Quantum Information and Measurement (QIM)

19 March - 21 March 2012, Laser Optics Berlin, Berlin, Germany

Online Conference Program Now Available

Online Access to Technical Digest Now Available! Full Technical Attendees now have an alternate way to access the digest papers at the meeting. Access the papers through Optics InfoBase using the same login email address and password provided during the meeting registration process. Access is currently limited to Laser Congress Full Technical Attendees only. If you need assistance with your login information, please use the forgot password utility or "Contact Help" link.

Quantum information is an exciting, rapidly growing area of scientific interest and development, attracting cutting-edge theoretical and experimental research worldwide. Its rapid development gave birth to a number of novel quantum applications that provide exciting perspective and opens new horizons in many areas of measurement and technology. Optical methods play a key role in many implementations of quantum information and quantum technology. The conference topics will cover theoretical development and experimental implementation of qubits and quantum gates using optical, semiconductor, atomic, superconducting, and hybrid environments. Special emphasis will be given to fresh creative ideas targeting quantum information techniques and applications such as quantum metrology and sensors, quantum communication and networking, quantum memories and routers, quantum imaging, etc.

Topics:
- Entanglement-enabled quantum technologies
- Precise quantum measurement and quantum metrology
- Non-classical light sources and novel detectors
- Quantum imaging
- Quantum sensors
- Integrated and on-chip quantum devices
- Quantum communication systems
- Quantum optics of light-atom interactions
- Quantum repeaters and quantum memory
- Quantum nanomechanics and photonics
- Quantum spintronics devices and applications

General Chairs
- Robert Boyd, Univ. of Ottawa, Canada, and Univ. of Rochester, USA
- Alexander Sergienko, Boston Univ., USA

Program Chairs
- Janos Bergou, CUNY Hunter College, USA
- Saverio Pascazio, Univ. of Bari, Italy

Research in Optical Sciences is collocated with:
Research in Optical Sciences Congress

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- High Intensity Lasers and High Field Phenomena (HILAS)
- International Conference on Ultrafast Structural Dynamics (ICUSD)
- Quantum Information and Measurement (QIM)

This Optics and Photonics Congress (OPC) is designed to examine some of the latest research advances in Optical Physics and Chemistry. The advent of ultra-short pulse, extremely high power lasers is making it possible to examine material system responses to very intense light beams and to study the evolution of the structure and optical properties of these systems as they are strongly perturbed. Of equally strong interest are the subtle effects observed when photons are generated in entangled states. These entangled photons have the potential of leading to major advances in the development of advanced information and computing systems. This Congress on research topics in the optical sciences includes three meetings which will bring together world renowned researchers to discuss forefront advances in the optical sciences. The High-Intensity Lasers and High Field Phenomena (HILAS) meeting will discuss the latest developments in high peak power lasers and the material interactions resulting from the use of these lasers. A related meeting in this OPC, the 2ND International Conference on Ultrafast Structural Dynamics, will examine material system structural modifications at ultra-short time scales and the time evolution of these modifications. The third meeting, Quantum Information and Measurement (QIM), will present the most recent research advances in the field of entanglement phenomena and will examine how this phenomena may be exploited to advance information transfer and processing technologies.

Congratulations to the 2012 Research in Optics Congress Student Presentation Award Winners!

Sponsored by OSA

ICUSD - Denis Anielski, Max Planck-Institut fur Kernphysik, Germany
Time-Resolved Photoelectron Diffraction on Laser-Aligned Molecules, JT2A.38

HILAS - Bastian Borchers, Max Born Inst., Germany
Carrier-envelope Phase Double Stabilization Setup with sub-10 Attosecond Timing Jitter, HW3C.5

QIM - Shlomi Kotler, Weizmann Inst. of Science, Israel
Single-Ion Quantum Lock-in Amplifier, QM2A.3

Special Events

Student Event: Site-Seeing Tour of Potsdam
Sunday, 18 March, 14:00
Thursday, 22 March, 11:00
OSA, the Student Chapter Potsdam, and the Berlin Optik Student Chapter are offering a free guided tour for students to the famous palaces and parks around Potsdam. It was the city of residence for the Prussian kings and is a town of unique and stunning beauty. Large areas of the city were awarded official UNESCO World Heritage status in 1990. The tour will take about two hours and feature many of the most important sites within the city. For more information and to sign-up, contact Jonas Gortner

Welcome Reception
Monday, 19 March
17:00- 21:00
Hall 13, Messe Berlin
This Reception brings together all of the three meetings, HILAS, ICUSD, and QIM, within the congress for a fun evening of networking with light appetizers and drinks. This event will take place on the Laser Optics Berlin show floor and is a great opportunity to learn about the latest products and innovations. Complimentary to full Technical attendees.

Joint Poster Session
Tuesday, 20 March
10:30- 12:30
Exhibit Hall 12, Messe Berlin
The Joint Poster session is an integral part of the technical program and offer a unique networking opportunity, where presenters can discuss their results one-to-one with interested parties. Each author is provided with a 4 ft. x 8 ft. (1.22 m x 2.44 m) board on which to display the summary and results of his or her paper. This event will be held on the Laser Optics Exhibit Floor. The posters will be displayed all three days of the conference.

Special Student Workshop "How to Start Your Own Company"
Tuesday, 20 March
19:00 - 20:00
Sydney, Messe Berlin

Featuring: Wolfgang Gries, CEO/Managing Director and Founder of DirectPhotonics Industries GmbH, Germany
Learn directly from an expert in the industry and gain insight from his experiences. He will offer practical advice on starting your business that will help young professionals and students starting on their career path. This program is sponsored by the Berlin Optik Student Chapter and OSA.

Postdeadline Session
Tuesday, 20 March
19:00 - 21:00
Madrid, Messe Berlin
The postdeadline session will give participants the opportunity to hear new and significant material in rapidly advancing areas. Only those papers judged to be truly excellent and compelling in their timeliness were accepted. More information, including the schedule and location, will be posted in the weeks preceding the conference.

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Sponsored by:

Research in Optical Sciences is collocated with:

The Berlin region is one of the most important technology centers for the Optical and Microsystems industry. Science and business will profit from ideal conditions for intelligent networking at Laser Optics Berlin, which takes place March 19-21, 2012. The combination of congress, trade fair and experts' forums makes Laser Optics Berlin the top platform for exhibitors from the entire industry. In 2012 the congress will be organized by the Optical Society of America (OSA) for the very first time.

Another first: microsys berlin will take place within the scope. As a combination of exhibition and lecture program, microsys berlin concentrates on the interface between optical technologies and microsystems technology.

With its compact format and diverse synergies, Laser Optics Berlin offers exhibitors customized presentation opportunities. From the economically priced table-top displays to trade fair stands of every size, you can individually configure your trade fair presence. We are happy to advise you. www.laser-optics-berlin.de
Contact: laser-optics@messe-berlin.de
Quantum Information and Measurement (QIM) Meeting: Quantum information is an exciting, rapidly growing area of scientific interest and development, attracting cutting-edge theoretical and experimental research worldwide. Its rapid development gave birth to a number of novel quantum applications that provide exciting perspective and opens new horizons in many areas of measurement and technology. Optical methods play a key role in many implementations of quantum information and quantum technology. The conference topics will cover theoretical development and experimental implementation of qubits and quantum gates using optical, semiconductor, atomic, superconducting, and hybrid environments. Special emphasis will be given to fresh creative ideas targeting quantum information techniques and applications such as quantum metrology and sensors, quantum communication and networking, quantum memories and routers, quantum imaging, etc.

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Invited Speakers

Plenary Speakers

Quantum Information Processing and Quantum Simulations with Trapped Ions, Ian Walmsley, University of Oxford, UK
Elements of a Practical Quantum Network Rainer Blatt, Leopold-Franzens Universitat Innsbruck, Austria

Invited Speakers

Quantum-Optomechanics: Quantum Experiments with Massive Mechanical Systems, Markus Aspelmeyer, University of Vienna, Austria
Emission and Absorption of Single Photons by Single Atoms, Jürgen Eschner, Univ. of Saarland, Germany
Ultimate Sensitivity in Precision Optical Measurements Using Intense Gaussian Quantum Light: A Multi-modal Approach, Claude Fabre, Univ. Pierre et Marie Curie, France
Quantum Key Distribution Using Hyper Entanglement, Dan Gauthier, Duke University, USA
Quantum Information Storage in Atomic Media, Elisabeth Giacobino, University of Paris, France
Compressive Sensing in the Quantum Domain, John Howell, University of Rochester, USA
Single-qubit Laser: Generation of Nonlinear Coherent State, Sergei Kilin, National Academy of Sciences of Belarus, Belarus
Advanced Quantum Communication via Hyperentanglement, Paul Kwiat, Univ. of Illinois at Urbana-Champaign, USA
Quantum Images from 4-Wave Mixing in Atomic Vapors, Paul Lett, NIST, USA
Strong Atom-Photon Coupling in Free Space, Gerd Leuchs, University of Erlangen, Germany
Directions in Optical Implementations of Quantum Key Distribution, Norbert Lutkenhaus, Institute for Quantum Computing, University of Waterloo, Canada
Integrated Quantum Photonics, Jeremy O’Brien, University Of Bristol, UK
Quantum Feedback Experiments with Atoms and Cavities, Jean-Michel Raimond, Université Pierre et Marie Curie, France
Quantum Networking with Individual Qubits of Light and Matter, Gerhard Rempe, MPQ, Germany
Adaptive Quantum Measurement via Swarm-Intelligence Machine Learning, Barry Sanders, University of Calgary, Canada
Complementarity Revisited, Wolfgang Schleich, Universitat Ulm, Germany
Coherent Coupling of a Superconducting Flux Qubit to an Electron Spin Ensemble in Diamond, Kouichi Semba, NTT Basic Research Laboratories, Japan

Quantum Information Processing with Integrated Optics and Pulsed Light, Christine Silberhorn, University of Paderborn, Germany

Quantum Interferometry, Augusto Smerzi, Univ. of Trento, Italy

Experimental Tradeoffs in Quantum Measurement: Uncertainty Relations, Weak Measurements and Quantum Metrology, Aephraim Steinberg, Univ. of Toronto, Canada

Nano Optical Fibers for Photonic Quantum Information, Shigeki Takeuchi, Hokkaido Univ., Japan

Single Photons, Entanglement Swapping and Heralded Photon Amplification for Device Independent Quantum Key Distribution, Robert Thew, University of Geneva, Switzerland

Experimental Studies Toward the Quantum Communications with Orbiting Terminals, Paolo Villoresi, University of Padova, Italy

Entangling Two Remote Rb-87 Atoms, Harald Weinfurter, Univ. of Munich, Germany

Exploiting the Quantum Advantage, Andrew White, University of Queensland, Australia

Coherent Coupling of a Superconducting Flux Qubit to an Electron Spin Ensemble in Diamond, Kazuya Yuasa, Waseda Univ., Japan
Welcome to the 2012 OSA Optics & Photonics Research in Optical Science Congress! This year, we have three topical meetings collocated together to form this Congress. The three meetings are High Intensity Lasers and High Field Phenomena (HILAS), International Conference on Ultrafast Structural Dynamics (ICUSD) and Quantum Information and Measurement (QIM).

The aim of the High-Intensity Sources and High-Field Phenomena meeting is to assemble a multi-disciplinary group of participants to present and exchange breakthrough ideas relating to the physics and applications of high field sources, and related developments in high intensity lasers and related technology. The conference topics include both fundamental science and applications of high field phenomena, as well as technical aspects related to source development. We have scheduled 15 invited and 45 contributed oral presentations, together with 11 poster presentations, for you to attend.

The field of structure research in the ultrafast time domain is new and rapidly developing. The goal is for the International Conference on Ultrafast Structural Dynamics (ICUSD) to serve as a platform for discussing the latest development in the field and for new connections to be made, while hearing from early stage researchers. We have scheduled 4 tutorials, 12 invited and 40 contributed oral presentations, together with 19 poster presentations, for you to attend. The program highlights most recent advances in electron and x-ray diffraction as well as ultrafast spectroscopy addressing transient structures.

Quantum information and measurement (QIM) is an exciting, rapidly growing area of scientific interest and development, attracting cutting-edge theoretical and experimental research worldwide. Entanglement is a key resource for quantum information, communication, and quantum computing, whereas decoherence is the main adversary. Optical methods play a key role in quantum information research and in emerging quantum measurement applications. We have scheduled 2 plenary, 24 invited and 83 contributed oral presentations, together with 32 poster presentations, for you to attend.

We all are very pleased to have you join us and we look forward to a great meeting!

HILAS
Jon Marangos, Imperial College London, UK, General Chair
Joachim Ullrich, Max-Planck-Institut fur Kernphysik, Germany, General Chair
Andrius Baltuska, TU Vienna, Austria, Program Chair
Jens Biegert, ICFO, Spain, Program Chair

ICUSD
Thomas Elsaesser, Max Born Inst., Germany, General Chair
Majed Chergui, École Polytechnique Federale de Lausanne, Switzerland, General Chair

QIM
Robert Boyd, Univ. of Ottawa, Canada, and Univ. of Rochester, USA, General Chair
Alexander Sergienko, Boston Univ., USA, General Chair
Janos Bergou, CUNY Hunter College, USA, Program Chair
Saverio Pascazio, Univ. of Bari, Italy, Program Chair
Program Committee

High Intensity Lasers and High Field Phenomena (HILAS)

General Chairs
Joachim Ullrich, Max-Planck-Institut fur Kernphysik, Germany
Jon Marandos, Imperial College London

Program Chairs
Andrius Baltuska, TU Vienna, Austria
Jens Biegert, ICFO, Spain

Committee Members
Sterling Backus, Colorado State Univ., USA
Giulio Cerullo, Politecnico di Milano, Italy
Eric Cormier, CELIA, France
Sandro DeSilvestri, Politecnico di Milano, Italy
John Dudley, Univ. Franche-Comté, France
Takao Fujii, IMS Okazaki, Japan
Simon Hooker, Oxford Univ., UK
Jason Jones, Univ. of Arizona, USA
M. Krishnamurthy, TIFR - Tata Institute of Fundamental Research, India
Ruxin Li, Shanghai Inst. of Optics and Fine Mech, China
Yasuo Nabekawa, RIKEN, Japan
Chang Hee Nam, Kist, Korea
Günter Steinmeyer, Max Born Inst., Germany
Amelle Zair, Imperial College London, UK

Quantum Information and Measurement (QIM)

General Chair
Robert Boyd, Univ. of Ottawa, Canada, and Univ. of Rochester, USA
Alexander Sergienko, Boston Univ., USA

Program Chairs
Saverio Pascazio, Univ. of Bari, Italy
Janos Bergou, CUNY Hunter College, USA

Committee Members
Harald Weinfurter, Univ. of Munich, Germany
Eugine Polzik, Univ. of Kopenhagen, Denmark
Aephraim Steinberg, Univ. of Toronto, Canada
Jeremy O’Brien, Univ. of Bristol, UK
Paul Kwiat, UIUC, USA
Hans Bacher, Australian National Univ., Canberra, Australia
Jean-Michel Raimond, Univ. of Paris, France
Andrew Shields, Cambridge Univ., Toshiba Europe, UK
Vladimir Buzek, Univ. of Bratislava, Slovakia
Sergei Kilin, Institute of Physics, Minsk, Belarus
Wolfgang Schleich, Univ. of Ulm, Germany
Luigi Lugiato, Univ. of Insbruck, Italy
Paul Lett, NIST, USA
Claude Fabre, Univ. Pierre et Marie Curie, France
Oliver Benson, Univ. of Berlin, Germany
Paolo Villoresi, Univ. of Padova, Italy
Jürgen Eschner, Univ. of Saarland, Germany
Rosario Fazio, Scuola Normale Superiore, Pisa, Italy
Tommaso Calarco, Univ. of Ulm, Germany
Viktor Zadkov, Moscow State Univ., Russia
Kazuya Yuasa, Waseda Univ., Japan
Jian-Wei Pan, Hefei NLPSM, China

International Conference on Ultrafast Structural Dynamics (ICUSD)

Chairs
Thomas Elsaesser, Max Born Inst., Germany
Majed Chergui, École Polytechnique Fédérale de Lausanne, Switzerland

Committee Members
Shin-ichi Adachi, High Energy Accelerator Research Organization (KEK), Japan
Roger Falcone, Lawrence Berkeley National Lab., USA
Peter Hamm, Univ. of Zurich, Switzerland
Jon Marangos, Imperial College London, London
M. Garcia, Universität Kassel, Germany
Dwayne Miller, Univ. of Toronto, Canada; Univ. of Hamburg, Germany
Ilme Schlichting, Max-Planck-Institut, Germany
Special Events

Welcome Reception
Monday, 19 March, 17:00–21:00
Exhibit Hall 13

This Reception brings together all of the three meetings, HILAS, ICUSD, and QIM, within the congress for a fun evening of networking with music, light appetizers and drinks. This event will take place on the Laser Optics Berlin show floor and is a great opportunity to learn about the latest products and innovations. Complimentary to all full technical attendees.

