that day between the assigned time schedules. The schedule of the poster sessions is presented on the respective pages of the advance programme.

Each author is provided with a bulletin board measuring 950 mm wide × 1755 mm high on which to display a summary of the paper. Tape to fix the posters will be provided (pins cannot be applied).

Note: A catering counter with drinks and snacks will be built up in the middle of the hall.

Speakers’ Information

Duration of the talks:

- Contributed presentations are 15 minutes including discussion
- Invited presentations are 30 minutes including discussion
- Tutorial presentations are 60 minutes including discussion
- Keynote presentations are 45 minutes including discussion
- Plenary presentations are 45 or 60 minutes including discussion

Speakers are asked to check-in with the session chair in the room of their relevant session ten minutes before the beginning of the session.

During the World of Photonics Congress a network-based presentation system will be used along with a congress specific interface to ensure a high quality of all presentations.

Speakers were requested to upload their presentations prior to the conference, to a protected server of M Events Cross Media GmbH (http://www.m-events.com) until May 11, 2013. Those who did not do it are kindly requested to do it on-site in the Speakers’ Check-IN (Hall B0, ground floor, congress centre).

Important:

In any case all speakers need to check their presentations at the Speakers’ Check-IN when they arrive to the ICM!

Please be assured that the presentations are securely protected against any external access. This applies for both the on line upload as well as the upload on-site. After the conference all submitted files will be deleted from all storage media.
Each meeting room is equipped with a laptop, or wireless lavaliere. A network-based presentation system will be used along with a conference specific interface to ensure the perfect quality of all presentations. Therefore, **own laptops cannot be connected in the lecture room. All presentations must be uploaded in advance to the server.**

Laser pointers are not provided.

Internet access will not be available during the presentation.

**Tech-Focus Sessions**

A feature of CLEO®/Europe-IQEC 2013 will be the Tech-Focus sessions which will concentrate on a selected Fibre and Solid-State Lasers topic. It will consist of a combination of extended tutorial introductory material and authoritative technical reviews. CLEO®/Europe-IQEC 2013 will feature two Tech-Focus sessions on Fibre and Solid-State Lasers: a Comparison from an Industrial Point of View, jointly held with the LIM conferences and taking place on **Tuesday afternoon, Room 13a.**

All paid registrants are invited to attend the Tech-Focus sessions at no additional charge. Those wishing to attend the Tech-Focus who are NOT FULL FEE registrants must pay the one-day fee.

**Short Courses**

Twelve short courses at an extra cost will be presented in parallel from Sunday 12 May to Thursday 16 May 2013 (half days each). Each course is scheduled in two parts: Course Part I (1 hour ½), coffee break, Course Part II (1 hour ½). The courses are open to attendees of the World of Photonics Congress and Laser World of Photonics Exhibition subject to payment of the course fee.

Advance registration is required in order to obtain the short course material. This material will not be available for purchase during the conference.

**Laboratory Tours**

Guided laboratory tours through selected Munich (Garching) Laser Laboratories will take place on Friday, 17 May 2013.

The programme will be published beginning of May. See **http://www.cleoeurope.org/laboratory-tours.**

CLEO®/Europe-IQEC participants can sign up for the laboratory visits during the conference: They will be invited to sign up on lists hanging on the message board located in the corridor between Entrance West and ICM.

If possible, Laboratory tour attendants should book their return flights in the evening, to be sure, that there is enough time.

**Important: Transport!**

Munich suburban map and respective information can be downloaded at [www.mvv-muenchen.de/mvv/XSLT-TRIP_REQUEST2?language=en](http://www.mvv-muenchen.de/mvv/XSLT-TRIP_REQUEST2?language=en). Depending on the weather the event may also take place outside.

**Reception and Social Events**

**Opening Reception with Celebration of the 40th Laser World of Photonics.**

**Monday 13 May 2013, from 17:30 to 22:00,**

**ICM Foyer, Ground Floor, Congress Centre**

All exhibitors and attendees of the World of Photonics Congress are cordially invited to attend the opening reception "Bavarian evening". Enjoy music, food and cold drinks and use the atmosphere to network.

**CLEO®/Europe-IQEC Conference Dinner**

**Tuesday 14 May 2013, beginning from 19:00, Löwenbräukeller, Munich**

The delegates registered with the CLEO®/Europe-IQEC 2013 are invited to the conference reception at a special cost of €10,- per participant and €35,- per additional guest. The dinner will take place at the famous Löwenbräukeller ([http://www.loewenbraeukeller.com/en/](http://www.loewenbraeukeller.com/en/)) in downtown Munich. A rich selection of fine Bavarian food will be provided.

**Happy Hour**

**Wednesday 15 May 2013, from 17:30 to 18:30,**

**ICM Foyer, Ground Floor, Congress Centre**

The event is sponsored by the Quantum Electronics and Optics Division of the European Physical Society. Beer and pretzels will be served. Depending on the weather the event may also take place outside.
Exhibition Information

From 13 to 16 May, a major exhibition of laser and electro-optic equipment and services, LASER World of PHOTONICS 2013 will be held in conjunction with the congress.

The latest technology first hand will be exhibited. The range of products exhibited will cover innovative optical technologies:
- Laser and Optoelectronics;
- OPTICS;
- Manufacturing Technology for OPTICS;
- Sensors, Test and Measurement;
- Laser and Laser Systems for Production Engineering;
- Optical Information and Communication;
- Biophotonics and Medical Engineering;
- Imaging;
- Illumination and Energy;
- Security.

All conference registrants will have free entrance to the technical exhibition. Longer lunch breaks are organised to allow visits to the exhibition.

This combination of theory and practice, an extensive program of conferences and related events and the presence of all market leaders, decision-makers and users make LASER World of PHOTONICS unique and, at the same time, the most important international information and networking platform for the industrial, research and development sectors.

LASER World of PHOTONICS features more than 1,000 exhibitors from more than 30 countries and gives you a complete overview of all the latest trends and applications. The international research community meets the industry at the World of Photonics Congress that is held in conjunction with LASER World of PHOTONICS.

Further information on the exhibition is available at http://world-of-photonics.net/en/laser/visitors

OPENING HOURS OF THE EXHIBITION
The exhibition will be opened from Monday through Wednesday 09:00 - 17:00 and on Thursday 09:00 - 16:00.

Application Panels
The application panels organized by Messe München International are now a permanent part of the World of Photonics Congress. The series of lectures that are held in the forums of the LASER World of PHOTONICS 2013 exhibition halls bridge the gap between science and practical application.

Well-known speakers from industry and research institutes report on the latest research and development findings in the sector of optical technologies and discuss the latest challenges with you.

The Applications Panels at the 2013 fair will feature a number of new sectors for photonics applications. A series of 16 panels will be held on the four days of LASER World of PHOTONICS at the trade-fair centre in Munich from May 13 – 16, 2013. Broken down into three main categories – i.e. Biophotonics and Medical Engineering (4 topics - Hall B1), Lasers and Laser Systems for Production Engineering (7 topics - Hall C2) and Optical Technologies (7 topics - Hall B2) – they will give attendees a comprehensive look at the latest trends and developments.

NEW TOPICS INCLUDE:
- Laser applications and optical diagnostics in ophthalmology
- Unmet Needs in Photonics and Medicine
- Laser – Additive Manufacturing
- Organic and Printed Electronics, Partner: OE-A
- Optronical Systems in Security Applications
- High-power diode lasers and VCSELs: most efficient and flexible beam sources

The admission is free for the Laser World of PHOTONICS participants. Some panels are held in German and some in English. For further information, see the separate brochure.

On-Site Facilities for Attendees

ONLINE DATABASE
The entire program of events at the World of Photonics Congress is available online at http://world-of-photonics.net/en/photonics-congress/structure/conference-program-2013. The database features versatile search functions and can help you to compile a personal congress schedule that you can transfer to your PDA. It also features information about all lectures and poster shows on specific topics and about the companies with exhibits at the fair.

W-LAN LOUNGE
All congress participants using their own laptops/netbooks/pads have free access to the Internet in the W-LAN Lounge at the Congress Centre (ICM, ground floor, foyer).

CAREER CENTER (MAIN ENTRANCE WEST, BOOTH 80G)
Societies can publish job advertisements on a job board and congress attendees like students can use the career coaching. Stock position on job board is charged. Messe München and wirth + partner Consulting Group manage the LASER World of PHOTONICS Career Center.

At the Career Center, job applicants can find job, training and apprenticeship openings of LASER World of PHOTONICS exhibitors. At the same time, personnel consultants offer career coachings free of charge for Young Professionals and professionally experienced engineers and physicists on every trade fair day between 10 am and 5 pm.

You can register for the career coaching either on site at the trade fair or in advance at info@wirth-partner.com or +49 (0)89 / 4599580.

Find out about the job openings already now on our on line career centre at http://www.world-of-photonics.net/en/laser/start/hidden/jobboerse2013

CATERING
All conference attendees are invited to attend the free coffee breaks as marked in the tables of the days at a glance (first pages of the advance programme). Lunches are not included in the conference fee.

A number of gastronomy facilities are available on site. Depending on the weather the beer garden outside will be open.

Besides three permanent food-service operations in the foyer – the ICM Bistro, ICM Bar and ICM Café – you can also visit the restaurant “Am See”, which can be reached directly via the 1st floor. Snack bars with large assortments of snacks and beverages are located on the ground floor in each hall. The snack bars in the ICM are located on the ground floor and the first floor.

Full-service restaurants are located on the first floors of the East and West Entrances and above the halls. Other self-service restaurants located on the first floor can also be found in the exhibition halls offering international cuisine:

- Food Gallery, between Halls A1 and A2 (at the south end).

When the weather is nice, the terrace is open. The restaurant has a seating capacity of 350.
office services are currently proposed at cost: from 08:00 to 19:00 hour, closed Saturday).

- Asia Garden (Asian cuisine), between Halls B4 and B5 (along the Expressway). The restaurant features Asian-style décor and serves wok dishes and Asian specialties. The restaurant has a seating capacity of 300.
- Paganini (Italian cuisine), between Halls A5 and A6 (at the south end). When the weather is nice, the terrace is open. The restaurant has a seating capacity of 300.
- It also offers additional services:
  - Information about cultural attractions in Munich
  - Hotel information
  - Flight/train information
  - Information about Munich International Trade Fairs
  - Taxi service (directly in front of ICM main entrance)

**BANKS**

No bank-counter but ATM-machines to withdraw money (one is located between the “Messehaus” and hall A1, another is located between halls A4 and B4);

At the “Riem Arcaden” (three-minute walk from West Entrance) you will find:

- An ATM self-service machine (Münchner Bank)
- A branch office of the Sparda-Bank for customers to make deposits and withdraw funds. No currency exchange.

A ReiseBank branch is located at the Munich East train station (Ostbahnhof, Orleansplatz 11). Other banks are also to be found in the centre of Munich or at the main railway station.

**Taxi service**

The taxi service is located in front of the ICM main entrance.

**Airport shuttle**

An airport shuttle is organised in connection with the trade fair from 12 to 16 May 2013. Cost € 8 one-way, € 13,50 round trip.

Shuttle buses directly stop in front of the West, East and North Entrances and in front of the entrance of the ICM Congress Centre. Shuttle buses provide service between the Munich Airport and the trade-fair centre during the following schedule (every 30 minutes, on the hour and half-hour):

- Airport - Trade-fair centre: 8 am - 6 pm
- Trade-fair centre - Airport: 9:30 am - 7 pm

The trip takes approximately 45 minutes. Information regarding departure locations and special fares is available at all information counters at the trade-fair centre.

**First-aid**

First-aid stations are located in the East and West Entrances.

As a service partner of Munich International Trade Fairs, Aicher Ambulanz Union is responsible for the medical needs of guests and visitors at the trade-fair center and the ICM. Phone: +49 89 742200, +49 89 949-28103 (for first-aid emergency call), mobile: +49 171 5663514.

**Pharmacy**

The nearest pharmacy is “SaniPlus” in the Riem Arcaden shopping centre. It is located on the ground floor in the right portion of the building.

**How to reach the ICM Centre**

**By car:**

simply follow the trade fair signs from the outskirts and throughout the city to the ICM. There you will find parking space.

**By train:**

The ICM is about 20 minutes from Munich central station (Hauptbahnhof) by underground U2, exit “Messestadt West”. The U2 subway runs from 4:12 in the morning to about 1:00 after midnight. Further information on the underground is available at http://www.mvv-muenchen.de/ or at the information counters on the trade fair grounds.

**From the airport:**

At Munich airport, the station for urban railway lines S1 and S8 is directly below the central area. Trains in the direction of the city centre run at
10-minute intervals. There are two routes from the airport to the ICM:

- **Route S1 / U2:** S1 from the airport to Feldmoching station or Munich Central Station (Hauptbahnhof). Change to underground U2 that takes you directly to the ICM - Messestadt West.

- **Route S8 / U2:** S8 from the airport to Munich central station (Hauptbahnhof). Change to underground U2 that takes you directly to the ICM - Messestadt West.

**By taxi from the airport:**
Taxis are available in front of the terminals. The journey takes about 35 minutes, depending on the volume of traffic (cost around 60 EUR).

**By hire car from the airport:**
All the major car rental firms are represented at Munich airport. The car rental centre with its own parking facilities is in front of module A, to the north of car park P6. Please take the following route: From Munich Airport follow the signs “Messe/ICM” on the A92 in the direction of Munich to the motorway intersection Eching/Neufahrn. Then take the A92 in the direction of Munich to the motorway intersection München-Nord. Continue on the motorway ring road A99 in the direction of Salzburg to the motorway intersection München-Ost. Then take the A94 in the direction of Munich to the exit Feldkirchen-West or München-Riem. The journey takes about 35 minutes, depending on the volume of traffic.

**How to take a taxi from the ICM Centre to the airport**
You will find taxi ranks at all trade fair entrances and in front of the ICM going to the airport (Central Building).

**Airport shuttle**
An airport shuttle is organised in connection with the trade fair from 12 to 16 May 2013. Cost € 8 one-way, € 13.50 round trip. Shuttle buses directly stop in front of the West, East and North Entrances and in front of the entrance of the ICM Congress Centre. Shuttle buses provide service between the Munich Airport and the trade-fair centre during the following schedule (every 30 minutes, on the hour and half-hour):
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**Conference Registration**

<table>
<thead>
<tr>
<th>Conference Registration Fees</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS/OSA/IEEE Member with the online digest</td>
<td>€ 590</td>
</tr>
<tr>
<td>Non-Member with the online digest</td>
<td>€ 710</td>
</tr>
<tr>
<td>EPS/OSA/IEEE Student Member (*) with the online digest</td>
<td>€ 195</td>
</tr>
<tr>
<td>Student Non-Member (*) with the online digest</td>
<td>€ 230</td>
</tr>
<tr>
<td>One Day without the online digest</td>
<td>€ 290</td>
</tr>
<tr>
<td>Student (*) extra fee for Short Course</td>
<td>€ 220</td>
</tr>
<tr>
<td>Regular extra fee for Short Course</td>
<td>€ 350</td>
</tr>
<tr>
<td>Reception ticket per participant</td>
<td>€ 10</td>
</tr>
<tr>
<td>Additional reception ticket per guest</td>
<td>€ 35</td>
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</tbody>
</table>

(All registration fees are exempt from Value Added Tax). (*) Applications for the student rates must include a photocopy of an official student identity card, which must also be presented on-site when collecting registration materials.
The full week registration fee for the meeting includes admission to all CLEO®/Europe-IQEC 2013 technical sessions, as well as to those of all conferences collocated with Laser 2013. It includes admission to the technical exhibition. Digest will be online. A login and password will be given. Coffee Breaks are included (as mentioned in the days at a glance). Tickets for public transportation are not included in the fees.

One-day registration fees are available for those wishing to attend one particular session rather than the whole conference. Please note that the online digest will not be included. Coffee Breaks are included. Tickets for public transportation are not included in the fees.

**NOTE:** One-day registration tickets are activated on the day the participant goes through the gates of the congress or the fair and will only be valid for that day.

Registration forms are available on site.

### Cancellation Policy

An administration charge of € 50 will be made for processing refunds. A request for cancellation must be made in writing. In the case of cancellation, requests received on or before Wednesday, 1 May 2013 will be refunded (less the administration charge). No refunds will be available if notice of cancellation is received after 2 May 2013.

### Note to Exhibitors

Each exhibitor at LASER World of PHOTONICS 2013 is entitled to one free ticket to the World of Photonics Congress 2013. Each exhibitor may also purchase up to five congress tickets for a special price.

All tickets are personalized, i.e. they are valid only for the person whose name appears on the ticket, and they are not transferrable.

Special tickets to the World of Photonics Congress may only be ordered and used by exhibiting companies.

The official Congress Proceedings are not included in the discount price for special tickets for exhibitors.

Tickets will be pre-produced and will be available for pick-up at the World of Photonics Registration Desk in the West Entrance. Messe Munich manages the order of these tickets.

Beyond that, exhibitors must purchase any additional tickets to the World of Photonics Congress from one of the organizing scientific associations at the regular price.

**PLEASE NOTE:**

Neither the free special tickets nor the discount special tickets are available to speakers or poster presenters appearing at the World of Photonics Congress 2013. Speakers and poster presenters must register with the respective organizing association.

### Registration Hours and Location

Registration for technical sessions will take place at the ICM centre. To enter the ICM centre please take the main Entrance West (named “Haupteingang WEST”).

CLEO®/Europe-EQEC 2013 registration counters are located on the left side at the end of the main corridor just prior you enter the exhibition halls.

### Registration Hours

<table>
<thead>
<tr>
<th>Date</th>
<th>Times</th>
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<tbody>
<tr>
<td>Saturday 11 May</td>
<td>16:00-18:00</td>
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<tr>
<td>Sunday 12 May</td>
<td>08:00-17:00</td>
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<tr>
<td>Monday 13 May</td>
<td>08:00-17:00</td>
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<tr>
<td>Tuesday 14 May</td>
<td>08:00-17:00</td>
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<tr>
<td>Wednesday 15 May</td>
<td>08:00-17:00</td>
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<tr>
<td>Thursday 16 May</td>
<td>08:00-15:00</td>
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</tbody>
</table>

### Conference Hours

<table>
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<tr>
<th>Date</th>
<th>Times</th>
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</thead>
<tbody>
<tr>
<td>Sunday 12 May</td>
<td>09:00-12:30 / 13:30-18:00</td>
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<tr>
<td></td>
<td>(CB-2 until 12:45)</td>
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<tr>
<td>Monday 13 May</td>
<td>08:30-12:30 / 13:30-18:00</td>
</tr>
<tr>
<td>Tuesday 14 May</td>
<td>08:30-12:30 / 13:00-17:30</td>
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<tr>
<td>Wednesday 15 May</td>
<td>08:30-12:00 / 13:00-17:30</td>
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<tr>
<td></td>
<td>and 18:45-20:15</td>
</tr>
<tr>
<td>Thursday 16 May</td>
<td>08:30-12:15 / 13:00-17:30</td>
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<tr>
<td></td>
<td>(CM-6 until 12:15)</td>
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### Short Course Hours

<table>
<thead>
<tr>
<th>Date</th>
<th>Times</th>
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<tbody>
<tr>
<td>Sunday 12 May</td>
<td>09:00-12:30 / 14:30-18:00</td>
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<tr>
<td>Monday 13 May</td>
<td>14:30-18:00</td>
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<tr>
<td>Tuesday 14 May</td>
<td>14:00-17:30</td>
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<tr>
<td>Wednesday 15 May</td>
<td>08:30-12:00 / 14:00-17:30</td>
</tr>
<tr>
<td>Thursday 16 May</td>
<td>08:30-12:00</td>
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### Supports

All supports were distributed. No additional requests can be received.

### Hotel Information

The ICM is located about 20 minutes from the Munich Central Station (Hauptbahnhof) by underground U2, exit ‘Messestadt West’. Whether you are looking for a hotel, a guesthouse, a private accommodation, or a boarding house you should be able to find your accommodation downtown or in the surrounding area of Munich.

Messe Munich has arranged for an on-line hotel reservation which can also be used for the CLEO®/Europe-IQEC 2013 participants at: [http://www.tradefairs.com/index.html](http://www.tradefairs.com/index.html)

The Hotel Guide of the Munich Trade Fairs offers you a large variety of accommodation possibilities for a pleasant stay. Whether near the ICM or centrally located and in the middle of the nightlife of Munich’s trendy neighbourhoods or close to the mountains with a high recreation value - here you will find a comprehensive offer of accommodation in and around Munich as well as in the alpine upland - meeting your personal criteria.

Hotels can be directly searched and booked via the Hotel Directory.

Hotels, pensions, apartments or youth hostels in Munich can also be found at: [http://www.muenchen.info/de/hotels/welcome_en.html](http://www.muenchen.info/de/hotels/welcome_en.html)

A larger variety of rooms can be found using the links:

- [http://www.muenchen.de/health/Service/4Hotel/511/index.html](http://www.muenchen.de/health/Service/4Hotel/511/index.html)
- [http://www.muenchen.de/int/en/accomodation-hotels.html](http://www.muenchen.de/int/en/accomodation-hotels.html)

Rooms, apartments and holidays homes can be found using the following link:

- [http://www.checkin-muenchen.de/index.php?mms=1](http://www.checkin-muenchen.de/index.php?mms=1)

### Transportation in Munich

Munich offers very good transportation means (hire cars, trams, metro and buses). Participants of the World of PHOTONICS congress who use local public transportation to get to Neue Messe Munich must buy a travel ticket, at their own expense.
Tickets can be purchased from all bus drivers, tram drivers, automatic ticket-dispensing machines at stations (S and U-Bahn stops) and from kiosks displaying the MVV logo. Some ticket machines accept 10 € and 20 € banknotes and most will give change. Please have some small coins ready! You can select your respective language on the ticket machines.

Buy your ticket depending on the zones you will cross and the time length you will need to travel:

- **Stripe ticket (Streifenkarte):** Stamp two stripes per zone. You are allowed to change and interrupt your journey. Return and round trips are not permitted.
- **Single trip ticket:** Valid for one person for one trip. You are allowed to change and interrupt your journey. Return and round trips are not permitted. The fare depends on the number of zones passed through.
- **Single day ticket (Tageskarte):** The most popular day tickets are also available as excellent value-for-money 3-day tickets. If you want to stay for 2 days, 4 days or even longer, simply combine the 1-day ticket and 3-day tickets.
- **Partner day ticket:** Available for as many trips as you like for up to five adults together.

### Fares for single day tickets

1. Inner District (Innenraum)  
   - **white zone** € 5,80  
2. Munich XXL (München XXL)  
   - **white and green zones** € 7,80  
3. Outer District (Außenraum)  
   - **green, yellow, red zones** € 5,80  
4. Entire Network (Gesamtnetz)  
   - **all zones** € 11,20

**Fare for 3-day Inner District**  
- **white zone** € 14,30

For your trip Munich city / Munich airport you will need a stripe ticket (8 stamps) or an entire network ticket. Inner District includes the city centre (Marienplatz, Hauptbahnhof,...) and Neue Messe Munich.

Once you have purchased your ticket, be sure to validate it by stamping it in the blue boxes you will see. This should be done prior to entering the station or immediately after boarding a bus or tram. To validate a stripe ticket (Streifenkarte) you must fold back the sections not required and insert the ticket into the validating machine (see below for number of required sections). Once you have validated your ticket, you can travel with any form of transport as long as you continue to travel in the same direction.

More information on the MVV, see:  
http://www.mvv-muenchen.de/en/homepage/index.html

A subway map can be downloaded from:  
http://www.travelthroughgermany.com/web-site2/munichsubway.htm

### Munich, Germany

The celebrated capital of Bavaria, located in the foothills of the Alps, is one of the major cities in Europe. The 1.3 million inhabitants city is famous for its science and industry environment. Munich offers fantastic opportunities for shopping, museums, theatres, art galleries and sightseeing. Its October beer festival is world famous. Tourist attractions include the Bavarian beer and South German cuisine tradition, and many half-day or one-day excursion opportunities to the nearby Bavarian Alps or places such as the fairy-tale castle of Neuschwanstein or the beautiful Tegernsee.

In May the weather is likely to be warm and the sun is likely to shine, although rain is not impossible. Munich enjoys an outstanding public transportation system, and the modern Münchner Messe complex where CLEO®/Europe-IQEC 2013 and all Laser 2013 events will be held is easy to reach from the airport, from the city centre and from most parts of the city by U-Bahn and S-Bahn lines. Shuttle bus service to the Munich airport will be available as well during most of the Laser 2013 week.

**Munich’s Churches:**

Munich is well-known for its many churches, among them:

- **Frauenkirche (Church Of Our Lady),**  
  1 Frauenplatz, Munich

**Munich’s Museums:***

- **Glyptothek**  
  Königsplatz 3, 80333 München,  
  Tel. 089/28 61 00

**Opening hours:** Tue, Wed, Fr-Su 10:00-17:00,  
Thu 10:00-20:00, Mo closed

**Cost:** Adult 3,50 €, Reduced 2,50 €, Sun 1,00 €

- **Deutsches Museum**  
  Museumsinsel 1, 80538 München, Tel: 089 / 2179-0 oder 2179 433 (recorded information)

Opening hours: daily 09:00-17:00
Getting there: all S-Bahn trains, to Isartor; Tram 18, to Museumsinsel

The Deutsches Museum is the world’s largest Museum of science and technology. The laws of nature, instruments and technological
General Information

Methods are presented on a scientifically high level using an entertaining way.

Also part of the Deutsches Museum: the Verkehrszentrum (featuring all kinds of vehicles - from formula 1 car to bicycle) and the Flugwerft (focussing on airplanes)

Deutsches Museum Verkehrszentrum
Theresienhöhe 14a, 80339 München,
Tel. 089/315 71 40
Opening hours: daily 9:00-17:00, Tue-Su 10:00-17:00, Mo completely closed on Sunday.
Getting there: Bus 53, Tram 17 to Haus der Valein (Odeonsplatz or Tram 19
http://www.hypo-kunsthalle.de

Villa Stuck
Prinzregentenstr. 60, 81675 München,
Tel. 089/45 55 51 25
Opening hours: Tue-Su 10:00-17:00, Tue till 21:00, Mo closed
Getting there: U-Bahn lines 4 to Prinzregentenplatz or U-Bahn line 5 to Max-Weber-Platz or Bus 53 or Tram 18 to Friedensengel
http://www.villastuck.de/

Bayerisches Nationalmuseum
Prinzregentenstr. 3, 80538 München,
Tel. 089/211 24-1
Opening hours: Tue-Su 10:00-17:00, Mo closed, Thu 10:00-20:00
Getting there: Bus 53, Tram 17 to Haus der Kunst/Nationalmuseum, U-Bahn lines 4/5 to Lehle
http://www.bayerisches-nationalmuseum.de/Engl/b.htm

Münchner Stadtmuseum
Sankt-Jakobs-Platz 1, 80331 München,
Tel. 089/233-223 70 and 233-255 86
Opening hours: Tue- Su 10:00-18:00 (Mondays closed)
Getting there: all S-Bahn trains to Marienplatz, U-Bahn line 3/6 to Marienplatz, U-Bahn lines 1/2 to Sendlinger Tor, Bus 52 to Viktualienmarkt, Bus 56 to Blumenstraße
http://www.muenchner-stadtmuseum.de/en.html

MUNCHEN’S FAMOUS PLACES TO BE VISITED:

Marienplatz
The Marienplatz is named according to the column of the Virgin Mary at its centre. The statue, erected in 1638 to celebrate the end of the Swedish invasion, is topped by a gilded statue of Virgin Mary which was sculpted earlier, in 1590 by Hubert Gerhard. At each corner of the column’s pedestal is a statue of a putti, created by Ferdinand Murmann. The four putti’s symbolize the city’s overcoming of war, pestilence, hunger and heresy.

The place is famous for its carillon in the New Town Hall Tower (Glockenspiel im Rathaussturm). This is the largest carillon in Germany, with near-lifesize figures performing the traditional Coopers’ Dance and a jousting match. Three times a day at 11:00, 12:00 and 17:00.

The Marienplatz is a central place for the city’s Founding Festival as well as for Fasching (carnival) celebrations and the popular Christmas market. The major restaurants, coffees and shops are located in this area. Shops are completely closed on Sunday.

Königsplatz
Commissioned by Ludwig I, this neo-Classical square boasts the Propyläen gateway and the Glyptothek, a small but enchanting collection of Greek and Roman sculpture. Also the sight of an annual summer outdoor concert series.

Isartor (Isar Gate)
Most easterly of Munich’s three remaining town gates, dating from the 14th century. Careful restoration has recreated the dimensions and appearance of the original structure. The Isar Gate accommodates the Valentin Museum.

Karlstor (Charles’ Gate)
Westerly town gate from 14th century. Incorporated at the end of the 18th century into the square known as “Stachus” (officially Karlplatz). Today it marks one end of Munich's primary pedestrian zone.

Sendlinger Tor (Sendlinger Gate)
Remaining towers of southerly fortifications from the 14th century.

BEER GARDENS

Nothing defines Munich more than its beer. You cannot talk about one without the other and you could never fully discover Munich without at least sampling its brews. Today the Munich breweries dispense 123 million gallons of beer annually. That is why many beer gardens are located in Munich:

Augustiner-Größgaststätte
Pedestrian Zone, Neuhauser Straße 16, 80331 Munich, Tel. 089/2 60 41 06.
The Augustiner-Größgaststätte is one of the
more traditional Munich establishments, with a history that reaches back to 1328. The Augustin Brothers began brewing something heavenly in Augustiner's back rooms up until 1855 when the actual brewing plant was moved to Landsberger Straße. Today Augustiner Großgaststätte is a traditional beer hall with a small courtyard beer garden, smack dab in the middle of Munich's Marienplatz pedestrian zone. The food is great and the beer is the best.

**Altes Hackerhaus**
Sendlinger Str. 14, Munich,
Tel. 089/2605026, http://www.hackerhaus.de

**Opening hours**: 9 am to midnight daily.
Located in Munich's newspaper publishing district and near Sendlinger Tor, Altes Hackerhaus has a long history involving two of the City's most renowned beer producing families, the Hackers and the Pschorrs. An entire wall in the restaurant is dedicated to the family tree, dating back to 1738 when the first Hackerhaus was founded. Highlights include a small but comfortable interior courtyard beer garden, and an outstanding restaurant serving excellent Bavarian fare. Although average by Munich high standards, Altes Hackerhaus benefits from its proximity to the Marienplatz (just a few blocks away) and easy access from the nearby U-Bahn stop at Sendlinger Tor.

**Chinesischer Turm (Chinese Tower)**
One of Munich's largest beer gardens, and perhaps its most famous. With more than 7,000 seats around the famous erzat Chinese pagoda

in the middle of Englischer Garten (900-acre park with shaded paths, brooks, ponds and swans), this place could hardly be overlooked.

**Location**: Englischer Garten 3, open from 11:00 to midnight.
The park stretches from the centre of the city (near Odeonsplatz) to the northern city border.

**Access**: The best way to reach it is the bus No. 54 from "Muenchner Freiheit" underground station (exit at stop "Chinesischer Turm")

Munich is very famous for its **theatres** but also for its **Olympic Park** (see http://www.olympiapark.de/index.html) located Spiridon-Louis-Ring 21, 80809 Munich, Tel.: 089/30 67 - 0, Fax: 089/30 67 - 22 22

**Getting there**: U-Bahn line 3 to Olympiazentrum

**Further information on Munich** is available at http://www.muenchen.de/ (8 languages available).

**Conference Management**

*European Physical Society*
6 rue des Frères Lumiére • 68200 Mulhouse, France

This programme is edited by **P. Helfenstein** and **A. Wobst**.

**Language**

English is the official language of the conferences.
CLOE’/Europe IQEC 2013 will present twelve Short Courses held in parallel. These courses will take place from Sunday 12 May 2013 to Thursday 16 May 2013 at the ICM (Rooms 12 and 22) or the Exhibition Halls (Rooms A218 and A221). The courses are at extra cost. Advance registration is recommended in order to obtain the short course material. This material will not be available for purchase during the conference. The courses are intended for engineers, scientists and graduate students with some general knowledge of optics and photonics who wish to improve their detailed understanding of the particular technical domains covered. Each course is scheduled in two parts: Course Part I (90 minutes), coffee break, Course Part II (90 minutes).

**Detailed Programme:**

> **SUNDAY, 9:00–12:30, ROOM 12**

**Short Course 10:**

**Frequency Combs and Applications**

**Course description:**

A laser frequency comb allows the conversion of the very rapid oscillations of visible light of some 100s of THz down to frequencies that can be handled with conventional electronics. This capability has enabled the most precise laser spectroscopy experiments yet, that allowed testing quantum electrodynamics, to determine fundamental constants and to search for possible slow changes of these constants. Using an optical frequency reference in combination with a laser frequency comb has made it possible to construct all optical atomic clocks that are now outperforming even the best cesium atomic clocks. Direct frequency comb spectroscopy by employing individual modes of the comb may be used for recording broadband molecular absorption. While this has practical relevance for sensitive trace gas analysis, frequency combs may be converted to the extreme ultra violet where no single mode laser exists. Therefore this method might allow high-resolution laser spectroscopy in this unexplored region for the first time. Frequency combs are also used to calibrate astronomical spectrographs and might reach an accuracy that is sufficient to observe the change of the expansion rate of the universe in real time and to find Earth-like extra solar planets. I will discuss the frequency comb principles in detail and present the various applications.

**Benefits and Learning Objectives:**

- A short history of the frequency comb.
- Basic properties both, in the time domain and frequency domain.
- Frequency metrology.
- Time domain applications.
- Practical issues for setting up and running a frequency comb.
- Various methods of direct frequency comb spectroscopy.
- XUV frequency combs.
- Applications such as all optical clocks and in astronomy.

**Intended Audience:**

This course is intended to be beneficial for graduate students and industrial and academic researchers who plan to work with frequency combs.

**Biography:**

Thomas Udem studied physics at the University of Giessen/Germany and at the University of Washington in Seattle/USA. In 1993 he received his diploma from the University of Giessen. After that he was working towards the PhD at the Max-Planck-Institute of Quantum Optics in Garching/Germany, which he received from the Ludwigs Maximilians Universität Munich/Germany in 1997. Since then he has been working at the Max-Planck-Institut of Quantum Optics and at the National Institute for Standards and Technology in Boulder/USA. In 2004 he received his habilitation from the Ludwigs Maximilians Universität Munich/Germany and became a fellow of the Max-Planck-Institute of Quantum Optics. His scientific work involves precision optical metrology that involves simple atomic systems such as hydrogen, opto-mechanics and precision spectroscopy with ion traps and precision astronomy. In addition he is conducting research that aims at making XUV radiation from high harmonic generation useful for high-resolution spectroscopy. In 2006 he received the Röntgen Award of the University of Giessen. He is a fellow of the Optical Society of America and the American Physical Society as well as a member of the German Physical Society.

> **SUNDAY, 9:00 – 12:30, ROOM 22**

**Short Course 8 – Fibre Amplifiers**

**Course description:**

This course begins with a general introduction to laser amplifiers, explaining the basic physical principles and properties of amplifiers, including e.g. four-level vs. quasi-three-level gain media, gain saturation in steady state and in pulse amplification, and amplified spontaneous emission (ASE). It then continues with more specific details for fibre amplifiers, including an overview on different amplifying ions and host media, double-clad fibres, mode areas, effective transition cross sections, influence of the pump wavelength, and ASE limitations. After a discussion of continuous-wave amplification, specific issues of pulse amplification will be discussed for the pulse duration regimes of picoseconds, femtoseconds and nanoseconds. Finally, a brief overview on the physical modeling of amplifiers will be given. In order to obtain an improved qualitative and quantitative understanding of various effects, various case studies supported by numerical simulations with the software RP Fiber Power will be presented. These demonstrate, for example, the typical strong saturation effects, characteristics of ASE, differences between forward and backward pumping, issues of cladding pumping and challenges for emission of Yb-doped amplifiers at short wavelengths.

**Benefits and Learning Objectives:**

- Understand the basic principles of laser amplifiers.
- Know the key properties of rare-earth-doped fibres, such as different dopant ions, effective transition cross sections, effective mode area, gain saturation characteristics, etc.
- Understand various techniques for alleviating various detrimental effects.
- Identify the key limitations for the performance of continuous-wave and pulsed amplifiers, and roughly quantify the typically possible performance figures.

**Rüdiger Paschotta,**

*RP Photonics Consulting GmbH, Bad Dürrenheim, Germany*
Intended Audience:
This course is intended for researchers and industry people with a basic background in laser technology, but not necessarily with a detailed expertise on optical amplifiers or fibre technology.

Biography:
Rüdiger Paschotta is an expert in laser physics, nonlinear optics and fiber technology. He originally had a career as a researcher, working at the University of Konstanz (Germany), the Optoelectronics Research Center (UK), the University of Paderborn (Germany) and ETH Zurich (Switzerland). Since mid 2005, he is working full time in his company RP Photonics Consulting GmbH, which moved to Bad Dürreheim, Germany, in 2010. He is providing technical consultancy primarily for companies being active in laser technology and related fields. Also, RP Photonics offers simulation software for fiber amplifiers and lasers as well as for various other fields in photonics. Rüdiger Paschotta became well known also as the author of the open-access Encyclopedia of Laser Physics and Technology.

Applications of Photonic Crystals

Course description:
Photonic crystals came to the fore in the early 90’s due to their ability to confine light and control its flow to an unprecedented degree. The field has since made major technological advances and has evolved from a scientific curiosity to the stage where many interesting applications can be considered. The presence of photonic crystals is now felt across the entire photonics spectrum and any major photonics conference will feature them in a variety of sessions, ranging from LEDs for light extraction to solar cells for light trapping, to photonic circuits for low power optical switching and modulation, to enhanced nonlinear effects, and to strong confinement effects for optical biosensing and for quantum optics. I will provide the conceptual background for these applications. After establishing their band structure as the main framework for describing the properties of photonic crystals, I will explore the key properties that make them unique and that allow us to tailor their properties for specific applications, addressing questions such as, “What determines the wavelength response and bandwidth?”; “Why do photonic crystal cavities exhibit such a high Q-factor?”; “What is slow light and why is it interesting?”; “How can we use photonic crystals to couple light in and out of high index materials?”

Benefits and Learning Objectives:
- Understand the photonic band structure and how it relates to the physical lattice.
- Appreciate how the band structure relates to photonic functionalities and applications.
- Determine the wavelength response and bandwidth of a photonic crystal structure.
- Appreciate the origin of the strong confinement offered by photonic crystals and how extremely high Q-factors can be created in very small volumes, e.g. for strong light-matter interaction and for quantum optics.
- Appreciate the concept of slow light waveguides and its applications.
- Be able to design grating couplers and relate their properties to LEDs for light extraction and to solar cells for light trapping.
- For each application, appreciate the unique advantages that photonic crystals may offer.

Intended Audience:
The course is appropriate for researchers and applications engineers who have heard about photonic crystals and are considering them for specific applications, but need to understand better how they work and what functionalities they might be able to offer. The course is conceptual and intuitive and only uses mathematical tools where absolutely necessary. It only assumes an appreciation for the major concepts in photonics, such as optical modes, phase and interference effects, as well as solid-state concepts such as crystal lattices, dispersion curves and band structures.

Biography:
Thomas F. Krauss has moved from St Andrews to York University where he has started a full-time position in Jan 2013. He is in the process of setting up a State-of-the-Art nanofabrication laboratory in the York Nanocentre that is due to be completed April 2013. Krauss pioneered the development of planar photonic crystals worldwide in the 1990s and he is one of the leading researchers in the field, with 240 refereed journal publications, >900 annual citations and an “h” factor of 50. He gives 10-15 invited presentations and chairs 2-3 conferences per year. He has led industrial projects (sponsored e.g. by Intel and Osram) and has coordinated a number of EU projects, e.g. FP5-PICCO (2000-2003) and FP6-SPLASH (2007-2010). He is a Fellow of the Royal Society of Edinburgh, the Optical Society (OSA) and the Institute of Physics.

Benefits and Learning Objectives:
- Recognise that HHG is an important short-wavelength light generation phenomenon that can arise in a strong-field laser matter interaction.

Course description:
In the field of nonlinear optics, high harmonic generation (HHG) is an interesting phenomenon: it arises in a strong-field laser matter interaction. The aim of this tutorial is to provide an introduction to the theory of HHG with an emphasis on recent experimental advances and their potential applications. We shall cover the key concepts of HHG and its applications to interesting problems like attosecond science. In the first lectures, the fundamental theory of HHG will be developed, and the role of strong-field laser pulses will be highlighted. The application of HHG to the generation of isolated attosecond pulses will be covered in detail, and the potential of HHG for high field science will be illustrated. A brief introduction to applications of HHG, will be given, including HHG in the context of isolated attosecond pulses.

Benefits and Learning Objectives:
- Understand the fundamentals of HHG and its applications.
- Learn about recent experimental advances in HHG.
- Develop an appreciation for the potential of HHG in attosecond science.
Technical Programme

- Appreciate the enabling laser technology and understand the pivotal role that HHG plays in Attosecond Science as a proven route to generating attosecond duration light pulses.
- Comprehend the basic physical principles of HHG in terms of both the single emitter and macroscopic (phase-matching) responses.
- Understand the semi-classical 3-step recollision model of HHG.
- Be familiar with the various experimental implementations of HHG and gain an appreciation of the dependencies on key experimental parameters.
- Learn about the key properties of HHG radiation and how it relates to other short-wavelength sources.
- Gain an appreciation of the scientific applications of HHG, especially in attosecond science.
- Obtain a perspective of the current state of the art of HHG and an appreciation of important recent developments as well as trends for future research.

Intended Audience:
This course is aimed at researchers with little or no background in high harmonic generation or attosecond science, as well as those more familiar with the topic, who wish to improve their understanding and keep abreast of recent developments in the field and learn about some of the experimental details that don’t appear in journal articles!

Biography:
John W.G. Tisch is a Professor of Laser Physics at the Blackett Laboratory, Imperial College London. His research interests are ultrafast laser physics and high-intensity laser-matter interactions, especially the generation and application of high-power femtosecond laser pulses to generate coherent x-ray pulses of attosecond duration. He is a recognised world-authority on High Harmonic Generation (HHG) and Attosecond Science and Technology and joint founder of the UK Attosecond Programme. Tisch has been an elected member of the Commission on Atomic, Molecular, and Optical Physics of the International Union of Pure and Applied Physics, and has also served on a number of international conference committees, including High Field Short Wavelength and CLEO. He was one of the Founding Chairs of the international conference series “Ultrafast Dynamical Imaging of Matter” and is Joint General Chair for the conference Ultrafast Optics IX. He is a member of the international Scientific Advisory Committee for the Extreme Light Infrastructure (ELI) European project and a Fellow of the Institute of Physics. He has dual Swiss and Australian nationality and is married with two children. In his spare time he enjoys competitive running, cycling, tennis, carpentry and playing trumpet and piano.

> MONDAY, 14:30 – 18:00, ROOM A221

Short Course 6:
Practical Quantum Optics

Gerd Leuchs,
University of Erlangen, Erlangen, Germany

Course description:
What does it mean if optics is quantum? Is high-core quantum optics solely concerned with the study of fundamental physics questions or is it also useful for practical applications? The course will give answers to these questions. An introduction to quantum aspects in optics will be given and experimental demonstrations will underline some of the counter intuitive quantum phenomena. The generation, propagation and detection of quantum light are central topics. Practical quantum optics is all about noise, noise reduction and over coming established sensitivity limits in interferometry, imaging, communication and sensing. Such applications of modern quantum optical technologies will be addressed in detail. Mathematical descriptions of the light field and its interaction with matter will be given whenever necessary but emphasis is put on practical considerations.

Biography:
Gerd Leuchs studied Physics and Mathematics at the University of Cologne until 1975 and finished with the diploma degree. In 1975 he moved to the University of Munich as research associate in the group of Prof. Dr. H. Walther. His PhD-thesis in 1978 deals with the fine structure splitting of sodium Rydberg atoms. From 1979 to 1980 he was visiting fellow at the University of Colorado in Boulder, USA. In 1982 he received the Habilitation degree at the University of Munich on multiphoton processes in atoms. 1980 he obtained a Feodor-Lynen Stipend of the Alexander-von-Humboldt Foundation and, from 1983 to 1985, a Heisenberg-Fellowship of the Deutsche Forschungsgemeinschaft, which he used to work at JILA and NIST in Boulder. From 1985 to 1989 he led the gravitational wave detection group of the Max-Planck-Society in Garching. There one focus of his research was the generation of quantum noise reduced light beams and their application towards the improvement of the sensitivity of laser interferometers. From 1990 to 1994 he served as Technical Director of Nanomach AG at Buchs in Switzerland. After having spent 5 years in industry he took over the chair of optics at the University of Erlangen-Nuremberg and continued to do research on quantum noise reduced light, this time focussing on soliton pulses in optical fibers including world first demonstrations. This led to the generation of entangled intense beams with applications in quantum information and quantum key distribution. He discovered, that quantum cryptography
with intense coherent beams has no in principle distance limitation that came as a surprise. Since 1994 he is Professor of Physics at the University of Ottawa. Since 2000 he started the Center of Modern Optics at Ottawa. In 2004 he was appointed Fellow of the Optical Society of America and Fellow of the Institute of Physics, UK. In 2005 he won the Quantum Electronics Prize of the European Physical Society and was appointed a member of the German Academy of Science Leopoldina. From 2004 to 2008 he served as director of the ‘Max Planck Research Group of Optics, Information and Photonics’. After two successful scientific evaluations the Max Planck Society decided to establish the new Max Planck Institute for the Science of Light at Erlangen and since January 2009 Gerd Leuchs is one of the directors of the Max-Planck Institute for the Science of Light (MPL).

Gerd Leuchs published more than 250 publications in peer reviewed scientific journals and numerous invited papers; he is editor of 3 books and inventor of 10 patents. In 2012 he received the cross of merit of the Federal Republic of Germany. Since 2012 he is Adjunct Professor at the University of Ottawa in Canada.

Course description:
The course will provide a self-contained overview of ultrafast optical techniques. After a brief review of the fundamental linear and nonlinear processes, the propagation and generation of ultrashort light pulses will be covered. Pulse formation in important solid-state and fiber lasers and amplifiers will be described. The achievable performance of each device will be discussed along with the factors that limit the performance. Applications to the generation of electromagnetic pulses in new frequency regimes (terahertz and ultrashort x-rays pulses, e.g.) will be touched on briefly. Techniques for the measurement of short pulses will be described. Example applications will include studies of ultrafast phenomena in solids and molecules, nonlinear microscopes for biological imaging, and generation of frequency combs.

Benefits and Learning Objectives:

• Learn how linear and nonlinear wave processes govern the formation and propagation of ultra-short pulses.
• Understand techniques for measuring ultrashort pulses.
• Become familiar with the key parameters of practical short-pulse sources.
• Learn the basic features of ultrafast-optical measurements.
• Gain an overview of the field of ultrafast science, including recent developments.

Biography:
Frank Wise received a BS degree from Princeton University, an MS degree from the University of California-Berkeley, and a PhD degree from Cornell University. Since 1989 he has been on the faculty in Applied Physics at Cornell. He has 25 years of experience developing sources of ultrashort pulses and using them to measure ultrafast phenomena in semiconductors, molecules, nanostructures, and glasses. He is an author or co-author on about 200 papers in refereed journals and holds 10 patents. Highlights of his research include the first time-domain observation of intramolecular vibration. In recent years his group has developed new pulse-shaping techniques for femtosecond fiber lasers, which have led to order-of-magnitude increases in the pulse energy over prior designs. This work includes lasers that support self-similar evolution or recently-identified dissipative solitons. Wise developed the first commercial femtosecond laser, in 1986, and this led to the creation of Clark Instrumentation, Inc. (now Clark-MXR, Inc.) to market femtosecond lasers and associated instruments. His group is now transferring ultrafast fiber-laser technology to industry.

TUESDAY, 14:00 – 17:30, ROOM A218
Short Course 12: Ultrafast Lasers and Applications

Frank Wise,
Cornell University, Ithaca, United States

Course description:
The course will discuss both fundamentals and applications of silicon photonics. Silicon photonics is rapidly emerging as an attractive platform for realizing cheaper photonic integrated circuits. Active optical cables based on silicon photonics are now already being employed in some of the highest performance supercomputers and several major semiconductor companies have announced activities in this domain.

The course will start with explaining the reasons for this sudden interest and the possible advantages of the platform. Next the fundamentals of the waveguide platform and its performance will be discussed (straight and bend waveguides, filters, fiber-chip coupling …). Subsequently we will also discuss more advanced devices such as detectors, high-speed modulators and lasers. In each case we will also touch upon the problems that still need to be resolved and give a comprehensive overview of the current state-of-the-art.

In a second part we will discuss the integration in a standard CMOS processing environment and on different approaches to integrate silicon photonics circuits with optical circuits. Finally we give a review of current and future applications, in optical communications, optical interconnect and optical sensing.

The course will contain extensive references for further study.

Benefits and Learning Objectives:

• Understand why silicon photonics forms a promising platform for realizing densely integrated photonic integrated circuits.
• Understand the operation of basic (splitters, filters, couplers) and more advanced (detectors, modulators, lasers) silicon photonics devices.
• Understand the main challenges still to be resolved.
• Get insight in the different approaches to combine silicon photonics with electronics.
• Get insight in the fabrication technology and in possibilities for getting processed devices in a cost-effective way, e.g. though the epixfab multiproject wafer service.
• Understand for what type of applications silicon photonics may form a suitable technology platform.
Biography:
Dries Van Thourhout got his PhD in applied physics from Ghent University in 2000 and subsequently spent 2 years at Bell Laboratories, Crawford Hill, NJ US. Currently he is a professor at Ghent University and associated with imec, Europe’s largest nano-electronics research centre. He has extensive experience in integrated optics, silicon photonics and heterogeneous integration on silicon photonics. He has worked on fundamental research topics (such as optomechanics and nanocrystals) but has also been involved in more application-oriented projects such as the EU projects WADIMOS (optical interconnect) and SMARTFIBER (silicon photonics read out chip for fibre bragg sensing), which he is coordinating. He is also strongly involved in the EU funded integrated project HELIOS, which covers the whole value chain of silicon photonics. He has authored or coauthored over 150 journal publications, over 300 conference contributions and over 10 patents. He has given tutorials on silicon photonics at major conferences such as OFC, ACP and CLEO. He is associated reviewer for IEEE PTL and holder of an ERC starting grant. In 2012 he was awarded with the “Laureate of the Academy” prize of the Belgian Academy of Sciences.

Course description:
The course will start with a quick introduction to Ultrafast Optics, Nonlinear Optics and fundamentals of pulse characterization. Then, characterization methods from the most basic (i.e. autocorrelations) to recent and advanced ones will be covered in detailed. Applicability, advantages and limitations of various approaches will be reviewed. Specifically, the course participants will learn about the basic principles and limitations of autocorrelation and interferometric approaches; complete intensity and phase measurement using more advanced techniques such as Frequency Resolved Optical Gating (FROG), Spectral phase interferometry for direct electric-field reconstruction (SPIPER) and related methods. Particular considerations for measurements in extreme cases such as near-single-cycle regime and very complicated temporal structures will be reviewed. Finally, extensions of the methods to include spatial evolutions and complete spatio-temporal pictures will be covered.

Benefits and Learning Objectives:
- Understand the basic principles of Ultrafast Optics and Nonlinear Optics.
- Understand the basics of ultrashort pulse characterization.
- Learn the basics of autocorrelation and Interferometric autocorrelation.
- Learn the basics of intensity and phase measurements with more advanced techniques.
- Obtain a detailed understanding, applicability and limitations of commonly used methods.
- Identify the critical issues, relevant to measurements of pulses in the single-cycle regime.
- Obtain an understanding of spatio-temporal dynamics of femtosecond pulses.
- Learn the necessary techniques for spatio-temporal pulse measurements.
- Obtain the relevant practical skills for building of pulse characterization devices.
- Obtain an appreciation for recent trends and advances in the area of pulse characterization.

Intended audience:
The course is intended for researchers working with fundamental or applied aspects of Ultrafast Optics, in both academic and industrial institutions. Basic background and familiarity in Ultrafast Optics will be sufficient. Ultrashort pulse characterization methods will be covered from basic concepts to advanced techniques.

Biography:
Selçuk Aktürk received his BS degree in Physics from Bilkent University in Ankara, Turkey (2001), and PhD degree in Physics from Georgia Institute of Technology in Atlanta, GA, USA (2005). He worked as a post-doc researcher at GaTech and Research Scientist at Swamp Optics LLC until 2006. He continued his post-doctoral research at Laboratoire d’Optique Appliquée, Ecole Polytechnique – ENSTA in Palaiseau, France from 2006 to 2009. Since April 2009, he is at the Istanbul Technical University, Department of Physics, currently at Associate Professor level. Selçuk Aktürk’s research activities involve ultrashort pulse characterization in time and space, of interactions of high intensity laser pulses with matter, and laser material processing. He co-authored about 40 peer-reviewed journal articles and numerous conference proceedings. His achievements were recognized by several awards from institutions including Georgia Institute of Technology, Turkish Academy of Sciences, The Abdus-Salam International Centre for Theoretical Physics and International Commission for Optics. He is a member of Optical Society of America and SPIE.

Course description:
This course provides an overview of optical parametric oscillators (OPOs), from basic operation principles to advanced devices. The course will begin with a description of the fundamental concepts in nonlinear optics and frequency conversion, followed by a discussion of OPO devices, an overview of the latest advances in OPO technology, and applications. The discussion will cover OPOs operating in all temporal regimes, from the continuous-wave (cw) to the ultrafast femtosecond time-scales. Specifically, the course participants will gain knowledge of the basic principles of nonlinear frequency conversion and optical parametric
TECHNICAL PROGRAMME

generation; phase-matching, amplification and tuning; OPO design issues, including nonlinear material and pump laser selection criteria; OPO operation in different time-scales, generic device architectures, pumping and resonance configurations; cw OPOs: singly-resonant, pump-enhanced, doubly- and triply-resonant oscillators, pump power threshold and frequency behaviour, frequency tuning and control, solid-state, fiber, and semiconductor disk laser pumping, visible to mid-IR generation, novel device architectures; pulsed OPOs: operating principle, threshold condition, compact all-solid-state oscillators, high- and low-energy devices, single-mode operation, UV to mid-IR and THz generation; synchronously-pumped OPOs: picosecond OPOs: high-repetition-rate cw and pulsed oscillators, solid-state, Ti:sapphire and fiber laser pumping, birefringent and quasi-phase-matched devices, UV to mid-IR generation; femtosecond OPOs: Ti:sapphire, solid-state, and fiber-pumped devices, collinear and noncollinear pumping, birefringent and quasi-phase-matched oscillators, spectral and temporal control, UV to mid-IR generation; applications of OPO devices in different operating regimes.

Learn the necessary techniques for spatial, spectral, and temporal control of OPO devices in different operating regimes.

Gain a perspective of current OPO technology, the important recent developments in the field, as well as novel and emerging applications of OPO sources.

Intended Audience:
This course is intended for researchers with little or no background in OPOs, as well as those more familiar with the subject area, who wish to enhance their understanding and update their knowledge of the latest developments in OPO device technology. The course will benefit graduate students and other industrial and academic researchers already involved or in early stages in OPO development.

Biography:
Majid Ebrahimi-Zadeh is an ICREA (Institucio Catalana de Recerca i Estudis Avancats) Professor at IFCO-The Institute of Photonic Sciences, Barcelona, Spain. He has published over 450 journal papers and peer-reviewed communications, including 70 invited papers and 11 post-deadline papers at major international conferences. He has edited 2 books and has authored 11 major invited book chapters and reviews in volumes such as Science, OSA Handbook of Optics, Springer, Handbook of Laser Technology and Applications, Laser and Photonics Review, and Phil. Tans. Roy. Soc. A (2003). He has been a regular instructor of the short course on OPOs at CLEO/USA since 1997 and at CLEO/Europe since 2007.

Majid Ebrahimi-Zadeh has served more than 40 times on the technical, organizing, advisory, and steering committees of major international conferences and has chaired 3 international conferences. He has served as advisory editor of Optics Letters, guest editor of J. Opt. Soc. Am. B, topical editor of Optics Letters, associate editor of Advances in Nonlinear Optics, and associate editor of IEEE Photonics Journal, and serves as the current Chair of Nonlinear Optics Technical Group at OSA. Majid Ebrahimi-Zadeh is the co-founder, president and chief scientist of Radiant Light (www.radiantis.com), a company he created from his research laboratory in Barcelona in 2005. He is a recipient of Innova Prize for technology innovation and enterprise (Spain: 2004), Berthold Leibinger Innovationspreis (Germany: 2010), and a fellow of OSA and SPIE.

Course description:
This course aims to provide a comprehensive, focused overview of optical coherence tomography (OCT) from basic operation principles to advanced state-of-the-art technology. The course introduces OCT technology and applications not only from an optical and technological viewpoint, but also from biomedical and clinical perspectives. The different parts of the course are presented in a style comprehensible to a broad audience. The course will begin with a discussion of fundamental OCT concepts, key technological components (broad bandwidth and swept source laser technology, high speed detection technologies) parameters (imaging resolution, imaging speed, penetration depth, imaging sensitivity), critical design issues and data analysis and signal post processing in OCT leading to a review of the current state-of-the-art OCT technologies (commercial and scientific).

Multispectral functional extensions of OCT (Doppler OCT, Doppler angiography, spectroscopic OCT, OCT elastography, optophysiology) as well as contrast enhanced OCT (polarization sensitive OCT, contrast agents in OCT), hybrid multimodal OCT imaging approaches (adaptive optics OCT; OCT/multiphoton microscopy; OCT/photoacoustic tomography; OCT/fluorescence imaging; OCT/Coherent Anti-Stokes Raman Scattering) and their (bio)medical and nonmedical applications will also be presented. Finally OCT technology transfer, OCT market and the economic impact of OCT as well as possible future directions of OCT will be discussed.

Benefits and Learning Objectives:
- Understand the basic principles of OCT (time domain OCT, spectral/Fourier domain OCT, swept source OCT, full-field OCT, digital holography)

WEDNESDAY, 14:00 – 17:30, ROOM A218

Short Course 2:

Optical Coherence Tomography and Applications

Wolfgang Drexler,
Medical University
Vienna, Vienna, Austria
Obtain an appreciation for limitations of different OCT technologies
Gain a perspective of current light source technologies in OCT
Obtain an overview of state-of-the-art OCT developments including ultrahigh speed and resolution, functional, contrast enhanced, hybrid multi-modal OCT
Presentation of biologic, clinical and nonmedical applications of OCT
Get insight into the OCT market and technology transfer as well as possible future directions

Intended Audience:
This course is intended for researchers with background in optics, biophotonics and optical imaging (especially optical coherence tomography - OCT) as well as for those familiar with the subject area who wish to enhance their understanding and update their knowledge of the emerging developments in this field. The course will benefit researchers in both industry and academia and will be of interest not only to physicists, scientists and engineers, but also to biomedical and clinical researchers from different medical specialties.

Biography:
Wolfgang Drexler received his MS and PhD in Electrical Engineering in 1991 and 1995, respectively, at the Technical University of Vienna, Austria. From 2006 to 2009 he was a Full Professor of Biomedical Imaging at the School of Optometry and Vision Sciences at Cardiff University, Wales, UK. Since 2010 he is an Honorary Distinguished Professor at Cardiff University, UK. Since October 2009 he is a Full Professor of Medical Physics and the Head of the Center for Medical Physics and Biomedical Engineering at the Medical University of Vienna, Austria and is also Director of the Christian Doppler Laboratory for Laser Development and their Application in Medicine since 2011.

He spent 2 years at the Massachusetts Institute of Technology (MIT), Cambridge, USA, received the Austrian START Award from the Austrian Science Fund in 2001, the COGAN Award from ARVO in 2007, the Fear Memorial Award in 2008, the Gabriel Goscas Medal in 2009, the DOG’s Innovator’s Award in 2011 as well as the Edridge Green Medal from The Royal College of Ophthalmologists in 2012.

He is a member of the Austrian Academy of Science and has published more than 155 publications (including Nature Medicine and PNAS) in peer reviewed journals and is first, co-author or corresponding author of more than 400 conference proceedings or abstracts resulting in a h-index of 49. His group’s publications have been cited more than 7700 times in the last 10 years with more than 900 citations in years 2008, 2010 and 2011. He is (Co)Editor of 11 books, including “Optical Coherence Tomography: Technology and Applications” (2008). Wolfgang Drexler gave more than 160 invited or keynote talks since 2000 and has accomplished more than € 8.7 million research grant income in the last decade.

Course description:
This course is intended for researchers with little or no background in Laser Tweezers as well as for those familiar with the subject area wishing to enhance their understanding and update their knowledge of the field. The course will benefit researchers in both industry and academia. The course will provide an overview of Laser Tweezers starting from their basic operational principles to advanced systems that use spatial light modulators to trap and move many objects simultaneously. The course will cover the fundamental concepts and the critical design issues for anyone wishing to build or modify a tweezers system.

Specifically, the course participants will learn about the pros and cons of various optical configurations; strategies for multi-trap control; algorithms for holographic beam formation; user interfaces and options for high-speed position and force measurements. A guide will be given to free to download software for hologram design and spatial light modulator control.

We hope also to exhibit a commercial system with input from the suppliers to answer questions regarding possible customisation.

Benefits and Learning Objectives:
Understand the basic principles of Laser Tweezers.
Compare and contrast the various configurations for optical manipulation.
Understand the benefits and restrictions of different trap steering approaches.
Consider the pros and cons of various algorithms for hologram calculation and control of spatial light modulators.
Review the various options for tweezers-human interface.
Examine how high-speed video can be employed to give both force and position measurement.
Consider various example applications and what tweezers can do that other technologies cannot.

Biography:
Miles Padgett is Professor of Optics in the School of Physics and Astronomy at the University of Glasgow. He heads a 15-person team covering a wide spectrum from blue-sky research to applied commercial development, funded by a combination of Miles Padgett is Professor of Optics in the School of Physics and Astronomy at the University of Glasgow. He heads a 15-person team covering a wide spectrum from blue-sky research to applied commercial development, funded by a combination of government charity and industry. In 2001 he was elected to Fellowship of the Royal Society of Edinburgh. In 2007/8 he was a Leverhulme Trust, Royal Society Senior Research Fellow. From 2009 he holds a Royal Society/Wolfson Merit Award. In 2011 he was appointed to the Kelvin Chair of Natural Philosophy and became a Fellow of the Optical Society. In 2008 Padgett was awarded the UK Institute of Physics, Optics and Photonics Division Prize for a "distinguished record of achievement in research that spans fundamental aspects of optical angular momentum and applied optical sensors". In 2009 Padgett was awarded the Institute of Physics, Young Medal "for pioneering work on optical angular momentum". Padgett is recognised for his studies in the field of optics and in particular of optical angular momentum. His contributions include an optical spanner for spinning micron-sized cells, use of orbital angular momentum to increase the data capacity of communication systems and an angular form of the quantum Einstein-Podolsky-Rosen (EPR) paradox. With respect to Optical Tweezers, Padgett’s Group and their collaborators have focused on the use of spatial light modulators for forming multiple traps coupled to various user interfaces for high-speed interactive use.

Technical Programme
Short Course 5:
Laser Beam Analysis, Propagation and Spatial Shaping

James R. Leger,
University of Minnesota,
Minneapolis,
United States

Course description:
The propagation and focusing properties of real laser beams are greatly influenced by beam shape, phase distortions, degree of coherence, and aperture truncation effects. The ability to understand, predict, and correct these real-world effects is essential to modern optical engineering. Attendees of this course will learn a variety of techniques for measuring and quantifying the important characteristics of real laser beams, be able to calculate the effects of these characteristics on optical system performance, and explore a variety of beam shaping techniques to optimize specific optical systems.

The course starts with a basic and intuitive description of Gaussian beam characteristics from an ideal laser. These concepts are extended to non-Gaussian beams (e.g., high-order Hermite Gaussian beams, top-hat shapes, laser arrays, and non-diffracting beams) and the relative merits of various beam shapes are discussed. Beam characterization methods such as M2, Strehl ratio, and TDL are reviewed. Simple expressions for estimating the effects of laser aberrations and coherence on beam focusing and propagation are reviewed. Coupling of light into single and multi-mode fibres, as well as far-field light concentration limits are explored as real-world examples. The constant radiance theorem and étendue are employed as engineering tools to optimize optical design, and simple analytical tools are presented to estimate the effects of spatial beam shape, phase aberrations, and coherence on beam concentration. The course ends with a description of internal and external cavity beam shaping techniques using phase modulation (e.g., diffractive optical methods) and polarization modulation (e.g., cylindrical vector beams).

Benefits and Learning Objectives:
This course will enable participants to:
- Measure the quality of a laser beam using several methods.
- Interpret the meaning of various laser specifications.
- Understand Gaussian laser beam properties from an intuitive standpoint.
- Predict the propagation and focusing properties of non-ideal and aberrated laser beams.
- Determine the concentration limits of a light field.
- Design optimal beam concentration optics.
- Compare different beam profiles for specific applications and calculate ideal performance.
- Design beam shaping optics using polarization and phase manipulation.

Intended Audience:
This course is designed to provide laser engineers, optical system designers, and technical management professionals with a working knowledge of laser beam characterization, analysis, and modification. Physical and intuitive explanations of most topics are designed to make the concepts accessible to a wide range of participants.

Biography:
James Leger received his BS degree in Applied Physics from the California Institute of Technology (1974) and Ph.D. degree in Electrical Engineering from the University of California, San Diego (1980). He has held previous positions at the 3M Company, and MIT Lincoln Laboratory. He is currently professor of Electrical Engineering at the University of Minnesota, where he holds both the Cymer Professorship of Electrical Engineering and the Mr. and Mrs. George W. Taylor distinguished professorship. His research group is studying a wide variety of optical techniques, including laser mode control and beam shaping techniques, spectral and coherent laser beam combining, optical metrology, solar energy optics, design of nonclassical imaging systems, and microoptical engineering. James Leger is currently serving as deputy editor of Optics Express, and has recently served as a member of the CLEO (US) steering committee and the Board of Directors of the Optical Society of America.

James Leger has been awarded the 1998 Joseph Fraunhofer Award/Robert M. Burley Prize by the Optical Society of America, the 1998 Eta Kappa Nu outstanding teaching professor award, the 2000 George Taylor Award for Outstanding Research at the University of Minnesota, the 2006 Eta Kappa Nu Outstanding teaching Professor award, the ITSB professor of the year award (2006), the Morse Award for Outstanding Undergraduate Teaching (2006), the George Taylor Distinguished Teaching Award (2007), and the George Taylor Service Award (2008). He has recently been inducted into the academy of distinguished teachers at the University of Minnesota. He is a Fellow of the Optical Society of America, Fellow of the Institute of Electrical and Electronic Engineers (IEEE), and Fellow of the International Society of Optical Engineers (SPIE).
TECH-FOCUS SESSIONS

An attractive feature of the CLEO®/Europe technical programme has been the Tech Focus format. Tech-Focus sessions concentrate on selected photonics applications of industrial importance. The 2013 programme features two Tech-Focus sessions entitled "Fibre and Solid-State Lasers - A Comparison from an Industrial Point of View - High Power" jointly held with the LIM 2013 conference, which showcase this exciting field through presentations from leading academic and industrial researchers. Both sessions consisting of a total of 6 invited presentations take place on Tuesday afternoon.

CLEO®/Europe-IQEC 2013 paid registrants are invited to attend the Tech-Focus sessions at no additional charge. Those wishing to attend the Tech-Focus who are NOT FULL FEE registrants of the conferences must pay the one-day fee.

TF-1/LIM.2
Applications and Market Segments for Ultra-High Brightness Direct Diode Lasers
• W. Gries, S. Heinemann, H. Fritsche, and W. Súptitz, DirectPhotonics Industries GmbH, Berlin, Germany
Ultra-high brightness (UHB) direct diode laser systems with kW output power are on the verge of market introduction. This talk discusses applications and market dynamics of UHB direct diode lasers.

TF-2/LIM.2
Ultrafast Solid State Laser with High Pulse Energy – New Applications
• H. Amler, S. Sobolewski, and J. Thumbs, Photon Energy GmbH, Ottensoos, Germany
Usually for marking applications ns-lasers are used. Since a new ps-laser source is available with lower costs, new possibilities are opened up to use the advantages of this laser type also for marking applications.

TF-1/LIM.3
The Power of Choice of Solid State Lasers for Successful Industrial Laser Applications
• K. Löffler, TRUMPF Laser und Systemtechnik GmbH, Ditzingen, Germany
The presentation will show on examples from successful laser applications the use and need for the different solid-state laser resonator concepts. It will describe CW-high power as well as short pulse lasers in the ps / ns range.

TF-2/LIM.3
Ultrafast Fiber Lasers and Bulk Lasers for Material Processing - A Comparison
• N. Hodgson, R. Knappe, and M. Bengtsson, Coherent Inc., Santa Clara, CA, United States
The technology and performance of high energy picosecond and femtosecond lasers in fiber and bulk solid state geometry are reviewed. Ultrafast laser systems providing pulse energies of up to 100s of microjoules are compared with respect to their applicability in material processing.

PLENARY SESSIONS

PL-1: CLEO®/Europe 2013 Plenary Talk

PL-2: World of Photonics Opening with Plenary Talk

Adolf Giesen, DLR, German Aerospace Center, Stuttgart, Germany

Biography
Dr. Adolf Giesen received his Ph.D. in 1982 at the University of Bonn, Germany. Then, he joined DLR (the German Aerospace Center), institute of Technical Physics at Stuttgart working on rf-excited CO₂-lasers. In 1986 he moved to the University of Stuttgart, Institut für Strahlwerkzeuge as head of the laser development department. At the University he continued working on CO₂-lasers as well as on optical components for high power lasers. In 1992 he started working on thin disk lasers (in collaboration between the University of Stuttgart and DLR). 2002 he received the “Berthold Leibinger Preis” for the invention and the work on thin disk lasers and in 2004 he received the “Rank Prize” also for the invention and the work on thin disk lasers. Since 2007 he is director of the Institute of Technical Physics of DLR and he is continuing the work on high power lasers, especially for aerospace applications as well as for security and defense applications.

Abstract
The design ideas of thin disk lasers will be explained. Results for continuous wave operation and for pulsed operation show the capability for building high power lasers with high efficiency and good beam quality, simultaneously.

PL-2: World of Photonics Opening with Plenary Talk

Monday, 09:30 – 10:45
Location: Room 1

Words of Welcome will also be addressed during the session.
STEFAN HELL

Max Planck Institute for Biophysical Chemistry,
Göttingen, Germany

Biography
Stefan W. Hell is a director at the Max Planck Institute for Biophysical Chemistry in Göttingen, where he leads the Department of Nano-Biophotonics. He also leads a research group at the German Cancer Research Center (DKFZ) in Heidelberg.

Stefan W. Hell received his diploma (1987) and doctorate (1990) in physics from the University of Heidelberg. From 1991 to 1993 he worked at the European Molecular Biology Laboratory, followed with stays as a senior researcher at the University of Turku, Finland, between 1993 and 1996, and as a visiting scientist at the University of Oxford, England, in 1994. In 1997 he joined the Max Planck Institute for Biophysical Chemistry in Göttingen, where he has built up his current group dedicated to subdiffraction-resolution microscopy. In 2003, following his appointment as a director, he established the Department of Nano-Biophotonics. Stefan W. Hell is credited with having developed the first viable approach for overcoming Abbe’s diffraction barrier in a far-field light microscope. For his work he has received several awards, including the Prize of the International Commission in Optics (2000), the Otto-Hahn-Prize (2009), the Gothenburg Lise-Meitner Prize (2011), and the Körber European Science Award (2011).

Abstract
Throughout the 20th century the resolution of optical microscopy relying on conventional lenses was limited by diffraction. We show how this limit can be radically overcome and how this change impacts various fields of science.

PL-3: IQEC 2013 Plenary Talk and Awards Ceremony

Tuesday, 10:30 – 12:30
Location: Room 1

A series of Prizes and Award Ceremonies will also be presented during the session.

PL-3.1 MON

Coherent Back Scattering and Anderson Localization of Ultra Cold Atoms

Alain Aspect,
Laboratoire Charles Fabry, Institut d’Optique, Palaiseau, France

Biography
Born in 1947, Alain Aspect is an alumni of ENS Cachan and Université d’Orsay. After three years teaching in Cameroon, he became a lecturer at ENS Cachan, with his research at Institut d’Optique. In 1985 he took a research position at ENS/College de France, with Claude Cohen-Tannoudji. Since 1992 he has been a CNRS senior researcher (emeritus since 2012), at Institut d’Optique. He is also a professor at Institut d’Optique Graduat School (Augustin Fresnel chair), and at Ecole Polytechnique, in Palaiseau.

He is a member of the Académie des Sciences (France), Académie des Technologies (France), National Academy of Sciences (USA), OAW (Austria).

Research
Alain Aspect first research bore upon tests of Bell’s inequalities with entangled photon pairs (PhD 1983), then wave-particle duality for single photons.

With Claude Cohen-Tannoudji he developed new methods for cooling atoms with lasers.

Since 1992, he is in the Atom Optics group that he has established at Institut d’Optique, where research bears upon quantum atom optics, quantum degenerate gases and atom lasers, quantum simulators of disordered materials.

Abstract
Ultra cold atoms in a disordered potential created with a laser speckle are used to study Anderson Localization and Coherent Back Scattering.

TUTORIAL TALKS

Sunday, 11:00 – 12:00
Location: Room 14a

CM-2.1 SUN

Resource Efficiency Improvements through Laser Processing of Designer Materials

William O’Neill, University of Cambridge, Cambridge, United Kingdom

This tutorial explores the laser technologies and processes that can effect change in the resource efficiencies of production operations. Three basic visions are presented along with case studies to demonstrate their implementation.

Il-4.1 THU

Geometry and Light: The Science of Invisibility

Ulf Leonhardt, Weizmann Institute of Science, Rehovot, Israel

Science Magazine listed transformation optics among the top 10 science insights of the decade 2000-2010. The tutorial gives an introduction into this subject that may, literally, transform optics.
An overview is given of the generation, coherent detection and application of ultra-broadband terahertz pulses which cover substantial parts - or all - of the far-infrared and infrared spectral regimes.

**CF/IE-7.1 MON**

**Optofluidic for Energy Applications**

- Demetri Psaltis, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

We will discuss optofluidic solar fuel systems that rely on microstructured components with combined optical and fluidic functionality to improve the efficiency of solar energy harvesting.

**IC-1.1 TUE**

**Quantum Simulations using Ultracold Atoms**

- Immanuel Bloch, Max-Planck Institute of Quantum Optics, Garching, Germany

Ultracold quantum gases offer remarkable opportunities for probing and controlling quantum matter. In my talk I will discuss highlights and future perspectives of this interdisciplinary research field.

**IC-5.1 MON**

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The influence of nuclear motion on the electron dynamics in an efficient sub-cycle control of the molecule K$_2$

$^1$R. Sienering$^1$, P. von den Hoff$^1$, T. Bayer$^3$, H. Braun$^2$, T. Baumber$^2$, M. Wellerhaupt$^3$, and R. de Vivie-Bieldt$^3$

$^1$Department für Chemie, Ludwig-Maximilians-Universität, München, Germany; $^2$Institut für Physik und CINSAT, Universität Kassel, Kassel, Germany

Selective population of dressed states (SPDS) is a control pathway in atoms and molecules including explicitly the electronic dynamics. We highlight the influence of the nuclear motion on the electron dynamics in the potassium dimer.

