

International Conference on Ultrafast Structural Dynamics (ICUSD)

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

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[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.

The meeting covers the new and rapidly developing field of structure research in the ultrafast, i.e., femto- to picosecond time domain. Light induced structural dynamics are mapped in real-time by techniques such as x-ray diffraction, electron diffraction, and x-ray absorption, using femtosecond x-ray and/or electron pulses synchronized with optical pulses. Such structure research is complemented by nonlinear multidimensional spectroscopy to observe microscopic interactions and measure their strength. Structural dynamics in a very broad range of systems are elucidated and basic physical, chemical and biological processes are analyzed in a quantitative way, including theoretical calculations and simulations. Addressing such complex scientific problems requires the combination of knowledge and methodology from different fields in an interdisciplinary approach. The meeting serves as a platform for discussing the latest developments in this area, for establishing new collaborations and for giving early stage researchers the opportunity to present their work and get in touch with a broader community.

Topics covered by the meeting:

- Generation of ultrashort x-ray and electron pulses
- Methods of ultrafast structural research
- Multidimensional electronic and vibrational spectroscopy
- Ultrafast structural dynamics of photoexcited systems in physics, chemistry, biology, and materials sciences
- Fluctuating equilibrium structures in the condensed phase
- Theory of ultrafast structural dynamics

Chairs

Thomas Elsaesser, *Max Born Inst., Germany*

Majed Chergui, *École Polytechnique Fédérale de Lausanne, Switzerland*

Proceedings from OSA conferences are archived in [Optics InfoBase](#) OSA's online library for OSA flagship journals and partnered and copublished journals.

Research in Optical Sciences is collocated with:



 **LASER OPTICS BERLIN**
International Trade Fair and Congress
19 – 21 March 2012

Sponsored by: 

Research in Optical Sciences Congress

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

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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 

ICUSD - Denis Anielski, Max Planck-Institut für 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

Syndey, 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.

Student Party

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International Trade Fair and Congress
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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: microsyst berlin will take place within the scope. As a combination of exhibition and lecture program, microsyst 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

International Conference on Ultrafast Structural Dynamics (ICUSD)

Conference Program

[About ICUSD and Topic Categories](#)

[Download Pages from the Program](#)

[Invited Speakers](#)

[Special Events](#)

[Call for Papers](#)

[Schedule-at-a-Glance](#)

[Online Conference Program](#)

About International Conference on Ultrafast Structural Dynamics (ICUSD)

International Conference on Ultrafast Structural Dynamics (ICUSD) meeting covers the new and rapidly developing field of structure research in the ultrafast, i.e., femto- to picosecond time domain. Light induced structural dynamics are mapped in real-time by techniques such as x-ray diffraction, electron diffraction, and x-ray absorption, using femtosecond x-ray and/or electron pulses synchronized with optical pulses. Such structure research is complemented by nonlinear multidimensional spectroscopy to observe microscopic interactions and measure their strength. Structural dynamics in a very broad range of systems are elucidated and basic physical, chemical and biological processes are analyzed in a quantitative way, including theoretical calculations and simulations. Addressing such complex scientific problems requires the combination of knowledge and methodology from different fields in an interdisciplinary approach. The meeting serves as a platform for discussing the latest developments in this area, for establishing new collaborations and for giving early stage researchers the opportunity to present their work and get in touch with a broader community.

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Invited Speakers

Tutorials

Ultrafast X-ray Diffraction, Andrea Cavalleri, *Ctr for Free-Electron Laser Science (CFEL), Germany*

Nonlinear Terahertz Spectroscopy, Keith A. Nelson, *MIT, USA*

Watching Time-Evolving Molecular Structures with 2D IR Spectroscopy, Andrei Tokmakoff, *MIT, USA*

Invited Speakers

Two-dimensional THz Spectroscopy of Graphene, Pamela Bowlan, *Max-Born-Institut., Germany*

Time Resolved X-Ray Spectroscopies and Scattering, Christian Bressler, *European XFEL GmbH, Germany*

Coherent THz Spectroscopy and Imaging, Thomas Feurer, *University of Berne, Switzerland*

Ultrafast X-Ray Studies of Ferroelectric Materials, Aaron Lindenberg, *Stanford Univ, USA*

Multidimensional Stimulated Resonant Raman X-ray Spectroscopy of Molecules, Hamed Merdji, *CEA Saclay, France*

Ultrafast Coherent Diffractive Imaging using a Lab-Based soft X-ray Source, Shaul Mukamel, *Univ. of California at Irvine, USA*

Time-resolved X-Ray Scattering from Phonons, David A. Reis, *Stanford PULSE Inst., SLAC Nat. Accelerator Lab., USA*

Femtosecond Electron Diffraction for the Study of Charge Density Waves, Germán Sciaini, *Univ. of Hamburg, University of Toronto, Canada*

MeV Ultrafast Electron Diffraction, Xijie Wang, *Brookhaven National Laboratory, Upton, USA*

Status and Future of SACLA: The Japan's X-ray Free-Electron Laser, Makina Yabashi, *RIKEN Harima Inst., Japan*

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

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

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 für 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 Fédérale 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 für 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, *CELLA, France*
Sandro DeSilvestri, *Politecnico di Milano, Italy*
John Dudley, *Univ. Franche-Comté, France*
Takao Fuji, *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, *Kaist, Korea*
Günter Steinmeyer, *Max Born Inst., Germany*
Amelle Zair, *Imperial College London, UK*

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*

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*
Eugene Polzik, *Univ. of Copenhagen, Denmark*
Aephraim Steinberg, *Univ. of Toronto, Canada*
Jeremy O'Brien, *Univ. of Bristol, UK*
Paul Kwiat, *UIUC, USA*
Hans Bachor, *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 Insubria, 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*

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 Post-deadline 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 Optics 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.

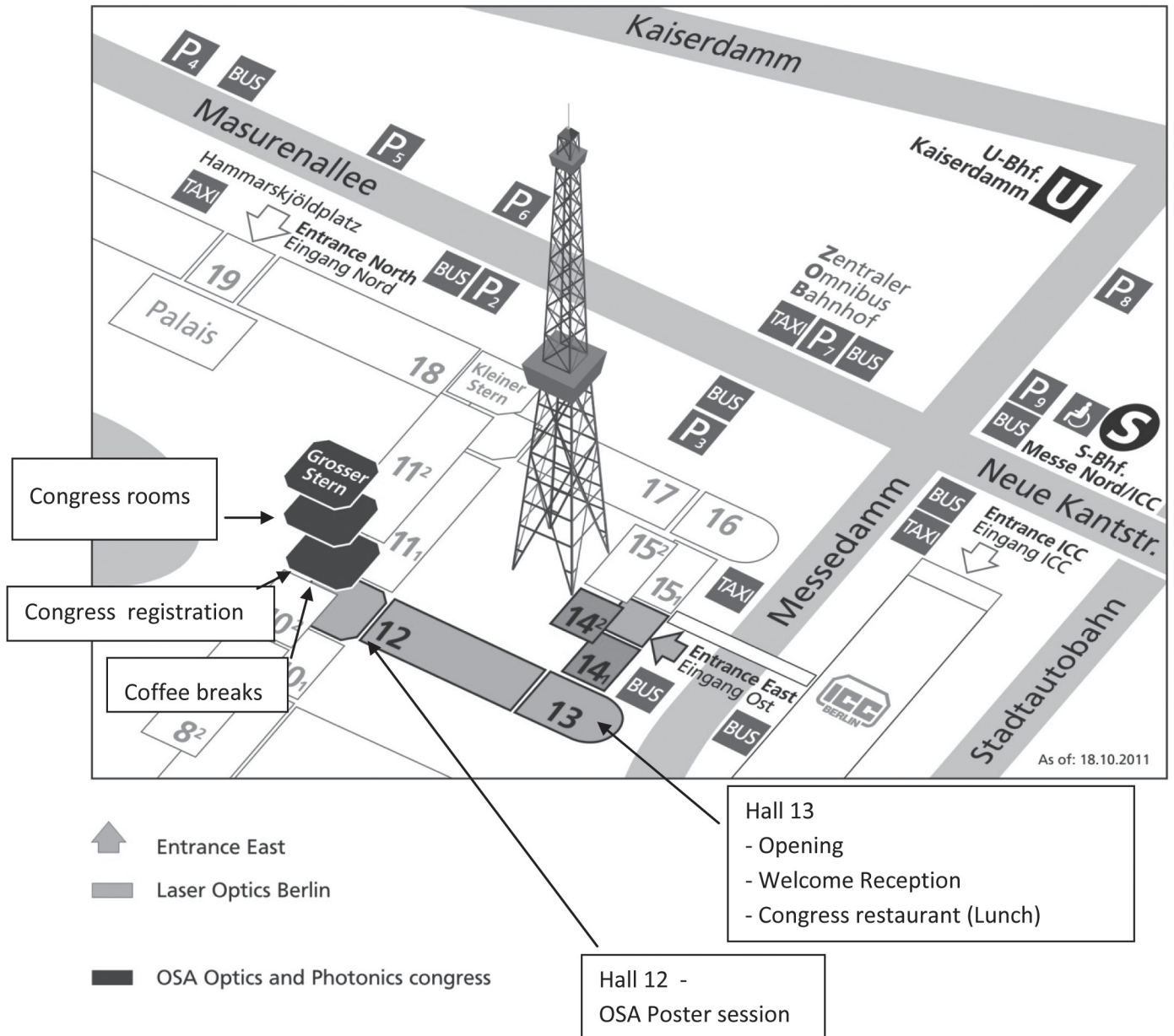
Exhibit Hall Hours

19–20 March	10:00–17:00
21 March	10:00–16:00

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



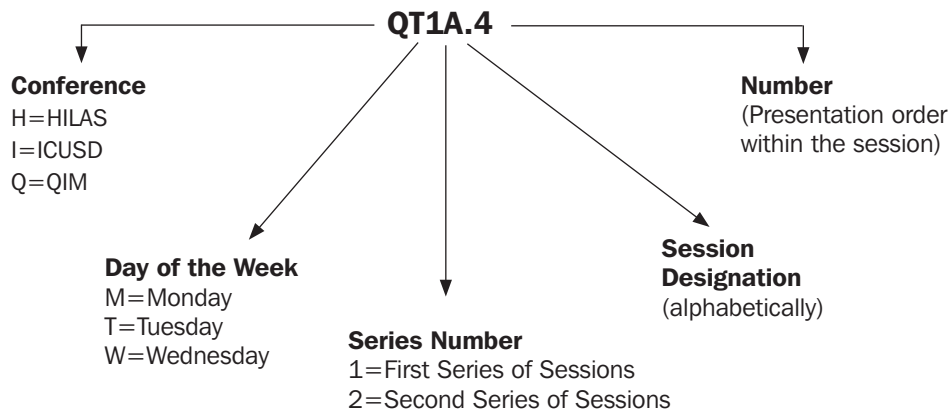
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Agenda of Sessions — Monday, 19 March

	Madrid	Sydney	Hong Kong	Istanbul
	QIM	QIM	HILAS	ICUSD
07:00–16:30	Registration, <i>Grosser Stern</i>			
08:15–8:30	QIM Opening Remarks		HILAS Opening Remarks	ICUSD Opening Remarks
08:30–10:00	QM1A • Quantum Measurement	QM1B • Quantum Atom-Photon Interaction	HM1C • Short Wavelength Sources	IM1D • X-ray Scattering
10:00–11:00	Coffee Break, <i>Grosser Stern</i>			
11:00–13:00	QM2A • Quantum Information and Measurement with Atoms and Ions		HM2C • Short Wavelength Sources and Applications	IM2D • X-ray Diffraction
13:00–14:30	Exhibit Hall / Lunch, <i>Hall 13</i>			
14:30–16:30	QM3A • Novel Systems for Quantum Measurement	QM3B • Quantum Information and Measurement with Photons I	HM3C • HHG1	IM3D • Electronic Excitations
17:00–21:00	Welcome Reception, <i>Hall 13</i>			

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

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

Agenda of Sessions — Tuesday, 20 March

	Madrid	Sydney	Hong Kong	Istanbul
	QIM	QIM	HILAS	ICUSD
07:00–18:30	Registration, <i>Grosser Stern</i>			
08:00–10:00	QT1A • Quantum Light and Matter Interaction	QT1B • Quantum Gaussian Light	HT1C • Lasers, OPA, OPCPA	IT1D • X-ray Diffraction II
10:00–10:30	Coffee Break, <i>Grosser Stern</i>			
10:30–12:30	JT2A • Joint QIM, HILAS, ICUSD Poster Session, <i>Exhibit Hall 12</i>			
12:30–14:00	Exhibit Hall / Lunch, <i>Hall 13</i>			
14:00–16:00	QT3A • Photon Entanglement	QT3B • Quantum Information	HT3C • OPCPA and Waveform Synthesis	IT3D • Electron Diffraction
16:00–16:30	Coffee Break, <i>Grosser Stern</i>			
16:30–18:30	QT4A • Quantum Communication I	QT4B • Quantum Imaging	HT4C • HHG2	IT4D • THz Spectroscopy
19:00–21:00	Joint QIM & HILAS Postdeadline Paper Session, <i>Madrid</i>			

— Wednesday, 21 March

	Madrid	Sydney	Hong Kong	Istanbul
	QIM	QIM	HILAS	ICUSD
07:00–18:00	Registration, <i>Grosser Stern</i>			
08:00–10:00	QW1A • Quantum Communication II	QW1B • Novel Quantum Information and Measurement Techniques I	HW1C • Electronic Dynamics	IW1D • Structure Probes and Methods
10:00–10:30	Coffee Break, <i>Grosser Stern</i>			
10:30–12:30	QW2A • Quantum Communication III	QW2B • Quantum Entanglement	HW2C • Electronic Dynamics and Attosecond Physics	IW2D • X-ray Absorption
12:30–14:00	Exhibit Hall / Lunch, <i>Hall 13</i>			
14:00–16:00	QW3A • Quantum Information and Measurement with Photons II	QW3B • Quantum State Engineering I (starts at 14:45)	HW3C • NL and Extreme NL Optics	IW3D • 2D-IR
16:00–16:30	Coffee Break, <i>Grosser Stern</i>			
16:30–18:00	QW4A • Novel Quantum Information and Measurement Techniques II	QW4B • Quantum State Engineering II	HW4C • Atomic and Molecular Physics (ends at 18:15)	IW4D • Phonon & Vibrational Probes

Key to Conference Abbreviations

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07:00 – 16:30 Registration, *Grosser Stern***8:15–8:30**
Opening Remarks**08:30–10:00**
QM1A • Quantum Measurement
Saverio Pascazio; *Universita degli Studi di Bari, Italy, Presider***QM1A.1 • 08:30** **Invited**
Experimental Tradeoffs in Quantum Measurement: Uncertainty Relations, Weak Measurement and Quantum Metrology, Aephraim Steinberg¹, Dylan Mahler¹, Lee Rozema¹, Ardavan Darabi¹, Amir Feizpour¹, Xingxing Xing¹, Yasaman Soudagar¹, Alex Hayat¹; ¹Physics, Univ. of Toronto, Canada. I will present an overview of several recent and ongoing experiments investigating the limitations on quantum measurement. Was Heisenberg's original limit wrong? When and how is entanglement useful for metrology?**QM1A.2 • 09:00**
Multi-Photon Entanglement for Sub Shot-Noise Sensitivity, Christian Schwemmer^{1,2}, Roland Krischek^{1,2}, Witlief Wieczorek³, Wieslaw Laskowski⁴, Philipp Hyllus⁵, Harald Weinfurter⁶, Augusto Smerzi⁷, Luca Pezze⁸; ¹Faculty of Physics, Ludwig-Maximilians Universität, Germany; ²Max-Planck-Inst. for Quantum Optics, Germany; ³Facultät für Physik, Universität Wien, Austria; ⁴Inst. of Theoretical Physics and Astrophysics, Univ. of Gdansk, Poland; ⁵Dep. of Theor. Physics, Univ. of the Basque Country, Spain; ⁶Laboratoire Charles Fabry, Univ. Paris-Sud, France; ⁷Dipartimento di Fisica, Univ. di Trento, Italy. We experimentally demonstrate a general criterion to identify multi-photon entangled states useful for quantum metrology and prove their applicability for phase estimation with a sensitivity higher than the shot-noise limit.**QM1A.3 • 09:15**
Withdrawn**08:30–10:00**
QM1B • Quantum Atom-Photon Interaction
Markus Aspelmeyer; *Univ. of Vienna, Austria, Presider***QM1B.1 • 08:30** **Invited**
Strong Atom-Photon Coupling in Free Space, Gerd Leuchs^{1,2}, Robert Maiwald^{1,2}, Andrea Goll^{1,2}, Martin Fischer^{1,2}, Benoit Chalopin^{1,2}, Marianne Bader^{1,2}, Simon Heugle^{1,2}, Markus Sondermann^{1,2}; ¹Department of Physics, Univ. of Erlangen, Germany; ²Max Planck Inst. for the Science of Light, Germany. The limit of strong coupling can be reached without resonators or near-field antennae by exciting a single atom in free space with a properly designed dipole mode.**QM1B.2 • 09:00**
Generation of a Macroscopic Singlet State in an Atomic Ensemble, Naimeh Behbood¹, Mario Napolitano¹, Giorgio Colangelo¹, Brice Dubost^{1,2}, Silvana Palacios Álvarez¹, Robert J. Sewell¹, Geza Tóth³, Morgan W. Mitchell^{1,4}; ¹ICFO-Institut de Ciències Fotòniques, Spain; ²Université Paris Diderot et CNRS, France; ³The Univ. of the Basque Country, Spain; ⁴ICREA-Institut de Recerca i Estudis Avançats, Spain. We report on an experiment for generating singlet states in a cold atomic ensemble. We use quantum non-demolition measurement and feedback control to produce a macroscopic spin state with total spin zero and reduced spin fluctuations.**QM1B.3 • 09:15**
Superadiabatic and Speed Limited Quantum Driving of Bose-Einstein Condensates in Optical Lattices, Donatella Ciampini^{1,2}; ¹Dipartimento di Fisica "E. Fermi", Università di Pisa, Italy; ²INO-CNR & CNISM UdR Dipartimento di Fisica "E. Fermi", Italy. We implement optimal control schemes that approach the quantum speed limit as well as superadiabatic driving, achieving nearly perfect fidelity for a two-level quantum system realized with BECs in optical lattices.**8:15–8:30**
Opening Remarks**08:30–10:00**
HM1C • Short Wavelength Sources
Simon Hooker; *Univ. of Oxford, UK, Presider***HM1C.1 • 08:30** **Invited**
Attosecond Lighthouses: A New Tool for Ultrafast Science and Metrology, Fabien Quere¹, Henri Vincenti¹; ¹CEA, France. The attosecond lighthouse effect provides an unprecedentedly simple way of generating isolated attosecond pulses, and provides new opportunities for ultrafast measurements. It is analyzed theoretically, and first experimental evidence of this effect is presented.**HM1C.2 • 09:00**
Generation of Coherent Radiation in the Water Window, Lap V. Dao^{1,2}; ¹CAOUS, Swinburne Univ. of Technology, Australia; ²Australian Research Council Centre of Excellence for Coherent X-Ray Science, Australia. The phase-matched harmonic radiation down to the water window region (~4.4 nm) is obtained and exhibits a good beam profile and high spatial coherence using a 1 kHz infrared pulses at 1400 nm.**HM1C.3 • 09:15**
Withdrawn**8:15–8:30**
Opening Remarks**08:30–10:00**
IM1D • X-ray Scattering
Majed Chergui; *Ecole Polytechnique Federale de Lausanne, Switzerland, Presider***IM1D.1 • 08:30** **Invited**
Time-resolved X-ray Scattering from Phonons, David A. Reis^{1,2}; ¹Photon Science, Stanford PULSE Inst., SLAC Nat. Accelerator Lab., USA; ²Photon Science and Applied Physics, Stanford Univ., USA. Advances in x-ray sources are enabling the study of material dynamics with unprecedented resolution down to the atomic-scale. We present first time- and momentum-resolved diffuse scattering measurements of nonequilibrium phonons in photoexcited semiconductors.**IM1D.2 • 09:00**
Cross-Correlation Based 2D Structure Determination from Multi-Particle Scattering Images, Bill Pedrini¹; ¹SwissFEL, Paul Scherrer Inst., Switzerland. A large set of X-ray scattering images on multiple identical gold nanoparticles (350 nm) in random orientation was used to determine the 2D structure of the nanoparticle template at 20 nm resolution applying the cross-correlation method.**IM1D.3 • 09:15**
Detection of Photoexcited High-frequency Monochromatic Phonon Pulses by Ultrafast x-ray Diffraction, Marc Herzog¹, André Bojahr¹, Jevgenij Goldshteyn², Wolfram Leitenberger¹, Ionela Vrejoiu³, Dmitry Khakulin⁴, Michael Wulff⁵, Roman Shayduk⁶, Peter Gaal¹, Matias Bargheer^{1,2}; ¹Institut für Physik und Astronomie, Universität Potsdam, Germany; ²Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Germany; ³Max-Planck-Institut für Mikrostrukturphysik, Germany; ⁴European Synchrotron Radiation Facility, France. 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.