Poster Presentations
Tuesday, 20 March, 10:30–12:30
Exhibit Hall 12

Poster presentation offer an effective way to communicate new research findings and provide an opportunity for lively and detailed discussion between presenters and interested viewers. HILAS, ICUSD and QIM’s posters will be presented during this session.

Postdeadline Papers Presentations
Tuesday, 20 March, 19:00–21:00
Madrid

Please see the update sheet for information concerning the Postdeadline Sessions. The purpose of the postdeadline session is to give participants the opportunity to hear new and significant materials in rapidly advancing areas. Only those papers judged to be truly excellent and compelling in their timeliness were accepted.

OSA Student Paper Competition

OSA is pleased to recognize the winners of the Research in Optical Sciences Congress best student paper awards, as selected by the Program Committees. Each of the three winners will be recognized in their session and presented with a certificate and an iPad2. Congratulations to:

Denis Anielski, Max Planck-Institut für Kernphysik, Germany
Time-Resolved Photoelectron Diffraction on Laser-Aligned Molecules, JT2A.38

Bastian Borchers, Max Born Inst., Germany
Carrier-envelope Phase Double Stabilization Setup with sub-10 Attosecond Timing Jitter, HW3C.5

Shlomi Kotler, Weizmann Inst. of Science, Israel
Single-ion Quantum Lock-in Amplifier, QM2A.3

Student Events
(time and location is printed in the update sheet)

On Tuesday, 20 March, the Berlin Opticsk Student Chapter and OSA will host two events for all students.

- 1-hour session on starting a photonics business with Wolfgang Gries, CEO/Managing Director and Founder of Direct-Photonics Industries GmbH
- Student Networking Party

Laser Optics Berlin - International Trade Fair and Congress

As a platform for introducing forward-looking ideas, technical trends and world’s firsts, the event offers trade visitors from research, development and production comprehensive insight into the innovative power of the optical technologies. Research and science are a significant part of the overall concept.

The heart of the event is the Scientific-Technical Congress, which takes place in parallel. In 2012, the congress will be organized by The Optical Society (OSA).

Starting in 2012 the industry forums Laser Optics Berlin and microsys berlin will be taking place under one roof. This will be the first business platform among German trade fairs to mirror the products and services of both the optical technology and microsystem technology industries. As another first, Laser Optics Berlin is presenting Warsaw as its official partner city in 2012.

Exhibit Hall Hours

<table>
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<tr>
<th>Date</th>
<th>Hours</th>
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<tr>
<td>19–20 March</td>
<td>10:00–17:00</td>
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<tr>
<td>21 March</td>
<td>10:00–16:00</td>
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OSA Booth

Stop by The Optical Society’s booth #702 at Laser Optics Berlin to receive great giveaways and free copies of Optics and Photonics News magazine. Discover our “Publish-Present-Network” initiative and learn about individual and corporate membership, publications, meetings, our philanthropic foundation, and other OSA activities. OSA staff will be there to answer your questions.
Map of Messe Berlin

Congress rooms
Congress registration
Coffee breaks

Hall 13
- Opening
- Welcome Reception
- Congress restaurant (Lunch)

Hall 12 - OSA Poster session

Messe Berlin GmbH - Messedamm 22 - 14055 Berlin
Telefon +49 (0)30 3038-2056 Telefax +49 (0)30 3038-2291
www.messe-berlin.de · laser-optics@messe-berlin.de
Agenda of Sessions — Monday, 19 March

<table>
<thead>
<tr>
<th>Time</th>
<th>Madrid</th>
<th>Sydney</th>
<th>Hong Kong</th>
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<td>07:00–16:30</td>
<td>Registration,</td>
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<tr>
<td>08:15–8:30</td>
<td>QIM Opening Remarks</td>
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<td>Remarks</td>
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<td>08:30–10:00</td>
<td>QM1A • Quantum</td>
<td>QM1B • Quantum</td>
<td>HM1C • Short</td>
<td>IM1D • X-ray</td>
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<td>Wavelength Sources</td>
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<td>Interaction</td>
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<td>10:00–11:00</td>
<td>Coffee Break,</td>
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<td>11:00–13:00</td>
<td>QM2A • Quantum</td>
<td>HM2C • Short</td>
<td>IM2D • X-ray</td>
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<td>Information and</td>
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<td>Atoms and Ions</td>
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<td>13:00–14:30</td>
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<td>14:30–16:30</td>
<td>QM3A • Novel</td>
<td>QM3B • Quantum</td>
<td>HM3C • HHG1</td>
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<td>17:00–21:00</td>
<td>Welcome Reception,</td>
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Explanation of Session Codes

The first letter of the code designates the meeting (For instance, H= High Intensity Lasers and High Field Phenomena, I= International Conference on Ultrafast Structural Dynamics, Q= Quantum Information and Measurement, J=Joint). The second element denotes the day of the week (Monday=M, Tuesday=T, Wednesday=W). The third element indicates the session series in that day (for instance, 1 would denote the first parallel sessions in that day). Each day begins with the letter A in the fourth element and continues alphabetically through a series of parallel sessions. The lettering then restarts with each new series. The number on the end of the code (separated from the session code with a period) signals the position of the talk within the session (first, second, third, etc.). For example, a presentation coded QT1A.4 indicates that this paper is part of Quantum Information and Measurement (Q) and is being presented on Tuesday (T) in the first series of sessions (1), and is the first parallel session (A) in that series and the fourth paper (4) presented in that session.

Key to Conference Abbreviations

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ICUSD International Conference on Ultrafast Structural Dynamics
QIM Quantum Information and Measurement
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<tr>
<td>08:00–10:00</td>
<td>QT1A • Quantum Light and Matter Interaction</td>
<td>QT1B • Quantum Gaussian Light</td>
<td>HT1C • Lasers, OPA, OPCPA</td>
<td>IT1D • X-ray Diffraction II</td>
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<td>10:00–10:30</td>
<td>Coffee Break, Grosser Stern</td>
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<td>10:30–12:30</td>
<td>JT2A • Joint QIM, HILAS, ICUSD Poster Session, Exhibit Hall 12</td>
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<td>12:30–14:00</td>
<td>Exhibit Hall / Lunch, Hall 13</td>
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<tr>
<td>14:00–16:00</td>
<td>QT3A • Photon Entanglement</td>
<td>QT3B • Quantum Information</td>
<td>HT3C • OPCPA and Waveform Synthesis</td>
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<td>19:00–21:00</td>
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## Agenda of Sessions — Wednesday, 21 March

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<td>08:00–10:00</td>
<td>QW1A • Quantum Communication II</td>
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<td>HW1C • Electronic Dynamics</td>
<td>IW1D • Structure Probes and Methods</td>
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<td>QW2A • Quantum Communication III</td>
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<td>HW2C • Electronic Dynamics and Attosecond Physics</td>
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<td>14:00–16:00</td>
<td>QW3A • Quantum Information and Measurement with Photons II</td>
<td>QW3B • Quantum State Engineering I (starts at 14:45)</td>
<td>HW3C • NL and Extreme NL Optics</td>
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<td>16:30–18:00</td>
<td>QW4A • Novel Quantum Information and Measurement Techniques II</td>
<td>QW4B • Quantum State Engineering II</td>
<td>HW4C • Atomic and Molecular Physics (ends at 18:15)</td>
<td>IW4D • Phonon &amp; Vibrational Probes</td>
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### Key to Conference Abbreviations
- **HILAS**: High Intensity Lasers and High Field Phenomena
- **ICUSD**: International Conference on Ultrafast Structural Dynamics
- **QIM**: Quantum Information and Measurement
is entanglement useful for metrology?

When and how the limitations on quantum measurement. Was recent and ongoing experiments investigating Canada.

We experimentally demonstrate Di Trento, Italy. 

producing a macroscopic spin state with total spin as well as superadiabatic driving, achieving nearly perfect fidelity for a two-level quantum system realized with BECs in optical lattices.

We present time-resolved XRD experiments which evidence the generation of a tunable high-frequency monochromatic phonon wavepacket by multiple optical excitation of a thin film transducer. The decay time of these phonon pulses is ~140 ps.
QM1A • Quantum Measurement—Continued

QM1A.4 • 09:30  Invited
Quantum Interferometry, Augusto Smerzi1; 1INO-CNR, Italy. Entanglement can increase the sensitivity of an interferometer well beyond the classical shot-noise limit. We discuss the last theoretical developments and a recent experiment demonstrating sub shot-noise with twin-Fock states created with trapped Bose-Einstein condensates.

QM1B • Quantum Atom-Photon Interaction—Continued

QM1B.4 • 09:30  Invited
Emission and Absorption of Single Photons by Single Atoms, Jürgen Eschner1,2, Jan Huwer1,2, Joyee Ghosh1,2, Nicolas Piro1,2, Francesco Dubiet1,2, Michael Schug1, Christoph Kruz1, Philipp Müller1,2, José Brito3,4,5, Experimentalphysik, Universität des Saarlandes, Germany; 3ICFO – Institut de Ciències Fotoniques, Spain. For quantum networking, we show high-rate single-mode emission of bandwidth-tunable single photons from a single ion, and heralded absorption by the ion of single photons from SPDC photon pairs. The heralded absorption preserves entanglement.

HM1C • Short Wavelength Sources—Continued

HM1C.4 • 09:30
Bright Femtosecond X-ray Beams from Betatron Radiation and Thomson Backscattering, Cedric Thaury1, Sebastien Corde1, Victor Malka1, Antoine Rousse1, Kim Tapiau1,2,3; 1Laboratoire d’Optique Appliquée, Ecole Polytechnique, France. Bright femtosecond x-ray beams, with controlled features and energy up to a few hundreds of keV, have been produced by wiggling relativistic electrons, from a laser plasma accelerator, in a plasma wiggler and an electromagnetic wave undulator.

HM1C.5 • 09:45
Monochromatised XUV Pulses for Ultrafast Science at the Artemis Facility, Emma Springate1, Cephise Cacho1, Edmond Turcu1, Fabio Frassette1, Paolo Villorini1,2, Luca Paletto1,2, Will Bryan1,2, Russell Minner1,2, Jonathan Underwood1,2, Jesse Peterson1,2, Stefan Kaiser1, Nicky Dave1, Alberto Simoni1, Haiyan Liu1,2,4, Adrian Cavalieri1, Sarnjeet Dhaliwal1,2, Helmuth Berger1,2,3; 1STFC Central Laser Facility, UK; 2National Research Council of Italy – Inst. of Photonics and Nanotechnologies, Italy; 3Department of Information Engineering, Univ. of Padova, Italy; 4Department of Physics, Swansea Univ., UK; 5Department of Physics, Univ. of Oxford, UK; 6Max Planck Department for Structural Dynamics, Centre for Free Electron Laser Science, Germany; 7Diamond Light Source, UK; 8Ecole Polytechnique Fédérale de Lausanne, Switzerland; 9Univ. Collège Londonium, UK; 10Southampton Univ., UK. XUV pulses produced through high harmonic generation can probe electron dynamics in complex solid materials and in gas-phase atoms and molecules. This is demonstrated in gas-phase and condensed matter experiments at the Artemis facility.

IM1D • X-ray Scattering—Continued

IM1D.4 • 09:30  Invited
Ultrafast Coherent Diffractive Imaging Using a Lab-Based Soft X-ray Source, Hamed Merdji1; 1IRAMIS/SPAM, CEA Saclay, France. We demonstrate femtosecond coherent imaging of nanometric objects using table-top soft X-ray laser harmonics source. We present applications in ultrafast nano-magnetism and control of azobenzene-based nanoparticles isomerization.

10:00–11:00 Coffee Break, Grosser Stern
11:00–13:00
QM2A • Quantum Information and Measurement with Atoms and Ions
Alexander Sergienko; Boston Univ., USA, Presider

Rainer Blatt graduated in physics from the Univ. of Mainz in 1979. He finished his doctorate in 1981 and worked as a research assistant. He received the “venia docendi” in experimental physics in 1988 at the Univ. of Hamburg, became professor of physics at the Univ. of Göttingen in 1994 and was appointed a chair at the Univ. of Innsbruck in 1995. Since 2003 Blatt holds the position of Scientific Director at the Institute for Quantum Optics and Quantum Information (IQOQI) of the Austrian Academy of Sciences (ÖAW). Rainer Blatt’s research focuses on trapped ions as a means to address fundamental questions in quantum optics, spectroscopy, and quantum information science.

11:00–13:00
HM2C • Short Wavelength Sources and Applications
Jon Marangos; Imperial College London, UK, Presider

We deterministically prepare and stabilize Fock states in a superconducting cavity by real-time quantum feedback using information provided by circular Rydberg atoms to react on the field and compensate the quantum jumps due to decoherence.

11:00–13:00
IM2D • X-ray Diffraction
David Reis; Stanford PULSE Inst., SLAC Nat. Accelerator Lab., USA, Presider

Ultrafast Structural Dynamics in Manganites Associated with Phase Transitions, Paul Beaud; Andrin Caviezel, Steven L. Johnson, Urs Staedt, Simon O. Mariager, Shih-Wen Huang, Christopher J. Milne, Fabien Pruneri, Simon O. Mariager, Shih-Wen Huang, Christopher J. Milne; Swiss Light Source, Paul Scherrer Institut, Switzerland; Inst. for Quantum Electronics, ETH, Zürich, Switzerland; Laboratoire de Spectroscopie Ultrarapide, EPL, Switzerland. We use femtosecond x-ray diffraction to study the structural dynamics in three dimensional manganites accompanying photo-induced phase transitions. Initial dynamics of the phase transition are found to be significantly faster than 200 fs.
Monday, 19 March

QM2A • Quantum Information and Measurement with Atoms and Ions—Continued

QM2A.3 • 12:15
Single-ion Quantum Lock-in Amplifier, Shlomi Kotler1, Nitzan Akerman1, Yinnon Glickman1, Anna Kelzer1, Roei Cerivo1; 1Physics of Complex Systems, Weizmann Inst. of Science, Israel. We implement a quantum analogue to the classical lock-in amplifier. With this method we reach a measurement sensitivity, two orders of magnitude better than with other single spin probe technologies.

QM2A.4 • 12:30
Microtrap Arrays On Magnetic Film Atom Chips For Quantum Information Science, Vanessa Leong1, Arely Tauschinsky1, Klaasjan Van Drunen1, Robert Spreeuw1; 1Inst. of Physics, Univ. of Amsterdam, Netherland. We discuss two approaches for developing a quantum information science platform, based on microtrap arrays on a magnetic-film atom chip. One uses Rydberg mediated interactions, the other simulates the Hubbard model in sub-wavelength lattices.

QM2A.5 • 12:45
Atomic Quantum Metrology with Polarization-Entangled States of Light, Florian Wolgramm1, Chiara Vitelli1, Federica A. Bedini1, Nicolas Godbout1, Morgan W. Mitchell1; 1ICFO - The Inst. of Photonic Sciences, Spain; 2Dipartimento di Fisica, Universita 'Sapienza' di Roma, Italy; 3COPL, Département de Génie Physique, École Polytechnique de Montréal, Canada; 4ICREA-Institució Catalana de Recerca i Estudis Avançats, Spain. We report on the first use of quantum entanglement to improve non-destructive measurement of a delicate system: We use narrowband NOON states to break the standard quantum limit in an optical magnetometer.

QM2B • Short Wavelength Sources and Applications—Continued

HM2C.3 • 12:00
Results of Recent Experiment at (x-Ray) Free Electron LASERS on Carbon-like Materials, Shafagh Dastjani Farahani1, Andreas Borgschulte2; 1Max-Planck-Strasse, Germany; 2Institut für Physik & Astronomie, Universität Potsdam, Germany. We report the first femtosecond X-ray diffraction experiments on LiBH4. During off-resonant excitation with 800-nm pulses we observe a purely electronic modification of the X-ray diffraction pattern, followed by coherent atomic motions.