Direct laser acceleration of non-relativistic electrons at a photonic structure

$^1$L. Bruder and $^1$H. Hommelhoff$^{1,2}$;
$^2$Max Planck Institute of Quantum Optics, Garching, Germany; $^3$Department of Physics, Friedrich Alexander University Erlangen Nuremberg, Erlangen, Germany

We report direct laser acceleration of non-relativistic 28keV-electrons at a dielectric grating with the inverse Smith-Purcell effect. We observe an acceleration gradient of 25MeV/m, already comparable to state-of-the-art RF-linacs and expect 1.5GeV/m for relativistic electrons.

Ultrafast restoration of valence electrons in 1,3-butadiene probed by time-resolved photoelectron spectroscopy with high harmonic pulses

A. Makida, H. Igarashi, T. Fujiiwa, and $^1$T. Sekikawa, Hokkaido University, Sapporo, Japan

Ultrafast recovery of the valence electrons to the ground state in 1,3-butadiene with a time constant of 53 fs after photoexcitation was observed by time-resolved photoelectron spectroscopy using high harmonic pulses.

IF-1: Pulse Manipulation with Nonlinear Optics

Chair: Rachel Grange, Friedrich Schiller University, Jena, Germany

Broadband deep-ultraviolet femtosecond pulse generation by third-order nonlinear optical processes in thin media

$^1$H. Crespo$^1$, F. Silva$^2$, and R. Weigand$^2$; $^1$IFIMUP-IN and Departamento de Física e Astronomia, Faculdade de Ciências, Universidade do Porto, R. do Campo Alegre 687, 4169-007, Porto, Portugal; $^2$Departamento de Optica, Facultad de Ciencias Físicas, Universidad Complutense de Madrid, Avda. Complutense s/n, 28040, Madrid, Spain

We demonstrate the generation and measurement of broadband deep-ultraviolet pulses using third-order nonlinear optical processes in thin media. These results are well described by simulations. The new pulse measurement technique of dispersion-scan is also discussed.

IF-1: Pulse Manipulation with Nonlinear Optics

Chair: Martin Koch, Phillips-University Marburg, Marburg, Germany

Ultra-broadband THz Pulses - From Millimeter Waves to the Infrared

$^1$H. Kroos and M. Thomson; Goethe University, Frankfurt, Germany

An overview is given of the generation, coherent detection and application of ultra-broadband terahertz pulses which cover substantial parts - or all - of the far-infrared and infrared spectral regimes.

CA-1: Nonlinear Frequency Conversion

Chair: Valdas Pasiskevicius, KTH Stockholm, Stockholm, Sweden

Absorption Coefficient and Raman Gain in CVD Diamond as Functions of Pump Wavelength: Towards Efficient Diamond Raman Lasers

$^1$V. Saito$^1$, S. Reilly$^3$, W. Lubeig$^2$, and A. Kemp$^1$;
$^2$Institute of Photonics, University of Strathclyde, Glasgow, United Kingdom; $^3$Department of Electronic and Electrical Engineering, University of Strathclyde, Glasgow, United Kingdom

Raman gain in synthetic diamond is measured at different wavelengths taking into account absorption losses. It is found to scale linearly with the pump wavenumber. A 6W intracavity diamond Raman laser will be discussed.

Narrow-linewidth UV laser source at 257 nm

$^1$X. Dèlè$^1$, L. Deyra$^1$, A. Benoit$^2,3$, M. Hanno$^2$, F. Balembots$^1$, B. Coquelin$^1$, D. Sangla$^1$, F. Salin$^1$, J. Didierjean$^1$, and P. Georges$^1$;
$^1$Laboratoire Charles Fabry, Palaiseau, France; $^2$Eole systems, Pessac, France; $^3$Institut de recherche XLIM, Limoges, France; $^4$Fibercryst, Villeurbanne, France

We report on a narrow-linewidth pulsed laser source emitting over 3 W at 257 nm. An Yb+YAG single crystal fiber power amplifier is used to overcome the Brillouin limitation in glass fibers.
EC tuning of a two color QCL active region design in the 3 to 4 µm region

-S. Riedl, A. Bismuto, A. Hugi, M. Beck, and J. Faist; Institute for Quantum Electronics, ETH Zurich, Zurich, Switzerland

A broadband Quantum-Cascade-Laser in the 3 to 4 µm region was tuned over 549 cm-1 using a grating-tuned external cavity set-up. The junction-mounted device was HR and AR coated and operated in pulsed mode.

CM-1.1 SUN

Synthesis and Characterization of Hybrid Copper-Chitosan Nanoantimicrobials by Femtosecond Laser-Ablation in Liquids

-A. Ancona1, G. Palazzo2, A. Trapani2, T. Sibillano3, F.P. Mezzapesa4, A.A. Picca4, M.C. Sportelli4, E. Bonerba4, G. Tantillo5, G. Trapani1, and N. Ciofi6; CNR-Istituto di Fotonica e Nanotecnologie U.O.S. Bari, Bari, Italy; 2Università degli Studi di Bari, Dipartimento di Chimica, Bari, Italy; 3Università degli Studi di Bari, Dipartimento di Farmacia-Scienze del Farmaco, Bari, Italy; 4Università degli Studi di Bari, Dipartimento di Medicina Veterinaria, Bari, Italy

We report on the synthesis by fs-laser ablation in liquids of novel copper-chitosan composite biodegradable nano-antimicrobial material. The hybrid nanocolloids were characterized by several techniques. Bioactivity tests demonstrated their efficacy against Gram-negative bacteria proliferation.

CM-1.2 SUN

Uni-directional liquid spreading realized by laser-based surface structuring

-E. Frideva1, J. Koch2, and R.N. Chichkov; Laser Zentrum Hannover e.V., Hannover, Germany

Slanted microspikes have been fabricated by ultra-short pulse laser irradiation of solid targets, placed at different angles to the incident laser beam. On the structured surfaces liquid guidance in a one preferred direction is demonstrated.

CM-1.3 SUN (Invited)

Film-free laser microprinting of complex materials

-A. Patrasioiu1, J.M. Fernández-Pradas1, J.L. Morena2, and P. Serra; Departament de Física Aplicada i Optica, Universitat de Barcelona, Barcelona, Spain

The mechanisms of ejection taking place during the film-free laser printing of liquids are investigated through time-resolved imaging: the acquired images reveal a complex jetting dynamics driven by a laser-generated cavitation bubble.

CD-1.1 SUN (Invited)

Nonlinear Optics with High Power Femtosecond Mid-Infrared Laser Pulses

-D. Kartashov1, S. Alihauskas2, A. Puglissi3, A. Zheltikov3, J. Kasparian4, J-P. Wolf5, D. Ficco6, and A. Baltuska1; 1Photonics Institute, Vienna University of Technology, Vienna, Austria; 2Russian Quantum Center, International Laser Center, Physics Department of M.V. Lomonosov Moscow State University, Moscow, Russia; 3Department of Physics and Astronomy, Texas A&M University, College Station, United States; 4Université de Genève, Genève, Switzerland; 5Institute of Photonics and Quantum Sciences, Heriot-Watt University, Edinburgh, United Kingdom

We present review of experimental and numerical investigations of interaction of high power mid-infrared femtosecond laser radiation with gases and solids. High-order nonlinear processes and new regimes of filamentation in gases and solids are discussed.

CB-1.2 SUN

Mid-wave infrared (3-5µm) AllnSb resonant-cavity LEDs

-L. Meriggi1, M.J. Steer2,3, M. Sorel1, C.N. Ironside1, J.G. Thayre1, and C. MacGregor2; 1University of Glasgow, Glasgow, United Kingdom; 2Quantum Device Solutions, Glasgow, United Kingdom

We present a mid-wave infrared AllnSb resonant cavity LED with a 5-pairs bottom Distributed Bragg Reflector. Measured photoluminescence shows 2.5-fold emission enhancement at 4-4.5µm and clear Fabry-Pérot modes, validating the modelled cavity reflectivity and dimensions.

CB-1.3 SUN (Invited)

Recent progress on single-mode quantum cascade lasers

-B. Hinkov1, P. Jouy1, A. Hugi1, A. Bismuto1,2, M. Beck1, S. Blaser2, and J. Faist3; 1Institute for Quantum Electronics, Swiss Federal Institute of Technology (ETH) Zürich, Zürich, Switzerland; 2Alpes Lasers SA, Neuchâtel, Switzerland

Recent progress on single-mode quantum cascade lasers is reviewed. Special emphasis is put on below-1W dissipations devices, monolithic master-oscillator power-amplifier geometries with peak power above 1W and switchable twin distributed feedback grating sources.

CD-1.2 SUN

Enhancement and shape control of weak molecular absorption signal with chirped-pulse mid-IR lasers

-E. Sorokin1, N. Tolstik2, and I.T. Sorokina1; 1TU, Wien, Austria; 2NTNU, Trondheim, Austria

The weak molecular absorption signal is enhanced by 140 times by power-tuning of a chirped-pulse mid-IR oscillator spectrally dispersion. The signal shape is continuously tuned between dispersion-like and peak-like by propagating in ZBLAN fiber.
Ultrafast Electron Dynamics in an Amino Acid Measured by Attosecond Pulses
L. Belshaw¹, F. Calegari², M. Duffy¹, A. Trabattoni², F. Frasnetto², L. Poletto³, M. Nisoli⁴, and J. Greenwood⁵
¹Centre for Plasma Physics, School of Maths and Physics, Queen’s University Belfast, Belfast, United Kingdom; ²Politecnico di Milano, Department of Physics, CNR-IFN, Milano, Italy; ³Institute of Photonics and Nanotechnologies, CNR-IFN, Padova, Italy

We investigated the ultrafast charge-migration in the amino-acid phenylalanine. By measuring the delay of a doubly-charged ion vs. delay between a 1.5-6 XUV pulse and a 6-fs pulse, a 30-fs charge migration process was measured.

Strong-field Photoemission of Electron Pulses from Sharp Metallic Tips
C. Ropers; University of Göttingen, Göttingen, Germany

Localized photoemission from single metallic nanotips is investigated with ultrashort pulses in a wavelength range between 0.8 and 8 micrometers. Kinetic energies of hundreds of eV and strong-field dynamics characteristic of spatial localization are observed.

Soliton Molecules: 4 Symbols for Quaternary Data Transmission
P. Rohrmann, A. Haase, and F. Mitschke; Universität Rostock, Institut für Physik, Rostock, Germany

Fiber-optic solitons can form stable molecules in dispersion-managed fibers. First experimental observations of a three-soliton molecule are reported. Using a flexible pulse shaper existence regimes of these bound states are mapped out.

Unifying the Description of Fiber-Optic Frequency Conversion: From Cascaded Four-Wave Mixing to Cherenkov Radiation
M. Erkintalo¹, Y. Xu¹, S.G. Murdoch¹, J.M. Dudley², and G. Genty³; ¹Department of Physics, University of Auckland, Auckland, New Zealand; ²Institut FemtoSTI, CNRS UMR 6174, Université de Franche-Comté, Besançon, France; ³Optics Laboratory, Tampere University of Technology, Tampere, Finland

We show theoretically and experimentally that cascaded fiber-optic four-wave mixing can mimic a higher-order nonlinear process and drive the amplification of a selected sideband. This process provides a physical frequency-domain interpretation of soliton-induced Cherenkov radiation.

Optical signal enhancement in supercontinuum generation
L. Orsila¹, J. Sand², G. Genty³, and G. Steeneyer¹,²
¹Optoelectronics Research Centre, Tampere University of Technology, Tampere, Finland; ²Department of Physics, Tampere University of Technology, Tampere, Finland; ³Max-Born-Institut für Nichtlineare Optik und Karzzeit-Spektroskopie (MBI), Berlin, Germany

The noise amplification capabilities of supercontinuum generation are exploited to enhance a weak optical intensity modulation by a factor of 30. This mechanism may enable retrieval of faint and otherwise undetectable signals in ultrafast optics.

Ultra-energetic THz pulses from a laser-driven particle accelerator
A. Gopai¹, P. Singh¹, S. Herzer¹, A. Schmidt¹, A. Reinhard¹, W. Ziegler², G. Paulus³, U. Dilnèr⁴, T. May⁵, H.-G. Meyer⁵, D. Broennel⁵, A. Karmakar⁵, and P. Gibson⁵; ¹Friedrich-Schiller University Jena, Jena, Germany; ²Helmholtz Institute Jena, Förbelsteig, Jena, Germany; ³Institute of Photonic Technologies, Jena, Germany; ⁴Institute of Advanced Simulation, Forschungszentrum Jülich, Jülich, Germany

We report the experimental realization of a GW class T-ray source based on laser-driven particle accelerators. The source has been characterized in detail. PIC simulations have been carried out to identify the source of T-rays.

Multi-octave MV/cm pulses filling the THz gap
C. Vicario¹, C. Rucherti¹, and C.P. Hauert¹,²; ¹Paul Scherrer Institute, 5232 Villigen PSI, Switzerland; ²École Polytechnique Fédérale de Lausanne, 1015 Lausanne, Switzerland

1.5 MV/cm THz electric fields are efficiently generated in organic crystals. The multi-octave spectrum extends over the full THz gap (0.1-10 THz). The source initiates coherent magnetization dynamics in thin ferroelectric film.

Ultrasoundband Infrared Pulse Ranging from Terahertz Region to Near Infrared Using Air for both Generation and Detection
E. Matsubara¹, M. Nagai, and M. Ashida; Osaka University, Osaka, Japan

We generated ultrabroadband coherent infrared pulses with 1-200 THz spectral range and detected their electric-field profile in a range up to 150 THz using air as media and sub-μs 10-fs pulses as a light source.

Power Scaling of Efficient Diamond Raman Lasers with 1240 nm and 1485 nm Output
A. McKay, O. Kittler, and R. Mildren; Macquarie University, Sydney, Australia

We report an external cavity diamond Raman laser with quantum conversion efficiency approaching 65% and output powers of 14.5 W. This represents a substantial improvement in efficiency compared to other high-average-power crystalline Raman lasers.
We propose a general strategy for fabricating polycrystalline nanostructures: electrochemistry assisted laser ablation in liquid (ECLAL). This is a green, simple, and catalyst-free approach under the ambient environment.

**Mid-infrared supercontinuum generation in suspended-core chalcogenide and tellurite optical fibers**


We report the experimental generation of mid-infrared supercontinuum in tellurite and chalcogenide suspended-core fibers pumped close to their zero-dispersion in femtosecond regime. The resulting supercontinuum extend until 2.8 µm in tellurite and 3.2 µm in chalcogenide fibers.

**Experimental characterization of hydrogenated amorphous silicon photonic crystal waveguides**


We report the linear characterization of photonic crystal waveguides realized in a CMOS compatible platform based on hydrogenated amorphous silicon. This platform is highly promising for compact and low power all-optical signal processing on-chip.
High spatio-temporal quality, CEP controlled, sub10fs frontend light source on XPW

A. Ricci1, 2, A. Jullien1, J-P. Rousseau1, and R. Lopez-Martens1, 2 Laboratoire d’Optique Appliquée, Palaiseau, France; 3 Thales Optométrie SA, Elancourt, France

300fs sub-10fs pulses with excellent spatio-temporal quality are produced by XPW filtering. High-fidelity of this inject is highlighted. Measured CEP drift is 170mrad rms. Complex spatio-temporal dynamics of XFW pulse shortening XFW is investigated.

Towards CEP stabilized pulses from a KLM Yb:YAG thin-disk oscillator

O. Pronin1, M. Seidel1, J. Bron1, E. Lücking1, I. Angelov1, V. Kalashnikov1, V. Pervak1, A. Apolon’ko2, 3, T. Udem1, and F. Krausz1, 2, 3 Ludwig-Maximilians-University, Munich, Germany; 4 Max-Planck-Institute of Quantum Optics, Garching, Germany; 5 Vienna University of Technology, Vienna, Austria

The 45 W output from a KLM thin-disk laser is spectrally broadened and compressed below 30 fs. The first experiment on carrier-envelope phase stabilization of a thin-disk laser is performed via control of the pump-diole current.

Broadband phase coherence between an ultrashort laser and an OPO using lock-to-zero CEO stabilization

R. McCracken1, J. Sun2, C. Leburn1, and D. Reid1, 3 Heriot Watt University, Edinburgh, United Kingdom; 4 Huazhong University of Science & Technology, Wuhan, China, People’s Republic of (PRC)

The carrier-envelope-offset frequencies of the pump, signal, idler and related sum-frequency mixing pulses have been locked to 0 Hz in a 20 fs-Tai-sapphire pumped optical parametric oscillator, satisfying a critical prerequisite for optical attosecond pulse synthesis.

Nonparaxial Soliton Refraction at Optical Interfaces with \((\chi^{(3)})\) and \((\chi^{(5)})\) Susceptibilities

J. Christian1, E. McCoy1, G. McDonald1, J. Sanchez-Castro1, and P. Chamorro-Pomas1; 1 University of Salforford, Manchester, United Kingdom; 2 Universidad de Valladolid, Valladolid, Spain

We give an overview of recent research results for the arbitrary-angle refraction of bright solitons. A new Snell’s law for cubic-quintic nonlinearity will be derived.

Photodetector terahertz microprobes for high-resolution contact-free imaging of large-scale sheet conductivity distributions

M. Nagel1, A. Safi1, C. Mathiesen1, S. Sivallsich1, T.M. Pleier1, and H. Koc1, 2, 3 AMO GmbH, Aachen, Germany; 4 Institute of Semiconductor Electronics, Aachen, Germany

A novel non-destructive contact-free measurement tool for sheet-conductivity imaging with up to 3 micrometre resolution is presented. Based on photovoltaic THz near-field transmission probing it is especially attractive for large-scale samples with inhomogeneous carrier-lifetime distributions.

Nonparaxial Soliton Refraction at Optical Interfaces with \((\chi^{(3)})\) and \((\chi^{(5)})\) Susceptibilities

J. Christian1, E. McCoy1, G. McDonald1, J. Sanchez-Castro1, and P. Chamorro-Pomas1; 1 University of Salforford, Manchester, United Kingdom; 2 Universidad de Valladolid, Valladolid, Spain

We give an overview of recent research results for the arbitrary-angle refraction of bright solitons. A new Snell’s law for cubic-quintic nonlinearity will be derived and tested, and predictions of giant Goos-Hänchen shifts also presented.

Detection of a 2.8 THz quantum cascade laser with a semiconductor nanowire FET

M. Ravaro1, 2, M. Locatelli1, 2, L. Vitó, M.L. Pea1, D. Ercolani1, L. Consolino1, S. Bartalimi1, A. Tredicce1, L. Sorba1, M.S. Vittol1, and P. De Natadale1, 2, 3, 4 IIQCN, Florence, Italy; 5 LENS, European Laboratory for NonLinear Spectroscopy, Sesto Fiorentino, Italy; 6 NEST, Istituto Nanoscienze - CNR and Scuola Normale Superiore, Pisa, Italy

We report a THz system composed by an InAs nanowire FET detector and a 2.8 THz bound-to-continuum QCL. We demonstrate transmission imaging with high resolution and signal-to-noise ratio.
CB-2: Quantum Cascade Lasers and Long Wavelength Emitters II

Chair: Guido Giuliani, University di Pavia, Pavia, Italy

CB-2.1 SUN 11:00
Broadband tunable quantum cascade lasers for external cavity

- N. Akikusa1, K. Fujita2, T. Dougakichev2, A. Ito1, and T. Edamura1
- Hamamatsu Photonics Development Bureau, Hamamatsu, Japan
- Hamamatsu Photonics Central Research Labs, Hamamatsu, Japan

A homogeneous broad gain bandwidth quantum cascade laser for external cavity is demonstrated. Spectrally homogeneous gain of antireflected dual-upper state (DAU) design provide wide and stable wavelength tunability with external cavity configuration.

CB-2.2 SUN 11:15
Distributed-Feedback Quantum Cascade Laser at 3.2 μm

- J.M. Wolf1, A. Bismuto2, M. Beck1, and J. Faisit1
- Institute for Quantum Electronics, Zurich, Switzerland
- Alpes Lasers S.A., Neuchâtel, Switzerland

We present single mode emission from Distributed-Feedback QCL done via optical lithography ranging from 3.19 to 3.3μm with peak power of up to 120mW at -20°C. Threshold current densities of 4.8ka/cm² were measured.

CB-2.3 SUN 11:30
Polarization Versatility of Surface Emitting Ring Cavity Quantum Cascade Lasers

- Vienna University of Technology, Vienna, Austria

We present our resent investigations on far field characteristics of ring cavity quantum cascade lasers. Depending on the device design, an azimuthally, radially or linearly polarized far field can be realized.

CM-2: Future Applications of Laser

CM-2.1 SUN (Tutorial) 11:00
Resource Efficiency Improvements through Laser Processing of Designer Materials

- W. O’Neill, University of Cambridge, Cambridge, United Kingdom

This tutorial explores the laser technologies and processes that can effect change in the resource efficiencies of production operations. Three basic visions are presented along with case studies to demonstrate their implementation.

CM-2.2 SUN 11:15
Phase-matched Cascaded of Nonlinear Bragg Scattering

- Y. Xu1, M. Erikintalo1, G. Genty2, and S. Murdoch1
- University of Auckland, Auckland, New Zealand
- Tampere University of Technology, Tampere, Finland

We demonstrate, both numerically and experimentally, how a nonlinear Bragg scattering cascade can mimic the direct phasematching of a higher-order nonlinearity. The cascade is shown to significantly relax the phasematching requirements for nonlinear Bragg scattering.

CM-2.3 SUN 11:30
Continuous-wave optical modulation at the frequency of molecular motion

- S-i. Izats1,2,3 and T. Imasaka1,2,3
- Department of Applied Chemistry, Graduate School of Engineering, Kyushu University, Fukuoka, Japan

We demonstrate highly efficient generation of a continuous-wave sideband with a frequency spacing of over 10 THz. This scheme is based on the phase-matched interaction with gaseous molecules in a dispersion-compensated high-finesse optical cavity.

CD-2: Nonlinear Wave Mixing Phenomena

CD-2.1 SUN 11:00
Four Wave Mixing efficiency in hydrogenated amorphous silicon waveguides

- C. Laca1, P. Minzioni1, E. Baldini1, J.M. Fedeli2, and L. Cristiani1
- Dipartimento di Ingegneria Industriale e dell’Informazione, Università di Pavia, Pavia, Italy
- CEA-Leti Minatec Campus, Grenoble, France

Four-Wave-Mixing efficiency and conversion bandwidth in hydrogenated amorphous silicon waveguides fabricated by PECVD is reported. Measuring a large number of samples, a reliable value of the nonlinear parameter γ=790 W-1m-1 was obtained.

CD-2.2 SUN 11:15
Mid-Infrared Difference-Frequency Generation in Silicon Waveguides Strained by Silicon Nitride

- F. Bianco1, M. Cazzanello2, A. Yeremyan1, M. Ghulinyan1, G. Pucker2, D. Modotto3, S. Wabnitz2, and L. Pavesi1
- University of Trento, Trento, Italy
- Bruno Kessler Foundation, Trento, Italy
- Università di Trento, Trento, Italy

We experimentally demonstrate and theoretically model mid-infrared difference-frequency generation in silicon waveguides where a quadratic nonlinear response is introduced through straining by a silicon nitride overlay.
Optimizing phase matching of high-order harmonic radiation in the range up to 1 keV
J. Seres1, E. Seres1, B. Landgraf1, B. Ecker2, A. Auerand1, T. Kühn3, and C. Spielmann2,1; 1Friedrich Schiller University, Jena, Germany; 2Helmholtz Institute Jena, Jena, Germany; 3GSI Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany.

We present a detailed experimental study to predict guidelines for maximizing the short wavelength high-order harmonic generation signal without perfect phase matching in helium in the 0.2-1 keV spectral range using 800 nm light pulses.

Trapping of dispersive waves in solitonic resonators and its role in supercontinuum generation
A. Yulín1, R. Drihen2, B. Malomed3, and D. Skryabin4,1; 1Centro de Física Teórica e Computacional, Faculdade de Ciências, Universidade de Lisboa, Lisbon, Portugal; 2Department of Physical Electronics, Faculty of Engineering, Tel Aviv University, Tel Aviv; 3Department of Physics & Co OPP, University of Paderborn, Paderborn, Germany; 4Centre for Photonics and Photonic Materials, Department of Physics, University of Bath, Bath, United Kingdom.

It is shown that dispersive waves can be trapped between optical solitons during supercontinuum generation. The dispersive waves mediated inter-soliton interactions and the modification of the spectrum of the trapped waves are studied in detail.

Understanding the fission of higher-order solitons under the action of the higher-order dispersion
R. Drihen1,2, B. Malomed3, D. Skryabin4, and A. Yulín1; 1Centro de Física Teórica e Computacional, Faculdade de Ciências, Universidade de Lisboa, Lisbon, Portugal; 2Department of Physical Electronics, Faculty of Engineering, Tel Aviv University, Tel Aviv; 3Department of Physics & Co OPP, University of Paderborn, Paderborn, Germany; 4Centre for Photonics and Photonic Materials, Department of Physics, University of Bath, Bath, United Kingdom.

A new approach is proposed to fabricate terahertz elements. A lens with 4mm focus length for 0.75THz is design, fabricated, and experimentally demonstrated. The thickness of the lens is only 1/4000 of the illuminating wavelength.

Long-range incoherent solitons
C. Michel1, B. Kibler1, G. Xu2, J. Garnier3, and A. Picocci2; 1Laboratoire de Physique de la Matière Condensée, Nice, France; 2Laboratoire Interdisciplinaire Carnot de Bourgogne, Dijon, France; 3Laboratoire de Probabilités et Modeles Aleatoires, Paris, France.

We show that a highly nonlocal or noninstantaneous nonlinear response prevents the natural process of thermalization of incoherent optical waves. The field self-organizes into long-range incoherent solitons, which constitute nonequilibrium stable states of the system.

Thz-Comb-Assisted Molecular Spectroscopy
L. Consolo1, S. Bartolini1, A. Taschini1, B. Battolom2, M.S. Vitiello3, H. Biese3, D. Rietich3, A. Tredicucci1, P. Ciancio Pastor4, R. Torre4, and P. De Natale1,1; 1Istituto Nazionale di Ottica - CNR, Firenze, Italy; 2European Laboratory for Non-Linear Spectroscopy, Sesto Fiorentino, Italy; 3NEST, Istituto Nanoscienze - CNR, Pisa, Italy; 4Cavendish Laboratory, University of Cambridge, J J Thomson Avenue, Cambridge, United Kingdom.

We report on the first measurements of the absolute frequency of a molecular transition in the THz domain, performed by a CW THz quantum cascade laser (QCL) and assisted by a THz Frequency Comb Synthesizer.

Q-Switched and Mode-Locked 639-nm Pr:YLF Laser with Cr : YAG Saturable Absorber
R. Abe, J. Kojou, K. Masuda, K. Hiroasa, and F. Kan-nari; Department of Electronics and Electrical Engineering, Keio University, 3-14-1 Hiyoshi, Kohoku-ku, Yokohama, Japan.

We demonstrated the first Q-switched mode-locking of Pr3+ : YLF laser using a Cr4+: YAG saturable absorber at 639 nm. The highest Q-switched mode-lock power was 475 mW at an absorbed pump power of 4 W.
Quantum cascade laser spectrometer for frequency metrology and high accuracy molecular spectroscopy around 10 μm

S. Mejri, P.L.T. Sow, O. Lopez, S.K. Tokunaga, A. Goncharov, B. Argence, B. Chantret, C. Charbonnet, A. Amy-Klein, B. Darquie, and C. Dauxois, Laboratoire de Physique des Lasers, Université Paris 13, Sorbonne Paris Cité, CNRS, Villetteaune, France

We are developing a ~10 μm quantum cascade laser (QCL) based spectrometer suitable for precision molecular spectroscopy. We have measured a record ~200 kHz free-running linewidth and phase-locked a QCL to an ultra-narrow stabilized CO₂ laser.

Nonlinear dynamics and Modulation Properties of Optically Injected Quantum Cascade Lasers

1. C. Wang², 2. V. Grillot², 3. V. Kovaniš³, and 4. J. Ever¹

¹Université Européenne de Bretagne, INSA, CNRS FO- TON, Rennes, France; 2. Telecom ParisTech, École Nationale Supérieure des Télécommunications, CNRS LTCI, Paris, France; 3. Éescientific Laboratory, Ohio State University, Columbus, United States

The bifurcation scenarios and modulation properties of injection-locked quantum cascade lasers are theoretically investigated. No dip frequency occurs in the modulation response while both positive and negative detunings enhance the modulation bandwidth.

Transverse-electric polarized intersubband electroluminescence from quantum cascade structures based on InAs/AlInAs quantum dashes

1. V. Liverini¹, 2. L. Neou², 3. F. Castellano², ³. A. Bismuto¹, 1. M. Beck¹, 2. F. Gramm², and 3. J. Faist³; 1. Institute for Quantum Electronics, ETH Zurich, Zurich, Switzerland; 2. CNR, Istitu to NanoScienza, Pisa, Italy; 3. Electron Microscopy ETH Zurich (EMEZ), ETH Zurich, Zurich, Switzerland

We demonstrate room-temperature transverse-electric electroluminescence from a quantum cascade structure based on InAs/AlInAs quantum dashes. The 110μeV electroluminescence originates from a laterally-confined dash state, confirmed by its dependence on crystallographic orientation and intersubband absorption measurements.

Robust, frequency-stable and accurate mid-IR laser spectrometer based on frequency comb metrology of quantum cascade lasers up-converted in orientation-patterned GaAs

S. Schiller¹, 2. M. Hansen¹, 3. I. Ernsting³, 3. S. Vasilyev³, 3. A. Grisard³, 4. E. Lallier², and 5. B. Gerard³; 1. Heinrich-Heine-Universität, Düsseldorf, Germany; 2. THales Research and Development, Grisy-Sèvres, France; 3. Research Institute for Quantum Electronics, Düsseldorf, Germany

We have developed a mid-infrared frequency comb spectrometer based on frequency comb metrology of quantum cascade lasers up-converted in orientation-patterned GaAs.
We characterized the full spatiotemporal
and spatio-spectral domain
of a hollow-core fiber compressor in the
spatiotemporal and spatio-spectral
domains
B. Alonso1, M. Miranda2, E. Silva2, V. Pervak3, J. Rauschenberger4, J. San Román5, I. Solá5, and H. Crespo5; 1Grupo de Investigación en Óptica Extrema (GIOE), Universidad de Salamanca, E-37008, Salamanca, Spain; 2IFIMUP-IN and Departamento de Física y Astronomía, Universidad do Porto, Rua do Campo Alegre 687, 4169-007, Porto, Portugal; 3UltraFast Innovations GmbH, Am Coulombwall 1, 85748, Garching, Germany; 4Ludwig-Maximilians-Universität München, Department für Physik, Am Coulombwall 1, 85748, Garching, Germany
We characterized the full spatiotemporal and spatio-spectral amplitude and phase of the
The characterization of sub-two-cycle pulses from a hollow-core fiber compressor in the spatiotemporal and spatio-spectral domains is crucial for understanding the temporal and spectral properties of these ultrashort pulses. This is particularly important in applications such as ultrafast spectroscopy, optical metrology, and material science. The characterization allows us to accurately control and manipulate the pulses, which is essential for advancing technologies that rely on precise and ultrafast light sources.

**IF-3: Nonlinear Light Interactions in Quantum Systems**
Chair: Jens Biegert, ICFO, Castelldefels, Barcelona, Spain
**IF-3.1 SUN 14:30**
Nonlinear magneto-optical effects and quantum coherences in cold rubidium atoms in an optical dipole trap
A. Wojcieszewski, S. Kycz, A. Stabrawa, M. Piotrowski, J. Zachorowski, and W. Gawlik; Institute of Physics, Jagiellonian University, Krakow, Poland
We investigate nonlinear magneto-optical effects in cold atoms. Nonlinearity results from creation of Zeeman coherences and thus can be controlled by magnetic fields or, alternatively, used for high-precision magnetometry.

**IF-3.2 SUN 14:45**
Transverse self-organization in cold atoms due to opto-mechanical coupling
G. Labeyrie, P. Gomez, E. Tesio, R. Kaiser, W. Firth, G. Robb, G.-L. Oppo, and T. Ackemann; 1Institut National de Recherche en Informatique et en Automatique (INRIA), Sophia Antipolis, France; 2University of Strathclyde, Glasgow, United Kingdom
We report the observation of transverse self-organization in cold atoms under the action of a single, retro-reflected pump laser mirror. The instability, resulting in hexagonal light and density patterns, is driven by opto-mechanical coupling.
### ROOM 13b

**Technology, Palaiseau, France; III-V Labs, Campus Polytechnique, Palaiseau, France**

We demonstrate a robust and simple method for measurement, stabilization and tuning of the frequency of cw mid-infrared lasers. We demonstrate 100kHz-level frequency inaccuracy, frequency instability <10 kHz, controlled frequency tuning and long-term stability.

### ROOM 14a

**14:30 – 16:00**

**CJ-1: Fibres and Components**
**Chair: Matthias Jäger, Institute of Photonic Technology, Jena, Germany**

**CJ-1.1 SUN 14:30**

All-fiber Kilowatt Signal Combiners for High Power Fiber Lasers

• A. Braglia, A. Calsiano, M. Olivero, A. Penna, and G. Perrone; Politecnico di Torino, Department of Electronics and Telecommunications, Torino, Italy

The fabrication of multi-kilowatt fiber-focused signal combiners for fiber laser power scaling is presented. Characterization results up to 2kW have validated the manufacturing procedure and highlight the suitability for further power increases.

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### ROOM 14b

**14:30 – 16:00**

**CD-3: Nonlinear Optics in Photonic Crystal Fibers**
**Chair: Danil Kartashov, Photonics Institute Vienna, Vienna, Austria**

**CD-3.1 SUN 14:30**

Efficient spectral broadening of multi-mj pulses in long hollow fibers


1. Institut für Quantenoptik, Leibniz Universität Hannover, Hannover, Germany
2. Laser-Laboratorium Göttingen e.V., Göttingen, Germany

Long-stretched flexible hollow fibers were used for spectral broadening of multi-mJ femtosecond pulses. Spectra supporting 3.46 ps with excellent beam quality were achieved at 65% transmission. The scalability of the approach will be discussed.

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### ROOM 21

**14:30 – 16:00**

**CK-3: Novel Materials and Structures**
**Chair: Tapio Niemi, Tampere University of Technology, Tampere, Finland**

**CK-3.1 SUN 14:30**

Experimental Demonstration of Photonic Floquet Topological Insulators

• J.M. Zeuner, Y. Plotnik, M.C. Rechtschaffen, Y. Liemer, M. Segev, and A. Szameit

1. Institute of Applied Physics, Friedrich-Schiller-Universität Jena, Jena, Germany
2. Technion, Israel Institute of Technology, Haifa, Israel

We experimentally demonstrate the first photonic Floquet topological insulator, which brings the striking concept of a completely new phase of matter with an insulating bulk and a conducting edge from electronics to optics.

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### ROOM 22

**14:30 – 16:00**

**IH-1: Mapping Near Fields**
**Chair: Fritz Keilmann, Ludwig-Maximilians-Universität, Munich, Germany**

**IH-1.1 SUN 14:30**

Mapping Nanoscale Optical Fields: a Magnetic Surprise

• B. le Feber, N. Rotenberg, D. Beggs, and K. Kuijpers

1. FOM Institute AMOLF, Amsterdam, The Netherlands
2. Bristol University, Bristol, United Kingdom

We find that an aperture probe collects signal not only from the electric near-field, but also from the magnetic near-field. We show how we can identify both electric and magnetic contributions in our measurements.

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### NOTES

**IH-1.2 SUN 14:45**

Near-field characterization of a plasmonic antenna based on fluorescence photocounts and decay rate measurements

• V. Kruchinichoff, D. Cao, A. Cazé, E. Castanié, P. Rierrat, N. Bardou, S. Collot, R. Carminati, and Y. De Wilde

1. Institut Langévin, ESPCI ParisTech, CNRS, Paris, France
2. Laboratoire de Photonique et Nanostructures (LPN-CNRS), Marcoussis, France

We report on the experimental and theoretical study of the local density of states and intensity fluctuations of the electro-magnetic field at the surface of a plasmonic nanooptica. Theory and experiments are in good agreement.
4.5 fs post-compressed pulses by combining d-scan and STARFISH techniques, which enabled studying the spatial chirp of the post-compression in the temporal and spectral domains.

CF/IE-3.3 SUN 15:00

Spatio-temporal metrology of high power femtosecond lasers

• V. Gallet, Commissariat à l’énergie atomique et aux énergies alternatives, Saclay, France.

We demonstrate three approaches for the spatiotemporal characterization of femtosecond lasers. Partial information is obtained through the spatially-resolved spectrum. We use interferometers based on optical fibers, in scanning or single shot mode, for complete reconstruction.

CF/IE-3.4 SUN 15:15

Complete Spatial Characterization of an Optical Wavefront Using a Variable-Separation Pinhole Pair

• Dr. Lloyd, K. O’Keefe, and S. Hooker, Department of Physics, University of Oxford, Clarendon Laboratory, Oxford, United Kingdom.

We present a technique for the complete characterization of the transverse spatial properties of an optical wavefront. Recovery of the spectrally-resolved profiles of phase, intensity, and spatial coherence is achieved in a single scan.

IF-3.3 SUN (Invited) 15:00

Optical parametric oscillation with distributed feedback in cold atoms

• W. Guerin1-2, A. Schliker3, P. Courteille4, and C. Zimmermann1; 1Physikalisches Institut, Eberhard-Karls-Universität Tübingen, Tübingen, Germany; 2Institut Non Linéaire de CNRS, Université de Nice Sophia-Antipolis, Valbonne, France; 3Instituto de Física de São Carlos, Universidade de São Paulo, São Carlos, Brazil.

We report the observation of distributed feedback lasing in an ordered cold atom sample. The atoms simultaneously provide gain via four-wave mixing and feedback via Bragg reflection. We discuss the properties of this system.

IF-3.4 SUN 15:30

Demonstration of reconfigurable optical functions inspired by quantum effects

• C. Ciret1-2, V. Coda1,2, A.A. Rangelov1, and G. Montemagni2,1; 1Université de Lorraine, LOMPS, Metz, France; 2Supélec, LOMPS, Metz, France; 3Department of physics, Sofia University, Sofia, Bulgaria.

Properly designed photinduced waveguide structures possess direct analogies with quantum optical functions. The analogy of three-waveguide systems with Electromagnetically induced transparency was demonstrated in a single scan.

CC-3.2 SUN 15:00

A continuous-wave, solid-state Stimulated Polariton THz Source

• A. Lee and H. Pask; Macquarie University, Sydney, Australia.

We present a diode end-pumped solid-state source which generates frequency-tunable continuous-wave (CW) terahertz (THz) radiation through stimulated polariton scattering (SPS) in a Mg-doped LiNbO3 crystal with low pump power requirements (3.76 W).

Counter-Propagating Difference-Frequency Generation in Diamond with Terahertz Fields

M. Clerici1,2, L. Caspani3, E. Rubinob1-3, M. Peccianti3, M. Cassatario1,3, A. Busacca3, T. Ozaki4, D. Faccio5, and R. Morandotti6; 1INRS-EMT, Varennes, Canada; 2School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh, United Kingdom; 3Dipartimento di Scienze e Alta Tecnologia, Università degli Studi dell’ Insubria, Como, Italy; 4Institute for complex Systems-CNR, Roma, Italy; 5DIETE, Università di Palermo, Palermo, Italy.

We show that both sum- and difference-frequency generation occur when overlapping an intense terahertz field with optical pulses in diamond. Remarkably, the difference-frequency generation process is naturally phase-matched for counter-propagating waves.

CC-3.4 SUN (Invited) 15:30

THz Emission from Intrinsic Josephson Junctions in High-Tc Superconductors for Imaging Applications

• K. Kadawalchi1,2,3,4, M. Tsujimoto3,4, K. Defranzari1,2,3, T. Kitamura1,2,3,4, K. Ishida1,2,3,4, C. Watanabe1,2,3,4, S. Sekimoto1,2,3,4, H. Miriun4,1-4, H. Miriun4,1-4, and T. Kashigawa1,2,3,4; Faculty of Pure & Applied Sciences, University of Tsukuba, Tsukuba, Japan; 2Graduate School of Pure & Applied Sciences, University of Tsukuba, Tsukuba, Japan; 3CREST-JST, Tokyo, Japan; 4National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan.

We present the first directly in-band pumped Ho:YLF laser using a GaSe diode stack with a center wavelength of 1930 nm as pump source. 8.7 W cw output power at room temperature were achieved.

CA-3.2 SUN 15:00

High-Pulse-Energy Cryogenic Ho:YLF Laser Pumped by a Tm:fiber Laser

• H. Fonnum, E. Lippert, and M. Haukstad; Norwegian Defence Research Establishment (FFI), Kjeller, Norway.

A cryogenically cooled Ho:YLF oscillator delivering Q-switched pulses of 550 mJ and beam quality M2 = 1.5 is demonstrated. The pump is a 100-W-Tm-fiber laser, giving a pulse energy to power efficiency of 3.5 J/kW.

CA-3.4 SUN 15:30

In-band diode pumped high power Ho:YLF laser

• K. Scholle1, S. Lamarrn1, F. Gatzemeier1, P. Koopmann2, and P. Fuhrberg3; 1LISA laser products OHG, Katlenburg, Germany; 2Institute of Laser-Physics, University of Hamburg, Hamburg, Germany.

We present the first directly in-band pumped Ho:YLF laser using a GaSe diode stack with a center wavelength of 1930 nm as pump source. 8.7 W cw output power at room temperature were achieved.

CL-1/ECBO-2 SUN (Invited) 15:30

Improved Precision in Optical Tweezers via Squeezed Light

• Bowen, M.A. Taylor, J. Janousek, V.R. Daria, J. Kniittel, B. Hage, and H. Bacher; The University of Queensland, Brisbane, QLD, Australia.

Squeezed light is used to improve the precision of particle tracking in living yeast cells. This first biological application of squeezed light allows the cytoplasm viscosity to be determined 64% faster than equivalent classical experiments.
514 W monolithic fiber laser with a femtosecond inscribed fiber Bragg grating
• R.G. Kämper¹, A. Liem², C. Vogtländer¹, J.U. Thomas¹, D. Richter¹, T. Schreiber¹, A. Tännermann¹,², and S. Nolte¹,²; ¹Institute of Applied Physics, Jena, Germany; ²Fraunhofer Institute of Applied Optics and Precision Engineering, Jena, Germany
We report on a monolithic cw fiber laser realized via fiber Bragg grating inscribed directly into the active core by ultrashort pulses with an output power of 514 W in an Yb-doped large mode area fiber.

Evolution of lasing during FBG-inscription in a Yb-Al-doped laser fiber
• F. Piebrandt, M. Leich, S. Jetschke, M. Rothhardt, M. Jäger, and H. Bartelt; Institute of Photonic Technology, Jena, Germany
We report on the inscription of a fiber Bragg grating in a Yb-Al-doped fiber under pumping conditions and on the spectral properties of a laser operating with such a grating.

Invasive laser drilling of transparent materials for the production of optical components
• M. Werner, D. Esser, and H.-D. Hoffmann; Fraunhofer Institute for Laser Technology, Aachen, Germany
Investigations of laser driven 3D volume glass processing are presented. The process allows for high flexibility in geometry compared to conventional Stack and Draw technique. A Photonic fiber preform has been manufactured.
Graphene is highly attractive for nonlinear optical and laser applications due to its strong, broadband nonlinearity. We employ THG in graphene for few-cycle pulse characterization using d-scan from the near- to mid-IR.

**The coherent artifact in modern pulse measurements**

M. Rhodes1, G. Steinmeyer2, J. Ratner3, and R. Trebino1; 1Georgia Institute of Technology, Atlanta, United States; 2Max-Born-Institut, Berlin, Germany

Dynamically unstable pulse trains may give rise to artifacts in modern pulse characterization techniques similar to the coherence spike in autocorrelation. These artifacts may lead to severe misinterpretation of FROG and SPIDER measurements.

**Compact gigawatt-class sub-picosecond Yb:YAG thin-disk regenerative chirped-pulse amplifier with high average power at up to 800 kHz**

R. Fleischhauer, R. Geis, A. Budnik, M. Wolf, J. Kleinbauer, and D. Sutter; TRUMPF Laser GmbH + Co. KG, Schramberg, Germany

We present sub-picosecond pulses obtained from a single-disk regenerative amplifier based on an industrial laser system (0.6 m² footprint). We use chirped-pulse amplification with a very compact single-pass grating compressor up to 160 W average power.

**Institute for Materials Science, Tsukuba, Japan**

A recent development of THz radiation from high temperature superconductor Bi2Sr2CaCu2O8+d not only from the fundamental aspect of the radiation mechanism but also from the aspects on the various imaging applications will be shown.
the non-instantaneous Raman response of the gas plays a key role.

we retrieve the image of a small fluorescent object hidden behind an opaque screen without any need to access the back nor any a-priori knowledge about either the object or the screen itself.

fundamental gaussian mode content measurements on active large core ccc fibers

* m. karow1,2, c. zhu3, d. kracht1,2, j. neumann1,2, a. galvanaukas4, and p. weßgl1,2; 1 laser zentrum hannover e.v., hannover, germany; 2 centre for quantum-engineering and space-time research - quest, hannover, germany; 3 department of electrical engineering and computer science, ann arbor, united states

the overlap of single-frequency laser beams, amplified in active chirally coupled core fibers, with the tem00 mode is investigated using confocal scanning ring cavity. up to 186w tem00-mode power were extracted.

nonlinear optics in hollow core pcf filled with gaseous and supercritical xenon

* m. azhar1, n. joly2,1, j. travers1, e. tani3, and p. russell1,2; 1 max planck institute for the science of light, erlangen, germany; 2 dept. of physics, friedrich-alexander universität, erlangen, germany

kagome-style hollow-core photonic crystal fiber filled with high pressure gaseous or supercritical xe offers a nonlinearity comparable to that of fused silica, together with pressure-tunable dispersion. spectral broadening and intermodular four-wave mixing are reported.

mode symmetries required for creating photonic dirac cones in the brillouin-zone center

• k. sakoda; national institute for materials science, tsukuba, japan

the mode-symmetry requirement for creating photonic dirac cones in the brillouin-zone center by accidental degeneracy is examined by a degenerate perturbation theory newly developed for the vector electromagnetic field of periodic structures.

biomedical imaging by infrared nanoscopy (nano-ftir)

* s. amarie1, a. gernescu2, t. geith2, s. mit2, e. banberg3, and e. keilmann2; 1 neaspec gmbh, martinstr, germany; 2 ludwig-maximilians-university münchen and center for nanoscience, munich, germany; 3 department of clinical radiology, ludwig-maximilians-university, großhadern campus, munich, germany; 4 anatomische anstalt, ludwig-maximilians-university, munich, germany

we recently applied the principles of ftir to scattering-type scanning near-field optical microscopy (s-nsom). results on human bone sections show detail at a resolution of 20 nm (i.e. two orders of magnitude improved resolution).
We present a new average power ultrafast laser system for durations from 1 fs to hundreds of fs, with an excellent beam quality. The brightness of the diode-pumped, multikilowatt high-repetition-rate laser was demonstrated in a sealed-off housing.

**Room 4b**

**CC-4.2 SUN**

**The Terahertz Polarization Pulse Shaping**

M. Sata, T. Higuchi, N. Kanaji, K. Konishi, Y. Yoshioka, T. Suzuki, K. Misawa, and M. Kawai-Gonokami

Department of Applied Physics, Tokyo University of Agriculture and Technology, Tokyo, Japan; CREST, Japan Science and Technology Agency, Tokyo, Japan; Department of Applied Physics, The University of Tokyo, Tokyo, Japan; Department of Physics, The University of Tokyo, Tokyo, Japan; Extreme Photonics Research Group, RIKEN Advanced Science Institute, Tokyo, Japan; Photon Science Center, The University of Tokyo, Tokyo, Japan; Interdisciplinary Reseach Unit in Photon-nano Science, Tokyo University of Agriculture and Technology, Tokyo, Japan.

We proposed and demonstrated terahertz polarization pulse shaping by tailoring the incident laser pulse for the desired terahertz waveform through optical rectification in a nonlinear optical crystal along its threefold axis.

**Room 4a**

**IF-4.2 SUN**

**Nonlinear Cerenkov radiation from a second ferroelectric domain wall**

Y. Sheng, V. Roppo, K. Kalinowski, W. Krolikowski

Australian National University, Canberra, Australia; Laboratoire de Photonique et de Nanostructures CRNS UPR 20, Marcoussis, France

We report on the observation of Cerenkov-type second-harmonic generation in the vicinity of the ferroelectric domain wall. We discuss the physics origin of this effect and demonstrate its application in three-dimensional visualization of ferroelectric-domain structures.

**IF-4.3 SUN**

**Discharge Mechanism and Threshold in Second Harmonic Generation by Periodically Poled LiTaO3**

O. Louchev, H. Hatano, S. Wada, and K. Kitamura

RIKEN, Wako, Japan; NIMS, Tsukuba, Japan

Combined theoretical and experimental study of the damage threshold for high-repetition pulsed second harmonic generation by periodically poled LiTaO3 is done.
Holographic approach for optical poration and trapping of developing embryos


We demonstrate a holographic approach using a Ti:Sapphire laser and spatial light modulator for optical injection and trapping of developing embryos. Our results show that optical tools maybe useful for embryo manipulation.

Microscopic manipulation using model superpositions in air-filled hollow-core photonic crystal fiber

- O.A. Schmidt, X. Jiang, F. Bacic, T.G. Euser, and P.S.J. Russell

Max Planck Institute for the Science of Light, Erlangen, Germany

We demonstrate a holographic approach using a Ti:Sapphire laser and spatial light modulator for optical injection and trapping of developing embryos. Our results show that optical tools maybe useful for embryo manipulation.

Combination of Optical Micromanipulation with Raman Spectroscopy for Cell Sorting

- C. Krafft, S. Doehring, and J. Popp

Institute of Photonic Technology, Jena, Germany

We have designed and modeled a new ytterbium rod-type fiber laser. The pulse duration is adjusted with a

Study of a high power self mode locked ytterbium rod-type fiber laser with tunable pulse duration

- P. Deslandes, M. Perriss, S. Zumb, D. Sanghe, F. Salin, and E. Freysz

Ecole Systems, Pessac, France

We have designed and modeled a new ytterbium rod-type fiber laser. The pulse duration is adjusted with a
and generates optical pulses with temporal contrast in excess of $10^{-11}$ at the power level of $100$ TW.

High Power Top-Hat Pulses for Efficient OPA Pumping

G. Fan, T. Balciunas, G. Andriukaitis, A. Pugzlys, and A. Baltuska; Vienna University of Technology, Vienna, Austria

We demonstrate phase-only shaping of high-energy broadband Yb amplifier pulses using acousto-optic programmable dispersion filter (AOPDF) for the generation of a top-hat temporal profile that provides efficient pumping of an optical parametric amplifier.

High symmetry orders probed by polarized Coherent Anti Stokes Raman Scattering and Four Wave Mixing

J. Duboisset, E.-Z. Bioud, P. Gasecka, P. Ferrand, H. Rigneault, and S. Brasselet; Institut Fresnel, Marseille, France

We implement incident polarizations tuning in FWM and CARS to probe molecular order, using a generic method to read-out symmetry information in crystalline and less organized samples.

Evanescent-Wave Proton Post-accelerator Driven by Intense THz Pulses

L. Pálffalvi$^1$, J. Fülöp$^{2,3}$, G. Tóth$^1$, and J. Hebling$^{1,2}$; 
$^1$Department of Experimental Physics, University of Pécs, Pécs, Hungary; $^2$MTA-PEE High-Field Terahertz Research Group, Pécs, Hungary; $^3$ELI-HU Mkt, Szeged, Hungary

A compact, cost effective solution is proposed for post-acceleration and monochromatization of protons leaving a laser driven accelerator. The evanescent field of intense THz pulses is used for acceleration and monochromatization.

12W efficient air cooled diode-pumped actively Q-switched Yb:KGW laser

V. E. Kiselev$^1$, A.S. Rudenko$^3$, A.E. Gulevich$^3$, N.V. Kondrtyuk$^3$, A.S. Yasukevich$^3$, N.V. Kuleshov$^3$, and A.A. Pavlyuk$^2$; Center for Optical Materials and Technologies, Belarusian National Technical University, Minsk, Belarus; 
$^2$Nikolaev Institute for Inorganic Chemistry, Siberian Branch of Russian Academy of Sciences, Novosibirsk, Russia

Compact diode-pumped actively Q-switched Yb:KGW laser is demonstrated with optical-to-optical efficiency of 50%. Output power of 12.2 W with repetition rate up to 50 kHz and pulse duration of 10-24 ns was obtained.
cell sorting. Raman spectra of optically trapped cells
are collected in microfluidic chips and are used for their
identification.

spectral filter from picoseconds to femtoseconds, with
10W average power, at 104 MHz.

CJ-2.5 SUN 17:45
7 nJ High-Fidelity 60 fs Pulses at 1035 nm from an
Integrated Ytterbium Fiber Oscillator with a
Higher-Order-Mode Fiber

A. Fernandez1, L. Zhu1, V. Kalashnikov1, A. Verhoef2,
K. Jespersen3, D. Lorenz3, L. Grüner-Nielsen2, and A.
Baltuska1; 1Institut für Photonik, Technische Universität
Wien, Wien, Austria; 2OFS Denmark, Brøndby, Denmark
We present a mode-locked Ytterbium-doped fiber oscil-
lator operating in the net normal-dispersion regime, de-
ivering 7 nJ pulses that can be dechirped down to 62 fs.
A higher-order mode fiber is used for intracavity disper-
sion compensation.

CK-4.6 SUN 17:45
Enhanced Second Harmonic Generation in
Microfiber Loop Resonators

R. Ismaeel, T. Lee, M. Gouveia, and G. Brambilla; Opto-
electronics research centre, Southampton, United Kingdom
Resonantly enhanced surface second harmonic genera-
tion was experimentally demonstrated by fabricating a
loop resonator from a 770nm diameter silica microfiber.
The conversion efficiency was enhanced by a factor of 5.7
compared to the straight microfiber.
13:30 – 14:30
IF-P: IF Poster Session

IF-P.1 SUN
Second harmonic generation and two-photon excitation fluorescence from individual nanocrystals of pyrazoline derivatives
1 Wroclaw University of Technology, Wroclaw, Poland; 2 University Aix Marseille, Fresnel Institute, Marseille, France
We investigate the quadratic nonlinear optical properties of individual nanocrystals of different derivatives of pyrazoline. We measure angular polarization dependence of second harmonic and two-photon fluorescence signals and their relation with a possible crystallographic structure.

IF-P.2 SUN
Pressure tunable cascaded third order nonlinearity and temporal pulse switching
F. Eileneberger, M. Bache, S. Minardi, and T. Persich; 1 Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität, Jena, Germany; 2 DTU Fotonik, Department of Photonics Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark
We investigate the impact of phase-mismatched cascaded third harmonic generation on pulse propagation in noble-gas filled Kagome fibers. The pressure tunable cascade facilitates temporal switching even in the presence of intrinsic higher order Kerr effect.

IF-P.3 SUN
Optomechanical Nonlinearity and Bistability in Dielectric Metamaterials
J. Zhang, J. E. MacDonald, and N. I. Zheludev; 1 University of Southampton, Southampton, United Kingdom; 2 Nanyang Technological University, Singapore, Singapore
We introduce a new type of dielectric metamaterial, inherently free of Joule losses, which exhibits a strong optomechanical nonlinearity, asymmetric transmission and optical bistability at optical intensities of less than 0.2 mW/μm2.

IF-P.4 SUN
Negative-frequency resonant radiation in quadratic media
M. Conforti, N. Westerberg, F. Baronio, S. Trillo, and D. Faccio; 1 University of Brescia, Brescia, Italy; 2 Heriot-Watt University, Edinburgh, United Kingdom; 3 University of Ferrara, Ferrara, Italy
We show that the extremely blue-shifted dispersive wave emitted in Kerr media owing to the coupling with the negative-frequency branch can be observed in quadratic media via second-harmonic generation.

IF-P.5 SUN
Kerr frequency combs in the normal and anomalous regimes
A. Coillet, R. Henriet, I. Balakrava, L. Larger, and Y. Chienbo; FEMTO-ST, Besançon, France
High-Q crystalline whispering-gallery mode resonators are used to generate optical frequency combs through four-wave-mixing in both normal and anomalous regimes of dispersion. A modal description provides analytical insight into these two phenomenologies.

IF-P.6 SUN
Study of multilayer nonlinear dielectric-metal structures: towards low power plasmon-solitons in realistic waveguides
W. Walasik, Y. Kartashov, and G. R. Renversez; 1 Institut Fresnel & Université d’Aix-Marseille, Marseille, France; 2 IEPT, Universitat Politècnica de Catalunya, Castelldefels, Spain
Using several improved vector models we study plasmon-soliton waves in multilayer nonlinear dielectric-metal planar structures. For the first time we obtain low power plasmon-solitons in structures compatible with fabrication technology of chalcogenide waveguides.

IF-P.7 SUN
Experimental observation of the spectral Gouy phase shift
E. R. Andrews, C. Finot, D. Oron, and H. Rigneault; 1 Institut Fresnel, CNRS, Aix-Marseille Université, École Centrale Marseille, Marseille, France; 2 Laboratoire Interdisciplinaire Carnot de Bourgogne, CNRS, Université de Bourgogne, Dijon, France; 3 Department of Physics of Complex Systems, Weizmann Institute of Science, Rehovot, Israel
Using interferometry based on a 4f pulse shaper, we experimentally observe the Gouy phase shift of a parabolic pulse subjected to spectral focusing in an optical fiber.

IF-P.8 SUN
Optical Kerr effect in nematic doped with azo-benzene functionalized POSS nanoparticles
A. Miniewicz, B. Mosset-Łęczkowska, J. Gironès, P. Karpiński, H. Galina, and M. Dutkiewicz; 1 Wroclaw University of Technology, Wroclaw, Poland; 2 Rzeszow University of Technology, Rzeszow, Poland; 3 Adam Mickiewicz University of Poznan, Poznan, Poland
Light-induced refractive index changes in nematic LC doped by azo-benzene functionalized POSS nanoparticles are reported. Optical Kerr effect experiment proves that nematic doped with polyhedral silsesquioxane shows all-optical switching at low cw laser power.

IF-P.9 SUN
Soliton delay driven by cascading and Raman responses
H. Gao, X. Zeng, B. Zhou, and M. Bache; 1 Group of Ultrafast Nonlinear Optics, DTU FotoniK, Technical University of Denmark (DTU), Kgs. Lyngby, Denmark; 2 Key Laboratory of Special Fiber Optics and Optical Access Networks, Shanghai University, Shanghai, China; 3 People’s Public of (PRC)
We analytically and numerically study the soliton pulse delay driven by the first order of cascading and Raman responses and demonstrate a potential delay balance by tuning the cascading delay time through phase mismatch.

IF-P.10 SUN
Influence of Phase Coherence on Seeded Supercontinuum Generation
S. Sørensen, C. Larsen, U. Møller, P. M. Maslennikov, C. L. Thomsen, and O. Bang; 1 DTU FotoniK, Technical University of Denmark, Kgs. Lyngby, Denmark; 2 NTK Photonics A/S, Birkerød, Denmark
The supercontinuum noise properties can be controlled by modulating the pump with a seed pulse. We investigate the influence of the seed’s phase-coherence and demonstrate the need to seed coherently to achieve a low-noise supercontinuum.

IF-P.11 SUN
Nonlinear magneto-optical rotation with amplitude-modulated light
P. Anielak, J. Sudyka, W. Gawlik, and S. Pustelny; 1 Center for Magneto-Optical Research, M. Smoluchowski Institute of Physics, Jagiellonian University, Kraków, Poland; 2 Department of Physics, University of California at Berkeley, Berkeley, United States
Various quantum superpositions states between Zeeman sublevels are created on demand in warm 85Rb vapour with the use of amplitude-modulated laser excitation. The coherence lifetime on the order of 1s is measured.

IF-P.12 SUN
Tuning Curve of Type-0 Spontaneous Parametric Down-Conversion
S. Lerch, B. Bessire, C. Bernhard, A. Stefanov, and T. Feurer; Institute of Applied Physics, Bern, Switzerland
We study the tuning curve of entangled photons generated by type-0 spontaneous parametric down-conversion in a PPKTP crystal. We demonstrate the X-shaped spatio-temporal structure of the spectrum by means of measurements and numerical simulations.

IF-P.13 SUN
Trans-spectral orbital angular momentum transfer via 4WM in Rb vapor
G. Walker, E. Rits, S. Franke-Arnold, and A. Arnold; 1 University of Glasgow, Glasgow, United Kingdom; 2 University of Strathclyde, Glasgow, United Kingdom
We transfer orbital angular momentum (OAM) from near-infrared pump light (780+776nm) to blue light (420nm) using a highly efficient single-pass near-resonant four-wave-mixing process in Rb vapour.

IF-P.14 SUN
Nonlinear Conversion between Ultrafast Radially- and Azimuthally-Polarized Pulses in an Anisotropic Media
M. Suzuki, K. Yamane, Y. Toda, and R. Morita; 1 Hokkaido University, Sapporo, Japan; 2 JST, CREST, Sapporo, Japan
Nonlinear conversion between ultrashort radially- and azimuthally-polarized pulses in an anisotropic crystal is investigated. It is analyzed with the spatially-extended Stokes parameters, which are the integrals of the Stokes parameters in a beam cross section.

IF-P.15 SUN
Effect of Domain Shape on Noncollinear Second-Harmonic Emission in Disordered Quadratic Media
M. Ayoub, M. Puslück, P. Roedig, K. Koyov, S. Kroesen, J. Imbrock, and C. Denz; 1 Institute of Applied Physics, Muenster, Germany; 2 Max Planck Institute for Polymer Research, Mainz, Germany
The effect of the individual domain shape in nonlinear photonic structures on the noncollinearly emitted second-harmonic signal is experimentally studied and numerically proved in different size distributions, rang- ing from the nano to the micro scale.
CL-P: CL Poster Session

CL-P.1 SUN
PNA-modified photonic crystal fibers for DNA detection

• A. Candiani1, S. Gianetti1, A. Bertucci2, R. Mwas Naife3, H. Al-Handal2, M. Konskatitzki3, A. Cucinotta3, S. Pissadakis3, R. Corradin3, and S. Selleri1; 1Information Engineering Department, University of Parma, Parma, Italy; 2Department of Chemistry, University of Parma, Parma, Italy; 3Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology – Hellas (FORTH), Heraklion, Greece; 4Institute of Laser for Post-graduate Studies, University of Baghdad, Baghdad, Iraq

Functionalized photonic crystal fibers Bragg gratings for specific DNA detection are presented. Spectral measurements in reflection mode show a clear wavelength shift of the resonant peaks when specific DNA targets are detected.

CL-P.2 SUN
Towards refractive index corrected optical coherence tomography as a navigation tool for bone surgery

• M. Rahbari1, J. Diaz Diaz2, J. Thommes2, O. Majdani3, R. Roth1, T. Ortmaier1, and E. Reitmeier1; 1Hannover Center for Optical Technologies, Leibniz Universität Hannover, Hannover, Germany; 2Institute of Mechatronic Systems, Leibniz Universität Hannover, Hannover, Germany; 3Clinical for Laryngology, Rhinology and Otology, Hannover Medical School, Hannover, Germany

We present a strategy for geometrical calibration and refractive index correction for Optical Coherence Tomography in bone. This enables quantitative measurements inside bone materials and forms the basis for optical navigation in robot aided surgery.

CL-P.3 SUN
Enhancing Two-Photon Excited Fluorescence by Using Thermal Light

• A. Jecelow1,2, M. Seefeld2, H. Kurzke2, A. Heuer2, and R. Menzel2; 1Centre for Quantum Dynamics, Griffith University, Brisbane, Australia; 2University of Potsdam, Institute of Physics and Astronomy, Photonics, Potsdam, Germany

The photon bunching effect of thermal light is exploited to enhance the efficiency of two-photon excited fluorescence in a common fluorophore and water soluble quantum dots. This has potential applications in microscopy.

CL-P.4 SUN
Second Harmonic Generation imaging of collagen fibrillogenesis

• S. Bancelin1, C. Arnot2, V. Machaïras1, E. Decencière3, C. Albert5, G. Mosser3, T. Coradin3, and M.C. Schanne-Klein3; 1École Polytechnique – LOB (CNRS, Inserm), Palaiseau, France; 2Lab. for Chemistry of Condensed Matter, UPMC-College de France - CNRS, Paris, France; 3Centre of Mathematical Morphology - Mines ParisTech, Fontainebleau, France

We visualized collagen fibrillogenesis using time-lapse Second Harmonic Generation microscopy and obtained reproducible kinetics of the fibril 3D density. Correlation to Transmission Electron Microscopy showed that SHG detects fibrils down to 30-50 nm diameter.

CL-P.5 SUN
Determination of axial fluorophore distributions without strong focusing apertures using noncollinear optical parametric amplification

• M. Graf5, A. Hoffmann5, and C. Spielmann1,2; 1Institute of Optics and Quantum электроники, Аббе Центра фотоники, Jena, Germany; 2Helmholtz-Institut, Jena, Germany

A new method is presented for investigation of structured fluorescence samples using low numerical apertures for ophthalmologic application. It is used to determine the axial fluorophore distribution along the propagation direction of an excitation pulse.

CL-P.6 SUN
Nonparaxial Circular and Weber beams from caustics

• A. Mathis, F. Courvoisier, L. Froehly, R. Giust, L. Farfaro, M. Jacquot, and J. Dudley; Université de Franche-Comté, Besançon, France

Using a caustic-based approach and an appropriate modeling of high-numerical aperture microscope objectives with Debye integral, we report analytical solutions for different nonparaxial accelerating beams and experimental realization actually in the nonparaxial regime.

CL-P.7 SUN
Optical tweezers assembly line for the micro-assembly of functional zeolite nanocontainer structures

• A. Barroso1, M. Woerdemann1, M. Veiga-Gutiérrez2, L. De Cola3, and C. Dzen3; 1Institute of Applied Physics, University of Muenster, Muenster, Germany; 2Physics Institute and Center for Nanotechnology (CoTech), University Münster, Muenster, Germany

We present an optical tweezers assembly line that enables the construction of sophisticated 2D and 3D photonic functional structures of zeolite L crystals nanocontainers.

CL-P.8 SUN
Microscopic Second-order Susceptibility Tensor Analysis

• M.J. Huttunen1, L. Naskali1, M. Virkki1, G. Bautista2, A. Der3, and M. Kauranen1; 1Department of Physics, Tampere University of Technology, Tampere, Finland; 2Institute of Biophysics, Biological Research Centre of the Hungarian Academy of Sciences, Szeged, Hungary

We demonstrate microscopic tensor analysis technique based on polarized second-harmonic generation microscopy and genetic algorithms. The technique is applied to characterize nonlinear responses of bacteriorhodopsin chromatophores, and could provide a new diagnostic tool of tissues.

CL-P.9 SUN
On-chip microparticle detection and sizing using a dual-wavelength waveguide laser

• E.H. Bernhardt, K.D. van der Werf, A.J.F. Hollink, K. Würhoff, R.M. de Ridder, V. Subramaniam, and M. Pollnau; University of Twente, Enschede, The Netherlands

An integrated intra-laser-cavity microparticle sensor based on a dual-phase-shift, dual-wavelength distributed feedback channel waveguide laser in ytterbium-doped aluminum oxide is presented. Single micro-particles with diameters ranging between 1 µm and 20 µm are detected.

CL-P.10 SUN
Adapted AWG Design for Localised Spectroscopic Measurements

• Z. Hu1, H. Yin, A. Glidie2, and J. Cooper2; 1Division of Medical and Biological Measurements, National Institute of Metrology, Beijing, China, People’s Republic of (PRC); 2School of Engineering, University of Glasgow, Glasgow, United Kingdom

For localised spectroscopic measurements, AWG design was modified to work with microfluidic system. Lens curvatures were incorporated into the ends of the integrated waveguides and the controllable focusing properties were evaluated by fluorescence measurements.

CL-P.11 SUN
Laser Diode Vibrometry for Non-Contact Monitoring of the Arterial Stiffness: Detection of the Heart Beat and Measurement of the Pulse Wave Velocity

• G. Capelli1, M. Benedetti1,2, M. Norgia1, and G. Giuliani1,2; 1University of Pavia, Pavia, Italy; 2Iluliet S.C.L, Pavia, Italy; 3Politecnico di Milano, Milano, Italy

We demonstrate the simultaneous use of two diode laser vibrometers to measure the heart rate and arterial Pulse Wave Velocity without contact. This tool can be applied to cardiovascular risk prevention on a large scale.

CL-P.12 SUN
Optical Injector of Particles for X-ray Diffraction Imaging

• R. Kirian1, N. Ekerskarn2, A. Rode1, J. Kupper1,3,4, D. DePonte1, and H. Chapman1,3,4; 1Center for Free-Electron Laser Science, DESY, Hamburg, Germany; 2Research Physics Centre, Research School of Physics and Engineering, Australian National University, Canberra, Australia; 3Department of Physics, University of Hamburg, Hamburg, Germany; 4The Hamburg Centre for Ultrafast Imaging, Hamburg, Germany

We apply a high aspect-ratio first order Bessel beam, generated using a vortex beam through an axicon, to guide biological macromolecules and viruses to the focus of femtosecond x-ray free-electron laser for coherent diffractive imaging.

CL-P.13 SUN
Cell Material interaction investigated by Digital Holographic Microscopy

• L. Miccio1, P. Mennello1,2, F. Merola1, S. Pusco3, V. Embrione4, P. Netti1, and F. Ferraro1; 1Istituto Nazionale di Ottica del CNR, Pozzuoli, Italy; 2Istituto Italiano di Tecnologia, Napoli, Italy

Investigation of the interaction between cells and sub- strates is performed by Digital Holographic Microscopy. The potentiality of this well known interferometric tech- nique is exploited to investigate the cross talk interaction between cell and biomaterials.

CL-P.14 SUN
High-resolution phase and amplitude modulation using a digital micromirror device

• S.A. Goedjen, J. Bertolotti, H. Yilmaz, D. Akbulut, W.L. Vos, and A.P. Mork; Complex Photonic Systems (COPS), MESA+ Institute for Nanotechnology, University of Twente, Enschede, The Netherlands

We demonstrate a new phase and amplitude modulation method using a digital micromirror device. This provides the high level of control, high resolution and high speed required by many wavefront shaping applications.

CL-P.15 SUN
Monolithic Y-branch dual wavelength DBR laser at 671 nm for Shifted Excitation Raman Difference Spectroscopy

• M. Maitwald, J. Fricke, A. Ginos, J. Pohl, B. Sampf, G. Erbert, and G. Tränkle; Ferdinand-Braun-Institut, Berlin, Germany

A monolithic dual wavelength diode laser at 671 nm will be presented. Electro-optical and spectral properties will be given. Raman experiments demonstrate the suitability of these devices for shifted excitation Raman difference spectroscopy (SERDS).
CL-P.1 SUN
Ciliary white light generated during femtosecond laser ablation on transparent dielectrics

• Y. Liu, Y. Brelet, Z. He, L. Ye, S. Mitrykovskiy, A. Hourad, B. Forestier, A. Couairon, and A. Mysyrowicz, Laboratoire d'Optique Appliquée, Palaiseau, France, 2 University of Antwerp, Antwerp, Belgium, 3 Laboratoire de Physique des Interfaces et des Couches Minces, Palaiseau, France; 4 Centre de Physique Théorique, Ecole Polytechnique, Palaiseau, France

We report on a new nonlinear optical phenomenon, coined as ciliary white light, during laser ablation on transparent dielectrics. It is universally observed on 14 different dielectrics including glasses, crystals and polymers.

CM-P.2 SUN
Pulsed Laser Generation of Novel Nanomaterials for Organic Electronics

• E. Stratakis1,2, M.M. Stylianakis1,2, K. Savva1,2, C. Fotakis1,2, and E. Kymakis1,2, 1 Institute of Electronic Structure and Laser, Foundation for Research & Technology Hellas, (IESL-FORTH), P.O. Box 1527, Heraklion 711 10, Greece, 2 University of Crete, Heraklion 714 09, Greece, 3 Heraklion, Greece, 4 Center of Materials Technology and Photonics & Electronic Engineering Department, Technological Educational Institute (TEI) of Crete, Heraklion, 71003, Greece, Heraklion, Greece


CM-P.3 SUN
Highly Antibacterial UHMWPE Surfaces by Pulsed Laser Ablation ofTitanium Targets

• D. Delle Selle1,2, P. Alfano3, V. Nascisi1,2, A. Tala4, S.M. Tredici, and L. Velardi1,2, 1 Lea, Dipartimento di Matematica e Fisica, Università del Salento, Lecce, Italy; 2 INFN section of Lecce, Lecce, Italy; 3 Laboratorio di Microbiologia, DiSTeRA, Università del Salento, Lecce, Italy

Results about an highly antibacterial UHMWPE implanted with Ti ions obtained by Laser Ablation are presented. Morphological and elemental analysis and antibacterial tests show substantial enhancements with respect to the blank material.

CM-P.4 SUN
Nanosecond pulsed laser irradiation of silver-doped nanocomposite glass

• L. Fleming and A. Abdolvand; School of Engineering, Physics and Mathematics, University of Dundee, Dundee, United Kingdom

Glass embedded with silver nanoparticles is modified using a nanosecond pulsed laser at 532 nm. The modified areas show a broadening and red shift of the SPR band, in accordance with the Maxwell-Garnett theory.

CM-P.5 SUN
Creating metallic films by laser irradiation of silver ion exchanged glasses

• S. Wackerow and A. Abdolvand; School of Engineering, Physics & Mathematics, University of Dundee, Dundee, United Kingdom

Glass with silver ions was fabricated and irradiated at scanning speed of 14 mm/s using a nanosecond laser at 355 nm, leading to spatially-selective one-step precipitation of silver particles and fabrication of glass-silver composite.

CM-P.6 SUN
Fabrication of a DFB Laser in SU-8 by Direct Femtosecond Laser Writing

• W. Horn, S. Kroesen, and C. Denz; University of Muenster, Muenster, Germany

We demonstrate the fabrication of a DFB laser in Rhamdin 6G doped SU-8 by femtosecond laser writing. We characterize spectral emission, threshold and lifetime by optically pumping the device with a pulsed Nd:YAG laser source.

CM-P.7 SUN
Dental Tissue Ablation by means of a Picoscences Laser

• M. Sotz1, C. Fornaini2, A. Cucinotta1, E. Merigo2, P. Vescov2, and S. Selleri1, 1 Department of Information Engineering, University of Parma, Parma, Italy; 2 Oral medicine and Laser-Assisted Surgery Unit, Dental School, Parma, Italy

An “in vitro” study of dental surfaces ablation, by means of a 1064nm picoseconds laser, has been carried out. High quality holes have been drilled, avoiding cracks, carbonization, and high temperature rise by proper cooling.

CM-P.8 SUN
Study of the Stress-Strain State in Glass-Carbon Plates after Ultrafast Laser Processing

• T. Sokolova, Y. Chebotarevsky, E. Surmenko, A. Konyushin, I. Popov, and D. Bessonov; Gagarin Saratov State Technical University, Saratov, Russia

Paper describes the theoretical simulation of the mechanical stresses that occur in a glass-carbon plate under the influence of a series of ultrashort laser pulses with high energy density.

CM-P.9 SUN
Laser-assisted Microstructuring and Blackening of Copper

• G. Tang, A. Hound, and A. Abdolvand; School of Engineering, Physics and Mathematics, University of Dundee, Dundee, United Kingdom

Large-area microstructures have been induced on copper surfaces using a 532 nm nanosecond laser to produce black copper, which absorbs 97% of light from 250-750 nm, and over 80% between 750-2500 nm.