Madrid

Quantum Information and Measurement

QM1A • Quantum Measurement—Continued

QM1A.4 • 09:30 **Invited**

Quantum Interferometry, *Augusto Smerzi*¹; *INO-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.

Sydney

QM1B • Quantum Atom-Photon Interaction—Continued

QM1B.4 • 09:30 **Invited**

Emission and Absorption of Single Photons by Single Atoms, *Jürgen Eschner*^{1,2}, *Jan Huwer*^{1,2}, *Joyee Ghosh*^{1,2}, *Nicolas Piro*², *Francois Dubin*², *Michael Schug*¹, *Christoph Kurz*¹, *Philipp Müller*¹, *José Brito*¹; ¹Experimentalphysik, Universität des Saarlandes, Germany; ²ICFO - Institut de Ciències Fotòniques, 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.

Hong Kong

High Intensity Lasers and High Field Phenomena

HM1C • Short Wavelength Sources—Continued

HM1C.4 • 09:30

Bright Femtosecond X-ray Beams from Betatron Radiation and Thomson Backscattering, *Cedric Thaur*¹, *Sebastien Corde*¹, *Victor Malka*¹, *Antoine Rousse*¹, *Kim Taphuoc*¹; 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 Springate*¹, *Cephise Cacho*¹, *Edmond Turcu*¹, *Fabio Frassetto*², *Paolo Villoresi*^{2,3}, *Luca Poletto*², *Will Bryan*^{4,5}, *Russell Minns*^{1,10}, *Jonathan Underwood*^{1,9}, *Jesse Petersen*^{5,6}, *Stefan Kaiser*⁶, *Nicky Dean*⁵, *Alberto Simoncig*⁶, *Haiyun Liu*⁶, *Adrian Cavalieri*⁶, *Sarnjeet Dhesi*¹, *Helmuth Berger*⁶; 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. College London, 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.

Istanbul

International Conference on Ultrafast Structural Dynamics

IM1D • X-ray Scattering—Continued

IM1D.4 • 09:30 **Invited**

Ultrafast Coherent Diffractive Imaging Using a Lab-Based Soft X-ray Source, *Hamed Merdji*¹; 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*

Quantum Information and Measurement

High Intensity Lasers and High Field Phenomena

International Conference on Ultrafast Structural Dynamics

11:00–13:00

QM2A • Quantum Information and Measurement with Atoms and IonsAlexander Sergienko; *Boston Univ., USA, Presider***QM2A.1 • 11:00** Plenary

Quantum Information Processing and Quantum Simulations with Trapped Ions, Rainer Blatt^{1,2}, ¹*Inst. of Experimental Physics, Univ. of Innsbruck, Austria*; ²*Inst. for Quantum Optics and Quantum Information, Austrian Academy of Sciences, Austria*. The use of trapped ions for quantum information processing is reviewed. Quantum simulations employ well controlled quantum systems to make predictions on another quantum system under investigation. With trapped ions quantum relativistic effects and spin systems are simulated.



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.

QM2A.2 • 11:45 Invited

Quantum Feedback Experiments with Atoms and Cavities, Jean-Michel Raimond¹, Clément Sayrin¹, Igor Dotsenko¹, XingXing Zhou¹, Bruno Peaudecerf¹, Theo Rybarczyk¹, Sebastien Gleyzes¹, Michel Brune¹, Serge Haroche²; ¹*LKB, UPMC, ENS, CNRS, France*; ²*Collège de France, France*. 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

HM2C • Short Wavelength Sources and ApplicationsJon Marangos; *Imperial College London, UK, Presider***HM2C.1 • 11:00** Invited

Protein Crystal Structure Determination and Radiation Damage at a Dose of 3 GGy using a Free-Electron Laser, Ilme Schlichting^{1,2}, Lukas Lomb^{1,2}, Thomas R. Barends^{1,2}, ¹*Department of Biomolecular Mechanisms, Max Planck Inst. for Medical Research, Germany*; ²*Max Planck Advanced Study Group, Center for Free Electron Laser Science, Germany*. Radiation damage induced by 2 keV femtosecond X-ray pulses was studied in protein microcrystals as a function of pulse length and fluence. Dose and dose rate dependent effects were observed, suggesting the occurrence of “hotspots” for damage.

HM2C.2 • 11:30 Invited

High Harmonic Spectroscopy of Molecular Isomers, Ravi Bhardwaj¹, Michael Wong¹, Jean-Paul Brichta¹, Sergeui Patchkovskii², Micheal Spanner²; ¹*Physics, Univ. of Ottawa, Canada*; ²*National Research Council, Canada*. High harmonic generation in unaligned molecular isomers is shown to be distinguishable and is attributed to differences in angle dependent sub-cycle ionization yields.

11:00–13:00

IM2D • X-ray DiffractionDavid Reis; *Stanford PULSE Inst., SLAC Nat. Accelerator Lab., USA, Presider***IM2D.1 • 11:00** Tutorial

Controlling and Probing Atomic, Electronic and Magnetic Structural Dynamics in Complex Oxides, Andrea Cavalleri¹; ¹*Max Planck Department for Structural Dynamics, Germany*. In this tutorial, we will discuss key advances in control and probing of atomic structures, of electronic and magnetic order and of transient band structures in strongly correlated electron systems. These dynamics are typically controlled with near and far infrared radiation and probed with ultrafast x-ray scattering, spectroscopy and with time and angle resolved photo-emission.

IM2D.2 • 11:45 Invited

Ultrafast Structural Dynamics in Manganites Associated with Phase Transitions, Paul Beaud¹, Andrin Caviezel¹, Steven L. Johnson², Urs Staub¹, Simon O. Mariager¹, Shih-Wen Huang¹, Christopher J. Milne³, Ekaterina Möhr-Vorobeva¹, Sebastian Grübel¹, Jeremy A. Johnson¹, Gerhard Ingold¹; ¹*Swiss Light Source, Paul Scherrer Institut, Switzerland*; ²*Inst. for Quantum Electronics, ETH, Zürich, Switzerland*; ³*Laboratoire de Spectroscopie Ultrarapide, EPFL, 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.

Madrid

Quantum Information and Measurement

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 Keselman¹, Roei Ozeri¹; 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 Leung¹, Atreju Tauschinsky¹, Klaasjan Van Druten¹, Robert Spreuw²; ¹Inst. of Physics, Univ. of Amsterdam, Netherlands. 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 Wolfgramm¹, Chiara Vitelli², Federica A. Beduini², Nicolas Godbout³, Morgan W. Mitchell⁴; ¹ICFO - The Inst. of Photonic Sciences, Spain; ²Dipartimento di Fisica, Università "Sapienza" di Roma, Italy; ³COPL, Département de Génie Physique, Ecole 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.

Sydney

Hong Kong

High Intensity Lasers and High Field Phenomena

HM2C • 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, A. London², C. Bostedt³, S.p. Hau-Riege⁴, S. Moeller⁵, J. Bozek⁶, H. Chapman⁷, K. Tiedtke⁸, S. Toilekis⁹, H. Wabnitz¹⁰, R. Sobierajski¹¹, M. Jurek¹², M. Stormer¹³, A.J. Glesson¹⁴, J. Chalupsky¹⁵, T. Burian¹⁶, L. Vysin¹⁷, L. Juha¹⁸, H. Sinn¹⁹, Th. Tschentscher²⁰, J. Gaudin²¹; ¹European XFEL, Germany; ²Inst. of Physics, Academy of Sciences of the Czech Republic, Czech Republic; ³CCRLC Daresbury Laboratory, UK; ⁴GKSS-Forschungszentrum Geesthacht GmbH, Max-Planck-Strasse, Germany; ⁵Center for Free-Electron Laser Science, Germany; ⁶HASYLAB/DESY, Germany; ⁷Lawrence Livermore National Laboratory, USA; ⁸SLAC National Accelerator Laboratory, USA; ⁹Inst. of Physics, Polish Academy of Sciences, Poland. Carbon based materials have been irradiated by FELs x-ray pulses. The damage threshold is determined for $h\nu = 25, 91, 177$ and 830 eV. The irradiated material is characterized ex-situ by AFM, μ -Raman and photoemission spectroscopy.

HM2C.4 • 12:15

Pulse Width Dependent Damage Testing of Critical Components in Vacuum for Petawatt Class Short Pulse Lasers, Enam Chowdhury¹, Patrick Poole², Rebecca Daskalova¹, Richard Freeman¹, Douglas Smith²; ¹The Ohio State Univ., USA; ²Plymouth Grating Laboratory, USA. Vacuum damage testing of novel pulse compression gratings and mirrors have been damage tested with a 30 fs - 200 fs, 800 nm laser, and found that damage threshold increases weakly as pulse duration shortens.

HM2C.5 • 12:30 **Invited**

XUV-driven Electronic Correlation Probed with Strong THz Light Fields, Markus Drescher, Univ. of Hamburg, Germany. Strong (~ 1 MV/cm) THz fields steer the motion of XUV-ionized photo- and Auger-electrons in an atomic potential, revealing an intrinsic time-dependent nonlinear spectral chirp of the correlated particles.

Istanbul

International Conference on Ultrafast Structural Dynamics

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. Pressacco², Gerhard Ingold¹, Andrin Caviezel¹, Ekaterina Möhr-Vorobeva¹, Paul Beaud³, Steven L. Johnson¹, Christopher J. Milne⁴, Robert Feidenhans⁵, C. Back⁶, Christoph Quitmann⁷; ¹Swiss Light Source, Paul Scherrer Institut, Switzerland; ²Fakultät für Physik, Univ. of Regensburg, Germany; ³Inst. for Quantum Electronics, ETH Zürich, Switzerland; ⁴Ecole Polytechnique Fédérale 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 PbZr_{0.2}Ti_{0.8}O₃ Thin Films by Ultrafast Reciprocal Space Mapping, Daniel Schick¹, André Bojahr¹, Marc Herzog¹, Peter Gaal¹, Matias Bargheer²; ¹Institut für Physik & Astronomie, Universität Potsdam, Germany. We present first results on mosaicity changes in a ferroelectric PbZr_{0.2}Ti_{0.8}O₃ 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 Zamponi¹, Johannes Stingl¹, Benjamin Freyer¹, Michael Woerner¹, Thomas Elsaesser¹, 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

Quantum Information and Measurement

High Intensity Lasers and High Field Phenomena

International Conference on Ultrafast Structural Dynamics

14:30–16:30

QM3A • Novel Systems for Quantum MeasurementGerd Leuchs; *Univ. of Erlangen, Germany, Presider***QM3A.1 • 14:30** **Invited**

Quantum-Optomechanics: A Mechanical Platform for Quantum Foundations and Quantum Information, Markus Aspelmeyer¹; 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. I will present the status, prospects and challenges of this emerging field of quantum optomechanics.

QM3A.2 • 15:00

Quantum Optomechanics, Klemens Hammerer^{1,2}; ¹Institut für Theoretische Physik, Leibniz Universität Hannover, Germany; ²Institut für Gravitationsphysik, Leibniz Universität Hannover, Germany. Optomechanical systems are approaching the quantum regime. We show that mechanical systems can be efficiently interfaced to atoms, and how dissipative coupling can be achieved in a Michelson-Sagnac-Interferometer.

QM3A.3 • 15:15

Optomechanical Systems as Single Photon Routers, Sumei Huang¹, Girish Agarwal¹; ¹Oklahoma 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 microwatt.

14:30–16:30

QM3B • Quantum Information and Measurement with Photons IJürgen Eschner; *Saarland Univ., Germany, Presider***QM3B.1 • 14:30** **Invited**

Integrated Quantum Photonics, Jeremy O'Brien¹; 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 and nonlinear photon sources.

QM3B.2 • 15:00

Optimal Multi-photon Phase Sensing with a Single Interference Fringe, Guoyong Xiang^{1,2}, Holger Hofmann^{3,4}, Geoff J. Pryde⁵; ¹Centre for Quantum Dynamics and Centre for Quantum Computer Technology, Griffith Univ., Australia; ²Key Lab of Quantum Information, Univ. of Science & Technology of China, China; ³Graduate School of Advanced Sciences of Matter, Hiroshima Univ., Japan; ⁴JST, Japan. The maximally-entangled NOON state does not achieve optimal phase sensitivity when $N > 4$, rather, the Holland-Burnett state is optimal. We experimentally demonstrate this enhanced sensitivity using the six-photon Holland-Burnett state.

QM3B.3 • 15:15

High Resolution Measurement of Polarization Mode Dispersion in Discrete Telecom Devices using Quantum Interferometry, Alexander Sergienko¹, Andrew Fraine¹, Olga Minaeva¹, David Simon¹, Roman Egorov¹; 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 optical technology over conventional measurement.

14:30–16:30

HM3C • HHG1Jens Biegert; *ICFO, Spain, Presider***HM3C.1 • 14:30**

Megahertz High Harmonic Generation at the μW Level with Fiber CPA Systems, Steffen Hädrich^{1,2}, Manuel Krebs¹, Stefan Demmler¹, Jan Rothhardt^{1,2}, Jens Limpert^{1,2}, Andreas Tünnemann^{1,3}; ¹Inst. of Applied Physics, Germany; ²Helmholtz-Institut Jena, Germany; ³Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany. We present high harmonic generation at MHz repetition rate performed with a fiber CPA system. Up to 5.7 μW are converted to a single harmonic at 49 nm. Additionally, further scaling potential is presented.

HM3C.2 • 14:45

Efficiency Scaling of High Harmonic Generation Driven by a Tunable Optical Parametric Amplifier in the Visible, Giovanni Cirri^{1,2}, Chien-Jen Lai¹, Eduardo Granados^{1,3}, Shu-Wei Huang¹, Phillip Keathley¹, Alexander Sell¹, Franz Kärtner^{1,2}; ¹Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, MIT, USA; ²Center for Free-Electron Laser Science, DESY and Univ. of Hamburg, Germany; ³IKERBASQUE, Basque Foundation for Science, Spain. High Harmonic Generation efficiency increases for short driver wavelengths. We study experimentally the driver wavelength dependence around 32 eV by driving the process with a tunable Optical Parametric Amplifier in the visible range.

HM3C.3 • 15:00

Polarization Gating in Plasmon-assisted Low-intensity High Harmonic Generation, Anton Husakou¹, Freek Kelkensberg², Joachim Herrmann¹, Marc J. Vrakking²; ¹Max Born Inst., Germany; ²FOM Inst. AMOLF, Netherlands. We predict that generation of isolated attosecond pulses by sub-1-TW/cm² pump pulses is possible by the polarization gating technique and plasmonic field enhancement in the vicinity of a specifically designed metal nanostructure.

HM3C.4 • 15:15

Quasi-phase-matched High Harmonic Generation Using Trains of Uniformly-spaced Ultrafast Pulses, Kevin O'Keefe¹, Tom Robinson¹, Simon M. Hooker¹; ¹Oxford Univ., UK. We investigate quasi-phase-matching of high harmonic generation over a range of harmonic orders using trains of up to 8 uniformly-spaced counter-propagating pulses, produced using an array of birefringent crystals.

14:30–16:30

IM3D • Electronic ExcitationsAndrei Tokmakoff; *MIT, USA, Presider***IM3D.1 • 14:30** **Invited**

UV Two-Dimensional Transient Absorption Spectroscopy, Gerald Auböck¹, Cristina Consani¹, Frank van Mourik¹, Majed Chergui¹; ¹Laboratory of Ultrafast Spectroscopy, EPFL, Switzerland. We present a broadband UV two dimensional transient absorption setup (70–80 nm excitation, 80–100 nm probe, centered at 310 nm). Data on different systems will be shown and the capabilities of the setup discussed.

IM3D.2 • 15:00

Two-Dimensional Electronic Spectroscopy for Vibrational Wavepacket Analysis and Electronic Structure Determination, Niklas Christensson¹, Tomas Manca², Franz Milota¹, Oliver Bixner¹, Harald F. Kauffmann¹, Juergen Hauer¹; ¹Faculty of Physics, Univ. of Vienna, Austria; ²Faculty of Mathematics and Physics, Charles Univ. in Prague, Czech Republic. We discuss two unconventional studies in two-dimensional electronic spectroscopy. First, it aids vibrational wavepacket analysis in a solvated molecule near the zero-phonon line. Second, it refines the electronic energy level scheme of β -carotene.

IM3D.3 • 15:15

Two-Dimensional Optical Spectroscopy of Charge Transfer, Tomas Manca¹, Niklas Christensson², Oliver Bixner², Vladimír Lukeš³, Franz Milota², Harald F. Kauffmann², Juergen Hauer²; ¹Faculty of Mathematics and Physics, Charles Univ. in Prague, Czech Republic; ²Faculty of Physics, University of Vienna, Austria; ³Department of Chemical Physics, Slovak Technical Univ., Slovakia. Interaction of exciton and charge transfer states in a molecular dimer is traced by the dynamics of the cross-peaks in two-dimensional electronic spectra. Simulations reveal the corresponding chain of electron transfer steps in the dimer.

Madrid

Quantum Information and Measurement

QM3A • Novel Systems for Quantum Measurement—Continued**QM3A.4 • 15:30**

Optimal Mass-sensing with a Nano-mechanical Resonator, Daniel Braun¹; ¹Univ. Toulouse Paul Sabatier, France. I 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, Shabir Barzanjeh¹, Mehdi Abdi¹, Paolo Tombesi¹, Gerard J. Milburn²; ¹Physics 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.

QM3A.7 • 16:15

High-Sensitivity Absolute Atomic Gravimeter, Christine Guerlin¹, Tristan Farah¹, Anne Louchet-Chauvet¹, Sébastien Merlet¹, Franck Pereira Dos Santos¹; ¹LNE-SYRTE, CNRS-Observatoire de Paris, France. Our cold atom free fall interferometer measures the acceleration of gravity with performances comparable to the best classical absolute gravimeters. Current developments to overcome these state-of-the-art limits include the use of ultracold atoms.