HM2C.4 • 12:15
Pulse Width Dependent Damage Testing of Critical Components in Vacuum for Petawatt Class Short Pulse Lasers, Enam Chowdhury1, Patrick Poole1, Rebecca Daskalova1, Richard Freeman1, Douglas Smith2; 1The Ohio State Univ., USA; 2Inst. of Physics, Polish Academy of Sciences, Poland. Carbon based materials have been irradiated by FELs x-ray pulses. The damage threshold is determined for hv = 25, 91, 177 and 830 eV. The irradiated material is characterized ex-situ by AFM, p-Raman and photoemission spectroscopy.

HM2C.5 • 12:30
XUV-driven Electronic Correlation Probed with Strong Ti Laser Fields, Markus Drescher, Univ. of Hamburg, Germany. Strong (~ 1 MV/cm) Ti laser fields steer the motion of XUV-ionized photo- and Auger-electrons in an atomic potential, revealing an intrinsic time-dependent non-linear spectral chp of the correlated particles.

IM2D • X-ray Diffraction—Continued

IM2D.3 • 12:15
Lattice and Magnetic Dynamics of a Laser Induced Phase Transition in FeRh, Simon O. Mariager1, F. Presseco1, Gerhard Ingold1, Andrin Carviede1, Ekaterina Mühr-Vorobeva1, Paul Beaud3,1, Steven L. Johnson1, Christopher J. Milne1, Robert Federrath1, C. Back1, Christoph Quastmann1; 1Swiss Light Source, Paul Scherrer Institut, Switzerland; 2Fakultät für Physik, Univ. of Regensburg, Germany; 3Inst. for Quantum Electronics, ETH Zürich, Switzerland; 4École Polytechnique Fédrale Lausanne, Switzerland; 5Niels Bohr Inst., Univ. of Copenhagen, Denmark. We study the two coupled components of the laser induced phase transition in FeRh. We compare structural and magnetization dynamics measured with respectively time-resolved x-ray diffraction and magneto optical Kerr effect.

IM2D.4 • 12:30
Following Strain-Induced Mosaicity Changes of PbZr0.2Ti0.8O3 Thin Films by Ultrafast Reciprocal Space Mapping, Daniel Schick1, André Bojahr1, Patrick Poole1, Rebecca Daskalova1, Richard Freeman1, Douglas Smith2; 1The Ohio State Univ., USA; 2Inst. of Physics, Polish Academy of Sciences, Poland. We present first results on mosaicity changes in a ferroelectric PbZr0.2Ti0.8O3 thin film on a ps timescale utilizing a new ultrafast reciprocal space mapping technique.

IM2D.5 • 12:45
Femtosecond X-Ray Powder Diffraction on LiBH4, Flavio Zamponti1, Johannes Stingl1, Benjamin Freyer1, Michael Wörner1, Thomas Elsaesser2, Andreas Borgschulte2; 1Max Born Inst., Germany; 2Laboratory for Hydrogen and Energy, EMPA, Switzerland. We report the first femtosecond x-ray diffraction experiments on LiBH4. During off-resonant excitation with 800-nm pulses we observe a purely electronic modification of the transient diffraction pattern, followed by coherent atomic motions.

13:00–14:30 Exhibit Hall / Lunch, Hall 13

Research in Optical Sciences • 19–21 March 2012
Quantum Optomechanics: A Mechanical Platform for Quantum Foundations and Quantum Information, Markus Aspelmeyer; 1Univ. of Vienna, Austria. Quantum optical control over the motion of nano- and micromechanical resonators has now become possible in a broad variety of architectures. We will present the status, prospects and challenges of this emerging field of quantum optomechanics.

Integrated Quantum Photonics, Jeremy O’Brien; 1Univ. Of Bristol, UK. We have developed an integrated waveguide approach to photonic quantum circuits for high performance, miniaturization and scalability. Here we report high-fidelity silica-on-silicon integrated optical realizations of key quantum photonic circuits, including two-photon quantum interference and a controlled-NOT logic gate. Finally, we give an overview of our recent work on fundamental aspects of quantum measurement and diamond nonlinear photon sources.

Optomechanical Systems as Single Photon Routers, Sonnet Huang; Giorgio Agarwal; Oklaho-oma State Univ., USA. We show how EIT in cavity optomechanical systems can be used to produce a switch for a probe field in a single photon Fock state using very low pumping powers of few microwatts.

High Resolution Measurement of Polarization Mode Dispersion in Discrete Telecom Devices using Quantum Interferometry, Alexander Ser- gienko, Andrew Fraine, Olga Minaeva, David Si- man, Roman Egorov; 1Dept. of ECE/ENG, Boston Univ, USA. A quantum interferometric technique for measuring polarization mode dispersion (PMD) of commercial telecommunication wavelength selective switch (WSS) demonstrates advantages of quantum technology over conventional measurement.

High-resolution and high-speed measurement of third-order nonlinear susceptibilities, Vincenzo Vitelli; 1Pu- blic University of Navarra, Spain. We present a new interferometric technique for second harmonic generation detection in disordered systems that is based on a phase-sensitive homodyne detection scheme. This setup is based on a Mach-Zehnder interferometer with a pair of cascaded optical switches: one is used to generate the input signal, while the other is used to create the local oscillator.

Efficient Quantum Control of Two-Level Molecules Using Orthogonal Bipolaritons, Melanie Schurer; 1University of Wuerzburg, Germany. We present an experiment of quantum control of two-level molecules using orthogonal bipolaritons. The molecules are excited by an off-resonant laser that creates a coherent superposition of the two vibrational states. The resulting state is then probed by a resonant laser and the interference pattern is detected. This experiment demonstrates the potential of quantum control of molecules using bipolaritons.

Efficient Quantum Control of the Vibrational States of a Molecule Using Bipolaritons, Melanie Schurer; 1University of Wuerzburg, Germany. We present an experiment of quantum control of the vibrational states of a molecule using bipolaritons. The molecule is excited by an off-resonant laser that creates a coherent superposition of the two vibrational states. The resulting state is then probed by a resonant laser and the interference pattern is detected. This experiment demonstrates the potential of quantum control of molecules using bipolaritons.

Optomechanical Dynamics and Nonlinear Photon Sources, Giovanni Cirmi; 1ICFO, Spain. We present a broadband UV two dimensional transient absorption setup that is capable of measuring the dynamics of the cross-peaks in two-dimensional electronic spectroscopy in a specifically designed metal nanostructure. We use this setup to study the dynamics of a metal nanostructure near the zero-phonon line. Second, we refine the electronic energy level scheme of β-carotene.
Monday, 19 March

Research in Optical Sciences • 19–21 March 2012

Quantum Information and Measurement

QM3A • Novel Systems for Quantum Measurement—Continued

QM3A.4 • 15:30
Optimal Mass-sensing with a Nano-mechanical Resonator, Daniel Brun1,2; 1Univ. Toulouse Paul Sabatier, France. We report the quantum Cramér-Rao bound on the sensitivity of mass-sensing with a nano-mechanical resonator as function of its quantum state and identify the quantum states which allow the largest sensitivity for given maximum energy.

QM3A.5 • 15:45
Withdrawn

QM3A.6 • 16:00
A Reversible Optical to Microwave Quantum Interface, David Vitali1, Shahtre Barzanjeh1, Mehdi Ahdi1, Paolo Tombesi1,2, Gerard J. Milburn1; 1Physik Division, Univ. of Camerino, Italy; 2Centre for Engineered Quantum Systems, School of Physical Sciences, Univ. of Queensland, Australia. We describe a quantum interface between an optical and a microwave field based on their common interaction with a nano-mechanical resonator, which is an effective source of optical-microwave two-mode squeezing.

QM3B • Quantum Information and Measurement with Photons—I—Continued

QM3B.4 • 15:30
Invited Quantum Information Processing with Integrated Optics and Pulsed Light, Christine Silberhorn1, Univ. of Paderborn, Germany. We present our latest results on photonic quantum systems using integrated optics and pulsed states of light. Our approach offers distinct features for the implementation of advanced quantum devices and networks, and compressed information encoding.

QM3B.5 • 16:00
Integrated Photonic Quantum Information Processing based on Polarization Encoding, Fabio Scarmaine1, Linda Sansoni1, Paolo Matutano1, Andrea Crespi1, Roberta Ramponi1, Roberto Osellame1,2; 1Dipartimento di Fisica, Sapienza Università di Roma, Italy; 2Istituto di Fotonica e Nanotecnologie, Consiglio Nazionale delle Ricerche, Italy. We present the first integrated optical quantum computer.
08:00–10:00
**Q1A.1 • Quantum Networking with Individual Qubits of Light and Matter, Gerhard Rempe**

Invited

Quantum Networking with Individual Qubits of Light and Matter, Gerhard Rempe; ‘Max-Planck Inst. of Quantum Optics, Germany. Two remote atoms permanently trapped in two optical resonators and reversibly connected by single photons constitute an elementary version of a scalable quantum network with the ability to send, retrieve, store and process quantum information.

08:00–10:00
**Q1A.2 • Coherent Storage and Retrieval of an Image using a Gradient Echo Memory in an Atomic Vapor, Jeremy B. Clark**

Invited

Coherent Storage and Retrieval of an Image using a Gradient Echo Memory in an Atomic Vapor, Jeremy B. Clark; 1,2 Quantic Glaucoros, Alberto Martin, Paul D. Lett; 1 Univ. of Maryland, USA; 1,2 IQM USA, 1,2 NST, USA. We experimentally demonstrate the storage of an image in the long-lived ground state coherence of a warm atomic rubidium ensemble using a gradient echo memory.

08:00–10:00
**Q1B.1 • Quantum Gaussian Light**

Daniel Gauthier, Duke Univ., USA, President

Ultimate Sensitivity in Precision Optical Measurements using Intense Gaussian Quantum Light: A Multi-Modal Approach, Claude Fabre1, Olivier Pennel1, Pu Jian1, Nicolas Treps2, Julien Fade3, Daniel Braun3, Laboratoire Kastler Brossel, France; ‘Institut de Physique de Rennes, France; ‘Laboratoire de Physique Théorique, France. We study the Quantum Cramer Rao limit in parameter estimation when the parameter is encoded in intense Gaussian quantum light. It can be reached without entanglement, just by squeezing a single well-defined light mode.

08:00–10:00
**Q1B.2 • Generation of non-Gaussian Pulsed States by Conditional Measurements, Alessia Allevi**

Invited

Generation of non-Gaussian Pulsed States by Conditional Measurements, Alessia Allevi; 1,2 Fondazione Bruno Karsi, Italy; 1,2 CNR-IONC, Italy. We present the latest experimental achievement on quantum information. By performing conditional measurements on classically and quantum correlated optical states with different photo-resolving detectors we generated non-Gaussian states in the mesoscopic regime.

08:00–10:00
**HT1C.1 • Science on the Texas Petawatt Laser and Technology Development Toward an Exawatt Laser, Todd Ditmire**

Invited

Science on the Texas Petawatt Laser and Technology Development Toward an Exawatt Laser, Todd Ditmire; ’Univ. of Texas at Austin, USA. I will review recent experiments on the 150 fs, 180 J Texas Petawatt laser including cluster fusion, wakefield acceleration and proton-heated, warm dense matter experiments. I will also discuss recent technology work toward an exawatt laser.

08:00–10:00
**HT1C.2 • Contrast Enhancement for Astra-Gemini Laser, Yunxin Tang**

Contrast Enhancement for Astra-Gemini Laser, Yunxin Tang; 1,2, Chris J. Hooker, Bryn Parry, Oleg Chetkov, Steve Hawkes, Klaus Erdel, Rajeev Pettathil, John L. Collier; 1 Central Laser Facility, Rutherford Appleton Lab., UK. We report on the contrast enhancement for Astra-Gemini laser following identifying the major source of coherent contrast, in conjunction with plasma mirrors. Replica prepulses were suppressed or eliminated by employing the wedged optics.

08:00–10:00
**IT1D.1 • X-ray Diffraction II**

Andrea Cavalleri; Max Planck Department for Structural Dynamics, Germany, President

Time-resolved Laue Diffraction at High Positional Accuracy and the Optimizing of Time-Resolution at Synchrotron Beamlines, Philip Coppens; Chemistry, Univ. at Buffalo, The State Univ. of New York, USA. Modification of the Laue technique to allow high-accuracy pump-probe experiments will be discussed. They include the RATIO method which eliminates the wavelength dependence of the results. A method to increase the time-resolution below the length of the synchrotron X-ray pulse will be described.

08:00–10:00
**IT1D.2 • The Rotating Crystal Method in Femtosecond X-Ray Diffraction**

Benjamin Freyer, Johannes Stingl, Flavio Zamponi, Michael Woerner, Thomas Elsaesser; ’Max-Born Inst. Berlin, Germany. We demonstrate the rotating crystal method in femtosecond x-ray diffraction. A pump-probe scheme maps structural dynamics of a photoexcited bismuth crystal via changes of the diffracted intensity on a multitude of Bragg reflections.

Dr. Philip Coppens received his Ph.D from the Univ. of Amsterdam in 1960 on the basis of solid-state photochemistry research done at the Weizmann Inst. of Science. He continued his research at Brookhaven National Laboratory before moving to the State Univ. of New York at Buffalo, where he is currently SUNY Distinguished Professor of Chemistry. After extensive work on electron density mapping by accurate X-ray diffraction he returned to his earlier interest in photo-induced chemical changes in molecular crystals including reactions in supramolecular solids and time-resolved studies of species with lifetimes of microseconds and less by pulsed laser-pump/X-ray probe experiments. For more information see harker.chem.buffalo.edu.

08:00–10:00
**IT1D.3 • The Rotating Crystal Method in Femtosecond X-Ray Diffraction**

Benjamin Freyer, Johannes Stingl, Flavio Zamponi, Michael Woerner, Thomas Elsaesser; ’Max-Born Inst. Berlin, Germany. We demonstrate the rotating crystal method in femtosecond x-ray diffraction. A pump-probe scheme maps structural dynamics of a photoexcited bismuth crystal via changes of the diffracted intensity on a multitude of Bragg reflections.

Research in Optical Sciences • 19–21 March 2012
**Invited**

10:00–10:30 Coffee Break, Grosser Stern

### Madrid

**Quantum Information and Measurement**

**QT1A • Quantum Light and Matter Interaction—Continued**

**QT1A.4 • 09:00**

**Invited**

**Coherent Coupling of a Superconducting Flux Qubit to an Electron Spin Ensemble in Diamond, Katsuki Sembba**; NTT Basic Research Laboratories, NTT Corporation, Japan. We report evidence of coherent strong coupling, observation of vacuum Rabi oscillations, between a superconducting artificial atom (flux qubit) and a macroscopic number of electron spins in the form of nitrogen-vacancy color centres in diamond.

**QT1B • Quantum Gaussian Light—Continued**

**QT1B.4 • 09:00**

**Probing Multimode Squeezing with Correlation Functions, Andreas Christ**; Raisa Laiho; Andreas Ekestein; Katja Aschenbrener; Christine Silberhorn; Applied Physics, Univ. of Paderborn, Germany; IQO Group, MPl, for the Science of Light, Germany; Departments of Physics, Universidade de Fisica, Universidade Federal de Pernambuco, Germany. We use broadband correlation functions to probe multimode squeezed states. Measuring the higher-order correlations enables loss independent access to the state characteristics which is less costly and time-consuming than standard tomographic methods.

**QT1B.5 • 09:15**

**Multiparticle Photonic Entanglement Generated from Polarization Squeezing at 795 nm, Federico A. Beduini**; Morgan W. Mitchell; ICFO - Institut de Ciencies Fotoniques, Spain; ICREA - Institut Catalana de Recerca i Estudis Avançats, Spain. We describe an experiment to generate photonic multiparticle entangled states from polarization squeezing generated by a sub-threshold OPO. The technique is very efficient: about 5 x 10^5 atom-tuned entangled photons per second are generated.

**QT1B.6 • 09:30**

**Fundamental Limit to Qubit Control with Coherent Field, Katsumi Igeta**; Nobuyuki Imoto; Masato Kasah. NTT Basic Research Laboratories, Japan; Japan Science and Technology Agency, CREST, Japan; Graduate School of Engineering Science, Osaka Univ, Japan; Photon Science Center, The Univ of Tokyo, Japan. The accuracy in controlling qubit with coherent field is studied by full quantum treatment. We found n/2 pulse fidelity error found ~ 1/(n photon number) as previously known but to depends strongly on initial state of qubit.