CM-P.10 SUN
Multiple-wavelength DFB laser based on 3D surface relief gratings

• X. Wu1,2,3, D. Sun1, L. Ledoux-Rak1, C.T. Nguyen1, and N.D. Lai1, 1 Laboratoire de Photonique et Méculeaire, UMR CNRS 8537, Ecole Normal Superieure de Cachan, Cachan, France; 2 Condensed Matter Physics, East China Normal University, 3663 Zhongshan North Road, Shanghai, China; 3 People’s Republic of (PRC) Polymer-based 3D structures are fabricated by holographically assembling multiple 1D surface relief gratings. By varying the period of each 1D layer, these structures allow to realize multiple-wavelength distributed feedback lasers.

CM-P.11 SUN
Laser Induced Plasma Detection by Flat and Circular Interdigital Electrodes in Laser Material Processing

• Y.-J. Chang, C.-T. Chen, C.-C. Ho, J.-C. Hsu, and C.-L. Kuo; National Yangm University of Science and Technology, DaulouTN, China, Republic of (ROC)

We propose flat and circular interdigital electrode designs to increase the detection signal of laser-induced plasma for monitoring laser material processing. The results indicated the signal increase by 2.5 times and 3 times, respectively.

CM-P.12 SUN
Microfabrication of notches for electric contacts in the conductive ceramic fiber by femtosecond pulses

• A. Aleskenov, L. Matule, G. Chozhevsk, K. Stankivitse, D. Paipulas, and V. Struktaitis; Laser Research Centre, Vilnius, Lithuania

With the help of femtosecond laser micromachining we demonstrate fabrication of micronotches in conductive ceramic fibres. The notches, with 60-200 um width are intended to attach electrical wires in the metallic mould wear sensor.

CM-P.13 SUN
Time Resolved and Spectral Analysis of Solar Absorber Cu-Al and Al-Al Laser Weld Emission

• P. Siozos; Institute of Electronic Structure and Laser - Foundation for Research and Technology Hellas, Heraklion, Greece

The time resolved and spectral analysis of emission during laser welding in the fabrication of solar heat collectors is presented. The results provide significant information concerning laser welding, for the optimization of the weld quality.

CM-P.14 SUN
Ultrafast laser ablation giving unstructured surface roughness prior to the emergence of LIPSS

• M. Ardon and D. Hand; Heriot Watt University, Edinburgh, United Kingdom

Ultrafast laser pulses around the ablation threshold form LIPSS on metal regardless of surface preparation. Experimental results suggest initial ablation gives unstructured roughness allowing further pulses to couple with plasmons via scattering and grating-like interaction.

CM-P.15 SUN
Direct laser fabrication of composite material 3D microstructured scaffolds

• S. Rekstyte1, E. Balcianas1,2, D. Baltrukien2, V.
Direct femtosecond laser writing of waveguide structures and Bragg gratings for integrated NIR optics using multi scan technique

M. Thiel, G. Fluchenecker, M. Kohring, and W. Schade; Fraunhofer Heinrich-Hertz-Institute, Goslars, Germany

We present a multi scan technique to produce integrated optics for NIR light sources. Basic element is a bundle of parallel, slightly overlapping single waveguides. The waveguide bundles are very well suited for implementing Bragg gratings.

CM-P.16 SUN

Fabrication of ridge waveguides by femtosecond-laser structuring of (Yb,Nb):RTT/RTT using beam multiplexing with a Spatial Light Modulator

• A. Ruiz de la Cruz1, J. Cugat2, R. Solé2, A. Ferrer3, J. Masson2, X. Mateo2, J.J. Carvajal3, M. Aguiló3, G. Lifante3, F. Díaz3, and J. Solís1; 1Laser Processing Group, Instituto de Óptica (CSIC), Madrid, Spain; 2Física e Cristallografía de Materiales e Nanomateriais (FiCMA-FCNA), Universitat Rovira i Virgili, Tarragona, Spain; 3Ultrafast Dynamics Group, Institute for Quantum Electronics, ETH Zurich, Zurich, Switzerland

We fabricated ridge waveguides, inscribing trenches in a (Yb,Nb):RTT eplayer with a fs-laser using the approximation technique multiplexing the beam with a SLM. We achieved propagation losses lower than 4 dB/cm for λ=972 nm.

CM-P.17 SUN

CM-P.19 SUN

Fabrication of SERS active surface structures on rotating polynime sample by excimer laser irradiation

• T. Czimidz, Z. Bengery, J. Kopnicyz, I. Hanyecz, and B. Hopf; Department of Optics and Quantum Electronics, University of Szeged, Szeged, Hungary

In this study the fabrication of polynime nanostructures by excimer laser irradiation is presented and the suitability of the produced morphologies in surface enhanced Raman scattering spectroscopy applications is demonstrated.

CM-P.20 SUN

Optimized hydrogen sensing properties of nanocomposite NiO:Au and NiO:Pd thin films at ppb-concentration levels

• M. Kandyba1, C. Chatzimanolis1,2, C. Charitidis2, M. Gugwetze2, and M. Kompticas; 1National Hellenic Research Foundation, Athens, Greece; 2National Technical University of Athens, Athens, Greece; 3Institute of Electron Technology, Warsaw, Poland

We present results on the fabrication of p-type NiO:Au and NiO:Pd thin-film electrochemical sensors, which are able to detect hydrogen in air at ppb-level concentrations, operating at low temperatures.

CM-P.21 SUN

Alleviating the mechanical tolerances in femtosecond laser micromachining by diffraction focusing

• S. Torres-Peiro, J. Gonzalez-Ausejo, O. Mendoza-Yero, G. Minguez-Vega, and J. Lanzac; GROC-UJI, Institut de Noves Tecnologies de la Imatge (INIT), Castellón, Spain

Demonstration of the alleviating mechanical tolerances in micromachining processes employing 30s pulses and diffraction lenses by means of the study of the ablation region along the axial direction.

CM-P.22 SUN

Laser-Induced Forward Transfer-Assisted Flip-Chip Bonding of Optoelectronic Components

• K. Kaur1, J. Missinne1, B. Vandecasteele1, G. Steenberge1, S. Persichney2, R. Mandampamaritly2, and E. Smits2; 1Centre for Microystems Technology, IMEC/Agent University, Gent, Belgium; 2FNO/Host Centre, Eindhoven, Netherlands

We report the Laser-Induced Forward Transfer (LIFT) of micro-bumps of silver nanoparticle and solder based paste for flip-chip bonding of single VCSEL chips. The electrical characterization results of the bonded chips are also presented.

CM-P.23 SUN

Experimental and numerical study of cw green laser crystallization of a-Si:H thin films

• O. Garcia1, D. Munoz-Martín1, J.J. Garcia-Ballesteros1, Y. Chen1, M. Morales1, J. Calabre1, J.J. Gandía1, and C. Molpeceres1; 1Centro Láser UPM, Universidad Politécnica de Madrid, Madrid, Spain; 2CIEMAT, Madrid, Spain

In this work, experimental and numerical study results of cw green laser crystallization of a-Si:H thin films are presented.

The process parameters predicted by the numerical model are consistent with those experimentally observed.

CM-P.24 SUN

Self-Assembled Nanostructuring of a-Si:H Films with Ultrashort Light Pulses

• M. Grecuvi1, M. Bera2, A. Kazansk1, and P. Kazanys2; 1Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom; 2Physics Department, M.V. Lomonosov Moscow State University, Moscow, United Kingdom

Dichroism and record high birefringence of femtosecond laser induced nanostructures in oxidized a-Si:H is demonstrated. Ultrashort laser writing can be used for printing integrated polarization optical elements with submicron precision in amorphous silicon thin films.

CM-P.25 SUN

Rapid, low-cost patterning of microstructures in poly(dimethylsiloxane) via mask-less laser-machining

• C. Sons1, I. Kats, R. Mills, M. Feinagule, A. Masaybei, J. Butement, and R. Eason; Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom

We report on the use of a rapid and mask-less laser machining procedure that enables the creation of micron-scale structures in poly(dimethylsiloxane) (PDMS), used commonly in implementation of lab-on-chip devices and micro-contact printing.

CM-P.26 SUN

Non-thermal Material and Tissue Processing with 100 MHz and 500 MHz Repetition Rate Bursts

• C. Kers1, H. Kalaycioğlu1, O. Akçaalan1, B. Elenid1, F.D. Ilday1, H. Hoogland1, and R. Hofszath1; 1Department of Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey; 2Department of Physics, Bilkent University, Ankara, Turkey; 3Department of Electrical and Electronics Engineering, Ankara University, Ankara, Turkey; 4Menlo Systems GmbH, Munich, Germany

We demonstrate efficient micro-machining results on Cu and dentin samples obtained with high repetition rate (100 MHz and 500 MHz) pulses in the form bursts from an in-house developed mJ-level Yb integrated fiber amplifier.

CM-P.27 SUN

Hydrogenated amorphous silicon films grown by pulsed laser deposition

• M. Kandýla, A. Mellos, and M. Komptias; National Hellenic Research Foundation, Athens, Greece

We employ pulsed laser deposition for the fabrication of a-Si:H solar cells in the p-i-n configuration. Varying the PLD parameters, we optimize the morphology, conductivity, and optical properties of the a-Si:H layers for maximum efficiency.

CM-P.28 SUN

Thermoelastic generator fabricated via laser-induced forward transfer

• M. Feinagule, C. Sons1, E. Koukharenko2, and R. Eason1; 1Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom; 2School of Physics and Astronomy, ECS, University of Southampton, Southampton, United Kingdom

We present a laser-induced forward transfer as a novel method to fabricate thermoelastic generators on polymer substrates. The thermoelastic voltage and resistance of the device were determined as a measure of the device’s thermoelastic performance.

CM-P.29 SUN

Laser-induced forward transfer on compliant receivers

• M. Feinagule, P. Horak, C. Sons, and R. Eason; Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom

We present the role of compliant polymer films on receivers during laser-induced forward transfer of thin solid films. Experiments and finite element simulation show the influence of such films on adhesion and morphology of deposits.

CM-P.30 SUN

The Laser Furnace: A Revolution in Ceramics and Glass Processing

J. de Francisco, V. Lennikov, R. Lahoz, L.A. Angurel, L.C. Estopa, and •G.F. de la Fuente; ICMA (CSIC-Universidad Zaragoza), Zaragoza, Spain

This paper presents a novel processing tool, which combines laser irradiation with a continuous roller furnace, with the aim of processing ceramics and glass products without thermo-mechanical damage.
13:30 – 14:30

CC-P: CC Poster Session

CC-P.1 SUN InGaAs/AlInGaAs THz Quantum Cascade Lasers

* K. Ohtani, M. Beck, G. Scalari, and J. Faist; Institute for Quantum Electronics, ETH Zurich, Zurich, Switzerland
We report on operation of InGaAs/AlInGaAs THz quantum cascade laser. The devices exhibit a low threshold current density (100 A/cm²) with output power (1-2 mW) at 10 K in continuous wave mode.

CC-P.2 SUN Mid-infrared frequency comb spanning an octave based on an Er fiber laser and difference-frequency generation

* S. Amari1 and F. Keilmann2; 1Neaspec GmbH, Martinstedt, Germany; 2LASNIX, Berg, Germany
We describe a coherent mid-infrared continuum source (18 - 75 THz) covering the full infrared “fingerprint” molecular vibration region. Application in near-field microscopy will be shown.

CC-P.3 SUN Multi-cavity terahertz quantum cascade lasers

* D. Bachmann1, M. Krall1, M. Maret2, H. Detz1, A.M. Andrews3, G. Strasser4, K. Uettmann1, and J. Darmo5; 1Institute of Photonics, Vienna, Austria; 2Institute of Solid-State Electronics, Vienna, Austria
In a systematic investigation, the multi-purpose of sectioned terahertz quantum cascade laser cavities is demonstrated. Depend on the operation mode, THz amplification, modulation or detection can be achieved concurrently in a single device.

CC-P.4 SUN Pulsed THz generation from InAs/AlGaS quantum dot structures

* N.S. Dighefatt1, M. Aldurabti2, M. Missouia2, T. Ackermann1, and M.A. Cataluna1; 1University of Dundee, Dundee, United Kingdom; 2University of Manchester, Manchester, United Kingdom
We demonstrate efficient coupling to metal wires from propagating mode by introducing broadband terahertz radial beams, and experimental investigations to determine coupling efficiency are performed, the maximum coupling efficiency is as large as 60%.

CC-P.5 SUN THz emission from quantum dot-based THz antennas pumped by a tunable quantum-dot laser diode

* R.L. Leinhardt1, D. Carnogin2, R. Pedrosa1, V. Blau2, S. Schuwel3, C. Reardon4, E. Clarke5, and E. Rajafol5; 1University of Dundee, Dundee, United Kingdom; 2University of St Andrews, St Andrews, United Kingdom
** EPSRC National Centre for III-V Technologies, University of Sheffield, Sheffield, United Kingdom
We demonstrate an efficient THz source comprising an InAs quantum dot-based semiconductor antenna optically pumped by a tunable dual-mode quantum-dot semiconductor laser, giving tunable THz output signal between about 250 GHz and 3 THz.

CC-P.6 SUN Generation of broadband terahertz Laguerre-Gaussian beam

* R. Imai1, N. Kanda2, T. Higuch1, Z. Zheng1, K. Konishi1, and M. Kawai-Gonokami1,2; 1Department of Applied Physics, The University of Tokyo, Tokyo, Japan; 2RIKEN Advanced Science Institute, Wako, Japan
** Department of Physics, The University of Tokyo, Tokyo, Japan
We demonstrate a method to generate broadband terahertz Laguerre-Gaussian beam with the topological charge of +1 and -1 by mode conversion from broadband THz radial beam using a quarter wave plate and a polarizer.

CC-P.7 SUN Efficient Coupling of Broadband Terahertz Radial Beams to Metal Wires

* Z. Zheng1, N. Kanda2, K. Konishi1, and M. Kawai-Gonokami1,2; 1Department of Applied Physics, The University of Tokyo, Tokyo, Japan; 2RIKEN Advanced Science Institute, Wako, Japan
** Photon Science Center, The University of Tokyo, Tokyo, Japan
We demonstrate efficient coupling to metal wires from propagating mode by introducing broadband terahertz radial beams, and experimental investigations to determine coupling efficiency are performed, the maximum coupling efficiency is as large as 60%.

CC-P.8 SUN THz propagation in hybrid hollow core fibers with metal wires inclusion

* R. Leinhardt1, J. Anthony1, and A. Argrozo2; 1Physics Dept, University of Auckland, Auckland, New Zealand; 2Institute of Photonic and Optical Sciences (IPOS), School of Physics, The University of Sydney, Sydney, Australia
We present novel designs for hollow-core THz waveguides that include metal wires. For the HE1-like mode attenuation in the order of 0.4 cm-1 can be achieved. Experimental results agree well with numerical full-vectorial finite-difference simulations.

CC-P.9 SUN Generation and Field-Resolved Detection of Ultrafast Synthetic Multi-THz Transients

* D.V. Seletskii, C. Schmidt, B. Mayer, A. Pashkin, and A. Leitenstorfer; Department of Physics and Center for Applied Photonics, University of Konstanz, Konstanz, Germany
** Intense fundamental and second harmonic few-cycle multi-THz pulses are combined to generate synthetic waveforms with strongly symmetry-broken temporal envelope. Access to these waveforms sets an exciting platform for novel experiments in THz nonlinear optics.

CC-P.10 SUN Carrier envelope phase control of monochromatic THz pulses using an artificial dispersive medium

* M. Nagai, E. Matsumura, Y. Minowa, and *M. Ashida; Osaka Univ., Toyonaka, Japan
We experimentally control carrier envelope phase of intense monochromatic THz pulse by passing through an artificial dispersive medium based on the parallel metal plates. This gives us a new field of phase-sensitive THz nonlinear spectroscopy.

CC-P.11 SUN Nonlinear phase shifts of bichromatic pump waves during terahertz wave generation in air

* K. Steponkenvičius, V. Pyragaitė, V. Smilgevičius, and V. Vaitkaitis; Vilnius university Laser Research Center, Vilnius, Lithuania

It is shown that the properties of terahertz radiation generated in air by tightly focused bichromatic femtosecond laser pulses can be well explained only if the nonlinear phase shifts of both pump waves are considered.

CC-P.12 SUN Broadband THz-Wave Generation with Organic Crystals OH1 and DSTEMS

* M. Jazbinsek, R. Ruiz, C. Medrano, and P. Günter; Rainbow Photonics AG, Zurich, Switzerland
We report on efficient THz-wave generation and detection in a broad THz range 1-12 THz using recently developed OH1 and DSTEMS electro-optic crystals and evaluate the corresponding phase-matching configurations for femtosecond and nanosecond pump-laser sources.

CC-P.13 SUN Influence of the acquisition method on terahertz tomography

* I.-P. Gouillot1, B. Recur2, L. Frederique1, *I. Manek-Hörninger1, P. Desbarats1, and P. Mounia1; 1LOMA, Bordeaux 1 University, CNRS UMR 5798, Talence, France; 2LabR1, Bordeaux 1 University, CNRS UMR 5800, Talence, France
** Terahertz tomography is a technique which allow to reconstruct the structure of an object. In this work, we study the influence the acquisition method on the noise of terahertz tomography with different reconstruction algorithms.

CC-P.14 SUN Understanding and controlling on-axis and off-axis THz emission patterns from 2-color femtosecond laser filaments

* A. Kouloukidi1,2, M. Massiaouti2, A. Gorodetsky3, and S. Tsotzias1,2; 1Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology - Hellas (FORTH), Heraklion, Greece; 2Department of Materials Science and Technology, University of Crete, Heraklion, Greece
** We present new experimental findings coupled with a comprehensive model explaining both on-axis and off-axis components of the far-field spatial distribution of intense broadband THz beams generated by femtosecond laser filaments in gases.

Thin films of magnetite were deposited on different single crystal substrates by pulsed laser deposition at 1064 nm and characterized by XRD, AFM, Raman and Mössbauer spectroscopies, MOKE and SQUID.
Properties and Origin of Frequency Noise in Mid-IR Distributed Feedback Quantum Cascade Lasers

L. Tombez1, S. Schilt1, G. Di Domenico1, S. Blaser2, A. Muller3, T. Gresch1, B. Hinkov1, M. Beck2, J. Faist1, and D. Hofstetter1; 1University of Neuchâtel, Neuchâtel, Switzerland; 2Alpes Lasers SA, Neuchâtel, Switzerland; 3ETH Zurich, Zurich, Switzerland

We present and compare the frequency-noise properties of ridge and buried-heterostructure DBR-QCLs at 4.53um. The physical origin of the noise is discussed, showing the dominant contribution of internal electrical noise.

CA-P.5 SUN

A barium tungstate anti-Stokes Raman laser C. Wang1, *X. Zhang1, Z. Cong1, Z. Liu1, W. Wei1, W. Wang2, Z. Wu1, Y. Zhang1, L. Li1, X. Chen1, P. Li1, H. Zhang2, and Q. Wang1; 1School of Information Science & Engineering and Shandong Provincial Key Laboratory of Laser Technology and Application, Shandong University, Jinan, China, People's Republic of (PRC); 2State Key Laboratory of Crystal Materials, Shandong University, Jinan, China, People's Republic of (PRC)

A BaWO4 anti-Stokes Raman laser is investigated. The first and second order anti-Stokes lasers are obtained with the highest energies of 0.76 mJ and 0.12 mJ and the conversion efficiencies of 0.95% and 0.15%, respectively.

CA-P.6 SUN

Faraday Isolator with 33 dB Isolation Degree at the 1.5 kW CW Laser Power

I. Snegov1 and O. Palashov; 1Institute of Applied Physics of the Russian Academy of Sciences, Nizhny Novgorod, Russia

Experimentally demonstrate a prototype of a water cooled Faraday isolator with compensation of thermally induced depolarization within the magnetic field with a record level of 33 dB isolation at the 1.5 kW cw laser power.

CA-P.7 SUN

1.5 kW Burst of Picossecond Pulses with Scalable Energy and Average Power Generated by Diode Pumped Nd-laser System

B. Oreshkov, V. Aleksandrov, H. Iliev, A. Trifonov, and I. Buchvarov; Sofia University, Sofia, Bulgaria

We report generation of a burst of picosecond pulses easily scalable using diode pumped Nd-based technology. Burst of 6ps-pulses with duration (10ns-1000ns) , 1510-1650 W is obtained at 0.5 kHz repetition rate.

CA-P.8 SUN

Hybrid Q-Switched Laser Source With Timing Jitter Lower Than 100 ns at High Repetition Rate (30 kHz)

F. El Bassir1, 2, J. Jaffres1, A. Jalouca1, D. Pagnoun1, and V. Coudere2; 1Xlmin, photonics department, Limoges, France; 2CILAS, Orleans, France; 3Horus Lasers, Limo- ges, France.

We present an active/passive Q-switched laser source based on a dual cavity configuration with modulated pump pumping, emitting 600 ps pulses at tunable repetition rate up to 30 kHz with timing jitter < 100 ns.

CA-P.9 SUN

Near Diffraction Limited Pulses with 52-ml, 1.2 ns at 0.5 kHz, Generated by Nd-based MOPA D. Chuchamishy1, B. Oreshkov2, A. Gaydarzhiev3, A. Trifonov1, and I. Buchvarov2, 1Department of Physics, Sofia University, Sofia, Bulgaria; 2Northwestern University School of Medicine, Chicago, United States.

We present Nd-based, diode pumped amplifier system emitting up to 52-ml pulse energy with 1.2-ns pulse duration and near diffraction limited beam (quality factor <1.3), operating at 0.5 kHz repetition rate.

CA-P.10 SUN

Tunability and CW efficient laser operation in KLa(XO4)2:Nd3+, (X = W or Mo), disordered laser crystals

M. Rico1, 2 and X. Han1; 1Centro de Láseres Pulsados Ultracortos, CLPU, Villamayor, Spain; 2Instituto de Ciencia de Materiales de Madrid, CSIC, Madrid, Spain

RT CW laser operation for disordered crystals (Nd3+:KLa(WO4)2 and Nd3+:KLa(MoO4)2) with slope efficiency to > 50% output power (>6 W for KLM) and tunable laser (15 nm range for KLM) are demonstrated in several configurations.

CA-P.11 SUN

Passive Mode-locking of a Diode Pumped Nd:ScYSiO5 Laser

V. Aleksandrov1, H. Iliev1, L. Zheng2, L. Su2, J. Xu2, G. Aka3, and I. Buchvarov2; 1Department of Physics, Sofia University, Sofia, Bulgaria; 2Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai, China; People's Republic of (PRC); 3Laboratoire de Chimie de la Matière Condensée de Paris, Paris, France.

Single wavelength, passive mode-locking of Nd:ScYSiO5 disordered laser crystal is demonstrated, achieving output power of 150mW at 99MHz repetition rate and 5.7ps pulse duration as well as dual wavelength mode-locking with output power of 500mW.

CA-P.12 SUN

Control of Spectral Parameters in Vanadate Lasers

J. Antony, Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russia

We have experimentally investigate, for the first time, angular dependences of the luminescence intensity of Stark transitions in Nd-doped vanadate crystals. We suggest some directions to create active media with new parametrs.

CA-P.13 SUN

High Repetition Rate Electro-optical Cavity-dumped Nd:GdVO4 Laser

Y. Ma, X. Yu, X. Li, C. Wang, R. Yan, and J. Yu; Harbin Institute of Technology, Harbin, China, People's Republic of (PRC)

High repetition rate electro-optical cavity-dumped YVO4/Nd:GdVO4 laser pumped by 808 nm LD and GdVO4/Nd:GdVO4 laser pumped 879 nm LD are presented. The pulse width remained constant at ~3.8 ns for both two lasers.

CA-P.14 SUN

Diode-side-pumped Nd:YAG slab laser with self-adaptive resonator

J. Jabzynski, W. Zurzdan, M. Kaskow, L. Gorajek, J. Kwiatkowski, and K. Kopczynski; Military University of Technology, Warsaw, Poland.

Four-wave-mixing inside Nd:YAG slab pumped by 2D laser diode stacks, in self adaptive closed-loop resonator.
was exploited to achieve 250 mJ energy in free-running with parameter M2 < 1.4.

CA-P.15 SUN
High Efficiency Multi-Mode Laser Diode-Pumped Cavity-Dumped Ytterbium-Doped Yttrium Aluminum Garnet Laser
N. Shimjo1, S. Matsuura1, M. Inoue1, D. Kimura1, Y. Sasatani2, A. Maruko2, D. Mizuno2, M. Nishio3, and S. Kawato1,2,3; 1Graduate School of Engineering, University of Fukui, Fukui, Japan; 2Research and Education Program for Life Science, University of Fukui, Fukui, Japan; 3Japan Synchrotron Radiation Research Institute (JASRI), Fukui, Japan
A laser-diode-pumped cavity-dumped micropump Yb:YAG:O12 laser was developed with the slope efficiency of 72% and optical-to-optical conversion efficiency of 56%, which are the highest in laser-diode-pumped short pulse lasers.

CA-P.16 SUN
Versatile Pulsed Source using a pulsed diode seed and ultrahigh gain beam geometry amplifier
A. Teppitkasak, G. Thomas, and M. Damzen; Imperial College London, London, United Kingdom
A flexible high peak power laser source is investigated with a pulsed diode seed laser (duration 3ns @ 10kHz) experiencing 4X4dB gain in a Nd:YVO4 bounces amplifier (gain > 50dB with CW seed) at 1064nm.

CA-P.17 SUN
Tunability of Yb:LuAG Laser with High Dopant Concentration
J. Šulc1, J. Mäsiček1, Z. Huibka1, H. Jelinkova1, K. Nejezchleb2, and V. Škoda1; 1Czech Technical University in Prague, FNSPE, Czech Republic; 2Crytur, Ltd. Turnov, Turnov, Czech Republic
Yb:LuAG crystals with Yb-doping concentration 15 and 20% were investigated as the active medium of tunable diode pumped laser. Using birefringent filter, 35 nm wide tunability was reached (1025-1060 nm for 20% doping).

CA-P.18 SUN
Efficient performance of Yb:YAG/Cr:Yb:YAG self-Q-switched microchip lasers under high-brightness laser-diode pumping
J. Dong, Y. Cheng, and Y. Ren; Department of Electronic Engineering, School of Information Science and Technology, XianJen University, Xian, China, People’s Republic of (PRC)
We report on highly efficient performance of Yb:YAG/Cr:Yb:YAG self-Q-switched microchip lasers by bonding Yb:YAG to Cr:Yb:YAG crystal under high-brightness laser-diode pumping.

CA-P.19 SUN
Comparative study of Nd:YAG solar laser performance in end-pumping and side-pumping configurations
J. Aimeida, D. Liang, and D. Garcia; CEFITEC, Departamento de Física, PCT, Universidade Nova de Lisboa, Campus de Caparica, Portugal
A comparative study of Nd:YAG solar laser performances in end-pumping and side-pumping configurations is reported. The highest collection efficiency is achieved with end-pumping configuration, while side-pumping approach provides the best beam brightness figure of merit.

CA-P.20 SUN
Approaching the Thermodynamical Limit of Optical Pumping — Intra-cavity Pumped Thin Disk Laser with Very Low Quantum Defect
C. Vorholt and U. Wittrock; Muenser, University of Applied Sciences, Steinfurt, Germany
We demonstrate the first intra-cavity pumped thin disk laser. The laser has a quantum defect of only 1.74%. A slope efficiency of 8.27% and an average output power of 10.33 W.

CA-P.21 SUN
Radiation-Balanced Thin-Disk Laser System
G. Nemova1 and R. Kashyap1,2; 1Department of Engineering Physics, Polytechnique de Montréal, Montréal, Canada; 2Department of Electrical Engineering, Polytechnique de Montréal, Montréal, Canada
A novel scheme for an athermal laser, which consists of a series of radiation-balanced thin disks placed inside a single resonator, is presented. Heat generated during the amplification process is offset by anti-Stokes emission.

CA-P.22 SUN
Efficiency of Single-Mode Thin-Disk Lasers
J. Perchermeier and U. Wittrock; Muenser University of Applied Sciences, Photonics Laboratory, Steinfurt, Germany
The thermo-optical aberrations of the gain medium of an Yb:YAG thin-disk laser were measured with high resolution. Moreover, we investigated how the TEM00 mode radius affects the beam quality and output power of different resonators.

CA-P.23 SUN
High power femtosecond 1030nm burst-mode front-end and pre-amplifier for the European XFEL pump-probe laser development
M. Kellert1, K. Kruše1, M. Pergamen1, G. Kalska1, T. Mars2, and M. Lebedev2; 1European X-ray Free-Electron Laser-Facility GmbH, Hamburg, Germany; 2Laser Im-pulse, Heidelberg, Germany
We present the 100kHz - 4.5MHz, 400W burst-mode femtosecond Yb:YAG pre-amplifier with Ytterbium-all- fiber front-end of the European X-ray Free-Electron Laser Facility (European XFEL) non-collinear optical parametric amplifier development for pump-probe experiments at the European XFEL.

CA-P.24 SUN
Fiber based modulator systems at 1053 nm for shaped long pulse on LULI2000
M. Loic, Z. H. Ping, B. Erick, and A. Patrick; Laboratoire pour l’utilisation des lasers Intenses, Ecole Polytechnique, Palaiseau, France
LULI2000 is one of the most energetic laser facilities in Europe. We present a new as fiber-based front-end for upgrading the LULI2000 facility.

CA-P.25 SUN
Wavelength selection, spatial filtering and polarization control of an Er:YAG laser cavity by resonant-grating mirror
A. Aubourg1,2, M. Rumpf3, M. AbdoH-Amhmed4, J. Didierjean5, N. Aubry5, T. Graf5, B. Balembois5, and P. Georges1; 1Laboratoire Charles Fabry, Institut d’Optique, Palaiseau, France; 2Fibercryst, Villeurbanne, France; 3Institut für Strahlwerkzeuge, Stuttgart, Germany
A resonant grating mirror concurrently fulfills the task of an etalon, a spatial filter and a polarizer inside an Er:YAG cavity, leading to comparable beam characteristics with a simpler design.

CA-P.26 SUN
Diode pumped Er:YAG single crystal fiber laser passively Q-switched with Cr:ZnSe saturable absorber emitting at 1645 nm or 1617 nm
A. Aubourg1,2, J. Didierjean5, N. Aubry5, B. Balembois5, and P. Georges1; 1Laboratoire Charles Fabry, Institut d’Optique, Palaiseau, France; 2Fibercryst, Villeurbanne, France
We successfully passively Q-switched a diode pumped Er:YAG cavity emitting at 1645 nm or 1617 nm depending on the inserted losses. Pulse energies went up to 0.5 mJ at 820 Hz.

CA-P.27 SUN
2 µm Diode Pumped Tm:YAG Laser with 180 mJ Pulse Energy
A. Heinrich1, M. Harlander1, T. Bragagna1, C. Hagen2, and B. Nussbaumer2; 1Pantec Biosolutions AG, Ruggell, Liechtenstein; 2Pantec Engineering AG, Ruggell, Liechtenstein
A pulsed, diode-pumped, monolithic 2 µm laser is pre-sented. The Tm:YAG laser rod is side-pumped by qcw laser diodes (785 nm) and generates at room tempera-ture 200 µs pulses at 100 Hz with 180 mJ.

CA-P.28 SUN
InP-Diode Laser Stack Pumped Ho:YAG or Cr:ZnSe Thin Disk Lasers
G. Renz, J. Speiser, and A. Giesen; German Aerospace Center, Stuttgart, Germany
Direct diode pumping of Ho:YAG or Cr:ZnSe with InP-diode-laser stacks at 1908 nm in thin disk laser concepts lead to 22 W and 4.2 W cw output power at 2990 nm and 2400 nm, respectively.

CA-P.29 SUN
Ho+ Lasing at 2060 nm in co-doped (Ho,Tm):KLu(WO4)2
X. Mateos1,2, V. Jambuanathan3, M.C. Pajol4, M. Aguiló5, F. Diaz6, U. Grieben6, and V. Petrov6; 1Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, 2Max-Born-Institute, 3D-12489, Berlin, Germany, 4Físcas y Cristalografía de Materiales y Nanomateriales (FICMA-FINCA), Universidad Rovira i Virgili (URV), Tarragona, Spain
Improved operation of the co-doped (Ho,Tm):KLu(WO4)2 laser is reported under Tisapphire laser pumping with Ho oscillation at 2060 nm and tuning range as wide as 160 nm, presumably related to both ions.

CA-P.30 SUN
Diode-Pumped Dysprosium-doped PdGa2S4 Mid-Infrared Laser
M. Doroshenko1, M. Jelinkova1, J. Sulec1, H. Jelinkova1, M. Nemez2, V. Osiko1, V. Badikov3, and D. Badikov3; 1A M Prokhorov General Physics Institute of RAS, Moscow, Russia; 2Tsinghua University in Prague, Prague, Czech Republic; 3Kishan State University, Krasnodar, Russia
The Dy:PgGa2S4 laser generating at 4320nm pumped by 1.7mW laser-diode was investigated. Slope efficiency 10% and pulsed output power 9.5mW for 120mW absorbed power was reached (5ms, 20Hz). In CW maximum out-put power was 48W.

CA-P.31 SUN
Compression of Long-Cavity Tisapphire Oscillator Pulses with Large-Mode-Area Photonic Crystal Fibers
J. Witek1, B. Racl2, and P. Dombi1,3; 1Wigner Research Centre for Physics, Budapest, Hungary; 2Max-Planck-Institut für Quantenoptik, Garching, Germany
We performed nonlinear compression of transform limited 75-fs laser pulses delivered by a long-cavity Tisapphire oscillator to 18-fs, 100-fs pulses using large mode area photonic crystal fibers and chirped mirrors in a simple, scalable scheme.
CA-P.32 SUN

First Results of ChemCam on Mars and Further Laser Developments for New Space Programs

B. Faure¹, E. Durand², S. Maurice³, D. Bruneau¹, and E. Montmessin¹, ¹CNES, Toulouse, France; ²Thales Optronique S.A., Elnacourt, France; ³IRAP, Toulouse, France; ⁴LATMOS, Guyancourt, France

First results of ChemCam (LIBS Instrument onboard Curiosity Martian Rover) are presented. New developments on the solid-state ChemCam laser for new space programs are presented. First results relative to these new developments are presented.
### ROOM 1

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 – 9:15</td>
<td>PL-1: CLEO/Europe 2013 Plenary Talk</td>
<td>Chair: W. Andrew Clarkson, University of Southampton, Southampton, United Kingdom</td>
<td></td>
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<tr>
<td>9:30 – 10:45</td>
<td>PL-2: World of Photonics Opening with Plenary Talk</td>
<td>Chair: Peter E. Andersen, Technical University of Denmark, Roskilde, Denmark</td>
<td></td>
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<tr>
<td>10:00 – 11:15</td>
<td>PL-1.1 MON (Plenary)</td>
<td>Thin Disk Lasers&lt;br&gt;• A. Giesen; DLR, German Aerospace Center, Stuttgart, Germany&lt;br&gt;The design ideas of thin disk lasers will be explained. Results for continuous wave operation and for pulsed operation show the capability for building high power lasers with high efficiency and good beam quality, simultaneously.</td>
<td>CH-1.1 MON (Plenary)</td>
</tr>
<tr>
<td>11:00 – 12:30</td>
<td>CF/IE-5: Novel Methods in Ultrafast Optics</td>
<td>Chair: Roberto Osellame, Politecnico di Milano, Milan, Italy</td>
<td></td>
</tr>
<tr>
<td>11:00 – 12:30</td>
<td>JSI-1: Nuclear Photonics</td>
<td>Chair: Ken Ledingham, University of Strathclyde, Glasgow, United Kingdom</td>
<td></td>
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<tr>
<td>11:00 – 12:30</td>
<td>JSI-1.1 MON (Invited)</td>
<td>Nuclear Photonics with Extreme Gamma-ray Sources&lt;br&gt;• C.P.J. Barton, Lawrence Livermore National Laboratory, Livermore, United States&lt;br&gt;Tunable, polarized, mono-energetic, gamma-ray (MeVa-ray) beams can be created via Compton scattering of pulsed lasers off of ultra-bright electron beams.</td>
<td>JSI-1.2 MON</td>
</tr>
<tr>
<td>11:00 – 12:30</td>
<td>CI-1.1 MON (Plenary)</td>
<td>Words of Welcome by Norbert Bargmann, Deputy CEO Messe Munich International. Honor of exhibitors of the first LASER World of PHOTONICS. Words of Welcome by Prof. Dr. Peter Loosen, President of the Steering Commit-tee World of Photonics Congress, Fraunhofer Institute for Laser Technology (ILT), Aachen, Germany.</td>
<td></td>
</tr>
<tr>
<td>11:15 – 12:00</td>
<td>PL-1.2 MON</td>
<td>Nanoscopy with Focused Light&lt;br&gt;• S. W. Hell; Max Planck Institute for Biophysical Chemistry, Göttingen, Germany&lt;br&gt;Throughout the 20th century the resolution of optical microscopy relying on conventional lenses was limited by diffraction. We show how this limit can be radically over-come and how this change impacts various fields of science.</td>
<td></td>
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**CF/IE-5.2 MON** 11:15 Phase-locked pulses for two-dimensional spectroscopy by a birefringent delay line<br>• C. Manzon¹, D. Brida², and G. Cerullo³;¹INFN-CNISM, Dipartimento di Fisica, Politecnico di Milano, Milano, Italy;² Department of Physics and Center for Applied Photonics, University of Konstanz, Konstanz, Germany;³ Department of Physics, University of Catania, Catania, Italy<br>We introduce a device for the generation of collinear, interferometrically locked ultrashort pulse pairs. Their delay is controlled with attosecond precision and
Adaptive Quantum Non-Demolition Measurement of Fock States

High-efficiency Bragg Grating Enhanced On-chip Photon-number-resolving Detectors

Ultra-bright source of polarization-entangled photons in a linear double-pass configuration

Pulse Compression in a Synchronously Pumped Optical Parametric Oscillator with a Graphene Saturable Absorber
C. Laporte, J.-B. Dherbecourt, J.-M. Melkonian, M. Raybaud, C. Drag, and A. Godard

Optofluidics for Energy Applications
D. Psaltis, École Polytechnique Federale de Lausanne, Lausanne, Switzerland

Control of the absorption recovery time in GaSb SESAMs
J. Pujaste, S. Suomalainen, A. Härkönen, U. Griebner, G. Steinmeyer, and M. Gutiérrez

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Coherent Acoustic Phonons in Semiconductor Bragg Mirrors
F. Schättiger, O. Ristow, M. Hettich, and T. Dekorsy, University of Konstanz, Konstanz, Germany

We report on coherent acoustic phonon spectroscopy of semiconductor Bragg mirrors. Comparing the experimental results with the calculated acoustic phonon dispersions enables a high accuracy determination of the structural parameters.
We realize a fully stabilized dual-comb spectrometer covering 14 cm⁻¹ with individual tooth linewidth of 4 MHz by using mid-IR QCL based frequency combs centered at 1430 cm⁻¹.

CH-1.3 MON 11:30

Methane sensing at 3.4μm using Chirped Laser Dispersion Spectroscopy with DFG source

"S. Schiller"¹, A. Görlich², G.M. Tino², U. Sterz³, C. Lüdtke³, P. Görl², E.M. Bäz³, K. Borg³, D. Calonico³, W. Kaender³, S. Bize³, and R. Holzwarth¹⁰; ¹Heinrich-Heine-Universität, Düsseldorf, Germany; ²Universita di Firenze, Firenze, Italy; ³Physikalisch-Technische Bundesanstalt, Braunschweig, Germany; ⁴National Physical Laboratory, Teddington, United Kingdom; ⁵Leibniz Universität, Hannover, Germany; ⁶University of Birmingham, Birmingham, United Kingdom; ⁷Instituto Nazionale di Ricerca Metrologica, Torino, Italy; ⁸Optica GmbH, München, Germany; ⁹Observatoire de Paris, Paris, France; ¹⁰Mento Systems GmbH, München, Germany

Compact, low-power consumption and robust lattice optical clock apparatus have been developed, as a first step towards instruments for use in space. The clock transitions of both bosonic 88Sr and fermionic 171Yb have been observed

ID-1.3 MON 11:30

Asynchronous Mid-IR Optical Parametric Oscillator Frequency Combs

Z. Zhang¹,², X. Fag³,², "T. Gardner",¹ and D.T. Reid³; ¹Heriot-Watt University, Edinburgh, United Kingdom; ²Tianjin University, Tianjin, China; ³People's Republic of China (PRC); ⁴National Physical Laboratory, London, United Kingdom

We report high-power, carrier-envelope-offset (CEO) frequency stabilized, asynchronous dual frequency combs operating at 3.3-micrometer. The two channels, each with 100 mW average power, share all
The energy storage efficiency inside an optical resonator is an analogue for the dynamics of single-photon-single-atom absorption experiments. We present experiments on coupling a light pulse to a resonator with high efficiency.

IA-1.3 MON 11:30
Strong coupling between single atoms and non-transversal photons
J. Volz, C. Junge, D. O’Shea, and A. Rauschenbeutel, Atominstitut, Vienna University of Technology, Vienna, Austria
We investigate the interaction between single atoms and non-transversally polarized photons in whispering-gallery-mode microcavities. Our experimental results show that the non-transversal polarization decisively alters the physics of strong light-matter interaction.

IA-1.4 MON 11:45
Observation and measurement of interaction-induced dispersive optical nonlinearities in an ensemble of cold Rydberg atoms
V. Parigi1,2,3, E. Bimbard4, I. Stanjevic5, A.J. Hilliard5, F. Nogrette5, R. Tuvelle-Brouillet1, A. Ourjoumtsev5, and P. Grangier5,1
1Laboratoire Charles Fabry, Institut d’Optique, CNRS, Université Paris-Sud, Palaiseau, France, 2Laboratoire Kaistar Brssel, Université Pierre et Marie Curie, Ecole Normale Supérieure, CNRS, Paris, France, 3QUANTOP, Institut für Physik und Kultur, 4CNRS, Paris, France
We demonstrate a novel technique for coupling of two synchronously-pumped optical parametric oscillators using an antiresonant ring interferometer, providing dual-wavelength operation with arbitrary tuning and high intracavity power in each beam without gain coupling.

CD-5.3 MON 11:30
Dual-wavelength synchronously-pumped femtosecond optical parametric oscillator using antiresonant ring interferometer
A.E. Martin6,7,9, V.R. Badarla6,7, and M.E. Zadeh1,2; 6Institute of Photonic Sciences (ICFO), Barcelona, Spain; 7Instituto Catalán de Recerca i Estudis Avançats (ICREA), Barcelona, Spain
We demonstrate a novel technique for coupling of two synchronously-pumped optical parametric oscillators using an antiresonant ring interferometer, providing dual-wavelength operation with arbitrary tuning and high intracavity power in each beam without gain coupling.

CD-5.4 MON 11:45
3.3 - 3.7 micrometer Nested Cavity OPO pumped by an amplified micro-laser for portable DIAL
J. Barrientos-Barriada, J.-B. Dherbecourcia, M. Raybaud3, A. Gouzer4, J.-M. Mercier5, M. Lefèvre6, B. Fauré7, and G. Souahitè6,7,8
1Onera, The french aerospace lab, Palaiseau, France; 2Teem Photonics, Meylan, France
We present here a new laser transmitter for DIAL LIDAR, based on a 3.3 - 3.7 micrometer nested cavity OPO, pumped by a specifically designed nanosecond micro-laser amplified to 200J level.

CK-5.2 MON 11:45
Quasi-bidimensional disordered structures for light trapping in thin-film solar cells
M. Barret1,2, F. Pratesi3, K. Vynck1, M. Prascoli4, M. Tormen1, and D. Wiersma1,2,4,1 European Laboratory for Non-linear Spectroscopy (LENS), Sesto Fiorentino, Firenze, Italy; 2Istituto Nazionale di Ottica (CNR-INO), Firenze, Italy; 3IOM-CNR, Laboratorio TASC, Trieste, Italy; 4Laboratorio Nazionale TASC-INFN, Basovizza, Trieste, Italy
A novel kind of disordered quasi-bidimen-
We have demonstrated HHG seeded FEL operation in the ELV region with ECD-based timing-drift control to maximize temporal overlap between HH pulses and electron bunches. The seeding operation was successful with a hit rate over 20%.

**Development of active gratings for ultrafast monochromators**
F. Frascati1, S. Bonora1, G. Brusatin1, G. Della Giustina2, S. Stagira2, C. Vozzi3, E. Zanchetta4, and L. Polotto1; 2CNR-Institute of Photonics and Nanotechnology, Padova & Milan, Italy; 3Department of Industrial Engineering, University of Padova, Padova, Italy; 4Department of Physics, Politecnico di Milano, Milan, Italy

The design of active deformable gratings to be used in grazing-incidence monochromators for UV/VUV ultrafast pulses is discussed. A double-grating configuration has been realized to demonstrate the compensation of the grating front-tilt.

**Resonance Scanning Interferometer for Group Delay Dispersion Measurements**
M. Trubetskov1, M. von Pechmann2, L. Aamand1, E. Raszkovszky1, K. Vadovoyanov2, F. Krausz1,4, and V. Pervak1,5, 1Max-Planck Institute of Quantum Optics, Garching, Germany; 2Research Computing Center, Moscow State University, Moscow, Russia

Recent experimental attempts to observe the low energy nuclear excitation with femtosecond lasers are discussed. An ionized electron motion in the superintense laser field might lead to the nuclear excitation through inverse internal conversion, inelastic scattering and photoexcitation.
Quantum Networks based on Single Atoms in Optical Cavities

S. Ritter, C. Nölleke, C. Hahn, A. Reiserer, A. Neuzaer, M. Uphoff, M. Mücke, E. Figueras, J. Bohmann, and G. Rempe; Max-Planck-Institut für Quantenoptik, Garching, Germany

Single atoms in optical cavities are ideally suited as universal quantum network nodes. We demonstrate the reversible exchange of quantum information and the creation of remote entanglement between two identical atoms in optical cavities are ideally suited as universal quantum network nodes. We report on a photon pair source, ideally suited for long distance quantum communication. We show that the coupling strength is the key parameter for the performance of whispering gallery optical parametric oscillators. Moving the coupling prism by only 500 nm yields a 4-orders-of-magnitude efficiency change.

Optical Parametric Oscillator based on Gold–Palladium Core–Shell Nanorod Arrays

C. M. Zouros, O. E. Park, J. J. Lee, and J. F. Donegan; University of Jönköping, Sweden

We present a novel approach for fabricating extremely high sensitivity due to the modulation of plasmonic resonances of the arrays. We realize an ultrafast, efficient type-II parametric downconversion source in a periodically poled KTP waveguide at telecom wavelengths producing separable and symmetric photon pairs. Their indistinguishability and purity is verified by Hong-Ou-Mandel interference measurements.

Nano-scale Characterization of Semiconductors Using Helium Temperature Scanning Transmission Electron Microscopy

C. O. O'Connor, F. Wurtz, and A. Zayats; King's College London, London, United Kingdom

We describe a novel optical hydrogen sensor based on gold/palladium core–shell nanorod arrays synthesized using highly ordered porous alumina template that provide extremely high sensitivity due to the modification of plasmonic resonances of the arrays.

Optical Parametric Oscillator based on a Hydrogen Cyanide for Bio-medical Applications

A. W. H. Xu, Y. C. C. Cheng, and L. W. M. Loke; National University of Singapore, Singapore

We report on a photon pair source, ideally suited for long distance quantum communication. One photon of the pair is compatible with a solid state quantum memory and the other photon is at telecommunication wavelength.

Optical Hydrogen Sensors based on Au/Pd Core–Shell Nanorod Arrays

M. Nasir, W. Dickson, J.-S. Bouillard, A. Mansourian, D. O’Connor, G. Wurtz, and A. Zayats; King’s College London, London, United Kingdom

We describe a novel optical hydrogen sensor based on gold/palladium core–shell nanorod arrays synthesized using highly ordered porous alumina template that provide extremely high sensitivity due to the modulation of plasmonic resonances of the arrays.

Fluorescently encoded nanowires for the detection of hydrogen cyanide for bio-medical applications

A. W. H. Xu, Y. C. C. Cheng, and L. W. M. Loke; National University of Singapore, Singapore

We report on a photon pair source, ideally suited for long distance quantum communication. One photon of the pair is compatible with a solid state quantum memory and the other photon is at telecommunication wavelength.

Facile Fabrication of Nanorod Arrays Using a Photochemical Reaction in an Optical Cavity

H. Z. Zhang, X. F. Chen, and G. J. Salamo; Imperial College London, London, United Kingdom

We demonstrate the reversible exchange of quantum information and the creation of remote entanglement between two identical atoms in optical cavities are ideally suited as universal quantum network nodes. We report on a photon pair source, ideally suited for long distance quantum communication. We show that the coupling strength is the key parameter for the performance of whispering gallery optical parametric oscillators. Moving the coupling prism by only 500 nm yields a 4-orders-of-magnitude efficiency change.

Journal of Lightwave Technology

P. A. Norwood, J. C. Stuart, and A. J. Shields; University of Sheffield, Sheffield, United Kingdom

We report on a photon pair source, ideally suited for long distance quantum communication. One photon of the pair is compatible with a solid state quantum memory and the other photon is at telecommunication wavelength.
Today the onset of mode instabilities is one of the most limiting effects for averagepower scaling of fiber lasers. We give an overview about possible theoretical explanations and discuss first experiments demonstrating mitigation strategies.

14:45
CD-6.2 MON
Broad and tunable second harmonic generation from 250 to 430 nm from a 80 MHz picosecond white light source
- M. Brudler and E. Riedel, LS für BioMolekularle Optik, LMU, München, Germany

We show tunable second harmonic generation from 250 to 430 nm from a visible picosecond supercontinuum Megahertz source, study the influence of the numerical aperture on the frequency doubling process, and perform broadband achromatic doubling.

14:45
CD-6.3 MON
Blue-to-red tunable SHG from a diode-pumped PPKTP laser
- K. Fedorova1, G. Sokolovskii1, P. Battle1, I. Krestnikov1, D. Livshits2, and E. Rajfalov1

1, Institute of Applied Physics, Jena, Germany; 2, Helmholtz Institute Jena, Jena, Germany; 3, Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

We employed polarization 2D spectroscopy, Fourier analysis and modeling of beats with

14:30
JSIV-1.2 MON
Femtosecond stimulated Raman spectroscopy in 1D and 2D - direct observation of intramolecular motions and intermolecular interactions
- M. Kloos, R. van Grondelle, and J. Kennes

Free University Amsterdam, Amsterdam, The Netherlands

Femtosecond pump-probe experiments greatly contributed to understanding of elementary events in photosynthesis. Lately also more complex multi-pulse experiments such as femtosecond stimulated Raman spectroscopy were harnessed to study physical nature of life.

14:30
JSIV-1.3 MON
On Origin of Coherence Dynamics in Biological Complexes
- D. Zigmantas1, D. Palecek1, J. Dostal1, J. Åster1, and V. Bukov1

1, Lund University, Lund, Sweden; 2, Vilnius University, Vilnius, Lithuania

We employed polarization 2D spectroscopy, Fourier analysis and modeling of beats with

14:30
JSIV-1.1 MON
High Frequency Vibrational Coherences and Coupling in the Excited State of Polyenic Biochromophores
- T. Buckap, J.P. Kraick, M.S. Marek, and M. Motzkus

Physikalisch-Chemisches Institut, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany

High-frequency vibrational coherences in the excited state of Retinals (REts) and Carotenoids (CArs) are investigated with pump-DFWM. Newly observed C-C stretching bands in the excited states of REts and CArs is discussed.

14:30
JSIV-2.1 MON
Quantum Coherent Effects in Biology I
Chair: Philipp Kukura, University of Oxford, Oxford, United Kingdom

JSIV-2.2 MON
Durable, Superhydrophobic, Antireflection and Low Haze Glass Surfaces using scalable metal dewetting nanostructuring
- D. Infante1, A. Carrilero1, D. Tulli1, K.W. Köck2, P. Mazumder2, L. Tian2, and V. Pruneri1,3

1, ICFP, University of Copenhagen, Denmark; 2, Corning Inc., Corning, United States; 3, ICREA, Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain

Antireflective properties of nanostructured glass substrates, that were fabricated by etching a self-assembled metallic mask in an industrially scalable process, have been investigated both experimentally and theoretically. Moreover, their wetting behavior could be turned superhydrophobic.

15:00
CE-2.2 MON
Oxidation-free and ultra-smooth thin silver films grown on a copper seed layer
- N. Formica1, D.S. Ghosh1, A. Carrilero1, T. Lai Chen2, R. Simpson2, and V. Pruneri1,3

1, ICFP, Institute of Photonic Sciences, Castelldefels, Spain; 2, Singapore University of Technology and Design, Singapore; 3, ICREA, Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain

We demonstrated low-threshold, efficient diode pumped Q-switched and chirped pulse amplification in CdSeP, pumping at 1064 nm with 120-ps-long pulses at 230-kHz repetition rate and seeding at the signal wavelength for generation of bandwidth-limited idler pulses at 6100 nm.
We demonstrate spectral broadening of a low noise, near-infrared, microring resonator based frequency comb to close to two thirds of an optical octave. This opens a viable route towards self-referencing of microring-based comb generators.

ID-2.4 MON 15:15
Low phase-noise mid-infrared frequency combs based on microrings
C. Wang1,2, T. Herr3, P. Dehaye2,6, A. Schliesser1,2, B. Holzwarth3,5, T. Hänsch1,4, N. Piqué1,4,5, and T. Kippenberg1,2; 1École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; 2Max-Planck-Institut für Quantenoptik, Munich, Germany; 3Max Planck-Institut für Quantenoptik, Munich, Germany; 4Institut des Sciences Moléculaires d’Orsay, CNRS, Orsay, France; 5National Institute of Standards and Technology, Boulder, United States
We present mid-infrared frequency combs from crystalline MgF2 micro-resonators at 2.5 micron wavelength. Low phase-noise is confirmed by both heterodyne beat note and transmission noise measurements.

ID-2.5 MON (Invited) 15:30
Microresonator frequency combs
• S. Papp, P. DeHaye, and S. Diddams; National Institute of Standards and Technology, Boulder, CO, United States
We will describe recent experiments with microring-based optical frequency combs that characterize their time- and frequency-domain behavior. Our work explores low-noise operating regimes of microcombs for precision metrology applications.

CL-3.4 MON 15:30
Experimental observation of synchronization in a biomechanical rotational motors system
• C. Denz, L. Dewenter, A. Barroso, C. Alpman, and M. Woerdemann; Institut für Angewandte Physik, Westfälische Wilhelms-Universität Münster, Münster, Germany
We demonstrate the hydrodynamic interaction and synchronization in bio-mechanical systems, as pairs of flagellated bacteria, in dependence of their distance and show first promising results.

CL-3.5 MON 15:45
Maximum control of light propagation through turbid media in the presence of noise
• H. Yilmaz, W.L. Vox, and A.P. Mosk; Complex Photonic Systems (COPS), MESA+ Institute for Nanotechnology, University of Twente, the Netherlands
with multicolor confocal and STED fluorescence microscopy. It allows visualization of proteins on DNA with high spatial resolution (50 nm) and temporal resolution (<50 ms), and to test for the possibility of quantum mechanical wavefunctions based on quaternions or octonions rather than complex numbers.

IA-2.3 MON 15:15
Single quantum dots as photon pair emitters
• A. Predojevic1, T. Huber1, M. Jelcic2, H. Jayakumar1, T. Kauten1, G.S. Solomon1, R. Filig1, and G. Weihs1; 1Institute for Experimental Physics, University of Innsbruck, Innsbruck, Austria; 2Department of Optics, Palacky University, Olomouc, Czech Republic; 3Joint Quantum Institute, National Institute of Standards and Technology and University of Maryland, Gaithersburg, United States
We present our measurements performed on a quantum dot system suitable for the generation of time-bin entangled photon pairs.

IA-2.4 MON 15:30
Bell States Generation on a III-V Semiconductor Chip at Room Temperature
A. Orieux1, G. Boucher1, A. Eckstein2, A. Lemaître2, P. Filloux3, I. Favero3, G. Lee4, T. Coudreau1, A. Keller1, P. Milman1, and S. Duc2; 1Université Paris Diderot, Sorbonne Paris Cité, Laboratoire de Matériaux et Phénomènes Quantiques, CNRS-UMR 7162, Paris, France; 2Laboratoire de Photonique et Nanosciences, Marne-la-Vallée, France; 3Université Paris Sud, Institut des Sciences Moléculaires d’Orsay, CNRS - UMR 8214, Orsay, France
We demonstrate the generation of polarization entangled Bell states at room temperature and telecom wavelength on a 3-5 semi-conductor chip. A theoretical model provides ways to understand and control the amount of entanglement.

CB-CC-1.5 MON 15:15
Terahertz Photonic Crystal Quantum Cascade Laser Coupled to a Second Order Bragg Vertical Exactor
• C. Gu, S. Hao, H. Diao, G. Scalari1, M. Beck1, I. Safit, and R. Houdré2; 1Feldmannsche Technische Hochschule Zürich (ETHZ), Institut für Quantenelektronik, Zürich, Switzerland; 2Ecole Polytechnique Fédérale de Lausanne (EPFL), Institut de Physique de la Matière Condensée, Lausanne, Switzerland
We present single mode surface emission around 3.1 THz of a Quantum Cascade Laser. A deep etched 2D photonic crystal double metal cavity supports the laser mode and uses second order Bragg gratings as actuators.

CB-CC-1.6 MON 15:45
Fabrication and Characterization of Terahertz Emitting GaAs/AlGaAs Micropillar Quantum Cascade Structures in a Double Metal Waveguide
• M. Kraß1, M. Brandstetter1, C. Deutsch1, H. Dett2, and T. Zeebauer1,2,3; 1Department of Physics, Aalto University, Espoo, Finland; 2Department of Physics, University of Vienna, Austria; 3Vienna University of Technology, Austria
Temperature as a guiding mechanism for high-power very-large-mode-area active fibers

- F. Jansen1, F. Stutzki1, H.-I. Otto1, C. Jauregui2, J. Limpert1,2, and A. Tünnermann1,2,3,1 Institute of Applied Physics, Friedrich-Schiller-University Jena, Jena, Germany; 2 Helmholtz-Institute Jena, Jena, Germany; 3 Fraunhofer Institute for Applied Optics and Precision Engineering IOF, Jena, Germany

Temperature is demonstrated to be a viable guiding mechanism for high power very large mode area fibers. An index-antiguiding-core fiber delivering 129W in effective single-mode operation is demonstrated. The relation to gain-guiding-index-antiguiding fibers is discussed.

Temperature as a guiding mechanism for high-power very-large-mode-area active fibers

- F. Jansen1, F. Stutzki1, H.-I. Otto1, C. Jauregui2, J. Limpert1,2, and A. Tünnermann1,2,3,1 Institute of Applied Physics, Friedrich-Schiller-University Jena, Jena, Germany; 2 Helmholtz-Institute Jena, Jena, Germany; 3 Fraunhofer Institute for Applied Optics and Precision Engineering IOF, Jena, Germany

Temperature is demonstrated to be a viable guiding mechanism for high power very large mode area fibers. An index-antiguiding-core fiber delivering 129W in effective single-mode operation is demonstrated. The relation to gain-guiding-index-antiguiding fibers is discussed.
Both microscopic and macroscopic physics

We present experimentally and theoretically developed methods for the generation of X-rays on a tabletop level. We demonstrate the production of high-energy X-rays by harmonically mixing femtosecond to zeptosecond to coherent radiation. This approach allows for the study of extreme nonlinear optics and may further improve the penetration depth of X-rays into biological tissues. 

16:30 – 18:00

**ROOM 4a**

**ID-3: Precision Measurements**

Chair: Mauro Nisoli, Politecnico di Milano, Milan, Italy

**CL-4: Structural Imaging**

Chair: Monika Ritsch-Marte, Innsbruck Medical University, Innsbruck, Austria

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Room 4b

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**CL-4.1 MON (Invited)**

In Vivo Three-Photon Imaging of Subcellular Structures of an Intact Mouse Brain using Quantum Dots

N. Horton, K. Wang, C.-C. Wang, and C. Xia

Cornell University, Ithaca, United States

Three-photon fluorescence microscopy at the 1700 nm spectral window enables in vivo imaging of subcellular structures in an intact mouse brain. Subcellular imaging using three-photon excitation of quantum dots may further improve the penetration depth.

16:30 – 18:00

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**ROOM 13a**

**IA-3: Quantum Effects**

Chair: Tatiana Wilk, Max-Planck-Institut für Quantenoptik, Garching, Germany

**IA-3.1 MON**

Time-resolved double-slit interference pattern measurement with entangled photons


Institute for Quantum Computing, University of Waterloo, Waterloo, Canada; Instituto de Física, Nicolaus Copernicus University, Torun, Poland; Politecnico di Milano, Dipartimento di Elettronica e Informazione, Milano, Italy; Micro Photon Devices, Bolzano, Italy

There is debate about how individual particles passing through a double slit setup build up the well-known interference pattern. We report the pattern formation by photons using time-resolved single photon sensitive measurements.

16:30 – 18:00

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**ROOM 13b**

**CB-3: Ultrafast Semiconductor Lasers I**

Chair: Maria Ana Catalina, University of Dundee, Dundee, United Kingdom

**CB-3.1 MON**

Generation of ultra-high repetition rate optical pulses through external injection in passively mode-locked monolithical semiconductor lasers

V. Puzino, M. Sorel, and M.J. Strain; University of Glasgow, Glasgow, United Kingdom Passively mode-locked semiconductor lasers in a Fabry-Pérot configuration show locking at repetition rates up to 910GHz when two external continuous waves are injected in the saturable absorber, with mutual spacing multiple of the fundamental frequency.

16:30 – 18:00

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**CB-3.2 MON**

A Fast Time Domain Travelling Wave method for simulation of Quantum Dot Lasers and Amplifiers

M. Gioannini, P. Bardella, and I. Montrosset; Department of Electronics and Telecommunication, Politecnico di Torino, Torino, Italy

We present a Fast Time Domain Traveling Wave simulator for Quantum Dot lasers and amplifiers. The method is applied to the simulation of wide band SOAs and single section Fabry Perot lasers emitting optical pulses.
Fotonik, Kgo, Lyngby, Denmark

Fiber designs with resonant structures can be robust to thermal load. We demonstrate 314W of average power from ROD fiber amplifier using a fiber design with resonant structure.

2Northwestern University, Feinberg School of Medicine, Chicago, United States

We demonstrate 5-mJ pulse energy in 580-ps laser pulses from mid-IR, PPSL based optical parametric oscillator-amplifier system, tunable in the highly interesting water absorption band between 3000-nm and 3500-nm, operated at 0.5-kHz repetition rate.

16:30 – 18:00
CJ-4: Coherent Combining
Chair: Thomas Schreiber, Fraunhofer IOF, Jena, Germany

CJ-4.1 MON (Keynote) 16:30
Coherent Combining of Fiber and Solid-State Lasers
G. Goodno; Northrop Grumman Aerospace Systems, Redondo Beach, United States

We review recent advances in coherent laser combining, including active laser control methods, diffractive optics beam combining, and high coherence fiber and SSL amplifiers that have enabled unprecedented brightness scaling of cw sources.

16:30 – 18:00
CD-7: New Devices for Frequency Conversion based on Quadratic Nonlinearities
Chair: Concita Sibilia, Università di Roma La Sapienza, Rome, Italy

CD-7.1 MON 16:30
Nonlinear beam splitter based on second-harmonic generation by femtosecond laser-induced phase gratings in lithium niobate

J. Imbrock, S. Kroesen, M. Ayoub, W. Horn, and C. Dzen; Institute of Applied Physics and Center for Nonlinear Science, Muenster, Germany

An integrated nonlinear photonic beam splitter device based on nonlinear second-harmonic generation is induced by a directly femtosecond laser written phase grating in lithium niobate. The efficiency, bandwidth, and tuning characteristic are examined.

CD-7.2 MON 16:45
Propagation of second-harmonic generation in LiNbO₃ nanowires

A. Sergeev, R. Geiss, E.-B. Kley, T. Pertsch, and R. Grange; Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University, Jena, Germany

We demonstrate propagation of second-harmonic (SH) in a 29 μm long LiNbO₃ nanowire. We show that nanowire length and facets significantly influence the SH signal. We excite fluorescent dyes with the delivered SH signal.

16:30 – 18:00
JSIV-2: Quantum Coherent Effects in Biology II
Chair: Marcus Matkowsky, University of Heidelberg, Heidelberg, Germany

JSIV-2.1 MON (Invited) 16:30
Robust design principles for quantum enhanced excitation transport

M. Walchbrater, R. Meule, T. Wellens, and A. Buchleitner; 1Institute of Physics, Albert-Ludwigs-University, Freiburg i. Brsg., Germany; 2Institut voor Theoretische Fysico, KU Leuven, Herteleer, Belgium; 3Complex System Group, Department of Theoretical Physics, University of Havana, Cuba, Cuba

We propose a model for highly efficient quantum transport through finite, disordered systems, which is statistically robust against configurational changes. We discuss the potential relevance thereof for excitation transport in photosynthetic light harvesting complexes.
Limited images at wavelengths below a wavelength 

Two Xpulse Lensless Imaging With a 

Excitation Energy for Electronic Bridge Excitation of the Th-229 Nucleus O.A. Herrera Sancho, N. Nemitz, C. Tamm, M. Okhapkin, and E. Peik: Physikalisches-Technische Bundesanstalt, Braunschweig, Germany Laser excitation of a nuclear transition in Th-229 is proposed as the basis of an optical clock. Two-photon excitation of electronic levels of Th0 may be used to excite the nucleus via electronic bridge processes.

Light Source and a Multiwavelength Phase 

we introduce and experimentally demonstrate a "Ramsey-comb" based on two amplified frequency comb pulses, resulting in kHz-level accuracy on two-photon transitions in Rb and Cs that challenges traditional frequency comb spectroscopy.

Imaging Molecular Organization of Cell Membranes and Proteins Assemblies Using Polarimetric Fluorescence Microscopy X. Wang, A. Kress, J. Saviatier, H. Rigneault, A. Duboisset, P. Ferrand, and S. Brussellet; Institut Fresnel, Aix-Marseille University, Campus St. Jérôme, Marseille, France 

A general polarization-resolved fluorescence confocal microscopy method is presented, based on a full control of the excitation polarization state. We image directly molecular orientational order in a biological sample, independently on its orientation or morphology.

Quantum Coherent Control of Gaussian Multiparticle Entanglement 

G. Patra1, C. Navarrete-Benloch2,3, G.J. de Valcárcel2, and C. Fabre2; Laboratoire de Physique des Lasers, Atomes et Molecules, Université Lille 1, Villeneuve d'Ascq, France; 2Département d'Optique, Université de València, Burjasot, Spain; 3Max-Planck-Institut für Quantenoptik, Garching, Germany; 3Laboratoire Kastler-Brossel, Université Pierre et Marie Curie-Paris6, ENS, CNRS, Paris, France 

We theoretically show that optical parametric oscillators can produce a great variety of multiparticle entangled states by an appropriate control of the parametric interaction, that we accomplish by tailoring the spatio-temporal shape of the pump.

Long Distance Ultra-Stable Frequency Dissemination on a Dedicated Wavelength Channel of a Telecommunication Network O. Lopez1, P.-E. Pottie2, B. Chanteau3, F. Stefani1, A. Berry3, C. Chardonne4, G. Santarelli5, and J.-C. Prismot6; 1Laboratoire de Physique des Lasers, Atomes et Molecules, Université Lille 1, Villeneuve d'Ascq, France; 2LNE-SYRTE, Observatoire de Paris, CNRS, Paris, France; 3Laboratoire Photonique, Numérique et Nanosciences, Talence, France 

We have demonstrated an ultra-stable opti-

Simultaneous Two-Photon Absorption and Stimulated Raman Scattering Imaging by Spatial Overlap Modulation Microscopy K. Isobe1, H. Kawano2, A. Suda3, A. Kamagai2, A. Miyawaki2, and K. Midorikawa1; 1RIKEN Advanced Science Institute, Wako, Japan; 2RIKEN Brain Science Institute, Wako, Japan; 3Tokyo University of Science, Noda, Japan 

We show the separation of two-photon absorption signals from stimulated Raman scattering signals by spatial overlap modulation.

Quantum Frequency Conversion of Visible Single Photons from a Quantum Dot to a Telecom Band A. Lenhard2, S. Zaske2, C. Keßler2, J. Kettler2, C. Aренд3, C. Hepp2, R. Albrechts2, W.-M. Schulz2, M. Jetter2, P. Michler2, and C. Becherer1; 1Universität des Saarlandes, Saarbrücken, Germany; 2Institut für Halbleit-
eroptik und Funktionelle Grenzflächen and Research Center ScOPE, Stuttgart, Germany 

We report on quantum frequency conversion of visible single photons from a semi-conducting quantum dot laser.

Limited images at wavelengths below a wavelength
Passive coherent combining of 15 fiber lasers by phase contrast filtering.

New Design Opportunities For Ultrashort Quasi-Phase-Matching Devices

Coherent internal conversion of pyrene revealed by pump-probe and ultrabroad 2D-UV spectroscopy

Cascaded Up-Conversion Of Twin-Beam OPG In Nonlinear Photonic Crystals

Cohesive internal conversion of pyrene revealed by pump-probe and ultrabroad 2D-UV spectroscopy

4-channel Coherently Combined femtosecond Fiber CPA system delivering 1.3 mJ pulses with 532 W Average Power

Functionalizing nonlinear crystals

Conical Intersection Dynamics in Rhodopsin and its Analog Isorhodopsin

Retrieving the spatial distribution of cavity modes in ZnO nanowires by near-field imaging and electrodynamics simulations

Strong Two-Photon Excitation Fluorescence from GaAs and InP Nanowires on Glass Substrate

Photor-counting Raman Spectroscopy of Silicon Nanowires

Strong two-photon excitation fluorescence from GaAs and InP nanowires on glass substrate.

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Strong two-photon excitation fluorescence from GaAs and InP nanowires on glass substrate.
A high sensitivity fiber optic gyroscope on multiplexed telecommunications network

A new class of quasi-phase matching high order harmonic generation is proposed where the polarization of the driving field is controlled in a waveguide. The first circularly polarized quasi-phase matched source is shown to be possible.

We demonstrate third-harmonic generation microscopy of lipid films using tightly focused linear, circular and radial polarizations. The technique revealed strongly anisotropic regions in lipid films suggesting that the lipid films displayed molecular ordering.

We perform quantum pattern recognition with much fewer photons than the complexity of the sought arbitrary pattern.
We report on a fiber CPA system consisting of four coherently combined fiber amplifiers. With this system, we could achieve an average power of 532 W with pulse energies of up to 1.3 mJ.

Energy scaling of ultrafast fiber systems using chirped and divided pulse amplification

Y. Zaouter¹, F. Guichard², L. Daniault³, M. Hanna², F. Morin⁴, C. Hönninger⁵, E. Mottay⁶, F. Druon², and P. Georges⁷

Amplitude Systems, Pessac, France;
²Laboratoire Charles Fabry - Institut d’Optique - CNRS - Université Paris-Sud, Palaiseau, France

We implemented for the first time both chirped and divided pulse amplification in the same femtosecond fiber amplifier setup leading to the generation of 430 pJ, 320 fs pulses at 100 kHz.

Energy scaling of ultrafast fiber systems using chirped and divided pulse amplification

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Mode Control of Light Scattering by Nanoparticles

**CK-P.1 MON**

**Mode Control of Light Scattering by Nanoparticles**

*B. Hourahine and F. Papoff; Department of Physics, SUPA, University of Strathclyde, Glasgow, United Kingdom*

We demonstrate that it is possible to substantially change the optical properties of nanoparticles by control of the coupling of incident light fields with the intrinsic optical modes of these structures using simple interference effects.

**CK-P.2 MON**

**SERS from Au and Ag nanoarrays made using photochemical patterning**

*S. Damm*1, N.C. Carville*2, M. Manzo*1, K. Galleo, B.I. Rodriguez*1, and J. Rice*1; *School of Physics and Conwaway Institute of Biomedical and Biomedical Research, University College Dublin, Dublin, Republic of Ireland; 2Department of Applied Physics, KTH-Royal Institute of Technology, Stockholm, Sweden

SERS from Au and Ag nanoarray patterns created using proton exchange process, where the polarization properties of the surface of ferroelectric LiNbO3 substrate is altered, creating site specific Au and Ag nanoparticle deposition.

**CK-P.3 MON**

**Strong Near Field Coupling and Enhanced Energy Extraction in Metal Nanostructures**

D. McArthur*1; B. Hourahine, and F. Papoff; University of Strathclyde, Glasgow, United Kingdom

We show that a gold nanodisc at subwavelength distances from a dipole source can extract a larger amount of energy from the source and induce greater transmission than the surrounding dielectric medium alone.

**CK-P.4 MON**

**Stationary and ultrafast optical behavior of a 1D-photon cavity containing gold nanoparticles**

*K. Morell*1, X. Wang*2, J. Gonzalez*1, and B. Palportn*1; 1Instituto de Optica, CSIC, Madrid, Spain; 2Ecole Centrale Paris, Laboratoire de Photonique Quantique et Moléculaire, UMR 8537-CNRS, Ecole Normale Supérieure du Cachan, Châtelet-Malabry, France

We show that interference effects in Fabry-Perot type photonic cavities containing Au nanoparticles allow increasing their ultrafast transient transmittance by more than one order of magnitude at wavelengths close to that of the defect mode.

**CK-P.5 MON**

**Analysis of gold nanoantennas utilizing plasmonic field enhancement for high-order harmonic generation**

* M. Noack*1, 2, N. Pflaum*1, 1, C. Waltermann*1, 2, M. Kovacev*1, 1, V. Knittel*1, D. Akeiner*1, A. Hütten*1, A. Leitenstorfer*1, 2, U. Murgner*1, 2; 1QUEST Centre for Quantum Engineering and Space-Time Research, Hannover, Germany; 2Institut für Quantenoptik, Leibniz Universität Hannover, Hannover, Germany; 3Department of Physics and Center for Applied Photonics, Konstanz, Germany; 4Thun Films & Physics of Nanostructures, Department of Physics, Bielefeld, Germany

We present an analysis of gold nanoantennas to facilitate high-order harmonic generation with a laser oscillator. In experiments plasma-lines and low order harmonics are observed. Experimental issues are discussed and explained by a theoretical model.

**CK-P.6 MON**

**Mesoscopic Light Trapping in Random Arrays of Semiconductor Nanowires**

*T. Strudley*1, T. Zehnder*1, E. Bakkers*1, and O. Muskena*1; 1Faculty of Physics and Astronomy, University of Southampton, Southampton, United Kingdom; 2Department of Applied Physics, Eindhoven University of Technology, Eindhoven, The Netherlands

Arrays of semiconductor nanowires have been grown with exceptionally small optical mean free paths. These random arrays exhibit significant fluctuations in transmission, allowing the investigation of mesoscopic light transport in a three dimensional medium.

**CK-P.7 MON**

**Demonstration of Wavelength Tuning of Silica Toroid Microcavity via Additional Laser Rellow**

*W. Yoshiba, K. Ishikawa, and T. Taniabe; Keio University, Yokohama, Japan

We demonstrate the resonant wavelength tuning of a silica toroid microcavity by conducting additional laser reflow. Our study implies better controllability in cavity quantum electrodynamics and electromagnetically induced transparency based on an ultra-high Q cavity.