Sydney

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; ¹Univ. 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 Sciarrino¹, Linda Sansoni¹, Paolo Mataloni¹, Andrea Crespi^{2,3}, Roberta Ramponi^{2,3}, Roberto Osellame^{2,3}; ¹Dipartimento di Fisica, Sapienza Università di Roma, Italy; ²Istituto di Fotonica e Nanotecnologie, Consiglio Nazionale delle Ricerche, Italy; ³Dipartimento di Fisica, Politecnico di Milano, Italy. Integrated photonics have a strong potential for quantum information processing. We demonstrate an integrated Controlled-NOT gate for polarization encoded qubits and investigate how the particle statistics influences a two-particle quantum walk.

QM3B.6 • 16:15

Beating the Classical Resolution Limit via Multi-photon Interferences of Independent Light Sources, Steffen Oppel^{1,2}, Thomas Büttner¹, Pieter Kok¹, Joachim von Zanthier^{1,2}; ¹Institut für Optik, Information und Photonik, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany; ²Erlangen Graduate School in Advanced Optical Technologies (SAOT), Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany; ³Department of Physics and Astronomy, Univ. of Sheffield, UK. We discuss multi-photon interferences up to fifth order between indistinguishable photons emitted by independent light sources. For certain detector positions we observe an interference pattern which beats the classical resolution limit.

Hong Kong

High Intensity Lasers and High Field Phenomena

HM3C • HHG1—Continued**HM3C.5 • 15:30**

High-field Nonlinear Fiber Optics, KaFai Mak¹, John C. Travers¹, Philipp Hoelzer¹, Wonkeun Chang¹, Nicolas Y. Joly^{2,1}, Mohammed F. Saleh¹, Fabio Biancalana¹, Philip Russell^{1,2}; ¹Max Planck Inst. for the Science of Light, Germany; ²Univ. of Erlangen-Nuremberg, Germany. Soliton compression of few- μ J fs-pulses leads to ionization in gas-filled photonic crystal fiber, and the emission of blue-shifting solitons. By pressure-tuning the dispersion we observe the transition between plasma and Kerr influenced propagation.

HM3C.6 • 15:45

Low- and high-order Harmonic Generation Inside an Air Filament, Tobias Vockerodt^{1,2}, Daniel Steingrube^{1,2}, Emilia Schulz^{1,2}, Martin Kretschmar¹, Uwe Morgner^{1,2}, Milutin Kovacev^{1,2}; ¹Inst. of Quantum Optics, Leibniz Universität Hannover, Germany; ²QUEST Centre of Quantum Engineering and Space-Time Research, Germany. Third-order and high-order harmonic generation inside a self-guided femtosecond filament in air is demonstrated. We observe broadband ultraviolet radiation with a Fourier-limited pulse durations below 5fs and conversion up to the 25th harmonic order.

HM3C.7 • 16:00

Phase-matching Aspects in High-order Harmonic Generation from Liquid Water Droplets, Milutin Kovacev^{1,2}, Uwe Morgner^{1,2}, Daniel Steingrube^{1,2}, Heiko G. Kurz^{1,2}, Detlev Ristau¹, Manfred Lein^{1,2}; ¹Leibniz Univ. Hannover, Germany; ²QUEST - Centre for Quantum Engineering and Space-Time Research, Germany; ³Laser Zentrum Hannover e.V., Germany. We report on phase-matching aspects during high-order harmonic generation from micrometer-sized liquid water droplets. Phase-matching effects are studied by variation of the focal position and the density of the target.

HM3C.8 • 16:15

High-Order Harmonic Generation in Stabilized Plasma Plumes Using the 800 and 1300 nm Femtosecond Pulses, Rashid Ganeev¹, C. Hutchison¹, A. Zair¹, T. Witting¹, F. Frank¹, S. Weber¹, W. A. Okell¹, J. W. Tisch¹, J. P. Marangos¹; ¹Imperial College London, UK. We show the advantages of using the rotating targets for plasma harmonic generation, which allowed the dramatic improvements of harmonic stability in the case of resonance enhancement and application of 1300 nm radiation.

Istanbul

International Conference on Ultrafast Structural Dynamics

IM3D • Electronic Excitations—Continued**IM3D.4 • 15:30**

Ultrafast Electronic Relaxations in Metal Mixed-Ligand Dithiolene Complexes, Andrea Cannizzo¹, Franziska Frei¹, Thomas Feurer¹, Ahmad Odeh², Frank van Mourik², Majed Chergu², Davide Espa³, Maria Laura Mercuri³, Luca Pili³, Angela Serpe³, Paola Deplano³, Antonin Vlček⁴; ¹Inst. of Applied Physics, Univ. of Bern, Switzerland; ²Laboratoire de Spectroscopie Ultrarapide, Ecole Polytechnique Fédérale de Lausanne, Switzerland; ³Dipartimento di Chimica Inorganica ed, Università di Cagliari, Italy; ⁴Queen Mary Univ, UK. Here we present our first results on the fs to ps relaxations in a series of square-planar d8 metal mixed-ligand dithiolene complexes, investigated with fs time resolved broadband transient absorption spectroscopy

IM3D.5 • 15:45

Photoisomerisation Quantum Yield, Double Quantum and Stimulated Emission Cross Section with Femtosecond Excitation of the Photoactive Yellow Protein for Pump-Probe Protein Diffraction, Jasper J. van Thor¹, Craig N. Lincoln¹; ¹Division of Molecular Biosciences, Imperial College London, UK. We consider conditions for femtosecond pump-probe photocrystallography. The quantum yield of photoisomerisation of the Photoactive Yellow Protein strongly depends on peak power, dispersion and wavelength with femtosecond optical excitation.

IM3D.6 • 16:00

Fast Recombination after Electron Photo-Detachment of Hydroxide in H-bonded Liquids, Hubert Rossmadl¹, Martin K. Fischer¹, Alfred Laubereau¹, Hristo Iglev¹; ¹Physics, E11, TU Munich, Germany. PREP spectroscopy on OH⁻ in H-bonded liquids reveals an ultrafast geminate recombination channel. The process is assigned to formation of short-lived OH \cdot - pairs facilitated by the inhomogeneous local H-bonding environment of OH \cdot .

IM3D.7 • 16:15

Heterodyne Detected Transient Grating UV/VIS-pump IR-probe Measurements of Energy Transport through Proteins, Halina Strzalka¹, Shabir Hassan¹, Paul M. Donaldson¹, Peter Hamm¹; ¹PCI, Universität Zürich, Switzerland. The transient grating technique is applied to UV/VIS-pump IR-probe measurements to obtain a background free transient infrared signal. In comparison with conventional UV/VIS-pump IR-probe measurements the S/N is enhanced by a factor of 25.

17:00–21:00 Welcome Reception, Hall 13

07:00–18:30 Registration, Grosser Stern

08:00–10:00

QT1A • Quantum Light and Matter InteractionShigeki Takeuchi; *Hokkaido Univ., Japan, Presider*QT1A.1 • 08:00 **Invited**

Quantum Networking with Individual Qubits of Light and Matter, *Gerhard Rempe*¹; ¹Max-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.

QT1A.2 • 08:30

Coherent Storage and Retrieval of an Image using a Gradient Echo Memory in an Atomic Vapor, *Jeremy B. Clark*^{1,2}, *Quentin Glorieux*², *Alberto Marino*², *Paul D. Lett*³; ¹Univ. of Maryland, USA; ²JQI, USA; ³NIST, 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.

QT1A.3 • 08:45

Realization of Nonlinear Interferometer using the Four Wave Mixing in Hot Rubidium Vapor, *Jietai Jing*^{1,2}, *Cunjin Liu*^{1,2}, *Zhifan Zhou*^{1,2}, *Florian Hudels*^{1,2}, *Z. Y. Ou*^{1,3}, *Weiping Zhang*^{1,2}; ¹State Key Lab of Precision Spectroscopy, Department of Physics, East China Normal University, China; ²Quantum Inst. for Light and Atoms, Department of Physics, East China Normal Univ., China; ³Department of Physics, Indiana Univ.-Purdue Univ. Indianapolis, USA. We experimentally realized a nonlinear interferometer which has a visibility close to 1 and can result in an enhancement of phase sensitivity with a factor of 2G2 compared to the linear interferometer.

08:00–10:00

QT1B • Quantum Gaussian LightDaniel Gauthier; *Duke Univ., USA, Presider*QT1B.1 • 08:00 **Invited**

Ultimate Sensitivity in Precision Optical Measurements using Intense Gaussian Quantum Light: A Multi-Modal Approach, *Claude Fabre*¹, *Olivier Pinel*¹, *Pu Jian*¹, *Nicolas Treps*¹, *Julien Fide*², *Daniel Braun*³; ¹Laboratoire Kastler Brossel, France; ²Institut de Physique de Rennes, France; ³Laboratoire 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.

QT1B.2 • 08:30

Generation of non-Gaussian Pulsed States by Conditional Measurements, *Alessia Allevi*^{1,2}, *Stefano Olivares*^{3,4}, *Matteo G. A. Paris*^{5,4}, *Maria Bondani*^{6,2}; ¹Dipartimento di Scienza e Alta Tecnologia, Università degli Studi dell'Insubria, Italy; ²C.N.I.S.M. U.d.R. Como, Italy; ³Dipartimento di Fisica, Università degli Studi di Trieste, Italy; ⁴CNISM U.d.R. Milano Statale, Italy; ⁵Dipartimento di Fisica, Università degli Studi di Milano, Italy; ⁶Istituto di Fotonica e Nanotecnologie, C.N.R., Italy. Non-Gaussianity is a resource for 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.

QT1B.3 • 08:45

Experimental Preparation of Eight-partite Cluster State with Continuous Variable Entanglement, *Xiaolong Su*¹, *Yaping Zhao*¹, *Shuhong Hao*¹, *Changde Xie*¹, *Kunchi Peng*¹; ¹State Key Laboratory of Quantum Optics and Quantum Optics Devices, Inst. of Opto-electronics, Shanxi Univ., China. Cluster state is the essential resource for one-way quantum computing. Here, we present the latest experimental achievement on the preparation of eight-partite linear and two-diamond shape cluster states with continuous variable entanglement.

08:00–10:00

HT1C • Lasers, OPA, OPCPATobias Witting; *Imperial College London, UK, Presider*HT1C.1 • 08:00 **Invited**

Science on the Texas Petawatt Laser and Technology Development Toward an Exawatt Laser, *Todd Ditmire*¹; ¹Univ. 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.

HT1C.2 • 08:30

Contrast Enhancement for Astra-Gemini Laser, *Yunxin Tang*¹, *Chris J. Hooker*¹, *Bryn Parry*¹, *Oleg Chekhlov*¹, *Steve Hawkes*¹, *Klaus Ertel*¹, *Rajeev Pattathil*¹, *John L. Collier*¹; ¹Central 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.

HT1C.3 • 08:45

A Cryogenic Gas Cooled Multi-Slab Yb:YAG Amplifier Producing 6.4 J at 10 Hz, *Klaus Ertel*¹, *Saamyabrata Banerjee*¹, *Paul D. Mason*¹, *Paul J. Phillips*¹, *Cristina Hernandez-Gomez*¹, *John L. Collier*¹; ¹Central Laser Facility, STFC Rutherford Appleton Laboratory, UK. We present preliminary results for DiPOLE, a cryogenic Yb:YAG DPSSL amplifier using a temporary extraction architecture. Measured average powers and optical-to-optical efficiencies already compare favourably to existing systems.

08:00–10:00

IT1D • X-ray Diffraction IIAndrea Cavalleri; *Max Planck Department for Structural Dynamics, Germany, Presider*IT1D.1 • 08:00 **Tutorial**

Time-resolved Laue Diffraction at High Positional Accuracy and the Optimizing of Time-Resolution at Synchrotron Beamlines, *Philip Coppens*¹; ¹Chemistry, 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.



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.

IT1D.2 • 08:45

The Rotating Crystal Method in Femtosecond X-Ray Diffraction, *Benjamin Freyer*¹, *Johannes Stingl*¹, *Flavio Zamponi*¹, *Michael Woerner*¹, *Thomas Elsaesser*¹; ¹Max-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.

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, Kouichi Semba¹, 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.

QT1A.5 • 09:30

Storing Quantum States in a Slow Light Cavity, Stefan Kröll¹, Lars Rippe¹, Mahmood Sabooni¹, Axel Thuresson¹, Samuel T. Kometa¹, ¹Dept of Physics, Lund Univ., Sweden. High efficiency quantum state storage using cavities made out of 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 Vogl¹, Ryan T. Glasser¹, Paul D. Lett¹, ¹Laser 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.

QT1B • Quantum Gaussian Light—Continued**QT1B.4 • 09:00**

Probing Multimode Squeezing with Correlation Functions, Andreas Christ¹, Kaisa Laiho², Andreas Eckstein², Katiúscia N. Cassemiro^{2,3}, Christine Silberhorn^{1,2}, ¹Applied Physics, Univ. of Paderborn, Germany; ²IQO Group, MPL for the Science of Light, Germany; ³Departamento de Física, 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

Multipartite Photonic Entanglement Generated from Polarization Squeezing at 795 nm, Federica A. Beduini¹, Morgan W. Mitchell^{1,2}, ¹ICFO - Institut de Ciències Fòtoniques, Spain; ²ICREA, Institució Catalana de Recerca i Estudis Avançats, Spain. We describe an experiment to generate photonic multipartite entangled states from polarization squeezing generated by a sub-threshold OPO. The technique is very efficient: about $5 \cdot 10^4$ atom-tuned entangled photons per second are generated.

QT1B.6 • 09:30

Fundamental Limit to Qubit Control with Coherent Field, Kazuhiro Igeta^{1,2}, Nobuyuki Imoto³, Masato Koashi¹, ¹NTT Basic Research Laboratories, Japan; ²Japan Science and Technology Agency, CREST, Japan; ³Graduate School of Engineering Science, Osaka Univ., Japan; ⁴Photon Science Center, The Univ. of Tokyo, Japan. The accuracy in controlling qubit with coherent field is studied by full quantum treatment. We found $\pi/2$ pulse fidelity error found $\sim 1/(\text{photon number})$ as previously known but to depends strongly on initial state of qubit.

QT1B.7 • 09:45

Studying Photon Antibunching of Bunched Emitters, Silke Peters¹, Daniel Scholz¹, Helmut Hofer¹, Stefan Kück¹, Mark Rodenberger¹, Waldemar Schmunk¹, Michael Weyrauch¹, ¹PTB Braunschweig, Germany. We report on the single photon emission of bunched NV-centres by focusing on different spatial fractions of the emission spot, which shows that $g(2)(0) < 0.5$ does not sufficiently prove the single photon characteristics of the centres.

HT1C • Lasers, OPA, OPCPA—Continued**HT1C.4 • 09:00**

High Energy Optical Parametric Chirped Pulse Amplification in Yttrium Calcium Oxyborate, Xiaoyan Liang¹, Lianghong Yu¹, Jin-Feng Li¹, Xiaoming Lu¹, Cheng Wang¹, Yuxin Leng¹, Ruxin Li¹, Zhizhan Xu¹, Yanqing Zheng², Anhua Wu², ¹Shanghai Inst. of Optics and Fine Mechanics, China; ²Shanghai Inst. of Ceramics, China. We report the high energy non-collinear optical parametric chirped-pulse amplification with yttrium calcium oxyborate. 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 **Invited**

Two-color Pumped OPCPA System with μ J Pulse Energy and a Spectral Bandwidth of 1.5 Octaves from VIS to NIR, Anne Harth^{1,2}, Marcel Schultze¹, Tino Lang^{1,2}, Stefan Rausch^{1,2}, Thomas Binhammer³, Uwe Morgner^{1,2}, ¹Institut für Quantenoptik, Universität Hannover, Germany; ²Centre for Quantum Engineering and Space-Time Research (QUEST), Germany; ³VENTEON Laser Technologies GmbH, Germany. We present a double-stage OPCPA system which is pumped by two different wavelengths. It delivers a coherent 450 THz broad output spectrum around 650 nm with a Fourier limited pulse duration of sub-3 fs.

HT1C.6 • 09:45

High average-power, Self-CEP Stable Few-cycle Pulses at 2.1 μ m Through Collinear OPA in BiB3O6, Francisco Silva¹, Philip K. Bates¹, Adolfo Esteban-Martín¹, Majid Ebrahim-Zadeh^{1,2}, Jens Biegert^{1,2}, ¹ICFO - Institut de Ciències Fòtoniques, Spain; ²ICREA - Institució Catalana de Recerca i Estudis Avançats, Spain. Passively phase stabilized six cycle pulses at 2.1 μ m and 3kHz are generated through collinear OPA in BiB3O6 with an energy of 372 μ J and 42 fs pulse duration. HHG up to 72 eV is demonstrated.

IT1D • X-ray Diffraction II—Continued**IT1D.3 • 09:00**

Watching Femtosecond Symmetry Breaking in Bismuth with X-Ray Diffraction, Steven L. Johnson¹, Paul Beaud², Ekaterina Möhr-Vorobeva², Andrin Caviezel², Gerhard Ingold², Christopher J. Milne³, ¹Inst. for Quantum Electronics, ETH Zurich, Switzerland; ²Swiss Light Source, Paul Scherrer Institut, Switzerland; ³Laboratoire de Spectroscopie Ultrarapide, EPFL, Switzerland. We use femtosecond x-ray diffraction to make a quantitative study of the structural symmetry-breaking coherent Eg 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 phonon mode to individual Bloch states in photoexcited Bismuth, Jerome Faure^{1,2}, ¹LOA, France; ²Laboratoire des Solides Irradiés, 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 phonon coupling with the Bloch state wave vectors.

IT1D.5 • 09:30 **Invited**

Ultrafast x-ray Studies of Ferroelectric Materials, Aaron Lindenberg^{1,2}, Dan Daranciang^{2,3}, John Goodfellow¹, ¹Materials Science and Engineering, Stanford Univ, USA; ²PULSE Inst., Stanford Univ./SLAC, USA; ³Chemistry, 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.

10:30–12:30
JT2A • Joint Poster

JT2A.1

Perturbative Treatment of Up-conversion Detection of Pulsed-shaped Entangled Photons, *André Stefanov¹, Bänz Bessire¹, Christof Bernhard¹, Thomas Feuer¹*; ¹*Inst. of Applied Physics, Univ. of Bern, Switzerland*. We perturbatively describe the sum frequency generation of broadband entangled photons in a non linear crystal and use this to explain the results of the implementation of different interferometric setups with an SLM.

JT2A.2

A Non-Gaussian Master Equation for the Optomechanical Strong Coupling Regime, *Niels Lörch¹*; ¹*Inst. for Theoretical Physics Hannover and Max Planck Inst. for Gravitational Physics, Germany*. We derive a Non-Gaussian master equation for the strong coupling regime ($g \gg \kappa$) of an optomechanical system and aim to describe quantum phenomena such as negativity in the mechanical Wigner function analytically.

JT2A.3

Experimental Study of Free-space Beam Propagation for Single-photon Quantum Communications, *Giuseppe Vallone¹, Paolo Villoresi¹, Ivan Capraro¹, Alberto Dall'Arche¹, Andrea Tomaello¹, Francesca Gerlin¹*; ¹*Department of Information Engineering, Univ. of Padova, Italy*. We report on the study 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 statistic of arrival of single photons.

JT2A.4

Decomposition of Rank-two Mixed States and Quantum State Discrimination, *Luis Roa¹*; ¹*Departamento de Física, Universidad de Concepción, Chile*. We study how the mathematical property of pure-state decomposition of a mixed state is related to the quantum state discrimination.