**QT1A.5 • 09:30**

**Storing Quantum States in a Slow Light Cavity, Stefan Krull**; Lars Rippe; Mahmoud Sabooni; Axel Thuesen; Samuel T. Kometa; Dept of Physics, Lund Univ., Sweden. Rare earth crystals is investigated. In these cavities the speed of light is reduced by 3-4 orders of magnitude which open for exciting possibilities.

**QT1A.6 • 09:45**

**Superluminal Twin Beams, Superluminal Images and the Arrival Time of Spatial Information in Optical Pulses with Negative Group Velocity, Ulrich Vogl**; Ryan T. Glasser; Paul D. Lett; Laser cooling and trapping group, NIST, USA. We generate superluminal pulses via four-wave mixing in 85Rb vapor, both for the injected and the generated beam, and imprint images on the pulses and time-resolve the arrival of information in the spatial domain.

### Sydney

**High Intensity Lasers and High Field Phenomena**

**HT1C • Lasers, OPA, OPCPA—Continued**

**HT1C.4 • 09:00**

**High Energy Optical Parametric Chirped Pulse Amplification in Yttrium Calcium Oxynitrate, Xuyuan Liang**; Linghong Yu; Jin-Feng Li; Xiaoming Li; Cheng Wang; Yuxin Li; Ruxin Li; Zhizhan Xu; Yanfang Zheng; Anhui Wu; Shanghai Inst. of Optics and Fine Mechanics, China; Shanghai Inst. of Ceramics, China. We report the high energy non-collinear optical parametric chirped-pulse amplification with yttrium calcium oxynitrate. The amplified energy of 3.36J centered at 800nm was generated with pump of 35J. After compression, the pulse duration was 44.3fs.

**HT1C.5 • 09:15**

**Two-color Pumped OPCA System with al Pulse Energy and a Spectral Bandwidth of 1.5 Octaves from VIS to NIR, Anne Härter**; Marcel Schultz; Tina Lang; Stefan Roach; Thomas Bihlmayer; Univ. of Göttingen; Institut für Quantenoptik, Universität Hannover, Germany; Center for Quantum Engineering and Space-Time Research (QUEST), Germany; VENTOON Laser Technologies GmbH, Germany. We present a double-stage OPCA system which is pumped by two different wavelengths. It delivers a coherent 430 THz broad output spectrum around 650 nm with a Fourier limited pulse duration of sub-3 fs.

**HT1C.6 • 09:30**

**Experimental investigation of the coupling of an optical photon mode to individual Bloch states in photoswitched Bismuth, Jerome Faure**; LOA, France; Laboratoire des Solides et Matériaux, France. The effect of lattice distortions on electronic states in Bismuth is investigated using time resolved photoemission spectroscopy. The data reveals a strong dependence of the electron photon coupling with the Bloch state wave vectors.

### Hong Kong

**International Conference on Ultrafast Structural Dynamics**

**IT1D • X-ray Diffraction II—Continued**

**IT1D.3 • 09:00**

**Watching Femtosecond Symmetry Breaking in Bismuth with X-Ray Diffraction, Christopher J. Milne**; Inst for Quantum Electronics, ETH Zurich, Switzerland; Swiss Light Source, Paul Scherrer Institut, Switzerland. We use femtosecond x-ray diffraction to make a quantitative study of the structural symmetry-breaking coherent Jg mode of bismuth created by intense laser excitation. Coherent amplitudes on the order of 0.1 pm are observed.

**IT1D.4 • 09:15**

**Experimental investigation of the coupling of an optical photon mode to individual Bloch states in photoswitched Bismuth, Jerome Faure**; LOA, France; Laboratoire des Solides et Matériaux, France. The effect of lattice distortions on electronic states in Bismuth is investigated using time resolved photoemission spectroscopy. The data reveals a strong dependence of the electron photon coupling with the Bloch state wave vectors.

**IT1D.5 • 09:30**

**Invited**

Ultrafast x-ray Studies of Ferroelectric Materials, Aaron Lindenberg; Dan Durang; John Goodfellow; Materials Science and Engineering, Stanford Univ., USA; SLAC Inst., Stanford Univ., USA; Chemistry, Stanford Univ., USA. Femtosecond x-ray scattering studies reveal large amplitude increases in the polarization of thin film ferroelectrics and elucidate the first steps in their bulk photovoltaic response. Complimentary terahertz emission and second harmonic generation studies are also presented.
Erlangen-Nuremberg, Germany; 3Department of Informatics and Communications Technology, Univ. of Padova, Italy. We report on the study of the propagation of a laser beam over a 144 free-space link. We report on the losses of the channel, the temporal scintillation of the intensity and, by attenuating the beam, the statistical behavior of single photons.

JT2A.4 Decomposition of Rank-two Mixed States and Quantum State Discrimination, Luis Roa1, 2Departamento de Física, Universidad de Concepción, Chile. We calculate analytically the quantum state decomposition of pure-state superpositions and estimate generated density matrices.

JT2A.5 Conclusive Entanglement Modification by a Local Non-unitary Operation, Luis Roa1, 2Departamento de Física, Universidad de Concepción, Chile. Using the scheme proposed by Y. Roa et al. [1] we propose a protocol to increase conclusively the entanglement of a bipartite system by means of local operations.

JT2A.6 Entanglement for 2x2-dimensional systems, Luis Roa1, 2Departamento de Física, Universidad de Concepción, Chile. We calculate analytically the entanglement of formation for a family of bipartite 2x2-dimensional mixed states which are obtained from tripartite 2x2x2 pure states.

JT2A.7 Quantum Interference and Entanglement of Photons which Do Not Overlap in Time, Ralph Wagner1, Christopher van Driel1, Maximilian von Zanthier1, 2Girish Agarwalla1, 2Inst. for Optics, Information and Photonics, Univ. Erlangen-Nuremberg, Germany; 3Erlangen Graduate School in Advanced Optical Technologies (SAOT), Univ. Erlangen-Nuremberg, Germany; Department of Physics, Oklahoma State Univ., USA. We report on quantum interferences and entanglement of photons which exist at different intervals of time. The corresponding correlation function is shown to violate Bell’s inequalities.

JT2A.8 Electromechanical Method for Generating of Optical Vortices, Birn Skal1, Varyu Yatskov1, Rostislav Vlkh1, Inst. of Physical Optics, Ukraine. We have shown that the conically shaped electric field created in electrooptic crystals can lead to appearance of orbital angular momentum in the outgoing light beam. It is verified experimentally on Bi2GeO4 crystals.

JT2A.9 Quantum Correlation Assists State Discrimination, Luis Roa1, 2Departamento de Física, Universidad de Concepción, Chile. We study the roles of quantum correlations, entanglement, discord, and dissonance needed for performing unambiguous quantum state discrimination assisted by an auxiliary system.

JT2A.10 Towards High Sensitivity Randomness Sensing Using an Atom Chip, Carlos L. Garrido Alzar1, Wenhua Liu1, Arnaud Landragin1, SVTRE, CNRS-Observatoire de Paris, France. We propose to develop a new generation of compact high sensitivity gyroscopes using guided matter-waves on atom chips, able to fulfill the requirements of metrological applications.

JT2A.11 Effect of Telegraph Noise on the Entanglement of Two Charge Quanta, Agi Avishai1, Physics, Faculté des Sciences de Tunis, Tunisia. We investigate the dynamics of two charge quanta subject to telegraph noise. In order to study the effect of the telegraph noise on the entanglement we adopt the concurrence. We show that the telegraph noise lead to complete disentanglement.

JT2A.12 Atom-light Interactions at High Densities and High Magnetic Fields, Lee Weller1, Physics Department, Durham Univ., UK. We present the physics underlying the transmission of light through a dense atomic vapour, accounting for self-broadening and the application of a large axial magnetic field. We investigate the spectral effects in the swapping of a multiprobabilistic transform from symmetric to asymmetric distributions.

JT2A.13 Spectral Effects in Polarization-Entanglement Swapping, Daniel Erenso1, Daniel Bonior1, Benjamín Barrientos1, Jonathan Bentley1, Hannah Norris1, 2Physics & Astronomy, Middle Tennessee State Univ., USA; 3Core Research for Evolutional Science and Technology, Japan Science and Technology Agency, Japan. We investigate the topological structure of entangled qudits under unitary local operations. As a main result, we predict a fractional topological phase for cyclic evolutions. This result is potentially useful for implementations of quantum gates.

JT2A.14 Decoherence, Entanglement Decay and Equilibration Produced by Chaotic Environments, Gabriela B. Lemos1, Fabricio Dantas1, Physics, UFRGS, Brazil. We investigate decoherence in quantum systems coupled to dephasing-type interactions to an arbitrary environment with chaotic underlying classical dynamics.

JT2A.15 Nonlinear Coherent Loss for Generating Non-classical States, Alexander B. Mikhalychev1, Dmitri S. Mogilevtsev1, 2, Sergei Y. Klimin1, 2, I. I. Stepanov Inst. of Physics of NASB, Belarus. We discuss exploiting artificially designed nonlinear coherent loss for generating non-classical states of a bosonic mode. We show how to generate Fock states superpositions and estimate generated states purity and maximal achievable fidelity.

JT2A.16 Study of the Temporal-Evolution of a Star-like Quantum State of Light Through the Wigner Function, Daniel Lopez-Carrillo1, Juan P. Bettepe-Cuartas1, Herbert Vink-Posad1, 2Universidad Nacional de Colombia, Colombia; Universidad de Antioquia, Colombia. In this work, the temporal evolution of the interaction between a two-energy level atom and a star-like quantum state of light and the entanglement of these states were studied using the Wigner quasiprobability function.

JT2A.17 Optimal Binary Codes and Measurements for Classical Communication over Qubit Channels, Nicola Dall’Asta1, 2, Nicola Laurenti1, Francesco Tucci1, 2Department of Information Engineering (DEI), Univ. of Padova, Italy. Developing a suitable geometric representation, we provide algorithmic solutions to the problem of finding pairs of states and measurements that optimize either error probability or mutual information for a given arbitrary qubit channel.

JT2A.18 Geometry Versus Entanglement in a Quantum Spin System, Hamidre S. Dhar1, School of Physical Sciences, Jawaharlal Nehru Univ., India. We investigate quantum entanglement properties in spin-1/2 Heisenberg ladder are influenced by its pseudo-2D geometry. Such non-intuitive qualitative manifestations can have important implications on the application of information processing tasks.

JT2A.19 Withdrawn

JT2A.20 Withdrawn

JT2A.21 Perfect Probabilistic Transformations between Symmetric Sets of Quantum States, Erika Andersen1, Vedran Dunjko1, 2Physics, Heriot-Watt Univ., UK. We study probabilistic transformations between sets of quantum states. An example is a multiprobabilistic transform from symmetric coherent states to qubit states. We suggest an asymptotically optimal linear optical realization based on quantum scissors.

JT2A.22 Information Transfer and Randomness in Quantum Measurements, Sergey Maryann2, 3Lebedev inst. of Physics, Russian Federation. Information transfer and capacity in measuring systems studied. It’s shown that information about measured state purity can’t be transferred to information receiver, so it stipulates randomness in individual events.

JT2A.23 Incoherent Light As a Control Resource, Alexander Polchinski1, 2Chemical Physics, Weizmann Inst. of Science, Israel; 3Mathematical Physics, Steklov Mathematical Inst., Russian Academy of Sciences, Russian Federation. We discuss the use of incoherent light as a resource for controlling the atomic dynamics and review the method for engineering arbitrary pure and mixed atomic states using a special combination of incoherent and coherent light.

JT2A.24 Nonlinear Process in Atomic Coherent System, Junxing Zhang1, 2Shanxi Univ., Inst. of Opto-Electronics, China. We investigate the efficient Four-Wave Mixing in EIA system. The reflection is explained as the result of enhancement by the quantum coherence and the compensation of phase mismatch from anomalous dispersion of EIA.

JT2A.25 Beamlike Polarization Entangled Photons Pairs Generation by 2x2 Fiber, Hsin-Pin Lo1, 2Atsushi Yabushita1, Chih-Wei Lui1, Pochang Chen1, Takayoshi Kobayashi1, 2, 3Department of Physics, National Tung Hua Univ., Taiwan; 4Department of Electrophysics, National Chiao-Tung Univ., Taiwan; 5Core Research for Evolutional Science and Technology, Japan Science and Technology Agency, Japan. We propose photon pairs generated by pumping the 2x2 fiber, the polarization entangled photons pairs be measured from the output.

JT2A.26 Withdrawn

JT2A.27 Quantum Holograms based on the Faraday Interaction. Spontaneous Emission in Such Systems, Dennis Vahlbrøn1, 2, 3Inst. for Theoretical Physics, Inst. for Gravitational Physics, Leibniz Univ. Hannover, Germany. We present a scheme for parallel spatially multimode quantum memory for light based on Faraday interaction in spin polarized atomic ensembles. Also we study decoherence processes which appear due to spontaneous emission in such systems.

JT2A.28 Fractional Topological Phase for Entangled Qudits, Antonino Z. Khoury1, Luis E. Oxman1, 2Instituto de Fisica, Universidad Federal Fluminense, Brasil. We investigate the topological structure of entangled qudits under unitary local operations. As a main result, we predict a fractional topological phase for cyclic evolutions. This result is potentially useful for implementations of quantum gates.

JT2A.29 Coherence and Entanglement Created by a Finite-Size Atomic Ensemble in a Ring Cavty, Li-hui Sun1, 2Gao-xiang Li1, 2Wen-ju Gu1, 2Zhibin Fueck1; 3Department of Physics, Huazhong Normal Univ., China; 4College of Physical Science and Technology, Yangtze Univ., China; 5National Centre for Mathematics and Physics, KAUST, Saudi Arabia. We report several new interesting aspects of coherence and entanglement behavior that emerge in the interaction of an atomic ensemble with field modes of a ring cavity when the size of the atomic ensemble is not taken to the thermodynamic limit.
Tuesday, 20 March

Exhibit Hall 12

Joint Quantum Information and Measurement / High Intensity Lasers and High Field Phenomena / International Conference on Ultrafast Structural Dynamics Poster Session

JT2A.30

Bright Beam High-novel States, Axt Kolkrain1; 1Electrical and electronics eng, Gediz Univ, Turkey

JT2A.36

Photoduced Structural Dynamics of Epitaxial BiFeO3 Thin Films Probed by Ultrafast Hard X-ray Diffraction, Hazard Wwe1, Pice Chwe1, Donald A. Wale1, Juan H. Lee1, Carolina Adamsa1, Jon Blesfjeld1, Eric M. Dufresne1, Darrell Schlotman1, Joshua W. Ferejeld1, Paul G. Ramotow1, Yuen Lin1; 1X-ray Science Division, Argonne National Laboratory, USA; 2Department of Materials Science and Engineering and Materials Science Program, University of Chicago, USA; 3Institute for Solid State Physics, Russian Academy of Sciences, Russia. We simulate the dynamics of an (1,0) zigzag BN-nanotube upon intense femtosecond laser excitation. We demonstrate that three photon modes are simultaneously excited and analyse the possibility to steer these modes.

JT2A.37

Three displaceably excited coherent phonons in infinite BN nanotubes, Bernd Baurer1, 2; 1Universität Kassel, Germany; 2Universität Göttingen, Germany. We simulate the dynamics of a 1.50 zigahe BN nanotube upon intense femtosecond laser excitation. We demonstrate that three phonon modes are simultaneously excited and analyse the possibility to steer these modes.

JT2A.38

Time-Resolved Photoelectron Diffraction on Laser-Aligned Molecules, Demi Ansd1, Rebecca Bolle1, 2; 1Max Planck Advanced Study Group at CFEL, Germany; 2Max Planck Institut für Medizinische Forschung, Universität Heidelberg, Germany. We present static and time-resolved photoelectron angular distributions of laser-aligned P(3He)D and OCS molecules photoionized by 26 eV laser pulses. Dynamic structural changes of a molecule during Coulomb explosion were recorded.

JT2A.39

Laser-induced Nonthermal Melting in Si, Tobias Zier1, 2; 1Theoretische Physik III, Universität Bayreuth, Germany; 2Institut für Theoretische Physik, Universität Bayreuth, Germany. We present simulations of the lattice dynamics in a quantum well driven by ultrafast optical pulses. Our calculations provide insight into the generation mechanisms for coherent phonons and show how squeezed phonon states can be excited.