**CK-P.8 MON**

**Fluorescence in Planar and Ridge Waveguides Fabricated in Erbium-Doped Lithium-Niobate-On-Insulator (Er:LNIO) Displays**

*C.E. Ritter*1, D. Kip*1, G. Stone*1, V. Dierolf*1, H. Hul*1, and W. Sohler*1; 1Helmut Schmidt University, Hamburg, Germany; 2Leibig University, Wiesbaden, United States; 3University of Paderborn, Paderborn, Germany

Waveguide ridges are fabricated in Erbium-doped lithium-niobate-on-insulator (Er:LNIO) substrates using precision diamond-blade dicing. First results of the investigation of Erbium centers using Raman and fluorescense spectroscopy are presented.

**CK-P.9 MON**

**Fiber polarization mode excitation applied to confocal microscopy**

*C. Zeh*1, T. Härting*2, and L.M. Eng*1; 1Fraunhofer Institute for Nondestructive Testing IZFP, Dresden Branch, Dresden, Germany; 2Institut für Angewandte Photophysik, Technische Universität Dresden, Dresden, Germany

The contribution has been withdrawn by the authors.

**CK-P.10 MON**

**Optical Fiber Nanotips as carriers for Molecular Beacon-based Biosensors**

*S. Pell*1, A. Barucci*1, A. Giannetti*1, F. Coo*1, S. Tombelli*1, C. Trono*1, G.C. Righini*1, 2, and F. Balconi*1; 1Istituto di Fisica Applicata "Nello Carrara", Sesto Fiorentino (Firenze), Italy; 2Centro Fermi, Roma, Italy

We present a biosensor using a optical fibre immunoassay. We focus on the mRNA detection usefull for cancer theranostics, in this case for survivin protein monitoring and inhibition.

**CK-P.11 MON**

**Light propagation in disordered media: from Maxwell equations to a spherical p-spin model and light condensation effects**

*L.D. Tönb and A. Fratalocchi; King Abdullah University of Science and Technology, Thuwal, Saudi Arabia

We develop a novel theory to tackle the complexity of light mode condensation in the presence of disorder and strong localization. We numerically investigate our findings by performing a massively parallel ab-initio FDTD simulation campaign.

**CK-P.12 MON**

**Role of spatial coherence in the Goos–Hänchen shift**

*M. Merano, G. Umbrico, and G. Mistura; Dipartimento di Fisica e Astronomia G. Galilei, Università degli studi di Padova, Padova, Italy

We investigate experimentally the role of spatial coherence in the Goos-Hänchen shift. We find that beams generated from sources with a low spatial coherence suffer the same shift of a fully coherent beam.

**CK-P.13 MON**

**Focusing by a Flat Woodpile 3D Photonic Crystal**

*L. Magistral, C. Cojocaru*1, V. Purlys*1, T. Trill*1, G. Galiérticu*1, M. Peckas*1, M. Malinauskas*1, and K. Staliunas*1; 1Departement de Fisica i Enginyeria Nuclear, Universitat Politècnica de Catalunya, Terrassa, Spain; 2Laser Research Center, Department of Quantum Electronics, Vilnius University, Vilnius, Lithuania; 3Center for Physical Sciences and Technology, Vilnius, Lithuania; 4Instituto Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Spain

In this paper we report numerical and experimental observation of a beam focusing behind a flat 3D woodpile photonic crystal at the visible wavelength range.
Photonic crystals are a promising technology to increase the light extraction from scintillators. Two simulation techniques were combined to investigate the impact of photonic crystals on total yield and propagation times of extracted photons.

C.K.-P.21 MON

**Polarization and Nonlinear Effects in Diffraction-Induced Laser Pulse Splitting in One-Dimensional Photonic Crystals**

S. Sisakthakul, A. Skryrins, V. Bushuks, S. Chekalin, V. Kompaneets, A. Maydokovskyi, T. Marzina, V. Novikov, and B. Mantyzov

1. Department of Physics, M. V. Lomonosov Moscow State University, Moscow, Russia; 2. Institute of Spectroscopy, Russian Academy of Sciences, Institute for Spectroscopy, Tashkent, Uzbekistan

We propose a novel mechanism for unconventional absorption harnessing in the Restrahlen band of a semiconductor, which relies on manipulating the energy velocity and its gradient at the surface of a suitably constructed photonic crystal.

C.K.-P.25 MON

**Near field focusing of beams reflected by flat mirror**


1. Department of Physics and Astronomy, Universidad de Barcelona, Terrassa, Spain; 2. Laser Research Center, Dep. Of Quantum Electronics, Vilnius University, Lithuania; 3. Instituto Catalán de Recerca i Estructura Avançada (ICREA), Barcelona, Spain

We predict generally that narrow beams can focus in reflected light from interface photonic structures, and we demonstrate the effect experimentally in particular realization, i.e. in reflection from one-dimensional chiral mirror with flat surface.

C.K.-P.26 MON

**Micro/Nano-Structuration of Silicon using Photonic Nanojet Mechanism**

L.N.D. Kallepalı, D. Grojı, L. Charnasson, P. Delaporte, O. Utıca, A. Merlen, and A. Sangar

1. Aix Marseille Université, CNRS, L3P UMR 7341, 13288, Marseille, France; 2. Aix Marseille Université et Sud Toulon Var, CNRS, L3P UMR 7334, 83957, Toulon, France

We have successfully fabricated large scale arrays of micro/nano-craters on silicon substrates using Langmuir-Blodgett deposition technique and UV nanosecond laser-assisted photonic nanojet ablation from C18 functionalized silica microshapers. Details of structured samples will be discussed.

C.K.-P.27 MON

**Enhancement UPCONVERSION LUMINESCENCE in InAs-QANTUM DOTS by GAPS PHOTONIC CRYSTAL SLAB-DEFECT WAVEGUIDE**


1. Chisso Institute of Science and Technology, Chisso, Japan; 2. Wakayama University, Wakayama, Japan; 3. National Institute for Materials Science, Tsukuba, Japan

In this work, we present the 1.55 μm to 1.3 μm upconversion luminescence based on two-photon absorption in InAs-quantum dots Gaps photonic-crystal slab-defect waveguide.

C.K.-P.28 MON

**Unconventional infrared absorption with polaritonic photonic crystals**

G.C.R. Devarapu and S. Foteniopoulou; School of Physics, College of Engineering, Mathematics and Physical Sciences (CEMS); University of Exeter, Exeter, United Kingdom

We propose a novel mechanism for unconventional absorption harnessing in the Restrahlen band of a semiconductor, which relies on manipulating the energy velocity and its gradient at the interface of a suitably constructed photonic crystal.

C.K.-P.29 MON

**Prototype of Thermo-optic Switch Consisting of Mach-Zehnder Polymer Waveguide Drawn by Focused Proton Beam**


1. Gunma University, Kiryu, Japan; 2. Japan Atomic Energy Agency, Takasaki, Japan; 3. Osaka University, Osaka, Japan

In our previous work, we demonstrated single-mode Y-junction and Mach-Zehnder (MZ) type PMMA-based waveguides drawn by proton beam writing (PBW). In this work, we first attempted to fabricate a thermo-optic switch using the MZ waveguide.

C.K.-P.30 MON

**3D Imaging by low one-photon absorption technique**

Q. Li, M.T. Do, I. Ledoux-Rak, and N.D. Lai; Laboratoire de Photonique Quantique et Moléculaire, Ecole Normale Supérieure de Cachan, Cachan, France

A new method for 3D imaging based on low one-photon absorption is theoretically and experimentally demonstrated. As compared to the two-photon-absorption (TPA) technique, this method is suitable using a continuous laser or an incoherent light.

C.K.-P.31 MON

**Self-synchronization of Radiating 2D Spaser Array**

A.V. Dorofenko1, A.A. Zalyubovsky2, A.P. Vinogradov3, E.S. Andrianov4, A.A. Pukhov5, and A.A. Lisyansky; 1. Institute for Theoretical and Applied Electromagnetics RAS, Moscow, Russia; 2. Moscow Institute of Physics and Technology, Dolgoprudny, Moscow region, Russia; 3. Department of Physics, Queens College of the City University of New York, New York, United States

We show that a two-dimensional array of spasers can be self-synchronized so that all the dipole moments oscillate in phase. Such an array produces a narrow beam of coherent light due to superradiance.
A novel scheme for controllable self-pulsing operation in a semiconductor photonics-crystal nanolaser is presented. Parameters suitable for an experimental realization are proposed on the basis of coupled photonic-crystal L3 cavities leading to 35p duration pulses.

**CK-P.33 MON**

Integrated planar Bragg grating stabilized diode lasers

J. Gates, S. Lynch, C. Holmes, C. Sima, P. Mennea, and P. Smith; Optoelectronics Research Centre, Southampton, United Kingdom

An external grating stabilised laser suitable for use in spectroscopy around 1650nm is based on a semiconductor-chip coupled to a UV written planar Bragg grating, with power of 7mW and a sub 500kHz line-width.

**CK-P.34 MON**

Photon-localization induced random lasing from an amplifying periodic-on-average random system

A.K. Tiwari and S. Misquandi; Nano-optics and Mesoscopic Optics Laboratory, Tata Institute of Fundamental Research, Mumbai, India

We experimentally demonstrate random lasing from an amplifying periodic-on-average random system. Transfer matrix calculations show that lasing originates from localized near-bandedge modes and is frequency-sensitive.

**CK-P.35 MON**

Photon Management in Two-dimensional Disordered Media

M. Barresi1,2, K. Vynck1,3, F. Pratesi4, F. Riboli3, and D.S. Wiersma1; 1European Laboratory for Non-linear Spectroscopy (LENS), Via N. Carrara 1, 50019, Sesto Fiorentino, Italy; 2Istituto Nazionale di Otica (CNR-INO), Largo Fermi 6, 50125, Firenze, Italy; 3Institut Langevin, ESPCI ParisTech, 1 rue Jussieu, 75005, Paris, France

A new nanophotonic strategy based on engineered-disorder light trapping approaches will be proposed to harvest solar radiation in absorbing thin films. These photonic architectures are applied to a realistic solar cell and numerically investigated.

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13:30 – 14:30
**CB-P: CB Poster Session**

**CB-P.1 MON**

Narrow linewidth, micro-integrated extended cavity diode laser for precision potassium atom interferometry in micro-gravity environment

E. Lusvandam1, C. Kaucba2, A. Sahn3, A. Wicht1,2, G. Erber1, and G. Traenkle; 1Ferdinand-Braun-Institut Leibniz-Institut für Hochfrequenztechnik, Berlin, Germany; 2Humboldt-Universität zu Berlin, Berlin, Germany

We present a very compact, robust, narrow linewidth micro-integrated extended cavity laser (ECDL) for precision potassium atom interferometry in a micro-gravity environment.

**CB-P.2 MON**

Actively Mode-Locked Semiconductor Disk Laser Using Vertical Cavity Modulator

J. Rautianäinen, A. Rantamäki, M. Tavast, and O.G. Oktosnikov; Optoelectronics Research Centre, Tampere, Finland

An actively mode-locked semiconductor disk laser using a low-loss broadband vertical-cavity modulator has been demonstrated for the first time. Accurate control of the repetition rate and pulse duration could be useful for various upcoming applications.

**CB-P.3 MON**

Identification of the delay time in semiconductor lasers with optical feedback

M.C. Soriano1, R.M. Nguimdo2, and P. Colet1; 1IFISC (CSIC-UIB), Palma de Mallorca, Spain; 2APHY, Vrije Universiteit Brussel, Brussels, Belgium

In this contribution, we discuss the effect of different observables in the identification of delay times in semiconductor lasers subject to delayed optical feedback.

**CB-P.4 MON**

Spatially resolved Stokes parameters of small area oxide-confined Vertical-Cavity Surface-Emitting Lasers

A. Molitor1, S. Hartmann1, P. Debernardi2, and W. Eis/phü1,2; 1Institute of Applied Physics, Technische Universität Darmstadt, Darmstadt, Germany; 2Instituto de Electrónica y de Ingeniería de la Información y de las Telecomunicaciones, Torino, Italy; 3Center of Smart Interfaces, Technische Universität Darmstadt, Darmstadt, Germany

We present experimentally obtained spatially resolved Stokes parameters of small area VCSELs. These results in comparison with numerical simulations of the VCSELs emitted light will grant an insight into the complex polarization behavior of VCSELs.

**CB-P.5 MON**

Wavelength Control of Integrated Semiconductor Lasers with Tunable Intra-cavity Arranged Waveguide Gratings Operating at 1.7 μm

Y. Iao1,2, B. Tilma1, P. Thijs3, M. Smits1, and E. Bente1; 1COBRA, Eindhoven University of Technology, Eindhoven, The Netherlands; 2Centre for Optical and Electromagnetic Research, Hangzhou, China, People’s Republic of (PRC)

In this contribution we present a control method and its experimental verification for a laser using tunable arranged waveguide gratings. In combination with QD materials or AMQWs the tuning can be extended for e.g. application in optical coherence tomography.

**CB-P.6 MON**

Subkilohertz-narrowed, frequency-phase-locked mid-IR quantum cascade lasers for high-precision molecular spectroscopy

F. Cappelli, S. Bartalini, P. Cantoni, I. Galli, G. Giu/fredi, D. Mazzotti, and P. De Natale, Istituto Nazionale di Otica (INO) - CNR and European Laboratory for Nonlinear Spectroscopy (LENS), Sesto Fiorentino FI, Italy

We narrow QCL radiation below 1 kHz by using two different techniques: frequency locking to a molecular transition and phase locking to an absolutely-referenced difference-frequency-generated source. Applications of both techniques are presented.

**CB-P.7 MON**

Emission wavelength multistability in semiconductor ring lasers

A. Perez-Serrano1, J. Javalyo2, and S. Balle; 1Weierstrass Institute (WIAS), Berlin, Germany; 2Université de les Illes Balears (UIB), Palma de Mallorca, Spain; 3IMEDEA (UEB-CSIC), Esporles, Spain

We theoretically investigate wavelength multistability in semiconductor ring lasers by performing dynamical simulations and the linear stability analysis of a spatio-temporal traveling wave model. We discuss the effect of carrier diffusion and spatial hole burning.

**CB-P.8 MON**

Anti-colliding design for passively mode-locked lasers

J. Javalyo and S. Balle; Departamento de Fisica, Univesrity of les illes balears, Palma de Mallorca, Spain

The performance of two-section, passively mode-locked semiconductor lasers is analyzed placing the saturable absorber section close to an anti-reflection coated facet. This leads to shorter pulses, increased output power and reduced jitter.

**CB-P.9 MON**

Improved Performance of Slotted Single-Mode Lasers

A. Abdullaev1, Q. Lu1, W.-H. Guo2, M. Nawrocka3, J. O’Callaghan4, and J. Donegan5; 1Trinity College Dublin, Dublin, Republic of Ireland; 2Department of Electrical & Computer Engineering, University of California Santa Barbara, California, United States; 3Tyndall National Institute, Cork, Republic of Ireland

Slotted single-mode lasers integrated with semiconductor-photonic-amplifier (SOA) is presented. The laser exhibits a threshold ~19mA with the SOA unbiased. Stable single mode performance has been demonstrated with SMSR >50 dB and output power >45mW.

**CB-P.10 MON**

Eight-Channel Slotted Single-Mode Laser Array

Q. Lu1, W.-H. Guo2, M. Nawrocka3, A. Abdullaev1, J. O’Callaghan4, and J. Donegan5; 1Trinity College Dublin, Dublin, Republic of Ireland; 2Department of Electrical & Computer Engineering, University of California Santa Barbara, California, United States; 3Tyndall National Institute, Cork, Republic of Ireland

An 8-channel single-mode laser array based on slots is presented. Lasing wavelengths span ~21nm has been obtained with the threshold of ~17–20mA, slope efficiency >0.2mW/mA and SMSR >70dB for the fabricated array.

**CB-P.11 MON**

Increasing the luminance of a red emitting laser light source by spectral beam combining

G. Blame; D. Fete, A. Sahin, B. Eppich, and K. Paschke; Ferdinand-Braun-Institut, Berlin, Germany

Spectral beam combining of a bar of DBR tapered lasers near 635 nm at a power level ~1W improved the beam propagation factor. The incoherent multi-wavelength emission of the bar reduced the speckle contrast.

**CB-P.12 MON**

1 Watt from 1.56 μm Single Frequency Semiconductor Disk Laser

A. Rantamäki1, J. Rautianäinen1, A. Sirbu2, A. Mercuta2, E. Kapon2, and O. Oktosnikov1; 1Optoelectronics Research Centre, Tampere University of Technology, Tampere, Finland; 2École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

1.56 μm single-frequency semiconductor disk laser with 1 watt of output power and coherence length over 5 km in optical fiber is demonstrated. The result presents the highest power reported for this type of lasers.
CB-P.13 MON

Investigation of design parameters of 633 nm diode lasers with internal surface gratings for narrow spectral linewidth

- D. Feiße, G. Blum, W. John, J. Pohl, B. Sumpf, H. Thiem, M. Reggiani, J. Wiedmann, and K. Päschke;
- Ferdinando Vittorio; Institut, Leibniz-Institut für Höchstfrequenztechnik, Berlin, Germany;
- egeyad Photonics GmbH, Berlin, Germany

Wavelength stabilized diode lasers for applications in spectroscopy and interferometry have been developed by monolithical integration of tenth order surface DBR gratings. The influence of design parameters like grating period et al. will be presented.

CB-P.14 MON

Random lasers driven by engineered pumping
- M. Leoni1,2, C. Conti3, and C. Lopez3;
- Instituto de Ciencia de Materiales (CSIC), Madrid, Spain;
- Instituto dei Sistemi Complessi (CNR), Rome, Italy; 3Department of Physics, University Sapienza, Rome, Italy

Without a cavity random lasers are intrinsically uncontrollable. Engineering the scattering elements helps controlling emission frequency. Engineering the pumping gives access to parameters such as feedback regime, synchronisation, mode size and single mode selection.

CB-P.15 MON

Modelling Dilute Nitride 1.3 µm Quantum Well Lasers: Incorporation of N compositional fluctuations
- X. Sun and J. trìorism; University of Bristol, Bristol, United Kingdom

Compositional fluctuations of N in GaInNAs result in quantum dot-like fluctuations in the conduction band edge. It is observed to reduce the photon luminescence intensity, broaden the line-width and increase the laser threshold.

CB-P.17 MON

High-Order Laguerre Gaussian Modes with Vertical-External-Cavity-Surface-Emitting-Laser
- M. Sellahi1, M. Myara2, I. Sagnes3, B. Slin3, and A. Garnache1;
- IES-CNRS UMR5214, Université de Montpellier 2, Montpellier, France; 2LPN-CNRS, Marcoussis, France

We demonstrate the generation of single frequency high order Laguerre Gauss transverse modes with Vertical-External-Cavity-Surface-Emitting-Laser. This was achieved by means of sub-wavelength metallic masks deposited on GaAs semiconductor structures and the spatial-hole-burning based mode interaction.

CB-P.18 MON

Generation of Single Frequency Highly Coherent
- X. Sun and J. trìorism; University of Bristol, Bristol, United Kingdom

We present an experimental analysis of the influence of the length of the absorber section on the differential internal efficiency by improved diode lasers at low temperatures. We demonstrate experimentally that this is dominated by improved diode lasers.

CB-P.19 MON

High-Power Optically Pumped Semiconductor Disk Lasers Using Second-Harmonic Generation
- A. Heim, S. Menzel, M. Rampa, A. Ziegler, and P. Unger; Institute of Optoelectronics, UniZ University, Germany

Characteristics of optically pumped semiconductor disk lasers are presented for the fundamental and second-harmonic regime at 1044nm and 520nm, respectively. High efficiencies for both spectral regions, and wide tuning of the second-harmonic is demonstrated.

CB-P.20 MON

Locking of Laser Cavity Solitons Trapped by Defects in VCSELs
- P. Paulus1, C. McIntyre2, Y. Noblet1, W. J. Firth1, P. Cole1, T. Ackemann1, and G. L. Oppo1;
- 1Technische Universität Berlin, Germany; 2University of Strathclyde, Glasgow, United Kingdom

Defects due to growth fluctuations in semiconductor lasers induce trapping and frequency shifts of laser solitons. We experimentally and theoretically demonstrate phase and frequency locking of trapped solitons in VCSELs with frequency-selective feedback.

CB-P.21 MON

InP quantum dot based semiconductor disk laser emitting at 655 nm
- H. Kuhle, R. Bek, F. Hargart, C. Kessler, E. Koroknay, T. Schwarzlück, M. Jetter, and P. Michler; Institut für Halbleiteroptik und Funktionelle Grenzflächen und Research Center SCoPE, University of Stuttgart, Germany

We present an InP quantum dot semiconductor disk laser emitting at a wavelength of 654 nm. Investigations of the laser system show an output power of 1.4 W with a slope efficiency of 25.4%.

CB-P.22 MON

Characterization of 60GHz passively mode-locked quantum well Fabry-Perot laser for RoF and WPAN applications
- K. Carnay, R. Maldonado-Basilio, S. Philippe, and P. Landais; Rits Institute, Dublin City University, Dublin, Republic of Ireland

Characterization of a passively mode-locked FP laser operating at 60GHz with only d.c. bias applied is presented. A beat tone linewidth of 10kHz is measured, making the device suitable for RoF and WPAN applications.

CB-P.23 MON

Mode-Locked semiconductor laser with controllable intracavity dispersion and absorption
- J. Balzer1, B. Döpke1, A. Klehr2, G. Ebert2, G. Tränkle1, and M.R. Hoffmann1;
- 1Lehrstuhl für Photonik und Terahertztechnologie, Ruhr Universität Bochum, Bochum, Germany;
- 2Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik, Berlin, Germany

We present an experimental analysis of the influence of intracavity group delay dispersion and absorption on the performance of a passively mode locked semiconductor laser diode.

CB-P.24 MON

Fast controlled switching of modes in semiconductor lasers
- S. Slipchenko; Infine Physical-technical Institute, St. Petersburg, Russia

Mode switching effects in semiconductor lasers based on asymmetric heterostructure with low internal optical losses have been investigated and physical principles of new type fast optical power switcher have been developed.

CB-P.25 MON

Spectral gain and cavity loss characterization of an optically-pumped external-cavity surface-emitting quantum well laser
- C.R. Head1, K.G. Wilcox1, O.J. Morris1, A.P. Turnbull1, H.E. Beer2, I. Farrer2, D.A. Ritchie2, and A.C. Tropper1;
- 1School of Physics and Astronomy, Southampton University, Southampton, United Kingdom; 2Cavendish Laboratory, University of Cambridge, Cambridge, United Kingdom

We present two novel methods exploiting the transient laser build-up behavior in order to extract spectral laser gain and cavity loss parameters of a 1-micrometer optically-pumped external-cavity surface-emitting quantum well laser.

CB-P.26 MON

Colliding Pulse ModeLocked Lasers for Terahertz Photomixing
- C. Brenner1, H. Horstkemper2, L. Camara Mayorga2, A. Klehr2, G. Ebert2, and M. Hofmann1;
- 1Ruhr-Universität, Bochum, Germany; 2Max-Planck Institut, Bonn, Germany;
- Ferdinand-Braun-Institut, Berlin, Germany

Observation of frequencies up to 1THz with a standard homodyne THz detection setup incorporating colliding pulse mode-locked lasers. Presentation of background and results.

CB-P.27 MON

Theoretical analysis of timing jitter in two-section passively mode-locked semiconductor lasers
- A. Pimenov1, N. Rebrow2,3, R. Rachinski4,5, and A. Vladimirov1,6,7;
- 1Weierstrass Institute, Berlin, Germany;
- 2Tyndall National Institute, Cork, Republic of Ireland;
- 3Cork Institute of Technology, Cork, Republic of Ireland;
- 4Laurel Technology College Cork, Cork, Republic of Ireland;
- 5University of Texas at Dallas, Dallas, United States

We consider a delay-differential model of a passively mode-locked semiconductor laser. We apply perturbation theory to obtain estimate of pulse timing jitter and study the dependence of noise induced characteristics on laser parameters.

CB-P.28 MON

Efficiency optimization of high power diode lasers at low temperatures
- C. Prevert, P. Cramp, H. Wenzel, S. Knigge, B. Bugge, and G. Ebert; Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik, Berlin, Germany

9XsXmm Xlong-cavity (4 mm) high power broad-area lasers achieve power conversion efficiency of 74% at 55s, increased by 10% compared to room temperature. We demonstrate experimentally that this is dominated by improved differential internal efficiency.

CB-P.29 MON

Influence of the length of the absorber section on the mode locking behaviour of a 1064nm DBR laser determined on a single device
- A. Klehr, T. Prizivarka, O. Brix, B. Bugge, H. Wenzel, and
We study the dynamical characteristics of a monolithic flared MOPA at 1.5 µm. Radio-frequency and optical spectra under CW biasing evidence regimes of self-pulsations and compound cavity effects. A Travelling-Wave Model reproduces the observed dynamics.

CB-P.33 MON

Bursting in an Optically Injected Two-Mode Laser: The Cusp-Pitchfork Bifurcation

S. Osborne1, N. Blackbeard2, S. O’Brien1, and A. Amano1,2,3,3

Tyndall National Institute, University College Cork, Cork, Republic of Ireland; 2School of Mathematical Sciences, University College Cork, Cork, Republic of Ireland

We present an interesting bursting mechanism in a two-mode laser subjected to optical injection. We show that this bursting is organized by an interaction between a cusp and pitchfork of limit-cycles.

CB-P.34 MON

How to control single mode emission of VCSEL arrays?

T. Czyżewski1, M. Demo1,2, M. Wasia3, R.P. Sarzala, E. Lamotte, N. Volet2, V. Jakslov, and E. Kapov1

1Institute of Photonics, Lodz University of Technology, Lodz, Poland; 2Laboratory of Physics of Nanostructures, Ecole Polytechnique Federal de Lausanne (EPFL), Lausanne, Switzerland

In this paper we present the simulation results of optimization of carrier injection, heat flow and optical confinement aimed for single mode operation of VCSEL arrays.

CB-P.35 MON

Widely-Tunable Five-Section Slotted Lasers

M. Navrotsky1, Q. Ly1, W.-H. Gao2, A. Abdulla1, F. Bello1,2, J. Callaghan2, and J. Donegan2

1 Trinity College Dublin, Dublin, Republic of Ireland; 2Department of Electrical & Computer Engineering, University of California Santa Barbara, California, United States; 3Tyndall National Institute, Cork, Republic of Ireland

A re-growth free five-section tunable laser based on slots suitable for photonic integration is presented. A discrete tuning range ~ 55nm with SMSR>30dB has been reported for the fabricated device using the Vernier tuning effect.

CB-P.36 MON

Dynamics of colliding pulse passively semiconductor mode-locked ring lasers with an intra-cavity Mach-Zehnder modulator

V. Maksimenko1, J. Javaloyes2, M. Smitt3, S. Balle4, and E. Bentel1

1 Technical University of Eindhoven, Eindhoven, The Netherlands; 2Université de les Illes Balears, Palma de Mallorca, Spain

We study the dynamics of InGaAsP/InP passively mode-locked quantum well ring lasers in the presence of a gain flattening intra-cavity frequency dependent filter. Control and pulse width reduction is achieved.

CB-P.37 MON

Traveling wave modelling and mode analysis of semiconductor ring lasers

M. Radziunas1,2; Weierstrass Institute, Berlin, Germany

The traveling wave model is used for analyzing dynamics of semiconductor ring lasers. Dependence of instability on mode selection is shown to be different within different dynamical regimes that are analyzed.

CB-P.38 MON

Theoretical study of beam quality improvement in spatially modulated broad area edge-emitting devices

M. Radziunas1, R. Herrera2, R. Botey3, and K. Staliunas4,5,6

1 Weierstrass Institute, Berlin, Germany; 2Institut de Fisica i Quimica de la Serra i de l’Ebre, Universitat Rovira i Virgili, Tarragona, Spain; 3 Departament de Fisica i Enginyeria Nuclear, Universitat Politècnica de Catalunya, Terrassa, Spain; 4 Departamento de Fisica y Engineria Nuclear, Universitat Politècnica de Catalunya, Barcelona, Spain; 5 Instiutio Catalana de Recerca i Estudis Avancats (ICREA), Barcelona, Spain

We analyze properties of broad area amplifiers and lasers with longitudinally and laterally modulated electrical contact. We demonstrate how a proper choice of the spatial periods improves the far fields of the emitted beam.

CB-P.39 MON

High resolution mapping of the dynamics of a nonlinear semiconductor laser system

J. Toomey, Y. Nobile, C. Nickkhawde, and D. Kane; MQ Photonics Research Centre, Macquarie University, Sydney, Australia

High resolution time series from a semiconductor laser with optical feedback system have been analysed and mapped to confirm previously identified major dynamically, observe new low feedback dynamics, and to test reproducibility over time.

CB-P.40 MON

Why Plutonic-Crystal VCSELs do not provide high power emission in the single-mode regime?

L. Frasunkiewicz1, T. Czyżewski1, M. Wasia3, M. Demski1, R.P. Sarzala, W. Nawkowski, and K. Panajotov2

1 Institute of Physics, Lodz University of Technology, Lodz, Poland; 2 Department of Applied Physics and Photonics, Vrije Universiteit Brussel, Brussels, Belgium

In this paper we investigate the influence of parameters of photonic crystal on the slope efficiency, emitted power and tuning range in single mode VCSELs.

CB-P.41 MON

Analysis of gain properties in silver-clad nanowire lasers

Z. Abdal Sattar and K.A. Shore; Bangor University, Bangor, United Kingdom

Analysis of GaN nanowire lasers is performed for wavelengths in the range 330nm-830nm. Modal gains of order 8000cm-1 and 1100cm-1 are found for TE01 and TM01 modes respectively thereby enabling lasing with appropriate cavity lengths.
Quantum state fusion in photons
- N. Spagnolo, C. Vitelli, L. Aparo, E. Sciarrino, E. Santamato, and L. Marrucco
- Dipartimento di Fisica, Sapienza Università di Roma, Roma, Italy; 2Center of Life NanoScience @ La Sapienza, Istituto Italiano di Tecnologia, Roma, Italy; 3Dipartimento di Scienze Fisiche, Università di Napoli “Federico II”, Compl. Univ. di Monte S. Angelo, Napoli, Italy; 4CNR-SNIP, Complesso Universitario di Monte S. Angelo, Napoli, Italy

We propose and experimentally demonstrate a physical process, named quantum state fusion, in which two input qubits written in two input photons in different degrees of freedom are combined into a single output photon.
they are all well-suited for the purpose. The utilized Ti:sapphire oscillator is investigated. We report on an optical memory which enables the reversible mapping of Laguerre-Gaussian modes at the single-photon level. This opens the possibility of storage of qubits encoded in orbital angular momentum.

IB-P.19 MON
Broadband Quantum-Correlated Photon-Pairs in the O-Band Generated from a Dispersion-Engineered Silicon Waveguide
M.T. Liu¹, Y. Huang¹,², W. Wang³, and H.C. Lim¹,³
¹School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore; Singapore, Singapore; ²Currently with Institute of Microelectronics, Agency for Science, Technology and Research (A*STAR), Singapore, Singapore; ³Emerging Systems Division, DSO National Laboratories, Singapore, Singapore

We investigate the first broadband source of quantum-correlated photon-pairs in the O-band using a 2.6-mm-long dispersion-engineered silicon waveguide.

IB-P.20 MON
Multidimensional Quantum Walks: Diabolical Points, Optical Wave-like propagation and Multiparticle Entanglement
G.J. de Valcárcel¹, C. Di Franco¹, M. Hinarajoa, A. Pérez, E. Roldán¹, A. Romanelli¹, and F. Silva¹
¹Departament d’Optica, Universitat de València, Burjassot, Spain; ²Departament de Física Teòrica and IFIC, Universitat de València and CSIC, Burjassot, Spain; ³Instituto de Física, Facultad de Ingeniería, Universidad de la República, Montevideo, Uruguay; ⁴Centre for Theoretical, Atomic, Molecular and Optical Physics, Queen’s University, Belfast, United Kingdom

We study multidimensional quantum walks concentrating on their dispersion relation. We describe wave-like propagation as well as dynamics governed by diabolical points. We demonstrate that alternate QWs exhibit genuine multiparticle entanglement and discuss their implementability.

ID-P.17 MON
State transfer with time-dependent Hamiltonians in waveguide arrays
S. Weinnmann¹, A. Kay², R. Keil¹, S. Nolte¹, and A. Szameit¹
¹Institute of applied Physics, Abbe Center of Photonics, Friedrich-Schiller-University Jena, Jena, Germany; ²Department of Mathematics, Royal Holloway, University of London, Egham, United Kingdom

We emulate perfect quantum state transfer through a chain of spin-1/2-particles with time-dependent couplings in waveguide arrays. The transfer scheme to imperfections of the couplings is analyzed experimentally.

ID-P.18 MON
A reversible optical memory for twisted photons
L. Veissier¹, A. Nicolas¹, L. Giner¹, D. Maxein¹, A. Sherechef², E. Gubicino¹, and J. Laurat¹
¹Laboratoire Kastler Brossel, Paris, France; ²State Polytechnic University, Saint Petersburg, Russia

We report on an optical memory which enables the reversible mapping of Laguerre-Gaussian modes at the single-photon level. This opens the possibility of storage of qubits encoded in orbital angular momentum.

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We present several con onlineffl"sfffl "ffffi...
| ROOM 14a | 8:30 – 10:00 | IB-2: Integrated Quantum Photonics and Simulation  
Chair: Andreas Poppe, Austrian Institute of Technology, Vienna, Austria  
IB-2.1 TUE (Invited) 8:30  
Quantum simulation with integrated photonics  
- F. Sciarrino; Sapienza Università di Roma, Rome, Italy  
Integrated photonic circuits with three dimensional geometries, realized with ultrafast laser writing, have a strong potential to perform quantum information processing. By adopting such approach we report several experiments of quantum simulation. |
| ROOM 14b | 8:30 – 10:00 | CA-5: Yb-Doped Thin Disk Lasers  
Chair: Eugenio Sorokin, Technical University, Vienna, Austria  
CA-5.1 TUE 8:30  
Towards high average output power and short pulse duration of SESAM modeled thin disk lasers  
- C. Schriber1, C. Saraceno1, F. Emasy2, M. Golling1, K. Bell1, C. Kranke1, T. Siemkiewicz1, G. Huber2, and U. Keller3  
1ETH Zürich, Zurich, Switzerland, 2University Hamburg, Hamburg, Germany; 3The Hamburg Centre for Ultrafast Imaging, Hamburg, Germany  
We explore the pulse duration limits of high-power SESAM modeled thin disk lasers based on Yb-doped sesquioxide. We achieve 25 W and 185 fs with Yb:Lu2O3. The novel broadband gain material Yb:Sc,Y4O3 enables 101-fs pulses. |
| ROOM 21 | 8:30 – 10:00 | IG-1: Synchronization Dynamics & Opto-mechanical Self-organization  
Chair: Thorsten Ackemann, University of Strathclyde, Glasgow, United Kingdom  
IG-1.1 TUE (Invited) 8:30  
Synchronization of N coupled dipoles: From Anderson to Dicke  
- R. Kaiser; INLN, Nice, France  
Interferences in multiple scattering of light in dense media is expected to lead to Anderson localisation. We show that the synchronisation between the induced dipoles rather leads to extended Dicke super- and subradiance. |

**IB-2.2 TUE 9:00**  
Anderson localization of bosonic and fermionic two-particle systems with integrated optics  
- L. Sansoni1, F. Sciarrino1,2, P. Mataloni1,2, A. Crespi1,2, R. Osellame1,4, R. Rambourg1,2, V. Giovannetti1, and R. Fazio1,2  
1Dipartimento di Fisica, Sapienza Università di Roma, Roma, Italy; 2Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (INO-CNR), Firenze, Italy; 3Istituto di Fotonica e Nanotecnologie, Consiglio Nazionale delle Ricerche (INO-CNR), Firenze, Italy; 4Laboratoire Charles Fabry, Institut d’Optique, Palaiseau, France; 5Chimie-Paristech, Laboratoire de Chimie de la Matière Condensée de Paris, Paris, France; 6Institut für Strahlverfahren, Stuttgart, Germany; 7FRI gmbh, Idar-Oberstein, Germany; 8Amplitude Systemes, Pessac, France  
We present the first results on high-power fs oscillators based on Yb:CALGO in thin disk architecture. We demonstrate 28 W, 1.3 μ, 30fs pulses and 28 W, 0.9 μ, 197 fs pulses. |

**IG-1.2 TUE 9:00**  
Spontaneous Opto-Mechanical Structures in Cold Atomic Gases  
- E. Tesi1, G. Rohrb1, T. Ackemann1, P. Gomes1, A. Arnold1, W. Firth1, G.-L. Oppo1, G. Labeyrie2, and R. Kaiser2  
1University of Strathclyde, Glasgow, United Kingdom; 2University of Hamburg, Hamburg, Germany  
Birefringence optimization in PM fibers by specifically influencing the draw induced intrinsic stresses  
- E Just, R. Spittel, S. Grimm, S. Ungr, J. Bierlich, M. Jäger, K. Schuster, and H. Bartelt; Institute of Photonic Technology, Jena, Ger-
We propose a method for generating linear and nonlinear fundamental Bessel-like optical beams and higher-order vortex Bessel-like beams that follow arbitrary trajectories with a remarkably invariant main lobe. Our results are experimentally verified in free-space.

**CD-8.3 TUE 9:15**

Self-Organized Optical Waveguides Targeting Luminescent Objects in Photopolymers

*T. Yoshimura and M. Seki,* Tokyo University of Technology, Hachioji, Tokyo, Japan

Self-organized waveguides targeting luminescent objects in photopolymers was investigated to find that, with increasing the write beam wavelength, tolerance of lateral misalignment increases while waveguides diffuse due to an increase in the write beam diffraction.

**CD-8.4 TUE 9:30**

Sharp Transition between ballistic and diffusive Transport in PT-symmetric Media

*T. Eichelkraut, R. Heßmann, S. Stützer, S. Nolte, and A. Szameit,* Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Jena, Germany

It is theoretically and experimentally demonstrated that in PT-symmetric media ballistic and diffusive transport coexist, but on different time scales. The transition between both regimes is rather sharp and depends only on the gain-loss ratio.

**Quantum Electronics, Szeged, Hungary**

Novel reflector, nano-cavity-array and nano-cavity-deflector-array integrated SNSPD devices were designed, consisting of NbN patterns on silica substrate. It was shown that the coupled plasmonic resonances result in huge absorbance enhancement on long period-integrated devices.

**BS-1.3 TUE (Invited) 9:15**

Producing correlated photons using superconducting circuits

*G. Johansson,* Chalmers University of Technology, Gothenburg, Sweden

In this talk, I will discuss the production of correlated pairs of microwave photons using superconducting circuits. Starting from the basic non-linear element, i.e. the Josephson Junction, I’ll cover both theory and recent experimental demonstrations.

**CI-2.4 TUE 9:30**

Integrated Microwave Photonic Signal Processors in TriPlex Waveguide

*L. Zhuang*¹, A. Leinse*², R. Heideman*², R. van Dijk*, and C. Roeloffzen*¹, ¹University of Twente, Enschede, The Netherlands; ²LioniX BV, Enschede, The Netherlands; ³SATRAX BV, Enschede, The Netherlands

Various complex RF functionalities have been demonstrated on the integrated microwave photonic signal processors realized in TriPlex waveguide technology, including an integrated beamformer which enables full Ku-band, squint-free, seamless beamsteering, satellite-tracking phased array antennas.

**It is shown that both in gases and transparent materials plasma, produced by leading part of intense fs-ps laser pulses, results in strong intensity limitation. Up to 99% of pulse energy can be scattered outside focused beam caustic.**

**ROOM 4a**

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**ROOM 4b**

**Paris Sud, Orsay, France; ²L-NESS - Dipartimento di Fisica del Politecnico di Milano, Como, Italy**

We report recent results obtained on Ge/SiGe quantum well optoelectronic device for high speed and low power consumption light modulation at telecom wavelengths.

**ROOM 13a**

**It is shown that both in gases and transparent materials plasma, produced by leading part of intense fs-ps laser pulses, results in strong intensity limitation. Up to 99% of pulse energy can be scattered outside focused beam caustic.**

**ROOM 13b**

**SESAM mode-locked red AlGaInP semiconductor disk laser emitting at 665 nm**

*T. Schwarzbaücker, B. K. Kahler, M. Jetter, and P. Michtel,* Institut für Halbleiteroptik und Funktionelle Grenzflächen and Research Center ScPE, University of Stuttgart, Stuttgart, Germany

We present a mode-locked AlGaInP based red-emitting semiconductor disk laser. Using a SESAM in a v-shaped cavity, a repetition rate of 810 MHz with a FWHM pulse duration below 50 ps will be shown.

**ROOM 13b**

**Mode-locked operation of a 2-um GaSb-based semiconductor disk laser using a single-walled carbon-nanotube saturable absorber**

*S. Kaspar*¹, M. Rattunde¹, J. Wagner¹, C. Schilling¹, W. Bromer¹, A. Bächle¹, S.Y. Choi³, D.-I. Yem², F. Rotermund², A. Schmidt², and U. Griebner¹, ¹Fraunhofer-Institute for Applied Solid State Physics, Freiburg, Germany; ²Department of Physics & Division of Energy and Systems Research, Ajou University, Suwon, Korea, South; ³Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany

A mode-locked semiconductor disk laser emitting around 2050 nm using a single-walled carbon nanotubes based saturable absorber is demonstrated generating ps-pulses with average powers up to 50 mW at 1.1 GHz.
We report on thin disk laser experiments using a 5.9% Yb-doped CaF2:Al2O3. At 30 W of output power, 70% slope efficiency and 57% optical-to-optical efficiency represent the best values obtained with this material so far.

Simulations of two particle dynamics employing dynamic coin control in 2D quantum walks

A. Schreiber,1,2,3, E. Katzschmann,1, A. Gabris,1, P.P. Rohde,1, K. Laiho1,2,3, M. Stafjordh,1, V. Potocke,1, C. Hamilton,1, L. Jez,1 and C. Silberhorn1:

1Applied Physics, University of Paderborn, Warburger Strasse 100, 33098 Paderborn, Germany; 2Max-Planck-Institute for the Science of Light, G"unther-Scharowsky-Str. 1 / Bau 24, 91058 Erlangen, Germany; 3Department of Physics, Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Brehova 7, 115 19 Praha, Czech Republic

We present the simulation of interacting bosonic particles, exhibiting bunching or anti-bunching behavior. Our approach uses a photonic realization of a 2D discrete-time quantum walk exploiting the dynamic access to the coin state.

On-chip quantum teleportation

B. Metcalf1, N. Thomas-Peter1, B. Spring1, G. Humphreys1, N. Langford,3, S. Kolthammer,1, M. Barbieri,1, X-M. Jin,1, J. Gates1, D. Kandyb3, D. Smith1, P. Smith,1, and L. Walshe2:

2Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom

We present results showing the first quantum teleportation of a single qubit photonic state on an integrated photonic chip.
Artificial glial-like waveguides for biomimetic volume optics
E. DelRe1, A. Pierangelo1,*, F. Parravicini1, S. Gentilini2, and A. Agrawal1; 1Department of Physics, University of Rome “La Sapienza”, Rome, Italy; 2EPICM, Ecole Polytechnique, CNRS, Palaiseau, France; 1ISC-CNR, University of Rome “La Sapienza”, Rome, Italy; 2Applied Physics Department, Hebrew University of Jerusalem, Jerusalem, Israel

We demonstrate in paraelectric photorefractive crystals the use of three-dimensional funnel index of refraction patterns analogous to those of retinal glial cells as support for tunable and multi-functional volume optical component miniaturization and integration.

Strongly Interacting Many Body Physics with Circuit Quantum Electrodynamics Networks
M. Leib1, L. Neumeier1, P. Deppe2, A. Marx3, R. Gross3, and M. Hartmann1; 1TU Munich, Munich, Germany; 2Walther-Meißner-Institut, Munich, Germany

We propose experiments involving networks of either Josephson junction intersected superconducting resonators or superconducting resonators intersected by multiple Josephson junctions. Because of the non conserved number of excitations in these networks we concentrate on the driven dissipative regime.

1D optical SUSY structures for selective mode filtering
M. Heinrich1, M. A. Miri2, S. Stüttze3, R. El-Ganainy3, S. Note2, A. Szameitat1, and D. N. Christodoulides1; 1CREOL, The College of Optics and Photonics, Florida, Orlando, United States; 2Institute of Applied Physics, Friedrich Schiller Universität, Jena, Germany; 3Department of Physics, University of Toronto, Toronto, Canada

We demonstrate that supersymmetry endows dissimilar optical structures with the same scattering and guided wave characteristics. We explore continuous supersymmetric one-dimensional settings, as well as SUSY photonic lattices, for designing versatile integrated filtering arrangements.

Prize and Award Ceremonies

2013 Awards of the European Physical Society - Quantum Electronics and Optics Division: Quantum Electronics Prizes

The 2013 Prize for fundamentals aspects of Quantum Electronics and Optics is awarded to Maciej Lewenstein, The Institute of Photonic Sciences (ICFO), Castelldefels (Barcelona), Catalan Institution for Research and Advanced Studies (ICREA), Barcelona, Spain. The Prize is awarded to Professor Lewenstein for outstanding contributions to several areas of theoretical quantum optics and to the use of quantum gases for quantum information and to attosecond optics.

The 2013 Prize for applied aspects of Quantum Electronics and Optics is awarded to Federico Capasso, Harvard University, Cambridge, MA, United States. The Prize is awarded to Professor Capasso for seminal contributions to the invention and demonstration of the quantum cascade laser.

Fresnel Prizes

The 2013 Fresnel Prize for fundamental aspects is awarded to Yu-Ao Chen, National Laboratory for Physical Sciences at Microscale and Department of Modern Physics, University of Science and Technology of China, Hefei, P. R. China, for outstanding achievements in the fields of multi-photon entanglement, quantum communication, quantum computation and quantum simulation based on manipulation of photons and atoms.

The 2013 Fresnel Prize for applied aspects is awarded to Gerasimos Konstantatos, The Institute of Photonic Sciences (ICFO), Castelldefels (Barcelona), Spain, for salient contributions to the science and technology of solution-processed quantum dots and their applications to a variety of optoelectronic devices with ground-breaking performances.

PhD Thesis Prizes

The 2013 Thesis Prizes for fundamental aspects are awarded to: Pascal DeHaye, National Institute of Standards and Technology, Boulder, CO, USA and Thomas Monz, University of Innsbruck, Institute for Experimental Physics, Innsbruck, Austria.

The 2013 Thesis Prizes for applied aspects are awarded to: Florian Kaiser, Universität der Nice Sophia Antipolis, Nice, France and Clara Saraceno, ETH Zurich, Zurich and University of Neuchâtel, Neuchâtel, Switzerland.

See EPS-QEOD Prize Ceremony Brochure.
Fabrication and characterisation of an integrated-optic controlled-phase gate

• T. Meaney¹, D. Biggerstaff², A. Fedrizzi², M. Broome³, M. Delaney⁴, A. Gilchrist⁵, M. Steel⁶, A. White⁷, and M. Wadsworth³

¹Centre for Ultra-high bandwidth Devices for Optical Systems (CUUDOS), MQ Photonics Research Centre, Department of Physics and Astronomy, Macquarie University, North Ryde, Australia; ²Centre for Engineered Quantum Systems(EQuS), School of Mathematics and Physics, University of Queensland, Brisbane, Australia; ³Centre for Quantum Computer, and Communication Technology, School of Mathematics and Physics, University of Queensland, Brisbane, Australia; ⁴EQuS, Department of Physics and Astronomy, Macquarie University, North Ryde, Australia

We describe the fabrication and classical characterisation of a new laser written quantum circuit—a controlled-phase gate. We minimise losses at 800nm, produce accurate coupling ratios and extract the unitary of the circuit.

The Herbert Walther Award:

The Optical Society (OSA) and the Deutsche Physikalische Gesellschaft (DPG) will present the 2013 Herbert Walther Award to H. Jeff Kimble of the California Institute of Technology (Caltech), Pasadena, USA for his pioneering experimental contributions to quantum optics, cavity quantum electrodynamics, and quantum information science. The Herbert Walther Award honors Professor Herbert Walther for the seminal influence of his groundbreaking innovations in quantum optics and atomic physics and for his numerous contributions to the international scientific community. Established in 2007, the Award recognizes distinguished contributions in quantum optics and atomic physics as well as leadership in the international scientific community. Kimble will join the list of esteemed past recipients including Alain Aspect, Marlan O. Scully, Serge Haroche and David J. Wineland.

OSA Fellow Member Recognition:

OSA Fellows will be recognized during the Awards Ceremony of CLEO/Europe-IQEC 2013. Philip Russell, OSA 2013 Vice President, will recognize six scientists as “OSA Fellows”.

The distinction will go to:

Thorsten Ackermann, University of Strathclyde, UK
Christoph Harder, Harder & Partner GmbH, Switzerland
Martti Kauranen, Tampere University of Technology, Finland
Brian W. Pogue, Dartmouth College, USA
Markus Pollnau, University of Twente, The Netherlands
Monika Ritsch-Martt, Innsbruck Medical University, Austria

Pristine spider silk fibers as waveguiding microstructure in free space and in an integrated photonic chip

• N. Huby¹, A. Renault³, S. Beausil¹, V. Vie¹, T. Lefèvre², F. Paquet-Mercier³, M. Pézolet³, and B. Béche¹

¹Institut de Physique de Rennes, Rennes, France; ²Centre de recherche sur les matériaux avancés, Québec, Canada

Waveguiding properties of spider silk fiber are presented in free space and in integrated chip. Efficient propagation and optical coupling are demonstrated in both cases. These results pave the way for biophotonic applications.
14:00 – 15:30
CD-9: UV - Sources
Chair: Luc Bergé, CEA, Arpajon, France

14:00 – 15:30
IC-1: Atomic Quantum Simulators
Chair: Holger Müller, University of California, Berkeley, United States

Tunable fiber-laser-based picosecond source for the ultraviolet
-C.K. Suddaphol1, G.K. Samanta2, A. A., and M. Ebrahim-Zadeh1; 1ICFO-The Institute of Photonic Sciences, Barcelona, Spain; 2Theoretical Physics Division, Physical Research Laboratory, Ahmedabad, India; 3Instituto Catalana de Recerca i Estudis Avancats (ICREA), Passeig Lluís Companys 23, Barcelona, Spain
We report a picosecond UV source at 240-MHz tunable across 316-339 nm based on intracavity frequency doubling of fiber-laser-green-pumped MgO:PLTL OPO in BiB3O6, providing 30 mW of average power at 334.48 nm.

14:00 – 15:30
IC-1.1 TUE (Keynote)
Quantum Simulations using Ultracold Atoms
-1. Bloch; Max Planck Institute of Quantum Optics, Garching, Germany; Ludwig-Maximilians University, Munich, Germany
Ultracold quantum gases offer remarkable opportunities for probing and controlling quantum matter. In my talk I will discuss highlights and future perspectives of this interdisciplinary research.

14:00 – 15:30
CL-5: Microscopic and Sensing Technologies
Chair: Jürgen Popp, Friedrich-Schiller University, Jena, Germany

Towards endoscopes with no distal optics
-1. Andreu1, G. Bouwmaans2, S. Momenrej2, and H. Rigneaud2; 1Institut Fresnel, CNRS, Aix-Marseille Université, École Centrale Marseille, Marseille, France; 2IBICICA USR3380 - PhLAM UMR8523, Université Lille 1, Villeneuve d’Ascq, France
We report a step towards lens-less sensing endomicroscopy. A fiber bundle relays a shaped wavefront, resulting in focusing at the distal end without distal optics. Video-rate imaging is achieved by galvanometric scanning through the bundle.

14:00 – 15:30
CL-5.3 TUE
Bragg Wavelength Sensitivity of Higher Order Modes to Temperature and Strain in Highly Birefringent Microstructured Fibers
-T. Tenderenda1, M. Musiarska2, M. Szymanski1, M. Becker3, M. Rothhardt5

The data was presented here. An SPR sensor, realized with a typical Kretschmann configuration, is integrated in an optical cavity resonator. Reflective index variations are measured by a cavity-ring-down technique.

14:00 – 15:30
CH-2: Novel Optical Sensing Systems
Chair: Tomasz Nasilowski, Military University of Technology, Warsaw, Poland

14:00 – 15:30
CH-2.2 TUE
A broadband cavity ring-down spectrometer for the near infrared
-K. Šalíř1, M. Böhm1, O. Reich1, and H.-G. Löhmannsören1; University of Potsdam, Institute of Chemistry, Physical Chemistry, Institute of ESPEC, Potsdam, Germany
We report on a cavity ring-down spectrometer based on a near-infrared broadband light source. First successful measurements of the ring-down signal of a cavity filled with carbon dioxide have been performed.
CB-5: Dynamics and Chaos in Semiconductor
Chair: Pascal Llandais, Dublin City University, Dublin, Ireland

CB-5.1 TUE 14:00
Non-equilibrium Laser Dynamics of Quantum-Dot Lasers with Optical Feedback and Injection

- B. Lignfeld, W. Chen, E. Scholl, and K. Lüdge; 1Institut für Theoretische Physik, TU Berlin, Berlin, Germany; 2Sandia National Laboratories, Albuquerque, United States

Due to the non-equilibrium between resonant and off-resonant states in QD lasers, the α-factor will inaccurately describe their dynamics. Using a more elaborate model, we predict new interesting dynamics in optical injection and feedback setups.

CB-5.2 TUE 14:15
Polarization Chaos from a Free-Running Quantum Dot Laser Diode

- M. Virta1,2, K. Panajotov2,3, H. Thielen2, and M. Scaimanda1,1; 1Optel Research Group and LOMPS (Laboratoire Matériaux Optiques, Photoniques et Systèmes) EA-4423, Supélec ; Université de Lorraine, Metz, France; 2Brussels Photon Team, Department of Applied Physics and Photonics (B-PHT TONA), Vrije Universiteit Brussels, Brussels, Belgium; 3Institute of Solide State Physics, Sofia, Bulgaria

In this contribution, we demonstrate generation of polarization chaos, i.e. chaotic mode hopping between two elliptically polarized states, in a free-running quantum dot vertical-cavity surface-emitting laser and provide a theoretical framework of the phenomenon.

CB-5.3 TUE 14:30
Experimental distinction of weak and strong chaos in delay-coupled semiconductor lasers

- M.C. Soriano1, X. Porté1, D.A. Arroyo-Almanza2, C.R. Mirasso1, and I. Fischer1; 1IFISC (CSIC-UIB), Palma de Mallorca, Spain

CB-3 TUE 14:00
Heralded photonic interaction between distant single ions

- M. Schüg1, J. Huwel1,2, C. Kurz1, P. Müller1, and J. Eschner1; 1Universität des Saarlandes, Saarbrücken, Germany; 2ICFO - Institut de Ciències Fotoniques, Barcelona, Spain

We establish photonic interaction between two distant single calcium ions. Triggered single photons with controlled temporal shape are released in the sender ion; their absorption by the receiver ion is detected employing a quantum-jump scheme.

IB-3.1 TUE 14:00
Teleportation of the polarization state of a coherent light pulse onto a single atom

- N. Ortégé1, D. Burchard1, R. Garthoff1, J. Hofmann1, M. Krug1, W. Rosenfeld1,2, and H. Weinfurter1,2; 1Fakultät für Physik, Ludwig-Maximilians Universität München, München, Germany; 2Max-Planck Institut für Quantenoptik, Garching, Germany

We successfully performed quantum teleportation of the polarization state of an attenuated laser pulse onto the spin state of a single 87Rb atom trapped at a distance of 20 meters.

IB-3.2 TUE 14:15
Trapped Ions for Simulating Interacting Spins

- R. Lanyon, C. Hempel, P. Jarczew, R. Blatt, and C.F. Roos; Institute for Quantum Optics and Quantum Information, Innsbruck, Austria

IB-3.3 TUE (Invited) 14:30
Trapped Ions for Simulating Interacting Spins

- R. Lanyon, C. Hempel, P. Jarczew, R. Blatt, and C.F. Roos; Institute for Quantum Optics and Quantum Information, Innsbruck, Austria

IB-6.2 TUE 14:30
CW, Q-switched and mode-locking oscillations at 2.1 μm in novel Tm3+-Lu2O3 ceramics lasers

- O. Antypov1, A. Novokov1, A. Zinoviev1, H. Yagi1, A. Lagatsky1, W. Sibbett2, and E. Ivkin3; 1Institute of Applied Physics of Russia, Nizhny Novgorod, Russia; 2University of Kent, Canterbury, United Kingdom; 3University of Maryland, College Park, United States

CG-6.1 TUE 14:00
Carbon Nanotube and Graphene Saturation Absorbers: A New Generic Mode-Locking Technology

- F. Rotermund; Aix University, Sawon, Korea

Saturable absorbers based on carbon nanotubes and graphene are successfully used for mode-locking of a variety of ultrafast bulk solid-state lasers. Recent progress in such novel mode-locking devices will be presented.

CG-6.2 TUE 14:30
Looking Inside the Recollision Process

- D. Shafr1, H. Sofier2, B.D. Brun2, M. Dupini1, Y. Mairesse3, C. Vezi1, S. Stagira4, S. Patchkovskii1, M.Y. Ivanov5,6, O. Smirnova1, and N. Dudovich1; 1Weizmann Institute of Science, Rehovot, Israel; 2CEIA

We present the experimental approaches and results of an angular streaking experiment with elliptically polarized intense few-cycle laser pulses that indicate a real tunneling time in tunnel ionization for the first time.

CG-6.3 TUE (Invited) 14:30
Electrically Controlled Liquid Crystal Plasmonic Metamaterials

- O. Buchnev1, J.-Y. Ou1, M. Kaczmarek2, N.I. Zheludev1,3, and V.A. Fedotov1; 1Optoelectronics Research Centre and Centre for Nanostructured Photonic Metamaterials, University of Southampton, Southampton, United Kingdom; 2School of Physics and Astronomy, University of Southampton, Southampton, United Kingdom; 3Centre for Disruptive Photonic Technologies, Nanyang Technological University, Singapore, Singapore

We experimentally demonstrate high-contrast electrical modulation of near-IR spectra of plasmonic metamaterials loaded with liquid crystals. That was achieved engaging volume and, for the first time, in-plane switching modes in the resulting plasmonic hybrid devices.
Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, Spain
We report stable cw UV generation in single-pass configuration based on sum-frequency mixing of 1064nm and 532nm radiations for the first time, in BIBO, providing >68mW of UV power with frequency deviation <437kHz over >2.5hrs.

CD-9.4 TUE 14:45
Generation of sub-10 fs UV light by up-conversion of visible pulses
A. Canavese, P. Farinello, C. Manzoni, and G. Cerullo, IFN-CNR, Dipartimento di Fisica, Politecnico di Milano, Milan, Italy
We introduce a simple system for the generation of broadband UV pulses in the 320-380 nm spectral range by broadband visible pulses. UV pulse duration is ~8 fs, close to the transform-limited.

IC-1.2 TUE 14:45
Quantum phases and transport of one-dimensional disordered bosons
L. Tian1, C. D’Errico2, E. Lucioni3, L. Gori3, M. Inguscio4,5, and G. Modugno1,2—LENS and Dipartimento di Fisica e Astronomia, Università di Firenze, Firenze, Italy; 3Consiglio Nazionale delle Ricerche-INO, Firenze, Italy
We experimentally studied the equilibrium quantum phases and the dynamical transport properties of disordered interacting systems, by employing one dimensional ultracold bosons in optical lattices.

IC-1.3 TUE (Invited) 15:00
Exploring cavity-mediated long-range interactions in a quantum gas
T. Donner1, F. Brennecke2, R. Motto1, R. Landig1, K. Baumann1,2, and T. Esslinger1—Institute of Quantum Electronics, ETH Zurich, Zurich, Switzerland; 2Department of Physics, Stanford University, Stanford, California, United States
We observe how cavity mediated long-range atom-atom interactions lead to a phase transition in a quantum gas, and study the mode-softening of an excitation and the divergence of density fluctuations in this open system.

CL-1.4 TUE 15:00
In situ visualization of collagen architecture in biological tissues using polarization-resolved Second Harmonic microscopy
I. Guachenko1, G. Latour2, Y. Goulam Houssen2, V. Tran2, J.-M. Allain2, and M.-C. Schanne-Klein1—Ecole Polytechnique - LBO (CNRS, Inserm), Palaiseau, France; 2Ecole Polytechnique - LMS (CNRS, Mines ParisTech), Palaiseau, France
We implemented polarization-resolved SHG microscopy to probe the main orientation and the local disorder of collagen fibril assemblies in rat-tail tendons and human corneas. We successfully retrieved structural information in agreement with theoretical models.

CL-5.4 TUE 14:45
Depolarization Sensing by Field Orthogonality Breaking
M. Alouini and I. Fàcil, Institut de Physique de Rennes, Université Rennes 1, CNRS, Rennes, France
A new depolarization sensing modality based on the concept of field orthogonality breaking and compatible with remote sensing through optical fibers is presented. First experimental validations pave way for high sensitivity realtime depolarization endoscopic imaging.

CL-5.5 TUE 15:00
Application of a shaped, divergent Laser Beam for the optical Measurement of the Size and Density of ambient Particulate Matter
R. Schreiber1,2,3, R. Strzoda1, A. Hartmann3, M. Fleischer4, and M.-C. Amann1—1TU Munich, Munich, Germany; 2Siemens AG, Munich, Germany
We present a new method to measure particle size and mass based on a shaped, divergent laser beam using the inertia-dependent particle movement inside an optical measurement device based on three measurement steps.

Ultra-high brightness (UHB) direct diode laser systems with kW output power are on the verge of market introduction. This talk discusses applications and market dynamics of UHB direct diode lasers.

TF-1/LIM.3 TUE (Tech Focus) 15:00
The Power of Choice of Solid State Lasers for Successful Industrial Laser Applications
K. Loeffler, TRUMPF Laser und Systemtechnik GmbH, Ditzingen, Germany
The presentation will show on examples from successful laser applications the use and need for the different solid state laser resonator concepts. It will describe CW-high power as well as short pulse lasers in the ps/ and ns range.
Laser-manipulated strings of trapped ions are an interesting system for implementing quantum simulations of interacting spins. I will present experiments with small ion crystals and discuss the prospects of doing experiments with long ion strings.

Fast Random Bit Generation Based on a Single Chaotic Semiconductor Ring Laser

We demonstrate the onset of strong and weak chaos in the dynamics of semiconductor lasers with delayed optical feedback (coupling). We provide guidelines for the identification and discuss the importance for synchronization-based applications.

Femtosecond pulse generation with Tm-doped sesquioxides

We observe surprising low-energy features in the 2.2-2.1 µm spectral region is reported. In particular, 105-fs pulses are generated with Tm:Lu2O3 at 2020 nm using a SESAM mode-locking approach.

New features of strong-field ionization with low-frequency fields in the tunnelling regime

Si-nanorod-based plasmonic metamaterials: modelling and experiment

We propose a fast and efficient analytical model for modelling silicon based plasmonic metamaterials, with the possibility of engineering them in order to exploit the optical properties of Si for amplification and switching.
We demonstrate the use of a plasma column from laser filamentation to create an optical lattice using lattice amplitude photoconductivity in ultracold fermions in the presence of a strong magnetic field. The plasma column allows for the efficient generation of a high-resolution radiation source with a linewidth of 5.9 eV and a power of 10 ps. We also present the experimental realization of coherent optical tomography using a frequency-tunable diode laser for Lidar-Radar velocimetry.

**Endoscopic polarimetric imaging system**

**Phase-shifting interferometry to determine the absolute diameter of a silicon sphere using a frequency-tunable diode laser**

**Recent developments in wireless Lasers and their Applications**

**Miniature Spectrometer and Beam Splitter for an Integrated Optically Isolated Laser Source**

**An integrated optical fiber laser system for medical applications**

**Miniature spectrometer and beam splitter for an integrated optically isolated laser source**

**Phase-shifting interferometry to determine the absolute diameter of a silicon sphere using a frequency-tunable diode laser**

**Recent developments in wireless Lasers and their Applications**

**Miniature spectrometer and beam splitter for an integrated optically isolated laser source**

**Phase-shifting interferometry to determine the absolute diameter of a silicon sphere using a frequency-tunable diode laser**

**Recent developments in wireless Lasers and their Applications**

**Miniature spectrometer and beam splitter for an integrated optically isolated laser source**
<table>
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<th>ROOM 13b</th>
<th>CB-5.6 TUE 15:15</th>
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<tr>
<td>Photon Statistics of Quantum Dot Superluminescent Diodes at the Transition from Amplified Spontaneous Emission to Stimulated Emission</td>
<td></td>
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</table>
*S. Hartmann, A. Molitor, M. Blažek, and W. Etschmüller; Institute of Applied Physics, Technical University Darmstadt, Darmstadt, Germany; 2Center of Smart Interfaces, Technische Universität Darmstadt, Darmstadt, Germany; 3EYONIK Industries AG, Ilanz, Switzerland
We demonstrate the simultaneous tailoring of first and second order coherence properties of light emitted by a Quantum-Dot Superluminescent Diode by applying optical feedback. A continuous change from thermal to Poissonian photon statistics is observed. |

<table>
<thead>
<tr>
<th>ROOM 14a</th>
<th>IB-3.5 TUE 15:15</th>
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<tr>
<td>Experimental test of the robustness of the non-classicality of single photons</td>
<td></td>
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</table>
*T. Huber, A. Predojević, M. Ježek, D. Fager, G. Solomon, R. Filip, and G. Weihs; 1Institut für Experimentalphysik, Universität Innsbruck, Innsbruck, Austria; 2Department of Optics, Palacký University, Olomouc, Czech Republic; 3Joint Quantum Institute, National Institute of Standards and Technology and University of Maryland, Gaithersburg, United States
We performed a measurement revealing the goodness of the non-classicality of single photons in a lossy or noisy environment using a semiconductor quantum dot as single-photon emitter. |

<table>
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<tr>
<th>ROOM 14b</th>
<th>CA-6.5 TUE 15:15</th>
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<tr>
<td>21.4 kW peak power from a 240 Hz-Yb:YAG cryogenically cooled, end pumped, zigzag slab laser</td>
<td></td>
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</table>
*L. Zhang, X. Xie, S. Roither, D. Kartashov, M. Schoffer, D. Shahriar, P. Corkum, A. Baltuska, A. Staudte, and M. Kitzler; 1Photonics Institute, Vienna University of Technology, Vienna, Austria; 2Joint Laboratory for Attosecond Science of the National Research Council and the University of Ottawa, Ottawa, Canada; 3Department of Physics of Complex Systems, Weizmann Institute of Science, Rehovot, Israel
We demonstrate experimentally spatial control of electron wavepackets released from atoms with two-color orthogonal laser pulses. It is shown that electron-electron correlation in nonsequential double ionization can be determined by the spatial field shape. |

| CA-7.1 TUE 16:00 |
| Cryogenically Cooled End Pumped Yb:YAG Zigzag Slab Laser |
*J. Guin, D. Ottaway, P. Veitch, and J. Munch; School of Chemistry and Physics, University of Adelaide, Australia
We report a 210W, cryogenically cooled end pumped zigzag slab with diffraction limited beam quality. We discuss the challenges associated with cooling a crystal from room to cryogenic temperatures in a robust laser head design. |

| ROOM 21 | IB-4.1 TUE (Invited) 16:00 |
| Quantum Networks Enabled by Quantum Optics |
*F.J. Kimble; California Institute of Technology, Pasadena, United States
An overview of quantum networks is presented from formal to physical. Research at Caltech is described for the realization of lithographic quantum optical networks composed of single atoms that interact strongly by way of single photons. |

| ROOM EINSTEIN | CE-5.5 TUE 16:00 |
| Laser Materials |
*F. Kück, Physikalisch-Technische Bundesanstalt, Braunschweig, Germany
Characterising Few and Single Nano-Antennas with Rotating Polarisation |

*G. Lilley, T. Molsacli, and K. Unterainler; Photonics Institute, Vienna University of Technology, Vienna, Austria
In this work, we present a novel technique to efficiently and quantitatively characterize the extinction cross-section of few and single nano-antennas by using laser light with a rotating polarization. |
as an effective radio-frequency emitting antenna.

CD-10.3 TUE (Invited) 16:30
High speed, high performance all-optical information processing utilizing nonlinear optical transients

- D. Brunner, M.C. Soriano, C.R. Mirasso, and I. Fischer, Instituto de Fisica Interdisciplinar y Sistemas Complejos (IFISC), UIB, Palma de Mallorca, Spain

Nonlinear transients can be utilized for information processing systems. By optically inducing transient states in a telecommunication laser diode, we experimentally perform all-optical information processing, achieving data rates exceeding gigabyte per second.

IC-2.3 TUE 16:30
Stern-Gerlach Interferometer on an Atom Chip

- S. MacLachlan, I. Japha, and R. Folman, Ben-Gurion University, Beer Sheva, Israel

We theoretically propose and analyze, and experimentally demonstrate, the building blocks of a matter-wave beam-splitter based on magnetic field gradients, which can be used for freely propagating or trapped Bose-Einstein condensates or thermal ensembles.

IC-2.4 TUE 16:45
Exploring quantum magnetism in a chromium Bose-Einstein Condensate

- A. De Pace1,2, A. Chotia1, A. Sharma1, E. Maréchal1,2, P. Pedri2, I. Vernac1, B. Laburthe-Tolra1,2, and O. Gorceix1,2

LPL, CNRS, UMR7538, Villeurbanne, France; 1Laboratoire de Physique des Lasers, Université Paris13, Sorbonne Paris Cité, France

We demonstrate phase-sensitive amplification in a $\chi^{(3)}$ chalcogenide waveguide.

Room 4a

CD-10.2 TUE 16:15
Phase-sensitive amplification in a $\chi^{(3)}$ photonic chip

- J. Schröder1, R. Nei1, Y. Puquiot1, D.-Y. Cho2, S. Madden2, B. Luther-Davies2, and B.J. Eggleton1

1Centre for Ultra-high Bandwidth Devices (CUDOS), The School of Physics, The University of Sydney, Sydney, Australia; 2CUDOS, Laser Physics Centre, Research School of Physics and Engineering, Australian National University, Canberra, Australia

We demonstrate phase-sensitive amplification inside a $\chi^{(3)}$ chalcogenide waveguide. Our experiment is based on an elegant spectral slicing scheme using a spectral pulse-shaper. We achieve 10 dB of phase-sensitive gain.

IC-2.2 TUE 16:15
Observing the onset of effective mass of a Bose-Einstein condensate in an optical lattice

- R. Chang, S. Potnis, R. Ramos, C. Zhuang, M. Hallaj, A. Hayat, F. Duque-Gomez, J.E. Sipe, and A.M. Steinberg, Department of Physics and the Institute for Optical Sciences, University of Toronto, Toronto, Canada

We subject a BEC in an optical lattice to an abruptly applied force, finding that while the effective mass is an accurate description at long timescales, the initial response is described by the bare mass.

Room 4b

CL-6.2 TUE 16:15
Singlet Oxygen luminescence detection with a fibre-coupled superconducting nanowire single-photon detector

- N. Gemmell1, A. McCarthy1, B. Liu2, M. Tannen1, S. Dorenbos1, V. Zwiller1, M. Patterson1, G. Buller1, B. Wilson1, and R. Haufield1

1Heriot Watt University, Edinburgh, United Kingdom; 2Jaravinski Cancer Centre and McMaster University, Hamilton, Canada; 3Kalvi Institute of Nanoscience, Delft University of Technology, Delft, The Netherlands; 4Ontario Cancer Institute & University of Toronto, Toronto, Canada; 5University of Glasgow, Glasgow, United Kingdom

We report on the direct monitoring of singlet oxygen luminescence at 1270 nm wavelength using a fibre coupled superconducting nanowire single photon detector. These results open the pathway to practical dose monitoring in photodynamic therapy.

CL-6.3 TUE 16:30
Low threshold microcavity dye lasers for biosensing applications

- S. Wiegele1, T. Grossmann1, T. Beck1, J. Fischer1, T. Wiemhold1, T. Mappe1,2, and H. Kal1

1Institute for Applied Physics, Karlsruhe Institute for Technology, Karlsruhe, Germany; 2Institute of Microstructure Technology, Karlsruhe Institute of Technology, Karlsruhe, Germany; 3Carl Zeiss AG, Corporate Research and Technology, Jena, Germany

We report on novel dye lasers consisting of dye-doped polymers showing thresholds as low as 0.5 nJ in air and 1.6 nJ in water. Proof-of-principle experiments show that these lasers are suitable for biosensing applications.

CL-6.4 TUE 16:45
Detection of Plasmonic Nanoparticles Using Whispering Gallery Mode Resonators

- I. Swain1, J. Knitt1, and W. Bowen1,2

1Department of Physics, University of Queensland, Brisbane, Australia; 2Centre for Engineered Quantum Systems, University of Queensland, Brisbane, Australia

We demonstrate a novel multiwavelength laser structure based on superimposed Bragg gratings on multiwavelength AlGaInAs-InP. A passively mode locked regime with a repetition rate tunable over 17 GHz is presented.

CB-6.3 TUE 16:30
Multimodal Laser Based on Superimposed Bragg Gratings on Multiquantum Well AlGaInAs-InP

- A.D. Smirnov3, M.J. Strain1, V. Paisin2, M. Sorel3, and S. LaRochelle1

1Centre d’Optique, photonique et laser (COPL), Université Laval, Québec, Canada; 2Department of Electronics and Electrical Engineering, University of Glasgow, Glasgow, United Kingdom

We demonstrate a novel multiwavelength laser structure based on superimposed Bragg gratings on multiwavelength AlGaInAs-InP. A passively mode locked regime with a repetition rate tunable over 17 GHz is presented.

CB-6.4 TUE 16:45
Continuously tunable, narrow linewidth mm-wave generation from a monolithically integrated triple DFB laser chip

- M. Zavola1,2, M. Sorel3, G. Giuliani2, and M.J. Strain1

1University of Glasgow, Glasgow, United Kingdom; 2Università di Pavia, Pavia, Italy
### CA-7.2 TUE 16:15

Efficient Operation of a Pulsed Diode Pumped Cryogenic Gas Cooled Yb:YAG Multislab Amplifier Delivering 7.4 J at 10 Hz

- P. Mason, K. Ertel, S. Banerjee, J. Phillips, A. Linterm, J. Greenhalgh, C. Hernandez-Gomez, and J. Collier; Central Laser Facility, STFC Rutherford Appleton Laboratory, Didcot, United Kingdom

Improvements to the DIOPOLE prototype diode-pumped cryogenic gas-cooled Yb:YAG multislab amplifier have enabled efficient and stable operation at repetition rates up to 10 Hz delivering 7.4 J pulses with an optical-to-optical efficiency of 23%.

### CA-7.3 TUE (Invited) 16:30

The Opportunity of High Average and High Peak Power Lasers


This talk will describe our scalable diode pumped laser concept called DIOPOLE that will in principle offer diode driven PW+ class lasers as a new basis for applications based on compact, efficient and reliable sources.

### CE-6.2 TUE 16:30

Actively Q-Switch operation of diode-pumped Er3+, Yb3+, Ce3+: Ca2Al2SiO7 single crystal laser at 1.5-1.6 μm

- A. Jaffrézic, R. Viana, P. Loiseau, G. Aka, C. Lazar, and E. Lallier; 1 LCMCP, Paris, France; 2 TRT, Palaiseau, France

First demonstration of actively Q-Switch laser operation in Er, Yb, Ce:Ca2Al2SiO7 under diode-pumping in safe eye range is realized. Comparison is done with commercial phosphate glass.