JT2A.5

Conclusive Entanglement Modification by a Local Non-unitary Operation, *Luis Roa¹*; ¹*Departamento de Física, Universidad de Concepción, Chile*. Using the scheme proposed by L. 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 2xd-dimensional systems, *Luis Roa¹*; ¹*Departamento de Física, Universidad de Concepción, Chile*. We calculate analytically the entanglement of formation for a family of bipartite 2xd-dimensional mixed states which are obtained from tripartite 2x2xd pure states.

JT2A.7

Quantum Interference and Entanglement of Photons which Do Not Overlap in Time, *Ralph Wiegner¹, Christoph Thiel¹, Joachim von Zanthier^{1,2}, Girish Agarwal³*; ¹*Inst. for Optics, Information and Photonics, Univ. Erlangen-Nuremberg, Germany*; ²*Erlangen Graduate School in Advanced Optical Technologies (SAOT), Univ. Erlangen-Nuremberg, Germany*; ³*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 two-photon correlation function is shown to violate Bell's inequalities.

JT2A.8

Electrooptical Method for Generating of Optical Vortices, *Ihor Skab¹, Yuriy Vasyukiv¹, Rostyslav Vlokh¹*; ¹*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 Bi12GeO20 crystals.

JT2A.9

Quantum Correlation Assists State Discrimination, *Luis Roa¹*; ¹*Departamento 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 Rotation Sensing Using an Atom Chip, *Carlos L. Garrido Alzar¹, Wenhua Yan¹, Arnaud Landragin¹*; ¹*SYRTE, 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 Qubits, *Afey Ayachi¹*; ¹*Physique, Faculté des Sciences de Tunis, Tunisia*. We investigate the dynamics of two charge qubits 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 led to complete disentanglement.

JT2A.12

Atom-light Interactions at High Densities and High Magnetic Fields, *Lee Weller¹*; ¹*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.

JT2A.13

Spectral Effects in Polarization-Entanglement Swapping, *Daniel Erenso¹, Daniel Bonior¹, Benjamin Bunnell¹, Jonathan Bentley¹, Hannah Norris¹*; ¹*Physics & Astronomy, Middle Tennessee State Univ, USA*. Polarization entanglement swapping in spectrally correlated photons produced by a spontaneous parametric down conversion and photons entangled by a beam splitter is studied. The concurrence is used to investigate the spectral effects in the swapping.

JT2A.14

Decoherence, Entanglement Decay and Equilibrium Produced by Chaotic Environments, *Gabriela B. Lemos¹, Fabricio Toscano¹*; ¹*Federal Univ. of Rio de Janeiro, Brazil*. We investigate decoherence in quantum systems coupled via dephasing-type interactions to an arbitrary environment with chaotic underlying classical dynamics.

JT2A.15

Nonlinear Coherent Loss for Generating Nonclassical States, *Alexander B. Mikhalychev¹, Dmitri S. Mogilevsev¹, Sergei Y. Kilin¹*; ¹*B. 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, *Juan C. López-Carreño¹, Juan P. Restrepo-Cuartas², Herbert Vinck-Posada¹*; ¹*Universidad Nacional de Colombia, Colombia*; ²*Universidad de Antioquia, Colombia*. In this work, the temporal evolution of the interaction between a two energy levels 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 Binary Communication over Qubit Channels, *Nicola Dalla Pozza¹, Nicola Laurenti¹, Francesco Ticozzi¹*; ¹*Department 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, *Himadri S. Dhar¹*; ¹*School of Physical Sciences, Jawaharlal Nehru Univ., India*. We observe that 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 Andersson¹, Vedran Dunjko¹*; ¹*Physics, Heriot-Watt Univ., UK*. We study probabilistic transforms 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 Mayburov¹*; ¹*Lebedev 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 Pechen^{1,2}*; ¹*Chemical Physics, Weizmann Inst. of Science, Israel*; ²*Mathematical 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, *Junxiang Zhang¹*; ¹*Shanxi 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 Photon Pairs Generation by 2x2 Fiber, *Hsin-Pin Lo^{1,2}, Atsushi Yabushita³, Chih-Wei Luo³, Pochung Chen¹, Takayoshi Kobayashi^{2,3}*; ¹*Department of Physics, National Tsing Hua Univ., Taiwan*; ²*Department of Electrophysics, National Chiao-Tung Univ., Taiwan*; ³*Core Research for Evolutional Science and Technology, Japan Science and Technology Agency, Japan*. Beamlike photon pairs generated by pumping the Type-II BBO crystal. Then inserting into the 2x2 fiber, the polarization entangled photon pairs be measured from the output.

JT2A.26

Withdrawn

JT2A.27

Quantum Holograms based on the Faraday Interaction. Spontaneous Emission in Such Systems, *Denis Vasilyev¹*; ¹*Inst. for Theoretical Physics, Inst. for Gravitational Physics, Leibniz Univ. Hanover, 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, *Antonio Z. Khoury¹, Luis E. Oxman¹*; ¹*Instituto de Física, Universidade Federal Fluminense, Brazil*. 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 Cavity, *Li-hui Sun^{1,2}, Gao-xiang Li¹, Wen-ju Gu¹, Zbigniew Ficek³*; ¹*Department of Physics, Huazhong Normal Univ., China*; ²*College of Physical Science and Technology, Yangtze Univ., China*; ³*National Centre for Mathematics and Physics, KACST, 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.

JT2A • Joint Poster—Continued

JT2A.30

Bright Beam High-noon States, *Aziz Kolkiran*^{1,2}; ¹Electrical and electronics eng, Gediz Univ., Turkey; ²Electrical and electronics eng, Izmir Katip Celebi Univ., Turkey. We show how to generate High-noon states at high flux of photons using coherent beam stimulated non-collinear parametric down conversion (PDC) process.

JT2A.31

Multi-Quabit Entanglement of Nanomechanical Resonators, *Mahmoud Abdel-Aty*^{1,2}; ¹Science, Univ. of Bahrain, Bahrain; ²Mathematics, Sohag Univ., Egypt. We discuss the entanglement dynamics of interaction between a multi-qubit system (Cooper-pair boxes) and a nanomechanical resonator. New type of oscillations employing different entanglement measures is introduced.

JT2A.32

Ultrafast All Optical Switching in Paramagnetic Magneto-optical Crystals, *Guohong Ma*¹; ¹Physics Department, Shanghai Univ., China. Ultrafast optical switching of magnetization in paramagnetic magneto-optical crystals was demonstrated. The switching as fast as 200 fs is reached, the switching amplitude is revealed to be proportional to the MO coefficient of the crystal.

JT2A.33

Control of Quantum Fluctuation of Atomic Displacements by Femtosecond Laser Pulses, *Jianbo Hu*^{1,2}, *Oleg V. Misochnko*³, *Kazutaka G. Nakamura*^{1,2}; ¹Materials and Structures Laboratory, Tokyo Inst. of Technology, Japan; ²JST-CREST, Japan; ³Inst. of Solid State Physics, Russian Academy of Sciences, Russian Federation. By employing a two pump-one probe technique, we have realized coherent control of quantum fluctuation of atomic displacements via exciting two-phonon bound states generated by off-resonant impulsive stimulated second-order Raman scattering.

JT2A.34

Coherent and Squeezed Phonon States Generated in a Quantum Well by Ultrafast Optical Excitation, *Thomas Papenkort*¹, *Vollrath Martin Axt*², *Tilmann Kuhn*¹; ¹Institut für Festkörpertheorie, Universität Münster, Germany; ²Institut für Theoretische Physik III, Universität Bayreuth, Germany. We present simulations of the lattice dynamics in a quantum well driven by ultrashort optical pulses. Our calculations provide insight into the generation mechanisms for coherent phonons and show how squeezed phonon states can be excited.

JT2A.35

TD-DFT Molecular Dynamics simulations of ultrafast processes, *Pablo Lopez-Tarifa*¹, *Basile Curcho*², *Ivano Tavernelli*¹, *Ursula Rothlisberger*¹; ¹LCBC, EPFL, Switzerland. A combination of Time-Dependent Density Functional Molecular Dynamics and Born-Oppenheimer Molecular Dynamics is applied to study the first stages that follow the singly and doubly electron ionization of small biomolecules.

JT2A.36

Photoinduced Structural Dynamics of Epitaxial BiFeO₃ Thin Films Probed by Ultrafast Hard X-ray Diffraction, *Haidan Wen*¹, *Pice Chen*², *Donald A. Walko*¹, *June H. Lee*¹, *Carolina Adamo*³, *Jon Ihlefeld*⁴, *Eric M. Dufresne*⁵, *Darrell Schlom*⁶, *John W. Freeland*¹, *Paul G. Evans*⁷, *Yuelin Li*¹; ¹X-ray Science Division, Argonne National Laboratory, USA; ²Department of Materials Science and Engineering and Materials Science Program, Univ. of Wisconsin-Madison, Madison, USA; ³Department of Materials Science and Engineering, Cornell Univ., USA; ⁴Sandia National Laboratories, USA. The photoinduced dynamical reverse piezoelectric effect in epitaxial BiFeO₃ thin films has been characterized by time-resolved hard X-ray diffraction measurements for ultrafast optical control of room temperature multiferroics.

JT2A.37

Three displacively excited coherent phonons in infinite BN-nanotubes, *Bernd Bauerhenne*¹; ¹Universität Kassel, Germany. We simulate the dynamics of a (5,0) zigzag BN-nanotube upon intense femtosecond laser excitation. We demonstrate, that three phonon modes are simultaneous excited and analyse the possibility to steer these motions.

JT2A.38

Time-Resolved Photoelectron Diffraction on Laser-Aligned Molecules, *Denis Anielski*^{1,3}, *Rebecca Boll*^{1,3}, *Daniel Rolles*^{1,2}; ¹Max Planck Advanced Study Group at CFEL, Germany; ²Max-Planck-Institut für medizinische Forschung, Germany; ³Max-Planck-Institut für Kernphysik, Germany. We present static and time-resolved photoelectron angular distributions of laser-aligned pFAB and OCS molecules photoionized by fs-FEL pulses. Dynamic structural changes of a molecule during Coulomb explosion were recorded.

JT2A.39

Laser-induced Nonthermal Melting in Si, *Tobias Zier*¹, *Eeue S. Zijlstra*¹, *Martin E. Garcia*¹; ¹Theoretical Physics, Univ. Kassel, Germany. In Si an ultrashort laser pulse excitation induces a nonthermal state with ensuing bond softening which leads to nonthermal melting. Our simulations allow us to explain the concerted decay of several x-ray diffraction peaks.

JT2A.40

2D-IR Spectroscopy of Intermolecular Ion-Water Coupling, *Joanna Borek*¹, *Fivos Perakis*¹, *Peter Hamm*¹; ¹Physical Chemistry Inst., Univ. of Zurich, Switzerland. We present 2-color 2D-IR spectra of saturated aqueous solutions of pseudohalide 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 Owschimmikow*¹, *Burkhard Schmidt*², *Nikolaus Schwentner*³; ¹IOAP, TU Berlin, Germany; ²Institut für Mathematik, FU Berlin, Germany; ³Institut für Experimentalphysik, FU Berlin, Germany. We identify the basic processes in the response of a molecule to a linearly polarized laser field. We disentangle the contributions of J and M 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, *André Bojahn*¹, *Daniel Schick*¹, *Marc Herzog*¹, *Matias Bargheer*^{1,2}; ¹Universität Potsdam, Institut für Physik und Astronomie, Germany; ²Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, 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.43

Ultrafast Tr-ARPES with Artemis XUV Beamline, *Cephise Cacho*¹, *Edmond Turcu*¹, *Chris Froud*¹, *Will Bryan*², *Jesse Petersen*³, *Nicky Dean*³, *Stefan Kaiser*⁴, *Andrea Cavalleri*¹, *Alberto Simoncini*⁵, *Haiyun Liu*⁴, *Adrian Cavalleri*¹, *Sarjeet Dhesi*⁶, *Luca Poletto*⁶, *Paolo Villoresi*⁶, *Fabio Frassetto*⁶, *Emma Springate*¹; ¹Artemis, CLF, UK; ²Department of Physics, Swansea Univ., UK; ³Clarendon Laboratory, Oxford Univ., UK; ⁴Max Planck Research Department for Structural Dynamics, Centr for Free Electron Laser, Germany; ⁵Physical Science Division, Diamond Light Source, UK; ⁶LUXOR, CNR-INFN, Italy. A new HHG XUV beamline at Artemis, user open-access facility at CLF, offers unique capabilities optimised for Tr-ARPES. Current result on ultrafast melting of Mott and charge order in TaS₂ will be presented.

JT2A.44

Model-free Investigation of Ultrafast Bimolecular Chemical Reactions: Bimolecular Photoinduced Electron Transfer, *Bernhard Lang*¹, *Arnulf Rosspointner*¹, *Eric Vauthey*¹; ¹Physical Chemistry, Univ. of Geneva, Switzerland. Using photoinduced bimolecular electron transfer reactions as example we demonstrate how diffusion controlled bimolecular chemical reactions can be studied in a model-free manner by quantitatively combining different ultrafast spectroscopical tools.

JT2A.45

Dynamics of the OH Stretching Vibration in Aqueous Hydrates, *Jasper C. Werhahn*¹, *Sotiris S. Xantheas*², *Hristo Iglev*¹; ¹Physics, E11, TU Munich, Germany; ²Chemical & Material Sciences Division, Pacific Northwest National Laboratory, USA. Nonlinear IR spectroscopy gives evidence for intermolecular energy transfer as primary channel for the relaxation of the OH stretching vibration of HDO. Properties of bifurcated hydrogen bonds are unambiguously compared to strong and weak ones.

JT2A.46

Saturation Behavior of Femtosecond Laser Ablation in Silicon-on-insulator, *Hao Zhang*¹, *Dries Oosten*¹, *Denise Krol*¹, *Jaap Dijkhuis*¹; ¹Utrecht Univ., Netherlands. Submicron single-shot ablation features produced by femtosecond laser pulses was investigated in silicon-on insulator with atomic force microscopy. The results are fitted with a model that includes secondary absorption in the laser-induced plasma.

JT2A.47

REGAE: New Source for Atomically Resolved Dynamics, *Masaki Hada*¹, *Julian Hirscht*¹, *Dongfang Zhang*¹, *Stephanie Manz*¹, *Kostyantyn Pichugin*¹, *Dmitry Mazurenko*¹, *Shima Bayesteh*², *Hossein Delsim-Hashemi*², *Klaus Floettmann*², *Markus Huening*³, *Sven Lederer*², *Gustavo Moriena*³, *Christina Mueller*³, *German Sciaini*^{1,3}, *Dwayne Miller*^{1,3}; ¹Center for Free Electron Laser Science, Max Planck Research Department for Structural Dynamics, Univ. of Hamburg, Germany; ²Deutsches Elektronen-Synchrotron, Germany; ³Department of Chemistry and Physics, Univ. of Toronto, Canada. In this paper, we show the design and theoretical calculation of our new femtosecond electron source based on rf-accelerator generating 2-5 MeV electron bunches with high electron density and high coherence length.

JT2A.48

Radio-frequency Electron Bunches Compression for Ultrafast Diffraction Experiment, *Stefano Dal Conte*¹; ¹Department of Applied Physics, Technical Univ. of Eindhoven, Netherlands. We temporally compress highly charged electron bunches (100 fC). The linear chirp of a waterbag bunch is inverted by using a synchronized 3 GHz cavity leading to short (< 100 fs) and high-density electron pulses.

JT2A.49

Structure Changes of Ferromagnetic/Ferroelectric Oxide Nanolayers by Ultrafast X-ray Diffraction at Laser-based and Synchrotron-based Sources, *Lena Maerten*¹, *Daniel Schick*¹, *Marc Herzog*¹, *André Bojahn*¹, *Jevgenij Goldshytyn*¹, *Wolfram Leitenberger*¹, *Ionela Vrejoiu*³, *Roman Shayduk*², *Peter Gaal*¹, *Matias Bargheer*^{1,2}; ¹Institut für Physik und Astronomie, Universität Potsdam, Germany; ²Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Germany; ³Max-Planck-Institut für Mikrostrukturphysik, Germany. We present ultrafast x-ray diffraction experiments on oxide nanostructures 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 Cannizzo*¹, *Franziska Frei*¹, *Thomas Feuerer*¹; ¹Inst. of Applied Physics, Univ. of Bern, Switzerland. herein we will present a set-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.

JT2A.51

Design and Construction of a 700-W CW Diode-Pumped Nd:YAG rod laser with high beam quality and highly efficient concentrator of Pump-Light, *Iraj Mashaiekhayas*¹; ¹Iranian National Center for Laser Science, Islamic 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 • Joint Poster—Continued

JT2A.52

Probing Femtosecond Filamentation via High-order Harmonics, Daniel Steingrube^{1,2}, Emilia Schulz^{2,3}, Martin Kretschmar¹, Thomas Binhammer², Mette Garde^{4,5}, Arnaud Couairon⁶, Uwe Morgner^{2,3}, Milutin Kovacev^{1,2}; ¹Leibniz Universität Hannover, Institut fuer Quantenoptik, Germany; ²Quest, Centre for Quantum Engineering and Space-Time Research, Germany; ³VENTEON Laser Technologies GmbH, Germany; ⁴Department of Physics and Astronomy, Louisiana State Univ, USA; ⁵PULSE Inst., SLAC National Accelerator Laboratory, USA; ⁶Centre de Physique Theorique, Ecole Polytechnique, France. High-order harmonic radiation generated by intensity spikes inside a femtosecond filament is measured. We demonstrate the potential of our setup for probing the nonlinear filamentation dynamics and present a simple attosecond light source.

JT2A.53

Coupled-coherent State Approach for High-order Harmonic Generation, Jie Wu¹, Bradley B. Augstein¹, Carla Faria¹, Adam Kirrander², Dmitry Shalashilin³; ¹Physics & Astronomy, Univ. College London, UK; ²Laboratoire Aimé Cotton Bat, France; ³Chemistry, Univ. of Leeds, UK. We present the first ever computation of HHG spectra using the orbit-based Coupled-Coherent State (CCS) method, whose outcome exhibits a plateau and a cutoff. The CCS fully accounts for quantum interference and the binding potential.

JT2A.54

Above-threshold Ionization (ATI) from Non-homogeneous Fields, Marcelo Ciappina¹, Jens Biegert^{1,2}, Romain Quidant^{1,2}, Maciej Lewenstein^{1,2}; ¹QOT, ICFO, Spain; ²ICREA, 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 Ilchi-Ghazaani¹, Parviz Parvin¹, Vajjheh Daneshfarooz¹; ¹Physics Department, Amirkabir Univ. 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 Emelin¹, Mikhail Ryabikin¹; ¹Inst. 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

Spatio-Spectral Coupling in Multi-Petawatt Ti:Sapphire Lasers, Gabriel Mennerat¹, Fabio Giambruno^{1,2}, Antoine Freneaux^{1,2}, Frederic Leconte^{1,2}, Gilles Cheriaux²; ¹ILE, France; ²LOA, France; ³CEA, France. The influence of the radially varying Ti:Sapphire gain on the spectral amplitude and phase of a 15 femtoseconds pulse is studied

JT2A.58

Analysis of Gold Nanoantennas for Harmonic Generation Utilising Plasmonic Field Enhancement, Nils Pfullmann^{1,2}, Christian Waltermann^{1,2}, Milutin Kovacev^{1,2}, Vanessa Knittel³, Rudolf Bratschitsch³, Alfred Leitenstorfer³, Uwe Morgner^{1,2}; ¹Leibniz Universität Hannover, Institut für Quantenoptik, Germany; ²QUEST Centre for Quantum Engineering and Space-Time Research, 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 Roeser¹, Markus Loeser¹, Mathias Siebold¹, Ulrich Schramm¹; ¹HZDR, 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, Morten Bache¹, Binbin Zhou¹; ¹Department 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 Brugnera¹, F. Frank¹, A. Zair¹, J. P. Marangos¹; ¹Physics, Imperial College London, UK. We examine trajectory selection and resulting yield modulation in high harmonic generation using a multicolor field composed of an 800nm 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, Liat Dovrat¹, Michael Bakstein¹, Daniel Istrati¹, Assaf Shaham¹, Hagai Eisenberg¹; ¹Racah Inst. of Physics, Hebrew Univ., Israel. The dependence of the photon-number distribution from parametric down-conversion 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. Chvykov, K. Krushelnick; ¹Univ. of Michigan, USA. We demonstrate the optimal conditions whereby amplification using the Extraction During Pumping (EDP) technique can deliver up to four times more energy than a conventional amplifier. This allows kJ level energy extraction with existing technology.