JT2A.40

2D-IR Spectroscopy of Intermolecular Ion-Water Coupling, Osamu Bokum1, Kwan Pancha1, Peter Ham1; 1Physical Chemistry Inst., University of Zurich, Switzerland. We present 2-color 2D-IR spectra of saturated aqueous solutions of pseudohydilide and azide ions to extract the intermolecular coupling between the ion and its surrounding water molecules and thus measure solvation shell dynamics.

JT2A.41

State-selective Alignment of Molecules by Intense Nonresonant Laser Pulses, Nina Owischok1, Burkhard Schmidt1; 1Max Planck Institute of Quantum Optics, Garching, Germany; 2Institut für Experimentelle Physik, Universität Stuttgart, Germany. We develop a basic concept of the response of a molecule to a linearly polarized laser field. We disentangle the contributions of Landau quantum numbers, and show how rotationally hot and cool wave packets can be created.

JT2A.42

Calibrated Real Time Detection of Nonlinearly Propagating Giant Strain Waves, Andrei Bogatyrev1, 2; 1Institut für Festkörper - pan; 3Inst. of Solid State Physics, Russian Academy of Sciences, Russia. We present static and time-resolved high X-ray diffraction measurements for ultrafast control of room temperature multiferroics.

JT2A.43

Ultrafast Tr-ARPES with Arctemis XUV Beamline, Cepheus Cachir1, Edmond Tucsa1, Chris Froud1, Will Bryan1, Jesse Peteres1, Nicky Dean1, Stefan Kaiser2, Andrea Cavalleri3, Alberto Simoncini1, Haiyan Liu1, Adriano Cavaliere1, Saroj Dhl2, Luca Potel4, Paolo Villor4, Fabio Frasstetti1, Emma Springate1; 1Arctemis, CLF, UK; 2Department of Physics, Swansea University, UK; 3Clarendon Laboratory, Oxford University, UK; 4Max Planck Research Department for Ultrafast Structural Dynamics, Universität Hamburg, Germany. At the Arctemis facility, cold electrons and high coherence length are optimised in order to be able to perform ultrafast time-resolved ARPES. Current result on ultrafast melting of Mott and charge order in Ta2X will be presented.

JT2A.44

Model Free Investigation of Ultrafast Biomolecular Chemical Reactions: Biomolecular Photoionization Electron Transfer, Bernhard Lang1, Arnold Russpickern1, Eric Vauthey1; 1Physikalische Chemie, Universität zu Basel, Switzerland. We present ionization electron diffraction experiment results for photosensitized intramolecular reactions. In the model-free approach we are able to determine the position and orientation of the reacting species accurately.

JT2A.45

Dynamics of the OH Stretching Vibration in Aqueous Hydrates, Jasper C. Werhahn1, Sotiris Noj1; 1Arctemis, CLF, UK; 2Department of Physics, Swansea University, UK; 3Max-Planck-Institut für Mikrostrukturphysik, Universität Halle, Germany; 4Centre for Free Electron Laser, Germany; 5Physical Science Division, Diamond Light Source, UK; 6LUXOR, CNR-INFM, Italy. A new XUV beamline at Arctemis, user open-access facility, at CLF, offers unique capabilities optimised for Tr-ARPES. Current result on ultrafast melting of water and charge order in Ta2X will be presented.

JT2A.47

REGEA: New Source for Atomically Resolved Dynamics, Masaki Hadari1, 2; 1Institut für Experimentalphysik, Universität Stuttgart, Germany; 2Institut für Physik und Astronomie, Universität Oldenburg, Germany. We show ultrafast all-optical reflectivity measurements on nonlinear propagating strain pulses for different fluences calibrated by ultrafast X-ray diffraction (UXRD) to the corresponding induced strain amplitudes.

JT2A.48

Radio-frequency Electron Bunch Compressions for Ultrafast Diffraction Experiment, Stefano Dal cones1; 1Department of Applied Physics, National Center for Laser Science, Islamic Republic of Iran; 2Iranian Atomic Energy Agency, Iran. The temporal shape of a water bag is compressed by using a synchronized 3 GHz cavity cavity to extend the electron bunch duration from 200 to 100 fs.

JT2A.49

Structure Changes of Ferromagnetic/Ferroelectric Oxide Nanolayers by Ultrafast X-ray Diffraction at Laser-based and Synchrotron-based Sources, Lena Maiert1, 2; 1Department of Physics, Swansea University, UK; 2Max-Planck-Institut für Mikrostrukturphysik, Universität Halle, Germany. We present x-ray diffraction results from different multiferroic systems consisting of ferromagnetic and ferroelectric layers. We discuss how the strain couples to heat in electrons, phonons and magnons.

JT2A.50

Versatile Non Collinear Four-Wave Mixing Set-Up Fully Based on Femtosecond Pulse Shaping for Coherent Electronic Spectroscopy, Andrea Caneschi1, Francesca Frei2, Thomas Feurer1; 1Inst. of Applied Physics, Univ. of Bern, Switzerland. Within this point we set a up for four wave mixing experiments in the Vis and IR, fully based on femtosecond pulse shaping. Several examples from different molecular systems are shown.

JT2B.01

Design and Construction of a 700-W CW Diode-Pumped Nd:YAG rod laser with high beam quality and high efficiency and highly efficient concentrator of Pump-Light, Araj Maheshkhanlou1; 1Iranian Atomic Energy Agency, Iran; 2Institute for Sustainable Energy, University of Edinburgh, The Republic of Iran. In this work design and construction of a diode pumped solid state laser of 700-W CW with high efficiency and reliability, very good beam quality, high uniform pumping intensity in the active area is presented.
JT2A.52 Probing Femtosecond Filamentation via High-order Harmonics, Daniel Steingrube1, Emilie Schulz2, Martin Kretschmar3, Thomas Binhammer3, Mette Garde4, Arnaud Couton5, Uwe Morgen6, Milutin Kovacev1,2, Leibniz Universität Hannover, Institute für Quantenoptik, Germany; 2BASF Services GmbH, Germany; 3Département de Physique et Astronomie, Louisiana State Univ., USA; 4PULSE Inst., SLAC National Accelerator Laboratory, USA; 5Centre de Physique Théorique, Ecole Polytechnique, France.

JT2A.54 Above-threshold Ionization (ATI) from Non-homogeneous Fields, Marcelo Ciupina1, Jens Biegert1,2, Romain Quidan3, Maciej Lewenstein4, QOT, ICFO, Spain; ICREA, Spain. We present theoretical studies of above-threshold ionization (ATI) produced by nonhomogeneous fields. This kind of fields appears when a plasmonic nanostructure is illuminated by a short laser pulse.

JT2A.55 Various Techniques for Power Scaling Fiber Laser Output, Maryam Ichi-Ghazani, Parviz Parvin1, Vajieh Daneshpour2,3; Physics Department, Amirkabir University of Technology, Islamic Republic of Iran. Here, different amplifying methods for power scaling of fiber lasers are represented comprising beam combining of multifiber lasers, distributed array as well as MOPA arrays. Those models are done numerically for Yb:silica fiber lasers.

JT2A.56 Excitation of Residual Current by Femtosecond Laser Pulses in Gas of Asymmetric Molecules, Leonid Alexandrov1, Mikhail Emelev2, Mikhail Ryabikin3; Inst. of Applied Physics, RAS, Russian Federation. Results of numerical simulations of molecular gas ionization by femtosecond laser pulses are presented. It is shown that the value of residual current and efficiency of its excitation can be significantly increased by the use of asymmetric molecules.

JT2A.57 Spatial-Spectral Coupling in Multi-Petawatt Ti:Sapphire Lasers, Gabriel Memmer1, Fabia Giumbroni1, Antoine Frenou2, Frederic Leconte1, Gilles Cherixau3, ILE, France; ILOA, France; CEA, France. The influence of the radially varying Ti:Sapphire gain on the spectral amplitude and phase of a 1.5 femtoseconds pulse is studied using the orbit-based Coupled-Coherent State (CCS) method, whose outcome exhibits a plateau using Ti:Sapphire gain on the spectral amplitude and phase of a 1.5 femtoseconds pulse is studied.

JT2A.58 Analysis of Gold Nanoantennas for Harmonic Generation Utilising Plasmonic Field Enhancement, Nils Pfullmann1,2, Christian Waltermann3,4, Milutin Kovacev1,2, Vanessa Knittel1, Raphael Brutschitsch1, Alfred Leitenstorfer1, Uwe Morgen2,3; Leibniz Universität Hannover, Institut für Quantenoptik, Germany; 2QUEST Centre for Quantum Engineering and Space-Time Research, Hamburg, Germany; 3Department of Physics and Center for Applied Photonics, Univ. of Konstanz, Germany. We present an analysis of the plasmonic field enhancement in gold nanoantennas based on FDTD calculations. In experiments up to the 7th harmonic-order is observed. Experimental issues are discussed and explained by a theoretical model.

JT2A.59 Pulse Shortening by spectral gain modulation in a regenerative Yb:CaF2 laser amplifier, Fabian Roeren1, Markus Loser2, Matthias Stöb2, Ulrich Schramm1; HZDR, Germany. We successfully demonstrate bandwidth enhancement via gain modulation in a regenerative Yb:CaF2 amplifier implementing a birefringent quartz crystal. 260 fs pulses of a Yb:KGW oscillator can be shortened down to 220 fs after amplification.

JT2A.60 Cascaded Soliton Compression of Energetic Femtosecond Pulses at 1030 nm, Martin Bache1, Binbin Zhou1,2, Department of Photonics Engineering, DTU Fotonik, Denmark. We discuss soliton compression with cascaded second-harmonic generation of energetic femtosecond pulses at 1030 nm. We discuss problems encountered with soliton compression of long pulses and show that sub-10 fs compressed pulses can be achieved.

JT2A.61 Trajectory Selection in High Harmonic Generation Using Multicolor Fields, David Hoffmann1, Leonardo Brugners1,2, F. Frank1, A. Zait1, J. P. Marangos1,2; Physics, Imperial College London, UK. We examine trajectory selection and resulting yield modulation in high harmonic generation using a multicolor field composed of an 800 nm fundamental and its perpendicularly polarized second harmonic.

JT2A.62 The Dependence of the Photon-number Distribution of Parametric Down-conversion on the Number of Collected Modes, Lat Dovrat2, Michael Bakshi2, Daniel Istrati1, Assaf Shabani1, Hagai Eisenberg1, Rachel Inst. of Physics, Hebrew Univ., Israel. The dependence of the photon-number distribution from parametric downconversion on the number of collected modes is directly measured using Silicon Photo-Multiplier number-resolving detectors. Measurements are analyzed using a novel crosstalk model.

JT2A.63 Large Aperture Multi-Pass Amplifiers for High Peak Power Lasers, V.V. Chvykov1, K. Krushelnick1,2, V.V. Vorobev1, V. Chvykov1,2; Amundsen Institute of Applied Physics of the Russian Academy of Sciences, Russia. We propose new method for self-compression of few-cycle relativistic laser pulses at petawatt power level with duration less than plasma period, using non-stationary self-focusing of spatially confined wave packet in transparent plasma.

JT2A.64 Self-Compression of a Few-Cycle Petawatt Laser Pulses in Transparent Plasma, S. Skoblenik1,2, A. Bakulin1, A. Litvak1, V. Mironov1,2; The Institute of Applied Physics of the Russian Academy of Sciences, Russia. We propose new method for self-compression of few-cycle relativistic laser pulses at petawatt power level with duration less than plasma period, using non-stationary self-focusing of spatially confined wave packet in transparent plasma.
Experimental Observation of the Ultra-narrow Temporal Entanglement of Twin Beams by Means of Frequency Up-conversion
Ottavia Jakóbiewicz1, Jean-Luc Blanchet1, Alessandra Gatt1, Enrico Brambilla1, Luigi Gugli1, Paolo Di Trapani1; Dipartimento di Scienza e Alta Tecnologia, Università dell’Insubria, Italy; *Istituto di Fotonica e Nanotecnologie, CNR, Italy. We report here about the experimental observation of an ultra-narrow temporal correlation (6.7 fs FWHM) of twin beams produced by a type I BBO crystal, detected by means of the inverse process of sum-frequency generation.

Dissipation-boosted Entanglement of Coupled Harmonic Oscillators, Erika Andersson1, Chi-Tsung Jau1, Michael J W Hall1, Mats Jönsson2, Patrik Ohberg1; Physics, Heriot-Watt University, UK; *Theoretical Physics, FSFE, Australian National University, Australia; ‡Centre for Quantum Dynamics, Griffith University, Australia; †Department of Physics, University of Gothenburg, Sweden. We show that entanglement in initially classical states of coupled harmonic oscillators, caused by squeezing, is enhanced by dissipation. The enhancement vanishes if the oscillator baths are identical, suggesting that "heat flow" may be necessary.

Spin Squeezing of Large-Spin Ensembles via Quantum Non-demolition Measurement, Robert J Siewert1, Marco Kaschhackel2, Mario Napoli2, Brice Dubout2, Naimesh Babood2, Morgan W Mitchell3, †ICFO - Institute of Photonic Sciences, Spain; ‡Department of Physics, University of Cambridge, UK; *Laboratoire Matériaux et Phénomènes Quantiques, Université Paris Diderot and CNRS, France. We report the first demonstration of spin squeezing of a large-spin system via quantum non-demolition (QND) measurement. We observe 2 dB of metrological squeezing in an ensemble of ~100 laser cooled 87Rb atoms in the F = 1 hyperfine ground state.

Optical Quantum Information Processing using Forced Fermion-like Behavior of Photonic Qubits, Todd Pittman1, James Pranson1; Physics, UMBC, USA. We review a new paradigm for optical quantum logic gates that relies on forced "fermions-like" behavior of photonic qubits, and describe experimental work on demonstrating these gates with entangled photons from a parametric down-conversion source.

Two-photon Interference and Polarization Entanglement of Photon Pair Beam by Path Overlap Scheme, Atsushi Yabushita1, Hsin-Pin Ko1, Chih-Wei Luo1, Pochung Chen1, Takayoshi Erika Andersson1, Chai-Harmonic Oscillators, from dissimilar sources. 

Photon Pairs from Cavity-Enhanced Parametric Down-Conversion with Tunable Bandwidth for Quantum Interfaces, Andreas Althöfer1, Lars Kael1, Martin Kerbach1, Oliver J Bennewitz1; *Institut für Physik, Humboldt-Universität zu Berlin, Germany; †Institut für Nanotechnologie, CNR, Italy. "heat flow" may be necessary.

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period depends on the relative phase between how the two-photon correlation recurrence in a planar multimode waveguide, and show evolution of two-photon path-entangled states. We experimentally observe the by an estimation of the concurrence. The excitation was subsequently converted back into a photon and the entanglement revealed rare-earth-ion doped crystals were entangled by a Raman technique. We in-

We report on a new scheme for ultra-broadband optical parametric amplification at 2.1 µm delivering CEP-stabilized pulses of duration down to 16 fs (2.2 cycles) and energy up to 10 µJ at 100 kHz.

We investigate pair of isolated quantum dot excitons strongly coupled to a single mode microcavity, and quantum dot biexciton, as well as isolated quantum dot excitons strongly coupled to microcavity and lattice phonons. We report the realization of fully-controlled synthesis of femtosecond and subfemtosecond optical field waveforms using a comb of frequencies generated by the adiabatic Raman technique.

We use a self-referencing highly compact femtosecond transmission electron diffraction diffractometer to study the evolution of strongly coupled optical phonons and lattice phonon thermalization in single crystalline graphite after ultrashort laser excitation.

We present a structural study on SnPc/Ag(111) and Realization of a fiber-microsphere cavity at cryogenic temperature are reported.

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Heralded Quantum Entanglement between two rare-earth-ion doped crystals, Christoph Clasen1, Imam Umman1, Felix Busirske1, Nicolas Sangouard2, Michel Afzelius3, Nicolas Gisin4; 1GAP Optique, Univ. of Geneva, Switzerland. Two rare-earth-ion doped crystals were entangled by converting a single photon into a delocalized excitation. The excitation was subsequently converted back into a photon and the entanglement revealed rare-earth-ion doped crystals were entangled by a Raman technique. We report on a new scheme for ultra-broadband optical parametric amplification at 2.1 µm delivering CEP-stabilized pulses of duration down to 16 fs (2.2 cycles) and energy up to 10 µJ at 100 kHz.