### CE-6.3 TUE 16:45

Multiwatt Compact Ceramic Yb:YAG Passively Q-switched Laser

- A. Agnesi, L. Carril, F. Pirzio, G. Reali, T.T. Thomas, S. Veronesi, M. Tonelli, J. Le, Y. Pan, and J. Guo; 1 University of Pavia, Pavia, Italy; 2 NEST Istituto Nanoscienze - CNR and Dip. di Fisica Università di Pisa, Pisa, Italy; 3 Key Lab. of Transparent Opto-
We demonstrate optical detection of 40 nm x 10 nm gold nanorods using a frequency stabilized microtoroid resonator. We show that the technique is reproducible, with measured frequency shifts in good agreement with theoretical predictions.

IC-2.5 TUE (Invited)  17:00
Matter-wave clocks: measuring time and mass, and testing general relativity
H. Mueller; University of California, Berkeley, Berkeley, United States
We demonstrate a clock referenced to the Compton frequency of a cesium atom; a proposed gravitational Aharonov-Bohm experiment; and tests of general relativity and their interpretation in the standard model extension. Matter waves are clocks.

CL-6.5 TUE  17:00
Optical Manipulation of Single Cells in Femtosecond Laser Fabricated Lab-on-chip
R. Martinez Vasquez1, F. Braghieri1, P. Minzioni2, N. Bellini1,3, P. Païé3, G. Nava3, R. Rampini1, L. Cristiani1, and R. Ossella1; 1Istituto di Fotonica e Nanotecnologie IPN - CNR, Dipartimento di Fisica, Politecnico di Milano, Milano, Italy; 2Dipartimento di Ingegneria Industriale e dell’Informazione, Università degli Studi di Pavia, Pavia, Italy; 3SUPA, School of Physics and Astronomy, University of St. Andrews, St. Andrews, United Kingdom
Femtosecond laser micromachining has been successfully used to fabricate integrated optofluidic devices, which allows the analysis of cell-mechanical properties, fluorescence detection and sorting of single cells by means of optical forces inside a microfluidic chip.

CL-6.6 TUE  17:15
Charge-driven dispensing of picolitre drops for biomolecules microarrays by Pyro-Electro-hydrodynamic system
S. Grilli1, L. Miccio1, O. Gennari1, S. Coppola1,2, V. Vespini1, P. Orlando1, and P. Ferraro1; 1CNR-INFM, Pozzuoli, Italy; 2University of Naples Federico II, Napoli, Italy.3CNR-IRIP, Napoli, Italy
Spontaneous charge effects are used here for the first time for dispensing small volumes of DNA solution for microarray applications. The technique appears promising also for concentrating analytics in very diluted solutions.

CB-6.6 TUE  17:15
Room Temperature Plasmonic Nanowire Laser Near The Surface Plasmon Frequency
T. Sidropoulos1, S. Geburt2, R. Röder2, M. Ogrisiek2, S. Mater2, C. Rönniger2, and R. Oulton1; 1Imperial College London, London, United Kingdom; 2University of Jena, Jena, Germany
We present room temperature plasmonic lasing from semiconductor nanowires. Slow group velocity, associated with frequencies close to the surface plasmon resonance appears as a strong blueshift in the lasing frequency.

CB-6.5 TUE  17:00
Organic semiconductor distributed feedback (DFB) laser pixels fabricated via nanograting transfer and ink-jet printing
X. Liu1,2, S. Klinkhammer1,2, Z. Wang1,2, K. Suda1, N. Mecha1,3, C. Vanneste1, T. Mappes2, and U. Lemmer1; 1Light Technology Institute (LTI) and Center for Functional Nanostructures (CFN), Karlsruhe Institute of Technology, Karlsruhe, Germany; 2Institute of Microstructure Technology (IMT), Karlsruhe Institute of Technology, Karlsruhe, Germany; 3InnovationLab GmbH, Heidelberg, Germany
Nanograting transfer and ink-jet printing are demonstrated as two novel processing methods to fabricate spatially defined organic semiconductor distributed feedback (DFB) laser pixels with a high yield.

CD-10.4 TUE  17:00
Optoelectronic nonlinear transient computing with multiple delays
R. Martinenghi, A. Baylon-Fuentes, X. Fang, M. Jacquot, Y.K. Chembo, and L. Larger; University of Franche-Comté & FEMTO-ST/Optics Dpt, Besançon, France
A versatile photonic nonlinear transient computer is reported. Its hybrid analogue and digital architecture allows for an easy reconfiguration, and for direct implementation of in-line processing. Computational efficiency in parameter space is reported.

CD-10.5 TUE  17:15
10GHz bandwidth nonlinear delay electro-optic phase dynamics for ultra-fast nonlinear transient computing
A. Baylon-Fuentes, R. Martinenghi, M. Jacquot, Y.K. Chembo, and L. Larger; University of Franche-Comté, FEMTO-ST/Optics Dpt, Besançon, France
Photonics computing is performed via complex nonlinear dynamical transients. Electro-optic nonlinear delay phase dynamics is designed with Telecom grade devices, allowing up to 10GHz bandwidth for information processing according to Reservoir Computing concepts.
IB 4.4 TUE 17:00

Hybrid Quantum Teleportation

S. Takeda1, T. Mizuta1, M. Finao1, P. van Loock2, and A. Furusawa3; 1Department of Applied Physics, School of Engineering, The University of Tokyo, Tokyo, Japan; 2Institute of Physics, Johannes-Gutenberg University Mainz, Mainz, Germany

We experimentally realize deterministic, unconditional quantum teleportation of photonic qubits through the hybrid technique: continuous-variable teleportation of qubits. Optimal tuning of the teleporter's feedback signal enables a faithful qubit transfer even with imperfect resource squeezing.

CA 7.4 TUE 17:00

High Energy and Power Cryogenic Composite-Thin-Disk Yb:YAG Laser

I.E. Zapata1, W. Huang1, H. Cankaya2, A.-L. Calendron2, H. Lin1, E. Granados1, K.-H. Hong1, and F.X. Kärntner1,2; 1Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, MA, United States; 2Center for Free-Electron Laser Science, DESY and Department of Physics, University of Hamburg, Hamburg, Germany

A cryogenic Yb:YAG composite-thin-disk CPA design is presented with the ultimate goal of delivering 1 J, 10 ps, pulses at 100 Hz. First results on the 100 mJ preamplifier stage will be presented.

IB 4.5 TUE 17:15

Two Fundamental Experimental Tests of Nonclassicality with Qutrits

J. Ahrens1, E. Amsellem1, A. Cabello1, and M. Buremman1; 1Stockholm University, Stockholm, Sweden; 2Sevilla University, Sevilla, Spain

We report on experiments, the first one is the simplest task for which quantum mechanics provides an advantage over classical physics. The second one is on contextual correlations by sequentially measuring pairs of compatible observables.

CA 7.5 TUE 17:15

High-power and High-energy Cryogenically Cooled Disk Laser

I. Mukhin, E. Perevezentsev, O. Vadimova, I. Kaznetsov, O. Palashov, and E. Khazanov; Institute of Applied Physics of the Russian Academy of Science, Nizhny Novgorod, Russia

Cryogenic disk laser with ~0.12 J of output energy at 0.5 kHz repetition rate was developed by using composite active elements made of Yb:YAG ceramics and its active cooling by liquid nitrogen jet.
CD-P.5 TUE
Efficient Second-Harmonic Generation of Broadband Radiation in the Nonlinear Crystal with Constant Axial Temperature Gradient

1. Želadívců, K. Řegelskis, N. Gařvilín, and G. Rážaľkařs; Center for Physical Sciences & Technology, Vilnius, Lithuania

Results of numerical and experimental analysis of SHG in a nonlinear crystal with a constant axial temperature gradient are presented. The highly efficient (~85%) SHG of broadband radiation was demonstrated by use of this method.

CD-P.6 TUE
Formation and Amplification of Flat Top Picosecond Pump Pulses for OPCPA Systems

1. Adamonis2, R. Antipenko3, J. Kalenda3, A. Michailovac2,3, A. Piskarks3,4, A. Varanavicius1, and A. Zaukevičius1,2; 1 Vilnius University, Vilnius, Lithuania; 2Ekplu, Vilnius, Lithuania; 3Institute of Physics of Center for physical science and technology, Vilnius, Lithuania

Flat top OPCPA pump pulses extending 50 ps plateau time interval were formed by cascade second harmonic generation. Flat-top pulses were amplified up to F=0.128 J/cm2 energy fluence with modest pulse envelope temporal modulation.

CD-P.7 TUE
Multiphoton upconversion in rare earth doped nanocrystals for sub-diffraction microscopy

L. Caillat1,2, F. Pellè3, B. Hajj3; 1, 2; V. Shytkar3, D. Chavaud1, and Y. Zys; 1 Chimie ParisTech, Paris, France; 2 École Normale Supérieure, Cachan, France

We propose a new microscopy with a significant improvement in lateral resolution below diffraction limit based on high nonlinear multi-photon low excitation energy upconversion process in rare earth doped nanoparticles for cellular and animal imaging.

CD-P.8 TUE
Indirect excitation mediated optical transistors

1. Wilkes; Cardiff University, Cardiff, United Kingdom

A new design for an all-optical transistor is proposed and analysed by numerical modelling. Dipole-oriented indirect excitations in coupled quantum wells are used as an operating medium to control the switching of light with light.

CD-P.9 TUE
Mid-infrared supercontinuum generation in tapered ZBLAN fiber with a standard Erbium mode-locked fiber laser

1. Kubař1, C. Agger2, P.M. Moselund3, and O. Bang1,2; 1 DTU Fotonik, Kongens Lyngby, Denmark; 2NKT Photonics A/S, Birkerød, Denmark

Short pulses implemented in realistic ZBLAN fiber results in an IR Supercontinuum in the 0.86-4.36µm spectral range covering much of the ZBLAN transmission window when using an Erbium fiber laser to drive the broadening process.

CD-P.10 TUE
40 GHz nonlinear all optical switching in a Mach-Zehnder interferometer integrated device

C. Lacava1, M.J. Strain2, I. Cristiani3, and M. Sorel3; 1 Dipartimento di Ingegneria Industriale e dell’Informazione, Università di Pavia, Pavia, Italy; 2School of Engineering, University of Glasgow, Glasgow, United Kingdom

Here we propose a fully integrated silicon Mach-Zehnder interferometer for all optical switching operation. A 10% switching level at 40 GHz was obtained using a 27dBm pump power. No free carrier-related degradation effects were observed.

CD-P.11 TUE
Pulse compression in Er/Yb-doped fibres

M. Zajmimina1, J.M. Chavez-Bogado1, M. Böhme2, A.A. Rzehak3, R. Hovenier4, and M.M. Roth5; 1 Leibniz-Institut für Astrophysik, Potsdam, Germany; 2 University of Potsdam, Potsdam, Germany; 3 Instituto Tecnológico de Buenos Aires and CONICET, Buenos Aires, Argentina

The possibility of higher-order soliton compression was studied in Er/Yb-doped fibres. The stability of compressed pulses was investigated for such initial parameters as input power, nonlinear coefficient, and group velocity dispersion.

CD-P.12 TUE
High-power, Picosecond, Fiber-laser Green Source Based on BiB3O6 for Synchronous Pumping of MgO:PPPLT Optical Parametric Oscillator

C.K. Suddapallil1 and M. Ebrahim-Zadeh1,2; 1 CFC-The Institute of Photonic Sciences, Barcelona, Spain; 2 Instituto Catalán de Recerca i Estudis Avançats (ICREA), Passeig de la Vall de Gràcia, 23, Barcelona, Spain

We report a high-power, picosecond, fiber-laser-green source based on BiB3O6, providing 5.4W (<0.24%rms) of green power at 532nm to synchronously pump an MgO:PPPLT near-infrared OPO tunable across 874-1008nm signal and 1126-1359nm(ulter) with >30W over entire tuning range.

CD-P.13 TUE
Intense Lyman-α light source for generation of ultra-slow Muon

Y. Oishi1, K. Okumura2, K. Miyazaki1, N. Saito1, M. Iwasaki1, and S. Wada1,2; 1 RIKEN, Wako, Japan; 2 MEGAOPTO Corp., Wako, Japan

We develop an all-solid-state 1062.78 nm laser system. Its can applied to generation of intense Lyman-alpha coherent light source by use of two-photon resonant four-wave mixing.

CD-P.14 TUE
Soliton-Like Propagation in Dispersion-Managed Silicon Nanowaveguides

O. Tilipakki1, D. Zografopoulos2, and E. Kriezis1; 1 Department of Electrical and Computer Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece; 2 Consiglio Nazionale delle Ricerche, Istituto per la Microelettronica e Microsistemi, Roma, Italy

Dispersion-managed soliton-like pulse-train propagation in silicon nanowaveguides is theoretically studied. We investigate into the maximum achievable pulse repetition rate. The application of a carrier-sweep bias allows for bit rates beyond 1.28 Tbit/s.

CD-P.15 TUE
Double-seed stabilization of a continuum generated from fourth-order modulation instability

K. Hamann1, C. Finol1, R. Hubert1, A. Musset2, and A. Kudlinski; 1 Laboratoire Interdisciplinaire Carnot de Bourgogne, Dijon, France; 2 Laboratoire PhLAM, Lille, France

We experimentally and numerically study a fourth-order modulation instability process in a microstructured fiber. Using a single seed cannot reduce the large fluctuations: two seeds slightly detuned from the maximum gain frequency are required.

CD-P.16 TUE
Guiding of meter scale AC discharges by laser filamentation in air

A. Houard1, Y. Brelet1, G. Point1, J. Carbonnel1, Y.-B. André2, B. Prade3, L. Aranthouk3, and A. Mysyrowicz1; 1 Laboratoire d’Optique Appliquée, ENSTA ParTech, Ecole Polytechnique, CNRS, Palaiseau, France; 2 Laboratoire de Physique des Plasmas, Ecole Polytechnique, CNRS, Palaiseau, France

We report experiments of laser-guided discharges obtained in air with high voltage bursts delivered by a compact Tesla coil. Characteristics of the guided discharges are studied for electrode gaps ranging from 30 to 170 cm.

CD-P.17 TUE
Tunable multi-wavelength active conversion of 1550 nm signals in a Cr3+:LiCAF-PPLST laser

A.I. Torregrosa, H. Maestre, and J. Capmany; Communications Engineering Department, Universidad Miguel Hernandez, Elche, Spain

We report tunable and multiple wavelength conversion in the communications band from single-pass dif-
A compact high-power yellow-green CW laser source at 561nm based on frequency-doubling of a quantum-dot fiber-Bragg-grating laser in a PPLN waveguide is demonstrated with output power in excess of 90mW and conversion efficiency of 52.34%.

**CD-P.22 TUE**

Experimental demonstration of stimulated Raman scattering in the evanescent field of a tapered fiber nanomembrane in a liquid

- L. Sham,
- G. Paullat,
- G. Vienne,
- L. Tong,
- S. Lebrun,
- Laboratoire Charles Fabry, Institut d’Optique, CNRS, Univ Paris-Sud, Palaiseau, France;
- State Key Laboratory of Modern Optical Instrumentation, Department of Optical Engineering, Zhejiang University, Hangzhou, China; People’s Republic of (PRC);
- Present address: Data Storage Institute, Agency for Science, Technology and Research, Singapore, Singapore.

We present the first experimental demonstration of stimulated Raman scattering in the evanescent field of a nanomembrane immersed in a liquid which opens the way to the study of a new kind of versatile experiments.

**CD-P.23 TUE**

Phase locking of two infrared sources separated by 500 nm (100 THz)

- N. Ciudad,
- E. Du-Burek,
- and A. Ocèi,
- LNE-SYRTE, Observatoire de Paris, CNRS, Paris, France;
- LPL, université Paris 13, CNRS, Villeurbanne, France.

We report on phase locking of two IR lasers separated by 500 nm (1.5 and 1.03 μm) using independent harmonic generation processes in PPLN crystals. The phase lock is achieved within a 500 kHz bandwidth.

**CD-P.24 TUE**

Improving the Performance of Fiber Optic Parametric Amplifiers with Optical Phase Conjugation

- M. Jazayerifar,
- S. Warm,
- and K. Petermann; Technische Universität Berlin, Berlin, Germany.

Using the optical phase conjugation method we propose a modified fiber optic parametric amplifier (FOPA) that causes less nonlinear cross-talk than a conventional FOPA in WDM communication systems and verify this comparison with numerical simulations.

**CD-P.25 TUE**

Terabit/s Physical Random Bit Generation Based on Optoelectronic Phase-Chaos Systems

- R.M. Nyguim,
- P. Colé,
- and J. Danckaert,
- Applied Physics Research Group, APhY, Vrije Universiteit Brussel, 1050 Brussels Belgium, Brussels, Belgium;
- IFISC (CSIC-UIB), Campus Universitat Illes Balears, E-07122 Palma de Mallorca, Spain, Palma de Mallorca, Spain.

We propose an optoelectronic phase-chaos system based on telecom components for parallel generation of statistically independent random bit streams. The system can generate 1 Tb/s sequences passing all NIST tests for randomness.

**CD-P.26 TUE**

Energy Shading during Nonlinear Self-Focusing of Laser Pulses

- C. Travis,
- G.-L. Opo,
- G. Norris,
- and G. McComnel;
- 1Department of Physics, University of Strathclyde, Glasgow, United Kingdom;
- 2SPIRS, University of Strathclyde, Glasgow, United Kingdom.

Energy shading takes place as ultra-short spatio-temporal pulses propagate in a nonlinear medium. We characterise different mechanisms of energy shading depending upon the balance of nonlinearity, dispersion, diffraction, and saturation in the system.

**CD-P.27 TUE**

All-optical control of discrete light propagation in Photonic Liquid Crystal Fibers

- K. Rutkowska,
- L. Laudyn,
- and P. Jung; Warsaw University of Technology, Warsaw, Poland.

Results of theoretical studies and experimental tests on discrete light propagation in photonic crystal fibers are presented. Output spatial light intensity profile can be tuned dynamically by varying optical power of the signal beam.

**CD-P.28 TUE**

Linear detection of sub-bandgap energy photons in silicon: a photo-assisted Shockley-Read mechanism

- B. Vest,
- E. Lucas,
- J. Jackc,
- R. Haidar,
- and E. Rosencher;
- ONERA, The French Aerospace Lab, Palaiseau, France;
- École Polytechnique, Département de Physique, Palaiseau, France.

We investigate the linear response of silicon PIN diodes to sub-bandgap photons (1.4 um-1.6 um). We propose a model, based on the Shockley-Read process, to explain this result observed by many authors.

**CD-P.29 TUE**

High repetition rates and high quality optical pulse train generation based on solitons over finite background

- J. F atoms,
- R. Kibler,
- and C. Finot; Laboratoire Interdisciplinaire Carnot de Bourgogne, Dijon, France.

We take advantage of the strong temporal compression of a soliton over finite background evolving in a nonlinear fiber. A delay-line interferometer enables the generation of high-quality high-repetition rate pulse trains with the background annihilated.

**CD-P.30 TUE**

Tapered Liquid-Core All-Fibre Devices for Low-Threshold Raman Generation

- L. Xiao,
- N. Healy,
- and A. Peacock; Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom.

The first demonstration of a highly compact tapered liquid-core all-fibre device is presented. The low integration and tapering losses allow for cascaded Raman scattering, with a threshold two times lower than an untapered structure.

**CD-P.31 TUE**

Monolithic PM Raman fiber laser at 1679 nm for Raman amplification at 1810 nm

- A.S. Svane and K. Rottwitt; DTU Fotonik, Department of Photonics Engineering, Technical University of Denmark, Kongens Lyngby, Denmark.

We present a Monolithic PM Raman fiber laser at 1679 nm with 67% slope efficiency and demonstrate a Raman amplifier at 1810 nm with 9 dB on/off gain in 4.3 km PM fiber.

**CD-P.32 TUE**

Degenerated four-wave mixing in chiral nematic liquid crystal exhibiting Bragg-like reflection

- P. Karpinski and A. Miniewicz; Wroclaw University of Technology, Wroclaw, Poland.

We report about novel configuration for optical phase conjugation phenomenon in dode-chiral nematic liquid crystal exhibiting Bragg reflection. We observe temperature dependent light stop-band and enhancement of optical nonlinearity due to ‘low light’ propagation.

**CD-P.33 TUE**

Highly Efficient Discrete Band Mid-Infrared to Near-Infrared Wavelength Conversion Relying on Si1-xGex Alloys

- A. Bogris,
- A. Kapsalis,
- S. Syrridis,
- M. Brun,
- P. Labaye,
- S. Nicorci;
- 1Department of Informatics and Telecommunications, University of Athens, Athens, Greece; 2Department of Informatics, Technological Educational Institute of Athens, Athens, Greece; 3CEA, LETI, Grenoble, France.

The properties of mid-infrared to near-infrared up-converters relying on Si1-xGex alloys are numerically investigated. The aspects of the waveguide design for efficient wavelength conversion from (4-5 μm) to (1.3-1.6 μm) are highlighted for various Ge concentrations.
Generation of on-axis optical filaments by means of Dammann lenses
J. Pérez-Vicuña1, O. Mendoza-Yero1, R. Borrego-Variño2,1, G. Mínguez-Vega1, J. Rodríguez Vázquez de Aldana1, and J. Lamsa1,2,1 Instituto de Nuevas Tecnologías de la Imagen, Castellón, Spain, 2 Universidad de Salamanca, Salamanca, Spain
Dynamic spatial shaping of a 30 fs laser beam by encoding Dammann lenses in a spatial light modulator allows us the formation up to six on-axis stable and stationary filaments in a fused silica sample.

Nonlinear-optical response and Raman signals of nanocrystalline lithium niobate
B. Knube1, K. Buse1, G. Stone2, and V. Dierolf3,1 Department of Microsystems Engineering (IMTEK), University of Freiburg, Freiburg, Germany, 2 Department of Physics, Lehigh University, Bethlehem, United States
The self-centrosymmetric structure of lithium niobate nanocrystals is examined by frequency doubling and Raman spectroscopy. The nanocrystals exhibit the full nonlinear-optical coefficients. The measured vibrational modes indicate a crystal symmetry found in stoichiometric lithium niobate.

Hase matching for efficient nonlinear frequency generation in hybrid Si/Chalcogenide glass slit waveguides
P.W. Nolte, C. Bohley, and J. Schilling, ZIK Sili-nano, Martin-Luther-University Halle-Wittenberg, Halle, Germany
We theoretically investigated the situation for degenerate four wave mixing in silicon slot waveguides which are infiltrated by a chalcogenide glass (e.g. As2S3) promising efficient frequency generation within the vicinity of the pump wavelength.

Characterization of a Single-frequency-pumped Continuous-wave Extravacuum Diamond Raman Laser
O. Kitzler, A. McKay, and R. Mildren; MQ Photonics Research Centre, Macquarie University, Sydney, Australia
We report a continuous-wave diamond Raman laser of output power 15W pumped by a single-longitudinal-mode Yb fibre laser at 35% conversion efficiency. Operating conditions enabling single mode output are analysed.

1.5W Compact Green Laser Module for Laser Display Applications
Y. Gan, J. Sun, and C.-Q. Xu, McMaster University, Hamilton, Canada
We demonstrate a novel miniaturized green laser array using an mCerenkov laser module. A two-beam array shows a combined green light output power of over 1.5W with an optical-to-optical conversion efficiency of 30%.

Directional Selective Nonlinear Transmission of Femtosecond Pulses in Glass-Metal Nanocomposites
S. Mohan1, 2, H. Graener1, M. Bache1, and G. Seifert3, 1 DTU Fotonik, Technical University of Denmark, Kgs. Lyngby, Denmark, 2 Physics Institute, Martin-Luther-University Halle-Wittenberg, Halle, Germany, 3 Centre of Innovation Competence SiLi-nano, Martin-Luther-University Halle-Wittenberg, Halle, Germany
Through femtosecond Z-scan measurements, we show that silver-doped nanocomposite glass samples give directionally sensitive optical limiting. A theoretical model explains this as interplay between self-focusing and two-photon absorption in the nanoparticle layer.

Stimulated Raman scattering with a rapidly tunable non-collinear optical parametric oscillator
C. Hoffmann1, T. Lang2,3, and U. Morgner2,3,1, Institute of Quantum Optics, Leibniz Universitat Hannover, Hannover, Germany, 2 Center for Quantum Engineering and Space-Time Research, Hannover, Germany, 3 Laser Zentrum Hannover, Hannover, Germany
We present the fast acquisition of broadband Raman spectra covering the range of 3400-960 cm-1 via stimulated Raman scattering (SRS) with an update rate of 19.6 Hz. For realization a rapidly tunable NOPA is employed.

Self-phase-locked degenerate femtosecond optical parametric oscillator based on BiB03
W.R. Bakker1, A.E. Martin1, and M.E. Zadok1,2,1 Institute of Photonic Sciences (ICFO), Barcelona, Spain, 2 Instituto Catalán de Recerca i Estudis Avançats (ICREA), Barcelona, Spain
We present the first self-phase-locked degenerate femtosecond OPO based on a birefringent material (BiB03) synchronously-pumped by Ti:sapphire laser. The OPO provides an output spectrum as broad as 46 nm with 190 fs pulses.

 Kerr effect induced transient group-velocity dispersion of fused silica measured via real-time MIIPS and spectral interferometry
G. Raskarov2, A. Rybkin3, D. Pestov2, V.V. Lazovoy2, and M. Dantus3,1,2,1 Department of Chemistry, Michigan State University, East Lansing, United States, 2 Biophotonic Solutions Inc., East Lansing, United States
We demonstrate the measurement of transient dispersion in fused silica by RT-MIIPS. The results are validated via Fourier Transform Spectral Interferometry. The observed dispersion modulation is explained within a theoretical model.

High-speed stroboscopic imaging with frequency-doubled supercontinuum
F. Ryckewaert1, A. Noël2, I. Kassanakou2, G. Gentyl3, and H. Eaegstmøn4,1 Tampere University of Technology, Tampere, Finland, 2 University of Helsinki, Helsinki, Finland
We present a frequency-doubled supercontinuum light source with 1ns long pulses and tunable repetition rate for 3D stroboscopic imaging with sub-100 nm accuracy.

Nonlinear interaction of two crossing beams in chiral nematic liquid crystals
U. Laudyn1, F. Sala1, M. Sierakowski1, E. Nowinowski-Kruszelnicki2, and M. Karpezer1,1 Warsaw University of Technology, Faculty of Physics, Warsaw, Poland, 2 Military University of Technology, Warsaw, Poland
In this work, we present experimental and numerical results showing interaction of two crossing beams occurring in two planes simultaneously.

Hole-Size Increasing PCFs for Blue-Extended Supercontinuum Generation
S.T. Sørensen1, C. Larsen1, C. Jakobsen2, C.L. Thomsen3, and O. Bang1,2,1 DTU Fotonik, Technical University of Denmark, Kgs. Lyngby, Denmark, 2 NKT Photonics A/S, Birkerød, Denmark
We demonstrate supercontinuum generation into the deep-blue in single-mode PCFs with increasing hole-size fabricated directly at the draw-tower, and report a record 3 dB spectral flatness in the region 363-628 nm.

Picoscosecond pulse burst generation using cascaded Stimulated Brillouin Scattering in a chalcogenide As2Se3 fiber cavity
T.F.S. Buettner, I.V. Kabakova, D.D. Hudson, and B.J. Eggleton; Centre for Ultra-high-bandwidth Devices for Optical Systems (CUODS), Institute of Photonics and Optical Science (IPOS), School of Physics, University of Sydney, Sydney, Australia
We demonstrate a compact approach for the generation of ultra-high frequency picosecond pulse bursts based on cascaded Stimulated Brillouin Scattering in a chalcogenide As2Se3 fiber cavity and investigate the stability of the laser.

Highly Sensitive Dispersion Map Extraction from Highly Nonlinear Fibers Using BOTDA Probing of Parametric Amplification
Using an enhanced scheme for probing the distribution of parametric processes along fibers, a rapid and simple technique to map zero dispersion wavelength fluctuations of less than 0.02 nm with 2 meters resolution is demonstrated.

Intensity Noise of Normal-Pumped Picoscosecond Supercontinuum Generation
C. Mellor1 and O. Bang1,2,1 DTU Fotonik, Department of Photonics Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark, 2 NKT Photonics A/S, Birkerød, Denmark
We investigate the intensity noise in normal-pumped picosecond supercontinuum generation, where higher-order Raman lines cross into the anomalous dispersion regime at high power levels. The noise properties are compared to those of anomalous-pumped supercontinuum generation.

Non-quadratic intensity dependence of the second harmonic signal from the p-Si/SiO2 interface due to ultrafast photo-induced charge carrier screening
P. Neelhing1, E. Rohwer1, and H. Stafast1,1 Laser Research Institute, Physics department, University of Stellenbosch, Stellenbosch, South Africa, 2 Institute of Photonic Technology (IPT) and Faculty of Physics and Astronomy, Friedrich Schiller University, Jena, Germany
The instantaneous electric field induced second harmonic signals from highly boron doped Si with natural oxide, attributed to the built-in interfacial electric field, show a non-quadratic dependence on the incident, two-photon resonant, femtosecond laser intensity.
CE-P.1 TUE
Structural and optical properties of epitaxially grown Nd$^{3+}$-doped InYO$_3$, thin films on Lu$_2$O$_3$.
- S.-H. Wueselmann$^1$, S. Heinrich$^1$, C. Kränkel$^2$, and G. Hübner$^1,2$.
- $^1$Institute of Laser-Physics, Hamburg, Germany; $^2$The Hamburg Centre for Ultrafast Imaging, Hamburg, Germany.

Thin lattice matched Nd$^{3+}$ doped InYO$_3$ films were grown epitaxially on Lu$_2$O$_3$ substrates via pulsed Laser Deposition. We present several advantageous characteristics of the films, that make them interesting for optically active waveguides.

CE-P.2 TUE
Investigation of second order optical nonlinearity at the surface of GaP nanowaves.
- M. Swillo$^1$, R. Sanatimia$^1$, and S. Anand$^1$.
- $^1$School of Engineering Sciences, Royal Institute of Technology (KTH), Stockholm, Sweden; $^2$School of Information and Communication Technology, Royal Institute of Technology (KTH), Kista, Sweden.

Optical second order nonlinearity at the surface of GaP nanowaves is determined with respect to the bulk. Presented method utilizes polarization measurement of the second harmonic generation and mode confinement in nanowaves with various diameters.

CE-P.3 TUE
Ultra-Smooth Ridge Waveguides in Lithium Niobate Fabricated by Diamond Blade Dicing and High Temperature In-Diffusion of Titanium.
- C.E. Rüter, S. Suntsov, and D. Kip; Helmut Schmidt University, Hamburg, Germany.

Fabrication of ridge waveguides in lithium niobate with propagation losses below 0.1dB/cm is reported. The substrate covered with titanium is structured using optical grade dicing followed by in-diffusion at 1120°C, resulting in ultra-flat surfaces.

CE-P.4 TUE
Experimental Investigation of a Single Chiral Nano-Structure Made of a Composite Material
- P. Wochnik$^1,2$, K. Höflisch$^1$, S. Fritsch$^1,2$, S. Christiansen$^1,3$, P. Banzer$^1,2$, and G. Leuchs$^1,2$.
- $^1$Max Planck Institute for the Science of Light, Erlangen, Germany; $^2$Institute of Optics, Information and Photonics, Friedrich-Alexander-University Erlangen Nürnberg, Erlangen, Germany; $^3$Institute of Photonic Technology, Jena, Germany.

Electron-beam-induced deposition results in nanostructures made of a composite material of unknown optical parameters. By retrieving its refractive index, we investigate the interaction between a single chiral nano-structure and a tightly focused circularly polarized beam.

CE-P.5 TUE
Er$^{3+}$-doped LiYF$_4$-Polymer Nanocomposites for S+C+1 Band Amplification.
- X. Xue, S. Uchci, W. Gao, T. Suzuki, and Y. Ohishi; Toyotata Technological Institute, Nagoya, Japan.

Er$^{3+}$-doped LiYF$_4$-bisphenol A ethoxylate diacrylates nanocomposites were prepared. Under the excitation of a 978 nm laser, the optically transparent nanocomposites showed intense and broad emissions in S+C+1 band.

CE-P.6 TUE
Influence of Chromium and Niobium Co-doping on Laser Damage Threshold of Raman Active Crystals.
- L. Ilveva, P. Zorev, I. Voronina, E. Dunaeva, and A. Nekhoroshov; A.M. Prokhorov General Physics Institute, Russian Academy of Sciences, Moscow, Russia.

Raman active CaMoO$_4$ and BaW$_4$O$_9$ crystals were grown from the melt with special Cr$^{3+}$ and Nb$^{5+}$ impurity dopants. The optimization of their concentration leads to significant increase of the laser damage threshold.

CE-P.7 TUE
Photoluminescent properties of the ZnS:Yb crystals in the excitonic region.
- I. Radevici$^1,2$, K. Sushkevich$^1$, V. Sirkel$^1,2$, H. Huhtinen$^1$, D. Nedeglo$^1$, and P. Paturn$^1$.
- $^1$Wihuri Physical Laboratory, Department of Physics and Astronomy, University of Turku, Turku, Finland; $^2$Faculty of Physics and Engineering, Moldova State University, Chisinau, Moldova, Republic of.

Temperature evolution of the ZnS:Yb samples photoluminescent spectra were studied. Edge band concentration shift to the higher energies was observed. An assumption about occupation of selenium vacancies sites by Yb ions is made.

CE-P.8 TUE
90° Phase-matched Difference-Frequency Generation at 5.34-7.48 μm in BaGa$_4$S$_7$.
- K. Kato$^1,2$, T. Mikami$^1$, and V. Petrov$^1$.
- $^1$Chuoe Institute of Science and Technology, Chito, Japan; $^2$Okamoto Optics Works, Inc., Yokohama, Japan; $^3$Max-Born-Institut for Nonlinear Optics and Ultrafast Spectroscopy, Berlin, Germany.

The BaGa$_4$S$_7$ was used to generate the 5.34-7.48μm pulses by mixing the BBO/OPo output with its pump source at 1.0642μm under the temperature-tuned 90° phase-matching conditions. The new Sellmeier and thermo-optic dispersion formulas are presented.

CE-P.9 TUE
Thermal conductivity versus Yb$^{3+}$ concentration in Yb:CALGO: a material for high power ultrafast laser.
- A. Jaffrès$^1$, A. Suganuma$^1$, R. Viana$^1$, P. Loiseau$^1$, S. Ricaud$^1$, P. Georger$^1$, and F. Drumo$^1$.
- $^1$LCMP, Paris, France; $^2$LCPIO, Palaiseau, France.

Thermal conductivity values were experimentally determined for various ytterbium contents (2-15%) in the laser material Yb:CaGa$_4$O$_7$4. The variation is modeling with sites distribution and physical parameters.

CE-P.10 TUE
NIR to visible upconversion in double-clad optical fiber co-doped with Yb$^{3+}$/Ho$^{3+}$.
- M. Kochanowicz, D. Dorozs, J. Zmijova, and J. Dorosz.
- Bialystok University of Technology, Bialystok, Poland.

In the paper the upconversion luminescence in antimony-silicate germanate glass and double-clad optical fiber co-doped with Yb$^{3+}$/Ho$^{3+}$ was investigated. Luminescence bands at 547 nm (Ho$^3$+;5S2(5F4)→5I8) and 659 nm (Ho$^3$+;3F5→3II8) was obtained.

CE-P.11 TUE
Study on exposure strategy influences on optical propagation losses in silicon waveguides fabricated by electron beam lithography.
- AMO GmbH, Aachen, Germany.

In this work we demonstrate the beneficial effect of a multi pass exposure strategy on optical propagation losses of silicon waveguide structures fabricated using electron beam lithography, reducing those losses by at least 1.5 dB/cm.

CE-P.12 TUE
Facet Machining of Silica Waveguides with Nanoscale Roughness without Polishing or Lapping.
- University of Southampton, Southampton, United Kingdom.

We show optical quality facets can be machined into silica using a precision machining technique, with a Sa = 4.9 nm. In addition an integrated optical structure will be presented to characterise the interface loss.

CE-P.13 TUE
Evolution of a conically diffraacted Gaussian beam in free space.
- S. Grant and A. Abdolvand; University of Dundee, Dundee, United Kingdom.

Various parameters relating to the evolution of a Gaussian beam as it propagates along one of the optic axes of four KGL(WO4)2 crystals of differing lengths are reported, along with its cross section.

CE-P.14 TUE
Self-coloring of nanoparticles in polymethyl methacrylate through electrode-free dielectrophoresis.
- O. Gennari$^1$, V. Pagliarulo$^1$, S. Coppola$^1,2$, V. Vespina$^1$, L. Miccio$^1$, S. Grilli$^1$, and P. Ferraro$^1$.
- $^1$INO-CNRS, Pozzuoli, Italy; $^2$Dipartimento di Chimica e Materiali e Produzione Engineering, Napoli, Italy.

We propose an electrode-free dielectrophoretic approach for aligning nanoparticles into wires dispersed in non-aqueous suspensions of polymethyl methacrylate. The electric field gradients are generated through spontaneous charge templates arising pyroelectrically onto functionalized ferroelectric crystals.

CE-P.15 TUE
Cascade Conical Diffraction.
- S. Grant and A. Abdolvand; University of Dundee, Dundee, United Kingdom.

The use of multiple biaxial crystals in cascade configuration to produce conical diffraction is investigated. The polarization dependence and the effect of the relative angles of the crystals is reported as is the free-space cross-section.

CE-P.16 TUE
Laser texturing of ZnO:Al:Front contact for efficiency enhancement in thin-film silicon solar cells.
- D. Cantel$^1$, S. Fernández$^1$, J.D. Santos$^1$, I.P. González$^1$, C. Molpeceres$^1$, I. Torres$^1$, J. Girabe$^1$, and J.J. Gandía$^1$.
- 1Cenre de Investigaciones Energéticas, Medioambientales y Tecnológicas, Madrid, Spain; 2Centro Lázaro de la Universidad Politécnica de Madrid, Madrid, Spain.

A 355nm nanosecond laser source is used to texture AZO thin films. The textured films show appropriated morphology and good optoelectronic properties to be used in thin film silicon solar cells.

CE-P.17 TUE
Mapping Purity of Single-Walled Carbon Nanotubes in Bulk Samples with Multiples Coherent Anti-Stokes Raman Microscopy.
- A.S. Duarte$^1,2$, J. Rehinder$^1$, R.R.R. Correia$^1$, T. Buckup$^1$, and M. Motzkus$^1$.
- 1Physikalisch-Chemisches Institut, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany; 2Instituto de Física, Universidad Federal do Rio Grande do Sul, Porto Alegre, Brazil.

Multiples Coherent anti-Stokes Raman microscopy was used to retrieve information about impurities in a spin-coated SWNT distribution. An impurity map was constructed using the ratio between the D- and G-band in SWNTs vibrational spectrum.
CE-P.18 TUE
Kinetics of Effective Temperature of Nonlinear-Optical Crystals
O. Ryabukhin1,2, D. Myankov1,2, A. Konyakhin1,2, and O. Vershchin1,2
1Moscow Institute of Physics and Technology, Dolgoprudny, Russia; 2TNT “IRE-Polus,” Fyrauz, Russia

Novel method is proposed for determination of nonlinear-optical crystal heat transfer and optical absorption coefficients by measuring kinetics of crystal’s temperature-dependent piezoelectric resonance frequency during interaction with laser radiation.

CE-P.19 TUE
Photoluminescence emission in Er-activated good quality fluorotellurite thin film glasses
R. Morea1, A. Miguel1, T. Teddy-Fernandez1, J. Fernandez2,3, R. Balda1, and J. Gonzalez1
1Instituto de Optica, CSIC, Madrid, Spain; 2Dept. of Applied Physics I, Universidad del Pais Vasco UPV/EHU, Bilbao, Spain; 3Materials Physics Center CSIC-UPV/EHU and Donostia International Physics Center, San Sebastian, Spain

Good quality Er-doped fluorotellurite thin film glasses are produced by pulsed laser deposition. We show that their photoluminescence emission characteristics can be greatly improved through annealing treatments and discuss the responsible processes for that behavior.

CE-P.20 TUE
Analysis and fabrication of optical active nanostripes inspired by the blue Morpho butterfly
R.H. Siddique1, S. Diewald2, J. Leuthold3, and H. Hölcher1
1Institute for Microstructure Technology (IMT), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany; 2Center for Functional Nanostructures (CFN), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany; 3Institute of Photonics and Quantum Electronics (IPQ), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

Morpho butterfly nanostripes reflect blue in wide angle that outplays the regular interference theorem. Our experimental and theoretic analysis reveals alternative thin layers with Christmas tree shape are the origin of this fascinating blue iridescence.

CE-P.21 TUE
New route to Bi+-doped crystals: preparation and NIR luminescence of K, Rb and Cs ternary chlorides, containing univalent bismuth.
A. Romanov1,2, A. Veber3, Z. Patakhova1, D. Vyturina1, O. Usovich1, F. Grigoriev1,2, E. Haula1, L. Trusov1, P. Kazin1, V. Korchak1, V. Tsvetkov1, and V. Sulimon1,2
1Research Computing Center of M.V. Lomonosov Moscow State University, Moscow, Russia; 2Dimonta Ltd., Moscow, Russia; 3A.M. Prokhorov General Physics Institute, Russian Academy of Sciences, Moscow, Russia; 4N.N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, Moscow, Russia; 5Department of Chemistry, M.V. Lomonosov Moscow State University, Moscow, Russia

The ternary chlorides, doped with univalent bismuth can be prepared by crystallization from Lewis acidic melts. These crystals exhibit high-lived luminescence in NIR and can be the perspective optical media for broadband light amplification.

CE-P.22 TUE
Distributed Fibre Analysis with cm Resolution Using Gated Flexural Acoustic Waves
E.P. Alcusa-Saiz1, A. Diez1, M. Gonzalez-Herranz2, and M.V. Andre3
1Universidad de Valencia, Barjasor, Spain; 2Universidad de Alcalá de Henares, Alcalá de Henares, Spain

Accurate characterization of small fibre inhomogeneities along sections of about 1m, with centimetric resolution, is demonstrated using a time-domain distributed in-fibre acousto-optic interaction based on the propagation of short flexural acoustic wave packets.

CE-P.23 TUE
Band Edge and Random Lasing in Blue Phase Liquid Crystals
C.-W. Chen1, H.-C. Jau1, C.-C. Lin1, T.-H. Lin1, C.-T. Wang1, E.-C. Khoo1, and C.-H. Lee2
1Department of Photonics, National Sun Yat-Sen University, Kaohsiung, China, Republic of (ROC); 2Electrical Engineering Department, Pennsylvania State University, University Park, Pennsylvania, United States

The contribution has been withdrawn by the authors.

CE-P.24 TUE
Study of Femtosecond Laser-induced Grating in Lead Silicate Glasses
S. Chouli, M. Tondusou, and E. Freyss; LOMA, Universitè Bordeaux 1, Talence, France

We have studied the formation of gratings in PbO glasses induced by femtosecond pulses. These efficient gratings are produced in few picoseconds. The photo-induced refractive index change scales almost linearly with the PbO molar content.

CE-P.25 TUE
Luminescence properties of PMMA-based nanocomposites doped with Pr3+; YF3-Y2O3 nanocrystallites
A. Jusza1, L. Lipinska2, P. Polis2, and R. Piramidowicz2
1Institute of Microelectronics and Optoelectronics, Warsaw University of Technology, Warsaw, Poland; 2Institute of Electronic Materials Technology, Warsaw, Poland

We propose a dual-cone model of conical refraction involving the interference of two light cones behind the exit facet of the crystal and demonstrating an excellent agreement with experiment.

CE-P.26 TUE
Self-assembling of liquid crystal droplets on lithium niobate substrates driven by pyroelectric effect
F. Merola1, S. Grilli1, S. Coppola2, V. Vespini2, De Nicola1, P. Maddalena3, C. Carfagna4, and P. Ferraro4
1CNR-INO, Pozzuoli, Italy; 2Università Federico II, Dip. Ingegneria, Napoli, Italy; 3Università Federico II, Dip. Scienze Fisiche, Napoli, Italy; 4CNR-ICTP, Pozzuoli, Italy

Liquid crystal droplets are driven by pyroelectric effect on lithium niobate substrate covered with Polydimethylsiloxane. Droplets assemble themselves in different patterns such as microlens arrays.

CE-P.27 TUE
Photodarkening in optical fibres: comparative study of photo-induced defects using different photon sources
D. Milanese1, M. Chiesa2, S. Taccheo3, K. Mattsson4, H. Gehbav1, T. Robin5, L. Lablende1, D. Mecchin1, A. Montevil6, F. Freyra1, and B. Bonelli7
1Politecnico of Torino - DISAT, Torino, Italy; 2Dipartimento di Chimica, Università di Torino, Torino, Italy; 3Swansea University, Swansea, United Kingdom; 4DTU Fotonik, Technical University of Denmark, Lyngby, Denmark; 5Xipher S.A.S., Lannion, France; 6PERFOS, R&D Platform of Photonics Bretagne, Lannion, France

This report compares the effect of photon sources at different energies on Ce/Yb-doped optical materials for high power lasers. The investigation aims at studying the mechanism of photodarkening for the development of photodarkening-free fibres.

CE-P.28 TUE
Conical refraction: A dual-cone model
G.S. Sokolovskii1,2, D.J. Carnegie1, T.K. Kalkandjian3, and E.U. Rafailov1
1University of Dundee, Dundee, United Kingdom; 2Ioffe Physico-Technical Institute, St.Petersburg, Russia; 3Convergent Optics SL, Barcelona, Spain

We propose a dual cone model of conical refraction involving the interference of two light cones behind the exit facet of the crystal and demonstrating an excellent agreement with experiment.

CE-P.29 TUE
Microstructured Plastic Optical Fibers with Limited Modal Dispersion and Bending Losses
K. Wélkow1, P. Gdula1, P. Szczepański2, R. Buczyński3,4, and R. Piramidewicz1
1Institute of Microelectronics and Optoelectronics, Warsaw, Poland; 2National Institute of Telecommunication, Warsaw, Poland; 3Institute of Electronic Materials Technology, Warsaw, Poland; 4Faculty of Physics, University of Warsaw, Warsaw, Poland

New geometries of polymer microstructured fibers are proposed for limiting macrobending losses and modal dispersion. The numerical analyses are confronted with measurement results of manufactured mPOFs to verify applicability of developed model.

CE-P.30 TUE
DC electric field assisted fabrication and optical analysis of silver-doped nanocomposite glass
S. Wackerow and A. Abdolvand; School of Engineering, Physics & Mathematics, University of Dundee, Dundee, United Kingdom

We present DC electric field assisted fabrication of glass with embedded silver nanoparticles. Optical analyses of the fabricated composite glasses and their depth profiles were performed using cross-section images with an unprecedented clarity.

CE-P.31 TUE
Optical properties of the Bi+ center in KAIC4 crystal
A. Veber1, A. Romanov2,3, O. Usovich1, Z. Patakhova1, E. Haula1, V. Korchak1, L. Trusov4, P. Kazin4, V. Sulimov5,6, and V. Tsvetkov7
1A.M. Prokhorov General Physics Institute, Russian Academy of Sciences, Moscow, Russia; 2Research Computer Center, M.V. Lomonosov Moscow State University, Moscow, Russia; 3Dimonta Ltd., Moscow, Russia; 4Department of chemistry, M.V. Lomonosov Moscow State University, Moscow, Russia; 5N.N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, Moscow, Russia; 6Optical properties of the Bi+ center in KAIC4 crystal have been studied as a function of temperature. Experimental data were analyzed in terms of electron-phonon interaction of Bi+ center with the host crystal.

CE-P.32 TUE
Investigating the efficiency limitations of GaN-based emitters
B. Crutchley, I. Marko, A. Adams, and S. Sweeney; University of Surrey, Guildford, United Kingdom

In this paper we investigate the efficiency droop causing mechanisms in InGaN blue-green LEDs. From pressure and temperature dependence measurements we find that
a carrier density dependent defect-related process is likely to cause efficiency droop.

**CE-P.33 TUE**

**Fast transient bleaching in Rh6G-functionalized TiO2 nanoparticles: charge transfer dynamics**

L. Henkes1, E. Almeida1, C. Araújo1, A. Brito-Silva2, A. Batista2, and G. Machado2; 1Departamento de Física, Universidade Federal de Pernambuco, Recife-PE, Brazil; 2Centro de Tecnologias Estratégicas do Nordeste (CETENE), Recife-PE, Brazil

Charge transfer dynamics in Rh6G-functionalized amorphous TiO2 nanoparticles is investigated using transient bleaching (TB) spectroscopy. The TB shows a faster signal as compared to the bleaching of the free dye in solution.

**CE-P.34 TUE**

**Longitudinal acoustic phonons in 3-dimensional cobalt supracrystals detected by broadband picosecond acoustics**

D. Polli1, I. Liseichik2, C. Yan3, E. Duval3, G. Cerullo1,

and M.-P. Pillet1; 1Politecnico di Milano, Milano, Italy; 2Université Pierre et Marie Curie, Paris, France; 3Université Lyon, Lyon, France

Longitudinal acoustic phonons with few-GHz frequency were detected with femtosecond pulses and detected in three-dimensional supracrystals of 7-mm cobalt nanocrystal spheres. We extract the speed of sound (1100 m/s), which interestingly strongly depends on temperature.

**IC-P.1 TUE**

**Towards a Bose-Fermi mixture experiment in a 2D optical lattice with high optical resolution**

N. Mayer1, M. Perea-Ortiz1, C. O’Neale1, M. Ho压抑k1, M. Baumer1, K. Bong1, and J. Kronjäger1; 1School of Physics and Astronomy, Birmingham, United Kingdom; 2Institute of Laserphysics, Hamburg, Germany

Presented is a versatile setup for Bose-Fermi mixtures in optical potential including simultaneous magneto-optical trapping of two species, magnetic transport and cooling towards a BEC. In the context of this project new technologies were developed.

**IC-P.2 TUE**

**Chaotic Dynamics of Bose-Einstein Condensates in Optical Cavities**

M. Diver, G. Robb, and G.-L. Oppo; Institute of Complex Systems, SUPA and Department of Physics, University of Strathclyde, Glasgow, Scotland, United Kingdom

We consider a Bose-Einstein condensate interacting with a laser beam in an optical cavity. The modulated optical lattice induces chaotic oscillations that occur when increasing the amplitude of the pump beyond the bistable regime.

**IC-P.3 TUE**

**Institut de Ciencies Fotoniques**

T. Vanderbruggen1, S. Palacios1, N. Martínez2, and M. Mitchell1,2; 1ICFO - Institut de Ciencies Fotoniques, Castelldefels (Barcelona), Spain; 2ICREA - Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain

We propose a new method to produce a continuous source of spin-polarized cold atoms which are all-optically guided after their extraction from a magneto-optical trap (MOT).

**IC-P.4 TUE**

**Microwave ring trap for ultracold atoms**

G. Smuco, K. Burrows, and B. Garraway; School of Physics and Astronomy, University of Sussex, Brighton, United Kingdom

We propose a ring trap for ultracold alkali atoms via a combination of external and induced microwave fields. We consider the trapping characteristics, the trap lifetime, and its feasibility in an atom-chip configuration.

**IC-P.5 TUE**

**High-contrast spatial interference of BECs**

C. Carson, M. Zawadzki, P. Griffin, E. Riis, and A. Arnold; University of Strathclyde, Glasgow, United Kingdom

We use magnetic levitation and an optical plug to obtain 95% contrast spatial interference between two BECs. Interference patterns with fringe periods of 85 microns (individual de Broglie wavelengths 170 microns) are possible with 200ms levitation.

**IC-P.6 TUE**

**Towards an interferometer with thermal atoms trapped on a chip**

M. Ammar1, M. Dupont-Nivet1, L. Huel1, C. Guérin1,2, J. Reichel1, P. Rosenbusch1, I. Bouchoule1, C. Westbrook1, and S. Schwartz2; 1Thales Research and Technology, Palaiseau, France; 2Laboratoire Kastler-Brossel, Paris, France

We will discuss the possibility of building a trapped-atom interferometer without a Bose-Einstein condensate, to weaken the effect of atomic interactions, by using internal state labeling and two coplanar waveguides on an atom chip.

**IC-P.7 TUE**

**Temperature Limits in Laser Cooling of Free Atoms with Three-level Transitions**

F. C. Cruz1, M. L. Sandheimer2, and W. C. Magna2; 1Instituto de Física Gleb Wataghin, Universidade Estadual de Campinas, Campinas, Brazil; 2Departamento de Física, Universidade Federal Rural de Pernambuco, Recife, Brazil

We consider laser cooling of free atoms with simultaneous two-color excitation of three-level cascade transitions finding theoretically that temperatures below the Doppler limits associated with each of the individual transitions are obtained.

**IC-P.8 TUE**

**Collision of Discrete Breathers in Two-Species Bose-Einstein Condensates in Optical Lattices**

R. Campbell1, M. Borkowski1, and G.-L. Oppo1; 1University of Strathclyde, Glasgow, United Kingdom; 2University N Copernicus, Torun, Poland

Coupled discrete nonlinear Schrodinger equations describe two-species BEC in deep optical lattices. The collision of travelling discrete breathers can be either elastic or inelastic depending on the sign of the inter-species interaction parameter.

**JSV-P.1 TUE**

**Nano-Optical Measurements of Novel Superconducting Single Photon Detector Designs**

P. M. Hands1, 2, M. G. Turner1, L. Sun-Emmett-Alvarez2, W. Jiang2, Z. H. Barber2, R. J. Werburton3, and R. H. Prince, and J. Tafur Monroy; Technical University of Denmark, Copenhagen, Denmark

We present nano-optical studies of novel superconducting nanowire single photon detector designs, including spatial-resolvable multi-photon absorption. Local response and timing properties are investigated especially of SNAPs, and more recent results enhancing photoreponse will be presented.

**JSV-P.2 TUE**

**Comparison of 850-nm and 1550-nm VCSELs for Low-Cost Short-Reach IM/DD and OFDM SMF/MMF Links**

F. Karinou, L. Deng, R. Rodes, J. Beversee Jensen, K. Haufield1, 2University of Glasgow, Glasgow, United Kingdom; 3University of Cambridge, Cambridge, United Kingdom; 4University of Basel, Basel, Switzerland

We report on the experimental performance of a multimode 850 nm and a single-mode 1550-nm VCSEL employing IM/DD and OFDM-QPSK over SMF and MMF links for their potential application in low-cost, rack-to-rack optical interconnects.
Theoretical Study on Linewidth Characteristics of SGDBR Lasers for Coherent Optical Communications

M.A. Preciado, X. Shu, P. Harper, and K. Sagden; Aston Institute of Photonic Technologies, Birmingham, United Kingdom

The experimental demonstration of a single element, all fiber approach for first-order differentiator based on a fiber Bragg grating in transmission is reported, showing a good performance over an operational bandwidth of ~2 nm.

Free-space optical polarization demultiplexing and multiplexing by means of conical refraction

A. Turpin, Y. Losko, T.K. Kalaskandji, and J. Mompert; 1Departament de Física, Universitat Autònoma de Barcelona, Bellaterra, Spain; 2Conerfringent Optics SL, Avda Cubelles 28, Vilanova i la Geltrú, Spain

We present a novel technique for polarization multiplexing for free space optical communications by means of conical refraction that allows increasing in one order of magnitude the channel capacity in a propagation distance of ~5 m.

Experimental Characterization of a Burst-Enabled O-OFDM Transceiver

J.M. Fabrega, M. Svaluto Moreolo, E.J. Vilchez, and L. Nadal; Centre Tecnologic de Telecomunicacions de Catalunya, Castelldefels, Spain

A burst-enabled tunable 1550 nm O-OFDM based on Hartley transform is investigated and experimentally characterized. Its transmission performances have been assessed in terms of tunability and in the presence of EDFA transients.

Noise suppression characteristics of negative feedback optical amplifier using an optical triode

A. Sayfug, Y. Fujikawa, and Y. Maeda; Kinki University, Higashi-osaka, Japan

We investigated the relationship of inverted negative feedback signal intensity with bit error rate using optical triode. It was found out that power penalty was improved by 15 dB and noise suppression characteristic was obtained.

High-Power Dense Wavelength Division Multiplexer (HP-DWDM) for Diode Lasers using Volume Bragg Gratings (VBG)

S. Hengesbach, N. Krauch, C. Holly, M. Traub, and D. Hoffmann; 1Chair for Laser Technology, Aachen, Germany; 2Fraunhofer Institute for Laser Technology, Aachen, Germany

The authors present a compact dense wavelength division multiplexer with 1.5 nm center wavelength spacing for five spectrally stabilized diode laser bars with low beam quality (14 mm mrad). The multiplexing efficiency amounts 85%.

An Optically Modulated Radio Frequency Backscatter Wireless Data Link

H. Cantu; 1ComS, 2Electronics, B. Rometra, A. Kelly, and J. Figueiredo; 1University of Glasgow, Glasgow, United Kingdom; 2Universidade do Algarve, Faro, Portugal

Optical modulation of the impedance of an antenna coupled photo-detector is used to convert data from optical to wireless domains. Radio frequency backscatter is exploited as a low cost, low power, data link technology solution.

Mechanical Robustness of MMF Datacom Interconnections using Center-Launching Technique

A. Boletti, A. Gatto, P. Boggi, R. Martellini, E. Centeno Nieves, and M. Martellini; Politecnico di Milano, Milano, Italy

Robustness to mechanical perturbations of center-launching technique in multi-mode fiber is demonstrated compliant to ETSI recommendations to implement fully-transparent board-to-board and data server fiber interconnections where only the fundamental mode propagates without higher-order modes excitation.

Generalized directional coupling for high-precision manipulation of the optical phase for classical and quantum light

R. Heibmann, R. Keil, S. Nolte, and A. Szameit; Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-University, Jena, Germany

A precise method for optical phase manipulation of classical and quantum light in integrated waveguide structures is presented. We employ generalized directional couplers which allow the exact tuning of the effective index in such structures.

Performance Comparison between Electrical and Optical Backplanes


Comparison between performance of copper interconnections and fiber optics backplane is shown also by simulations to demonstrate their limitations in frequency and capabilities in terms of capacity, power budget and consumption.

An Optical Switch Based on Microring Resonators and Phase change Materials

M. Ruyle, J. Pellic, R. Simpson, J. van der Tol, and V. Pruver; 1ICFO-Institut de Ciències Fòtoniques, Castelldefels, Spain; 2Eindhoven University of Technology, Eindhoven, The Netherlands; 3Singapore University of Technology and Design, Singapore, Singapore; 4ICREA-Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain

We demonstrate optical switching at telecommunication wavelengths in a silicon microring resonator with a modulation of 10 dB, induced by a laser-driven transition from the amorphous to the crystalline phase of Ge2Sb2Te5 overcladding layer.

Equivalent Modeling of Micro-bending in Multimode-fibers with Parabolic Index Profile using Discrete Coupling

A. Juarez, E. Krune, and K. Petermann; Technische Universität Berlin, Berlin, Germany

A discrete model to estimate modal-coupling and its losses in MMF is presented and validated using coupled mode theory. The amount of discrete-coupling points can be reduced significantly if the overall losses are the same.

Generalized QAM regeneration using a phase-sensitive amplifier with dual-conjugated pumps

B. Stiller,2, G. Onishchukov1, E. Schmaas, and G. Leuchs1,3; 1Max Planck Institute for the Science of Light, Erlangen, Germany; 2Institute of Optics, Information and Photonics, University of Erlangen, Erlangen, Germany; 3Institute of Microwaves and Photonics, University of Erlangen, Erlangen, Germany

Phase regeneration of an 8QAM signal with two amplitude levels in a phase-sensitive amplifier with two conjugated pumps is numerically investigated. Effects limiting regenerator performance are identified and improvement possibilities are considered.

Investigating the influence of thermal coefficients on 2-D WH/TS OCDMA code propagation in optical fiber

T. Osadola, S. Idri, I. Glek, and K. Wogw; 1Department of Electronic and Electrical Engineering, University of Strathclyde, Glasgow, United Kingdom; 2Hofstra University, Hempstead, United States

Extensive studies have been carried out to analyse the bit error rate of a 32 User, 2D WH/TS OCDMA system propagating under the influence of environmental temperature variation caused by thermal coefficients of an optical fibre.

Phase modulation technique for high modulation wide band planar Bragg grating fabrication

C. Sima, J. Gates, C. Holmes, H. Rogers, P. Mennea, M. Zervus, and P. Smith; Optoelectronics Research Centre, Southampton, United Kingdom

A phase modulation controlled direct grating system is presented for fabricating high modulation, wide spectral band integrated Bragg gratings. The method also offers greater fabrication speed with a higher fidelity of control.

WDM-Filters fabricated with Hydrogenated Amorphous Silicon Ring and Racetrack Resonators

T. Lipka, J. Amthor, and J. Müller; Hamburg University of Technology, Institute of Micro Systems Technology, Hamburg, Germany

Wavelength-division multiplexers with low footprint were designed and realized with low-loss hydrogenated amorphous silicon. Four and eight channel devices based on cascaded racetrack and ring resonators were optically characterized and will be presented.
II-1.1 WED 8:30
Excitation of plasmon modes in a graphene monolayer supported on a 2D subwavelength silicon grating
• X. Zhu1,2, W. Yan1,2, P.U. Jepsen3, O. Hansen3,4, A. Mortensen3,4, and S. Xiao5,6; Department of Photonics Engineering, Technical University of Denmark, DK-2800 Kongens Lyngby, Denmark; 2Center for Nanostructured Graphene (CNG), Technical University of Denmark, DK-2800 Kongens Lyngby, Denmark; 3Department of Micro and Nanotechnology, Technical University of Denmark, DK-2800 Kongens Lyngby, Denmark; 4Center for Individual Nanoparticle Functionality (CINF), Technical University of Denmark, DK-2800 Kongens Lyngby, Denmark
We experimentally demonstrate graphene-plasmon excitation in a continuous graphene monolayer resting on a 2D subwavelength silicon grating. Measured transmission spectra illustrate the excitation of graphene-plasmons, which is further supported by numerical simulations.

II-1.2 WED 8:45
Ultrastrong light-matter coupling between high-mobility 2DEG and superconducting THz metasurfaces.
• G. Scalari1, C. Maisen1, S. Cibelli2, R. Leon2, E. Giovine2, P. Carelli2, D. Hagenmüller2, S. de Liberato2, G. Cioccolino2, F. Valmonra2, M. Beek1, and A. Paszczynski1; Institute of Quantum Electronics, ETH Zürich, Zürich, Switzerland; 2CNR-IFN, Institute for Photonics and Nanotechnologies, Rome, Italy; 3DSFC, Università dell’ Aquila, L’Aquila, Italy; 4Laboratoire Matériaux et Phénomènes Quantiques, Université Paris Diderot-Paris 7 and CNRS, Paris, France
We demonstrate ultrastrong light-matter coupling between a superconductor-based THz metasurface and the cyclotron transition of a single high-mobility two-dimensional electron gas. We measure a normalized coupling ratio of Ω/u = 0.27 for ω=420 GHz.

II-1.3 WED (Invited) 9:00
Quantum effects in tunneling plasmonics
• J. Aizpurua1, R. Esteban1, P. Nordlander2, and A. Borisov3; 1Materials Physics Center (CSIC-UPV/EHU) and DIPC, Donostia-San Sebastián, Spain; 2Laboratory for Nanophotonics, Rice University, Houston, United States; 3Institut des Sciences Moléculaires d’Orsay, CNRS-Université Paris-Sud, Orsay, France
As dimensions between metallic nanoparticles become subnanometric, quantum effects such as electron spill-
We demonstrated a tunable pulse width with a tunable laser with high peak power and average power. We have shown that the ultrafast excitation of surface plasmon polaritons can be controlled to directly imprint a homogeneous nanographite on GaN surface in air, using a simple two-step process of femtosecond laser ablation.

We have shown that the ultrafast excitation of surface plasmon decay clarifying the issues of plasma concentration experiments in the regime of permanent modulation processes at different wavelengths. It provides an original data set to test models for strong field ionization by femtosecond lasers.

Multiphoton-avalanche absorption yields with femtosecond laser pulses in the wavelength range 1300-2200 nm.

Multiphoton-avalanche absorption yields with femtosecond laser pulses in the wavelength range 1300-2200 nm.

We measure multiphoton-avalanche absorption yields inside various bandgap materials with femtosecond laser pulses at different wavelengths. It provides an original data set to test models for strong field ionization by femtosecond lasers.

Parametric feedback cooling of a single atom inside an optical cavity.

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We measure the ground state coherence properties of the atom by utilizing spatial interferometry measurements. We observe for the first time parametric feedback cooling of a single atom inside an intra-cavity standing wave dipole trap.

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We discuss the reactive ion etching of a non-linear crystal, RbTiOPO4 in a fluorene rich environment and the process optimisation to fabricate single-mode waveguides in (Y,Nb):RbTiOPO4 for lasing application around 1 micron.

The Kerr nonlinearity of the beta-barium borate crystal is popular for ultrafast cascading. We measure the main Kerr nonlinearity, and after correcting similar literature data for deterministic contributions we obtain an average value in excellent agreement with our results.

Absorption is measured from 410-2600 nm in lithium triborate crystals, employing a photoacoustic spectrome-
out and coherent tunneling modify their optical response. We introduce a theoretical framework to describe quantum effects in realistic plasmonic systems.

CI-3.4 WED 9:15
Impact of Four-wave Mixing Phase Noise Transfer on Wavelength Converted QPSK Signals
Tayeb Naimi, S. O Duill, and L. Barry
Dublin City University, Dublin, Republic of Ireland
We calculate impairments of a 10 Gbaud QPSK signal due to the phase noise transfer of the four-wave mixing process. We show how this effect places limits on pump sources used in wavelength converters.

CI-3.5 WED 9:30
Wavelength conversion of ps-duration pulses induced in mode-locked semiconductor lasers via strong optical injection
School of Electronic Engineering, Dublin City University, Dublin, Republic of Ireland
CNRS Laboratory for Photonics and Nanоструктуры, Marcoussis, France
Physics Department, University of Auckland, Auckland, New Zealand
III-V Lab, University of California, Los Angeles, California
A 48GHz passively mode-locked semiconductor laser is used as both a high repetition-rate pulse source and also nonlinear wavelength converter to achieve wavelength conversion up to 25nm for 1ps-duration pulses via strong external optical injection.

CI-3.6 WED 9:45
All Optical Clock Recovery of 40 GHz Quantum Dash Mode-Locked Laser to Return-to-Zero 160 Gb/s data stream
J. Parra-Cevallos, J. Luo, N. Calabretta, and P. Landais
Dublin City University, Dublin, Republic of Ireland
Cobra Research Institute, Eindhoven, The Netherlands
All optical clock recovery of 40 GHz quantum dash mode-locked laser has been achieved under injection of the 160 Gb/s coherent wavelength converted signal featuring no spectral component at 40 GHz.

CA-8.4 WED 9:15
Thermal and Non-Thermal Lensing of Yb:YAG and Tm:YAG Thin Slab Laser Gain Media
B. Fulford, D. Hall, J. Lee, and H. Baker; Heriot-Watt University, Edinburgh, United Kingdom
Rofin-Sinar UK Ltd., Kingston upon Hull, United Kingdom
The effective lens strength of edge-pumped Yb:YAG and Tm:YAG thin slabs under various conditions are compared. Discrepancy with a purely thermal model is discussed relative to the population difference profile and electronic refractive index change.

CA-8.5 WED 9:30
Temperature Development in Yb:YAG Thin-Disk Lasers at High Inversion Densities Confirming Nonlinear Losses
U. Wölters, K. Bell, C. Kraenkel, K. Petermann, and G. Huber; Institute of Laser Physics, University of Hamburg, Hamburg, Germany
At high outcoupling transmissions strong heat is generated in Yb:YAG thin-disk lasers, revealing a nonlinear loss process that reduces laser efficiency. These losses are analysed and compared to the photoconductivity results found in Yb:YAG.

CA-8.6 WED 9:45
Multimode Laser-Diode Pumped Continuous-Wave Mode-locked Yb3Al5O12 Laser
D. Kimura, S. Matsubara, K. Otsu, T. Ueda, M. Imoue, N. Shimojo, Y. Sasatani, A. Maruoka, D. Mizuno, M. Nishio, and S. Kawatay; Graduate School of Engineering, University of Fukui, Fukui, Japan
Research and Education Program for Life Science, University of Fukui, Fukui, Japan
Japan Synchrotron Radiation Research Institute (JASRI), Sayo, Japan
A laser-diode-pumped, continuous-wave microchip stoichiometric Yb3Al5O12 laser was realized at room temperature. It is the first for the laser-diode-pumped, continuous-wave stoichiometric Yb lasers, to our knowledge.

CA-8.7 WED 9:00
Long Range Active Hyperspectral Target Identification Using Near-IR Supercontinuum Light Source
A. Manninen, T. Kääriäinen, T. Parviainen, S. Buchler, M. Heikkinen, and T. Laurila; Centre for Metrology and Accreditation, Espoo, Finland
Defence Forces Technical Research Centre, Hankkia, Finland
LASEREX Systems, Forsas, Finland
Metrology Research Institute, Aalto University, Espoo, Finland
Active hyperspectral measurement at distances up to 250 meters in the daytime has been demonstrated. Cost efficient supercontinuum source employing a graded index optical fiber was used as the light source.
A state-of-the-art chirped-pulse fiber amplification system for energy scaling is presented. Using divided-pulse-amplification with an active stabilization system and pulse train tailoring, this system is able to extract multiple-mJ pulse energies from a LMA fiber.

**High Peak Power, High-Energy, High-Average Power Pulsed Fibre Laser System with Versatile Pulse Duration and Shape**

A. Malinowski, P. Gorman, C. Codemard, F. Ghiringhelli, A. Boyland, A. Marshall, and M. Durkin; SPI Lasers UK Ltd, Southampton, United Kingdom

We demonstrate a 1061nm all-fibre MOPA system with average power of 265W, capable of pulse energies up to 10.6mJ, peak powers exceeding 100kW with adjustable pulse duration in the range 500ps-500ns.

**Role of Multiple Shots of Femtosecond Laser Pulses in Ultrafast Localized Nanostructure Formation on Silicon Surface**

G. Miyaji and K. Miyazaki; Kyoto University, Uji, Japan

Pump-probe measurements of reflectivity have shown that superimposed multiple shots of low-fluence femtosecond laser pulses on silicon surface accumulate non-thermal bonding structure change to decrease the ablation threshold and induce subsequent formation of periodic nanostructures.

**Detecting The Motional State Of Single Atoms In A High-Finesse Optical Cavity By Heterodyne Spectroscopy**

S. Yooshiki, R. Reimann, S. Mansi, T. Kampfrath1, N. Thune, W. All1, and D. Meschede1; 1Institut für Angewandte Physik, Universität Bonn, Bonn, Germany; 2Department Physik, Universität Basel, Basel, Switzerland

We observe the quantized motion of single atoms strongly coupled to a high-finesse optical cavity and investigate dynamics of cavity-assisted atom cooling by means of photon-counting heterodyne spectroscopy.

**Free-standing Magneto-optical traps on a chip using micro-fabricated gratings**

C. Nishii3, M. Vangeleen1, J. Cotter2, P. Griffin3, E. Hinds4, C. Ironside1, P. Sco1, A. Sinclair4, E. Ris3, and A. Arnold1; 1University of Strathclyde, Glasgow, United Kingdom; 2Imperial College, London, United Kingdom; 3University of Glasgow, Glasgow, United Kingdom; 4National Physical Laboratory, Teddington, United Kingdom

We have realised a single-input-beam magneto-optical chip trap which loads 10^6 atoms from a 1cm² capture volume and delivers sub-Doppler temperatures. The on-chip gratings will also enable simple formation of stable 3D optical lattices.

**Ferroelectric Liquid-Crystalline Polymers for Photoinduced Switching of Nonlinear Optical Response**

M. Virkvik1, A. Priimagi1, K. Ogawa2, J.-i. Mamiya3, M. Kauranen4, and A. Shihido5; 1Department of Physics, Tampere University of Technology, Tampere, Finland; 2Chemical Resources Laboratory, Tokyo Institute of Technology, Yokohama, Japan; 3Department of Applied Physics, Aalto University, Espoo, Finland

We present the first observation of high-contrast photoinduced switching of second-order nonlinear optical response in crosslinked ferroelectric liquid-crystalline polymers. The fully reversible switching behaviour is triggered by two-photon absorption-induced photoisomerization of the crosslinking azobenzene molecules.

**Multimodal Nonlinear Imaging of Suspended Carbon Nanotubes Using Circular Polarizations**

G. Bautista1, M.J. Huttunen1, O. Herranen1, A. Johansson1, P. Myllyperkiö1, M. Ahiskog1, M. Pettersson1, and M. Kauranen1; 1Department of Physics, Tampere University of Technology, Tampere, Finland; 2Nanoscience Center, Department of Physics, University of Jyväskylä, Jyväskylä, Finland; 3Nanoscience Center, Department of Chemistry, University of Jyväskylä, Jyväskylä, Finland

We demonstrate multimodal second-harmonic and third-harmonic generation microscopy of suspended carbon nanotubes using circularly polarized excitation. Our results suggest the possibility of performing nonlinear chirality detection at the single nanotube or nanotube bundle levels.
II-1.2 Wed 10:30
Third harmonic spectroscopy of complex plasmonic Fano structures
• B. Metzger, M. Hentschel, T. Schumacher, M. Lippitz, and H. Giessen, 4th Physics Institute and Research Center SCoPE, University of Stuttgart, Stuttgart, Germany; 2 Max Planck Institute for Solid State Research, Stuttgart, Germany

We perform third-harmonic spectroscopy of complex plasmonic nanoantennas which exhibit EIT-like Fano resonances in their linear extinction spectrum. Strong third harmonic emission is found at the lower energy mode of the coupled plasmonic system.

II-2.2 Wed 10:45
Nanoparticle probes: Mode mapping and Nanoscope Imaging
• A. Singh, G. Calbris, and N.F. Halas, 1ICFO - The Institute of Photonic Sciences, Castelldefels (Barcelona), Spain; 2 CREAC: Instituto Catalán de Recerca i Estudis Avançats, Barcelona, Spain

We present stand-alone nanoparticle probes, where the nanoparticle is fabricated onto a fiber tip using FIB. We demonstrate a novel near-field scanning technique for sub-wavelength size mode imaging of dipole and gap optical nanoparticle tips.

II-2.3 Wed 11:00
Deeply subwavelength SPP components for nanophotonic circuitry
• A. Kriesel, S.P. Burgers, D. Plass, H. Pfeifer, H.A. Atwater, and U. Peschel, 1 Institute of Optics, Information and Photonics, University of Erlangen-Nuremberg and Max Planck Institute for the Science of Light, Erlangen, Germany; 2 Erlangen Graduate School in Advanced Optical Technologies, University of Erlangen-Nuremberg, Germany and Cluster of Excellence for "Engineering of Advanced Materials" (EAM), University of Erlangen-Nuremberg, Erlangen, Germany; 3 Thomas J. Watson Institute of Applied Physics, California Institute of Technology, Pasadena, United States

We propose a novel scheme for plasmonic nanocircuitry based on different plasmonic functional units like optimized optical Yagi antennas and ultrashort optical directional couplers. Those units are interconnected with low loss plasmonic SPP gap waveguides.

II-1.4 Wed 10:30
CI-4: Opto-Electronic Devices
Chair: Daniele Modotto, Università di Brescia, Brescia, Italy

CI-4.1 Wed 10:30
All-optical, Non-volatile, Chalcogenide Phase-change Meta-switch
B. Ghobadi, J. Zhang, I. Maddock, K.F. Macdonald, D.W. Hewak, and N.I. Zheludev, 1 University of Southampton, Southampton, United Kingdom; 2 Nanyang Technological University, Singapore, Singapore

Bistable all-optical switching in a chalcogenide phase-change metamaterials delivers high contrast optical signal modulation across the visible to mid-infrared spectral range in device structures down to 1/27 of a wavelength thick.