JT2A.64

Self-Compression of a Few-Cycle Petawatt Laser Pulses in Transparent Plasma, S. Skobelev¹, A. Balakin¹, A. Litvak¹, V. Mironov¹; ¹The 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.65

The FLOWER Project: Test of Possible Fluctuations of the Speed of Light in Vacuum, X. Sarazin; ¹Laboratoire de l'Accélérateur Linéaire, Université Paris, France. The goal of the project FLOWER is to test possible fluctuations of the speed of light by studying the time broadening of a femtosecond laser pulse in a multi-pass Herriot cell in vacuum.

Madrid

Quantum Information and Measurement

14:00–16:00

QT3A • Photon Entanglement

John Howell; *Univ. of Rochester, USA, Presider*

QT3A.1 • 14:00

Experimental Observation of the Ultra-narrow Temporal Entanglement of Twin Beams by Means of Frequency Up-conversion

Ottavia Jedrkiewicz¹, Jean-Luc Blanchet¹, Alessandra Gatti², Enrico Brambilla¹, Luigi A. Lugiato¹, Paolo Di Trapani¹; ¹Dipartimento di Scienza e Alta Tecnologia, Università dell'Insubria, Italy; ²Istituto 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.

QT3A.2 • 14:15

Dissipation-boosted Entanglement of Coupled Harmonic Oscillators, Erika Andersson¹, Chaitanya Joshi¹, Michael J W Hall^{2,3}, Mats Jonson^{1,4}, Patrik Ohberg¹; ¹Physics, Heriot-Watt Univ., UK; ²Theoretical Physics, RSPE, Australian National Univ., Australia; ³Centre for Quantum Dynamics, Griffith Univ., Australia; ⁴Department of Physics, Univ. 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.

QT3A.3 • 14:30

Photon Pairs from Cavity-Enhanced Parametric Down-Conversion with Tunable Bandwidth for Quantum Interfaces, Andreas Ahlrichs¹, Lars Koch¹, Martin Kerbach¹, Oliver J. Benson¹; ¹Institut of Physics, Humboldt-Univ. of Berlin, Nano-Optics Group, Germany. An optical parametric oscillator is used to generate photon pairs with tunable bandwidth. These photons can be made indistinguishable from photons generated by quantum dots allowing for quantum inference of photons from dissimilar sources.

QT3A.4 • 14:45

Two-photon Interference and Polarization Entanglement of Photon Pair Beam by Path Overlap Scheme, Atsushi Yabushita¹, Hsin-Pin Lo², Chih-Wei Luo¹, Pochung Chen², Takayoshi Kobayashi^{1,3}; ¹Department of Electrophysics, National Chiao-Tung Univ., Taiwan; ²Department of Physics, National Tsing Hua Univ., Taiwan; ³CREST, JST, Japan. Polarization entangled photon pairs are generally obtained at crossing points of light cones. This work generated photon pairs in beam shape and overlapped their light paths to demonstrate their two-photon interference and polarization entanglement.

Sydney

14:00–16:00

QT3B • Quantum Information

Gerhard Rempe; *Max-Planck Inst. of Quantum Optics, Germany, Presider*

QT3B.1 • 14:00 **Invited**

Quantum Information Storage in Atomic Media, Elisabeth Giacobino¹; ¹Laboratoire Kastler Brossel, Université Pierre et Marie Curie, France. Storage and read-out of quantum states of light based on EIT is studied in atomic ensembles. We compare storage schemes in Cs atomic vapors at room temperature and in cold atomic clouds.

QT3B.2 • 14:30

Spin Squeezing of Large-Spin Ensembles via Quantum Non-demolition Measurement, Robert J. Sewell¹, Marco Koschorreck², Mario Napolitano¹, Brice Dubost^{1,3}, Naimeh Behbood¹, Morgan W. Mitchell¹; ¹ICFO - Institut de Ciències Fotòniques, Spain; ²Departement of Physics, Univ. of Cambridge, UK; ³Laboratoire Mate riaux et Phénomènes Quantiques, Université Paris Diderot et 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 ~ 106 laser cooled 87Rb atoms in the F = 1 hyperfine ground state.

QT3B.3 • 14:45

Optical Quantum Information Processing using Forced Fermion-like Behavior of Photonic Qubits, Todd Pittman¹, James Franson¹; ¹Physics, UMBC, USA. We review a new paradigm for optical quantum logic gates that relies on forced "fermion-like" behavior of photonic qubits, and describe experimental work on demonstrating these gates with entangled photons from a parametric down-conversion source

Hong Kong

High Intensity Lasers and High Field Phenomena

14:00–16:00

HT3C • OPCPA and Waveform Synthesis

Takao Fuji; *Inst. for Molecular Science, Japan, Presider*

HT3C.1 • 14:00 **Invited**

High Repetition Rate Few-cycle OPCPA for Generation of Isolated Attosecond Pulses, Manuel Krebs¹, Steffen Hädrich^{1,2}, Stefan Demmler¹, Jan Rothhardt^{1,2}, Jens Limpert^{1,2}, Andreas Tümmernann^{1,2}; ¹Institut für Angewandte Physik, Friedrich-Schiller-Universität Jena, Germany; ²Helmholtz Inst. Jena, Germany. A 20W average power optical parametric amplifier system delivering CEP stable 20µJ, sub 5fs pulses at megahertz repetition rate is presented. First high harmonic generation experiments suggest its feasibility for isolated attosecond pulse generation.

HT3C.2 • 14:30 **Invited**

A Mid-IR, High Repetition Rate, Few-Cycle Laser Source for High-Field Physics Experiments, Michael Hemmer¹, Alexandre Thai¹, Matthias Baudisch¹, Jens Biegert^{1,2}; ¹ICFO - The Inst. of Photonics Sciences, Spain; ²ICREA - Institutio Catalana de Recerca i Estudis Avançats, Spain. We report on a high average power, few-cycle laser system operating in the mid-IR. The system delivers 20 microjoule energy pulses with ~67 fs duration at 160 kHz repetition rate with sub-250 mrad carrier-envelope-phase stability.

Istanbul

International Conference on Ultrafast Structural Dynamics

14:00–16:00

IT3D • Electron Diffraction

Thomas Elsaesser; *Max Born Inst., Germany, Presider*

IT3D.1 • 14:00 **Invited**

MeV Ultrafast Electron Diffraction, Xijie Wang¹; ¹Photon Science, Brookhaven National Laboratory, USA. A MeV-UED facility with sub-100 fs time resolution is developed at BNL; single-shot electron diffraction is realized for a 100-nm Al film with 10⁴ electrons, and superlattice of TaSe2 was observed with SRN of 400.

IT3D.2 • 14:30 **Invited**

Femtosecond Electron Diffraction for the Study of Charge Density Waves, Germán Sciaini^{1,2}, Maximilian Eichberger³, Hanjo Schäfer³, Marina Krumova⁴, Markus Beyer³, Helmut Berger⁶, Gustavo Moriena^{1,2}, Jure Demsar^{3,5}, Dwayne Miller^{1,2}; ¹Max Planck Research Department for Structural Dynamics, Univ. of Hamburg, Germany; ²Chemistry and Physics, Univ. of Toronto, Canada; ³Physics Department and Center of Applied Photonics and Zukunftskolleg, Univ. of Konstanz, Germany; ⁴Chemistry, Univ. of Konstanz, Germany; ⁵Complex Matter Department, Jozef Stefan Inst., Slovenia; ⁶Physics, EPFL, Switzerland. We studied the dynamics of the periodic lattice distortion (PLD) in 1T-TaS2 by femtosecond electron diffraction. Coherent atomic motions in the nearly commensurate phase and the rotation of PLD have been revealed with increased photoexcitation

QT3A • Photon Entanglement—Continued**QT3A.5 • 15:00**

Heralded Quantum Entanglement between two Rare-Earth-Ion Doped Crystals, *Christoph Clausen¹, Imam Usmani¹, Felix Bussières¹, Nicolas Sangouard¹, Mikael Afzelius¹, Nicolas Gisin¹, GAP-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 by an estimation of the concurrence.*

QT3A.6 • 15:15

Evolution of Two Photon Path Entangled States in Multimode Waveguides, *Eilon Poem¹, Yehonatan Gilead¹, Yaron Silberberg¹, Department of Physics of Complex Systems, Weizmann Inst. of Science, Israel. We experimentally observe the evolution of two-photon path-entangled states in a planar multimode waveguide, and show how the two-photon correlation recurrence period depends on the relative phase between the two paths.*

QT3A.7 • 15:30 **Invited**

Nano Optical Fibers for Photonic Quantum Information, *Shigeki Takeuchi^{1,2}, Research Inst. for Electronic Science, Hokkaido Univ., Japan; The Inst. of Scientific and Industrial Research, Osaka Univ., Japan. Application of ultra-thin tapered optical fibers to efficient single photon sources (1.7 million single photons coupled to a single mode fiber) and Realization of a fiber-microsphere cavity at cryogenic temperature are reported.*

QT3B • Quantum Information—Continued**QT3B.4 • 15:00**

Single and Coupled Photonic Crystal Cavities for Solid-State Cavity-QED, *Cristian Bonato¹, Jenna Hagemeyer², Dario Gerace³, Susanna M. Thon^{2,4}, Hyeonul Kim^{2,5}, Gareth Beirne¹, Morten Bakker¹, Lucio C. Andreani¹, Pierre M. Petroff, Martin P. van Exter¹, Dirk Bouwmeester^{1,2}; Huygens Laboratory, Leiden Univ., Netherlands; ²Univ. of California Santa Barbara, USA; ³Univ. of Pavia, Italy; ⁴Univ. of Toronto, Canada; ⁵Univ. of Maryland, USA. We discuss the implementation of quantum information schemes with quantum dots in photonic crystal cavities, focusing on the optimization of far-field emission profiles and independent electrical tuning on quantum dots in waveguide-coupled cavities*

QT3B.5 • 15:15 **Invited**

Quantum Ergodic Channels and Generation of Quantum States, *Kazuya Yuasa¹, Waseda Inst. for Advanced Study, Waseda Univ., Japan. We introduce “quantum ergodic/mixing channel” that drives a quantum system from any initial states to a certain target state. By making use of mathematical theorems on ergodicity and mixing, we construct schemes for generating entanglement.*

QT3B.6 • 15:45

Directional Entanglement in Coupled Quantum-dot Photonic-bandgap Microcavity Systems, *Marc-André Dupertuis^{1,2}, Raphael Faerber¹; Laboratory of Quantum Optoelectronics, EPFL, Switzerland; ²Laboratory of Physics of Nanostructures, EPFL, Switzerland. We investigate pair of isolated quantum dot excitons strongly coupled to microcavity, and quantum dot biexciton, as sources of directional entanglement in photonic bandgap microcavity circuits, and compare the results with polarisation entanglement.*

HT3C • OPCPA and Waveform Synthesis—Continued**HT3C.3 • 15:00**

Phase-stabilized sub 3-cycle 100 kHz Optical Parametric Amplifier at 2.1 μm, *Julien Nillon¹, Sébastien Montant¹, Guillaume Machinet¹, Eric Cormier^{1,2}; CELIA, France; ²Lawrence Livermore National Laboratory, USA. 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.*

HT3C.4 • 15:15 **Invited**

Optical Field Waveform Generation and Characterization, *Andy Kung^{1,2}, Inst. of Photonics Technologies, National Tsing Hua Univ., Taiwan; ²Inst. of Atomic and Molecular Sciences, Academia Sinica, Taiwan. 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.*

HT3C.5 • 15:45

Coherent Synthesis of Ultra-broadband Optical Parametric Amplifiers, *Cristian Manzoni¹, Shu-Wei Huang², Giovanni Cirri², Jeffrey Moses², Franz Kärtner^{2,3}, Giulio Cerullo¹; IFN-CNR Politecnico di Milano, Italy; ²Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, MIT, USA; ³Center for Free-Electron Laser Science, DESY and Univ. of Hamburg, Germany. We report on coherent synthesis of two broadband optical parametric amplifiers, resulting in octave-spanning (500-1000 nm) spectra supporting sub-4-fs pulse duration. Synthesized pulse timing is locked to sub-300-as by a balanced cross-correlator.*

IT3D • Electron Diffraction—Continued**IT3D.3 • 15:00**

Femtosecond Transmission Electron Diffraction on Single Crystalline Graphite, *Christian Gerbig¹, Silvio Morgenstern¹, Cristian Sarpe¹, Matthias Wollenhaupt¹, Thomas Baumert¹; Institut für Physik und Center for Interdisciplinary Nanostructure Science and Technology (CINaT), Universität Kassel, Germany. We use a self-referencing highly compact femtosecond transmission electron diffractometer to study the evolution of strongly coupled optical phonons and lattice phonon thermalization in single crystalline graphite after ultrashort laser excitation.*

IT3D.4 • 15:15

Time-Resolved Photoelectron Diffraction for Measuring Structural Dynamics at Surfaces, *Michael E. Greiff¹, Uni Zürich, Switzerland. Photoelectron Diffraction is an established method for structural analysis of surfaces. New light sources open the possibility for Time-Resolved Structural Dynamics via pump-probe spectroscopy. A structural study on SnPc/Ag(111) is presented.*

IT3D.5 • 15:30 **Invited**

Four-Dimensional Electron Nanocrystallography, *Chong-Yu Ruan¹, Physics and Astronomy, Michigan State Univ., USA. A framework to determine interfacial structure, temperature, and photovoltage dynamics based on surface sensitive ultrafast electron crystallography and voltammetry is demonstrated based on recent studies of surface supported nanomaterials.*

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

Madrid

Quantum Information and Measurement

16:30–18:30

QT4A • Quantum Communication I

Robert Thew; *Univ. of Geneva, Switzerland, Presider*QT4A.1 • 16:30 **Invited**

Directions in Optical Implementations of Quantum Key Distribution, Norbert Lütkenhaus¹; *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.

QT4A.2 • 17:00 **Invited**

Quantum Key Distribution Using Hyperentanglement, Daniel Gauthier¹, Hannah Guilbert¹, Yunhui Zhu¹, Meizhen Shi¹, Kevin McCusker², Bradley Christensen², Paul Kwiat², Thomas Brougham³, Stephen M. Barnett³, Venkat Chandar⁴; ¹Dept. of Physics, Duke University, USA; ²Department of Physics, Univ. of Illinois Urbana-Champaign, USA; ³Department of Physics, Univ. of Strathclyde, UK; ⁴Lincoln Laboratory MIT, USA. We describe our progress on achieving quantum key distribution with high photon efficiency and high rate using hyperentanglement. Our goal is encode 10 bits per photon and distribute a secure key at 1 Gbit/s.

QT4A.3 • 17:30 **Invited**

Experimental Studies Toward the Quantum Communications with Orbiting Terminals, Paolo Villoresi¹, Andrea Tomaello¹, Alberto Dall'Arche¹, Francesca Gerlin¹, Ivan Capraro¹, Giuseppe Vallone¹; ¹Information Engineering, Univ. of Padova, Italy. Realization of Quantum Communications in Space requires a deep understanding of issues including link-budget, turbulence mitigation and single-photon terminal synchronization. Here we report on supporting novel experiments on very long-distance links and modeling.

Sydney

16:30–18:30

QT4B • Quantum Imaging

Claude Fabre; *Univ. Pierre et Marie Curie, Presider*QT4B.1 • 16:30 **Invited**

Quantum Images from 4-Wave Mixing in Atomic Vapors, Paul D. Lett^{1,2}, Neil Corzo^{1,2}, Alberto Marino^{1,2}, Kevin Jones^{3,1}; ¹NIST, USA; ²Joint Quantum Inst., USA; ³Physics Department, Williams College, 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.

QT4B.2 • 17:00

Ghost Imaging by Intense Multimode Twin Beam, Alessia Allevis^{1,2}, Maria Bondani^{3,2}; ¹Dipartimento di Scienza e Alta Tecnologia, Università degli Studi dell'Insubria, Italy; ²C.N.I.S.M. U.d.R. Como, Italy; ³Istituto di Fotonica e Nanotecnologie, Consiglio Nazionale delle Ricerche, Italy. We present the first experimental implementation of the ghost-imaging protocol based on an intense multimode spontaneous parametric down-conversion process. Temporal and spatial properties of the quantum field used in the protocol are also discussed.

QT4B.3 • 17:15

Quantum Imaging Using Entangled States by Mixing Quantum and Classical Light, Yonatan Israel¹, Shamir Rosen¹, Itai Afek¹, Oron Ambar¹, Yaron Silberberg¹; ¹Physics of Complex Systems, Weizmann Inst. of Science, Israel. We show that by mixing quantum spontaneous parametric down-conversion with the classical coherent state we can generate robust narrow features for quantum lithography, and high fidelity NOON states and correlated-photon-holes states.

QT4B.4 • 17:30

Spatially Entangled 4-photons States from a Periodically Poled KTP Crystal, Michiel J. de Dood¹, Cigdem Yorulmaz¹, Alexander van der Torren¹, Jelmer Renema¹, Martin P. van Exter¹; ¹Leiden Inst. of Physics, Leiden Univ., Netherlands. 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.

Hong Kong

High Intensity Lasers and High Field Phenomena

16:30–18:30

HT4C • HHG2

Eric Cormier; *Univ. de Bordeaux CELIA, France, Presider*

HT4C.1 • 16:30

Laser-matter Processes Driven by Non-homogeneous Fields: the High-order Harmonics Generation Case, Marcelo Ciappina¹, Jens Biegert^{1,2}, Romain Quidant^{1,2}, Maciej Lewenstein^{1,2}; ¹QOT, ICFO, Spain; ²ICREA, Spain. We present theoretical studies of high-order harmonic generation (HHG) produced by nonhomogeneous fields. This kind of fields appears when a plasmonic nanostructure is illuminated by a short laser pulse.

HT4C.2 • 16:45

Measurement of Nonlinear Refractive Index and MPI Coefficients in Gases Using a Wavefront Sensor, Jens Schwarz¹, Patrick Rambo¹, Mark Kimmel¹, Briggs Atherton¹; ¹Sandia National Laboratories, USA. A wavefront sensor has been used to measure the Kerr nonlinear focal shift of a high intensity ultrashort pulse beam in a focusing beam geometry while accounting for the effects of plasma-defocusing.