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Heralded Quantum Entanglement between two rare-earth-ion doped crystals, Christoph Clasen1, Imam Umman1, Felix Busirske1, Nicolas Sangouard2, Michel Afzelius3, Nicolas Gisin4; 1GAP Optique, Univ. of Geneva, Switzerland. Two rare-earth-ion doped crystals were entangled by converting a single photon into a delocalized excitation. The excitation was subsequently converted back into a photon and the entanglement revealed rare-earth-ion doped crystals were entangled by a Raman technique. We report on a new scheme for ultra-broadband optical parametric amplification at 2.1 µm delivering CEP-stabilized pulses of duration down to 16 fs (2.2 cycles) and energy up to 10 µJ at 100 kHz.

We investigate pair of isolated quantum dot excitons strongly coupled to a single mode microcavity, and quantum dot biexciton, as well as isolated quantum dot excitons strongly coupled to microcavity and lattice phonons. We report the realization of fully-controlled synthesis of femtosecond and subfemtosecond optical field waveforms using a comb of frequencies generated by the adiabatic Raman technique.

We use a self-referencing highly compact femtosecond transmission electron diffraction diffractometer to study the evolution of strongly coupled optical phonons and lattice phonon thermalization in single crystalline graphite after ultrashort laser excitation.

We present a structural study on SnPc/Ag(111) and Realization of a fiber-microsphere cavity at cryogenic temperature are reported.

We report the realization of a fiber-microsphere cavity at cryogenic temperature.

We report the realization of a fiber-microsphere cavity at cryogenic temperature.
16:30–18:30  
QT4A • Quantum Communication I  
Robert Thew; Univ. of Geneva, Switzerland, Presider

**16:30-18:30**  
**QT4A • Quantum Key Distribution**  
Invited  
Directions in Optical Implementations of Quantum Key Distribution, Norbert Lutkenhaus; Inst. for Quantum Computing, Univ. of Waterloo, Canada. We will report on recent results that address side-channel aspects of quantum key distribution devices, the operation requirements of trusted repeater networks and also the security of protocols using phase-encoding.

**16:30-18:30**  
**QT4A • Quantum Imaging**  
Invited  
Quantum Images from 4-Wave Mixing in Atomic Vapors, Paul D. Lett; UC, Berkeley, USA. We have used four-wave mixing in hot atomic vapors to generate multi-spatial-mode entangled optical fields. I will review and discuss our recent progress in the construction of phase-sensitive and phase-insensitive amplifiers with this technique.

**16:30-18:30**  
**QT4A • Quantum Key Distribution Using Hyperentanglement**  
Invited  
Quantum Key Distribution Using Hyperentanglement, Daniel Gauthier, Hannah Gilbert; University of California, Berkeley, USA. We have developed a hyperentangled quantum key distribution protocol which is immune to all Gaussian side-channel attacks.

**16:30-18:30**  
**QT4A • Quantum Imaging**  
Invited  
Quantum Imaging Using Entangled States by Mixing Quantum and Classical Light, Yaron Silberberg; University of New South Wales, Australia. We show that by mixing quantum entangled photons with classical light, one can build a coherent, quantum microscope.

**16:30-18:30**  
**QT4A • Quantum Imaging**  
Invited  
Spatially Entangled 4-photons States from a Periodically Poled KTP Crystal, Daniel T. Solny; University of Washington, USA. We explore four-photon spatial entanglement created by stimulated emission of photon pairs in a 2 mm long periodically-poled KTP crystal. We vary the experimental conditions to explore and optimize the visibility of stimulated pairs.

**16:30-18:30**  
**QT4A • Quantum Imaging**  
Invited  
Attosecond Pulse Narrowing by Off-axis Detection, Carlos Hernandez-Garcia; University of Salamanca, Spain. Our simulations of high harmonic generation and propagation predict a shortening of the width of the synthesized attosecond pulses, when selecting the radiation at angles off axis.

**16:30-18:30**  
**QT4A • Quantum Imaging**  
Invited  
Temporal Gating for Broadband Attosecond Pulse Generation, Peixiang Liu; University of Science and Technology, Wuhan National Lab for Optoelectronics, China. We propose several schemes to microscopically control the harmonic processes and form the temporal gatings for HHG to produce the broadband supercontinua. The macroscopic effects including the spectral, temporal and spatial properties are discussed.
EPR-steering with entangled photon pairs. For implementations are given.

Mach-Zehnder interferometers. Realistic proposals for implementations are given.

We explore the possibility of generating broadband continuous variable entanglement in an integrated manner inside a system consisting of an array of waveguides with second order nonlinearity.

Strong field ionization imaging of electron dynamics. Agnieszka A. Jaron-Becker,1,2 JILA Univ. of Colorado, USA. Theory for ionization imaging for two dissociating nitrogen and bromine molecules is presented. It is shown how strong field ionization can be used to image dynamical electron rearrangement during dissociation.

Multi-electron corrections to the strong field approximation are calculated using the length and velocity forms of the dipole operator for diatomic molecules and found to have a limited influence on the overall harmonic yield.

Nanostructures in thin metal sheets are shown to be a promising tool for THz switching or THz nonlinear spectroscopy applications. If designed appropriately, such structures show extremely strong field enhancement in the gap region.

We demonstrate that Non Adiabatic Turn-on laser field allows one to avoid efficiency losses when the saturation level of atoms is reabsed, providing new route for attosecond pulses production via high-order harmonic generation.

Time-resolved THz Spectroscopy of the Ultrafast Photoinduced Insulator-metal Phase Transition of VO2. Tyler L. Cocker,1 Lyubov V. Titova,1 Sylvain Fourmaux2, Greg Holloway1, Heidi-Christina Bandulet1, Daniel Brassard1, Jean-Claude Kieffer2, My-Ali El Khakani2, Frank A. Hegmann2;1 Department of Physics, Univ. of Alberta, Canada; 2 INRS-EMT, Canada. THz spectroscopy is used to create a phase diagram of the ultrafast, photoinduced insulator-metal phase transition in VO2. The phase diagram is described by a nonthermal model based on critical electron and structural transition phonon densities.

Strong Field Ionization Imaging of Electron Dynamics, Agnieszka A. Jaron-Becker,1,2 JILA Univ. of Colorado, USA. Theory for ionization imaging for two dissociating nitrogen and bromine molecules is presented. It is shown how strong field ionization can be used to image dynamical electron rearrangement during dissociation.

Multi-electron corrections to the strong field approximation are calculated using the length and velocity forms of the dipole operator for diatomic molecules and found to have a limited influence on the overall harmonic yield.

Nanostructures in thin metal sheets are shown to be a promising tool for THz switching or THz nonlinear spectroscopy applications. If designed appropriately, such structures show extremely strong field enhancement in the gap region.
QW1A.1 • 08:00  Invited
Advanced Quantum Communication via Hyperentanglement, Paul Kwiat1; 1Univ. of Illinois at Urbana-Champaign, USA. Photons created via spontaneous downconversion may be simultaneously entangled in multiple degrees of freedom. This ‘hyperentanglement’ enables advanced capabilities in quantum communication, including multi-bit per photon quantum cryptography and superdense quantum teleportation.  

QW1A.2 • 08:30  
Detection Loophole Free Quantum Steering with Photons, Till Weinhold1,2; 1Devon Smith1,2, Geoff Gilmour1,2, Marcelo de Almeida1, Alessandro Fedrizzi1,2, Cyril Brancazio1,2, Brice Calkins1,2, Adriana Liu1,2, Thomas Gerrits1,2, Sue Wool Nam1,2, Andrew White1; 1Centre for Engineered Quantum Systems and Centre for Quantum Computation and Communication Technology (Australian Research Council), School of Mathematics and Physics, Univ. of Queensland, Australia; 2School of Mathematics and Physics, Univ. of Queensland, Australia, 3National Inst. of Standards and Technology, USA. Quantum steering allows the verification of shared entanglement even with an untrusted measurement device. We show the first photonic “detection loophole free” violation of a steering inequality by 48 standard deviations.

QW1A.3 • 08:45  
Thwarting the Photon Number Splitting Attack with Entanglement Enhanced BB84 Quantum Key Distribution, Christopher D. Richardson1, Carl Sabatke1, Jonathan Dowling1, Petr Anisimov2, Uri Vartanian1, Ania Lamin1; 1Hearne Inst. for Theoretical Physics, Louisiana State Univ., USA; 2Metall Research Group, Stony Brook Univ., USA; 3MathSense Analytics, MathSense Analytics, USA; 4Department of Physics and Astronomy, National Univ. of Singapore, Singapore. We develop an improvement to the BB84 scheme for quantum key distribution utilizing entanglement to improve the security of the scheme and enhance its resilience to the photon number splitting attack.

QW1B.1 • 08:00  Invited
Adaptive Quantum Measurement via Swarm Intelligence Machine Learning, Barry C. Sanders1, Alexander Hentschel1; 1Inst for Quantum Information Science, Univ. of Calgary, Canada. We construct an algorithm that learns through trial-and-error training how to devise optimal feedback-based single-shot phase estimation in interferometry. Our algorithm is robust against experimental imperfections, losses and decoherence.

QW1B.2 • 08:30  
Interaction-based Quantum Metrology Showing Scaling Beyond the Heisenberg Limit, Maria Napolitano1, Marco Kooschereck1, Brice Dubost1,2, Nacimeh Behbahani1,2, Robert Sewell1,2, Morgan W. Mitchell1,2; 1ICFO, Spain; 2Department of Physics, Univ. of Cambridge, UK; 3laboratoire Matériaux et Photoniques Quantiques, Université Paris Diderot, France; 4ICREA, Institució Catalana de Recerca i Estudis, Spain. Atom-mediated optical nonlinearities, within an atom-light quantum interface, allow spin measurement with sensitivity scaling better than the Heisenberg limit. This demonstrates the use of interactions as a new resource for quantum metrology.

QW1B.3 • 08:45  
Nanodiamonds for Integrated Quantum Technology: Charm and Challenge, Janik Wolters1, Andreas W. Schell1, Nikola Sadzak1, Tim Schröder1, Markus Braun1, Markus Ische1, Jürgen Luxury1, Bettina and Tobias Scholz1, Robert Moshammer1,2; 1Max Planck Inst. of Quantum Optics, Germany; 2Helmholtz-Zentrum Berlin (HZB), Germany. Nitrogen-vacancy (NV) centers in nanodiamonds are attractive for solid state quantum technology. We report on integrating NV-centers into photonic hybrid devices, point out future applications and address possible obstacles, like spectral diffusion.
The Implementation of a Quantum Key Distribution Scheme based on the Frequency-Time Uncertainty, Matthias Leifgen1, Robert Elschner1, Oliver J. Benson2, Colja Schubert2; 1Physics, AG Nano-Optics, Humboldt Universität Berlin, Germany; 2Photonic Networks and Systems, Fraunhofer Inst. for Telecommunications Heinrich Hertz Institut, Germany. The implementation of a new quantum key distribution scheme based on frequency-time uncertainty is presented, which uses mainly standard telecom components and offers strong robustness against decoherence in the transmission line.

Quantum State Characterization of High-dimensionally Entangled Photons, Jonathan Leach1, Megan Agnew1, Melanie McLaren3, Robert Boyd1,2; 1Inst. of Optics, Univ. of Rochester, USA; 2Inst. of Optics, USA; 3CSIR National Laser Centre, South Africa. We reconstruct the high-dimensionally entangled quantum state produced by parametric downconversion. Our results precisely characterize the entanglement, thus establishing the suitability of such states for applications in quantum information.

When Does an Electron Exit a Tunneling Barrier?, Nirit Dadonovich1,2, Werner Zrenner3, Robert Moshammer2, Joachim Ullrich2, Andreas Becker2, Jens Biegert1,4; 1Attoscience and Ultrafast Optics, ICFO-Institut de Recerca i Formació d’Alts Cercadors, Barcelona, Spain; 2Max Planck Institute for Quantum Optics, Germany; 3Institut für Experimentelle und Angewandte Physik, Univeristät zu Köln, Germany; 4ICREA-Institució Catalana de Recerca i Estudis Avançats, Spain. Here we present a theoretical investigation of the transport properties of molecules at various laser intensities, evidencing a control over multichannel contributions involving the nuclear motion.

Quantum Key Distribution Enhanced by a Quantum Relay Using Entangled Photons, Sergei Kilin1, B. I. Stepanov1, Inst. of Physics of NASB, Belarus. A particular set-up which uses only linear optics and heralding devices was performed, with stable visibility of 47.8%, an essential step towards practical implementation of quantum key distribution protocols.

Influence of Atmospheric Turbulence on the Performance of a High Dimensional Quantum Key Distribution System using Spatial Mode Encoding, Brandon Rodenberg1, Mahal Malhi2, Malcolm O’Sullivan1, Mohammad Mirhusein1, Robert Boyd1; 1Inst. of Optics, Univ. of Rochester, USA; 2Physics, Univ. of Ottawa, Canada. The effects of atmospheric turbulence on the channel capacity of a free-space quantum key distribution system with information encoded on the transverse modes of the photon are studied theoretically and experimentally.

Polarization Stable Long-Distance Interference of Independent Photons for Quantum Communications, Thiago Ferreira da Silva1,2, Douglas Vitoroti3, Guilherme B. Xavier1,4, Guilherme P. Temporal1, Jean Pierre von der Weid1; 1Center for Telecommunication Studies, Pontificia Catholic Univ. of Rio de Janeiro, Brazil; 2Optical Metrology Division, National Inst. of Metrology, Quality and Technology, Brazil; 3Departamento de Ingeniría Eléctrica, Universidad de Concepción, Chile; 4Center for Optics and Photonics, Universidad de Concepción, Chile. Interference between fully-independent faint laser sources over a channel capacity of two 8-km full polarization-controlled fiber links was performed, with stable visibility of 47.8%, an essential step towards practical implementation of quantum communication protocols.

Quantum State of High Dimensionally Entangled Photons, Ferrán Torró1,2, Natalia Zhiron1,2, Max Brune1,2, Cesar Ferreira3, 4; 1IFISC (CSIC-UIB), Palma de Mallorca, Spain; 2Universitat de les Illes Balears, Spain; 3Departamento de Física Teórica, Universidad del Bío-Bío, Curicó, Chile; 4Center for Optics and Photonics, Universidad de Concepción, Chile. The quantum state of high-dimensionally entangled photons can be characterized by the quantum state of their transverse modes, which is fully independent of the state of the other modes, even in the presence of losses, turbulence, and decoherence.
QW2A.5 • 11:30 Quantum Correction of Photon-scattering Errors, Nitzan Akselrad1, Shlomi Koller1, Yinon Glickman1,Boee Ozar1; Physics of Complex Systems, Weizmann Inst. of Science, Israel. Using a single trapped ion, we implement a quantum correction protocol for spontaneous photon-scattering error. Owing to ion-photon entanglement, measuring the photon polarization and emission time allows reversing the scattering process.

QW2B.4 • 11:30 Insensitivity of Entangled Photon Holes to Loss and Amplification, James Franson1; 1Physics, Univ. of Maryland, Baltimore County, USA. Entangled photon holes are a new form of entanglement in which there is a correlation between the absence of two photons. Entangled photon holes are shown to be relatively insensitive to photon loss and amplification.

QW2B.5 • 11:45 Encoding of Higher Dimensional States in the Time-energy Degree of Freedom, Daniel Richter1; 1Laser Spectroscopy, Max Planck Institute for Quantum Optics, Germany; 2Ludwig Maximilian Universität, Germany. We present experimental results on the preparation of higher dimensional time-energy entangled states. We performed measurements on suited entanglement and dimensional witnesses of the encoded states for dimensions of up to 4 x 4.

QW2B • Quantum Entanglement—Continued

QW2B.6 • 11:45 Revival of Silenced Echo for Optical Quantum Memories: Efficiency and Noise Level, Matthieu Bonaretti1, Yianneck Damion1, Thierry Chanteloup1, Jean-Louis Le Gouët1, María F. Fuscául Winter2; 1Laboratoire Aimé Cotton, France. We theoretically investigate the two photon echo that overcomes the main drawbacks of the latter, namely, contamination of the retrieval pulse by spontaneous emission and free induction decay.