CI-4.2 Wed 10:45
Electrostatic Control of Dual-core Optical Fibre with NEMS Functionality
• N. Podoluk, Z. Lian, F. Horak, and W.H. Loh; University of Southampton, Southampton, United Kingdom

We model an optical fibre with suspended cores for electrostatic actuation of the cores. With metal wires in the cladding, an applied voltage of 30V will move the cores, and change the fibre optical properties.

CI-4.3 Wed 11:00
Optical guiding and loss mechanisms in electro-optically induced waveguides based on isotropic liquid crystals
• M. Blas, H. Hartwig, K. Borrhurst, and F. Costache; Fraunhofer Institute for Photonic Microsystems, Dresden, Germany

A model for loss and guiding mechanisms in electro-optically induced waveguide devices based on nematic liquid crystals in isotropic phase was developed. Together with experimental data, an in-depth understanding of device characteristics was achieved.
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ber laser comb locked to tsXatomic clock
CJ-6.3 WED 11:00
Modification of Transparent Materials by Tightly
Focused Annular, Radially and Azimuthally
Polarized Ultrafast Laser Beams
J. Zhang, M. Gecevicius, M. Beresna, and P. Kazansky,
Optoelectronics Research Centre, University of Southamp
ton, Southampton, United Kingdom
Cylindrically polarized annular beam is produced by
femtosecond laser written S-waveplate. Self-assembled
nanostructures cannot be produced by longitudinal field
component radial polarization. Despite lower intensity
ring-shaped azimuthally polarized beam induced larger
retardance than radial.

10:30 – 12:00
ROOM 14a
CJ-6: Ultrafast Fibre Sources
Chair: Thomas Andersen, NKT Photonics, Birkerod, Denmark
10:30 – 12:00
ROOM 14b
CJ-6.1 WED 10:30
fs mode-locked fiber laser continuously tunable from
976 nm to 1070 nm
• R. Rayon1, J. Derriche1, L. Sarger2, and E. Cornier1;
• CELIABORDEAUX 1, TALENCE, France;
• LOMABORDEAUX 1, TALENCE, France.
We report on tunable femtosecond pulse generation from
an all-normal dispersion Yb-doped fiber–oscillator emitting
976nm to 1070nm. The laser delivers chirped pulses of 10ps with an energy of 220nJ. Pulses are exter-

ally recompressed below 350fs.

10:30 – 12:00
ROOM 21
IA-5: Non-Classical Light
Chair: Ana Predojevic, University of Innsbruck, Inns-
bruck, Austria
IA-5.1 WED (Invited) 10:30
Biological measurement beyond the quantum limit
• M. Taylor1, J. Janousek2, V. Daria2, J. Knittel1, B. Hage2, H.-A. Bachor2, and W. Bowens1; 1 Centre for Engi-
nered Quantum Systems, University of Queensland, Brisbane, Australia; 2 Department of Quantum Science, Australian National University, Canberra, Australia
We demonstrate the first biological measurement with
precision surpassing the quantum noise limit. Lipid par-
ticles within a living yeast cell are tracked with sub-shot
noise sensitivity, thereby revealing the biological dynam-
ics of the cellular cytoplasm.

10:30 – 12:00
ROOM EINSTEIN
CE-8: Lithium Niobate - Fabrication and Characterization
Chair: Volkmar Dierolf, Lehigh University, Bethlehem, USA
CE-8.1 WED 10:30
UV laser-induced piling inhibited domain building
blocks for photonic and nonlinear optical microstructures
G. Zis1, S. Malls1, Y. Ying1, and E. Soergel3;
1 Optoelectronics Research Centre University of Southamp-
ton, Southampton, United Kingdom; 2 Avesto Technologies, Singapore, Singapore; 3 Institute of Physics, University of Bonn, Bonn, Germany
We demonstrate that partial overlap of UV laser iradi-
ated tracks on the +2 face of lithium niobate crystals al-

ows the composition of arbitrary shaped complex large
scale ferroelectric domain structures by inhibition of pol-
ing.

CE-8.2 WED 10:45
Domain Wall Motion of MgO Doped Stoichiometric Lithium Niobate
J.W. Choi1, D.-K. Ko1, J.H. Re2, and N.E. Yu1; 1 Gwangju Institute of Science and Technology, Gwangju, Korea, South; 2 Pusan National University, Busan, Korea, South
In stoichiometric LN, sidewall wall velocity of a single
hexagonal domain was measured to 0.015 – 4.58 μm/s in
range 0.6 to 3.9 kV/mm. Asymmetric in-out shape and
lattice interaction was estimated using Ising-model.

10:30 – 12:00
CE-8.3 WED 11:00
Control of the properties of micro-structured waveguides in LiNbO3 fabricated by direct
femtosecond laser inscription
• H. Karakuzu, M. Dubov, and S. Boscolo, Aston Univer-
sity, Birmingham, United Kingdom
We report on buried waveguides fabricated in lithium
niobate by the method of direct femtosecond laser in-
scription. We demonstrate numerically that the disper-
sion and other properties of such waveguides can be con-
trolled by their geometry.
Optical phased array nanoantenna link
- D. Dregely, K. Lindorfer, M. Lippitz, and H. Giessen
- 4th Physics Institute and Research Center SCoPEx, University of Stuttgart, Stuttgart, Germany
- Max Planck Institute for Solid State Research, Stuttgart, Germany

We experimentally realized an optical phased array nanoantenna link using plasmonic antennas as transmitter and receiver. Phase control of the individual array elements led to beam steering at optical frequencies.

Scattering, interference, and switching of ultrashort surface plasmon polaritons
- Laser Zentrum Hannover, Hanover, Germany

Interference and scattering of ultrashort surface plasmon-polaritons (SPPs) are studied. Interference of SPPs is applied to tracking and autocorrelation of ultrashort SPPs. Ultrafast SPP-light scattering is demonstrated and applications as ultrafast switches are discussed.

Properties of Highly-Nonlinear Hybrid Silicon-Plasmonic Waveguides
- A. Pittalakis and E. Krichev; Aristotle University of Thessaloniki, Thessaloniki, Greece

We provide a theoretical investigation of nonlinear hybrid silicon-plasmonic waveguides exploiting a metal wedge. These waveguides can provide an exceptionally high nonlinear parameter while limiting the relative importance of the detrimental free-carrier effects.

Magnetic-Force-Induced Tunable Long-Period Fibre Grating and Its Application in Erbium-Doped Fibre Systems
- H. Sakata, K. Yamahata, and K. Wakamiya
- Shizuoka University, Hamamatsu, Japan

We present a tunable notch filter based on magnetic-force-induced fibre grating. A low amplitude is adjustable over 20 dB using a magnet with a coil spring. The device is also demonstrated in erbium-doped fibre systems.

Broadband All-Fiber Mode Multiplexer for Future MDM-WDM Transmission over Few-Mode Fibers
- C. Tsebres and D. Syridis
- National and Kapodistrian University of Athens, Athens, Greece

An all-fiber broadband mode multiplexer for mode and wavelength division multiplexing over few-mode fibers (FMFs) is analyzed. The multiplexer is based on cascaded FMF couplers and is optimized for operation over the C band.

Observation of Switching and Pulsed Behaviour in a Noise-Driven Resonant Tunneling Diode Excitable Optoelectronic Oscillator
- B. Romeo1, J. Javaloyes2, C. Ironside3, J. Figueiredo1, S. Balle2, O. Piro2, H. Castu1, and A. Kelly1
- 1Centro de Electrónica, Optoelectrónica e Telecomunicações, Departamento de Física, Universidade do Algarve, Faro, Portugal; 2Departamento de Física, Universitat de les Illes Balears, Palma, Spain; 3School of Engineering, University of Glasgow, Glasgow, United Kingdom

We demonstrate, experimentally and numerically, the dynamical behaviour of a simple noise activated optoelectronic oscillator comprising a resonant tunnelling diode-laser diode (RTD-LD) circuit, which exhibits switching and pulsed behavior that is characteristic of excitable systems.

650fs pulses at 1045nm from a passively Q-switched Nd:YVO4 microchip laser system
- R. Lehnen1, A. Steinmetz2, J. Limper1, and A. Tünnermann3,4
- 1Friedrich-Schiller-Universität Jena, Abbe Center of Photonics, Institute of Applied Physics, Albert-Einstein-Str. 15, 07745 Jena, Germany; 2Fraunhofer Institute for Applied Optics and Precision Engineering, Albert-Einstein-Str. 7, 07745 Jena, Germany

We present a novel concept to produce sub-ps pulses from a passively Q-switched Nd:YVO4 microchip laser system with a tunable emission wavelength. Pedestal-free 650fs pulses are demonstrated with a wavelength shift from 1064nm to 1045nm.

Large bandwidth interferometric technique for coherent beam combining
- M. Antier, J. BoisvertMartaud, C. Laser, E. Lallier, E. Lenormand, and A. Brignon
- Thales Research & Technology, Palaiseau, France

We demonstrate fiber phase-locking system using an interferometric method. The system allows complete phase error map measurement in a single acquisition. A 1kHz correction loop bandwidth was achieved, with a residual lambda/50 rms phase error.
Compressed of uJ-level fs Pulses from a Monolithic Yb-fiber Amplifier at 1 mm Wavelength in a Hollow-Core Photonic Bandgap Fiber
• A. Verhoeft1, T. Andersen2, T. Flory3, L. Zhu3, A. Galvanaukas1, A. Baltuska3, and A. Fernández3; 1Center for Ultrafast Optical Science, University of Michigan, Ann Arbor, United States
• We present pulse compression results from an all Yb-FCPA. The use of a DCF stretcher and HCPBF compressor allowed to obtain 250-nJ, 220-fs pulses, enabling direct fiber delivery of microjoule-energy femtosecond laser pulses.

Silicon chiral bulk bump formed by optical vortex laser ablation
• S. Takizawa1, F. Tukahashi2, K. Toyoda1, K. Miyamoto1, R. Morita1,2, and T. Otsuji1,3; 1Chiba University, Chiba, Japan; 2Hokkaido University, Hokkaido, Japan; 3JST CREST, Tokyo, Japan
• Silicon (Si) chiral bump formation by the single-shot deposition of the optical vortex pulse was demonstrated. The chiral bump formed on the proceeded surface exhibited a height of 1.5μm and tip diameter of 0.8um, respectively.

Augmented Gain Narrowing with Self Phase Modulation: 100-fs, 800-nJ from an All-Fiber-Integrated Yb Amplifier
• A. Rybka1,2,1, I. Pavlov1,2,1, C. Sene1,2,1, and F. O. Ilday3; 1Bilkent University, Ankara, Turkey; 2TUBITAK National Metrology Institute (UME), Kocaeli, Turkey; 3Institute of Physics, Kiev, Ukraine
• We developed an all-fiber-integrated Yb-amplifier, generating 1.15-microwave, 20-ps pulses, compressed to 100 fs. Gain narrowing is balanced by Kerr nonlinearity through optimization of each amplifier stage using numerical simulations.

Femtosecond laser macro and nano processing with nondiffracting Bessel and accelerating Airy beams
• F. Courvoisier1,2, A. Mathis1, J. Zhang1, L. Froehly1, V. Iknina2, L. Furfaro2, M. Jaquot1, R. Giusti1,2, P. A. Lacorte1, A. Couairon1, and J. Dudley2; 1Université de Franche-Comté, Besançon, France; 2École Polytechnique, Palaiseau, France
• The control of nonlinear light propagation with nondiffracting Bessel and Airy beams has open up several exciting applications in the field of ultrafast laser micro and nano machining. High aspect ratio and curved machining are reported.

Multi-mode Quantum Networks
• J. Janousek1, S. Armstrong2, B. Hage3, J. F. Morizur2, P.K. Lam3, and H. Bachor3; 1Australian National University, Canberra, Australia; 2Laboratoire Kastler Brossel, Paris, France
• We report on the experimental preparation of various multi-mode entangled states, with the ability to switch between them in real-time. Up to N-mode entanglement is measured with just one detector, here N = 8.

Measuring nonlocal coherence with weak-field homodyne detection
• T. Bartley1, G. Donati1, X.-M. Jin1,2, A. Datte1, M. Barbiere1, and I. Walmsley1; 1Clarendon Laboratory, Department of Physics, University of Oxford, Oxford, United Kingdom; 2Department of Physics, Shanghai Jiao Tong University, Shanghai, China, People’s Republic of (PRC)
• Using a weak-field homodyne detector, we experimentally observe nonlocal coherence between different photon number components across two modes. This is a direct application of a hybrid detector which counts photons with a phase reference.

Entanglement-enhanced probing of a delicate material system
• F. Wolfgaam1, C. Vitelli2, F. Bedini2, N. Godbout3, and M.W. Mitchell4; 1ICFO - Institut de Ciencies Fonamentals, Castelldefels (Barcelona), Spain; 2Center of Life Nanoscience at La Sapienza, Istituto Italiano di Tecnologia, Rome, Italy; 3CPL, Département de Génie Physique, École Polytechnique de Montréal, Montréal, Canada; 4ICREA-Institut Catalana de Recerca i Estudis Avancats, Barcelona, Spain
• Using atom-tuned narrowband N=0 states we demonstrate non-destructive probing of an atomic ensemble with sensitivity per photon and sensitivity per damage to the ensemble beyond the standard quantum limit.

Photorefractivity Vs. Wavelength a Comparative Study of Mg- and Zr-Doped Lithium Niobate Crystals
• G. Nava1, P. Minzioni1, I. Cristiani1, N. Argiolas2, M. Bazzan1, M.V. Ciampolillo3, G. Pozza1, A. Zaltron1, and V. Degiovanni1; 1Quantum Electronics Lab, Dip. di Ingegneria Industriale e dell’Informazione, University of Pavia, Pavia, Italy; 2 Dip. di Fisica e Astronomia, University of Padova, Padova, Italy
• Photorefractivity of Mg- and Zr-doped Lithium Niobate samples was compared considering different wavelengths and high intensities. Zr doping yield the same photorefractivity suppression as Mg while requiring half of the dopant concentration.

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• Photorefractivity of Mg- and Zr-doped Lithium Niobate samples was compared considering different wavelengths and high intensities. Zr doping yield the same photorefractivity suppression as Mg while requiring half of the dopant concentration.

Novel method of piezoelectric resonant spectroscopy allows to measure precisely the nonlinear-optical crystal equivalent temperature in process of laser frequency conversion. This method was applied for PLLN crystal temperature measurement in second harmonic generation experiment.

High-sensitivity absorption spectroscopy of lithium niobate crystals in the near and mid infrared regime
• S. Fieberg1, F. Kühnemann2, and K. Busch3; 1Fraunhofer Institute for Physical Measurement Techniques IPM, Freiburg, Germany; 2Department of Microsystems Engineering IMTEK, University of Freiburg, Freiburg, Germany
• Impurity band structures of lithium niobate crystals of different stoichiometry and doping are studied in the wavelength range 1460 to 1890 nm and 2450 to 4000 nm using a photothermal common-path interferometer.
We demonstrate numerically near- and mid-

Optical processes

We study experimentally the incoherent spatiotemporal dynamics in photonic crystal fibers. We report a transition for solitons in disordered photonic media. This transition is characterized by a localized-to-ballistic transition for gap-solitons in disordered photonic crystal waveguides. We prove that for solitons this transition goes faster than the square of the group velocity, highlighting their improved robustness against disorder.

We show that the spatial coherence of a random laser can be tuned by adjusting the scattering properties of the medium with a subwavelength structure.

We reveal that the spatial coherence of random lasers is limited by the sets of random scattering centers, which has a periodic spatial structure.

Near- and mid-IR few-cycle self-defocusing soliton compression in PPLN waveguide

We demonstrate numerically near- and mid-

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High-Resolution Imaging with Scattered Light

Fiber non-Turing all-optical computer for solving complex decision problems

We demonstrate an all-optical computer that solves one of the most difficult complex decision problems, the Hamiltonian challenge of finding a map that is a way that each town is visited exactly once.

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We reveal that the spatial coherence of random lasers is limited by the sets of random scattering centers, which has a periodic spatial structure.
Recent progress in passively stabilized single-frequency Brillouin fiber lasers with doubly-resonant cavities
A. Fotiadis1,2,3, V. Spirin2, C. López-Mercado1, D. Kinet1, E. Preid1, L. Zolotovskii2, E. Zlobina1, S. Kuhlau2, and P. Mégret1; 1University of Mons, Mons, Belgium; 2CISESE, Ensenada, Mexico; 3Ulyanov State University, Ulyanovsk, Russia; 4Institute of Automation and Electrometry, RAS, Novosibirsk, Russia; 5Joffe Physico-Technical Institute, St.Petersburg, Russia
Brillouin fiber lasers with doubly-resonant cavities are successfully stabilized through self-injection locking and dynamical population grading mechanisms. Pump-to-Stokes conversion efficiency of ~40% and Stokes linewidths <500Hz are achieved for both laser configurations.

All-fiber laser source for CARS-Microscopy
T. Gottschall1, M. Baumgartl1, M. Chemnitz2, J. Abreu-Afonso3, T. Meyer1, B. Dietzek1, J. Popp1, J. Limpert1, and A. Tönner1; 1Friedrich-Schiller-Universität Jena, Institute of Applied Physics, Abbe Center of Photonics, Jena, Germany; 2Departamento de Física Aplicada-ICMUV, Universidad de Valencia, Burjassot, Spain; 3Institut für Photonische Technologien Jena (IPHT) e.V., Jena, Germany; 4Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany
An all-fiber CARS laser based on four-wave-mixing (FWM) and its application to CARS microscopy is presented. In addition we demonstrate the enhancement of the spectral resolution by cw-seeding.

High-power Yb- and Tm-doped Fiber Amplifiers Seeded by a Femtosecond Erbium Fiber System
S. Komkis1,2, M. Warmann, P. Stors, D. Fehrenbacher, D. Brida, and A. Leitenstorfer; Department of Physics, University of Konstanz, Konstanz, Germany
Synchronous high-power Yb- and Tm-fiber amplifiers coherently seeded by the same

Loading and unloading of cavity excitation using a strongly coupled quantum dot in a photonic molecule
R. Bose1, K. Roy Choudhury2, T. Cal5, G.S. Solomon4, and E. Walschaers4; 1Department of Electrical Engineering, University of Maryland, College Park, College Park, United States; 2National Institute of Standards and Technology, Gaithersburg, United States
We will present the interaction of a single QD coupled to a 2D photonic molecule. We will discuss time-resolved experiments in this scheme.

Cladding-pumped high-power mode-locked thulium laser based on fiber prepared by powder sinter technology
D. Gaponov1, R. Daulat1, R. Janier2, S. Grimm1, K. Schwarz2, and P. Roy2; 1Xilum EMB CARBS Université de Limoges #7252, Limoges, France; 2Institute of Photonic Technology, Jena, Germany
We report on generation of high average power picosecond pulses directly from the modelocked thulium fiber laser by using efficient cladding-pumping. Tm-doped fiber fabricated with new glass powder technology.

Fundamentally mode-locked Yb3+-doped glass waveguide lasers with repetition rate of up to 15.2 GHz
A. Goudhary1, A. Lagutshik2, P. Kannan2, W. Sibber1, C. Brown1, and D. Shephard1; 1Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom; 2SUPA, School of Physics and Astronomy, University of St.Andrews, St.Andrews, Scotland
Narrowband source of correlated photon pairs via four-wave mixing in a cold atomic ensemble
B. Srivathsan2, G.K. Gulati1, M.Y.B. Chng3, G. Maslennikov2, D. Matsukevich1,2, A. Cerè1, and C. Kartisier1,2; 1Center for Quantum Technologies, Singapore, Singapore; 2Department of Physics, National University of Singapore, Singapore, Singapore
Complex polarization in non-z-cut whispering gallery mode resonators
F. Sedlmair1,2, M. Hauer1, J. Fürst1,2, D.V. Strekalov2, and H.G.L. Schwefel2; 1Max Planck Institute for the Science of Light, Erlangen, Germany; 2Institute for Optics, Information and Photonics, University of Erlangen-Nürnberg, Erlangen, Germany; 3SAOT, School in Advanced Optical Tech.

CD-11.4 WED 14:45
Spatial Soliton Dynamics in Curved Photonic Lattices
F. Dibel, P. Rose, M. Boguslawski, and C. Denz; Institut für Angewandte Physik and Center for Nonlinear Science (CeNoS), Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany
We report on the first experimental observation of stable and oscillating solitons in photorefractive photonic Weber lattices. The experimentally observed dynamic behavior of the Weber soliton is corroborated by comprehensive numerical simulations.

CD-11.5 WED 15:00
Spatio-temporal cleaning of a femtosecond laser pulse by a filament conjugate mirror
A. Jarras1, M. Durand2, A. Houard3, Y. Liu1, P. Prade1, M. Richards1, and A. Mysyrowicz1; 1Laboratoire d’Optique Appliquée, ENSTA ParisTech/CNRS/Polytechnique, Palaiseau, France; 2Towson Laser Institute, CREOL, University of Central Florida, Orlando, United States
A phase conjugate mirror was formed in air with two counter propagating filaments. This mirror can clean efficiently a femtosecond laser pulse both spatially and temporally.

IG-2.2 WED 14:45
Bound states in a temporal fiber network with parity-time symmetry
A. Regensburger1,2,3, M.-A. Miri4, C. Bersch1,2, J. Nauer1, G. Osnichukova1,2,3, D.N. Christodoulides4, and U. Peschel1,3; 1Institute of Optics, Information and Photonics, University of Erlangen-Nürnberg, Erlangen, Germany; 2Max Planck Institute for the Science of Light, Erlangen, Germany; 3Erlangen Graduate School in Advanced Optical Technologies (SAOT), Erlangen, Germany; 4CREOL, College of Optics and Photonics, University of Central Florida, Orlando, United States
We report on the first experimental observation of localized defect states in a large-scale parity-time (PT) symmetric photonic lattice. The system is realized in a time-multiplexed network consisting of two coupled optical fiber loops.

IG-2.3 WED 15:00
Complex beam dynamics in PT-symmetric optical lattices
K. Makris1, R. El-Ganainy2, and D. Christodoulides3; 1Department of Electrical Engineering, Princeton University, Princeton, United States; 2Max Planck Institute for the Physics of India, New Delhi, India; 3CREOL, University of Central Florida, Orlando, United States
The complex beam dynamics close to the exceptional point of a PT-symmetric optical lattice is systematically examined. Absence of anomalous diffraction, non-hermitian negative refraction, nonlinear evolution of power oscillations, and soliton formation are also investigated.

CI-5.4 WED 14:45
Evaluation of Radio-over-Fiber Link for 45-GHz- and 60-GHz-Band Simultaneous Transmissions
A. Kanno and T. Kawanishi; National Institute of Information and Communications Technology, Koganei, Japan
We configure and evaluate a broadband RoF signal simultaneous transmission system for 45-GHz and 60-GHz bands. Observed flatness of the frequency response at these bands and dynamic range are 2 dBp-p and 22 dB, respectively.

CI-5.5 WED 15:00
First Investigation of Fast OFDM Radio over Fibre System at 60 GHz Using Direct Laser Modulation
H. Shams and J. Zhao; Photonic Systems Group (PSG), Tyndall National Institute, University College Cork (UCC), Cork, Republic of Ireland
Fast OFDM (F-OFDM) was investigated for the first time in 60GHz radio-over-fibre system using direct laser modulation and optical frequency quadruple technique. The performance was evaluated for 10.3Gbps 4ASK F-OFDM and 16QAM conventional OFDM.

CA-10.4 WED 14:45
High energy and broadband Yb:CaF2 multipass amplifier using passive coherent combining
F. Friebe1, S. Ricciardi1, A. Pellegrini2, M. Hanus3, E. Mottay4, P. Camy3, J-L. Dousalan1, R. Moncorge3, P. Georges3, F. Druon4, and D. Papadopoulos1,2; 1Laboratoire Charles Fabry, Institut d’Optique, CNRS, Univ. Paris Sud, 2, Avenue Augustin Fresnel, Palaiseau, France; 2Laboratoire d’Utilisation des Lasers Intenses, Ecole Polytechnique, Palaiseau, France; 3Centre de recherche sur les ions, les Matériaux et la Photonique, CEA-CNRS-ENSICAEN, Université de Caen, Caen, France; 4Amplitude Systèmes, 11 avenue de Caranterie, Cité de la Photonique, Pessac, France
We report a diode-pumped Yb:CaF2 160-mJ, 20 Hz multipass amplifier using coherent combining in order to overcome damage threshold problems. The combination efficiency of the passive coherent combination is up to 96%.

CA-10.5 WED 15:00
The Prospects for Yb- and Nd-Doped Tungstate Microchip Lasers
V. Savitski1, R. Berch2, E. Frazek1, A. Kemp1, P. Loiko3, K. Yamashita4, N. Kalezhova5, and A. Palyuk6; Institute of Photonics, University of Strathclyde, Glasgow, United Kingdom; 1Center for Optical Materials and Technologies, Belarussian National Technical University, Minsk, Belarus; 2A.V.Nikolaev Institute for Inorganic Chemistry, Siberian Branch of RAS, Novosibirsk, Russia; 3NPD-Group and Yb:KY(WO4)2 crystals cut along the Ng-axis are used in quasi-microchip plane-plane lasers for the first time. Output powers up to 900mW are demonstrated. Cavity designs based on thermal lens sensitivity factors are discussed.

CA-10.4 WED 14:45
Observation of anomalous diffusion in a 1D optical random dimer
S. Stötzer1, U. Nieder2, T. Kottos3, R.A. Vicencio4, M.I. Molina5, A. Tinnermann6, S. Nolte1, D.N. Christodoulides1, and A. Szameit1; 1Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Germany; 2Department of Physics, University of Illinois at Urbana-Champaign, Champaign, USA; 3College of Optics and Photonics, University of Central Florida, Orlando, United States
We experimentally demonstrate anomalous diffusion in a disordered system with short-range correlations. The prototypical case of a random dimer is realized in a waveguide array and a localization-delocalization transition is observed.
ultrabroadband and passively phase-stable Er-fibre system is demonstrated. Microjoule-level pulse energy and sub-200 fs operation at a repetition rate of 10 MHz are achieved.

CJ-7.4 WED 14:45
Efficient CW All-fiber Optical Parametric Oscillator Operating Below 1 μm
1E. Zlobina, S. Kabliakov, and S. Babkin; 1Institute of Automation and Electrometry, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia; 2Novosibirsk State University, Novosibirsk, Russia
CW tunable all-fiber optical parametric oscillator based on photonic crystal fiber operating below 1 μm is realized for the first time. The FOPO has 9.7% slope efficiency and 460 mW output power at 972 nm.

CJ-7.5 WED 15:00
Ultra-broadband Wavelength Swept Tm-doped Fibre Laser
M. Tokurakawa1, J.M.O. Daniel1, C.S. Chen0g1, H. Liang2, and W.A. Clarkson1; 1Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom; 2School of Science & Technology, Nottingham Trent University, Nottingham, United Kingdom
A wavelength-swept Tm fibre laser source employing two fibre gain stages to achieve wide wavelength tuning is reported. The laser yielded over 500mW of output and had scanning range from 1750nm to 2080nm.

CF/IE-8.5 WED (Invited) 15:00
Photon Blockade Effect in the Ultrastrong Coupling Regime
A. Ruklofo1, M. Leib1, S. Savasta2, and M.J. Hartmann1; 1Technische Universität München, Munich, Germany; 2Università di Messina, Messina, Italy
We show photon coincidence counting statistics in the ultrastrong coupling regime. Exploiting the correct input-output relations within a suitable Master Equation approach, we calculate correlation functions that are valid for arbitrary degrees of light-matter interaction.
the optical pulses propagate in the soliton silicon photonic nanowire waveguides when temporal compression of ultra-short pulses is achieved. We demonstrate that one can achieve optical modulation in silicon photonic wires.

16:00 – 17:30
CD-12: Solitons and Nonlinearly Driven Self-organization
Chair: Thomas Persich, Friedrich Schiller University, Jena, Germany

CD-12.1 WED 16:00
Soliton pulse compression in adiabatically tapered silicon photonic wires
S. Lavdas1, J. Driscoll2, R. Gro-te3, R. Osgood4, and N. Panoiu5; 1 University College London, London, United Kingdom; 2 Columbia University, New York, United States

We demonstrate that one can achieve temporal compression of ultra-short optical pulses by more than three times in millimetre-long adiabatically tapered silicon photonic nanowire waveguides when the optical pulses propagate in the soliton regime.

16:00 – 17:30
IG-3: Polaritons and Quantum Fluids
Chair: Dmitry Skyabin, University of Bath, United Kingdom

IG-3.1 WED 16:00
Soliton and shock waves in an exciton polariton quantum pond
L. Dominici1,2, M. De Giorgi1,2, D. Ballarini1,2, E. Cancellieri1,3, F. Laussy4, E. Giaucobino5, A. Bramati6, G. Ghiberti1,2, and D. Sanvitto1,3; 1 Istituto Italiano di Tecnologia, IT-Lecce, Lecce, Italy; 2 NNL - Istituto Nanoscienze - CNR, Lecce, Italy; 3 Laboratoire Kastler Brossel, Université Pierre et Marie Curie-Paris 6, École Normale Supérieure et CNRS, Paris, France; 4 Università di Pisa, Tuscany, Italy; 5 Laboratoire d’Annecy - ÉNS Cachan, Cachan, France; 3 Laboratoire d’Annecy - ÉNS Cachan, Cachan, France

We present the real-time dual-polarization optofluidic detection of binding events of an antigen/antibody biological system with a polymeric vertically-coupled microring resonator as a transducer.

16:00 – 17:30
CI-3: Advances in Optical Sensor Devices
Chair: Stavros Pissadakis, Foundation for Research and Technology IESL-FORTH, Heraklion, Greece

CI-3.1 WED 16:00
Dual-polarization optofluidic biotodetection based on polymer microring resonators
C. Delezeide1, C. Noguès2, R. Castro3, J. Lasra3, M. Buckle2, T. Ledoux-Rak2, J. Zys2, and C.T. Nguyen1; 1 LPQM - ENS Cachan, Cachan, France; 2 LPBM - ENS Cachan, Cachan, France; 3 Institut d’Alember - ENS Cachan, Cachan, France

We present the real-time dual-polarization optofluidic detection of binding events of an antigen/antibody biological system with a polymeric vertically-coupled microring resonator as a transducer.

16:00 – 17:30
CK-6: Plasmonic Nanostructures and Applications
Chair: Sergei Romannov, Max Planck Institute for the Science of Light, Erlangen, Germany

CK-6.1 WED 16:00
Broad-spectrum chiral optical response in achiral structures patterned from silver nanoparticles by plasmon-assisted two-photon direct laser lithography
X. Vidal1,2, W.J. Kim3, A. Bae4, V. Tokar5, H. S. Joo6, M.T. Swihart4,5, P.N. Prasad6,7, 1 Macquarie University, Sydney, Australia; 2 Institute for Lasers, Photonics and Biophotonics, Buffalo, United States; 3 Tara Shevelchenko National University of Kyiv, Kyiv, Ukraine; 4 University at Buffalo, Buffalo, United States

We demonstrate a combined bottom-up and top-down technique for producing submicron-patterned structures that exhibit chiral optical response from ultraviolet to infrared wavelengths. Plasmon-enhanced molecular chirality provides chiral response without broken symmetry in the patterned structures.

16:00 – 17:30
JSIII-2: Rogue Waves and Soliton Dynamics
Chair: Stefan Skupin, Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

JSIII-2.1 WED 16:00
Rogue Waves of the Vector Nonlinear Schrodinger Equations
F. Baronio1, M. Conforti1, S. Wabnitz2, and A. Degasperis3; 1 University of Brescia, Brescia, Italy; 2 Universität Kaiserslautern, Kaiserslautern, Germany

We present a semirational vector solution of coupled nonlinear Schrodinger equations. This family of solutions includes known vector Peregrine solutions, bright- and dark-soliton solutions, and novel vector freak waves.
Mid-IR supercontinuum generation in thulium-doped fiber amplifier.

- V. Kamynin\textsuperscript{1}, Y. Sadovnikova\textsuperscript{2}, A. Karkov\textsuperscript{1}, and V. Tivetrov\textsuperscript{1}; \textsuperscript{1}Prokhorov General Physics Institute, Moscow, Russia; \textsuperscript{2}Moscow State University of Instrument Engineering and Computer Science, Moscow, Russia

Thulium doped fiber amplifier was used as medium for Mid-IR supercontinuum generation. High power density and flatness in the range from 1850 to 2530 nm was observed.

We report on a coherent wind up process of supercontinuum generation in a pulse laser source made of thulium:Yb\textsubscript{2}O\textsubscript{3}.

Monolithic generation and manipulation of nondegenerate photon pairs within a silicon-on-insulator quantum photonic circuit.

- J. Silverstone\textsuperscript{1}, D. Bonneau\textsuperscript{2}, R. Hadfield\textsuperscript{3}, V. Zwiller\textsuperscript{4}, J. Barony\textsuperscript{4}, J. O’Brien\textsuperscript{4}, and M. Thompson\textsuperscript{1}; \textsuperscript{1}University of Bristol, Bristol, United Kingdom; \textsuperscript{2}University of Glasgow, Glasgow, United Kingdom; \textsuperscript{3}TU Delft, Delft, The Netherlands

We report the first on-chip quantum interference between photons generated in two discrete spontaneous four-wave mixing sources, and the manipulation of this biphotonic state using silicon-on-insulator integrated optics.

Ultrafast optical parametric amplifiers.

- Chair: Daniel Brinda, Konstanz University, Konstanz, Germany

Ultra-fast fiber pumped CEP-stabilized dual stage NOPCPA System.

- J. Mitjavich\textsuperscript{1}, T. Binhammer\textsuperscript{2}, T. Lang\textsuperscript{3}, O. Prochnow\textsuperscript{2}, S. Rausch\textsuperscript{2}, P. Rudawski\textsuperscript{2}, C.L. Arnold\textsuperscript{2}, A. I. Hallister\textsuperscript{2}, and U. Morgner\textsuperscript{1,3,4}; \textsuperscript{1}Institute of Quantum Optics, Leibniz University Hannover, Hannover, Germany; \textsuperscript{2}VENTOEN Laser Technologies GmbH, Garbsen, Germany; \textsuperscript{3}Centre for Quantum Engineering and Space-Time Research (QUEST), Hannover, Germany; \textsuperscript{4}Department of Physics, Lund University, Lund, Sweden; \textsuperscript{5}Laser Zentrum Hannover (LZH), Hannover, Germany

NOPCPA pulses with 800 MW of peak-power at high repetition rates with excellent power and CEO phase stability are reported, together with detailed numerical analysis of the parametric amplification process.


- S. Fan; Stanford University, Ginzton Laboratory, Stanford, CA, United States

There is enormous potential for the use of nanophotonics in solar and thermal applications. In this talk, we show that one can use nanophotonic approach to enhance both the voltage and the current of the solar cells. We also show one can use nanophotonics effectively for a number of emerging thermal applications, including both novel approach for radiative cooling in the far field, and active control of heat flow in the near field.

Effective interaction of intense ultra-short laser pulse with nano-structure targets.

- A. Andreev; Max Born Institute, Berlin, Germany

It is shown that optimal foil target relief of nm scale significantly rises laser pulse absorption and improves fast particles and x-ray yield. Generated short electron bunches can be used for production of attosecond pulses.
We show experimentally and numerically that FPU recurrence in low dispersion nonlinear fiber optics experiences multiple appearances and disappearances.
We present the high power cladding pumped all-fiber laser based on the newly developed Erbium doped fiber. Output power of 75 W with record efficiency of 40% was obtained through optimization of fiber design.

Optical Repetition Rate Control of an Erbium-doped All-Fiber Laser

T. Hellwig, S. Rieger, T. Wabnitz, and C. Fallnich, Institut für Angewandte Physik, Westfälische Wilhelms-Universität, Münster, Germany

Optical repetition rate stabilization of a mode-locked all-fiber Erbium laser by changing the refractive index of an intra-cavity Ytterbium-doped fiber via optical pumping is presented.

Impact of parasitic, cascaded, and spatial effects to the spatio-temporal pulse shaping dynamics in optical parametric amplifiers

L. Zhang, J. Hu, S. Cui, and Y. Feng, Shanghai Institute of Optics and Fine Mechanics, Shanghai, China, People’s Republic of (PBC)

The contribution has been withdrawn by the authors.

Heat transfer and non-equilibrium Casimir forces in nanostructured surfaces

R. Guérot, S. Reynaud, and A. Lambrecht, Laboratoire Kastler-Brossel, ENS, UPMC, CNRS, Paris, France

I’ll review recent calculations for Casimir interactions between nanostructured surfaces both at thermodynamic equilibrium and out of equilibrium.

Sub-2-Cycle Laser-Driven Wakefield Electron Acceleration

S. W. Choi, J. Xu, D. Cardenas, T. Rivas, T. Wittmann, F. Krausz, S. Karsch, and L. Veksler

Max-Planck-Institut für Quantenoptik, Garching, Germany

We report on the first laser-driven electron acceleration experiment with a sub-2-cycle (sub-5 fs) multi-TW laser. About 10 MeV dark-current-free electron bunches were observed with charge few pc and few-10 mrad divergence.

Isolated Attosecond Pulse Generation in Transition Metal Ablation Plumes


Blackett Laboratory, Imperial College London, London, United Kingdom; Institute for Electronics, Tashkent, Uzbekistan; Institut für Theoretische Physik and Centre for Quantum Engineering and Space-Time Research (QUEST), Leibniz Universität Hannover, Hannover, Germany

We generate high order harmonics in transition-metal ablation plumes using a sub-2-cycle driving pulse. The giant photo-ionization resonances allow drastic flux enhancements. TDSE modelling and first experiments suggest sub-fs pulse durations from this source.

High-order harmonic generation from controlled plasma mirrors

S. Monchoir, Commissariat à l’Energie Atomique, Gif-sur-Yvette, France

We demonstrate experimentally that varying the density gradient of a plasma mirror allows control over the harmonic generation mechanisms. At very high intensity, this pa-
Bright Dispersive Waves in Dual-Core Microstructured Fiber under Different Laser Pumps
A. Tonello1, K. Krapa1, M. Andreana1, V. Couderc1, G. Manili2, D. Modotto2, U. Minoni3, S. Wabnitz4, A. Barthélémy5, A. Labruyère6, B.M.I. Shalaby7, P. Leproux8, and A.B. Aceves9; 1Université de Liège, Liège, Belgium; 2Université de Lorraine, Metz, France; 3Université de Brescia, Brescia, Italy; 4Southern Methodist University, Dallas, United States

An efficient dispersive wave generation around 1550 nm is obtained thanks to the dispersive properties of a dual-core microstructured fiber. Experimental and numerical results on the role of pump pulse wavelength and duration are reported.

Temporal long-range order in dynamic condensates
A. Hayat1, C. Lange1, L.A. Rozema3, R. Chang4, S. Petritsi5, H.M. van Driel6, A.M. Steinberg7, M. Steger7, D.W. Snoke7, L.N. Pfeffer2, and K.W. West2; 1Department of Physics, Centre for Quantum Information and Quantum Control, and Institute for Optical Sciences, University of Toronto, Toronto, Canada; 2Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, United States; 3Department of Electrical Engineering, Princeton University, Princeton, United States

We study interference between two dynamic exciton-polariton condensates, resonantly injected at different times, observing for the first time long-range temporal coherence in this system. This constitutes a new probe of ultrafast coherent dynamics in exciton-polaritons.

Diaphragm Etching in Extrinsic Fabry-Perot Interferometric Fiber Optic Pressure Sensors
S. Pogegg, D. Tisi, G. Leen, and E. Lewis; University of Limerick, Limerick, Republic of Ireland

We present a novel technique for diaphragm etching in extrinsic Fabry-Perot interferometric fiber optic sensors. The proposed approach accurately monitors online the surface etching in hydrofluoric acid, modeling the Fabry-Perot cavity evolution.

All-optical Polariton Transistor
D. Ballarin1, 2, M. De Giorgi1, 2, E. Cancelleri1, R. Houdré2, E. Giacobino5, R. Cingolani1, A. Bramati1, G. Gigli1, 2, 4, and D. Sanvitto1, 2; 1Istituto Italiano Tecnologia, Lecce, Italy; 2Istituto Nanoscienze - CNR, Lecce, Italy; 3Universidad Autonoma de Madrid, Madrid, Spain; 4EPFL, Lausanne, Switzerland; 5LKB, Paris, France; 6University of Salento, Lecce, Italy

We experimentally demonstrate the working principle of an all-optical transistor in semiconductor planar microcavities, based on the nonlinear interactions between two polariton fluids. The operation as AND/OR gate is shown in a three transistors configuration.

We present an extensive proof of the principle of silicon microring resonators operating as strain sensors as well as a complete study of the influence of the design choices and physical effects.

A mesoscopic plasmonic crystal (opal with a upper gold film) couples efficiently incident light to plasmons over a large visible spectrum. Plasmons excited by nanocrystals close to crystal surface, are radiating in far-field, increasing luminescence.

We show that Josephson plasma solitons in layered high-temperature superconductors can be excited with a strong terahertz electromagnetic field and detected by a transparency window in the perturbed loss function of the material.

Solitonization of the Anderson localization
H. Frederich1, C. Lethiec2, F. Wen2, J. Laverdant3, C. Schwob4, T. Popescu5, L. Dussillard5, L. Coolen1, and A. Maitre1; 1Université Pierre et Marie Curie, Paris, France; 2Laboratory for Nanophotonics,Rice University, Main St, Houston, United States; 3LPMC, Université de Lyon, Université Lyon 1 and CNRS, Villeurbanne, France; 4Service de Physique et Chimie des Surfaces et Interfaces, CEA, IRAMIS, GIF sur Yvette, France

A following the first experimental observation of a new mechanism for rogue wave (RW) formation (PRL 108, 233901 (2012)), we provide an extensive experimental study in mode-locked laser where comparison with non-RW pulsating regimes is provided.
of equilibrium in the framework of the scattering theory.

rameter changes the laser-induced plasma curvature, and hence the beam divergence.

We demonstrate for the first time the generation of isolated attosecond pulses from plasma driven by few-cycle lightwaves with near-relativistic intensity. This is also the first experimental demonstration of the attosecond lighthouse effect.
Surface RABBITT for determination of absolute ionization phase: a novel route towards absolute photoemission delays

R. Locher1, L. Castiglioni2, M. Luchini3, M. Greif1, L. Gallmann1, J. Osterwalder1, M. Hengsberger2, and U. Keller1, 1ETH Zurich, Zurich, Switzerland; 2University of Zurich, Zurich, Switzerland

The RABBITT technique to noble metal surfaces with simultaneous gas phase RABBITT we extracted absolute surface specific ionization phases for low energy photons (25eV - 35eV). This phase gives access to absolute photoemission delays.

Pushing the limits of environmentally stable fibre lasers: 120 fs, 42 nJ, all-PM all-fibre

C. Aguerarguery, A. Ruffle, M. Eriksen, and N. Broderick; Physics Department, University of Auckland, Auckland, New Zealand

We present a multi nano-foles ultra-short pulse laser combining all key features that fibre technology has to offer. We demonstrate the shortest pulse duration combined with the highest pulse energy out of an all-PM fibre laser.

High energy, monolithic fiber femtosecond lasers

- M. Mielke1, X. Peng1, K. Kim1, T. Booth1, W. Lee1, G. Masor1, X. Gu2, R. Lu1, M. Hamamoto2, R. Cline2, J. Nicholson1, J. Fini2, X. Liu3, A. DeSantolo3, P. Westbrook2, R. Windeler2, E. Monberg2, F. DiMarcello3, C. Headley4, and D. DiGiovanni5; 1Rayliance, Petaluma, United States; 2QFS Laboratories, Somerset, United States

We describe monolithic fiber femtosecond lasers with up to 300 µJ pulse energy and duration <50 fs. The energy is 6x higher than any previous demonstration, and the form factor is optimal for industrial manufacturing.

Thulium-doped Channel Waveguide Laser with 1.6 W of Output Power and Exceeding 80% Slope Efficiency

- K. van Dalfzen1, S. Aravazhi3, C. Grivas3, S.M. Garcia-Blanco1, and M. Pollina1; 1University of Twente, Enschede, The Netherlands; 2University of Southampton, Southampton, United Kingdom

A thulium-doped channel waveguide laser in a monolithic double tungstate delivered 1.6 Watts of output power and a slope efficiency exceeding 80 percent.

Photonic-crystal based concave mirror for highly coherent external-cavity semiconductor laser

- M.S. Seghalian1, M. Sellahi1, I. Sagnes2, G. Beaudoin2, X. Lafosse3, L. Legratie3, P. Lalanne4, M. Myers4, and A. Garnach1; 1ITES-CNRS UMR5214, Université Montpellier 2, Montpellier, France; 2LPM-CNRS, Marcoussis, France; 3Laboratoire Photonique, Numérique et Nanosciences, Institut d’Optique-Orsay, Orsay, France

We report how the fluidic noise generated by a single bacteria cell can be measured and quantified by using an optically trapped silica microparticle as a highly sensitive detector.

On-Chip Random Spectrometer

B. Redding, S.-F. Liew, R. Sarma, and H. Cao; Yale University, New Haven, United States

We develop a compact, high-resolution on-chip spectrometer based on multiple scattering of light through a disordered medium. We achieve wavelength resolution of 0.75 nm and 25 nm bandwidth using a 25µm - 50µm scattering structure.

Microresonator-Based Frequency Comb for Optical Self-Reference

- P. DeHaye, D. Cole, S. Papp, and S. Diddams; National Institute of Standards and Technology, Boulder, United States

We demonstrate an octave-spanning and coherent microresonator-based optical frequency comb with an electronically accessible mode spacing of 25.6 GHz. This is accomplished with pulse picking and external broadening in highly nonlinear fiber.

Coherent scattering from aligned single quantum emitters in a dielectric nanoguide

- S. Faze, P. Tüürschmann, S. Cötzinger, and V. Sandoghdar; Max Planck Institute for the Science of Light, Erlangen, Germany

We have developed a new solid-state platform for waveguide-QED, where both high optical densities and single emitter addressability are achieved. Our work paves the way for study of quantum transport in 1-dimensional photonic wires.

Teleportation using a Quantum Dot Entangled-Light-Emitting Diode

- J. Nilsson1, R.M. Stevenson1, K.H.A. Chan1,2, J. Skiba-Szymanska1, M. Lucamarini1, M.B. Ward2, A.J. Bennett2, C.L. Salter1,2, I. Furrer1, D.A. Ritchie2, and A.J. Shields1; 1Cambridge Research Laboratory, Toshiba Research Europe Limited, Cambridge, United Kingdom; 2Cavendish Laboratory, University of Cambridge, Cambridge, United Kingdom

We experimentally emulate the dynamics of a single NV electronic spin coupled to a nanomechanical resonator and explain a self-synchronization effect of the spin dynamics on the simulated mechanical motion.

Single-Photon and Photon-Number-Resolving Detectors Integrated with Waveguide Circuits


We report the integration of two key quantum measurement functionalities with waveguide circuits: A multi-mode interference coupler integrated with two superconducting single-photon detectors, and a waveguide photon-number-resolving detector able to measure up to four photons.
By irradiating unbiased graphene with linearly polarized light we observe ultrafast in-plane current due to the photon drag effect. We demonstrate all-optical control of the photocurrent in space and time domain using two-beam excitation setup.

PD-B.7 WED 19:45
Observation of dispersive-wave emission by temporal cavity solitons

J.K. Jang, S.G. Murdoch, S. Coen, and M. Erkintalo; Physics Department, The University of Auckland, Auckland, New Zealand

We report the first experimental observation of dispersive-wave emission by temporal cavity solitons. This could lead to broader microresonator Kerr frequency combs and supports the idea that Kerr combs are constituted of cavity solitons.

PD-B.8 WED 19:55
All-optical polarization-based temporal cloaking

P.-Y. Bony, P. Morin, M. Guasmi, S. Pitois, and J. Fatome; Laboratoire Interdisciplinaire Carnot de Bourgogne, Dijon, France

We present an experimental demonstration of temporal cloaking of a 10-Gbit/s incident signal based on the concept of nonlinear self-organization of light state of polarization in optical fiber-based systems.

PD-B.9 WED 20:05
Nanoparticle Measurement in the Optical Far-Field

D. Little, R. Karuwitch, A. Joyce, Q. Gao, T. Burgess, C. Jagadish, and D. Kanel; Macquarie University, Sydney, Australia

Radii of single nanowires are measured in the optical far-field using interferometric microscopy. Radius measurements are demonstrated to be accurate to within 2% of the nominal value, highlighting the nanometrology potential of this technique.
CFIE-P.1 WED

A high repetition rate PetaWatt Titanium Sapphire laser is proposed for laser plasma acceleration.

CFIE-P.10 WED

Realization of multi-dimensional laser mode combs by an actively mode-locked fiber laser.

CFIE-P.11 WED

Ultrafast and broadband Optical Nonlinearities from Strongly Phase-Mismatched Second Harmonic Generation.

CFIE-P.12 WED

Chirped pulse four-wave Raman mixing.
Coherent oscillations of the LO phonon-plasmon coupled mode, which have very short lifetime and usually been hidden in strong LO-phonon oscillations, have been selectively observed using femtosecond transient reflectivity measurement with a coherent control technique.

**CF/IE-P.21 WED**  
**XPW based Self-Referenced Spectral Interferometry for few-cycle pulse characterization in the short wavelength IR**  
A. Troncoso, S. Grilli, F. Mival, N. Forget, and C. Haser, 3 FLAIL Scherrer Institut, Villigen, Switzerland; 2 Fis. Nice, France; 3 Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland  
Ultra-short infrared pulses are fully characterized using Self-Referenced Spectral Interferometry. The device is capable of accurate measurement of few-cycle pulses (down to 13 fs at 1.6 μm) over the 1.2-2 μm spectral range.

**CF/IE-P.22 WED**  
**Kerr-lens Mode Locking Without Nonlinear Astigmatism**  
S. Yefet and A. Perel, Bar Ilan University, Ramat Gan, Israel  
We demonstrate complete cancellation of the nonlinear astigmatism in a mode locked Ti:Sapphire laser. We use a novel cavity folding where no special power specific compensation is needed and the Kerr nonlinearity is efficiently exploited.

**CF/IE-P.23 WED**  
**Modeling the Nonlinear Refractive Index in Atomic Gases**  
C. Köhler, R. Guichard, E. Lorrain, S. Cgelkovský, A.D. Bandrauk, L. Bergé, and S. Skupin, 3 CEA- DAM, DIF, Arpajon, France; 2 CNRS, UMR 7614, LCPMR, Paris, France; 1 Carleton University, Ottawa, Canada; 1 Université de Sherbrooke, Sherbrooke, Canada; 2 MNPS, Dresden, Germany; 3 Friedrich Schiller University, Jena, Germany  
We show that saturation of the nonlinear polarization of gases irradiated by intense laser pulses results from ionized electrons, by comparing numerical solutions of the time dependent Schrodinger equation to various models of laser filamentation.

**CF/IE-P.24 WED**  
**Selective detection of phonon-phonon coupled oscillation in indium phosphide using a coherent control technique**  
K. Nakamura, S. I. Harada, and J. His, 3 Tokyo Institute of Technology, Yokohama, Japan; 2 Japan Science and Technology Agency, Kagawa, Japan; 1 Graduate School of Sciences, Osaka Prefecture University, Sakai, Japan  
The detection frequency resolved reflection by the coherent phonon are analyzed by a simple model of semiconductor. The experimental features are well reproduced as a result of band-gap modulation by the LO phonon.

**CF/IE-P.25 WED**  
**Femtosecond laser-induced pulsed ultrasound source in water**  
Y. Breit, A. Jarras, A. Huard, R. Guillermin, J.-P. Sebba, J. Carbonaro, Y.-B. Andu, D. Fattaccini, and A. Mysyrowicz, 1 Laboratoire Optique Appliquée, ENSTA ParisTech-Ecole Polytechnique-CNRS, Palaiseau, France; 2 Laboratoire de Mécanique et Acoustique, Marseille, France; 3 DGA TN, Toulon, France  
We experimentally investigate the acoustic wave generated by an incident ultra short laser pulse in water. The subsequent acoustic wave presents a broadband signal in the ultrasound range.

**CF/IE-P.26 WED**  
**Dynamics of third harmonic yield from a femtosecond laser filament in air**  
Y. Liu, Y. Breit, S. Mityukovsky, A. Huard, A. Coutrot, and A. Mysyrowicz, 1 Laboratoire Optique Appliquée, Palaiseau, France; 2 Centre de Physique Théorique, Ecole Polytechnique, Palaiseau, France  
The third harmonic generation from a focused femtosecond laser pulse in air is studied in the parameter space. An optimal focusing condition is observed and the crucial role of plasma is identified.

**CF/IE-P.27 WED**  
**Dynamics of Fourier Domain Mode Locked Lasers**  
S. Slepnev, 2, R. O'Suhaugnessy, 2, B. Kelzmad, 2 S.P. Hegarty, 2 A.G. Vladimirsky, 2 and G. Hayer, 2, 3 Tyndall National Institute, Cork, Republic of Ireland; 2 Cork Institute of Technology, Cork, Republic of Ireland; 3 Weierstrass Institute for Applied Analysis and Stochastics, Berlin, Germany  
We analyse the dynamics of Fourier Domain Mode Locked lasers and show that the sweeping asymmetry in the output originates from the non-linearities of the amplifier resulting in two regions: chaos and mode group stepping.

**CF/IE-P.28 WED**  
**THz generation by filamentation of two-color femtosecond laser pulses**  
L. Bergé, S. Skupin, C. Koehler, I. Bashkikhin, and J. Herrmann, 1 CEA, DAM, DIF, Arpajon, France; 2 Max Planck Institute K.S, Dresden, Germany; 3 Weierstrass Institute, Berlin, Germany; 4 Max Born Institute, Berlin, Germany  
We theoretically study THz radiation produced by two-color laser filaments is numerically investigated. The dominant mechanism for THz generation is shown to be plasma currents. Calculated THz spectra for various pump pulse agree with previous experimental observations.

**CF/IE-P.29 WED**  
**Asynchronous ultrafast pump-probe experiments: Towards high speed ultrafast imaging with ultrahigh spatial resolution**  
A. Abbas, 1,2,3 Y. Guillet, 1 J.-M. Rampnoux, 1,2 J. Carlier, 3 P. Rigal, 3 E. Mottay, 3 B. Audoin, 3 and S. Dilaire, 3 1 Université de Bordeaux, CNRS, UMR 5295, Talence, France; 2 Université de Bordeaux, CNRS, UMR 5798, Talence, France; 3 Amplitude Systèmes, Pessac, France  
We report on a system able to record movies of ultrafast processes over 20 ns with a sub-picosecond time resolution. A movie of GHz surface acoustic waves propagating over 10000 micron-squared is presented.
We report on an all-optical and femtosecond time-resolved technique to investigate the adhesion between a single gold nanoparticle and a substrate in the GHz range. The detection scheme relies on an intrinsic common-path interferometer.

**CF/IE-P.33 WED**

Dynamics of coherent optical phonons in chalcogenide compounds


- Materials and Structures Laboratory, Tokyo Institute of Technology, Yokohama, Japan
- CREST, Japan Science and Technology Agency, Kawasaki, Japan

- Coherent oscillations of anisotropic Eg phonons have been observed in chalcogenide compounds (Bi2Se3, Bi2Te3, Sb2Te3) in addition to two isotropic A1g phonons using electro-optic sampling. The higher frequency phonons have the shorter lifetime.

**CF/IE-P.34 WED**

Measurement of orbital angular momentum spectrum of optical vortices based on electric-field reconstruction in a spatial domain

- K. Yamane, Z. Yang, K. Shigematsu, Y. Toda, and R. Morita
- Department of Applied Physics, Hokkaido University, and JST CREST, Sapporo, Japan

- A new measurement method for orbital angular momentum spectra of optical vortices, based on electric-field reconstruction in spatial domain, is demonstrated. The method is applicable to ultrabroadband optical vortices, and enables quasi-real-time measurement.

**CF/IE-P.35 WED**

Cross-correlation frequency-resolved optical gating by molecular vibration for ultrashort pulse

- X. Liu, H. Niu, W. Liu, D. Chen, B. Zhou, and M. Bache
- Technical University of Denmark, DTU Fotonic, Department of Photonics Engineering, DK-2800 Kgs. Lyngby, Denmark
- Key Laboratory of Optoelectronic Devices and Systems of Ministry of Education and Guangdong Province, Institute of Optoelectronics, Shenzhen University, Shenzhen, China

- People’s Republic of (PRC)

- Abstract: We experimentally demonstrate a molecular-vibration-based cross-correlation frequency-resolved optical gating (XFROG) technique for ultrashort pulse measurements, which use laser-induced impulsive Raman free induction decay of molecules vibrations as the gate function.

**CF/IE-P.36 WED**

Electron impact excitation of helium and neon atoms in filamentary plasma gratings

- J. Shi, W. N. Zhong, D. Wang, L. Ding, and H. Zeng
- East China Normal University, Shanghai, China

- People’s Republic of (PRC)

- We demonstrated a femtosecond pulse driven electron-impact method to efficiently enhance the fluorescence emission from filament-induced neon and helium ionization. Such an all-optical method holds the potential to improve the sensitivity of laser-induced breakdown spectroscopy.

**CF/IE-P.37 WED**

Ultrashort carrier dynamics of surfactant-corrodeated InAs/GaAs quantum-dot structures designed for THz applications

- N. Daghdestini, M. Aldarban, T. Pimowsky, T. Ochalski, G. Huyet, M. Misous, T. Ackemann, and M. A. Catala
- University of Dundee, Dundee, United Kingdom
- University of Manchester, Manchester, United Kingdom
- King Saud University, Riyadh, Saudi Arabia
- Tyndall National Institute, Cork, Republic of Ireland
- University of Strathclyde, Glasgow, United Kingdom

- Pump-probe investigations show that carrier lifetime in InAs/GaAs quantum-dot structures is dramatically faster when excited at 800 nm than at 1245 nm. Annealed samples exhibit shorter carrier lifetime than as-grown, increasing with pump power in both structures.

**CF/IE-P.38 WED**

Carrier-envelope phase of ultrashort pulses

- Institute for Molecular Science, Okazaki, Japan
- National Chiao Tung University, Hsinchu, China
- University of ROC

- The carrier-envelope phase of the pulse generated through the optical rectification was investigated. A clear difference of the carrier-envelope phase determination between the difference frequency generation and the optical rectification has been found.

**CF/IE-P.39 WED**

Attosecond Laser Clock

- J. Kaushal and O. Smirnova
- Max Born Institute, Berlin, Germany

- We present a new method to time strong field ionization in circularly polarised fields using spin-orbit interaction between the ionising electron and core as a clock.

**CF/IE-P.40 WED**

Generation of spectrally shaped UV-vis supercontinuum femtosecond pulses by means of diffractive lenses

- Universidad de Salamanca, Salamanca, Spain
- Centro de Láseres Pulsados, Salamanca, Spain
- GROCC-INT, Universitat Jaume I, Castellón, Spain

- We demonstrate the use of diffractive lenses to generate tunable supercontinuum pulses in the visible. An isolated anti-Stokes wing is described. The filament formation is studied and a complete characterization of the pulses is provided.

**CF/IE-P.41 WED**

Higher-order Kerr effect and harmonic cascading in gases

- M. Bachle, E. Eilenberger, and S. Minardi
- Technical University of Denmark, DTU Fotonic, Department of Photonics Engineering, Lyngby, Denmark
- Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Jena, Germany

- We show that cascading from the Kerr effect and the higher-order Kerr effect can modify the observed nonlinear index in gases: for near-IR wavelengths the observed saturation intensity increases, while it decreases for longer wavelengths.

**CF/IE-P.42 WED**

Improved performance characteristics for the integrated photonic pupil remapping interferometer Dragonfly

- N. Ivanovici, S. Gross, A. Arriola, N. Charles, P. Tuthill, B. Norris, P. Stewart, J. Lawrence, and M. Withford
- 1Sabaru Telescope, Hilo, United States
- 2Macquarie University, Sydney, Australia
- 3University of Sydney, Sydney, Australia
- 4Australian Astronomical Observatory, Sydney, Australia

- We present the considerable performance improvements of the ultrafast laser inscribed 3D pupil remapping photonic chips utilised in the Dragonfly astronomical interferometer and the associated gains to the instrument as a whole.

**CF/IE-P.43 WED**

Generation of tunable and ultrahigh repetition rate by fractional Talbot effect in frequency-shifted feedback lasers

- H. Guillaume, O. Ochiat, O. Hugon, W. Glastra, and P. Lacot
- CNRS/ULF Laboratoire Interdisciplinaire de Physique, Saint Martin d’Hères, France

- We demonstrate in a seeded frequency shifted feedback laser, the generation of Fourier-limited pulses at tunable and ultrahigh repetition rates, limited only by the laser spectral bandwidth. This property is interpreted as fractional Talbot effect.

**CF/IE-P.44 WED**

Supercontinuum generation in bulk diamond - experiment and the model

- T. Saradas, A. Lapini, B. Gadomska, and R. Rigoti
- 1Department of Chemistry, University of Warsaw, Warsaw, Poland
- 2European Laboratory for Non-linear Spectroscopy (LENS), Università di Firenze, Florence, Italy

- Supercontinuum was generated in a bulk diamond crystal. The blue edge of supercontinuum was found to be at 615 nm. Nonlinear envelope equation with strong Raman response was used for modeling.
CJ-P.3 WED
Er:LiLuF4 upconversion waveguide laser with femto-second-laser written circular cladding structures
P. Moglia1, S. Müller1, T. Calmano1, C. Kränkel1,2, and G. Huber1,2
1 Institut für Laser-Physik - Uni Hamburg, Hamburg, Germany; 2 The Hamburg Centre for Ultrafast Imaging, Hamburg, Germany

Upconversion waveguide lasers are realized by inscribing circular claddings in an Er:LiLuF4 crystal via a femtosecond-laser. By Ti:Sapphire pumping at 974 nm, laser oscillation at 522.6 nm was achieved with Pout = 10 mW.

CJ-P.4 WED
Mirrorless optical parametric oscillator in a stitched waveguide
C. Montes, P. Aschieri, and M. de Micheli; LPAC-CNRS, Université de Nice Sophia Antipolis, F-06108 Nice, France

A sequence of submicron periodically poled GaN waveguide elements, jointed by uniformly polarized domains representing stitching errors, achieve a mirrorless optical parametric oscillator unsensitive to them due to the coherence of the generated backscattered wave.

CJ-P.5 WED
Monolithic thulium-doped fiber laser with UV femtosecond-laser-induced fiber-Bragg-grating pair
P. Peterka1, P. Honszák1, M. Becker2, F. Todorov2, M. Pisárková2, O. Podrážský2, and I. Čišák1,2
1 Institute of Photonics and Electronics ASCR, v.v.i., Prague, Czech Republic; 2 Technical University of Liberec, Liberec, Czech Republic

We present experimental measurement and full numerical model for the simulation of mode-locked thulium lasers. Using full generalized envelope equation model, we obtain remarkable agreement with experiments and rigorously modelled gain dynamics.

CJ-P.6 WED
Refining the Modelling of Mode-Locked Fiber Lasers
M. Erkintalo, C. Aguerregaray, A. Rauge, and N. Broderick1
1 Institute of Photonics and Lasics, The University of Auckland, Auckland, New Zealand

We present a refined model for the simulation of mode-locked fiber lasers. Using full generalized envelope equations and rigorously modelled gain dynamics, we obtain remarkable agreement with experiments.

CJ-P.7 WED
Experimental Investigation of Delivery and Spectral Broadening of Nonlinear Second-Pulse Waves in Bragg fiber with Silicon Core
M. Jelínek1, V. Kabec2, H. Jelínková1, V. Matejček2, I. Kasík2, and O. Podrážský2
1 Czech Technical University in Prague, FNSPE, Prague, Czech Republic; 2 Institute of Photonics and Electronics AS CR, v.v.i., Prague, Czech Republic

Delivery of 1.06µm nanosecond millijoule-level laser pulses through the laboratory-fabricated silica-core Bragg fiber was investigated. Fiber transmittance up to 55% in fundamental transversal-mode was achieved together with significant spectral broadening ranging from 850 to 1650nm.

CJ-P.9 WED
Nonlinear Spectral Transformation of Partially Coherent Pulses of Mode-Locked Fiber Laser
S. Kobtsev1, S. Smirnov, A. Ivanenko, and S. Kukarin
Novosibirsk State University, Novosibirsk, Russia

Applicability of novel partially coherent lasing regimes for second harmonic generation is considered for the first time. It’s shown that such regimes are very promising having comparable transformation efficiency and higher peak power and energy.

CJ-P.10 WED
Temporal and Statistical Properties of the Ytterbium Doped Fiber Laser
A. Bednárová1, O. Gorbunov2, M. Politko2,3, S. Kablukov2, S. Smirnov1, D. Churkin4,5, M. Fedorov1,3, S. Turisym1, and S. Babín4
1 Institute of Computational Technologies SB RAS, Novosibirsk, Russia; 2 Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia; 3 Novosibirsk State University, Novosibirsk, Russia; 4 Inversion Fiber Co. Ltd., Novosibirsk, Russia

All-fiber continuous-wave Ho-doped laser utilizing the compressed Bragg grating reflector was realized with emission wavelength tuned from 2.1 to 2.045 µm.

CJ-P.11 WED
Engineering Wavelength Conversion Span in Cascaded Broadband Cherenkov Radiation
T. Wang1, J. Hu1, H. Guo2, and X. Zeng1,2
1 Shanghai University, Shanghai, China; 2 People’s Republic of (PRC); 2 Technical University of Denmark, Kgs. Lyngby, Denmark

We propose an efficient approach of engineering the wavelength conversion over 500 nm through optical Cherenkov radiation. Cascaded soliton spectral tunneling is numerically demonstrated in two-segment photonic crystal fibers with three zero dispersion wavelengths.

CJ-P.12 WED
NLSE-based modelling of a random distributed feedback fiber laser
D. Churkin1,2 and S. Smirnov1
1 Aston University, Birmingham, United Kingdom; 2 Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia; 3 Novosibirsk State University, Novosibirsk, Russia

For the first time we report full NLSE-based numerical modelling of a random distributed feedback fiber laser based on Rayleigh scattering, including calculation of spectral and statistical properties of radiation.

CJ-P.13 WED
Wavelength and Pulse Width Tunable 1 µm Yb-doped Programmable Fiber Laser
Y. Kim, A. Archaeubault, A. Dupuis, B. Bourgogne, G. Pena, and A. Villeneuve; Genia Photonics Inc., Laval, Canada

We present an Yb programmable laser where the wavelength and the pulse width can be tuned independently. Wavelengths are tuned from 1020 to 1080 nm and the shortest pulse after compression is 4 ps.

CJ-P.14 WED
Gain-switched, Yb-doped, all-fiber laser with narrow bandwidth
C. Larsen1, M. Giesberts1, S. Nyo2, O. Fitzar2, H.D. Hoffmann2, and O. Bang1,3
1 DTU Fotonik - Department of Photonics Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark; 2 Fraunhofer-Institute for Laser Technology, Aachen, Germany; 3 NKT Photonics A/S, Birkerød, Denmark

We demonstrate that an all-fiber, narrow bandwidth, high pulse energy pulsed laser can be constructed from commercially available components by applying gain-switching. After single-stage amplification the pulses are frequency doubled in pSiL with high efficiency.

CJ-P.15 WED
Anneling of pre-darkened ytterbium doped silica-Kinetik model
K.E. Mattoon; DTU Fotonik, Lyngby, Denmark

A common description by ~SiO2-Yb color center three-electron bond energies is through a Markov state statistical model in this presentation shown to match annealing data from pre-darkened ytterbium co-doped silica material of several sources.

CJ-P.16 WED
Development of a cascaded Raman fiber laser with 6.5 W output power at 1480nm supported by detailed numerical simulations
M. Stein1,2, E. Schreiber1,2, D. Krakl1,2, J. Neumann1,2, and P. Weigel1,2
1 Laser Zentrum Hannover e.V., Hannover, Germany; 2 Centre for Quantum Engineering and Space-Time Research - QUEST, Hannover, Germany

A cascaded Raman fiber laser delivering 6.5W output power at 1480nm was developed and optimized with a detailed numerical analysis. Comparison of experimental and simulated results shows good agreement with respect to all significant parameters.

CJ-P.17 WED
Precision-dicing of Nd:YAG ridge waveguides: A new platform for efficient integrated lasers
D. Kip1, C.E. Rüter1, Y. Ji2, F. Chen3, S. Akhmadaliev3, and S. Zhou1
1 Helmut Schmidt University, Hamburg, Germany; 2 Shandong University, Jinan, China; 3 People’s Republic of (PRC); 4 Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

Ridge channel waveguides in a neodymium-doped YAG crystals are fabricated using a combination of carbon ion implantation and diamond blade dicing, yielding high slope efficiency of 43% and output powers up to 84Wm.

CJ-P.18 WED
30 W, CW Yb-doped fiber laser tunable over 144 nm
R. Royon1, J. Lhermitte1, L. Sargé2, and E. Cormier1
1 CELLIA BOREAUX 1, TALENCE, France; 2 LOMA BOREAUX 1, TALENCE, France

An ytterbium-doped fiber laser continuously tunable from 976nm to 1120nm and delivering up to 30W of average power linearly-polarized is demonstrated. Moreover the bandwidth of our system can be tuned from 100pm to more than 1nm.

CJ-P.19 WED
Spectral width optimization in random DBF fiber laser
I. Vatnik1, D. Churkin1,2, and S. Babín1,3
1 Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia; 2 Aston Institute of Photonic Technologies, Birmingham, United Kingdom; 3 Novosibirsk State University, Novosibirsk, Russia

We experimentally study power and spectral properties...
of random distributed feedback laser depending on the cavity length. Increase of the random DBR fiber laser length results in narrower generation spectrum.

CJ-P.20 WED
High-power Widely Tunable Raman Fiber Laser
• A. El-Taher, P. Harper, S. Babin, and S. Turitsyn; 1Aston University, Birmingham, United Kingdom; 2Institute of Automation and Electrometry, Novosibirsk, Russia
A possibility to greatly increase a tuning range and output power of the Raman fiber laser by combining effects of highly-nonlinear fiber and Rayleigh-scattering based feedback in the cavity has been demonstrated.

CJ-P.21 WED
Efficient Spectral Broadening and Recompression of 200 fs Pulses from a Monolithic Yb:FCPA to 66 fs
• T. Florý, K. Regeliska, A.J. Verhoef, I. Bugar, L. Zhu, A. Zheiltikova, A. Fernandez, and A. Baltuska; 1Institut für Photonik, Technische Universität Wien, Wien, Austria; 2Center for Physical Sciences and Technology, Vilnius, Lithuania; 3Institute for Quantum Studies, Department of Physics, College Station, United States; 4International Laser Center, M.V. Lomonosov Moscow State University, Moscow, Russia
We present pulse post-compression down to 66-fs of a 200-fs microjoule-level ytterbium-doped fiber chirped-pulse amplifier. Post-compression is achieved in a 20-cm long piece of large mode area fiber and subsequent compression in a prism compressor.

CJ-P.22 WED
All-fiber passively Q-switched Erbium/Samarium laser
• C.E. Preda, G. Ravet, and P. Méret; University of Mons, Mons, Belgium
We present the experimental demonstration of a novel and simple all-fiber configuration, where an Er-doped fiber laser, using Sm-doped fiber as a saturable absorber, oscillates in self-Q-switch operation by using a cw pumping.

CJ-P.23 WED
Optical Parametric Amplification in Capillary-Assisted Chalcogenide Optical Fibers
• S. Singh, S. Varshney, and P. Dutta; Indian Institute of Technology, Kharagpur, India
We present detailed theoretical investigation of tunable optical parametric amplification in a 20cm long capillary-assisted chalcogenide optical fiber pumped at 2.94μm wavelength with 20W CW laser for generation of wide bandwidth radiations in mid-infrared range.

CJ-P.24 WED
Square Pulse Generation from All-Normal-Dispersion Graphene Oxide Mode-Locked Yb-Doped Fiber Laser
• Z. Cheng, S. Wu, Q.-H. Yang, and P. Wang; 1Institute of Laser Engineering, Beijing University of Technology, Beijing, China; 2Chinese Academy of Science (CAS) and Chinese Academy of Engineering Physics (CAEP)/CAS; 3School of Chemical Engineering and Technology, Tianjin University, Tianjin, China, People’s Republic of (PRC)
We demonstrated a mode-locked Yb-doped fiber laser with graphene oxide as saturable absorber, delivering square-shaped nanosecond pulse with highest pulse energy of 1.2nJ. The laser spectrum was Lorenz-shaped at 1064nm with bandwidth of 0.19nm.

CJ-P.25 WED
Vapor-Phase Doping of Ytterbium in High Power Laser Fiber
• R. Sen, S. Maita, A. Pal, and M. Pal; Fiber optics & Photonics Division, CSIR-Central Glass & Ceramic Research Institute, Kolkata, India
A state-of-the-art facility for vapor-phase deposition of rare-earth compounds has been established and process technology optimized for fabricating large core preforms/fibers doped with Yb- and Al- oxides with excellent longitudinal and radial uniformity.

CJ-P.26 WED
Single-pulse operation in actively Q-switched erbium-doped fiber lasers
• V. Barmenkov, L. Escalante-Zarate, S. Kolpakov, A. Kir’yanov, and M. Andres; 1Centro de Investigaciones en Optica, Leon, Mexico; 2Universidad de Valencia, Valencia, Spain
The features of an actively Q-switched erbium-doped fiber laser arranged in symmetric and quasi-symmetric configurations are reported. It is shown that single per modulation period Q-switch pulses without any multiple pulse-structure is attainable using both schemes.

CJ-P.27 WED
Suppression of photo-darkening by Ca additive in Yb-doped silica fiber
• Y. Fujimoto, S.-i. Sugiyama, M. Marakami, H. Nakano, T. Sato, and H. Shiraiga; 1Institute of Laser Engineering, Osaka University, Suita, Japan; 2Kinki University, Faculty of science and Engineering, Higashiosaka City, Japan; 3Shin-Etsu Quartz Products Co., Ltd., Koriyama
We found that Ca additive effectively suppresses the photo-darkening effect in Yb-doped silica fiber even at 6.0 wt% of high YbO2:O3 concentration. Ca ion works as a stabilizer to maintain the Yb3+ valence state.

CJ-P.28 WED
3.3 MHz repetition rate all-fiber laser oscillator mode-locked by polarization rotation in PM fiber
• S. Boivine1,2, J.-B. Leocourt, C. Courteig, D. Giannone, Y. Hernandez, and P. Megret; 1Multilis, Mons, Belgium; 2University of Mons, Mons, Belgium
We present an all-fiber passively mode-locked laser at 1031 nm based on non-linear polarization evolution in fully polarization maintaining cavity. The pulses duration is 2.83 picoseconds at a repetition rate of 3.3MHz.

CJ-P.29 WED
Fundamental Mode Amplification in 140 μm Core Diameter Fiber
M. Vanholsbergen, B. Shulga, and A. A. Ishaya; Ben-Gurion University of the Negev, Beer-Sheva, Israel
We experimentally demonstrate the preservation and amplification of the fundamental mode in highly multimode passive and active fibers. We investigate the performance as function of fiber length, coating radius and amplification conditions.