HT4C.3 • 17:00

Efficient High-Harmonic Generation in a Mixture of a Noble Gas and Metal Nanoparticles and on Rough Metal Surfaces, Anton Husakou¹, Joachim Herrmann¹, Kwang-Hyon Kim¹; ¹Max Born Inst., Germany. We investigate low-intensity high-harmonic generation enabled by the plasmonic electric field enhancement in a mixture of a noble gas with metal nanoparticles and near random rough surfaces. HHG efficiencies up to 10⁻⁶ are predicted.

HT4C.4 • 17:15

Attosecond Pulse Narrowing by Off-axis Detection, Carlos Hernandez-Garcia¹, Luis Plaja¹; ¹Física Aplicada, Universidad de 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.

HT4C.5 • 17:30

Temporal Gatings for Broadband Attosecond Pulse Generation, Peixiang Lu¹, Weiyi Hong¹; ¹School of Physics, Huazhong Univ. of Science and Technology, Wuhan National Lab for Optoelectronics, China. We propose several schemes to microscopically control the harmonic processes and form the temporal gating for HHG to produce the broadband supercontinua. The macroscopic effects including the spectral, temporal and spatial properties are discussed.

Istanbul

International Conference on Ultrafast Structural Dynamics

16:30–18:30

IT4D • THz Spectroscopy

Michael Woerner; *Max-Born Inst., Germany, Presider*IT4D.1 • 16:30 **Tutorial**

High Field Terahertz Generation and Nonlinear Terahertz Spectroscopy, Keith A. Nelson¹; ¹Chemistry, MIT, USA. Nonlinear THz spectroscopy is a growing subfield accessible with common tabletop laser systems. Methods for generation of intense THz pulses and recent nonlinear THz spectroscopy results from solid, liquid, and gas phase samples will be discussed.

IT4D.2 • 17:15 **Invited**

Two-dimensional THz Spectroscopy of Graphene, Pamela Bowlan¹, Klaus Reimann¹, Michael Woerner¹, Thomas Elsaesser¹; ¹Max-Born-Institut, Germany. Charge transport in graphene is studied by femtosecond two-dimensional THz spectroscopy at frequencies around 2 THz. Pump-probe signals reveal an induced interband absorption followed by carrier thermalization while photon echo signals are absent.

QT4A • Quantum Communication I—Continued**QT4A.4 • 18:00**

Arbitrarily Loss-tolerant Einstein-Podolsky-Rosen Steering Allowing a Demonstration Over 1-km of Optical Fiber with no Detection Loop-hole, Adam Bennet^{1,2}, David A. Evans^{1,2}, Dylan J. Saunders^{1,2}, Cyril Branciard³, Eric Cavalcanti¹, Howard M. Wiseman^{1,2}, Geoff J. Pryde^{1,2}; ¹Centre for Quantum Dynamics, Griffith Univ., Australia; ²Centre for Quantum Computation and Communication Technology (Australian Research Council), Griffith Univ., Australia; ³School of Mathematics and Physics, Univ. of Queensland, Australia. EPR-steering is a nonclassical effect which allows one party to verify that he shares entanglement with another party. Using new, arbitrarily loss-tolerant tests, we demonstrate detection-loop-hole-free EPR-steering with entangled photon pairs.

QT4A.4 • 18:15

New Near-Deterministic All-Optical Teleportation, Superdense Coding, and Cryptography Scheme, Mladen Pavicic, Uni of Zagreb, Kaciveva, Croatia. We present a new setup in which we near-deterministically separate all four photon Bell states by means of linearly concatenated Mach-Zehnder interferometers. Realistic proposals for implementations are given.

QT4B • Quantum Imaging—Continued**QT4B.5 • 17:45** **Invited**

Entropy, Information and Compressive Sensing in the Quantum Domain, John Howell¹, Gregory Howland¹, Robert Boyd^{1,2}, Petros Zerom¹, James Schmeeloch¹; ¹Univ. of Rochester, USA; ²Univ. of Ottawa, Canada. An introduction to compressive sensing and quantum imaging will be given. I will then show that compressive sensing can solve important problems in some applications of quantum imaging.

QT4B.6 • 18:15

Generation of Nonclassical Light in Waveguide Arrays, Amit Rai¹, Dimitris Angelakis^{1,2}; ¹Centre for Quantum Technologies, National Univ. of Singapore, Singapore; ²Science Department, Technical Univ. of Crete, Greece. 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.

HT4C • HHG2—Continued**HT4C.6 • 17:45**

Strong Field Ionization Imaging of Electron Dynamics, Agnieszka A. Jaron-Becker¹; ¹JILA 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.

HT4C.7 • 18:00

Multi-Electron Corrections in Molecular High-Order Harmonic Generation for Different Formulations of the Strong-Field Approximation, Bradley B. Augstein¹, Carla Faria¹; ¹Physics and Astronomy, UCL, UK. 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.

HT4C.8 • 18:15

Valley Structure in the Harmonic Efficiency at Ultra-high Laser Intensities, José Antonio Pérez-Hernández¹, Roland Guichard², Amelle Zaïr³, Luis Roso¹, Luis Plaja¹; ¹Centro de Láseres Pulsados, CLPU, Centro de Láseres Pulsados, CLPU, Spain; ²Laboratoire de Chimie Physique-Matière et Rayonnement (LCPMR), UPMC Université Paris 6, France; ³Department of Physics, Imperial College London, UK; ⁴Grupo de Investigación en Óptica Extrema (GIOE), Universidad de Salamanca, Spain. We demonstrate that Non Adiabatic Turn-on laser field allows one to avoid efficiency losses when the saturation level of atoms is rebased, providing new route for attosecond pulses production via high-order harmonic generation.

IT4D • THz Spectroscopy—Continued**IT4D.3 • 17:45**

Time-resolved THz Spectroscopy of the Ultrafast Photoinduced Insulator-metal Phase Transition of VO₂, Tyler L. Cocker¹, Lyubov V. Titova¹, Sylvain Fourmaux², Greg Holloway¹, Heidi-Christina Bandulet², Daniel Brassard², Jean-Claude Kieffer², My-Ali El Khakani², Frank A. Hegmann¹; ¹Department of Physics, Univ. of Alberta, Canada; ²INRS-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.

IT4D.4 • 18:00 **Invited**

Coherent THz Spectroscopy and Imaging, Thomas Feurer¹; ¹Univ. of Bern, Switzerland. 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.

07:00–18:30 Registration, Grosser Stern

08:00–10:00

QW1A • Quantum Communication IIHarald Weinfurter; *Univ. of Munich, Germany, Presider***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, Devin Smith¹, Geoff Gillett¹, Marcelo de Almeida¹, Alessandro Fedrizzi¹, Cyril Branciard², Brice Calkins³, Adriana Lita⁴, Thomas Gerrits⁵, Sae Woo Nam⁶, 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 Sabotke¹, Jonathan Dowling¹, Petr Anisimov², Ulvi Yurtsever³, Antia Lamas⁴; ¹Hearne Inst. for Theoretical Physics, Louisiana State Univ., USA; ²Metcalf 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.

08:00–10:00

QW1B • Novel Quantum Information and Measurement Techniques IWolfgang Schleich; *Universitat Ulm, Germany, Presider***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, Mario Napolitano¹, Marco Koschorreck², Brice Dubost^{1,3}, Naeimeh Behbood¹, Robert Sewell¹, Morgan W. Mitchell^{1,4}; ¹ICFO, Spain; ²Department of Physics, Univ. of Cambridge, UK; ³Laboratoire Matriaux et Phenomenes Quantiques, Universite Paris Diderot, France; ⁴ICREA, Institutio 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, Max Schoenger², Jürgen Probst², Bernd Löcherl², Oliver J. Benson¹; ¹Humboldt University Berlin, 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.

08:00–10:00

HW1C • Electronic DynamicsRobert Moshhammer; *MPI fuer Kernphysik, Germany, Presider***HW1C.1 • 08:00** **Invited**

Attosecond Electron Emission and Acceleration from Nanoparticles in Strong Fields, Matthias Kling^{1,2}; ¹Max Planck Inst. of Quantum Optics, Germany; ²Physics Department, Kansas State Univ., USA. We studied attosecond electron emission and acceleration from isolated dielectric and metallic nanoparticles in strong waveform-controlled 4-fs laser fields. Nanofocusing in large nanoparticles allows for an efficient acceleration of electrons towards the laser propagation direction.

HW1C.2 • 08:30 **Invited**

Attosecond Physics with Sub-optical-cycle Waveforms of Light, Eleftherios Gouliemakis¹; ¹Max-Planck-Institut für Quantum Optics, Germany. We present synthesis of intense light transients of sub-cycle temporal confinement and their first applications for attosecond control of matter.

08:00–10:00

IW1D • Structure Probes and MethodsChristian Bressler; *European XFEL Facility, Germany, Presider***IW1D.1 • 08:00** **Invited**

Status and future of SACLA: the Japan's X-ray Free-Electron Laser, Makina Yabashi¹; ¹RIKEN Harima Inst., Japan. Current status and future perspective of SACLA (Spring-8 Angstrom Compact free electron Laser) is presented. SACLA produces brilliant, coherent, ultrafast pulses in the hard x-ray region. User operation will start in March, 2012.

IW1D.2 • 08:30

Resonant X-Ray Emission Spectroscopy with Free Electron Lasers: Nonequilibrium Electron Dynamics in Highly Excited Polar Semiconductors, Faton Krasniqi^{1,2}, Yin-Peng Zhong^{1,2}, David A. Reis³, Mirko Scholz⁴, Robert Hartmann⁵, Andreas Hartmann⁵, Daniel Rolles^{1,2}, Artem Rudenko^{1,7}, Sascha W. Epp^{1,2}, Lutz Foucar^{1,2}, Mariano Trigo³, Matthias Fuchs³, David M. Fritz⁸, Marco Cammarata⁸, Diling Zhu⁸, Henrik Lemke⁸, Markus Braune⁹, Markus Ilchen⁹, Jorgen Larsson¹⁰, Simone Techer⁴, Lothar Strüder⁶, Ilme Schlichting⁷, Joachim Ullrich⁷; ¹ASG, Max-Planck-ASG at CFEL/DESY, Germany; ²Max Planck Inst. for Medical Research, Germany; ³PULSE Inst., SLAC National Accelerator Laboratory, USA; ⁴Max Planck Inst. for Biophysical Chemistry, Germany; ⁵pnSensor, Germany; ⁶Max Planck Inst.-Semiconductor Laboratory, Germany; ⁷Max Planck Inst. for Nuclear Physics, Germany; ⁸Linac Coherent Light Source, SLAC National Accelerator Laboratory, USA; ⁹DESY, Germany; ¹⁰Lund Univ., Sweden. Resonant x-ray emission spectroscopy with x-ray pulses from the LCLS was used to probe the nonequilibrium electron dynamics in CdTe. Time dependent emission intensity reflects the evolution of the non-equilibrium electron distribution function.

IW1D.3 • 08:45

Ultrafast Conformational Changes in Biomolecules Studied by Time-resolved Circular Dichroism, Francois Hache¹, Lucille Mendonça¹, Mai-Thu Khuc²; ¹LOB, CNRS-INSERM, France. Structural changes in biological processes are investigated thanks to a full set of time-resolved circular dichroism experiments. Ultrarapid conformational changes in proteins and microsecond protein denaturation in polypeptides have been studied.

QW1A • Quantum Communication II—Continued**QW1A.4 • 09:00**

The Secure Information Capacity of Photons Entangled in High Dimensions, Eliot Bolduc¹, Jonathan Leach¹, Robert Boyd^{1,2}, ¹Physics, Univ. of Ottawa, Canada; ²Univ. of Rochester, USA. High-dimensional entanglement is a key resource for quantum cryptography. We experimentally realise the criterion for secure quantum key distribution when using photons entangled in the orbital angular momentum and angle degrees of freedom.

QW1A.5 • 09:15

Experimental Demonstration of Quantum Digital Signatures, Robert J. Collins¹, Patrick J. Clarke¹, Vedran Dunjko^{2,3}, John Jeffers³, Erika Andersson¹, Gerald S. Buller¹, ¹School of Engineering and Physical Sciences, Heriot-Watt Univ., UK; ²School of Informatics, Edinburgh Univ., UK; ³Department of Physics, Univ. of Strathclyde, UK. We have built and tested the first experimental demonstration of a quantum digital signature test-bed system. We will present a case for quantum digital signatures, overview of the protocol, description of the system and results.

QW1A.6 • 09:30 **Invited**

Single Photons, Entanglement Swapping and Heralded Photon Amplification for Device Independent Quantum Key Distribution, Robert Thew¹, Clara I. Osorio¹, Natalia Bruno¹, Enrico Pomarico¹, Thiago Barbosa¹, Bruno Sanguinetti¹, Nicolas Sangouard¹, Hugo Zbinden¹, Nicolas Gisin¹, ¹Group of Applied Physics, Univ. of Geneva, Switzerland. We discuss several key challenges for quantum communication ranging from engineering photon sources through faithful entanglement swapping to heralded photon, or qubit, amplification and their implications for experimental device independent QKD.

QW1B • Novel Quantum Information and Measurement Techniques I—Continued**QW1B.4 • 09:00** **Invited**

Exploiting the Quantum Advantage, Andrew White¹, ¹Physics, Univ. of Queensland, Australia. Quantum correlations in both space and time allow a clear advantage over classical approaches: we discuss our recent results in engineering correlations for simulating quantum chemistry, emulating quantum materials, and performing semi-device-independent QKD.

QW1B.5 • 09:30

Quantum Reading Capacity, Cosmo Lupo¹, Stefano Pirandola², Vittorio Giovannetti², Stefano Mancini^{1,4}, Samuel L. Braunstein², ¹Physics Division, School of Science and Technology, Univ. of Camerino, Italy; ²Computer Science, Univ. of York, UK; ³Nest, Scuola Normale Superiore and Istituto Nanoscienze-CNR, Italy; ⁴INFN, sezione di Perugia, Italy. The maximum readout rate of a classical memory defines its reading capacity. We prove the advantages of employing nonclassical states of light (including squeezing and entanglement) for extracting information from optical memories, e.g. CDs, DVDs.

QW1B.6 • 09:45

Programmable Virtual Quantum Networks, Seiji Armstrong^{1,2}, Jiri Janousek¹, Boris Hage¹, Jean-Francois Morizur^{1,3}, Hans Bachor¹, Ping Koy Lam¹, ¹Quantum Science, Australian National Univ., Australia; ²Applied Physics, The Univ. of Tokyo, Japan; ³Laboratoire Kastler Brossel, Université Pierre et Marie Curie, France. We report on the experimental preparation of various multi-mode entangled states, with the ability to switch between them in real-time. Up to N-mode entanglement is measured with just one detector, here N = 8.

HW1C • Electronic Dynamics—Continued**HW1C.3 • 09:00**

Mid-infrared Photoelectron Emission and Acceleration at Metallic Nanotips, Georg Herink¹, Daniel R. Solli¹, Max Gulde¹, Claus Ropers¹, ¹Courant Research Center Nano-Spectroscopy and X-Ray Imaging, Univ. of Goettingen, Germany. We present localized photoemission from metallic nanotips using few-cycle pulses at near- and mid-infrared wavelengths ranging from 0.8–8 μm. Photoelectron energies up to hundreds of eV are observed, and a sub-cycle acceleration regime is reached.

HW1C.4 • 09:15

Double Ionization Dynamics of Ethylene in a Strong Laser Field, Xinhua Xie¹, Stefan Roither¹, Markus Schöffler¹, Daniil Kartashov¹, Li Zhang¹, Erik Löstedt², Atsushi Iwasaki², Kaoru Yamanouchi², Andrius Baltuska¹, Markus Kitzler¹, ¹Photonics Inst., Vienna Univ. of Technology, Austria; ²Department of Chemistry, School of Science, The Univ. of Tokyo, Japan. Dependence of ethylene double ionization on laser pulse duration and intensity was studied by Coulomb explosion imaging technique. It was found that multiple molecular orbitals are involved in the strong field double ionization of ethylene.

HW1C.5 • 09:30

Quantum Interference, Excitation and Multiple Orbitals in Atomic and Molecular High-harmonic Generation and Nonsequential Double Ionization, Carla Faria¹, ¹Physics and Astronomy, Univ. College London, UK. We address excitation, electron-electron correlation and quantum interference beyond the single-active electron and single-active orbital approximation in high-harmonic generation and nonsequential double ionization.

HW1C.6 • 09:45

Phase Dependence of Electron Localization in the Laser-Driven Dissociation of HeH⁺{2+}, Kunlong Liu¹, Peixiang Lu¹, ¹Wuhan National Laboratory for Optoelectronics, China. We theoretically study the electron localization in the laser-driven dissociation of HeH⁺{2+}. The upward shift and suppression of the localization probability are observed. The phenomena are found to be associated with the molecular structure.

IW1D • Structure Probes and Methods—Continued**IW1D.4 • 09:00**

Non-Adiabatic Ionization in Circularly Polarized Laser Fields, Ingo Barth¹, Olga 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.

IW1D.5 • 09:15

Time-Resolved X-ray Absorption, Emission, and Scattering Probes of Molecular Dynamics, Stephen H. Southworth¹, Anne Marie March¹, Gilles Doumy¹, Elliot P. Kanter¹, Linda Young¹, Bertold Kraussig¹, Phay J. Ho¹, Dipanwita Ray¹, Robert W. Dunford¹, Christian Butth¹, ¹Argonne National Laboratory, USA. We report on laser-pump/x-ray-probe investigations of photoexcitation and photodissociation dynamics of solvated molecules using high-repetition-rate techniques at the Advanced Photon Source.

IW1D.6 • 09:30

Direct Observation of Arrival Time Jitter for RF Compressed Femtosecond Electron Bunches by Ponderomotive Scattering, Meng Gao^{1,2}, Hubert Jean-Ruel^{1,2}, Ryan R. Cooney^{1,2}, Jonathan Stampe³, Mark De Jong³, German Sciaimi^{1,2}, Gustavo Moriena^{1,2}, Dwayne Miller^{1,2}, ¹Chemistry and Physics, Univ. of Toronto, Canada; ²Max Planck Department for Structure Dynamics, DESY, Germany; ³Canadian Light Source, Canada. Arrival time jitter and pulse duration is measured using ponderomotive scattering for dense femtosecond electron bunches compressed by a 3 GHz RF cavity. We report 65 fs RMS jitter over 2 hours.

IW1D.7 • 09:45

An Ultracold Electron Source for Ultrafast Electron Diffraction Experiments, Wouter Engelen¹, Nicola Debernardi¹, Edgar Vredenburg¹, Jom Luiten¹, ¹Eindhoven Univ. of Technology, Netherlands. We create ultrashort, ultracold electron bunches by accelerating electrons which are created by near-threshold photoionization of a cloud of laser-cooled atoms. With these bunches we can perform diffraction experiments of crystals of macromolecules.

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

10:30–12:30

QW2A • Quantum Communication IIISergei Kilin; *B. I. Stepanov Inst. of Physics of NASB, Belarus, Presider***QW2A.1 • 10:30**

Quantum Key Distribution Enhanced by Quantum Relays with Quantum Memories: Performances and Requirements, *Silvestre Abruzzo¹, Sylvia Bratzik¹, Hermann Kampermann¹, Dagmar Bruss¹, ¹Inst. for Theoretical Physics III, Heinrich-Heine-Universität, Germany.* Quantum relays with quantum memories are proposed as a possible solution for increasing the distance of quantum key distribution. We consider a particular set-up which uses only linear optics and heralding devices.

QW2A.2 • 10:45

The Implementation of a Quantum Key Distribution Scheme based on the Frequency-Time Uncertainty, *Matthias Leifgen¹, Robert Elschner², Oliver J. Benson¹, 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.