QW2A.7 • 12:00 Probing a Many-particle System Using a Single Qubit, Thomas Busch1,2, Thomas Fogarty1, Nicola Lo Giallo1, John Gould1, Mauro Paternostra1; 1Physics Department, Univ. College Cork, Ireland; 2Quantum Systems Unit, Okinawa Inst. of Science and Technology, Japan; 3Clarendon Laboratory, Univ. of Oxford, UK; 4Centre for Theoretical Atomic, Molecular and Optical Physics, Queen’s Univ. Belfast, UK. We theoretically investigate the behaviour of a single qubit coupled to a low-dimensional, ultra-cold quantum gas and show that the properties of the many-particle system can be deduced from the dynamics of the qubit.

QW2A • Quantum Communication III—Continued

QW2C.4 • 11:30 Attosecond Strong-field Electron Wavepacket Interferometry, Markus Kitzler1, Xinhuai Xie1, Stefan Roither1, Daniel Kartaschoff1, Emil Persson1, Diego G. Arbulu1, Ji Zhang2, Steffen Graf3, Markus Schöffler4, Joachim Borgdorfer1, Andreas Baltuska1; 1Photonics Inst., Vienna Univ. of Technology, Austria; 2Inst. for Theoretical Physics, Vienna Univ. of Technology, Austria; 3Inst. for Astronomy and Space Physics - IAFE (FCEN-UBA Conicet), Argentina. We demonstrate self-referenced wavefunction retrieval of a valence electron wavepacket during its creation by strong-field ionization with sub-10-attosecond precision, based on a distinct separation of interferences arising at different time-scales.

QW2C.5 • 12:00 Vectorial Phase Retrieval for Linear Characterization of Attosecond Pulses, Oren Raz1, Nirit Chergui1; 1Laboratory of Ultrafast Spectroscopy, Technion, Israel; 2Complex Systems, Weizmann Inst. of Science, Israel; 3Physics, Oxford Univ., UK. We propose a new linear all-optical method for attosecond pulses characterization. Our scheme is based on a combination of spectral and polarization measurements. We demonstrate this method numerically on pulses generated from aligned CO2 25 molecules.

QW2C • Electronic Dynamics and Attosecond Physics—Continued

QW2D.6 • 12:00 X-ray Absorption Studies of the Photo-induced Structural Changes of Myoglobin in Physiological, Frederico A. Lima1, Christopher J. Milne2,3,4, Thomas Penfold1,2, Renke M. van der Veen1; 1Complex Systems, Weizmann Inst. of Science, Israel; 2Physics, Oxford Univ., UK; 3Laboratoire de Chimie Et Biochimie Computationnelles, EPFL, Switzerland; 4FXE, European X-FEL, Germany; 5Pacific Northwest National Laboratory, USA; 6California Inst. of Technology, USA; 7Inst. for Quantum Electronics, ETH Zürich, Switzerland. We use ultrafast x-ray absorption spectroscopy to determine the solvent structure change upon laser abstraction of the electron from I-. The transition from hydrophilic to hydrophobic occurs over 4 ps during which a transient 1-OH2 species is formed.

QW2D.5 • 11:45 Probing the Transition from Hydrophilic to Hydrophobic Solution with Atto-Magneto-Chromatography, Frederico A. Lima1,2, Thomas Penfold1,2, Renke M. van der Veen1, Frederico A. Lima1,2, Anad El Nabhay1, Steven L. Johnson1, Paul Roux3, Rafael Abadal3, Christian Bressler1,4, Ivano Tavernelli1, Majed Chergui1,2; 1Laboratoire de Spectroscopie Ultrarapide, EPFL, Switzerland; 2Swiss Light Source, PSI, Switzerland; 3SwissFEL, PSI, Switzerland; 4Laboratoire de Chimie Et Biochimie Computationnelles, EPFL, Switzerland; 5FXE, European X-FEL, Germany; 6Pacific Northwest National Laboratory, USA; 7California Inst. of Technology, USA; 8Inst. for Quantum Electronics, ETH Zürich, Switzerland. We use ultrafast x-ray absorption spectroscopy to determine the solvent structure change upon laser abstraction of the electron from I-. The transition from hydrophilic to hydrophobic occurs over 4 ps during which a transient 1-OH2 species is formed.

QW2D.4 • 11:30 Molecular Structural Dynamics in Solution Revealed by Picosecond Time-Resolved XAFS, Shin-ichi Adachi1,2, Toshihiko Saito1, Shunsuke Nonaka1,2; 1Photon Factory, High Energy Accelerator Research Organization (KEK), Japan; 2PRESTO, Japan Science and Technology Agency (JST), Japan. We have examined transient electronic and structural modifications of metal complexes coupled with spin-state dynamics by time-resolved hard x-ray spectroscopy at Photon Factory Advanced Ring (PF-AR), KEK.

QW2D.3 • 11:00 Atomic Simulation of Attosecond Processes, Thomas Penfold1,2, Maurizio Benfatto3, Majed Chergui1,2; 1Complex Systems, Weizmann Inst. of Science, Israel; 2Physics, Oxford Univ., UK; 3Laboratori Nazionali di Frascati, Istituto Nazionale di Fisica Nucleare, Italy. We report the photo-induced structural changes of MBNO using ultrafast x-ray absorption spectroscopy. The NO recombination occurs in 216 ± 24 ps. The structural analysis indicates an intermediate structure where the NO is not completely ligated.

QW2D.2 • 11:00 Ultrafast Structural Dynamics of Covalent Bond Breaking in Doping Layer, Xiaoyi Zhang1,2, Grigory Dudovich1, Ian Walmsley2; 1Complex Systems, Weizmann Inst. of Science, Israel; 2Physics, Oxford Univ., UK. We propose a new linear all-optical method for attosecond pulses characterization. Our scheme is based on a combination of spectral and polarization measurements. We demonstrate this method numerically on pulses generated from aligned CO2 25 molecules.

QW2D • X-ray Absorption—Continued

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Barnett2, Miles J. Padgett1; 1School of Physics and
of OAM modes produced by down-conversion
down-conversion is a source of high-dimensional
Parametric
of Physics, Univ. of Strathclyde, UK.
Maximizing the Dimensionality of Orbital An-
mental Physics at the University of Oxford, where
is also the Pro-Vice-Chancellor for Research. His
group’s research covers a broad range of optical
science and engineering, especially in the areas
of ultrafast, nonlinear and quantum optics, both
from a fundamental perspective, and with a view
to applications in quantum technologies. He is a
Fellow of the Optical Society of America (OSA),
the American Physical Society (APS) and the In-
stitute of Physics (IoP), and a recipient of the APS
Fellowship, the Coblentz Award, the National
Fresenius Award, and the Ernest K. Plyler Prize
for Molecular Spectroscopy.

QW3A.1 • 14:00 elements of a Practical Quantum Network,
Ian A. Walmsley, Univ. of Oxford, UK. A scalable
photonic quantum network requires a means to
perform deterministic quantum operations at the
single-photon level. This can be accomplished
by means of linear optics, measurement by pho-
todetectors, and quantum memory. We discuss
progress in these components, and indicate some
practical thresholds in device performance for
some useful network operations.

QW3A.2 • 14:45
Maximizing the Dimensionality of Orbital Angular
Momentum Entanglement in Parametric
Down-conversion, Jacqui Romero1,2, Daniele
Giovannini1, Filippos M. Miatto1, Stephen M.
Barnett3, Miles J. Padgett1; 1School of Physics and
Astronomy, Univ. of Glasgow, UK; 2Department
of Physics, Univ. of Strathclyde, UK. Parametric
down-conversion is a source of high-dimensional
states entangled in orbital angular momentum
(OAM). We analyze and maximize the number
of OAM modes produced by down-conversion
and detected by our measurement apparatus.

QW3B.1 • 14:45
Single-Qubit Laser: Generation of Nonlinear
Coherent States, Sergiy Y. Klir1, Alexander B.
Mikhalychev1, 2, I. Stepanov Inst. of Physics of
NASB, Belarus. We show that the stationary
state of a single-qubit laser is a phase-averaged non-
linear coherent state, provide super convergent
iterations method for its finding and investigate
classical quantum properties of the state.

QW3B.2 • 14:45
Collimated-Beam Third- and Fifth-Harmonic
Generation by Mid-Infrared Ultrashort Pulses,
a, Alexander A. Voronin1, Giovanni Zhibrov1,2,
University of Toronto, Canada; 2Physical Chemistry,
Fritz-Haber-Institut, Germany; 3European Laboratory
for Non-Linear Spectroscopy, Italy; 4Chemistry,
University of Firenze, Italy. ‘Max Planck Group
for Atomically Resolved Dynamics, Centre for
Free Electron Laser Science, Univ. of Hamburg,
Germany. The linear and 2DIR responses of the
amide I vibration in liquid formamide are inves-
tigated experimentally and theoretically, focusing
the interplay of the structural dynamics and the
excitonic nature of the amide I modes.

QW3B • Quantum State Engineering
Paolo Villoresi; Univ. of Padova,
Italy, President
QW3A • Quantum Information and Measurement—Continued

QW3A.3 • 15:00
Dispersion-based Control of Spatial Modes for Parametric Down-conversion in a Multimode Waveguide, Michael Karpinski, Cezłow Radziwicz, Konrad Banaszek; 1Faculty of Physics, Univ. of Warsaw, Poland. We demonstrate a scheme to control spatial characteristics of spontaneous parametric down-converted light in a multimode waveguide, based on intermodal dispersion. The down-converted photons are characterized by measurement of beam quality factors.

QW3A.4 • 15:15
Filamentation of Few-Cycle Mid-Infrared Pulses in Gases, Danail Kartashov, Skirmantas Ališauskas, Andrius Baltuška, Alexander A. Vorontsov, Aleksei Zholkovic, Massimo Petrazza, Pierre Bejot, Jerome Kasparian, Audris Pugzlys; 1Vienna Univ. of Technology, Photonics Inst., Austria; 2Physics Department M.V. Lomonosov Moscow State Univ., International Laser Center, Russian Federation; 3Department of Physics and Astronomy, Texas A&M Univ., USA; 4Université de Genève, Switzerland. We report the first generation of femtosecond mid-infrared filaments in argon and nitrogen gases. The new effect of self-focusing suppression in nitrogen and a 350nm-5.5cm spectral continuum in argon are demonstrated.

QW3B • Quantum State Engineering I—Continued

QW3B.2 • 15:15
Experimental Study of the Decoherence of Biphoton Qutrits, Asaf Shabtai, Hagai Eisenberg; 1Racah Inst. of Physics, The Hebrew Univ. of Jerusalem, Israel. We have generated various distinguishable biphoton states, representing quantum trits. Their coherence was controllably changed and fully characterized by two-photon state tomography. Entanglement dynamics of the biphotons has also been studied.

QW3B.3 • 15:30
Observation of Electromagnetically Induced Transparency (EIT) in Rb-filled Hollow-core Fibre, Thomas M. Stace; 1Physics, Univ. of Queensland, Australia. Filling the cores of a hollow-core optical fibre with Rb has proven challenging. Here we report on progress to this end, and give experimental and theoretical evidence of substantial electromagnetically induced transparency at room temperature.

QW3B.4 • 15:45
The Interference of Light with Orbital Angular Momentum at Photon-count Level and Boris’s Rule, Alemnisio Jesus-Silva, Eduardo Fonseca, Jandir Hickmann; 1Optics and Materials Group, Brazil. We use photonic orbital angular momentum two-dimensional properties to obtain a triangular quantum interference pattern, confirming that only pairs contribute to the two-dimensional photon detection probability, as established by Boris’s rule.

QW3C • NL and Extreme NL Optics—Continued

QW3C.4 • 15:00
Theoretical Explanation of the Seliton Self-frequency Blusing in Gas-filled Hollow Core Photonic Crystal Fibres, Fabio Biancalana, Mohammad F. Saleh, Philipp Hotzler, Wonkeun Chang, John C. Treher, Nicolaus Y. Joly, Philip Russell; 1NPI, Max Planck Inst. for the Science of Light, Germany. By using a new theoretical framework based on equations for the electric field envelope, we provide a complete theoretical explanation of the plasma-induced soliton blushing, recently observed experimentally in a gas-filled hollow-core PCF.

QW3C.5 • 15:15
Carrier-envelope Phase Double Stabilization Setup with sub-10 Attosecond Timing Jitter, Bastian Barchers, Sebastian Koke, Gunter Steinmeyer; 1Max Born Inst., Germany. We demonstrate a novel setup for carrier-envelope phase stabilization combining a feedback loop with a feed-forward type stabilization technique to push the residual timing down to 8 attoseconds, setting a new record in stabilization performance.

QW3C.6 • 15:45
Surface Enhanced 2D-IR Spectroscopy of Gold Nanoparticle Capping Layers, Paul M. Donaldson; 1Racah Inst. of Physics, The Hebrew Univ. of Jerusalem, Israel. We use two-dimensional infrared spectroscopy to quantify gold nanoparticle IR activity to nanoparticle capping structure/dynamics.

QW3D • 2D-IR—Continued

QW3D.3 • 15:00
Two-dimensional Femtosecond Infrared Spectroscopy of Hydrogen-bonded Wires, Stevan Krajnovic, Martin Ochterski, Peter Voigtsberger; 1Inst. for Physical and Theoretical Chemistry, Univ. of Bam, Germany. 2D-IR reveals frequency-dependent OH-stretching lifetimes and line broadening parameters of synthetic hydrogen-bond wires thereby reflecting uniquely conformational disorder of the supporting scaffold and the resulting wire flexibility.

QW3D.4 • 15:15
Dynamics of N-H Stretching Excitations of Guanosine-Cytidine Base Pairs in Solution, Henk Fidder, Ming Yang, Lukasz Styz, Katharina Röttger, Erik Nibbering, Thomas Elsaesser, Friedrich Tempe, 1Max Born Instut, Germany; 2Institut für Physikalische Chemie, Christian-Albrechts-Universität zu Kiel, Germany. The NH-stretching region of guanosine-cytidine base pairs in chloroform was investigated with 2D-IR and pump-probe spectroscopy. Structural motifs are correlated with spectral features through off-diagonal couplings and observation of energy transfer.

QW3D.5 • 15:30
2D IR Spectroscopy of Ice Ih, Fivos Perakis, Peter Hammer; 1Inst. of Physical Chemistry, Univ. of Zurich, Switzerland. We present experimental 2D IR spectra of the OH stretch of ice Ih, for both the isotopic dilute (5% HOD in H2O) and neat (100% H2O) cases, complemented by simulations using the Lippincott-Schroeder model.

QW3D.6 • 15:45
Surface Enhanced 2D-IR Spectroscopy of Gold Nanoparticle Capping Layers, Paul M. Donaldson; 1Racah Inst. of Physics, The Hebrew Univ. of Jerusalem, Israel. We use two-dimensional infrared spectroscopy to quantify gold nanoparticle IR activity to nanoparticle capping structure/dynamics.

16:00–16:30 Coffee Break, Grosser Stern

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Open Quantum Walks as a Tool for Dissipative Quantum Computing, Francesco Petruccione, Ilja Sinayskiy; ‘UQZN, South Africa. Recently, open quantum walks (OQW) have been formulated as quantum Markov chains on graphs. It is shown that OQWs are a very useful tool for the formulation of dissipative quantum computing algorithms and for dissipative quantum state preparation.

The Quantum Zeno Paradox: A Matter of Information, Peter E. Tosschek; ’Inst. f. Laser-Physik, Universität Hamburg, Germany. Observation of expectation values does not admit the demonstration of the quantum Zeno paradox. Rather, iterative detection of transition times of an individual quantum object provides necessary and sufficient evidence.

Heisenberg-limited Metrology without Entanglement, Daniel Braun, John Martin; ’Inst. for Theoretical Physics, Technical Univ. of Berlin, Germany. We present the first experimental generation of a femtosecond quantum frequency comb using a synchronously pumped OPO, showing that it behaves as an assembly of independent squeezers in agreement with theoretical predictions.

Demonstrating the Quantum Nature of Light with a Single Detector, Geine Strudel, Stefan Schöntier, David Höckel, Sander N. Dorenbos, Valeriy Zwiller, Oliver J. Benson; ’AG Nonlinear Optics, TU Berlin, Germany; ’Kavli Inst. of Nanoscience, Delft Univ. of Technology, Netherlands. Utilizing a superconducting detector with a very short dead time, we performed the most fundamental experiment to demonstrate the quantum nature of light consisting only of a quantum emitter and a single detector.