CJ-P.30 WED
Infrared supercontinuum generation in soft-glass photonic crystal fiber pumped with a femtosecond Er-doped fiber laser mode-locked by graphene saturable absorber
• R. Buczynski1,2, G. Sobon2, J. Soto2, G. Stepieński2, D. Pysz2, T. Martyntykien2, M. Klimczuk2, R. Stepień2, and K. Abrashkin; 1Department of Glass, Institute of Electronic Materials Technology, Warsaw, Poland; 2Faculty of Physics, University of Warsaw, Warsaw, Poland; 3Laser & Fiber Electronics Group, Wroclaw University of Technology, Wroclaw, Poland; 4Institute of Physics, Wroclaw University of Technology, Wroclaw, Poland
A generation of flat, broadband infrared supercontinuum is reported in the single mode photonic crystal fiber made of lead-bismuth-gallate glass. The fiber is pumped with a femtosecond Er-doped fiber laser mode-locked by graphene saturable absorber.

CJ-P.31 WED
Efficient single-frequency pulsed all-fiber amplifier for coherent lidar
• C. Bolig, P.-G. Hofmeister, M. Kunze, J. Schmidt, S. Fayed, and R. Reuter; Physics Department, University of Oldenburg, Oldenburg, Germany
An efficient Erbium-amplifier is demonstrated which delivers up to 20 μJ single-frequency pulses with 100 mW average power for only 800 mW of pump power. No signs of SBS were present at this power.

CJ-P.32 WED
Highly Efficient fs-Laser Incribed Yb:YAG Waveguide Lasers Fabricated with a Novet Writing Scheme
T. Calmano, S. Müller, C. Kränkel1,2, and G. Huber1,2; 1Institute of Laser-Physics, University of Hamburg, Hamburg, Germany; 2The Hamburg Centre for Ultrafast Imaging, Hamburg, Germany
Femtosecond-laser written Yb:(7%):YAG waveguide lasers with a record high optical-to-optical efficiency of 67% and an output power of more than 1W are presented. For the waveguide fabrication a novel writing scheme with an oscillating translation was applied.

CJ-P.33 WED
160 W single-frequency laser based on active tapered double-clad fiber amplifier
• A. Trikheyev, A. Zurkov, V. Tretkvon, S. Filatova, J. Kertidal, V. Filipov, O. Okhotnikov, and Y. Chumorovsky; 1Prokhorov General Physics Institute, Russian Academy of Sciences, Moscow, Russia; 2Moscow State University of Instrument Engineering and Computer Science, Moscow, Russia; 3Optoelectronics Research Centre, Tampere University of Technology, Tampere, Finland; 4Institute of Radio Engineering and Electronics of the Russian Academy of Sciences, Moscow, Russia
160 W single-frequency laser based on two stage fiber amplifiers is presented. A GTWave fiber is used for the first stage and tapered double-clad fiber is used for the second stage of amplifier.

CJ-P.34 WED
High-average-power nanosecond pumped Yb-doped PCF fiber laser systems
• T. Yamamura1,2, H. Yoshida2, K. Tsukamoto2, H. Fujito, N. Miyangame1, M. Ishikawa1, T. Sokagawa1,2, and M. Tsukamoto; 1Kagaku Corp., Kyoto, Japan; 2Institute of Laser Engineering, Osaka University, Osaka, Japan; 3Advanced Laser and Process Technology Research Association, Tokyo, Japan; 4Joining and Welding Research Institute, Osaka University, Osaka, Japan
We have developed a high-power and high-average power Yb-doped rod PCF fiber laser system. The output power has been achieved to about 393 W by a 100-μm PCF rod type fiber.

CJ-P.35 WED
Pump Power Reduction by Photodarkening in Yb-doped Fibers
• S. Yoo1, N. Li2, X. Yu2, and J. Sahu3; 1Nanyang Technological University, Singapore, Singapore; 2Singapore Institute of Manufacturing Technology, Singapore, Singapore; 3University of Southampton, Southampton, United Kingdom

Design curves based optimization and fabrication of a high gain Yb-Er co-doped optical amplifier based on phosphate glass.

**Extended Abstract**

**Title:** Design curves based optimization and fabrication of a high gain Yb-Er co-doped optical amplifier based on phosphate glass.

**Authors:** T. Zhang¹, C. Šenel¹,², R. Hamid³, and F.O. Ilday⁴,

¹Department of Physics, Bilkent University, Ankara, Turkey;
²Department of Engineering, University of Cambridge, Cambridge, United Kingdom;
³We have presented an all-fiber dispersion-managed Yb-doped fiber laser with SWNT-DA. Using PCE for dispersion compensation, in the net normal dispersion regime mode-locked pulses with large linear chirp have been obtained, which can be compressed to 118 fs.

**CJ-P.40 WED**

**Title:** Generation of ultrashort pulse with high peak power using Mach-Zehnder-modulator-based flat comb generator and chirped pulse amplification.

**Authors:** N. Morohashii, T. Sakamotoii, K. Hanaiii, M. Okawaiii, T. Kawamishii, and I. Houaki.

**CJ-P.41 WED**

**Title:** A novel seven-core multimode tellurite fiber.

**Authors:** Z. Cheng, Z. Duan, M. Liao, W. Gao, D. Deng, T. Suzaki, and Y. Oishi.

**JSII-P.2 WED**

**Title:** Detection of hazardous substances using an electron multiplying camera.

**Authors:** J. Jarvis, Q. Yang, R. Oesterdorff, C. Schilling, R. Diandii, R. Aidami, A. Bächeli, W. Brommer, and J. Wagner.

**CJ-P.38 WED**

**Title:** First demonstration of a laser emission in hybrid nanostructured optical fibers based on SiO2/SrO2 system doped by ytterbium ions.


**JSII-P.3 WED**

**Title:** Experimental investigation of propagation properties of a silicon nanowire laser.

**Authors:** I. Ramcharan, S. Giri, D. Jha, and N. Mahapatra.

**CJ-P.42 WED**

**Title:** Narrowband fibre laser using a cylindrical optical microresonator as feedback element.

**Authors:** E. Baró, P. Deme, M. Vandenbosch, E. Meystre, R. Meystre, and R. Devreux.

**CJ-P.43 WED**

**Title:** Time- and Position-Dependent Modelling of High-Power Low-Repetition Rate Er-Yb-Fiber Amplifier.

**Authors:** I. Pavlov, E. Dulgergil, P. Ehlbi, and F.O. Ilday.

**CJ-P.44 WED**

**Title:** Experimental Investigation of Bending Properties of Large Mode Area Photonic Crystal Fiber with Double Lattice Constant Structure.

**Authors:** M. Napierski, E. Berel-Pawlik, P. Mergo, E. Berghmans, H. Thiendonk, and T. Noack.
Phase evolution of localized surface plasmon (LSP) modes is measured along a periodic gold nanorod chain integrated on silicon waveguide. Numerical analysis of this phase at different wavelengths clarifies LSP mode excitation mechanisms.

II-P.3 WED

Harmonic generation in plasmonic nanowires

- A. de Hoogh, M. Wulf, N. Rotenberg, and K. Kuppers; FOM Institute AMOLF, Amsterdam, The Netherlands

Near-field measurements reveal efficient second and third harmonic generation from a surface plasmon polaron propagating along a plasmonic nanowire. The influence of nanowire dimensions on the amplitude of the nonlinear signals is investigated.

II-P.4 WED

Passive plasmonic filters in metallic slot waveguides

- P. Neuteboom1,2, L. Lagae1,2, and P. Van Dorpe1,2; Imec, Leuven, Belgium; 2KU Leuven department of Physics, Leuven, Belgium

We present the numerical and experimental demonstration of plasmonic Bragg filters and resonators metallic slot waveguides. Tuning of the optical bandgap, the resonator center wavelength and the Q-factor will be shown.

II-P.5 WED

Tailoring channel plasmon polaritons in metallic V-grooves

- C. Smith, A. Thilsted, R. Marie, C. Vannabme, and A. Kristensen; Technical University of Denmark, Kgs. Lyngeby, Denmark

The intensity distributions of channel plasmon polaritons in metallic V-groove waveguides are tailored via controlled variation of the V-shaped cross section profile. Experiments measuring propagation length and coupling efficiency agree with numerical simulations.

II-P.6 WED

Towards a microscopic description of the optical nonlinearities of gold-based plasmonic devices

- E. Biancalana1 and A. Martin1; 1Max Planck Institute for the Science of Light, Erlangen, Germany; 2Heriot-Watt University, Edinburgh, United Kingdom

We describe the so-called thermo-modulation nonlinear effects on surface plasmon polaritons guided along gold nanowires, by introducing a NLS to model pulse propagation and predicting the appearance of a previously unknown intense spectral redshift.

II-P.7 WED

Reflection, Transmission, Absorption, Diffraction and Gain in Plasmonic-Photic Ag-Decked Monolayers of Dye-Doped Nanospheres

- N. Arnold, B. Ding, C. Hreleucu, and T.A. Klíar; Institute of Applied Physics, Johannes Kepler University, Linz, Austria

General framework for oblique irradiation modeling, which accounts for reflection, transmission absorption and diffraction, is presented. In our hybrid plasmonic-photonic structure, we find gain-enhanced extraordinary transmission, reflection, diffraction and various types of polarization conversion.

II-P.8 WED

Enhancing the fluorescence of thick-shell single CdSe-CdS nanocrystals through their coupling with plasmon resonances of gold films

- D. Canesse1, M. Mallek-Zouari1, S. Bui1, X. Quélin1, C. Javaze2, B. Mahler1, B. Dubertret2, and J-P. Hermier1,2; 1Groupe d’Etude de la Matière Condensée, Université de Versailles-Saint-Quentin-en-Yvelines, CNRS UMR8635, Versailles, France; 2Laboratoire d’Optique et d’Etude des Matériaux, CNRS UMR8213, Paris, France; 3Institut Universitaire de France, Paris, France

We investigate the classical and quantum properties of the emission of single CdSe-CdS nanocrystals with a thick shell coupled to plasmon modes of gold films. Strong enhancement of the nanocrystal fluorescence is reported.

II-P.9 WED

Second Harmonic Circular Dichroism from Au Covered Polyisoprene Nanospheres

- A. Belardini1, G. Lesha1, A. Beneventi2, M. Centini2, F. Mata3, S. Sennato1, C. Sibilla1, F. Buatier de Mongeot4, C. Martell3, M. Giordano5, and D. Chiappe2; 1Univ.Roma 1 Dip SBAL, Roma, Italy; 2Univ Genova Dip Fisica, Genova, Italy

Measurements of the second harmonic circular dichroism arising from polyisoprene nanospheres partially covered by thin Au layer show the presence of a geometrical induced chiral response due to mutual coupling of the nanopatterned metal caps.

II-P.10 WED

Optical magnetic response of laser fabricated Si nanoparticles

- U. Zywietz1, A. Elyakubkin1, W. Cheng2, S. Novikov2, C. Reinhardt1, S. Bozhevolnyi2, and B. Chichkov1; 1Laser Zentrum Hannover e. V., Hannover, Germany; 2Institute of Technology and Innovation, Odense M, Denmark

 Femtosecond laser-induced transfer is used to fabricate spherical Si nanoparticles with unique characteristics. Measured light scattering spectra of individual Si nanoparticles with radii of 50-300 nm demonstrate strong resonant responses in the visible spectral range.

II-P.11 WED

Direct mapping of plasmonic near-fields using infrared far-field vibrational spectroscopy

- D. Dregely1, F. Neubrech2, H. Duane1, and H. Giessen1; 14th Physics Institute and Research Center SCoPE, University of Stuttgart, Stuttgart, Germany; 2Department of Physics and Microelectronics, Human University, Changhai, China; 3People’s Republic of (PRC)

We mapped plasmonic near-field intensities by resonantly enhanced infrared far-field spectroscopy. We positioned a molecular probe at different locations of plasmonic antennas and measured the local vibrational signal with FTIR spectroscopy.

II-P.12 WED

Nonlinear gyrotropy in isotropic metamaterials

- I. Shadrivov; Australian National University, Canberra, Australia

We propose and demonstrate experimentally a metamaterial which chirality can be dynamically induced in a non-chiral medium. This becomes possible in a racemic mixture of metallic spirals, where one type of spirals is nonlinear.

II-P.13 WED

3D Metallic Photonic Crystals with Optical Bandgaps

- M. Farsari, I. Sakelari, N. Volpantzenakis, K. Terzaki, D. Gray, S. Soukoulis, M. Yavuzaklu, and M. Kafesaki; IESL-FORTH, Heraklion, Greece

We present the fabrication and characterization of high resolution, three-dimensional metallic woodpile structures, with bandgaps at optical wavelengths. These are made using Direct Is Laser Writing and selective metallization with electroless plating.

II-P.14 WED

Non-Radiating Excitations, Vector Potential Waves and Toroidal Metamaterials

- V. Savinov1, V.A. Fedotov1, A.V. Rogachev1, D.P. Tsai2, and N.I. Zheludev2,4; 1Optoelectronics Research Centre & Centre for Photonic Metamaterials, University of Southampton, Southampton, United Kingdom; 2Department of Physics, National Taiwan University, Taipei, Taiwan, China, Republic of (ROC); 3Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan, China, Republic of (ROC); 4Centre for Disruptive Photonic Technologies, Nanyang Technological University, Singapore, Singapore

We report on electromagnetic metamaterials that exploit interference between electrical and toroidal dipolar modes of excitation to generate non-trivial gauge irreducible vector potential in the absence of scattered electromagnetic fields.

II-P.15 WED

Plasmonic Crystals for solid-state lighting


It is generally believed that plasmonic structures only provide benefits for light emission when used with low quantum efficiency emitters. Herein we demonstrate a very large emission increase using emitters developed for solid-state lighting applications.

II-P.16 WED

A study in geometry: interferometric control of resonant coupling

- N. Rotenberg1, D.M. Berg1, I.E. Sipe1, and K. Kuppers1; 1FOM Institute AMOLF, Amsterdam, The Netherlands; 2University of Toronto, Toronto, Canada

Control over resonant coupling is demonstrated using two-component gratings that provide two coupling pathways. By tuning the relative phase between the two components, control to surface plasmons can be turned on/off, or made directional.

II-P.17 WED

Effective medium theory for Kapitza stratified media

- A. Ciattoni1 and C. Rizza2; 1Consiglio Nazionale delle Ricerche, CNR-SPIN, Coggiola, Equlia, Italy; 2Dipartimento di Scienza e Alta Tecnologia, Università dell’Insubria, Como, Italy

We show that a medium with rapidly and deeply modulated permittivity hosts a novel regime of diffraction-less propagation. Results are checked through the exact transmissivity analysis of a large modulation depth metal-dielectric layered slab.
Shallow water rogue waves in nonlinear optical fibers

JSIII-P.2 WED

Stabilizing optical rogue waves with fiber topography
*A. Bendahmane*,1 A. Musset*,1 A. Kudinski*,2 G. Genty*,2 and J. Dudley*1 1Laboratoire PhLAM UMR CNRS 8523, IRCICA, Université Lille 1, Villeneuve d’Ascq, France; 2Tampere University of Technology, Optics Laboratory, Tampere, Finland; 3Institute FEMTO-ST, UMR CNRS 6174, Université de Franche-Comté, Besançon, France

We demonstrate for the first time that a particular fiber topography can lead to sustained optical rogue waves. Experimental feasibility of implementing such a varying-topography along a photonic crystal fiber is also discussed.

JSIII-P.3 WED

Experimental demonstration of Rogue waves in disordered Luneburg-type photonic networks
*P. Tzitsios*1,2, M. Mattheakis*1, M. Thevener*1, D. Gray*4, G.P. Tsironis*1,3, and S. Tzitzikis*1,2 1Institute of Electromagnetic Structure and Laser, Foundation for Research and Technology Hellas, Heraklion, Greece; 2Materials Science and Technology Department, University of Crete, Heraklion, Greece; 3Physics Department, University of Crete, Heraklion, Greece

We study extreme waves in disordered Luneburg-type photonic networks demonstrating both experimentally and numerically the existence of rogue waves. We discuss the conditions the phenomenon appears and compare to other systems in optics.

JSIII-P.4 WED

Observation of a Photonic Berezinski-Kosterlitz-Thouless Transition
*G. Situ*1 and *J. Fleischer*2 1Shanghai Institute of Optics and Fine Mechanics, Shanghai, China, People’s Republic of (PRC); 2Princeton University, Princeton, United States

The contribution has been withdrawn by the authors.

JSIII-P.5 WED

Long-range Correlations and the Random Mass Dirac Model on an Integrated Optical Platform
*R. Keill*1, J. Zeuner1, F. Dressow1, M. Heinrich1,2, A. Tümmermann1, S. Nolte1, and A. Scardi*1 1Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Jena, Germany; 2CREOL, The College of Optics & Photonics, University of Central Florida, Orlando, United States

The Dirac equation with spatial mass disorder is simulated by an ensemble of waveguide lattices, including the regime of power-law decaying correlation functions. The results apply to Dirac fermions and a variety of magnetic solids.

JSIII-P.6 WED

Coherent and Incoherent Rogue Waves in Seeded Supercontinuum Generation
*S.T. Sørensen*, C. Larsen*, U. Mølmer*, P.M. Mølholm†, C.L. Thomsen*, and O. Bang†,‡ 1DTU Fotonik, Technical University of Denmark, Kgs. Lyngby, Denmark; 2NKT Photonics A/S, Birkerød, Denmark

Deterministic supercontinuum can be generated by seeding the modulation instability-induced pulse break-up. We investigate the influence of the modulation instability gain on seeding and demonstrate the generation of coherent and incoherent rogue waves.

JSIII-P.7 WED

Transition from diffraction in regular to Anderson localization in randomized nondiffracting photonic structures
*M. Boguñowski*, S. Brue, P. Rose, F. Diekel, and C. Damm 1Institute of Applied Physics and Center for Nonlinear Science (CeNoS), Muenster, Germany

We report on the experimental realizations of Anderson localization in optically induced randomized potentials. Implementing nondiffracting beams of randomized intensities offers a powerful method to bring disorder into regular structures.
### ROOM 1

**8:30 – 10:00**

**CJ-9: Raman Effects in Fibre Sources**
Chair: Ryszard Buczyński, University of Warsaw, Warsaw, Poland

**CJ-9.1 THU 8:30**

**Radial and azimuthal polarized all-fiber Raman oscillator**
- C. Jorcher¹, C. Jastrzebski¹, M. Becker², M. Rothhardt³, J. Limpert¹,³, and A. Tünnermann¹,²,⁴
  ¹Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Jena, Germany
  ²Institute of Photonic Technology, Jena, Germany
  ³Helmholtz-Institute Jena, Jena, Germany
  ⁴Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

We demonstrate an all-fiber Raman fiber oscillator for the generation of radially and azimuthally polarized beams. The influence and compensation of elliptical fiber core is theoretically and experimentally investigated.

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**CJ-9.2 THU 8:45**

**Fibre Raman laser directly pumped by multimode laser diode at 975 nm**
- T. Yao and J. Nilsson; Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom

We present the first-ever continuous-wave fiber Raman laser pumped directly by multimode diodes. The output power reaches 4 W at 1019 nm and the slope efficiency 55% with 3 km of multimode graded-index fiber.

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**CJ-9.3 THU 9:00**

**Raman Gain and Random Distributed Feedback Generation in Nitrogen Doped Silica Core Fiber**
- A. Lanin¹, D. Cherkin¹,₂, K. Golant¹, and S. Tarutyn³
  ¹Aston University, Birmingham, United Kingdom
  ²Institute of Automation

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### ROOM 4a

**8:30 – 10:00**

**II-3: Controlling and Harvesting Light with Plasmons**
Chair: Thomas Klar, Johannes-Kepler-Universität, Linz, Austria

**II-3.1 THU (Invited) 8:30**

**Plasmon Induced Light Harvesting**
- P. Nordlander; Rice University, Houston, United States

Plasmons can be light focuses into non-metal sized hotspots and also be efficient sources of hot energetic electrons. These processes can be exploited in light harvesting applications.

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**II-3.2 THU 9:00**

**Tunable light emission in Reconfigurable Plasmonic Metamaterials**
- G. Adamo¹,², W.T. Chen¹, E. Plum¹, J.-Y. Ou¹, J. Su¹, D.P. Tsai², and N. Zheludev¹,²
  ¹Optoelectronics Research Centre & Centre for Photonics Metamaterials, University of Southampton, United Kingdom
  ²Imperial College of Science, Technology and Medicine, London, United Kingdom

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### ROOM 4b

**8:30 – 10:00**

**CH-4: Metrology of Materials and Structures**
Chair: Stefano Selleri, University of Parma, Italy

**CH-4.1 THU 8:30**

**Spectral-Domain Low-Coherence Dynamic Light Scattering and Its Application to Measurement of the Air-Liquid Interface Effect**
- T. Watarai and T. Iwai; Tokyo University of Agriculture and Technology, Koganei, Japan

The proposed method realizes seamless measurements of the diffusion phenomenon of particles depending on the scattering position without any scanning operation.

The experimental results showed the decrease of the diffusion coefficient close to the interface.

**CH-4.2 THU 8:45**

**Assessment of used Turbine Blades on and beneath the Surface for Product Regeneration: Generation of a Damage Model Based on Reflection, Geometry Measurement and Thermography**
- M. Krauß¹, W. Frackowiak¹, A. Pösch¹, M. Küstner¹, W. Reimchen², E. Reithmeier², and H.J. Maier²
  ¹Leibniz Universität Hannover; Institute of Measurement and Automatic Control, Hannover, Germany
  ²Leibniz Universität Hannover; Institute of Materials Science, Hannover, Germany

For the inspection of used parts from aero engines a hierarchical inspection is developed. This multiscale approach uses hints from the macro scale to determine areas for a higher resolution measurement with different sensor principles.

**CH-4.3 THU 9:00**

**Optical Spectroscopy in the time-domain beyond 1.1 µm: a tool for the characterization of diffusive media**
- A. Farina¹, I. Bajguz¹, A. Bahgat Shehab¹, A. Dalla Mora¹, A. Tos³, F. Zappa¹, P. Tarone¹, R. Cabbeddu¹,², and A. Pifferi¹,²
  ¹University of Firenze, Italy
  ²Federal University of Santa Catarina, Florianópolis, Brazil
  ³University of the Free State, Bloemfontein, South Africa

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### ROOM 13a

**8:30 – 10:00**

**CK-7: Advanced Structures for Light Sources**
Chair: Markus Pollnau, University of Twente, The Netherlands

**CK-7.1 THU 8:30**

**Single Photon Nanophotonics Using NV Centers in Three-Dimensional Laser-Written Microstructures**
- A.W. Schell¹, J. Kaschke¹, J. Fischer², R. Henze¹, J. Wolters¹, M. Wegenèr³, and O. Benson³
  ¹Humboldt-Universität zu Berlin - AG NanoOptik, Berlin, Germany
  ²Institute of Applied Physics, DFG-Center for Functional Nanostructures, Institute of Nanotechnology, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany
  ³Chalmers University of Technology, Göteborg, Sweden

Combination of NV-center-containing nanodiamonds with a photoreis for 3D two-photon laser lithography allows easy integration and combination of single-photon emitters and microstructures. Single-photon emission from different 3D quantum-photonic elements like waveguides and resonators is shown.

**CK-7.2 THU 8:45**

**On-Chip Quantum Optics with Electronically Driven Quantum Dot Microcavities**
- C. Hofmann¹, F. Albert², E. Stock², M. Lerner³, C. Schneider³, S. Höfling³, A. Forchel³, M. Kamp³, and S. Reitzenstein³
  ¹Technische Universität Berlin, Berlin, Germany
  ²Universität Zürich, Zürich, Switzerland
  ³University of Rostock, Germany

A novel concept for on-chip quantum optics using an internal electrically pumped micro-laser is presented. The microcavity resonantly excites a quantum dot - microcavity system operating in the weak coupling regime of cavity quantum electrodynamics.

**CK-7.3 THU 9:00**

**A laser diode for integrated photon pair generation at telecom wavelength**
- G. Boucher¹, A. Oriex¹, B. Bottier¹, A. Ekdsteen¹, E. Galopin², A. Lemaître³, C. Manque¹, F. Favero¹, G. Leo¹, and S. Ducz¹
  ¹Université Paris Diderot, Sorbonne Universités, France
  ²Institut National des Sciences de l'Informatique et des Technologies de l'Information, France
  ³IFN-CNR, Rome, Italy

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### ROOM 13b

**8:30 – 10:00**

**CB-7: Semiconductor Lasers for Optical Communications**
Chair: Erwin Bente, Technische Universität, Eindhoven, Netherlands

**CB-7.1 THU 8:30**

**High-Speed Oxide Confined 850-nm VCSELs Operating Error-Free at 47 Gbit/s at room temperature and 40 Gbit/s at 85°C**
- P. Westerbeek¹, R. Safaïm¹, E. Haglund², J.S. Gustavsson³, A. Larson¹, and A. Joë³
  ¹Chalmers University of Technology, Göteborg, Sweden
  ²IQE Europe Ltd., Cardiff, United Kingdom

We demonstrate high-speed VCSELs capable of reaching small signal modulation bandwidths up to 28 GHz and error-free data transmission up to 47 Gbit/s at room temperature and 40 Gbit/s at 85°C.

**CB-7.2 THU 8:45**

**Transmission over 50 km using a directly modulated integrated two-section distributed feedback laser at 1550 nm**
- J. O’Carroll¹,², P.M. Anandarajah¹, R. Zhou¹, R. Phelan¹, B. Kelly¹, J. O’Gorman¹, and L.P. Barry¹
  ¹The Rince Institute, Dublin City University, Dublin, Republic of Ireland
  ²Editha Photonic Ltd., Dublin, Republic of Ireland
  ³Xiphophone Optics Ltd., Dublin, Republic of Ireland

A two-section device is presented, where optical injection from an integrated master to a slave laser is used to improve the device parameters, including its transmission performance. Transmission over 50 km is demonstrated at 1550nm.

**CB-7.3 THU (Invited) 9:00**

**Multi-wavelength Hybrid Silicon Lasers for Optical Interconnects**
- M. Heck, M. Davenport, G. Kurczewi, S. Jain, and J. Bowers; University of California Santa Barbara, Santa Barbara, United States

Integrated multi-wavelength sources are
IB-5.1 THU 8:30
Free space quantum key distribution over 500 meters using electrically driven quantum dot single photon sources

- M. Rau1, T. Heintze2, S. Unleber3, C. Schneider4, S. Frick1, G. Vest1, S. Nauerth1, M. Lerner1, M. Kamp1, S. Reitzenstein5, A. Forchel1, S. Höfling1, and H. Weinfurter1,2,4
- 1Fakultät für Physik, Ludwig-Maximilians-Universität München, Germany; 2Institut für Festkörperphysik, Technische Universität Berlin, Germany; 3Technische Physik und Wilhelm Conrad Röntgen Research Center for Complex Material Systems, Universität Würzburg, Germany; 4Max-Planck-Institut für Quantenoptik, Garching, Germany

We successfully demonstrated free-space QKD using electrically driven InAs quantum dot single photon sources embedded in micropillar cavities. The electrical excitation scheme allows a much tighter integration of the source compared to optically pumped schemes.

IB-5.2 THU 8:45
Quantum information in the presence of loss

- A. Barity, A.B. Young, B. Bell, and C. Hsu
- Merchant Venturers School of Engineering, Bristol, United Kingdom

We will examine the limitations loss poses to quantum information tasks, and summarise novel ways in which to circumvent losses to perform quantum metrology and loophole-free violation of Bell inequalities.

IB-5.3 THU 9:00
Experimental demonstration of continuous-variable quantum key distribution over 80 km of standard telecom fiber

- P. Jouguet1, S. Kanz-Jacques2, A. Leverrier3, P. Grangier4, and E. Diamanti5
- 1INRS, Quebec City, Canada; 2École Polytechnique, Palaiseau, France; 3Max-Planck-Institut für Quantenoptik, Garching, Germany; 4Laboratoire Kastler Brossel, Paris, France; 5École Polytechnique Fédérale de Lausanne, Switzerland

We will present our experimental demonstration of CV-QKD over standard telecom fiber for distances up to 80 km using continuous wave laser sources.
Raman-driven destabilization of giant-chip oscillators: fundamental limitations to energy scalability
C. Agueraray, A. Range, M. Erkintalo, and N. Broderick; Auckland University, Auckland, New Zealand
We study the destabilization of a GCO mode-locking operation through the emergence of a frequency-downshifted Stokes signal. Our results indicate that SRS imposes an ultimate limit on the energy scalability of GCO via cavity lengthening.

II-3.3 THU 9:15
Large Area Self-Assembled Plasmonic-Photonic Crystals for Spectral and Directional Reshaping of Fluorescence
C. Hrelesc[superscript 1], B. Ding[superscript 1], N. Arnold[superscript 1], G. Iac[superscript 1], and T.A. Kl[superscript 1]; [superscript 1]Institute of Applied Physics, Johannes Kepler University, Linz, Austria; [superscript 2]Institute of Physics, University of Belgrade, Belgrade, Serbia and Montenegro
We report on the spectral and directional modification of fluorescence by hybrid plasmonic-photonic structures. Spectroscopic experiments and numerical simulations reveal different fluorescence coupling mechanisms to dispersive photonic crystal modes and to localized void plasmons.

II-3.4 THU 9:30
Non invasive optical glucose monitoring at physiological levels using a functionalized plasmonic sensor
M. Mesch[superscript 1], C. Zhang[superscript 1], P.W. Braun[superscript 1], P. Rapp[superscript 1], C. Tur[superscript 1], and H. Giessen[superscript 1]; [superscript 1]4th Physics Institute and Research Center ScOpE, University of Stuttgart, Germany; [superscript 2]Department of Materials Science and Engineering, University of Illinois, Urbana-Champaign, USA; [superscript 3]Institute for System Dynamics, University of Stuttgart, Germany
We demonstrate noninvasive glucose monitoring using optical measurements of a plasmonic nanostructure that was functionalized using aminophenylboronic acid. This allows detection of the glucose in the vicinity of the gold nanostructure reproducibly at millimolar levels.

CH-4.4 THU 9:15
Nanometer Optical Coherence Tomography using broad-bandwidth XUV and soft x-ray radiation - XCT
S. Fuchs[superscript 1,2], A. Blum[superscript 1], C. Rödel[superscript 1,2], U. Zastrow[superscript 1], V. Hilbert[superscript 1], M. Wünsche[superscript 1], E. Förster[superscript 1,2], and G.G. Paulius[superscript 1,2]; [superscript 1]Institute of Optics and Quantum Electronics, University of Jena, Jena, Germany; [superscript 2]Helmholtz Institute Jena, Jena, Germany
We report on the extension of Optical Coherence Tomography using extreme ultraviolet and soft x-ray radiation and demonstrate an axial resolution of nanometers in silicon- and carbon-based samples.

CH-4.5 THU (Invited) 9:30
Phase-space Measurement and Coherence Synthesis of Optical Beams
L. Waller[superscript 1], G. Sitts[superscript 2], and J. Fleischer[superscript 3]; [superscript 1]University of California, Berkeley, Berkeley, United States; [superscript 2]Shanghai Institute of Optics and Fine Mechanics, Shanghai, China; [superscript 3]Department of Micro- and Nanotechnology, Technical University of Denmark, DTU Nanotech, Kgs. Lyngby, Denmark
Simple yet precise emission wavelength modelling of multilayer hybrid distributed feedback dye lasers is presented. The influence of the thickness of a high index top layer on emission wavelength and sensitivity is examined.

CK-7.4 THU 9:15
Multi-channel wavelength conversion using four-wave mixing in semiconductor ring lasers
A. Perez-Serrano[superscript 1], J. Javaloys[superscript 2], and S. Balle[superscript 3]; [superscript 1]Universitat de les Illes Balears (UIB), Palma de Mallorca, Spain; [superscript 2]IMEDEA (UIB-CSIC), Esporles, Spain
We propose to use a semiconductor ring laser to perform simultaneous multi-channel wavelength conversion by four-wave mixing. Cross-talk effects, arising from the peculiar four-wave mixing cascade of modes and their cross-gain saturation, are discussed.

CB-7.4 THU 9:30
Multi-channel wavelength conversion using four-wave mixing in semiconductor ring lasers
A. Perez-Serrano[superscript 1], J. Javaloys[superscript 2], and S. Balle[superscript 3]; [superscript 1]Universitat de les Illes Balears (UIB), Palma de Mallorca, Spain; [superscript 2]IMEDEA (UIB-CSIC), Esporles, Spain
We present our work on integrated hybrid silicon arrayed-waveguide grating-based lasers, mode-locked comb lasers and wideband quantum-well-intermixed single-frequency laser arrays.
IB-5.4 THU 9:15
Unconditional security of Gaussian post-selected continuous variable quantum key distribution
N. Walk1, T. Symul2, P.K. Lam3, and T. Ralph1
1 University of Queensland, Brisbane, Australia; 2 Australian National University, Canberra, Australia.

We extend the proof of security for continuous-variable quantum key distribution protocols using post-selection to account for arbitrary eavesdropping attacks by employing the concept of an equivalent entanglement based protocol using noiseless linear amplification.

IB-5.5 THU 9:30
Quantum teleportation over 143 km using active feed-forward between two Canary Islands
X. Ma, IQOQI, Vienna, Vienna, Austria; VCV, Vienna, Univ. of Vienna, Vienna, Austria.

The contribution has been withdrawn by the authors.

CF/IE-10.4 THU 9:15
Manipulating charge separation dynamics of zinc phthalocyanine based TIO2 films through asymmetrical pull-pull structures
D. Sharma1, G. Steen1, T. Torres1, J. Herk1, and A. Huizenga1
1 University of Twente, Enschede, The Netherlands; 2 Universidad Autonoma de Madrid, Cantoblanco, Spain.

Manipulation of the anchoring ligand results in significant changes in the charge separation dynamics of zinc phthalocyanine sensitized TiO2 films, investigated through femtosecond pump-probe spectroscopy.

IA-7.4 THU 9:15
Fabry-Perot Cavity Optomechanics with Ultrahigh Mechanical-\(Q\)-Factor Quartz Micropillars at Cryogenic Temperature
Laboratoire Kastler Brossel, ENS, UPMC, CNRS, Paris, France

We present recent progress towards optical detection of the zero-point-motion of a 25 mg-mechanical quartz resonator. We discuss the optimization of our system to achieve ground state cooling by classical and laser cooling techniques.

IA-7.5 THU 9:30
Squeezing-enhanced Optomechanical Phase Stable Few-cycle OPCPA for Strong Field Physics
U.B. Hofjä1, G. Harris1, L.S. Maiden1, H. Kerndorff2, M. Lassen2, B.M. Nielsen2, W.P. Bowen3, and U.L. Andersen3
1 Department of Physics, Technical University of Denmark, Kgs. Lyngby, Denmark; 2 Centre of Excellence in Engineered Quantum Systems, University of Queensland, St. Lucia, Australia
3 Center for Nano Science and Technology CNST@Polimi, Istituto Italiano di Tecnologia, Milano, Italy;
4 Dipartimento di Fisica, Politecnico di Milano, Milano, Italy; 5 Dipartimento di Chimica, Materiali e Eng.

We experimentally demonstrate a squeezing-enhanced transduction sensitivity in microcavity optomechanics. Probing the mechanical vibrations of a toroidal microcavity with seeded phase-squeezed vacuum we achieve a transduction sensitivity -0.72(± 0.01) dB below the shot noise level.

CF/IE-10.5 THU 9:30
Ultrafast spectroscopy of dinaphthylpolyynes
D. Fazzì1, F. Scotognella1,2, A. Milano1, D. Brida1, C. Mannozzi2, E. Cinquanta2, L. Gorogran1, P. Milano1, P. Cataldo1, M. Negro2, S. Stagira1, and C. Vassallo1
1 Center for Nano Science and Technology CNST@Polimi, Istituto Italiano di Tecnologia, Milano, Italy; 2 Dipartimento di Fisica, Politecnico di Milano, Milano, Italy; 3 Dipartimento di Chimica, Materiali e Eng.

We investigated experimentally and theo-

ROOM 21

2 Laboratoire de Photonique et de Nanostructu-
renes, Marcoussis, France

We present a new generation of optomechanical device designed to perform quantum optomechanics experiment. It combines the high reflectivity of a photonic crystal with the high mechanical Q-factor and low mass of a suspended nanomembrane.

ROOM 22

Knauer1,2, Max-Planck-Institut für Quantenoptik, Garching, Germany; 2 Ludwig-Maximilians-Universität München, Garching, Germany; 3 Ludwig-Maximilians-Universität München, München, Germany

We report on the design and setup of an optical parametric synthesizer delivering <5 fs pulses at 16 TW power. The extended spectrum is amplified in two separate parts using two-color pumped OPCPA.

CG-4.4 THU 9:15
Contrast improvement at petawatt-class lasers using ultrafast optical parametric amplification
E. Wagner1, C.P. Joos2, J. Fili3, T. Gottschall1, J. Hein1, J. Körner1, J. Limpert4, M. Roth1, T. Stöhr1, and V. Bagnoud1
1 Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany; 2 Instituto de Física and Quantum Electronics, Friedrich Schiller University, Jena, Germany; 3 Institute of Applied Physics, Friedrich Schiller University, Jena, Germany

We report on the development of a new compact temporal contrast boosting module for petawatt-class lasers. Using this module we were able to achieve an ASE contrast better than 10 orders of magnitude.

CG-4.5 THU 9:30
High Repetition Rate Carrier-envelope Phase Stable Few-cycle OPCPA for Strong Field Physics
S. Haldor1, J. Rothhardt1,3, S. Demmel1,3, M. Krebs1,3, J. Limpert1,3, and D. Tönnemann1,3,1, Friedrich Schiller University Jena, Jena, Germany; 2 Helmholtz-Institut Jena, Jena, Germany; 3 Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

A sub-two cycle optical parametric chirped pulse amplifier is presented at up to 1 MHz. Carrier envelope phase drifts are minimized by finding a new source of instabilities. Experiments on high harmonic generation are shown.

IFH-3.4 THU 9:30
High Purcell effect and directional emission for semi-conductor nanocrystals determinedistically positioned in a plasmonic patch antenna
C. Belais1,2, B. Hubert3, F. Bigourdans3, F. Marquier4, S. Michaelis de Vaucouleurs4, X. Lafosse1, L. Coles1,2, C. Schoib1,2, B. Dubertret1, J.I. Greffet1, P. Sennellier1,2, A. Maître1,2, and C. Javeaux1,2,1, Université Pierre et Marie Curie-Paris 6, Paris, France; 2 Institut des NanoSciences de Paris, Paris, France; 3 Laboratoire Charles Fabry, Institut d’Optique Graduate School, CNRS, Palaiseau, France; 4 Laboratoire de Photonique et de Nanostructures, Marcoussis, France; 5 Laboratoire de Physique et d’Etude des Matériaux, Paris, France

We realize a plasmonic patch antenna, by
Wavelength correlation maps in Raman supercontinuum generation
A. Aalto1, E. Nystöm1, P. Ryczkowski1, J.M. Dudley1, and G. Genty1; 1Tampere University of Technology, Tampere, Finland; 2Université de Franche-Comté, Besançon, France

We report on the experimental characterization of spectral correlation maps in supercontinuum generation arising from cascaded stimulated Raman scattering. Our analysis provides insight into the dynamics of the broadening process and noise amplification.

Twists and shifts make nonlinear metamaterials
M. Liu1, Y. Sun1, D. Powell1, I. Shadrivov1, M. Lapine2, R. McPhedran2, and Y. Kivshar1; 1Australian National University, Canberra, Australia; 2University of Sydney, Sydney, Australia
We propose a new concept of torsional metamaterials, by exploiting internal rotation within meta-atoms. We demonstrate that it is a more efficient approach for creating strong nonlinear response enhanced by near-field interactions.

Novel physics in photonic crystal nanolasers: Dynamics and Coherence
A. Lebreton1, I. Abram, R. Bräive, I. Sagnes, I. Robert-Philip, and A. Beveratos; CNRS - Laboratoire de Photonique et de Nanostructures, Marcoussis, France
Lasers of diffraction-limited volumes involve the interaction of small numbers of particles (photons and dipoles). We demonstrate that these small populations of discrete particles induce large intensity noise in the output of the laser.

Bidirectional Secure Key-Exchange Using Chaotic Semiconductor Lasers
X. Porte, M.C. Soriano, D. Brunner, and I. Fischer; IFISC (UIB-CSIC), Palma de Mallorca, Spain
We demonstrate the experimental implementation of a secure key-exchange protocol based on delay-coupled semiconductor lasers. We discuss its robustness against desynchronization events and the influence of different parameters on the bit rate and security.
IB-5.6 THU 10:30 – 12:00

**Timing Synchronization with Photon Pairs for Quantum Communications**

T. Lorinser, A. Happe, and A. Poppe; AT&T Austrian Institute of Technology, Vienna, Austria

We present a fully autonomous coincidence window tracking software for our quantum communication system. It is capable of real-time processing and remarkably, neither prior knowledge of the peer clock offsets, nor their drifts required.

IB-6: Photonic Quantum Computing

**Chair:** Shigeki Takeuchi, Hokkaido University, Sapporo, Japan

**IB-6.1 THU 10:30**

**Boson Sampling with realistic single-photon sources**

M. Broome1,2,3, A. Fedrizzi1,2, S. Rahimi-Keshari2, A. Branczyk3, I. Duru4, S. Aaronson5, T. Ralph6, and A. White1,2,3

1Centre for Engineered Quantum Systems, School of Mathematics and Physics, University of Queensland, Brisbane, Australia; 2Centre for Quantum Computer and Communication Technology, School of Mathematics and Physics, University of Queensland, Brisbane, Australia; 3Department of Chemistry and Centre for Quantum Information and Quantum Control, University of Toronto, Toronto, Canada; 4Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, Cambridge, USA

IB-6: Photonic Quantum Computing

**Chair:** Petra Gross, Universität Oldenburg, Oldenburg, Germany

**IB-6.11 THU 10:30 – 11:45**

**Ultrafast Microphotons and Plasmonics**

Chair: Petra Gross, Universität Oldenburg, Oldenburg, Germany

CF/IE-10.6 THU 9:45

**Multi-Delay, Phase-Coherent Pulse Pair Generation for Precision Ramsey-Comb Spectroscopy**

J. Morgenweg and K. Eiken, VU University, Amsterdam, The Netherlands

We present a parametric amplifier system capable of producing coherent pulse-pairs at the mJ-level with adjustable delays well into the microsecond range. The phase for different delays remains constant within 10 mrad.

10:30 – 11:45

**CM-6: Transparent Material Processing**

Chair: Marta Castillejo, Spanish National Research Council (CSIC), Madrid, Spain

**CM-6.1 THU 10:30**

**Ultrashort pulse-induced nanoaggregates: temperature stable optically active phase elements**

E. Zimmermann1, S. Richter1, C. Vetter1, S. Döring1, A. Tünnemann1,2, and S. Nolte1,2

1Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Jena, Germany; 2Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany

We present femtosecond direct written optical components exhibiting circular birefringence. In order to use these nanograting-based phase elements under harsh conditions we demonstrate their resistibility against temperatures up to 850°C.

10:30 – 12:15

**CG-4.6 THU 9:45**

**High-energy pulse synthesis of optical parametric amplifiers**

G. Cirmi1,2,3, S. Fang1,3, S.-H. Chia1,3, O.D. Mücke1, F.X. Kärner1,2,3,4, C. Maxeiner1,2, P. Farinello1, and G. Cerullo1, 3Center for Free-Electron Laser Science, Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany; 2Physics Department, University of Hamburg, Hamburg, Germany; 3the Hamburg Center of Ultrafast Imaging, Hamburg, Germany; 4Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Cambridge, United States; 5IFN-CNR, Dipartimento di Fisica, Politecnico di Milano, Milan, Italy

We demonstrate pulse synthesis of three optical parametric amplifiers, with 40-45 µJ energies each, resulting in a 1.9-fs transform-limited pulse duration. Scalability to the mJ level should easily be achieved, allowing for strong-field physics experiments.

10:30 – 12:00

**CG-5: Waveform Synthesis and Control**

Chair: Lukas Gallmann, ETH Zurich, Zurich, Switzerland

**CG-5.1 THU 10:30**

**Acoustic frequency combs for versatile carrier-envelope phase control**

E. Borchers, M. Mero, and G. Steinmeyer; Max-Born-Institut, Berlin, Germany

A novel approach for carrier-envelope phase stabilization is revealed, offering unconditional long-term stabilization with near-megahertz servo bandwidth and versatile slow drift compensation using only a single acousto-optic device.

10:30 – 12:00

**IH-3.5 THU 9:45**

**Plasmonic nanoantennas for enhanced single molecule analysis at micromolar concentrations**

D. Pauj1, M. Mirvelle2, T. Van Zanten3, *H. Rieupaulx4, N. Van Halst2, M. Garcia-Parrajo5, 2Institut Fresnel, CNRS, Aix-Marseille University, Eole Centrale Marseille, Marseille, France; 3ICFO Institut de Ciences Fotomiques, Castelldefels, Spain

We introduce a novel type of plasmonic nanoantenna especially designed for enhanced (up to 1000-fold) single molecule analysis in solutions at high concentrations (10 micromolar).

10:30 – 12:00

**IH-4: Quantum Nanophotonics**

Chair: Agnès Maître, Université Pierre et Marie Curie, Paris, France

**IH-4.1 THU (Invited) 10:30**

**Controlling stationary and flying quibits for solid-state quantum networks**

M. Aliferis; University of Cambridge, Cambridge, United Kingdom

We will discuss how resonance fluorescence allows control of quantum dot spins as well as coherent generation of tailored single photons suitable for distributed quantum networks.
CJ-10.2 THU 10:45
Bandwidth-Controllable Tunable Q-Switched Thulium Fibre Laser
L.M.O. Daniel and W.A. Clarkson; Optoelectronics Research Centre University of Southampton, Southampton, United Kingdom
A tunable Q-switched thulium fibre laser source with continuously-adjustable linewidth is described. The laser yielded peak power above 1kW at 1960nm and the spectral width could be varied from 0.6nm to 15nm.

CJ-10.3 THU 11:00
Tunable Operation of Core and Cladding Pumped Holmium Fibre Lasers
N. Simakov1,2, A. Hemming1, W.A. Clarkson1, A. Carter1, and J. Hauk1; 1Defence Science and Technology Organisation, Edinburgh, Australia; 2ORC, University of Southampton, Southampton, United Kingdom; 3Naferr Inc., East Granby, United States
We report the tuning range of a resonantly, cladding pumped holmium doped fibre (HDF) and compare this to the tuning range of a core pumped HDF. Further optimisation of double clad holmium fibres is discussed.

CJ-10.4 THU 11:15
LMA effectively single-mode thulium doped fibre with normal dispersion at wavelengths around 2μm
C. Baskiotis, A. Heid, S. Alam, and D. Richardson; Optoelectronics Research Centre, Southampton, United Kingdom

CH-5.2 THU 11:00
Ultra-rapid coherent anti-Stokes Raman dual-comb spectroscopy and microscopy
T. Igauchi1, S. Holzner2, B. Bernhard1,2, G. Guelachvili3, N. Picque1,2,3, and T. Hänsch1,2,3; 1Max Planck Institut für Quantenoptik, Garching, Germany; 2Institut des Sciences Moléculaires d’Orsay, CNRS, Orsay, France; 3Ludwig-Maximilians-Universität München, München, Germany
Ultra-broadband nonlinear Raman spectroscopy with two laser frequency combs is demonstrated. A Raman spectrum spanning 1200 cm⁻¹ is measured within less than 300 microseconds at 4 cm⁻¹ resolution with a signal-to-noise ratio of 1250.

CH-5.3 THU 11:15
Nonlinear Dual-Comb Spectroscopy with Two-Photon Excitation
S.A. Meek1, A. Hipke1,2,3, T.W. Hänsch1,2,3, and N. Picque1,2,3; 1Max Planck-Institut für Quantenoptik, Garching, Germany; 2Ludwig-Maximilians-Universität, Fakultät

CH-5.4 THU 11:15
Random amplification of coherent light in diffusive random lasers
R. Uppu and S. Majumdar; Nano-optics and Mesoscopic Optics Laboratory, Tata Institute of Fundamental Research, Mumbai, India
We demonstrate the amplification by an or-
On demand single photon-driven controlled-NOT gate

Optical Excitation of Unipolar Tesla Magnetic Nanostructures

Picoscoped pulsed laser-assisted reshaping of metallic nanoparticles embedded in a glass matrix

Pulse-Induced Generation in InGaN Laser

Adaptive spiral phase elements for the generation of few-cycle vortex pulses

Micro-indentation of isolated optical attosecond pulses

Advances in Femtosecond Laser Micro-indentation and Ablation of Optical Coherence Tomography Phantom

Direct Carrier-Envelope Phase Control of an Amplified Laser System

Experimental Realisation of Shor's Quantum Factoring Algorithm using optical Fibre

Experimental Demonstration of Quantum Data Compression

Superfluorescent 1.1 ps Pulse-On-Demand Generation in InGaN Laser

Magnetic Pulses in Plasmonic Nanostructures

MIIPSY cloning and coherent all-optical ultrafast plasmonic fields

CG-5.4 THU 10:45
Attosecond Sampling of Arbitrary Optical Waveforms

A Wyatt, T Witting, A Schiavi, D Fabris, J Marungos, T Tisch, and I Wulfmeyer
Clarendon Laboratory, University of Oxford, Oxford, United Kingdom.

CG-5.3 THU 11:00
Synthesis of isolated optical attosecond pulses

M Hassani, T Lux, A Monet, O Razskazovskaya, N Karpowicz, V Pervukh, F Kraus, E Goulielmakis
Max-Planck-Institut für Quantenoptik, Munich, Germany.

CG-5.2 THU 10:45
Direct Carrier-Envelope Phase Control of an Amplified Laser System

T Balzunas, L Pörl, T Stavishauskas, R Antipenko, A Varanavicius, A Baltuska, and G Steinmeyer
Photonics Institute, Vienna University of Technology, Vienna, Austria.

CM-6.3 THU 11:00
Advances in Femtosecond Laser Micro-indentation and Ablation of Optical Coherence Tomography Phantom

G.N. Smith, K Kalit, and M.I. Withford
OptoFab & MQ Photonics Research Centre, Macquarie University, Sydney, Australia.

CM-6.2 THU 10:45
Laser Ablation inside Transparent Thin Films

K Kanar, K.K. Lee, I.I. Ijogami, P.R. Herman, and N. Kherani
Department of Materials Science and Engineering, Toronto, Canada.

CM-6.1 THU 10:45
Superfluorescent 1.1 ps Pulse-On-Demand Generation in InGaN Laser

CEM Centre Suisse d’Electroménager et de Microtechnique, Neuchatel, Switzerland.

Buchner Institute for Applied Solid State Physics IAE, Freiburg, Germany.

EPEL Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland.

We report generation of solitary pulses of the width below 1.1 ps from a tandem-cavity InGaN/InGaN laser diodes in 415-425 nm wavelength range and we show that observed pulses are caused by cooperative superfluorescence.

Adaptive spiral phase elements for the generation of few-cycle vortex pulses

M. Buk, J. Brunner, A. Treffler, S. König, U. Waever, E. Martín-Grunwald, Max Born Institute, Berlin, Germany.

IMTEK University Freiburg, Freiburg, Germany.

The flexible generation of few-cycle vortex pulses with optical orbital momentum is enabled by novel types of low-dispersion, damage-resistant, thermally tunable spiral phase MEMS of large phase deviation. Specific ultrashort-pulse laser applications are proposed.

On demand single photon-driven controlled-NOT gate

Tohoku Research Europe Ltd, Cambridge, United Kingdom.

Optical Excitation of Unipolar Tesla Magnetic Nanostructures

E. Atmatzakis, A. Tsitras, N. Papasimakis, V. Fedotov, B. Lak'yanchuk, F.I. García de Abajo, and N. Zheludev

On demand single photon-driven controlling-NOT gate

Tohoku Research Europe Ltd, Cambridge, United Kingdom.

Optical Excitation of Unipolar Tesla Magnetic Nanostructures

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Real-time observation of ultrafast Rabi oscillations between excitons and plasmons in J-aggregate/metal hybrid nanostructures

Institut für Physik, Carl von Ossietzky Universität Oldenburg, Oldenburg, Germany.

We present a new approach towards coherent, all-optical ultrafast plasmonic devices.
We present a thulium doped large mode area fibre ensuring low-loss single-mode operation and normal dispersion for the fundamental core mode around a wavelength of 1930nm as well as an effective area larger than 600μm².

CJ-10.5 THU 11:30
All-Fiber Broadband Frequency Comb Source at 2050 nm Center Wavelength A. Thai1,2, H. Hoogland1, M. Engelbrecht1, J. Bieger1,3, and R. Holzwarth1,4; 1Menlo Systems, Munich, Germany; 2ICFO - Institut de Ciencies Fotoniques, Castelldefels (Barcelona), Spain; 3CRREA - Institut Català de Recerca en Ciències Avançades, Barcelona, Spain
We report on an all PM fiber system with a broadband amplifier based on co-doped Tm/Ho fiber, operating at 2050 nm center wavelength with 126 nm bandwidth and 670 mW output power at 100 MHz.

A Hybrid Fabrication Approach for Near-Infrared Double-Helix Metamaterials
M. Decker1, I. Staudte1, M. Remer2, E. Waller2, D.N. Nesher3, G. von Freymann1, and Y.S. Kivshar1; 1Nonlinear Physics Centre, Research School of Physics and Engineering, The Australian National University, Canberra, Australia; 2Physics Department and Research Center OPTIMAS, University of Kaiserslautern, Kaiserslautern, Germany
We employ a novel approach for fabricating three-dimensional metamaterials, which combines direct laser writing with electron-beam lithography. We experimentally realize and investigate a double-helix chiral metamaterial operating in the near-infrared spectral range.

35 kW Peak Power Picosecond Pulsed Thulium-doped Fibre Amplifier System Seeded by a Gain-Switched Laser Diode at 2 μm
A.M. Heidi1, Z. Li1, J. Sahu1, P.C. Shardlow1, M. Becker2, M. Rothhardt2, M. Ivan2, R. Pielan1, B. Kelly1, S.-a. Alam1, and D.J. Richardson1; 1Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom; 2Institute of Photonic Technology, Jena, Germany; 3Eblaera Photonics Ltd., Dublin, Republic of Ireland
We present the generation of picosecond pulses at 2 μm wavelength with a gain-switched laser diode and their amplification up to 3.5 μl energy and 35 kW peak power in a Thulium-doped fiber amplifier system.

CJ-10.6 THU 11:45
Optically excited field emitter arrays with plasmonic gate electrodes as ultrafast electron sources
A. Mustonen1, Paul Scherrer Institute, Villigen, Switzerland
We present the fabrication of 850nm GaAs-based 2-D VCSEL arrays with small device pitch for optical trapping. The modules are wire-bondable despite a few micrometer distance between top surface and a compactly integrated microfluidic chip.

CJ-10.7 THU 11:45
Detection of KCl and KOH using Collinear Photofragmentation and Atomic Absorption Spectroscopy
T. Sorvaäärvi1, J. Rossi, and J. Toivonen; Tampere University of Technology, Tampere, Finland
We present the recent results in extending dual comb spectroscopy to two-photon transitions. By measuring two-photon excitation of gas-phase rubidium and liquid-phase dye samples, we demonstrate both the high resolution and speed of the technique.

CJ-10.8 THU 11:45
Resonant States in Functionalized Waveguide Arrays - Guidonic Resonant Tunneling Double Barrier
N. Belabas1, G. Bouwmans2, E. Cambriè1, A. Tabineanu3, A. Levenson2, C. Minõ1, and J.-M. Moison2; 1Laboratory of Photonic and Nanostructures, Route de Nozay, 91460 Marcoussis, France; 2Laboratoire Phlam-IRCICA, Parc Scientifique de la Haute Borne, 59658 Villeneuve d’Ascq, France
We demonstrate discrete resonant states in functionalized coupled waveguide arrays theoretically and experimentally. Our double barrier patterning of the coupling creates tunnel resonances in the transmitted intensity, which paves the way towards all optical control.

CH-5.4 THU 11:30
Detection of KCl and KOH using Collinear Photofragmentation and Atomic Absorption Spectroscopy
T. Sorvaäärvi1, J. Rossi, and J. Toivonen; Tampere University of Technology, Tampere, Finland
We present the latest results in extending dual comb spectroscopy to two-photon transitions. By measuring two-photon excitation of gas-phase rubidium and liquid-phase dye samples, we demonstrate both the high resolution and speed of the technique.

CB-8.5 THU 11:30
Resonant States in Functionalized Waveguide Arrays - Guidonic Resonant Tunneling Double Barrier
N. Belabas1, G. Bouwmans2, E. Cambriè1, A. Tabineanu3, A. Levenson2, C. Minõ1, and J.-M. Moison2; 1Laboratory of Photonic and Nanostructures, Route de Nozay, 91460 Marcoussis, France; 2Laboratoire Phlam-IRCICA, Parc Scientifique de la Haute Borne, 59658 Villeneuve d’Ascq, France
We demonstrate discrete resonant states in functionalized coupled waveguide arrays theoretically and experimentally. Our double barrier patterning of the coupling creates tunnel resonances in the transmitted intensity, which paves the way towards all optical control.

CB-8.6 THU 11:30
Optically excited field emitter arrays with plasmonic gate electrodes as ultrafast electron sources
A. Mustonen1, Paul Scherrer Institute, Villigen, Switzerland
We present the fabrication of 850nm GaAs-based 2-D VCSEL arrays with small device pitch for optical trapping. The modules are wire-bondable despite a few micrometer distance between top surface and a compactly integrated microfluidic chip.
We report on efficient picosecond laser-induced optical dichroism in glasses with embedded spherical silver nanoparticles. The modifications depend on the beam polarization and the number of irradiated pulses per spot.

**CM-6.5 THU 11:30**

*In-situ characterization of fs laser shaping of quasi-percolated Ag nanoparticle layers embedded in amorphous Al2O3*

G. Baraldi, J. Gonzalez, and J. Siegel; Instituto de Optica, CSIC, Madrid, Spain

We demonstrate fs-laser induced reshaping of heterogeneous, non-spherical and randomly oriented Ag nanoparticles embedded in dielectric thin films. Optimum choice of laser fluence and polarization narrows and blueshifts the absorption band and induces polarization anisotropy.

**CM-6.6 THU 11:45**

*Formation of disruptions in molten fused silica induced by heat accumulation of ultrashort laser pulses at high repetition rates*

S. Richter, F. Burmeister, F. Zimmermann, A. Dörring, A. Tümmermann, and S. Nolte; Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Jena, Germany; Fraunhofer Institute of Applied Optics and Precision Engineering, Jena, Germany

We investigate the structure and periodicity of disruptions within the heat affected material in fused silica after irradiation with ultrashort laser pulses at high repetition rates for laser welding. We propose a model, which explains their formation.
Inhibited-coupling guiding hollow core photonic crystal fibers

F. Benabid; GPPMM group, Xilin Research Institute, CNRS, Université de Limoges, Limoges, France; Physics department, University of Bath, Bath, United Kingdom

We review the recent development on inhibited-coupling guiding hollow-core photonic crystal fiber and on the physical principles that led to the unique combination of record loss figures, quasi-single mode operation and very low dispersion.

Ultra-weak acoustic interactions of temporal cavity solitons

J.K. Jang, M. Ertincolto, S.G. Murdoch, and S. Coen; The University of Auckland, Auckland, New Zealand

We report on the weakest interactions ever observed between solitons. Cavity solitons recirculating in an optical fiber loop are found to shift their temporal separation by a few nanoseconds over millions of kilometres of propagation.

Optically monitored catalytic photonic crystal fibre microreactor

A.M. Cabillas1,2, M. Schmidt1,2,3, T.G. Euer1, B.J.M. Etzold1,3, N. Taccardi1,2,3, S. Unterkofer1,2, P. Wasserscheid1,3, and P.S.J. Russell1,2,4; 1Max Planck Institute for the Science of Light, Erlangen, Germany; 2Excellence Cluster "Engineering of Advanced Materials", Erlangen, Germany; 3Höchstes Institut für Chemische Reaktionstechnik, University of Erlangen-Nuremberg, Erlangen, Germany; 4Department of Physics, University of Erlangen-Nuremberg, Erlangen, Germany

We demonstrate that a hollow-core photonic crystal fibre can be turned into a catalytically active microreactor by depositing metallic catalyst nanoparticles in its core. We investigate the liquid-phase hydrogenation of azobenzene in such a fibre.

Observation of vortex soliton states in vertical-cavity surface-emitting lasers with feedback

J. Jimenez Garcia1, Y. Noblet1, P. Paulaud2, D. Gomila3, G.-L. Oppo1, and T. Ackemann1; 1SUPA and Department of Physics, University of Strathclyde, Glasgow, United Kingdom; 2TU Berlin, Institut für Theoretische Physik, Berlin, Germany; 3CICE, (CSIC-UB), Campus Universitat Illes Balears, Palma de Mallorca, Spain

We investigate experimentally and theoretically vortex soliton states in a VCSEL with frequency-selective feedback. We discuss...
14:00 – 15:30
IB-7: Fundamentals of Quantum Information
Chair: Miloslav Dusek, University of OloMOUS, OLOmos, Czech Republic
This tutorial will present an introduction to the basic ideas of quantum information processing and an overview of candidate physical implementations, tools and ideas pursued in quantum computing research.

14:00 – 15:30
CF/IE-12: Mid Infrared and Terahertz Phenomena
Chair: Giulio Cerullo, Politecnico di Milano, Milan, Italy
CF/IE-12.1 THU 14:00
Temporal Slicing of Intense Multi-Terahertz Transients Using an Ultrafast Semiconductor Switch
C. Schmidt, B. Mayer, J. Böker, D.V. Seletskiy, D. Binda, A. Pashkin, and A. Leitenstorfer; Department of Physics and Center for Applied Photonics, University of Konstanz, Konstanz, Germany
Intense multi-Terahertz transients are temporally controlled with sub-cycle precision using an ultrafast plasma mirror. Field-resolved detection is used to monitor the results of temporal slicing.

14:00 – 15:30
CM-7: Femtosecond Laser Writing
Chair: Roberto Osellame, Politecnico di Milano, Milan, Italy
CM-7.1 THU 14:00
Femtosecond Laser Written Photonic Circuits for Quantum Simulation
A. Crespi1, R. Osellame2, R. Ramponi1,2, L. Sansoni1, F. Sciarrino1, and P. Mataloni1; 1Istituto di Fotonica e Nanotecnologia - Consiglio Nazionale delle Ricerche, Milano, Italy; 2Dipartimento di Fisica - Politecnico di Milano, Milano, Italy; Dipartimento di Fisica - Sapienza Università di Roma, Roma, Italy
We demonstrate complex optical waveguide circuits, fabricated by femtosecond laser writing technology, implementing discrete-time quantum walks of polarization-entangled photon pairs. Tight phase control and polarization independent behaviour are shown.

14:00 – 15:30
CM-7.2 THU 14:15
Anti-resonant reflecting optical waveguides (ARROW) inscribed by the femtosecond direct-write technique
S. Gross, M. Alberich, A. Arriola, M.J. Wiltford, and A. Fuerbach; MQ Photonics Research Centre, Centre for Ultrahigh-bandwidth Devices for Optical Systems (CUDOS), Dept. of Physics and Astronomy, Macquarie University, North Ryde, Australia
We demonstrate the fabrication of anti-resonant reflecting optical waveguides (ARROW) using the femtosecond laser direct-write technique. Their strong wavelength dependent optical properties represent an

14:00 – 15:30
CG-6: FEL and High Photon Energy Science
Chair: Laszlo Veisz, Max-Planck-Institute of Quantum Optics, Garching, Germany
CG-6.1 THU (Invited) 14:00
Non-linear FEL Science
R. Sandia; Center for Free-Electron Laser Science, DESY, Hamburg, Germany; Department of Physics, University of Hamburg, Hamburg, Germany
I will discuss the interaction of atoms with radiation pulses from x-ray free-electron lasers. In the studies presented, the peak intensity approaches $10^{19}$ W/cm² and the photon energy ranges from 1.5 keV to 5.5 keV.

14:00 – 15:30
IH-5: Ultrafast Nanophotonics
Chair: Christoph Lienau, University of Oldenburg, Oldenburg, Germany
IH-5.1 THU 14:00
Ultrafast Terahertz Dynamics of a Cold Exciton-Polariton Gas
J.-M. Ménard1, C. Poelmann1, M. Porcher2, E. Galopin2, A. Lemaitre2, A. Amo2, J. Bloch2, and R. Huber1; 1University of Regensburg, Regensburg, Germany; 2CNRS-Laboratoire de Photonique et Nanostructures, Marcoussis, France
THz absorption of the intra-excitonic 1s-2p resonance traces the matter part of polaritons while they cool into a condensed phase. A macroscopic population of the zero-momentum state is investigated in comparison with simultaneous photoluminescence measurements.

14:00 – 15:30
IH-5.2 THU 14:15
Ultrafast Metamaterial Optical Modulator
A. Neira, G. Wurtz, P. Ginibreg, and A. Zayats; King’s College of London, London, United Kingdom
The ultrafast third order nonlinearity of metals is used for the design of a modulator which further enhances its effect by patterning the metal as a metamaterial.
their bistability, properties and phase locking between a vortex and a fundamental soliton and between two vortices.

**CH-6.3 THU (Invited)**

**Optical Readout of Coupling Between a Nanomembrane and an LC Circuit at Room Temperature**

C. Bague, A. Simonson, E. Zeuthen, J. Taylor, L.G. Villanueva, S. Schmid, A. Sorensen, A. Schliesser, K. Usami, and E.S. Polzik

We have demonstrated various polarization dynamics of bound state solitons in a carbon nanotube mode locked erbium doped fiber laser. Both locked and precessing polarization states have been observed for single and multiple bound state solitons.

**CH-9.3 THU**

**Re-inventing Multimode Interference Couplers Using Subwavelength Gratings**


We use the concept of subwavelength grating (SWG) refractive-index engineering to propose and experimentally demonstrate a reduced size, slotted 2×2 MMI coupler. We also present an ultra-broadband 2×2 MMI coupler which is based on SWG dispersion-engineering.

**CH-9.4 THU**

**Locally induced electro-optic activity in silicon nanophotonic devices**

C. Mathiesen, M. Nagel, S. Sawaalich, M. Waldow, B. Chmielak, T. Wahlbrink, J. Bolten, and H. Karz

An integrated electro-optic Mach-Zehnder modulator in silicon-nanophotonic-based technology is demonstrated using a novel CMOS-compatible process for local x²2, induction. Photo-conductive THz near-field probes are applied to monitor the local restriction and quality of the activated areas.

**CH-9.5 THU (Invited)**

**Integrated Photonic Devices in III-V Semiconductors for Optical Communications**

M.J. Wale; Oclaro Technology Ltd., Twycross, United Kingdom

Photonic integrated circuit (PIC) technology provides an important key to the realization of high-performance communications systems. This paper will examine systems needs and show how III-V semiconductor-
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ROOM 14a

Photonic evolution of a broadband acoustic frequency comb with 120 GHz central frequency and 200 GHz bandwidth in a Au/Si membrane.

CF/IE-12.3 THU 14:30

Single-shot detection of mid-infrared spectra by chirped-pulse upconversion with four-wave difference frequency generation in gases

†T. Fuji, Y. Nomura1, Y.T. Wang2, A. Yabushita3, and C.-W. Liao1, 1Institute of Molecular Sciences, Okazaki, Japan; 2National Chiao Tung University, Hsinchu, China, Republic of ROC.

Chirped-pulse upconversion of mid-infrared continuum with four-wave difference frequency generation in gases is realized. Single-shot detection of the entire mid-infrared spectrum from 250 to 5500 cm⁻¹ is demonstrated.

CF/IE-12.4 THU 14:45

A Novel Time-Resolved mid-IR Setup for the Investigation of Vibrational Dynamics in Aqueous Nanoclusters

‡J.C. Werthahn¹, M. Bradler², D. Hutzler³, S. Fuhrmann1, E. Riedle1, H. Iglev1, and R. Kienberger1; ¹Physik-Department E11, TU München, Garching, Germany; ²LS für BioMolekulare Optik, LMU München, München, Germany.

A novel mid-IR pump probe setup, tunable between 2000 and 4000 cm⁻¹ is presented. It yields one of the shortest IR probe pulses available today.

Measurements on ice and confined water nanoclusters will be discussed.

IB-7.2 THU 15:00

Witnessing Trustworthy Single-Photon Entanglement with Local Homodyne Measurements

•O. Morin1, J.-D. Bancal2, M. Ho3, P. Sekatski3, V. D’Auria1, N. Gisin1, J. Laurat1, and N. Sanguinetti; 1Laboratoire Kastler Brossel, UPMC, ENS CNRS, Paris, France; 2Group of Applied Physics, University of Geneva, Geneva, Switzerland.

We demonstrate a novel trustworthy witness avenue to dispersion engineered direct-write photonics.

ROOM 14b

Electro-optical Tuning of Waveguide Embedded Bragg Gratings in Lithium Niobate Induced by Direct Femtosecond Laser Writing

•S. Kroesen1, U. Paté1, W. Horn3, J. Imbruck3, and C. Denz2; 1University of Muenster, Germany; 2Santar Vallihkhai National Institute of Technology, Surat, India.

We report direct integration of electro-optical tunable Bragg grating waveguides (BGWs) in lithium niobate by direct femtosecond laser writing. The low loss two-dimensional waveguides are modulated periodically to obtain narrowband reflections in the c-band.

CM-7.3 THU 14:45

Coherent Stitching of Light in Femtosecond Laser-Focused Multi-Layered Volume Gratings

•M.L. Ng, D. Chanda, and P.R. Herman; Dept. of Electrical & Computer Engineering, University of Toronto, Toronto, Canada.

We propose and demonstrate a novel method for improving diffraction efficiency through strategic arrangement of multi-layered weak phase gratings to coincide with self-imaging Talbot planes. Enhanced diffraction is demonstrated in femtosecond laser written volume gratings.

CM-7.4 THU 15:00

Direct laser writing of metastable modifications in lithium niobate crystal with ultrashort laser pulses

•D. Papalus1, A. Cerkasukaitė2, V. Straukaitė1, V. Mielnikov1, and S. Joozdak1; 1Vilnius University, Laser Research Center, Vilnius, Lithuania; 2Shizuoka University, Division of Global Research Leaders, Hamamatsu, Japan; 3Swinburne University of Technology, Melbourne, Australia.

We present a novel ultrafast imaging system for insitu observation of carrier-envelope phase-dependent high harmonics in the water window using a few-cycle infrared light source.

CC-6.2 THU 14:30

Generation of Coherent Soft X-ray Radiation at High Repetition Rate

•J. Rothhardt1, S. Demnoler2, S. Haidrich1, M. Krebs2, J. Limpert1,2, and A. Tünnemann1,2; 1Heinrich-Hertz-Institute Jena, Jena, Germany; 2Friedrich-Schiller-University, Jena, Germany.

We report on the generation of coherent soft x-rays at high repetition rate. A flux of 2.10⁵ photons/s has been measured at 200 eV. Scaling to shorter wavelengths and higher photon flux is discussed.

ROOM 21

Generation of Carrier-Envelope Phase-Dependent High-Harmonics in the Water Window Using a Few-Cycle Infrared Light Source

•N. Ishii1, K. Kaneshima1, K. Kitano1, T. Kana1, S. Watanabe2, and J. Iitani1; 1Institute for Solid State Physics, University of Tokyo, Chiba, Japan; 2Research Institute for Science and Technology, Tokyo University of Science, Chiba, Japan.

We report on the generation of carrier-envelope phase-dependent high harmonics in the water window using few-cycle, phase-stabilized intense infrared pulses. This observation indicates that a 50-eV-wide atto-second continuum is generated around 300 eV.

CG-6.3 THU 14:45

Beyond Carbon K-edge harmonic emission using spatially and temporally synthesized laser field

•J.A. Pérez-Hernández1, M. Ciappina2,3, M. Lewenstein1,2, L. Rosé1, and A. Zair1; 1 Centro de Lisieux Pulsados (CLPU), Salamanca, Spain; 2ICFO-Institut de Ciencies Fotòniques, Barcelona, Spain; 3Auburn University, Alabama, United States; 3ICREA-Institut Catalá de Recerca i Estudis.

We demonstrate strong-field electron emission from various plasmonic nanoparticles induced by ultrashort laser pulses. Significant electric field enhancement attributed to surface plasmons enable the generation of up to 25-eV electrons in nano-localized fields around nanoparticles.

ROOM 22

Strong-field photoemitted electrons from metallic tips show carrier-envelope phase effects on short-range photoemission of electrons from nanometric gold tips and present a new way to steer and control the motion of electrons around metallic nanoparticles.

IH-5.3 THU 14:30

Ultrafast Strong-Field Photoemission from Plasmonic Nanoparticle Arrays

•P. Dombi1,2, A. Hör3, P. Páczki1, A. Márton1, A. Trigler1, J.R. Krenní, and U. Hohenester1; 1Wigner Research Centre for Physics, Budapest, Hungary; 2Max-Planck-Institut für Quantenoptik, Garching, Germany; 3Institut für Physik, Karl-Franzens-Universität, Graz, Austria.

We demonstrate strong-field electron emission from various plasmonic nanoparticles induced by ultrashort laser pulses. Significant electric field enhancement attributed to surface plasmons enable the generation of up to 25-eV electrons in nano-localized fields around nanoparticles.

IH-5.4 THU 14:45

Ultrafast dynamics of quantum confined carriers in a single CdSe nanowire

•T. Schuhmacher1, H. Giessen, and M. Lippitt2; 1Max Planck Institute for Solid State Research, Heisenbergstrasse 1, D-70569 Stuttgart, Germany; 2ETH Physics Institute, University of Stuttgart, Pfaffenwaldring 57, D-70550 Stuttgart, Germany.

Nonlinear spectroscopy allows us to track for the first time the decay and re-emission.
**ROOM 1**

**CJ-11.5 THU 15:15**

**Very large mode area Solid-Core Photonic BandGap fiber laser with hetero-structured cladding and Yb-doped Sol-Gel core**

*A. Baz, L. Bigot, G. Bouwmans, H. El Hamzaoui, M. Bouzaoui, and Y. Qiucempois; PhlAM-lRCA, Université Lille 1, Villeneuve d’Ascq, France*

We report the realization of a double clad LMA, Yb-doped, SC-PCGF with hetero-structured cladding, and a Sol-Gel made core. We measured a laser efficiency of 61.5% around 1.06µm wavelength, and a record MFD of 36µm.

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**ROOM 4a**

**IG-4.6 THU 15:15**

**Nonlinear dynamics of optoelectronic oscillators based on whispering-gallery mode resonators**

*A. Collet, R. Henriet, P. Salzenstein, K. Phan-Huy, L. Larger, and Y. Chembo; FEMTO-ST, Besançon, France*

We propose a nonlinear dynamics framework to study the stability and transient behavior of an optoelectronic oscillator based on whispering-gallery mode resonators. Experimental results are provided and successfully compared to numerical simulations.

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**ROOM 4b**

**CH-6.5 THU 15:15**

**Stabilized high-power laser for gravitational wave detection**

*C. Bogan1, K. Danzmann1, M. Freder2, H. Kim1, P. King3, P. Kwee3, J. Poeld3, O. Punckers1, R. Savage4, F. Seifert4, P. Wessels2, L. Winkelmann2, and B. Wilke1; 1Albert-Einstein-Institut, Hannover, Germany; 2Laser Zentrum Hannover e.V., Hannover, Germany; 3LIGO Laboratory, California Institute of Technology, Pasadena, United States*

Advanced gravitational wave detectors have stringent requirements concerning the frequency and the power stabilization of their 200 W laser sources. We demonstrate how these were fulfilled using a combination of several active and passive stabilization schemes.