QW2A.3 • 11:00

Influence of Atmospheric Turbulence on the Performance of a High Dimensional Quantum Key Distribution System using Spatial Mode Encoding, *Brandon Rodenburg¹, Mehul Malik¹, Malcolm O'Sullivan¹, Mohammad Mirhosseini¹, Robert Boyd^{1,2}; ¹Inst. of Optics, Univ. of Rochester, USA; ²Physics, Univ. of Ottawa, Canada.* The effects of atmospheric turbulence on a 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.

QW2A.4 • 11:15

Polarization-Stable Long-Distance Interference of Independent Photons for Quantum Communications, *Thiago Ferreira da Silva^{1,2}, Douglas Vitoreti¹, Guilherme B. Xavier^{3,4}, Guilherme P. Temporão¹, Jean Pierre von der Weid¹; ¹Center for Telecommunication Studies, Pontifical Catholic Univ. of Rio de Janeiro, Brazil; ²Optical Metrology Division, National Inst. of Metrology, Quality and Technology, Brazil; ³Departamento de Ingeniería Eléctrica, Universidad de Concepción, Chile; ⁴Center for Optics and Photonics, Universidad de Concepción, Chile.* Interference between fully-independent faint laser sources over two 8.5-km full polarization-controlled fiber links was performed, with stable visibility of 47.8%, an essential step towards practical implementation of quantum communication protocols.

10:30–12:30

QW2B • Quantum EntanglementPaul Kwiat; *Univ. of Illinois at Urbana-Champaign, USA, Presider***QW2B.1 • 10:30**

Bringing Entanglement to the High Temperature Limit, *Fernando Galve¹, ¹IFISC (CSIC-UIB), Spain.* Decoherence typically restricts quantum phenomena to very low temperatures. We report a nonequilibrium state for two coupled, parametrically driven, dissipative harmonic oscillators which has stationary entanglement at very high temperatures.

QW2B.2 • 10:45

Quantum State Characterization of High-dimensionally Entangled Photons, *Jonathan Leach¹, Megan Agnew¹, Melanie McLaren¹, Stef Roux², Robert Boyd^{1,2}; ¹Univ. of Ottawa, Canada; 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.

QW2B.3 • 11:00 Invited

Entangling Two Remote Rb-87 Atoms, *Harald Weinfurter^{1,2}, Benjamin Rosenfeld^{1,2}, Julian Hofmann¹, Norbert Ortegel¹, Michael Krug¹, Lea Gerard¹, Florian Henkel¹, Markus Weber¹; ¹Faculty of Physics, Ludwig-Maximilians Universität, Germany; ²Max-Planck-Inst. for Quantum Optics, Germany.* We report on entanglement of two Rb-87 atoms which are independently trapped in two laboratories 20 meter apart.

10:30–12:30

HW2C • Electronic Dynamics and Attosecond PhysicsAmelle Zair; *Imperial College London, UK, Presider***HW2C.1 • 10:30 Invited**

When Does an Electron Exit a Tunneling Barrier?, *Nirit Dudovich¹, ¹Weizmann Inst. of Science, Israel.* We probe the dynamics of tunnel ionization via high harmonic generation. We first characterize the ionization dynamics in helium atoms, and then apply our approach to resolve subtle differences in ionization from the different orbitals of a CO₂ molecule.

HW2C.2 • 11:00

On the Wavelength Dependence of the Suppressed Ionization of Molecules in Strong Laser Fields, *Judith Dura¹, Alexander Grün¹, Phipil Bates¹, Stephan M. Teichmann¹, Thorsten Ergler¹, Arne Senfbleber², Thomas Pflüger², Claus Dieter Schröter², Robert Moshhammer², Joachim Ullrich², Agnieszka Jarón-Becker³, Andreas Becker³, Jens Biegert^{1,4}; ¹Attoscience and Ultrafast Optics, ICFO - The Inst. of Photonics Sciences, Spain; ²Max Planck Institut für Kernphysik, Germany; ³JILA and Department of Physics, Univ. of Colorado, USA; ⁴ICREA-Institució Catalana de Recerca i Estudis Avançats, Spain.* We study ionization of molecules and atoms with same IP by intense laser field from 0.6–10 μm. A trend from ionization-suppression to non-suppression is found for many molecules as a function of wavelength.

HW2C.3 • 11:15

Multiorbital Contributions in N₂ Harmonic Phase Measurements, *Roland Guichard¹; ¹LCPMR, UPMC, France.* We will present and analyze High Order Harmonic spectra (amplitude and phase) obtained in aligned nitrogen molecules at various laser intensities, evidencing a control over multichannel contributions involving the nuclear motion.

10:30–12:30

IW2D • X-ray AbsorptionSteven Johnson; *ETH Zurich, Switzerland, Presider***IW2D.1 • 10:30 Invited**

Time-Resolved X-Ray Spectroscopies and Scattering, *Christian Bressler¹; ¹European XFEL, Germany.* We present our new results exploiting simultaneously picosecond and femtosecond x-ray emission spectra in concert with x-ray diffuse scattering patterns, which provide complementary information to x-ray absorption studies. Key systems presented include a photocatalytic compound.

IW2D.2 • 11:00

Organometallic Chemistry in Solutions Investigated with Time-resolved X-ray Spectroscopy, *Nils Huse¹, Hana Cho^{2,3}, Matthew L. Strader³, Tae Kyu Kim², Robert W. Schoenlein^{3,4}; ¹Max Planck Research Department for Structural Dynamics, Univ. of Hamburg & Center for Free Electron Laser Science, Germany; ²Department of Chemistry, Pusan National Univ., Republic of Korea; ³Chemical Sciences Division, Lawrence Berkeley National Laboratory, USA; ⁴Materials Sciences Division, Lawrence Berkeley National Laboratory, USA.* Transient X-ray spectroscopy provides a detailed picture of rearranging molecular orbitals and atoms and is well suited to study organometallic chemistry in solution which is of importance in organic synthesis, catalysis and materials science.

IW2D.3 • 11:15

Simulations of Ground and Excited State X-ray Absorption Spectra for Molecules in Solution: The Role of the Solvent, *Thomas Penfold^{1,3}, Ivano Tavernelli², Rafael Abela³, Ursula Rothlisberger², Majed Chergui¹; ¹Laboratoire de spectroscopie ultrarapide, EPFL, Switzerland; ²Laboratoire de chimie et biochimie computationnelles, EPFL, Switzerland; ³SwissFEL, PSI, Switzerland.* For the XAS of molecules in solution it is important to include the solvent in the analysis of the spectra. Here we present a theoretical investigation of the spectra for PtPOP [1,2,3] and Cu(dmp)₂[4,5].

QW2A • Quantum Communication III—Continued**QW2A.5 • 11:30**

Quantum Correction of Photon-scattering Errors, Nitzan Akerman¹, Shlomi Kotler¹, Yinon Glickman¹, Roe Ozeri¹, ¹Physics 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.

QW2A.6 • 11:45

Revival of Silenced Echo for Optical Quantum Memories: Efficiency and Noise Level, Matthieu Bonarota¹, Vianney Damon¹, Thierry Chanelière¹, Jean-Louis Le Gouët¹, Maria F. Pascual Winter¹, ¹Laboratoire Aimé Cotton, France. We present a novel quantum memory protocol inspired by 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 Busch^{1,2}, Thomas Fogarty¹, Nicola Lo Gullo¹, John Goolbsy¹, Mauro Paternostro¹, 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.8 • 12:15

Quantum Measurements As a Control Resource, Alexander Pechen^{1,2}, ¹Chemical Physics, Weizmann Inst. of Science, Israel; ²Mathematical Physics, Steklov Mathematical Inst., Russian Academy of Sciences, Russian Federation. We discuss the use of back-action of quantum measurements as a resource for controlling quantum systems and review its application to optimal approximation of quantum anti-Zeno effect.

QW2B • Quantum Entanglement—Continued**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 Richart^{1,2}, ¹Laser Spectroscopy, Max Planck Institut 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.6 • 12:00 Invited

Complementarity Revisited, Wolfgang P. Schleich¹, ¹Institut für Quantenphysik and Center for Integrated Quantum Science and Technology (IQST), Universität Ulm, Germany. We analyze two recent double-slit experiments using twin photons demonstrating the simultaneous observation of “which-slit” information and interference. They suggest new aspects of Niels Bohr's principle of complementarity.

HW2C • Electronic Dynamics and Attosecond Physics—Continued**HW2C.4 • 11:30 Invited**

Attosecond Strong-field Electron Wavepacket Interferometry, Markus Kitzler¹, Xinhua Xie¹, Stefan Roither¹, Daniil Kartashov¹, Emil Persson², Diego G. Arbó^{2,3}, Li Zhang¹, Stefanie Gräfe², Markus Schöffler¹, Joachim Burgdörfer², Andrius 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.

HW2C.5 • 12:00

Vectorial Phase Retrieval for Linear Characterization of Attosecond Pulses, Oren Raz¹, Nirit 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 only on spectral and polarization measurements. We demonstrate this method numerically on pulses generated from aligned SCO₂ molecules.

HW2C.6 • 12:15

Atomic Photoionization and Stabilization with Relativistically Intense Circularly Polarized Light: Magnetic Field Effects Revisited, Mikhail Emelin¹, Lev Smirnov¹, Mikhail Ryabikin¹, ¹Inst. of Applied Physics, RAS, Russian Federation. Results of three-dimensional numerical simulations of strong-field atomic stabilization in circularly polarized light are presented. These calculations resolve recent contradictions in the literature related to the role of magnetic field.

IW2D • X-ray Absorption—Continued**IW2D.4 • 11:30**

Molecular Structural Dynamics in Solution Revealed by Picosecond Time-Resolved XAFS, Shin-ichi Adachi^{1,2}, Tokushi Sato¹, Shunsuke Nozawa¹, 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

IW2D.5 • 11:45

Probing the Transition from Hydrophilic to Hydrophobic Solvation with Atomic Scale Resolution, Christopher J. Milne^{1,2}, Van Thai Pham^{1,6}, Thomas Penfold^{1,4}, Renske M. van der Veen^{1,7}, Frederico A. Lima^{1,2}, Amal El Nahhas¹, Steven L. Johnson^{2,8}, Paul Beaud², Rafael Abela^{2,3}, Christian Bressler^{1,5}, Ivano Tavernelli^{1,4}, Majed Chergui¹, 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 I-OH₂ species is formed.

IW2D.6 • 12:00

X-ray Absorption Studies of the Photo-induced Structural Changes of Myoglobin in Physiological, Frederico A. Lima¹, Christopher J. Milne¹, Mercedes Hannelore Rittmann-Frank¹, Renske M. van der Veen¹, Marco Reinhard¹, Thomas Penfold^{1,2}, Maurizio Benfatto³, Majed Chergui¹, ¹Laboratory of Ultrafast Spectroscopy, Ecole Polytechnique Fédérale de Lausanne, Switzerland; ²Laboratoire de Chimie et Biochimie Computationnelles, Ecole Polytechnique Fédérale de Lausanne, Switzerland; 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 de-ligated.

IW2D.7 • 12:15

Structural Dynamics Studies on Photoinduced Interfacial Electron Transfer using Ultrafast X-ray Spectroscopy, Xiaoyi Zhang¹, Grigory Smolentse², Sophie Cantor², Jianchang Guo³, Villy Sundström⁴, Lin Chen^{3,4}, Klaus Attenkofer¹, Guy Jennings¹, Charles Kurtz¹, ¹X-ray Science Division, Argonne National Laboratory, USA; ²Department of Chemical Physics, Lund Univ., Sweden; ³Chemical Sciences and Engineering Division, Argonne National Laboratory, USA; ⁴Department of Chemistry, Department of Chemistry, USA. We have used X-ray transient absorption spectroscopy to probe transient structures during interfacial electron transfer between dyes and TiO₂ nanoparticles. Electronic and structural changes of dyes in charge-separated state have been observed.

Quantum Information and Measurement

High Intensity Lasers and High Field Phenomena

International Conference on Ultrafast Structural Dynamics

14:00–16:00

QW3A • Quantum Information and Measurement with Photons IIRobert Boyd; *Univ. of Ottawa, Canada, Presider*

14:45–16:00

QW3B • Quantum State Engineering IPaolo Villoresi; *Univ. of Padova, Italy, Presider*

14:00–16:00

HW3C • NL and Extreme NL OpticsGunter Steinmeyer; *Max Born Inst., Germany, Presider*

14:00–16:00

IW3D • 2D-IRPeter Hamm; *Univ. of Zurich, Switzerland, Presider***QW3A.1 • 14:00 Plenary**

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 photodetectors, and quantum memory. We discuss progress in these components, and indicate some practical thresholds in device performance for some useful network operations.



Ian Walmsley is the Hooke Professor of Experimental 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 Institute of Physics (IoP), and a recipient of the APS Keithley Award and the IoP Young Medal. He is a former Director of the OSA and currently on the Board of Reviewing Editors of Science Magazine.

QW3A.2 • 14:45

Maximizing the Dimensionality of Orbital Angular Momentum Entanglement in Parametric Down-conversion, Jacqui Romero^{1,2}, Daniele Giovannini¹, Filippo M. Miatto², Stephen M. Barnett², 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 Invited

Single-Qubit Laser: Generation of Nonlinear Coherent States, Sergei Y. Kilin¹, Alexander B. Mikhalychev¹; ¹B. I. Stepanov Inst. of Physics of NASB, Belarus. We show that the stationary state of single-qubit laser is a phase-averaged nonlinear coherent state, provide super convergent iterations method for its finding and investigate characteristic quantum properties of the state.

HW3C.1 • 14:00 Invited

Collimated-Beam Third- and Fifth-Harmonic Generation by Mid-Infrared Ultrashort Pulses, Aleksei Zheltikov^{1,2}, Alexander A. Voronin¹, Daniil Kartashov³, Skirmantas Alisauškas³, Audrius Pugzlys³, Audrius Baltuška³; ¹Moscow State Univ., Russian Federation; ²Texas A&M Univ., USA; ³Vienna Univ. of Technology, Austria. Third- and fifth-harmonic generation by 80-fs pulses of 3.9- μ m radiation enables efficient multiplex frequency conversion of ultrashort mid-IR pulses and metrology of high-order nonlinear susceptibilities.

HW3C.2 • 14:30

Free-Space Nitrogen Laser from a Mid-Infrared Filament, Daniil Kartashov¹, Skirmantas Alisauškas¹, Audrius Pugzlys¹, Audrius Baltuška¹, Mikhail Schneider², Aleksei Zheltikov^{3,4}; ¹Vienna Univ. of Technology, Photonic Inst.s, Austria; ²Department of Mechanical and Aerospace Engineering, Princeton Univ., USA; ³Physics Department M.V. Lomonosov Moscow State Univ., International Laser Center, Russian Federation; ⁴Department of Physics and Astronomy, Texas A&M Univ., USA. We report the first experimental observation of laser emission from a femtosecond mid-infrared laser filament in molecular nitrogen. Nanosecond pulses at 337 nm and 357 nm wavelengths with energies up to 3.5 microjoules are generated.

HW3C.3 • 14:45

Phase-stable Sub-single-cycle Mid-infrared Pulses Generated Through Filamentation, Takao Fuji¹, Yutaka Nomura¹, Hideto Shirai², Noriaki Tsurumachi², Alexander A. Voronin³, Aleksei Zheltikov^{3,4}; ¹Inst. for Molecular Science, Japan; ²Kagawa Univ., Japan; ³Moscow State Univ., Russian Federation; ⁴Texas A&M Univ., USA. Phase-stable 0.74-cycle pulses in the mid-infrared region was generated by using four-wave mixing through filamentation. The pulse duration was measured as 10.8 fs at 4.4 μ m carrier wavelength with frequency-resolved cross-correlation optical gating.

IW3D.1 • 14:00 Tutorial

Watching Time-evolving Molecular Structures with 2D IR Spectroscopy, Andrei Tokmakoff; ¹MIT, USA. This tutorial will cover the use of equilibrium and transient 2D IR spectroscopy for studies of time-evolving molecular structures in chemical and biophysical dynamics, including experimental methods and modeling of the data.



Andrei Tokmakoff has been on the MIT faculty since 1998, and is currently Professor of Chemistry. His research group is recognized for studies of molecular dynamics in chemistry and molecular biophysics using ultrafast two-dimensional infrared spectroscopy, including descriptions of water hydrogen-bonding dynamics and protein conformational dynamics. His many awards and honors include the Alfred P. Sloan Research Fellowship, the Colblentz Award, the National Fresenius Award, and the Ernest K. Plyler Prize for Molecular Spectroscopy.

IW3D.2 • 14:45

Excitonic Effects in the 2DIR Spectra of Liquid Formamide, Alexander Paarmann^{1,2}, Manuela Lima¹, Riccardo Chelli^{3,4}, Roberto Rhigini^{3,4}, Dwayne Miller^{1,5}; ¹Physics and Chemistry, Univ. of Toronto, Canada; ²Physical Chemistry, Fritz-Haber-Inst., Germany; ³European Laboratory for Non-Linear Spectroscopy, Italy; ⁴Chemistry, Universita di Firenze, Italy; ⁵Max 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 investigated experimentally and theoretically, focusing the interplay of the structural dynamics and the excitonic nature of the amide I modes.

QW3A • Quantum Information and Measurement with Photons II—Continued**QW3A.3 • 15:00**

Dispersion-based Control of Spatial Modes for Parametric Down-conversion in a Multimode Waveguide, Michal Karpinski¹, Czeslaw Radzewicz¹, Konrad Banaszek¹, 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

Waveguide Single Photon Detectors for Integrated Quantum Photonic Applications, Dondü Sahin¹, A. Gaggero², J. p. Sprengers¹, S. Jahanmirinejad¹, G. Frucci¹, F. Mattioli², R. Leon², J. Beetz³, M. Lerner³, M. Kamp³, S. Höfling³, R. Sanjines⁴, A. Fiore⁵, ¹COBRA Research Inst., Eindhoven Univ. of Technology, Netherlands; ²Istituto di Fotonica e Nanotecnologie, CNR, Italy; ³Technische Physik and Wilhelm Conrad Röntgen Research Center for Complex Material Systems, Universität Würzburg, Germany; ⁴Ecole Polytechnique Fédérale de Lausanne, Switzerland. We demonstrate waveguide single-photon detectors based on NbN nanowires on top of GaAs/AlGaAs ridge waveguides. High quantum efficiencies of ~20% at 1300 nm with a response time of 3.6ns and timing jitter of ~60ps are reported.

QW3A.5 • 15:30

Playing the Aharon-Vaidman Quantum Game with a Young Type Photonic Qutrit, Piotr Kolenderski^{1,2}, Urbasi Sinha¹, Li Youning³, Tong Zhao¹, Matthew Volpini¹, Adan Cabello^{4,5}, Raymond Laflamme⁶, Thomas Jennewein¹, ¹Inst. for Quantum Computing, Univ. of Waterloo, Canada; ²Inst. of Physics, Nicolaus Copernicus Univ., Poland; ³Department of Physics, Tsinghua Univ., China; ⁴Departamento de Física Aplicada II, Universidad de Sevilla, Spain; ⁵Department of Physics, Stockholm Univ., Sweden. The Aharon-Vaidman game exemplifies the advantage of using quantum systems to outperform classical strategies. We present an experimental test of this advantage by using a qutrit encoded in a single photon passing through three slits.