Fabrication of Optical Nanofiber Cavity Using Focused Ion Beam Milling, Kali P. Nayak, Yuto Kawai, Fum L. Kien, Hiromichi Kataura, Youichi Sakaki; ’NanoScience Center, National Inst. for Material Science, Japan. We discuss the characteristics of optical nanofiber cavity fabricated using focused ion beam milling technique. Due to strong confinement of the field in such a nanofiber cavity, it can become a promising workbench for cavity-QED.

Degree in Photon-number Correlations, Liat Liat, CarolineroleId, Assaf Shmuel, Eli Megidish, Assaf Halany, Lior Cohen, Daniel Istrati, Hagi Eisenberg; ’Rasch Inst. of Physics, Hebrew Univ., Israel. We measure the two-mode photon-number distribution of parametric down-conversion for different degrees of correlation. The singular value decomposition of the joint probability matrix is shown to indicate the degree of non-classicality.

Direct Measurements of the Non-classicality Degree in Photon-number Correlations, Liat Liat, CarolineroleId, Assaf Shmuel, Eli Megidish, Assaf Halany, Lior Cohen, Daniel Istrati, Hagi Eisenberg; ’Rasch Inst. of Physics, Hebrew Univ., Israel. We measure the two-mode photon-number distribution of parametric down-conversion for different degrees of correlation. The singular value decomposition of the joint probability matrix is shown to indicate the degree of non-classicality.
QW4A • Novel Quantum Probability for Special Cases.

Inconclusive measurement results is allowed and optimal measurement for discriminating among Autonoma de Barcelona, Spain.

Informació i Fenomens Quantics, Universitat Janos A. Bergou 1, Ramon Munoz-Tapia2, Emilio Bagan1,2, Georgina of Leeds, UK; 2National Inst. of Informatics, Japan; 3NTT Basic Research Laboratories, Japan.

We show how using a continuous-variable ancilla to manipulate qubits can provide efficient quantum simulation, including a linear QFT and efficient phase estimation algorithm.

QW4B • Quantum State Engineering II—Continued

Optimal Measurement for the Discrimination of Inconclusive Outcomes, Janos A. Bergou 1, Ramon Munoz-Tapia 2, Emilio Bagan 1,2, Georgina A. Olivares Rentería 1, Physics and Astronomy, CUNY Hunter College, USA; 2Física Teorica: Informació i Fenoms Quantics, Universitat Autonoma de Barcelona, Spain.

We present the optimal measurement for discriminating among quantum states when a certain fixed rate of inconclusive measurement results is allowed and give analytical results for the maximal success probability for special cases.

QW4C • Atomic and Molecular Physics—Continued

Complete Fragmentation of Hydrocarbon Molecules Probed by Few-cycle Laser Pulses, Stefan Roither 1, Xinlin Xie 1, Daniel Kasthmare 1, Li Zhang 1, Markus Schiffer 1,2, Huailiang Xie 1,2, Atsushi Iwasaki 1, Tomoyuki Okino 1, Kiyofumi Tamanohasi 1, Andrius Balzakas 1, Markus Kitzler 1, Photonic Inst., Vienna Univ. of Technology, Austria; 2Institut für Kernphysik, Goethe-Univ., Germany; 3Center for Ultrafast Opelectronic Technologies, Fudan Univ., China; 4Department of Chemistry, School of Science, The Univ. of Tokyo, Japan.

We report detailed measurements of high-order harmonic generation in a series of complex, unaligned, polyatomic molecules and show that fingerprints of electronic structure are embedded in harmonic spectra.

QW4D • Phonon & Vibrational Probes—Continued

Attosecond Control of Laser Driven Plasmas, Rodrigo Lopez-Martinez 1, Antonin Bonet 2, Arnaud Malvache 1, Xiaowei Chen 1, Aurelie Jullien 1, Aurelien Ricci 1, Patrick Audhebert 1, Jean-Paul Geindre 1, Gérard Mourou 1, Fabien Quere 1, Laboratoire d’Optique Appliquée, ENSTA - Ecole Polytechnique - CNRS, France; Laboratoire pour l’Utilisation des Lasers Intenses, CNRS - Ecole Polytechnique, France; Institut de La Lumière Extreème, ENSTA - Ecole Polytechnique - CNRS, France; Service des Photons, Atomes et Molecules, CEA - DSM/DRECAM, France.

We demonstrate for the first time attosecond time scale control of collective electron motion in overdense plasmas driven by intense waveform-controlled few-cycle laser pulses.

Wednesday, 21 March 2012

Research in Optical Sciences • 19–21 March 2012
POSTDEADLINE PAPERS

Research in Optical Sciences

High Intensity Lasers and High Field Phenomena (HILAS)

International Conference on Ultrafast Structural Dynamics (ICUSD)

Quantum Information and Measurement (QIM)

Collocated with Laser Optics Berlin

ISBN 978-1-55752-941-1

19–21 March 2012
Laser Optics Berlin
Berlin, Germany
Postdeadline Sessions

HT5C • High Intensity Lasers and High Field Phenomena (HILAS) Postdeadline Session
Hong Kong, Messe Berlin
Tuesday, 20 March, 19:00 – 20:30
Jen Beigert; CFO - The Institute of Photonic Sciences, Spain, Presider

HT5C.1 • 19:00
Spectral Caustics in Attosecond Science, O. Raz1, O. Pedatzur1, N. Dudovich1, B.D. Bruner1; 1Weizmann Inst. of Science, Israel. By exploiting singularities of the semiclassical model that describes high harmonic generation (HHG), we are able to demonstrate a new level of control over the emitted attosecond pulse, reaching a narrow tunable spectral enhancement.

HT5C.2 • 19:15
Controlling Ionisation and Fragmentation Processes in CO2 via Laser Driven Inelastic Electron Recollisions, M. Oppermann1, S. Weber1, L. Frasinski1, J.P. Marangos1; 1Imperial College London, UK. For the first time, the angular dependence of nonsequential double ionisation and dissociation induced by laser driven inelastic electron rescattering was investigated experimentally in aligned CO2. A strong dependence on the recollision angle was found.

HT5C.3 • 19:30
Non-Adiabatic Ionization in Circularly Polarized Laser Fields, I. Barth1, O. Smirnova1; 1Max-Born-Institut, Germany. In contrast to theoretical predictions based on adiabatic tunneling picture, the accurate analytical ionization rates for p+ and p- orbitals in circularly polarized laser fields differ by an order of magnitude for typical experimental conditions.

HT5C.4 • 19:45
Inhomogeneous High Harmonic Generation in Krypton Clusters, H. Ruf1, C. Handschin1, S. Petit1, D. Descamps1, E. Mével1, E. Constant1, B. Fabre1, Y. Mairesse1, R. Cireasa1, N. Thiré2, V. Blanchet2; 1CELIA : Université Bordeaux , France; 2LCAR: Université de Toulouse, France. By performing high harmonic generation in a cluster and monomer mixture, we isolate the radiation originating from clusters. Surprisingly this radiation is depolarized. Our experiments show that it is produced by a new recollisional mechanism.

HT5C.5 • 20:00
Imaging the Kramers-Henneberger Atom, Felipe Morales Moreno, Thales Optronique SA; France. We present a two stages Ti:Sapphire amplifier system running at 1Hz reaching up to 65J supporting sub-30fs pulses. Extreme care have been taken on the beam profile quality as well as preventing transverse lasing.

HT5C.6 • 20:15
1Hz PetaWatt Class Laser for Laser Driven Wakefield Acceleration, Olivier Chalus1,2; 1Max-Born-Institut, Germany; 2National Research Council of Canada, Canada. We provide a unified concept for understanding and imaging excited state dynamics in atoms and molecules in intense laser fields, including microscopic description of high order Kerr non-linearities and their role in laser filamentation.
QT5C • Quantum Information and Measurement (QIM) Postdeadline Session
Madrid, Messe Berlin
Tuesday, 20 March, 18:45 – 21:00
Andrew White; Univ. of Queensland, Australia Presider

QT5A.1 • 18:45
The Biaxial Nonlinear Crystal BiB3O6 as a Polarization Entangled Photon Source using Non-collinear Type-II Parametric Down-conversion,
A. Halevy\textsuperscript{1}, E. Megidish\textsuperscript{1}, L. Dovrat\textsuperscript{1}, H. Eisenberg\textsuperscript{1}, P. Becker\textsuperscript{2}, L. Bohaty\textsuperscript{2}; \textsuperscript{1}Racah Inst. of Physics, The Hebrew Univ. of Jerusalem, Israel; \textsuperscript{2}Inst. of Crystallography, Univ. of Cologne, Germany. We describe the full characterization of BiB3O6 as a polarization entangled photon source using non-collinear type-II parametric down-conversion and experimentally demonstrate entanglement generation with up to 2.5 times higher rates compared to beta-BaB2O4.

QT5A.2 • 19:00
Phase-controlled Switching between Incoherent Optical Images in a Double-Λ System, H. Kang\textsuperscript{1}, B. Kim\textsuperscript{1}, Y. Park\textsuperscript{1}; \textsuperscript{1}GIST, Republic of Korea. Phase-controlled optical image switching with low light intensity was demonstrated in a double-Λ system. Switching by interference in a double-Λ system was observed as having a 90% switching depth between incoherent image pixels.

QT5A.3 • 19:15
Adaptive Measurement of the Spectral and Temporal Shape of Ultrashort Single Photons for Higher-Dimensional Quantum Information Processing, A. Zavatta\textsuperscript{1}, C. Polycarpou\textsuperscript{1}, M. Bellini\textsuperscript{1}, A. Zavatta\textsuperscript{2}, C. Polycarpou\textsuperscript{2}, G. Venturi\textsuperscript{2}, M. Bellini\textsuperscript{2}, K.N. Cassemiro\textsuperscript{3}, K.N. Cassemiro\textsuperscript{4}, \textsuperscript{1}Istituto Nazionale di Ottica (INO-CNR), Italy; \textsuperscript{2}Università di Firenze, Italy; \textsuperscript{3}Universidade Federal de Pernambuco, Brazil; \textsuperscript{4}Max Planck Inst. for the Science of Light, Germany. We describe a new method, combining techniques from the fields of ultrafast and quantum optics, for gaining full access to the spectral and temporal information encoded in the wavepacket mode of single, ultrashort, photons.

QT5A.4 • 19:30
High-performance Narrowband Filter for Atom-resonant Quantum Light Generation, J. Zielinska\textsuperscript{1}, F.A. Beduini\textsuperscript{1}, M. Mitchell\textsuperscript{1}, N. Godbout\textsuperscript{2}, M. Mitchell\textsuperscript{3}; \textsuperscript{1}ICFO - Institut de Ciencies Fotoniques, Spain; \textsuperscript{2}École Polytechnique de Montréal, Canada; \textsuperscript{3}ICREA, Spain. Spectral filters are indispensable elements in many quantum optics experiments. We present a Faraday anomalous dispersion filter based on optical properties of atomic vapor, which surpasses conventional interference filters in terms of key figures of merit.

QT5A.5 • 19:45
Polarization Entanglement Engineering at Telecom Wavelengths, F. Kaiser\textsuperscript{1}, L. Ngah\textsuperscript{1}, A. Issautier\textsuperscript{1}, O. Alibart\textsuperscript{1}, A. Martin\textsuperscript{1}, T. Sébastien\textsuperscript{1}, \textsuperscript{1}Univ. of Nice - Sophia Antipolis, France. We report an efficient polarization entanglement engineering scheme based on a stabilized birefringent delay line. The scheme is capable of
handling ultra narrowband photons making it compatible for multiplexing and quantum memory based applications.

**QT5A.6 • 20:00**  
**Complete Measurement of the Two-Photon Wave Function using High Contrast Quantum Interference, R. Pomeranz, Y. Shaked, A. Pe’er, Bar Ilan Univ., Israel.** Exploiting quantum pairwise interference, we measure the spectral phase of ultra-broadband entangled photon pairs. The nonclassical nature of the interference is manifested by observing the reduction of fringe contrast as linear loss is introduced.

**QT5A.7 • 20:15**  
**Experimental Demonstration of a Novel Superconducting Photon Number Resolving Detector, G. Frucci, Univ. of Technology Eindhoven, Netherlands.** We report the experimental demonstration of a novel photon number resolving detector (PNR) structure which can exhibit a large dynamic range. It is based on the series connection of N superconducting nanowires.

**QT5A.8 • 20:30**  
**Quantum Storage of a Photonic Polarization Qubit in a Doped Crystal, M. Gundogan, P.M. Ledingham, A. Almasi, M. Cristiani, H. de Riedmatten, H. de Riedmatten; ICFO-Institut de Ciencies Fotoniques, Spain; ICREA-Institució Catalana de Recerca i Estudis Avançats, Spain.** We report storage of photonic polarization qubits in a crystal. The average conditional fidelity of retrieved qubits exceeds 95% for a mean photon number $\mu=0.4$, higher than the classical benchmark proving the quantum nature of the storage.

**QT5A.9 • 20:45**  
**Entanglement between Photons that Never Co-existed, E. Megidish, A. Halevy, T. Shacham, T. Dvir, L. Dovrat, H. Eisenberg; Hebrew Univ., Israel.** We entangle two photons, with the first detected even before the other is created, by using entanglement swapping between temporally-separated polarization-entangled photon pairs. This result shows the nonlocality of quantum mechanics in space time.
Program Additions
New paper sessioned as IT1D.1, Multidimensional Stimulated Resonant Raman X-ray Spectroscopy of Molecules, Shaul Mukamel, Jason D. Biggs, Yu Zhang and Daniel M. Healion, University of California at Irvine, USA. Valence excitations can be studied by watching wavepackets launched by sequences of attosecond x-ray pulses. This is demonstrated by simulations for trans-Nmethylacetamide (NMA) at the oxygen and nitrogen K-edges. A Super Magic Angle (SMA) combination of two measurements with specific pulse polarization configurations can simplify the interpretation of these signals. [See Postdeadline papers for a copy of the PDF summary]

Presenter Changes:
IM1D.4 will be presented by Mathieu Ducaosso, CEA Saclay, France; instead of Hamed Merdji
QM3B.1 will be presented by Jonathan Mathews, Univ. of Bristol, UK instead of Jeremy O’Brien

Withdrawn Papers and Poster:
QM1A.4, Quantum Interferometry (Augusto Smerzi)
HM2C.3, Results of Recent Experiment at (x-Ray) Free Electron LASERs on Carbon-like Materials (Shafagh Dastjani Farahani)
IT1D.1, Time-resolved Laue Diffraction at High Positional Accuracy and the Optimizing of Time-Resolutions at Synchrotron Beamlines (Philip Coppens)
JT2A.14, Decoherence, Entanglement Decay and Equilibration Produced by Chaotic Environments (Gabriela B. Lemos)
JT2A.22, Information Transfer and Randomness in Quantum Measurements (Sergey Mayburov)
JT2A.28, Fractional Topological Phase for Entangled Qudits (Antonio Z. Khoury)
JT2A.30, Bright Beam High-noon States (Aziz Kolkiran)
JT2A.59, Pulse Shortening by Spectral Gain Modulation in a Regenerative Yb:CaF2 Laser Amplifier (Fabian Röser)

Presider Changes:
Rodrigo Lopez-Martens of ENSTA - Ecole Polytechnique, France will preside over Electronic Dynamics and Attosecond Physics (HW2C) on Wednesday, 21 March from 10:30-12:30
Student Events

How to Start your own Company, special session
Tuesday, 20 March, 19:00-20:00
Sydney, Messe Berlin
Featuring Wolfgang Gries, CEO/ Managing Director and Founder, Direct photonics Industries GmbH, Germany
Sponsored by OSA and the Berlin Optik Student Chapter

Student Party
Tuesday, 20 March, 20:00-22:00
Hall 13, Messe Berlin
Sponsored by OSA and the Berlin Optik Student Chapter.

Site Seeing Tour of Potsdam
Thursday, 22 March, 11:00-13:00
OSA, the Student Chapter Potsdam, and the Berlin Optik Student Chapter are offering a free guided tour to the famous palaces and parks around Potsdam to student attendees. Potsdam was the city of residence for the Prussian kings and is a town of unique and stunning beauty. Large areas of the city were awarded official UNESCO World Heritage status in 1990. The event will begin at 11.00 on Thursday, 22 March and take about two hours. It will feature many of the most important sites within the city. For more information and to sign-up, contact Jonas Gortner by email (gortner@opttech.tu-berlin.de) or phone (+49 151 2345 2800).

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