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**ROOM 13a**

**CH-7: Frontiers of Optical Sensing**

*Chair: Hannie Ludvigsen, Aalto University, Aalto, Finland*

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**ROOM 13b**

**CB-9.5 THU 15:15**

**Aluminium Free Active Region 780nm Tapered Semiconductor Optical Amplifiers for Rubidium Pumping**


We present a new tapered Semiconductor Optical Amplifier (SOA) structure, based on an Al free active region and entirely gain guided, that exhibits more than 600W output power at a wavelength of 780nm.
for single-photon entanglement based only on local homodyne measurements. This operational test is well suited for quantum networks, and highlights the potential of the optical hybrid approach.

**ROOM 14a**

**IB-7.3 THU 15:15**

Bell Violation with Entangled Photons, Free of the Fair-Sampling Assumption

M. Citrin1,2, A. Mech1, S. Ramelow1,3, B. Wittmann1,2, J. Kofler1,3, J. Beyer4, A. Lita5, B. Calkins5, T. Gerrits5, S.W. Nam5, R. Ursin3, and A. Zeilinger1,2, 1Institute for Quantum Optics and Quantum Information, Vienna, Austria; 2Quantum Optics, Quantum Nanophysics, Quantum Information, University of Vienna, Faculty of Physics, Vienna, Austria; 3Max Planck Institute of Quantum Optics (MPQ), Garching, Germany; 4Physikalisch-Technische Bundesanstalt, Berlin, Germany; 5National Institute of Standards and Technology (NIST), Boulder, CO, United States

Using superconducting transition-edge sensors and a photon pair source based on spontaneous parametric downconversion, we present the first demonstration of a Bell experiment using photons for which the well-known fair-sampling (or detection) loophole was closed.

**ROOM 14b**

16:00 – 17:30

**CF/IE-13: Charge Dynamics in Solids**

**Chair:** Christoph Lienau, University of Oldenburg, Oldenburg, Germany

**CF/IE-13.1 THU (Invited) 16:00**

Ultrafast Electromagnetic Charge Dynamics in Solids Mapped by Femtosecond X-ray Diffraction

E. Bl{"{o}chl}, E. Zamponi1, P. Bothard2, J. Stingl2, B. Fryer3, M. Woerner2, and A. Borghese2, 1Max-Born-Institute, Berlin, Germany; 2EMPA, D{"{u}sseldorf, Switzerland; 3Technische Universit{"{a}t Hamburg, Germany.

**ROOM 21**

**IB-8: Quantum State Characterization**

**Chair:** Mohamed Bourennane, Stockholm University, Stockholm, Sweden

**IB-8.1 THU 16:00**

Experimental Demonstration of Adaptive Quantum State Estimation

S. Takeuchi1, R. Okamoto1,2, M. Iefuji2, S. Oyama2, K. Yamaogata1, H. Imas1, and A. Fujiiwara1, 1RIES, Hokkaido University, Sapporo, Japan; 2I. S. I. R., Osaka University, Osaka, Japan; 3Dept. Mathematics, Osaka Univ., Osaka, Japan; 4University of Pavia, Pavia, Italy

The first experimental demonstration of adaptive quantum state estimation (AQSE) is reported. The angle of linear polarization of single photons is estimated using AQSE, and the strong consistency and asymptotic
tem capable of unprecedented simultaneous nanometer spatial resolution (2 nm) and subpicosecond temporal resolution (500 fs) based on coupling terahertz pulses to a scanning tunneling microscope.
An ion-exchanged Thulium-doped germanate glass channel waveguide laser operating near 1.9 micron P. Kannan, • A. Choudhary, J. Mackenzie, X. Feng, and D. Shepherd; Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom

We demonstrate for the first time to our knowledge, an ion-exchanged Thulium:germanate glass channel waveguide laser. Lasing was observed near 1.9 micron with an incident threshold power of 83mW and a propagation loss of 0.3dB/cm.

Experimental and numerical study of the predictability of rogue waves in semiconductor lasers J. Zamora-Munti, B. Garbin2, B. Sarlande3, M. Giudici4, J.R. Rios Leite2, C. Masoller2, and J.R. Tredicic1,2; IFISC (CSIC-UIB), Campus Universitat Illes Balears, Palma de Mallorca, Spain; 2 Universite de Nice Sophia Antipolis, Institut Non-Linéaire de Nice, Valbonne, France; 3 Departamento de Física, Universidade Federal de Pernambuco, Recife, Brazil; 4 Departamento de Física y Enginería Nuclear, Universidad Politécnica de Catalonia, Terrassa, Spain; 5 Université de la Nouvelle Calédonie - Pole Pluridisciplinaire de la Matiere et del Environnement, Nouvelle Calédonie, Nouméa, New Caledonia

Rogue waves in a semiconductor laser with optical injection are demonstrated experimentally and numerically. We show that the extreme pulses are predictable and that noise plays an important role in controlling their appearance

Bicell fiber optics homodyne phase demodulator - experimental results. Z. Holodyski1,2,3, I. Mertens1, T. Naslowski1,2,4, and L. Jaroszewicz4; 1 Military University of Technology, Warsaw, Poland; 2 IMT-PhoTech Ltd, Warsaw, Poland

We report novel possibility of phase demodulation using bicell photodetector. Homodyne fiber demodulator reconstruct widely frequency shifted different types of signals. Proposed setup highly limited data processing and enable extreme measurement precision.

On-Chip Collimated Planar Free Space Gaussian Beams utilising Optical Lenses on a Silicon on Insulator Chip G. Ren, T.G. Nguyen, and A. Mitchell; CUDOS, School of Electrical and Computer Engineering, University of Sydney, Australia

On-Chip Collimated Planar Free Space Gaussian Beams utilising Optical Lenses on a Silicon on Insulator Chip G. Ren, T.G. Nguyen, and A. Mitchell; CUDOS, School of Electrical and Computer Engineering, University of Sydney, Australia
IB-8.3 THU 16:30
Experimental state estimation for spatial qubits

• P. Kalenderski1,2, K. Johnsen1, C. Scarcella1, D. Hamel1, K. Shalm2, S. Tisa2, A. Tosi2, K. Resch1, and T. Jennewein1
1 Institute for Quantum Computing, University of Waterloo, Waterloo, Canada; 2 Institute of Physics, Nicolaus Copernicus University, Torun, Poland; 3 Politecnico di Milano, Dipartimento di Elettronica e Informazione, Milano, Italy; 4 Micro Photon Device, Bolzano, Italy

An estimation of a spatially encoded qubit state is demonstrated by implementing a 28-element quantum measurement using an array of detectors and carefully designed imaging optics.

CM-8.2 THU 16:15
The effect of porosity on cell ingrowth in 3D laser-fabricated biodegradable scaffolds for bone regeneration
P. Danilevicius1,2, L. Georgiadis1,2, F. Claeyssens1, C. Paterman1, M. Chatzinkolokou1,3, and M. Farsari1
1 IESL-FORTH, Heraklion, Greece; 2 Department of Materials Science and Technology, University of Crete, Heraklion, Greece; 3 Krioto Research Institute, University of Sheffield, Sheffield, United Kingdom

We demonstrate the fabrication by Direct Laser Writing of 3D biodegradable scaffolds with different pore sizes. We investigate the material biodegradability and effect of scaffold porosity on cell adhesion and proliferation using mouse pre-osteoblastic cells.

CM-8.3 THU 16:30
Ultrafast Non-thermal Electron Dynamics in Single Layer Graphene
• D. Bridl1, C. Manzoni2, G. Cerrillo3, A. Tomadin1, M. Polini2, R.R. Nair1, A.K. Geim1, K.S. Novoselov4, S. Milana5, A. Lombardo1, and A.C. Ferrari1
1 University of Konstanz, Konstanz, Germany; 2 Politecnico di Milano, Milano, Italy; 3 NEST, Scuola Normale Superiore, Pisa, Italy; 4 University of Manchester, Manchester, United Kingdom; 5 University of Cambridge, Cambridge, United Kingdom

We study the ultrafast dynamics of non-thermal electron relaxation in graphene upon impulsive excitation. The 10-fs resolution two-color pump-probe allows us to observe non-equilibrium electron relaxation at early times unveiling Auger processes and charge multiplication.

CM-8.4 THU 16:45
Initiator-Free Multiphoton Polymerization for 3D Nano-structured Fabrication
• A. Giakoumaki1,2, E. Kabouraki1,3, M. Vamvakaki1,2, and M. Farsari1
1 IESL-FORTH, Heraklion, Greece; 2 Department of Materials Science and Technology, University of Crete, Heraklion, Greece; 3 Krioto Research Institute, University of Sheffield, Sheffield, United Kingdom

We present recent high-precision direct laser fabrication of polymers focusing on light matter interaction mechanisms at nanoscale: multiphoton absorption, avalanche ionization and thermal effects. We show possible applications in integrated microoptics and biomedicine.

CG-7.2 THU 16:15
Multidimensional High Harmonic Spectroscopy
• V. Serbinenko and O. Smirnova; Max Born Institute, Berlin, Germany

We consider high harmonic generation in orthogonally polarized fundamental and weak multicolor fields as multidimensional pump-probe spectroscopy. We present an analytical approach, which extracts information about electron subcycle dynamics directly from the modulation of HHG signal.

CG-7.3 THU 16:30
Interrupted virtual single-photon transition
• J. Herrmann1, M. Weger1, R. Locher1, M. Sabbat2, P. Vivihiere3, U. Saalmann1, J.-M. Rost1, L. Gallmann1, and U. Keller1
1 Department of Physics, Institute of Quantum Electronics, ETH Zurich, Zurich, Switzerland; 2 Department of Quantum Electronics, ETH Zurich, Zurich, Switzerland; 3 Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

We report optical gain created by the interruption of the temporal evolution of the dipole response of a quantum-mechanical two-level system. A transient absorption experiment in helium confirms the results of our theoretical study.

CM-9.4 THU 16:45
Optical Response of Electron Wave-packet Interference Revisited
• M. Lucchini, J. Herrmann, A. Ludwig, M. Sabbat, R. Locher, L. Gallmann, and U. Keller, Department of Physics, Institute of Quantum Electronics, ETH Zurich, Zurich, Switzerland

We report on recent high-precision direct laser fabrication of polymers focusing on light matter interaction mechanisms at nanoscale: multiphoton absorption, avalanche ionization and thermal effects. We show possible applications in integrated microoptics and biomedicine.

CG-7.4 THU 16:45
An Experimental Observation of Electron Wave-packet Interference Revisited
• M. Lucchini, J. Herrmann, A. Ludwig, M. Sabbat, R. Locher, L. Gallmann, and U. Keller, Department of Physics, Institute of Quantum Electronics, ETH Zurich, Zurich, Switzerland

We report on recent high-precision direct laser fabrication of polymers focusing on light matter interaction mechanisms at nanoscale: multiphoton absorption, avalanche ionization and thermal effects. We show possible applications in integrated microoptics and biomedicine.
Visible laser operation of Pr:MgSrAl\(_2\)O\(_4\) waveguides

- F. Reichert\(^1\), T. Calmano\(^2\), S. Müller\(^2\), D. T. Marzahn\(^3\), P.W. Metz\(^3\), and G. Huber\(^1,2\)

\(^1\)Institut der Laser-Physik, Humboldt-Universität zu Berlin, Berlin, Germany
\(^2\)Max-Planck-Institut für Quantenoptik, Garching, Germany
\(^3\)Institut für die Physik der Bio- und Geowissenschaften, Leipzig University, Leipzig, Germany

We present the first experimental demonstration of operation of fs-laser-written waveguides inscribed in bulk Pr:MgSrAl\(_2\)O\(_4\) material at around 1.3 \(\mu\)m. Output powers of \(\sim 360\) \(\mu\)W, 1.065\,mm, and 504\,mm\(^2\) were obtained, respectively. Waveguides were characterized for losses and mode field diameters.

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Dispersive time stretching measurements of real-time spectra and statistics for supercontinuum generation around 1550 nm

- B. Wetzel\(^1\), T. Stäfano\(^2\), L. Largillier\(^2\), P.A. Lacour\(^2\), J.-M. Merol\(^2\), T. Sylvestre\(^2\), A. Kudlinski\(^2\), A. Mussot\(^2\), G. Gentil\(^2\), F. Dias\(^2\), and J.M. Dudley\(^3\)

\(^1\)Institut FEMTO-ST, UMR 6174 CNRS-Université de Franche-Comté, Besançon, France
\(^2\)IPNL/IRIGA-CNRS-Université de Toulouse, UMR 5850, Toulouse, Tarn, France (now at: UMR 7080, Université de Franche-Comté, Besançon, France)

We report on the experimental realization of spatially spiralling intensity distributions that can rotate in time. For this purpose we employ interfering Bessel beams of different order.

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Conical diffraction, pseudospin, and nonlinear wave dynamics in photonic Lieb lattices

- D. Leykam\(^4\), O. Bahlat-Treidt\(^2\), and A. Desyatnikov\(^3\)

\(^1\)Department of Applied Physics, Stanford University, Stanford, CA, USA
\(^2\)School of Natural Sciences, Swiss Federal Institute of Technology Lausanne (EPFL), Lausanne, Switzerland

We present the first experimental demonstration of conical diffraction patterns. The nonlinearity reduces circular to four-fold discrete rotational symmetry.

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Integrated Polymer Micro lenses for Two-dimensional Collimation of Light from Single-mode Optical Waveguides

- L. Chang, N. Ismail, R.M. de Ridder, M. Pollnau, and K. Wöhrhoff

We demonstrate direct on-chip integration of reflored polymer micro lenses, which enables light collimation from planar channel waveguides in both lateral and vertical directions. A divergence angle reduced by a factor of 25 is demonstrated experimentally.

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The effect of hole leakage and Auger recombination on the temperature sensitivity of GaInAsSb/GaSb mid-infrared lasers

- B.A. Iyo\(^1\), I.P. Marko\(^2\), K. Hild\(^1\), A.R. Adams\(^3\), S. Arafah\(^3\), M.-C. Amann\(^4\), and S.S. Sweeney\(^1\)

We investigate the effect of hole leakage and Auger recombination on the temperature sensitivity of GaInAsSb/GaSb mid-infrared lasers at 2.3\,\mu\m and 2.6\,\mu\m in order to investigate temperature and pressure. We show that Auger recombination and to a lesser extent hole leakage determine the temperature dependence of \(J_0\) in these devices.
of Physics, University of Regensburg, Regensburg, Germany; 2Department of Physics, University of Bielefeld, Bielefeld, Germany; 3Department of Physics, Ilmenau University of Technology, Ilmenau, Germany. The collective terahertz free-carrier response of 17–15 THz is tracked during ultrafast photo-induced melting of a charge-density wave. The subsequent reordering exhibits high sensitivity to the carrier density, as expected within an excitonic model.

**CF/IE-13.4 THU 17:00 Characterization and Manipulation of Energy Entangled Qudits**

- A. Stefanov, C. Bernhard, B. Bessire, and T. Feurer; University of Bern, Institute of Applied Physics, Bern, Switzerland
- We show the experimental realization of energy-bins entangled qudits, with dimension up to 4. We performed tomographic characterization of the states and showed violation of Bell inequalities for maximally and non-maximally entangled states.

**IB-8.5 THU 17:00 Nonmaximally entangled states**

- A. Stefanov, C. Bernhard, B. Bessire, and T. Feurer; University of Bern, Institute of Applied Physics, Bern, Switzerland
- We show the experimental realization of energy-bins entangled qudits, with dimension up to 4. We performed tomographic characterization of the states and showed violation of Bell inequalities for maximally and non-maximally entangled states.

**IB-8.6 THU 17:15 Nonlinear waveguide Ultrafast downconversion in a multimode photonic crystal nanocavity**

- M. Karpinski, C. Radzewicz, and K. Banaszek; Faculty of Physics, University of Warsaw, Warsaw, Poland
- We verified experimentally spatial purity of photon pairs generated via type-II parametric down-conversion in a multimode periodically poled potassium titanyl phosphate nonlinear waveguide. The process was restricted to fundamental spatial modes by exploiting intermodal dispersion.

**IB-8.6 THU 17:15 Laser crystallisation of Semiconductor Core Optical Fibres**

- N. Healy1, S. Mailis1, T. Day1, P. Sazio1, J. Badding1, and A. Peacock1; 1Optoelectronics Research Centre, Southampton, United Kingdom; 2Penn State University, Pennsylvania, United States
- We probe charge generation in PCPDTRF:PCBM blend. Exploiting sub-15 fs time resolution, for sufficient high pump energy, hot charge-transfer excitons are produced in less than 50 fs, that can rapidly separate into free polarons.

**CM-8.6 THU 17:15 Nonlinear waveguide Ultrafast downconversion in a multimode photonic crystal nanocavity**

- M. Karpinski, C. Radzewicz, and K. Banaszek; Faculty of Physics, University of Warsaw, Warsaw, Poland
- We verified experimentally spatial purity of photon pairs generated via type-II parametric down-conversion in a multimode periodically poled potassium titanyl phosphate nonlinear waveguide. The process was restricted to fundamental spatial modes by exploiting intermodal dispersion.

**CM-8.6 THU 17:15 Laser crystallisation of Semiconductor Core Optical Fibres**

- N. Healy1, S. Mailis1, T. Day1, P. Sazio1, J. Badding1, and A. Peacock1; 1Optoelectronics Research Centre, Southampton, United Kingdom; 2Penn State University, Pennsylvania, United States
- We probe charge generation in PCPDTRF:PCBM blend. Exploiting sub-15 fs time resolution, for sufficient high pump energy, hot charge-transfer excitons are produced in less than 50 fs, that can rapidly separate into free polarons.

**CM-8.5 THU 17:00 Core-scanned fibre Bragg gratings inscribed using ultrashort pulses and a point by point setup**

- R.G. Kramér2,1, R.I. Williams3, M.J. Withford3, A. Tünnermann4, and S. Nolte1; 1Institute of Applied Physics, Jena, Germany; 2Centre for Ultra-high-bandwidth Devices for Optical Systems, MQ Photonics Research Centre, Sydney, Germany
- We present a core-scanning technique for fibre Bragg gratings using a point-by-point inscription setup, that has markedly reduced scattering losses, flexible grating period and larger-area modifications with potential for inscription into large mode area fibres.

**CG-7.5 THU 17:00 Extreme Nonlinear Optical Processes with Beams Carrying Orbital Angular Momentum**

- C. Kern; Zürich, Switzerland
- We demonstrate the first time the fabrication and characterization of 3D nanostructures by multiphoton polymerization using a material without photoinitiator. We show that polymerization occurs through a photo-induced redox initiation.

**CG-7.6 THU 17:15 The role of the Kramers-Henneberger atom in the higher-order Kerr effect**

- S. Patchkovskiy1,2, M. Richter, F. Morales3, O. Smirnova2, and M. Ivanov3,4,5,6,1; 1Steacie Institute for Molecular Sciences, National Research Council of Canada, Ottawa, Canada; 2Max-Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany; 3Department of Physics, Humboldt University, Berlin, Germany; 4Department of Physics, Imperial College London, South Kensington Campus, London, United Kingdom
- Discussion the connection between strong-field ionization, saturation of the Kerr response, and the formation of the Kramers-Henneberger atom and long-living excitations in intense external fields.

**CG-7.6 THU 17:15 Time Domain Investigation of Radio Frequency Acousto-Mechanical Tuning of Photonic Crystal Nanocavity Modes**

- S.S. Kappfinger1, D.A. Fuhrmann, S.M. Thon2, H. Kim3, D. Bouwmeester, P.M. Petroff, A. Wixforth, and H.J. Kramer1; 1Lehrstuhl für Experimentelle Physik 1, Universität Augsburg, Augsburg, Germany; 2Physics Department, University of California, Santa Barbara, United States; 3Materials Department, University of California, Santa Barbara, United States
- The dynamic optical tuning of a photonic crystal nanocavity with embedded quantum dots by a radio frequency surface acoustic wave is investigated in the time domain. The observed characteristics promise real-time control of light-matter interactions.
**CG-P.1 THU**

**Micro-focusing of XUV attosecond pulses by grazing-incidence toroidal mirrors**

- L. Pollet1, F. Prassetti1, F. Calegari3, A. Trahabitomi2, and M. Nisoli3

1-CNR-Institute of Photonics and Nanotechnologies, Padova, Italy; 2Politecnico di Milano, Department of Physics, Milan, Italy; 3-CNR-Institute of Photonics and Nanotechnologies, Milan, Italy

The design of optical systems for micro-focusing of XUV attosecond pulses through grazing-incidence toroidal mirrors is presented. Two mirrors are used in a compensated configuration to provide high demagnification of the source with negligible aberrations.

**CG-P.5 THU**

**Tabletop Lensless Imaging Apparatus using an Ultrashort High Harmonic XUV Source**

- M. Zürich1, C. Kern1, and C. Spielmann1-2

1-Institute of Optics and Quantum Electronics, Jena, Germany; 2-Heinrich-Hertz-Institut Jena, Jena, Germany

We present an apparatus based on an ultrashort laser and high harmonic generation that allows for high-resolution lensless imaging with a selectable wavelength in the XUV-regime. Images with resolution in the micron-range were recorded.

**CG-P.6 THU**

**Optically Produced Collimated Quasimonochromatic Electron Beams For Laser-Plasma Acceleration**


3-Institute of Applied Physics of the Russian Academy of Sciences, Nizhny Novgorod, Russia; 2-Joint Institute for High Temperatures of the Russian Academy of Sciences, Moscow, Russia; 3-Vavilov State Optical Institute (GOI) Research Institute for Laser Physics, St Petersburg, Russia

We studied generation of quasimonochromatic electron bunches in the 0.2-0.8 MeV range when 10^-17 W/cm^2 femtosecond laser radiation interacted with aluminum foil edge. PIC simulations confirm acceleration in the self-modulated laser wakefield in preplasma.

**CG-P.7 THU**

**Development of a carrier-envelope phase stabilized, few-cycle laser system for precision spectroscopy in the time domain**

- T. Kanaia, T. Mizuno, and T. Azuma; RIKEN, Wako-shi, Japan

We report on a novel methodology of attosecond physics to explore fundamental physics and the present status of our laser and spectroscopy system, which was specially designed for this purpose from scratch.

**CG-P.8 THU**

**Far field characteristics of a petawatt-class laser using plasma mirrors**

- V. Bagnoud1, C. Brabets2, B. Ziebausser1, G. Scott1-2, H. Powell1, and D. Neely1-4

1-CSI Heinrich Hertz Center for Heavy Ion Research, Darmstadt, Germany; 2-Johann Wolfgang Goethe University, Frankfurt, Germany; 3-Rutherford Appleton Laboratory, Didcot, United Kingdom; 4-University of Strathclyde, Glasgow, United Kingdom

We propose and demonstrate a setup to directly measure the focus of a high-energy petawatt-class laser using plasma mirrors. This leads to new insights on the effect of plasma mirrors on the laser far field.

**CG-P.9 THU**

**Photoemission enhancement from copper illuminated with a radial polarized femtosecond laser pulse**

- H. Tomizawa1, H. Dewa2, A. Mizuno2, and T. Taniguchi2

1-Japan Synchrotron Radiation Research Institute, Hyogo, Japan; 2-RIKEN SPring-8 Center, Hyogo, Japan

We have developed a new compact of photocathode gun utilizes laser coherency, using radial-polarization on a metal cathode. The enhancement factor of photoemission was observed 1.4 times at 1.6 GV/m of the laser Z-field.

**CG-P.10 THU**

**Isolated attosecond pulses by self-compression in short gas-filled fibers**

- P.N. Anderson1, P. Horak1, J.G. Frey2, and W.S. Brocklesby1

1-Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom; 2-Chemistry, University of Southampton, Southampton, United Kingdom

Numerical simulations predict that self-compression and HHG can be performed in-situ within short gas-filled fibers to generate isolated 350 as XUV pulses from 40 fs NIR fields.

**CG-P.11 THU**

**Optimized Conditions for Intense Isolated Attosecond Pulse Generation**

- G. Ma1,2, J. Mikhailov1, F. Krausz1, G. Tkachov1, and L. Vesi1

1-Max-Planck-Institut für Quantenoptik, Garching, Germany; 2-Ludwig-Maximilians-Universität München, Garching, Germany

Optimized conditions for efficiently generating intense isolated attosecond pulses via relativistic high harmonic generation are investigated by simulations. An univalled high efficiency of about 1% for harmonics below 40nm is predicted in our coming experiment.

**CG-P.12 THU**

**Attosecond pulse shaping**

- D. Austin1 and J. Bigger1-2

1-Institut de Ciencies Fotoniques, Barcelona, Spain; 2-Institució Catalana de Recerca i Estudis Avançats, 08010 Barcelona, Spain; 3-Barcelona, Spain

We propose arbitrary shaping of attosecond pulses produced using high harmonic generation – including attosecond chirp compensation - using quasi-phase matching with a modulation of the dipole excitation that is spatially addressable along the the propagation axis.

**CG-P.13 THU**

**Electron-ion correlation effects in strong field ionization**

- J. Torlina1, M. Ivanov1,2,3, Z. Walters1,1, and O. Smirnova1

1-Max Born Institute, Berlin, Germany; 2-Humboldt University, Berlin, Germany; 3-Imperial College London, London, United Kingdom; 4-Planck Institute for the Physics of Complex Systems, Dresden, Germany

Strong field ionization is a fundamentally multielectron process which may leave the ion in different excited states. We develop an analytical theory accounting for ionic excitations induced by coupling between the departing and core electrons.

**CG-P.14 THU**

**The R-matrix method for attosecond spectroscopy**

- A. Harvey, F. Morales, O. Smirnova, and D. Brambilla; Max Born-Institut, Berlin, Germany

We present a tool for the control of the spectral phase and amplitude in high-order harmonic generation. Isolated attosecond pulses are produced by means of a folding effect on the electron quantum trajectories generating the harmonics.

**CG-P.15 THU**

**Power Efficient Relativistic Multi-Stage Stable UV Channel Formation in Underdense Plasmas**

- A.B. Borisov and C.K. Rhodes; University of Illinois at Chicago, Chicago, United States

Stability control of multi-TW relativistic channels leads to power efficient stable multi-stage UV channel formation in underdense plasmas with the efficiency of power transport into the channel exceeding 90%.

**CG-P.16 THU**

**Sub-fs pulse generation and characterisation in the VUV**

- D. Fabris1, T. Wittig1, J. Henkel2, F. Franke1, W. Okell3, Z. Abdelrahman1, M. Leit1, J. Marangoz1, and J. Tisch1

1-Imperial College London, London, United Kingdom; 2-Institut für Theoretische Physik and Centre for Quantum Engineering and Space-Time Research, Leibniz Universität Hannover, Germany

The method for production and characterisation of a sub-fs VUV (10-20 eV) pulse will be discussed. Theoretical simulations predicts atime duration of ~700as. Preliminary measurements show a photon flux of ~1010 photons/shot.
CG-P.17 THU
Plateau structure in photoelectron spectra of Kr gas induced by intense circular polarized laser pulses

T. Mizuno, T. Kanai, and T. Azuma; RIKEN Advance Science Institute, wako, Japan
We found the plateau structure of photoionization of Kr gas by circular polarized light. This is not explained by traditional rescattering process.

CG-P.18 THU
The LILIA (Light Ions Laser Induced Acceleration) experiment at LNP

S. Apostolov1, M.P. Anania2, C. De Martinis3, D. Delle Site4, A. Faezi5, G. Gatti6, D. Giebels7, D. Giudietti3, L. Gizz7, L. Labate8, P. Longrondé7, V. Lassiat9, A. Pola10, S. Sinigardi11, G. Turchetti12, V. Vardil1, L. Velardil1, G. Buccoli11, and M. Carraresi11
1INFN and Politecnico of Milan, Milan, Italy; 2INFN LNF Frascati, Frascati, Italy; 3INFN and University of Milan, Milan, Italy; 4INFN LEAS and University of Salento, Lecce, Italy; 5INFN and University of Pisa, Pisa, Italy; 6INFN and CNR of Pisa, Pisa, Italy; 7INFN and University of Bologna, Bologna, Italy
A laser named FLAME by 107 W/cm2 has been deployed. An experiment of light ions acceleration through laser-matter interaction (LILIA) has been proposed. Using AI targets protons of more than 1.6 MeV have been detected.

CG-P.19 THU
Enhanced High Harmonic Generation Driven by Two-Color Laser Pulses with Two Foci

E. Lai1, Y. Xiao1, S. Zhang2, D. Chen1, Y. Zhao1, and B. Liu1
1National Key Laboratory of Tunable Laser Technology, Harbin Institute of Technology, Harbin, China; People’s Republic of (PRC); 2Department of physics, Harbin Institute of Technology, Harbin, China, People’s Republic of
We demonstrate a enhancement of high harmonic generation in CO2, using by two color laser pulses with two foci. The intensity of harmonics H23 increased by a factor of 65 compared to a single focus.

CG-P.20 THU
Pulse Contrast Enhancement at the Orion Laser Facility

The Orion Laser, United Kingdom
Contrast enhancement of a petawatt beam line has been demonstrated by frequency doubling, at sub aperture, of a 500 J pulse. Details of beam line performance are presented showing a pulse contrast greater than 1015.

CG-P.21 THU
Proposal for sub-femtosecond pulse generation with controlled carrier-envelope phase

Z. Tibai1, G. Töth2, M. Meckler2, J. Fülop2, and J. Hebling2,3
1Institute of Physics, University of Pécs, Pécs, Hungary; 2MTA-PTE High-Field Terahertz Research Group, Pécs, Hungary
We propose a robust method for producing few-cycle pulses with prescribed shape in the EUV-VUV spectral range by coherent undulator radiation of relativistic ultrathin electron layers, which are produced by IFEL.

CPL®/Europe-IQEC 2013 · Thursday 16 May 2013

Hall B0

13:00 – 14:00
IA-P: IA Poster Session

IA-P.1 THU
Quantum control of spin-correlations in ultracold lattice gases

P. Hauke1, R. Sewell1, M. Mitchell2, and M. Lewenstein1,2
1ICFO, Barcelona, Spain; 2ICREA, Barcelona, Spain
We describe a new technique for preparing and detecting spatial spin-correlations and multipartite entanglement in a quantum lattice gas based on entropic cooling via quantum non-demolition (QND) measurement and feedback.

IA-P.2 THU
Propagation of few-photon states in waveguide arrays

N. Belabas Plougouven, C. Minot, I. Abram, J. Robert-Philip, and A. Beveratos; Laboratory for Photonic and Nanostructures, Marcoussis, France
We quantitatively explore the ability of coupled waveguide arrays to characterize and manipulate two-photon and NOON states. We emphasize in particular the potential of patterned arrays in which the coupling is structured.

IA-P.3 THU
Programming quantum interference with multiple scattering

S.R. Huisman, T.J. Huisman, T.A.W. Wolterink, A.P. Mosk, and P.W.H. Pinkse; MESA+ Institute for Nanotechnology, University of Twente, Enschede, The Netherlands
We control quantum interference in opaque scattering materials by phase modulation of incident optical modes.

IA-P.4 THU
Two-Photon Rydberg Excitation of Trapped Strontium Ions

C. Maier, P. Pokorny, G. Higgins, and M. Hennrich; Institute for Experimental Physics, Innsbruck, Austria
An alternative method for trapped-quantum computing may be realized by exciting the ions into Rydberg states. We will discuss ideas and progress of our experimental setup to realise two-photon Rydberg excitation of strontium ions.

IA-P.5 THU
Synthesis of arbitrary interference patterns with high visibility

S. Shabbir, M. Swillo, and G. Björk; School of Engineering Sciences, KTH Royal Institute of Technology, SE - 106 91, Stockholm, Sweden
Using coherent state input, we demonstrate the synthesis of arbitrary interference patterns and conclude that it is neither the shape of the interference pattern nor the visibility that differentiates quantum and classical interference.

IA-P.6 THU
Experimental Generation of 2000-Mode Entangled Graph States

S. Yokoyama1, C. Sorribphathpong2, T. Kaj1, R. Ukai1, S.C. Armstrong1,2, S. Suzuki1, I.-i. Yoshihawa1, N.C. Menicucci1, and A. Furusawa1
1The University of Tokyo, Tokyo, Japan; 2The Australian National University, Canberra, Australia; 3The University of Sydney, NSW, Australia
We report on the generation of a 2000-mode fully entangled graph state, suitable as a resource for quantum information protocols. The graph is created by entangling 1000 pairs of temporally encoded EPR states.

IA-P.7 THU
Measurement-induced amplification of optical cat-like states

A. Laghazani1, J. Neergaard-Nielsen1, J. Rigas2, C. Kragh1, A. Tipsmark1, and U. Lund Andersen1,2
1Department of Physics, Technical University of Denmark, Lyngby, Denmark; 2Quantum Information Theory Group, Institutt for Teoretisk Fysik Land Max-Planck Research Group, Institute of Optics, Information and Photonics,Universität Erlangen-Nürnberg, Erlangen, Germany
An amplification scheme of coherent state superpositions (CSS) is proposed using homodyne heralding. The width of homodyne post-selection is accounted for, as well as the impurity of squeezing for approximate CSSs. Recursive amplification is analyzed.

IA-P.8 THU
Fast and non-destructive vector field magnetometry with cold atomic ensembles

N. Beddows1, F. Martin Ciurana1, G. Colangelo1, M. Napolitano1, B. Sewell1, and M. Mitchell2,3
1ICFO - The Institute of Photonic Sciences, Castelldefels (Barcelona), Spain; 2ICREA - Institucio Catalana de Recerca i Estudis Avancats, Barcelona, Spain
We report on a fast, non-destructive and sensitive measurement technique that uses atomic spin precession and non-destructive Faraday rotation probing to measure all three components of the magnetic field with kHz bandwidth.

IA-P.9 THU
Dispersive Sensitivity of Amplitude and Phase Modulated Time-Energy Entangled Photons

C. Bernhard, B. Besire, A. Stefanov, and T. Feurer; University of Bern, Institute of Applied Physics, Bern, Switzerland
We investigate the effect of dispersion on spatial light modulator shaped time-energy entangled photons. We compare two coincidence detection descriptions for different shaper functions as a function of the dispersion.

IA-P.10 THU
Dynamical suppression of unwanted transitions in multistate quantum systems

G. Genov and N. Vitanov; Department of Physics, Sofia University, Sofia, Bulgaria
We propose a method to suppress unwanted transition channels and achieve perfect population transfer in multistate quantum systems by using composite pulse sequences.
IA-P.11 THU
Nonclassical lasing in circuit quantum electrodynamics
C. Navarrete-Benlloch, 1, J. García-Ripoll, 2 and D. Porras 1
1 Max-Planck Institute for Quantum Optics, Garching, Germany;
2 Instituto de Física Fundamental
CSIC, Madrid, Spain; 3 Universidad Complutense Madrid, Spain

We show how a proper driving of the gap of a superconducting qubit interacting with the modes of a resonator allows for the generation of nonclassical states of the latter both through cooling and amplification.

IA-P.12 THU
An on-chip cross-waveguide QD spin-photon interface and its applications
A.B. Young, 1, A.J. Ramsay, 1, I.J. Luxmoore, 2, N.A. Walsery, 3, A.C.T. Thijsen, 1, A. Laing 1, 2, M.G. Thompson 3, A.M. Fox 2, M.S. Skobic 2, J.G. Rarity 1, 3, and R. Oulton 1, 2
1 Merchant Venturers School of Engineering, University of Bristol, Woodland Road, Bristol, BS8 1TR, UK; 2 Bristol, United Kingdom; 3 School of Physics and Astronomy, University of Sheffield, Sheffield, S3 7RH, UK; 3 Sheffield, United Kingdom;
4 Wills Physics Laboratory, University of Bristol, Tyndall Avenue, Bristol, BS8 1FD, UK; 5 Bristol, United Kingdom; 6 Hitachi Cambridge Laboratory, Hitachi Europe Limited, Cambridge, CB3 OHE, UK; 7 Cambridge, United Kingdom.

We present a quantum dot spin-photon interface in a linear-cavity circuit that is simple to fabricate and may be used to produce >100 photon cluster states and entangle remote spins.

IA-P.13 THU
Photon pair generation in quadratic waveguide array: A classical optical simulation
M. Graef, 1, A. Solntsev, 2, R. Keil, 3, T. Tönnemann, 1, S. Nolte, 1, A.A. Sukhorukov, 1, 2 Y.S. Kivshar, 1, 2, and A. Szameit 1, 3
1 Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Jena, Germany;
2 Nonlinear Physics Centre, Research School of Physics, The Australian National University, Canberra, Australia.

Biphoton generated through spontaneous parametric down-conversion and their correlated quantum walks in one-dimensional nonlinear waveguide arrays are investigated. We experimentally emulate this process by the linear evolution of classical light in a two-dimensional structure.

IA-P.14 THU
Towards a down-conversion source of positively spectrally correlated and decorrelated photon pairs at telecom wavelength
T. Loui 1, 2, P. Koleiderski 1, 2, and T. Jennewein 1, 2
1 Institute for Quantum Computing, University of Waterloo, Waterloo, Canada; 2 Universität Ulm, Ulm, Germany; 3 Nicolaus Copernicus University, Toruń, Poland

We experimentally characterize a spontaneous parametric down-conversion source, based on a Beta-Barium Borate crystal capable of emitting photons with positive or no spectral correlations. Our system employs a carefully designed detection method exploiting two InGaAs detectors.

IA-P.15 THU
Single-cycle squeezing from chirped quasi-phase-matched optical parametric down-conversion
D. Horoshko 1, 2 and M. Kolobov 3, 2
1 Laboratoire PhLM, Université Lille 1, Villeneuve d'Ascq, France; 2 IRIF, Stepanov Institute of Physics, NASB, Minsk, Belarus

We describe the generation of squeezed light with an octave-broad spectrum of squeezing by means of parametric down-conversion in a quasi-phase-matched nonlinear crystal with a linear chirp of the spatial frequency of periodical poling.

IA-P.16 THU
Generation of Narrowband, Entangled Photon Pairs in Birefringent Fibre
A. McMillan 1, A. Clark 2, B. Bell 2, W. MacCutcheon 1, T. Wie 2, W. Wadsworth 2, and J. Rarity 1, 2
1 University of Bristol, Bristol, United Kingdom; 2 University of Sydney, Sydney, NSW Aus.

Entangled photon power source based on cross-polarised four-wave mixing in spliced sections of conventional birefringent fibre is demonstrated. The generated pair photons are widely separated in wave-length at 850nm and 1420nm.

IA-P.17 THU
Entanglement of macroscopic Bell states
T. Ishikawa 1, K. Kansier 2, G. Bytkov 1, M. Chekhov 1, 4, 5, and G. Leuchs 1, 2
1 Max-Planck Institute for the Science of Light, Erlangen, Germany; 2 Institut d'Optique Graduate School, Paris, France; 3 Ivan Franko State University of Printing Arts, Moscow, Russia; 4 M.V. Lomonosov Moscow State University, Moscow, Russia; 5 University of Erlangen-Nuremberg, Erlangen, Germany.

We generated a full set of macroscopic Bell states containing 10^6 photons per pulse, proved their entanglement, and observed the photon-number correlations with respect to both polarization and frequency modes.

IA-P.18 THU
Optimal Temporal Mode Extraction for Quantum State Engineering via a Direct Multimode Analysis of Homodyne Data
O. Morin, C. Fabre, and J. Laurat; Laboratoire Kastler Brossel, UPMC, ENS, CNRS, Paris, France

We propose a novel method to experimentally extract the optimal temporal mode in quantum state engineering. This technique only relies on a multimode analysis of homodyne data.

IA-P.19 THU
Spatially multimode Raman scattering: optical memory and new, direct method for measuring diffusion
R. Chapekiewicz and W. Wasilewski; Faculty of Physics, University of Warsaw, Warsaw, Poland

We present first to our knowledge generation and retrieval of spatially multimode collective excitations in warm Rubidium vapors. Analyzing their decorrelation we receive diffusion coefficients. Using Raman interface we produce highly correlated delayed images.

IA-P.20 THU
Two-photon spectra of quantum systems
E. del Valle 1, A. Gonzalez-Tudela 2, F.P. Laussy 3, C. Tejedor 1, and M.J. Hartmann 1
1 Technische Universität München, München, Germany; 2 Université Autonome de Madrid, Madrid, Spain

We apply our recently developed method to compute time and frequency resolved N-photon correlations to analyse different open quantum systems (light-matter coupling, resonance fluorescence, single and two-photon generation, entangled systems) via their "two-photon spectrum".

IA-P.21 THU
Non-collinear retrieving of stored orbital angular momentum of light in cold atoms
R. de Oliveira 1, 2, L. Pravost 1, P. Barbosa 1, D. Felinto 1, B. Bloch 1, and J. Tabosa 1
1 Universidade Federal de Pernambuco, Recife, Brazil; 2 Université Paris-Sud, Orsay, France; 3 Université Paris-Nord, Villeneuve, France

We report on the storage and non-collinear retrieving of orbital angular momentum of light in an ensemble of cold cesium atoms. The stored and retrieved beams are shown to have the same orbital angular momentum.

IA-P.22 THU
Single photon interference via induced coherence with and without induced emission
A. Heuser, S. Raube, and R. Menzel; Institute of Physics and Astronomy, University of Potsdam, Germany

Two signal beams emitted from two parametric downconverters show first order interference by the process of induced coherence. The differences, if induced coherence occurs with or without stimulated emission were under investigation.

IA-P.23 THU
Chronocyclic Wigner function of ultrafast time-frequency entangled parametric downconversion states
B. Brecht and C. Silberhorn; Applied Physics, University of Paderborn, Warburger Strasse 100, 33098 Paderborn, Germany

We present an alternative description of time-frequency entangled ultrafast PDC states, based on the chronocyclic Wigner function formalism. Our approach combines the seemingly disparate continuous and discrete variable theories and highlights remarkable similarities between them.

IA-P.24 THU
Indistinguishable particles in non-Hermitian lattices and their correlations
M. Graef 1, 2, R. Heilmann 1, 2, R. Keil 2, T. Eichelkraut 3, M. Heinrich 2, S. Nolte 1, 2, and A. Szameit 1, 3
1 Institute of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, Jena, Germany; 2 CREOL, The College of Optics & Photonics, University of Central Florida, Orlando, United States

We present a novel approach to investigate quantum random walks of indistinguishable particles in non-Hermitian lattices exhibiting loss. Especially analyzed are two-particle dynamics in quasi-part-time-symmetric systems for a variety of input states.

IA-P.25 THU
Spin cooling via incoherent feedback in an ensemble of cold Rb atoms
N. Behbood 1, F. Martin Ciurana 1, G. Colangelo 1, M. Napoliolano 1, R. Sewell 2, and M. Mitchell 1, 2
1 ICFO - The Institute of Photonic Sciences, Castelldefels (Barcelona), Spain; 2 ICREA – Institucio Catalana de Recerca i Estudis Avancats, Barcelona, Spain

We report an experimental study of a new technique for spin cooling an ensemble of ultracold atoms via quantum non-demolition measurement and incoherent feedback.

IA-P.26 THU
Towards Observation of Quantum Optomechanical Correlations
S. Deléglise, A. Tavernarakis, T. Karassoulof, P. Verlot, S. Zerkani, J. Teissier, D. Garcia-Sanchez, T. Briant, P-F. Cohadon, and A. Heidmann; Laboratoire Kastler Brossel, ENS, CNRS, Paris, France

Radiation pressure is responsible for the quantum back-action noise in continuous interferometric position measurements. We have designed a table-top experiment to demonstrate this effect and realize various quantum optics experiments with an optomechanical system.
whereby vacuum measurements show that the inhibition factor is frequency
neous emission in Zn photonic bandgap crystals. We theoretically study various polariton scattering
effects and using a microcavity opens up the possibility of producing entangled photon pairs. We model the sys-
tem theoretically by numerical simulations based on a quantum Langevin approach.

We achieved photon number squeezing at 1.55 μm using a noisy erbium-doped fiber laser, making use of collinear balanced detection technique, where intensity noise at a specific radio-frequency is canceled between two pulses.

Sub臹agnitude interference with Classical Light
P: Hong and G. Zhang. The MOE Key Laboratory of Weak Light Nonlinear Photonics and School of Physics, Nankai University, Tianjin, China, People’s Republic of (PRC)

We achieved subwavelength interference of a double-slit mask without post-selected operation with a new calssic-
sional source, which is realized by using a spatial light modulator to modulate a laser beam.

We theoretically study several polariton scattering schemes, and evaluate their merit as a source of entan-
gled photons. We investigate the effect of phonons and that of resonant Rayleigh scattering on the quality of en-
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tanglement.
incoherent dipoles-2D). By rotating the analyzer, we can infer from the polarized transmitted intensity the orientation of the emitter.

IH-P.13 THU
Optimized Thermal Conductivity Enhancement of Polar Nanotubes due to Surface Phonon-Polaritons
J. Ordóñez-Miranda, L. Tranchant, T. Antoni, and S. Volz; Ecole Centrale Paris, France, France
We study the contribution of the surface phonon-polaritons to the thermal conductivity of polar carbon nanotubes. For a SiO2 nanotube, values of about 1 W/mK are obtained, which are comparable to its bulk phonon thermal conductivity.

IH-P.14 THU
Enhancement of second-harmonic generation from gold nanorods in non-spherical nanoparticles
R. Caspicky1, H. Huss1,2, J. Mäktitalo1, R. Sikanen1, J. Lehtolaiti1, J. Laukkanen1, M. Kuittinen3, M. Kauranen1; 1Tampere University of Technology, Department of Physics, Tampere, Finland; 2Centre for Metrology and Accreditation (MIKES), Espoo, Finland; 3University of Eastern Finland, Department of Physics and Mathe- matics, Joensuu, Finland
We show that the presence of passive elements enhances second-harmonic generation from arrays of active metal nanoparticles. Our results provide a completely new concept for optimizing the nonlinear response of metal nanoparticles.

IH-P.15 THU
Size dependent surface plasmon resonance broadening in non-spherical nanoparticles: single gold nanorods
V. Jau1,3, M.F. Cardinal1,4, A. Lombardi1, A. Cra1, P. Maioli1, L. M. Liz-Marzán2, N. Del Fatti3, and F. Vallée2; 1FemtoNanoOptics group, Université Lyon 1, CNRS, Institut Lumière Matière, 43 Bd du 11 Novem- bre, 69622, Villeurbanne, France; 2Department of Química Física, Universidad de Vigo, 36310, Vigo, Spain; 3Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie, D-12489, Berlin, Germany; 4Department of Chemistry, North, 2145 Sheridan Road, Evanston, United States
We investigate the quantum size effects in metallic non-spherical nanoparticles.

The linewidth of the localized surface plasmon resonance is measured in single gold nanorods and shows a dependence on the two geometrical dimensions.

IH-P.16 THU
Plasmonic Oligomers as Effective Red Light Scatterers to Enhance the Performance of Organic Solar Cells
E. Pastorelli1,2, S. Budilà4, J. Martorell1,4, and N. Bonod1; 1Institut Fresnel, Marseille, France; 2IFCJ-Institut de Ciències Fotòniques, Barcelona, Spain; 3Institut Langevin, Paris, France; 4Universitat Politècnica de Catalunya, Terrassa, Spain
Metallized nanoparticles are being embedded in organic photovoltaic devices to better harvest the sun radiation. However, isolated nanoparticles have limited potential in such thin-film devices. We overcome this limitation by using dimers and trimers solutions.

IH-P.17 THU
Shape dependence of the quadratic nonlinear properties of gold nanoparticles
A. Anu1, A. Lehoux1,2, J. Zys3, H. Remita1, and S. Ledoux-Rah3; 1LPCM, Institut d’Alembert, ENS Cachan, Cachan, France; 2IJC, Université Paris Sud, Orsay, France; 3CNRS, Institut Lumière Matière, Amiens, France
We explore the quadratic nonlinear optical (NLO) properties of gold nanorods, showing the higher nonlinearity of high aspect ratio particles. A strong exaltation of NLO properties of dyes attached to nanorods is also ev- idenced.

IH-P.18 THU
A Plasmonic Switch based on Electrically Controlled Cavity Resonances
C. McPolin, D. O’Connor, J.-S. Bouillard, A. Krasavin, W. Dickson, G. Wurtz, and A. Zayats; King’s College London, London, United Kingdom
We numerically demonstrate a compact plasmonic switch, based on a cavity structure, that allows for the signal to be dynamically controlled via electrical means, yielding extinction ratios of up to 94dB.

IH-P.19 THU
Measurements on the Optical Transmission Matrices of Strongly Scattering Nanowire Layers
O. Abuladze1, T. Trudilzy2, J. Bertolotti2, T. Zehender3, E.R.A.M. Bakkers4,5, A. Lagendijk1, W.L. Vos3, O.L. Muskens2, and A.P. Mosk3; 1Complex Photonic Sys- tems (COPS), MESA+ Institute for Nanotechnology, University of Twente, Enschede, The Netherlands; 2School of Physics and Astronomy, University of Southampton, Southampton, United Kingdom; 3Department of Applied Physics, Eindhoven University of Technology, Eindhoven, The Netherlands; 4Kavli Institute of Nanoscience, Delft University of Technology, Delft, The Netherlands
We measure optical transmission matrices of strongly scattering Ge nanowire layers. Measured matrices show presence of correlations in the transmitted fields. We study the measured matrices to retrieve optical properties of the samples.

IH-P.20 THU
strongly scattering optical phenomena in GaAs powder
T. van der Beek1, P. Barthelemy2, P.M. Johnson3, D.S. Wiersma4, and A. Lagendijk1; 1FOM Institute AMOLF, Amsterdam, The Netherlands; 2Delft University of Tech- nology, Delft, The Netherlands; 3LENS and CNR-INFM, Firenze, Italy
The contribution has been withdrawn by the authors.

IH-P.21 THU
Quantum coherence controls the charge separation in a prototypical artificial light harvesting system
S.M. Falke1, C.A. Rozzi2, N. Spallanzani3, A. Rubis2, E. Molinari2, D. Brida1, M. Maturi1, G. Cerullo3, H. Schramm1, J. Christoffers3, and C. Lienau1; 1Fur Physik, Carl von Ossietzky Universität, Oldenburg, Germany; 2CNR, Centro S3, Centro S3, Modena, Italy; 3IFN-CNR, Dipartimento di Fisica, Politecnico di Milano, Milano, Italy
We report ultrafast nonlinear spectra and first-principles quantum-dynamics simulations of an artificial pro- totypical light harvesting system - a supramolecular triad. Our results provide strong evidence for quantum-correlated wavevike motion during the ultrafast photoinduced charge transfer.

IH-P.22 THU
Cooperative Electromagnetic Interactions and Linewidth Narrowing in Discrete Metamaterial Systems
S. Jenkis and J. Ruostokoski; School of Mathematics, University of Southampton, Southampton, United King- dom
We show how cooperative electromagnetic interactions between discrete resonators can lead to the formation and narrowing of a transmission resonance in planar metamaterials. Our results are in excellent agreement with previous experimental observations.

13:00 – 14:00
CH-P: CH Poster Session

CH-P.1 THU
Tilted Planar Bragg Grating Refractometers
C. Holmes, H. Rogers, K. Daly, L. Carpenter, C. Sinna, P. Menna, J. Gates, G. D’Alessandro, and P. Smith; University of Southampton, Southampton, United Kingdom
Tilted planar Bragg gratings are demonstrated as efective refractometers. Increased design flexibility, compa- red to more traditional fibre regimes, is explored and coupling into cladding and plasmonic modes is under- stood using a developed numerical approach.

CH-P.2 THU
Resonance Micromechanical Mass Sensor with Holographic Interferometer
R. Romasko1,2, T. Efimenko1,2, and Y. Kuchin1,2; 1Institute of Automation and Control Processes, F.E.B. R.A.S, Vladi- vostok, Russia; 2Far-Eastern Federal University, Vladivostok, Russia
We present experimental results of applying an adaptive interferometry technique based on dynamic holographic recording in photorefractive crystal for measurement of nano-objects mass adsorbed at micromechanical resonators with pico-gram resolution.

CH-P.3 THU
Optical Measurements on Rotating Micro-Tools
M. Benedetti1,2, G. Capelli1,2, M. Norga1,3, and G. Giuliani1,3; 1University of Pavia, Pavia, Italy; 2Jilhute S.R.L, Pavia, Italy; 3Politecnico di Milano, Milano, Italy
The vibrations and eccentricity of rotating micro-tools (diameter 600 μm, speed up to 30,000 rpm) are measured through a custom-made triangulation laser sensor.

CH-P.4 THU
Self-Mixing Dual-Frequency Laser Doppler Velocimeter
C.-H. Cheng, L.-C. Lin, and F.-Y. Lin; Institute of Pho- tonics Technologies, Department of Electrical Engineer- ing, National Tsing Hua University, Hsinchu, China, Re- public of (ROC)
Self-mixing dual-frequency laser Doppler velocimeter based on the hybrid dynamics of the optical injection and the optical feedback of a semiconductor laser has been demonstrated. It shows the direction discrimi- nability and high sensitivity.

CH-P.5 THU
Fiber Optic Vector Magnetic Field Gradient Sensing System
A. Davis; US Naval Research Laboratory, Washington, DC, United States
The contribution has been withdrawn by the authors.
Electro-Optic High Voltage Sensor for Utility Application

S. Wildermuth,1,2 K. Bohmer1, S. Marchese3,4 O. Steiger,1 J. van Mechelen,1 L. Rodom,1 G. Eriksson,1 and J. Czyzewski1,5 ABB Switzerland Ltd., Corporate Research, Baden-Dettwil, Switzerland; 1ABB AG, Corporate Research, Baden-Dettwil, Switzerland; 3ABB Sweden Ltd., Corporate Research, Västerås, Sweden; 5ABB Switzerland Ltd., High Voltage Components, Micafl Bussings, Zurich, Switzerland

We have developed an electro-optic ac-voltage sensor based on a novel concept for high-voltage-proof packaging. It passed all required dielectric tests (operating voltage: 300kV). Accuracy of 0.2% over a wide temperature range was experimentally verified.

High-Frequency DFB/DFB-Induced Noise Analysis and Static/Dynamic strain Sensing Applications

D. Tos1 and G. Perrone2 University of Limerick, Limerick, Republic of Ireland; Politecnico di Torino, Torino, Italy

High-feedback chaotic noise induced in DFB laser and FBG system is analyzed through eigendecomposition. Sensing application as static/dynamic FBG interrogation is presented.

Influence of the Mode Field Diameter on the Strain and Temperature Sensitivity of Different Fibres

M. Marwinski1,2, Z. Holynski1,2, M. Szymanski1,2 T. Tenderenda1,2, L. Ostrowski1,2, A. Lukowski1,2, K. Pawlik1,2, M. Napierala3,4, P. Marej,1 L. Jaroszewicz,1,2 and T. Naslowski1,2,5 Institute of Applied Physics, Military University of Technology, Warsaw, Poland; 2Istituto di Fotonica, Warsaw, Poland

In this paper we present the theoretical and experimental study of the influence of the mode field diameter on the fiber sensitivity to the temperature and longitudinal strain.

Coupled waveguide integrated optic segment piston sensor for the GMT

F. Bennet1, K. Uhlenendorf1, R. Gardhouse1, R. Con1, B. Espeland1, and A. Bouché1,2 Research School of Astronomy and Astrophysics, Australian National University, Mount Stromlo Observatory, Canberra, Australia; 2Giants Magellan Telescope Organization, P.O. Box 9993, Pasadena, United States

Integrated optic segment piston sensor for the GMT uses laser-written coupled waveguides produce an output signal dependent on the segment piston. Segment piston with a sensitivity of less than 35nm with input Strehl >15%.

Polymer Fiber Optic Sensors for Strain Monitoring in Solid Rocket Motors’ Propellant

C. Ricciotti1, L. Einader1, L. Bancalari1, and G. Tissi1,2,3 1National Hellenic Research Foundation, Theoretical and Physical Chemistry Institute, Photonics for Nanomaterials Applications Laboratory, Athens, Greece; 2Bayern-Chemie GmbH, Missile Propulsion Systems, Aschaffenbrum Inn, Germany; 3IMBDA Italia S.P.A, Missile Systems, La Spezia, Italy

Polymer Optical Fibers embedded in the propellant of Solid Rocket Motors are demonstrated for monitoring strains higher than 10%. A new architecture incorporating a closed-loop fiber is proposed and its theoretical behaviour is experimentally verified.

Full Characterisation of a Focussed Extreme Ultraviolet Beam Using a Non-Redundant Array of Apertures

A.D. Parsons1, R. Baksh2, R.T. Chapmure2,3, B. Mills2, J.F. Frey2, and W.S. Branchley2 1Optoelectronics Research Centre, Southampton, United Kingdom; 2School of Chemistry, Southampton, United Kingdom; 3Rutherford Appleton Laboratories, Didcot, United Kingdom

A novel technique for full coherent beam profiling utilising a Non-Redundant array of apertures is presented. The technique is applied experimentally in the EUV using a high harmonic source and the results investigated by simulations.

Measuring the Optical Properties of Natural Silks

D. Little and D. Kane MQ Photons Research Centre, Department of Physics and Astronomy, Macquarie University, Sydney, Australia

There is an emerging interest in natural silks as an optical material. Here we present an accessible new technique for measuring the optical properties of these challenging samples, including the first reported optical absorption measurements.

Dual Frequency Combs Fourier Transform Spectrometer in Mid-Infrared Region based on Femtosecond Optical Parametric Oscillators

Y. Jin, J. Mandos, S. Cristescu, and F. Harren; Institute for Molecules and Materials, Nijmegen, The Netherlands A dual frequency combs Fourier transform spectrometer is demonstrated for the mid-infrared region. Based on optical parametric oscillator (OPO), the spectral coverage tuned from 2.7um to 4.7um, make it suitable for trace gas sensing.

Ultrafast Leak Detection of Hydrocarbons Using a 3.3 um Fabry-Perot Quantum Cascade Laser

J. Jägerskog1, B. Tuzson2, H. Loos2, H. Prinz3, and B. Bismuto1,3, M. Beck, and L. Emmenegger1 1Empa, Swiss Federal Laboratories for Materials Science and Technology, Dübendorf, Switzerland; 2ETH Zurich, Zürich, Zurich, Switzerland; 3Alpes Lasers SA, Neuchâtel, Switzerland

We present a Mid-IR optical analyzer based on 3.3um Fabry-Perot QCL for industrial leak detection of aerosol propellants. Insensitive to water interference and operated without wavelength scanning, it reaches 1ppm precision within 10ms of measurement.

Detecting exoplanets with extreme adaptive optics and a single-mode fibre fed spectrograph

N. Jovanov1, N. Cronje1,2, O. Guyon1, F. Martinache2, and J. Lawrence3,4 1Subaru Telescope, Hilo, United States; 2Macquarie University, Sydney, Australia; 3Australian Astronomical Observatory, Sydney, Australia

We report on a novel astronomical spectrograph design that combines several photonic technologies with an extreme adaptive optics system in order to achieve the high precision required for characterizing near Earth mass exoplanets.

A Quantum Cascade Laser based mid-infrared Sensor for the Detection of Carbon Monoxide and Nitrous Oxide in the Jet of a Microwave Plasma Preheated Auto-Ignition Burner

F. Schad1, F. Eitel1, S. Wagner1,2, A. Dreizler1,3, and W. Elsäßer1,4 1Institute for Applied Physics, Darmstadt, Germany; 2Institute of Reactive Flows and Diagnostics, Darmstadt, Germany; 3Center of Smart Interfaces, Darmstadt, Germany

We report on mid-infrared TDLAS sensor for detection of N2O and CO in a microwave-plasma preheated auto-ignition burner. We achieve normalized detection limits below 8ppm/m for both molecules at elevated temperatures of up to 2000K.

Fluorescence excitation emission matrix spectroscopy of strongly absorbing samples using fibre-optic probes

W. Muencke1, J. Saunders2, H. Omran2, O. Reich1, and H. P. Loock3, University of Potsdam – insaSPEC, Potsdam, Germany; 2Queen’s University, Kingston, Canada

Fluorescence emission excitation matrix spectroscopy using fibre-optic probes is applied for the investigation of strongly absorbing samples. Four detector configurations are discussed. Theoretical simulations are validated with experimental results on strongly absorbing oil-contaminated jet fuel.

Non-destructive real-time monitor to measure 3D-bunch charge distribution with spectral decoding EO sampling

H. Tomizawa1,2, Y. Okayasu3, S. Matsubara1, T. Takagi1, K. Ogawa2, T. Matsukawa2, and H. Minamide3,4 1Japan Synchrotron Radiation Research Institute, Hyogo, Japan; 2RIKEN SPring-8 Center, Hyogo, Japan; 3RIKEN, Sendai, Japan

We developed a novel 3D-RCD monitor. This 3D-RCD monitor is based on an Electro-Optic sampling technique with multiple EO crystal detectors in spectral decoding. We successfully demonstrated the first bunch measurement with DAST crystal.

Adaptive Phase Estimation with Squeezed Thermal Light

A. Bern1, L. Madsen1, M. Lassen2, B. Nielsen1, M. Paris3, and U. Andersen1,4 1Department of Physics, Technical University of Denmark, Lyngby, Denmark; 2Department of Physics, Università degli Studi di Milano, Milano, Italy

In this work we investigate experimentally an adaptive phase estimation protocol, in which the phase information is encoded in a squeezed thermal state and extracted by means of homodyne measurements and Bayesian post-processing.

Phase Noise Performance of Double-Loop Optoelectronic Microwave Oscillators

R.M. Nguimdo1, Y.K. Chen2,3, P. Colet3, and L. Larger4 1Instituto de Física Interdisciplinar y Sistemas Complejos, IFISC (CSIC-UIB), Palma de Mallorca, Spain; 2UMR CNRS FEMTO-ST 6174/Optics Department, Université Franche-Comté, Besançon, France

We introduce an optoelectronic oscillator for ultra-pure microwave generation with two nonlinearly coupled delay loops. Besides reducing the phase noise spurious peaks, this system allows for stable microwave emission with larger amplitude.
CH-P.21 THU  
**Nanometrology using localized surface plasmon resonance spectroscopy**  
*C. Jepesten*, D.N. Lindstedt, A.V. Lauerberg, A. Kristenssen, and N.A. Mortensen; 1 Department of Photonics Engineering, DTU Fotonik, Technical University of Denmark, Kongens Lyngby, Denmark; 2 Danish Technological Institute, Aalborg, Denmark Initial results on the characterization technique: localized surface plasmon resonance (LSPR) spectroscopy is presented. The SPR spectroscopy is utilized to evaluate 4" wafer scale fabrication uniformity and its potential as a nanometrology tool is discussed.

CH-P.22 THU  
**Ultrasensitive plenoptic microscope for imaging through turbid media**  
W. Glauche, O. Hugon, O. Jacquin, H. Guillot de Chatellus, and E. Lacot; Laboratoire Interdisciplinaire de Physique, Saint Martin d’Hères, France  
An ultrasensitive plenoptic microscope combining Laser Optical Feedback Imaging and Synthetic Aperture techniques is presented; a comparison with a classical setup based on a microlens array is made.

CH-P.23 THU  
**Nanometrology of sub-wavelength circular holes in gold nanofilms using Optical Surface Profilometry**  
D. Little and D. Kane; MQ Photonics Research Centre, Department of Physics & Astronomy, Macquarie University, Sydney, Australia  
We measure the diameter of sub-wavelength circular holes in gold nanofilms using an optical surface profile, demonstrating the potential of optical surface profilometry as a viable nanometrology technique.

CH-P.24 THU  
**Optical fringe pattern processing using empirical mode decomposition based algorithms**  
M. Trusniak and K. Patorski; Institute of Micromechanics and Photonics, Warsaw University of Technology, Warsaw, Poland  
In the paper two empirical mode decomposition based fringe pattern processing techniques are presented. First algorithm performs fringe pattern enhancement and normalization, the second one separates fringe families encountered in gratings interferometry (moire) methods.

CH-P.25 THU  
**A Hollow Waveguide Michelson Interferometer**  
J. Baseryd, A.R. Davies, and B.M. Jenkins; 1 Physical Research Laboratory, Navrangpura, India; 2 Royal Holloway University of London, Egham, United Kingdom; 3 HollowGuide Ltd, Malvern, United Kingdom  
A novel Michelson interferometer is proposed where hollow waveguides guide the input radiation between the interferometer components. Significant decreases in sensitivity to angular misalignment are predicted with potential performance benefits for sensing, metrology and spectroscopy.

CH-P.26 THU  
**High-resolution broadband spectroscopy with a resonator in a band phase modulator**  
N. Berger, Technion - Israel Institute of Technology, Haifa, Israel  
Considerable enhancement of the resolution and spectral range of Fabry-Perot spectrometers is proposed. A 1-MHz resolution within a 62.9-GHz range is numerically demonstrated for a finesse of 72. The spectral range can achieve 10 THz.

13:00 – 14:00  
**IG-P: IG Poster Session**

IG-P.1 THU  
**Mirror transformation of Airy pulses under the action of third order dispersion.**  
R. Driven1, A. H¢, Z. Chen, B. Malomed, and R. Morandotti; 1 Department of Physical Electronics, Faculty of Engineering, Tel-Aviv University, Tel-Aviv, Israel; 2 Department of Physics & CeOPP, University of Paderborn, Paderborn, Germany; 3 Institut National de la Recherche Scientifique, Varennes, Quebec, Montreal, Canada; 4 Department of Physics & Astronomy, San Francisco State University, San Francisco, United States  
By analytical and numerical studies we demonstrate the mirror transformation of Airy pulses propagating in fibers with strong positive third order dispersion. After reaching a focal point, Airy pulse propagates with its acceleration reversed.

IG-P.2 THU  
**Generation of ultra-compressed solitons with propagation invariant, high tunable wavelength shift in Raman inactive gas-filled hollow-core photonic crystal fibers.**  
R. Driven1 and B. Malomed; 1 Department of Physical Electronics, Faculty of Engineering, Tel-Aviv, Israel; 2 Department of Physics & CeOPP, University of Paderborn, Paderborn, Germany  
Generating of ultra-compressed solitons with propagation invariant, high tunable wavelength up and down-shift in Raman inactive gas-filled hollow-core PCFs is proposed. Universal optimal third order dispersion strength parameter was found for the compression and conversion.

IG-P.3 THU  
**Polarization-domain-wall complexes in fiber lasers.**  
C. Lecaplain1, P. Greul1, and S. Wabnitz2; 1 Laboratoire Interdisciplinaire Carnot de Bourgogne, U.M.R. 6303 C.N.R.S., Dijon Cedex, France; 2 Dipartimento di Ingegneria dell’Informazione, Università di Brescia, Brescia, Italy  
We study theoretically and experimentally the emergence of polarization-domain walls in fiber oscillators. We highlight their complex composite nature and the multifaceted range of dynamics available while exploring the system parameters.

IG-P.4 THU  
**Rogue Waves Generated through Quantum Chaos**  
C. Liu, A. Falco2, T. Krauss1, and A. Fratalocchi1; 1 PRIMALIGHT, Department of Electrical Engineering and Department of Applied Mathematics and Computational Science, KAUST, Thuwal, Saudi Arabia; 2 School of Physics and Astronomy, University of St. Andrews, St. Andrews, United Kingdom; 3 Department of Physics, University of York, York, United Kingdom  
We demonstrate a new avenue to generation of rogue waves in a linear optical micro-cavity based on the phenomenon of quantum chaos by analytical theory and ab initio simulation.

IG-P.5 THU  
**Characterization of the synchronization regimes of a self-injected two-frequency laser.**  
M. Romanelli, L. Wang, M. Brunel, and M. Vallet; Institut de Physique de Rennes, Rennes, France  
We characterize quantitatively the bounded phase and the phase-locked regimes of a self-injected dual-frequency laser. By measuring the phase noise spectra, we show that the quality of the locking is the same for both regimes.

IG-P.6 THU  
**Pattern formation in optomechanical cavities.**  
J. Ruiz-Rivas1, C. Navarro-Benites2, G. Patera3, E. Roldán4, and G.J. de Valcárcel5; 1 Universitat de València, Valencia, Spain; 2 Max-Planck Institut für Quantenoptik, Munich, Germany; 3 Université de l’Ile de France  
We predict pattern formation, including cavity solitons, in an optomechanical cavity in which one of its mirrors can be deformed by radiation pressure.

IG-P.7 THU  
**Information processing using an electro-optic oscillator subject to multiple delay lines.**  
S. Ortín1, L. Appert2, L. Pesquera1, G. Van der Sande3, J. Danckaert4, and J.M. Gutiérrez5; 1 Instituto de Física de Cantabria (IFCA), Santander, Spain; 2 Vrije Universiteit Brussel, Brussels, Belgium  
We show numerically that a opto-electronic delay oscillator with multiple delay lines can solve high-demanding memory tasks. The inclusion of the extra delay lines increases the memory capacity of the photonic reservoir computer.

IG-P.8 THU  
**Front pinning induced by spatial inhomogeneous forcing in a Fabry-Pérot Kerr cavity with negative diffraction.**  
Y. Odent, S. Coulibaly, P. Glorieux, M. Taki, and E. Louvergneaux; Laboratoire de Physique des Lasers, Atomes et Molécules, Lille, France  
We evidence the pinning of propagating fronts subjected to inhomogeneous spatial forcing. The analytical results are confirmed by experiments in a Pêrot-Fabry Kerr cavity pumped by a Gaussian profile and submitted to negative diffraction.

IG-P.9 THU  
**Diffusive resonant radiation by spatial solitons in waveguide arrays.**  
F. Biancalana1 and T. Tran2; 1 Max Planck Institute for the Science of Light, Erlangen, Germany; 2 Heriot-Watt University, Edinburgh, United Kingdom  
We study analytically and numerically a new kind of diffusive resonant radiation emitted by spatial solitons, generated in waveguide arrays with Kerr nonlinearity, which mimics the resonant emission emitted by solitons in optical fibers.

IG-P.10 THU  
**Suppression of Modulation Instability by Spatio-Temporal Modulation.**  
K. Stilunus; UPCE-CREa, Barcelona, Spain
We show by analytical and numerical studies, that modulation instability can be universally suppressed by resonant spatio-temporal modulation of the system. We study universal CGLE model, but also consider implementation in concrete nonlinear optical systems.

IG-P.11 THU

Control of excitability in an optically injected semiconductor laser
M. Turconi, B. Garbin, M. Feyereisen, M. Giudici, and S. Barland; Institut Non Linéaire de Nice, Valbonne, France
We demonstrate the control of excitability in intensity pulses in a semiconductor laser with injected signal. Triggering those pulses via a phase modulation may prove useful due to the signal regeneration property of excitable systems.

IG-P.12 THU

Delay Induced Instabilities of Cavity Solitons in Passive and Active Laser Systems
M. Tili1, A. Vladimirov3,4, 1, A. Pimenov2,3, K. Panajotov2,4, D. Pazyrev2, S. M. Yanchuk2, and S. M. Guverich3; 1Université Libre de Bruxelles (ULB), Brussels, Belgium; 2Weierstrass Institute, Berlin, Germany; 3Cork Institute of Technology, Cork, Republic of Ireland; 4Vrije Universiteit Brussel, Brussel, Belgium; 2Humboldt University of Berlin, Berlin, Germany; 4University of Münster, Münster, Germany
We study delayed feedback effect on the dynamics of solitons in passive and active optical devices. We investigate the dependence of the drift instability threshold and soliton velocity on feedback phase and carrier relaxation rate.

IG-P.13 THU

Semi-analytical model for the evolution of femtosecond pulses during supercontinuum generation in synchronously pumped ring cavities
M.J. Schmiderberger1, 2, F. Bialciană1, 1, F. Chenette2, P.S. Russell1, 2, and N.Y. Joly3, 1; 1Max Planck Institute for the Science of Light, Erlangen, Germany; 2Department of Physics, University of Erlangen-Nuremberg, Erlangen, Germany; 3School of Engineering & Physical Sciences, Heriot-Watt University, Edinburgh, United Kingdom
We study supercontinuum generation in synchronously pumped photonic crystal fibre ring cavities using a numerically efficient, semi-analytical multiscale model based on a discrete map built up from numerical solutions of the generalised nonlinear Schrödinger equation.

IG-P.14 THU

Polarization characteristics of superoscillatory beams
K. Makris1, D. Papazoglou2, 3, S. Tsirtzizis2, 3, and D. Psaltis4; 1Department of Electrical Engineering, Princeton University, Princeton, United States; 2Institute of Electronic Structures and Laser, Foundation for Research and Technology Hellas, Heraklion, Greece; 3Materials Science and Technology Department, University of Crete, Heraklion, Greece; 4School of Engineering, Swiss Federal Institute of Technology Lausanne (EPFL), Lausanne, Switzerland
Polarization aspects of superoscillations are analyzed. A method that controls the polarization of the subwave-length regions with respect to the surrounding high intensity lobes is presented. Vectorial superoscillatory solutions of Maxwell’s equations are also examined.

IG-P.15 THU

Impact of Optimal Feedback on a Quantum Dot Laser Emitting Simultaneously from the Ground and Excited States
M. Virta1, 2, K. Panajotov3, 2, and M. Sianidou2; 1Optel Research Group and LMP (Laboratoire Matériaux Optiques, Photoniques et Systèmes) EA-4423, Supélec; 2Université de Lorraine, Metz, France; 3Brussels Photonics Team, Department of Applied Physics and Photonics (B-PHOT TONA), Vrije Universiteit Brussel, Brussels, Belgium; 4Institute of Solid State Physics, Sofia, Bulgaria
We theoretically study the impact of optical feedback on the mode competition between the ground and excited state of a quantum dot laser. We bring new light and provide a theoretical framework for recent experiments.

IG-P.16 THU

Resilience of large amplitude coherent output in coupled lasers
I. Zamora-Munt, M.A. Matias, and P. Colet; IFISC (CSIC-UIB), Campus Universitat Illes Balears, Palma de Mallorca, Spain
We study synchronization in laser arrays coupled through global frequency-filtered feedback and through direct optical injection on some elements into others. A suitable mathematical framework allows to understand the effect of the coupling topologies.

IG-P.17 THU

Delay feedback induces drift of multiplex cavity solitons in VCSEL devices
E. Averlant1, 2, A. Vladimirov2, 3, K. Panajotov3, H. Thieryn1, and M. Tili1; 1Faculté des Sciences, Université Libre de Bruxelles, Brussels, Belgium; 2Weierstrass Institute for Applied analysis and stochastics, Berlin, Germany; 3Department of applied physics and photonics (IR-TONA), Vrije Universiteit Brussel, Brussels, Belgium
We show that cavity solitons exhibit a spontaneous motion in VCSELs subject to injection and delay feedback. Their speed and the threshold of their drift are derived in the limit of nascent bistability.

IG-P.18 THU

On-off and Multistate Intermittencies in Cascaded Random Distributed Feedback Fibre Laser
A. Larin1, S. Sergeev2, D. Nassiev3, D. Churkin1, 2, and S. Turitsyn1; 1Aston University, Birmingham, United Kingdom; 2Institute of Automation and Electrometry SB RAS, Novosibirsk, Russia
We experimentally study intermittency in cascaded random distributed feedback fiber laser. The on-off intermittency developed near the second Stokes wave generation threshold is changed into multistate intermittencies at higher power.

IG-P.19 THU

Parametric resonance in periodically tapered optical fibers: scalar and vectorial modulational instability bands
A. Armarello1 and F. Bialciană1, 2; 1Max Planck Research Group “Nonlinear Photonic Nanostructures” Max Planck Institute for the Science of Light, Erlangen, Germany; 2School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh, United Kingdom
We analyse the modulational instability (MI) process induced by periodic variations of the parameters of an optical fibre along the propagation direction. It occurs in situations where conventional MI is forbidden and is widely tunable.
Authors' Index

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