QW3A.6 • 15:45

Hybrid Radial-Angular Quantum Correlations of Spatially Entangled Photons, Wolfgang Löffler¹, Vsevolod D. Salakhutdinov¹, Eric R. Eliel¹, ¹Leiden Inst. of Physics, Leiden Univ., Netherlands. We report the successful experimental exploration of the full transverse-mode space of spatially entangled photons, azimuthal and radial; and investigate theoretically and experimentally the relation to the Schmidt eigenmodes of the twin photons.

QW3B • Quantum State Engineering I—Continued**QW3B.2 • 15:15**

Experimental Study of the Decoherence of Biphoton Qutrits, Assaf Shaham¹, Hagai Eisenberg¹, ¹Racah Inst. of Physics, The Hebrew Univ. of Jerusalem, Israel. We have generated various indistinguishable 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. Stace¹, 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 Photo-count Level and Born's Rule, Alcenio Jesus-Silva¹, Eduardo Fonseca¹, Jandir Hickmann¹, ¹Optics and Materials Group, Brazil. We use photon's 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 Born's rule.

HW3C • NL and Extreme NL Optics—Continued**HW3C.4 • 15:00**

Filamentation of Few-Cycle Mid-Infrared Pulses in Gases, Daniil Kartashov¹, Skirmantas Ališauskas¹, Andrius Baltuška¹, Alexander A. Voronin², Aleksei Zheltikov^{2,3}, Massimo Petrarca⁴, Pierre Bejot⁴, Jerome Kasparian⁴, Audrius Pugzlys⁵, ¹Vienna Univ. of Technology, Photonic 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-5.5μm spectral continuum in argon are demonstrated.

HW3C.5 • 15:15 Invited

Carrier-envelope Phase Double Stabilization Setup with sub-10 Attosecond Timing Jitter, Bastian Borchers¹, Sebastian Koke¹, Gunter Steinmeyer¹, 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.

HW3C.6 • 15:45

Theoretical Explanation of the Soliton Self-frequency Blueshift in Gas-filled Hollow Core Photonic Crystal Fibres, Fabio Biancalana¹, Mohammed F. Saleh¹, Philipp Hoelzer¹, Wonkeun Chang¹, John C. Travers¹, Nicolas Y. Joly¹, Philip Russell¹, ¹NPN, 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 blueshift, recently observed experimentally in a gas-filled hollow-core PCF.

IW3D • 2D-IR—Continued**IW3D.3 • 15:00**

Two-dimensional Femtosecond Infrared Spectroscopy of Hydrogen-bonded Wires, Stephan Knop¹, Martin Olschewski¹, Peter Vöhringer¹, ¹Inst. for Physical and Theoretical Chemistry, Univ. of Bonn, Germany. 2DIR 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.

IW3D.4 • 15:15

Dynamics of N-H Stretching Excitations of Guanosine-Cytidine Base Pairs in Solution, Henk Fidler¹, Ming Yang¹, Lukasz Szycl¹, Katharina Röttger², Erik Nibbering¹, Thomas Elsaesser¹, Friedrich Temps¹, ¹Max Born Institut, 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

IW3D.5 • 15:30

2D IR Spectroscopy of Ice Ih, Fivos Perakis¹, Peter Hamm¹, ¹Inst. of Physical Chemistry, Univ. of Zurich, Switzerland. We present experimental 2D IR spectra of the OH stretch of ice Ih, for both the isotope dilute (5% HOD in D₂O) and neat (100% H₂O) cases, complemented by simulations using the Lippincott-Schroeder model.

IW3D.6 • 15:45

Surface Enhanced 2D-IR Spectroscopy of Gold Nanoparticle Capping Layers, Paul M. Donaldson¹, Peter Hamm¹, ¹Physikalisch-Chemisches Institut, Univ. of Zurich, Switzerland. 2D-IR spectroscopy is used to quantify gold nanoparticle IR surface enhancement. Changes in 2D lineshapes and the appearance of surface group cross peaks demonstrate that 2D-IR offers a unique sensitivity to nanoparticle capping structure/dynamics.

16:30–18:00

QW4A • Novel Quantum Information and Measurement Techniques IIPaul Lett; *NIST, USA, Presider***QW4A.1 • 16:30**

Open Quantum Walks as a Tool for Dissipative Quantum Computing, *Francesco Petruccione¹, Ilya Sinayskiy², ¹UKZN, 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.

QW4A.2 • 16:45

The Quantum Zeno Paradox: A Matter of Information, *Peter E. Toschek¹, ¹Inst. 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.

QW4A.3 • 17:00

Heisenberg-limited Metrology without Entanglement, *Daniel Braun¹, John Martin², ¹Univ. Toulouse Paul Sabatier, France; ²Institut de Physique Nucléaire, Atomique et de Spectroscopie, Université de Liège, Belgium*. We show that making SNS systems interact with a SN+1St enables Heisenberg limited sensitivity without entanglement, and robust under decoherence. An application is the measurement of the length of an optical cavity.

QW4A.4 • 17:15

N-photon Autocorrelator with Picosecond Temporal Resolution, *Zili Zhou¹, G. Frucci¹, Saeedeh Jahannirinejad¹, F. Mattioli², A. Gaggero², R. Leoni², A. Fiore¹; ¹COBRA Research Inst., Eindhoven Univ. of Technology, Netherlands; ²Istituto di Fotonica e Nanotecnologie (IFN), CNR, via Cineto Romano 42, 00156 Rome, Italy*. We demonstrate an ultrafast autocorrelator with single-photon sensitivity based on superconducting nanodetectors. Its temporal resolution is only limited by the hotspot relaxation time which has been directly measured to be ~ 20 ps.

16:30–18:00

QW4B • Quantum State Engineering IIAlexander Sergienko; *Boston Univ., USA, Presider***QW4B.1 • 16:30**

Direct Measurements of the Non-classicality Degree in Photon-number Correlations, *Liat Dovrat¹, Michael Bakstein¹, Assaf Shaham¹, Eli Megidish¹, Assaf Halevy¹, Lior Cohen¹, Daniel Istrati¹, Hagai Eisenberg¹; ¹Racah 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.

QW4B.2 • 16:45

Generation and Characterization of Multimode Quantum Frequency Combs, *Renné Medeiros de Araujo¹, Olivier Pinel¹, Pu Jian¹, Jinxia Feng², Benoît Chalopin^{1,3}, Claude Fabre¹, Nicolas Treps¹; ¹Laboratoire Kastler Brossel, France; ²State Key Laboratory of Quantum Optics and Quantum Optics devices, China; ³Max Planck Inst. for the Science of Light, 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.

QW4B.3 • 17:00

Demonstrating the Quantum Nature of Light with a Single Detector, *Gesine Stuedle¹, Stefan Schietinger¹, David Höckel¹, Sander N. Dorenbos², Valery Zwiller², Oliver J. Benson¹; ¹AG Nanooptik, HU Berlin, Germany; ²Kavli 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.

QW4B.4 • 17:15

Fabrication of Optical Nanofiber Cavity Using Focused Ion Beam Milling, *Kali P. Nayak¹, Yuto Kawai¹, Fam L. Kien¹, Kiyomi Nakajima², Hideki T. Miyazaki², Yoshimasa Sugimoto², Kohzo Hakuta¹; ¹Center for Photonic Innovations, Univ. of Electro-Communications, Japan; ²Nanotechnology Innovation 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.

16:30–18:45

HW4C • Atomic and Molecular PhysicsJoachim Ullrich; *Max-Planck-Institut für Kernphysik, Germany, Presider***HW4C.1 • 16:30** **Invited**

FEL Induced Molecular Dynamics: Time-Resolved and in 3D, *Robert Moshhammer¹, Yuhai Jiang¹, Artem Rudenko², Arne Senftleben¹, Kirsten Schnorr¹, Lutz Foucar², Moritz Kurka¹, Kai-Uwe Kühnel¹, Matthias Kling³, Stefan Dusterer⁴, Rolf Treusch⁴, Claus Dieter Schröter¹, Joachim Ullrich^{1,2}; ¹Max-Planck Institut für Kernphysik, Germany; ²Max-Planck Advanced Study Group at CFEL, Germany; ³Max-Planck Institut für Quantenoptik, Germany; ⁴DESY, Germany*. A setup for XUV-XUV pump-probe experiments with atoms and molecules using femtosecond FEL radiation will be presented along with first time-resolved results on the XUV induced fragmentation dynamics of small molecules.

HW4C.2 • 17:00 **Invited**

Towards Complete Space-time Reconstruction of Attosecond Pulses, *Eugene Frumker, JASLab-Joint Laboratory of Attosecond Science of Ottawa and NRC, Canada*. We introduce new approach for complete space-time reconstruction of the attosecond pulses. Measured spectrally resolved wavefront across one plane and knowledge of temporal profile at one point in space enables complete space-time characterization of the pulse.

16:30–18:00

IW4D • Phonon & Vibrational ProbesMartin Garcia; *Univ. Kassel, Germany, Presider***IW4D.1 • 16:30**

Ultrafast changes in lattice symmetry probed by coherent phonons at the onset of the photo-induced phase transition in VO₂, *Simon Wall¹, Daniel Wegkamp¹, Laura Foglia¹, Kannatassen Appavoo², Joyeeta Nag², Richard Haglund², Julia Stähler¹, Martin Wolf¹; ¹Physical Chemistry, Fritz Haber Inst., Germany; ²Physics and Astronomy, Vanderbilt Univ., USA*. We show that the coherent phonon spectrum, probed by whitelight spectroscopy[1], can be a marker for photoinduced structural transitions. In VO₂, the lattice potential symmetry is completely changed on ultrafast timescales before ionic motion occurs.

IW4D.2 • 16:45

Ultrafast structural change in single-walled carbon nanotubes using a few-cycle pulse laser, *Takayoshi Kobayashi¹, Zhaogang Nie¹, Juan Du¹, Hiromichi Kataura², Youichi Sakakibara Sakakibara², Yasumitsu Miyata²; ¹Univ. of Electro-Communications, Japan; ²National Inst. of Advanced Industrial Science and Technology, Japan; ³Nagoya Univ., Japan*. Coherent phonon dynamics in single-walled carbon nanotubes is studied by ultrafast spectroscopy using 7.1-fs laser pulses. Vibrational wave-packets motion due to the radial breathing, and the related coherent phonon generation is in-depth studied.

IW4D.3 • 17:00

Scattering of electrons with acoustic phonons in single-walled carbon nanotubes, *Olga A. Dyatlova¹, Christopher Koehler², Ermin Malic², Jordi Gomis-Bresco¹, Janina Maultzsch³, Andrey Tsagan-Mandzhiev¹, Tobias Watermann², Andreas Knorr², Ulrike Woggon¹; ¹Inst. for Optics and Atomic Physics, Technical Univ. of Berlin, Germany; ²Inst. for Theoretical Physics, Technical Univ. of Berlin, Germany; ³Inst. for Solid State Physics, Technical Univ. of Berlin, Germany*. We perform two color pump-probe experiments on nanotubes (8,7);(10,2);(11,3);(12,1). The dynamics were analyzed for three decay constants. A density-matrix formalism reveals that the fastest component is caused by intraband carrier-phonon scattering.

IW4D.4 • 17:15

Laser-induced Thermal Phonon Squeezing, *Euwe S. Zijlstra¹, ¹Fachbereich 10, Theoretical Physics, Germany*. On the basis ab initio molecular dynamics simulations we infer that thermal phonon squeezing - an ultrafast phenomenon that has not been reported before - pre-curses ultrafast melting of solids as a function of fluence.

QW4A • Novel Quantum Information and Measurement Techniques II—Continued**QW4A.5 • 17:30**

Ancilla-based Quantum Simulation, Katherine L. Brown¹, Suvabrata De¹, Viv Kendon¹, William J. Munro^{2,3}, ¹School of Physics and Astronomy, Univ. 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.

QW4A.6 • 17:45

Optimal Measurement for the Discrimination of Quantum States with a Fixed Rate of Inconclusive Outcomes, Janos A. Bergou¹, Ramon Munoz-Tapia², Emilio Bagan^{1,3}, Georgina A. Olivares Renteria¹, ¹Physics and Astronomy, CUNY Hunter College, USA; ²Fisica Teorica: Informacio i Fenomens 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.

QW4B • Quantum State Engineering II—Continued**QW4B.5 • 17:30**

Superradiance from Entangled Atoms, Ralph Wiegner¹, Joachim von Zanthier^{2,3}, Girish Agarwal², ¹Inst. for Optics, Information and Photonics, Univ. Erlangen-Nuremberg, Germany; ²Erlangen Graduate School in Advanced Optical Technologies (SAOT), Univ. Erlangen-Nuremberg, Germany; ³Department of Physics, Oklahoma State Univ., USA. We discuss the radiation properties of entangled atomic sources in comparison to sources in a separable state. We explain superradiance and subradiance of entangled sources in terms of interference among different photon quantum path ways.

QW4B.6 • 17:45

Optimal Minimum-cost Quantum Measurements for Imperfect Detection, Erika Anderson¹, ¹Physics, Heriot-Watt Univ., UK. Quantum measurements, useful in quantum information and metrology, are mostly optimized for ideal realisation. Real devices are however imperfect. We give optimal minimum-cost and minimum-error measurements for a general model of imperfect detection.

HW4C • Atomic and Molecular Physics—Continued**HW4C.3 • 17:30**

Nanostructure-enhanced Atomic Line Emission from Noble Gases driven by Low-Energy, Few-Cycle Laser Pulses, Murat Sivi¹, Matthias Duwe¹, Yaxing Liu², Katrin Siefertmann^{2,3}, Bernd Abel⁴, Claus Ropers¹, ¹Courant Research Center, Univ. of Goettingen, Germany; ²Department of Physical Chemistry I, Univ. of Goettingen, Germany; ³College of Chemistry, Univ. of California, Berkeley, USA; ⁴Faculty for Chemistry and Mineralogy, Univ. of Leipzig, Germany. We present extreme ultraviolet emission from noble gases driven by low-energy, few-cycle light pulses enhanced in plasmonic nanostructures. The origin of the emission is atomic fluorescence, and we find no sign of high harmonic radiation.

HW4C.4 • 17:45

Complete Fragmentation of Hydrocarbon Molecules Probed by Few-cycle Laser Pulses, Stefan Roither¹, Xinhua Xie¹, Daniil Kartashov¹, Li Zhang¹, Markus Schöffler^{1,2}, Huailiang Xu^{3,4}, Atsushi Iwasaki¹, Tomoya Okino⁴, Kaoru Yamanouchi¹, Andrius Baltuska¹, Markus Kitzler¹, ¹Photonics Inst., Vienna Univ. of Technology, Austria; ²Institut für Kernphysik, Goethe- Univ., Germany; ³Center for Ultrafast Optoelectronic Technologies, Jilin Univ., China; ⁴Department of Chemistry, School of Science, The Univ. of Tokyo, Japan. Multiparticle coincidence imaging reveals laser-driven ejection of energetic protons via concerted Coulomb explosions from unexpectedly high molecular charge states. The underlying mechanism is studied with laser pulses from 4.5 to 27 fs in duration.

HW4C.5 • 18:00

Measurement of Electronic Structure in Molecular High Harmonic Generation, Michael C. Wong¹, Jean-Paul Brichta¹, Abdullah H. Alharbi¹, Andrey E. Boguslavskiy¹, Ravi Bhardwaj¹, ¹Department of Physics, Univ. of Ottawa, Canada. 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.

HW4C.6 • 18:15

Quantum Control of Photodissociation Using Shaped Ultrafast Pulses, Uri Lev¹, Leigh Graham^{2,1}, Barry D. Bruner², Adi Natan³, Vaibhav S. Prabhudesai⁴, Oded Heber¹, Dirk Schwalm^{5,1}, Yaron Silberberg⁶, Daniel Zajfman¹, ¹Department of Particle Physics and Astrophysics, Weizmann Inst. of Science, Israel; ²Centre for Plasma Physics, School of Mathematics and Physics, Queens Univ. Belfast, UK; ³Department of Physics of Complex Systems, Weizmann Inst. of Science, Israel; ⁴Tata Inst. of Fundamental Research, India; ⁵Max-Planck-Institut fuer Kernphysik, Germany. We demonstrate the ability to control dissociation rates of H₂⁺ molecules from targeted vibrational levels using strong (4 × 10¹³ W/cm²) laser fields and simple analytically designed ultrafast pulse shapes.

HW4C.7 ▶**IW4D • Phonon & Vibrational Probes—Continued****IW4D.5 • 17:30**

Conditions for Generating Squeezed Phonon States in an Optically Excited Quantum Dot, Daniel Wigger¹, Doris E. Reiter¹, Vollrath Martin Axt², Tilmann Kuhn¹, ¹Institut für Festkörperteorie, Universität Münster, Germany; ²Institut für Theoretische Physik III, Universität Bayreuth, Germany. We study theoretically the fluctuation properties of LO phonons for a quantum dot excited by ultrashort pulses. For two pulses we analyze the excitation conditions to create squeezed phonons.

IW4D.6 • 17:45

Structure, Ultrafast Dynamics and Functionality of Nitrosylated Corynebacterium Glutamicum Catalase, Neil T. Hunt¹, Katrin Adamczyk¹, Candelaresi Marco¹, Michael Towrie², Gregory M. Greetham³, Anthony W. Parker³, Martin A. Walsh², Paul A. Hoskisson⁴, Nicholas P. Tucker¹, ¹Physics, Univ. of Strathclyde, UK; ²Diamond Light Source, UK; ³STFC Rutherford Appleton Laboratory, UK; ⁴SIPBS, Univ. of Strathclyde, UK. The structure and ultrafast dynamics of a catalase protein are reported using 2D-IR spectroscopy and X-ray crystallography. These are combined with biochemical studies of functionality to gain new insights into the structure function relationship.

HW4C.7 • 18:30

Attosecond Control of Laser Driven Plasmas, Rodrigo Lopez-Martens¹, Antonin Borot¹, Arnald Malvache¹, Xiaowei Chen¹, Aurélie Jullien¹, Aurélien Ricci¹, Patrick Audebert², Jean-Paul Geindre², Gérard Mourou³, Fabien Quere⁴, ¹Laboratoire d'Optique Appliquée, ENSTA - Ecole Polytechnique - CNRS, France; ²Laboratoire pour l'Utilisation des Lasers Intenses, CNRS - Ecole Polytechnique, France; ³Institut de La Lumière Extrême, ENSTA - Ecole Polytechnique - CNRS, France; ⁴Service des Photons, Atomes et Molécules, 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.

Key to Authors and Presiders

(**Bold** denotes Presider or Presenting Author)

- Abdel-Aty, Mahmoud-**JT2A.31**
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Cocker, Tyler L-**IT4D.3**
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- Eschner, Jürgen-**QM1B.4, QM3B**
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- Faerber, Raphael-**QT3B.6**
- Farah, Tristan-**QM3A.7**
- Faria, Carla-**HT4C.7, HW1C.5, JT2A.53**
- Faure, Jerome-**IT1D.4**
- Fedrizzi, Alessandro-**QW1A.2**
- Feidenhans'l, Robert-**IM2D.3**
- Feizpour, Amir-**QM1A.1**
- Feng, Jinxia-**QW4B.2**
- Ferreira da Silva, Thiago-**QW2A.4**
- Feurer, Thomas-**IM3D.4, IT4D.4, JT2A.1, JT2A.50**
- Ficke, Zbigniew-**JT2A.29**
- Fidder, Henk-**IW3D.4**
- Fiore, A.-**QW3A.4, QW4A.4**
- Fischer, Martin K-**IM3D.6**
- Fischer, Martin-**QM1B.1**
- Floettmann, Klaus-**JT2A.47**
- Fogarty, Thomas-**QW2A.7**
- Foglia, Laura-**IW4D.1**
- Fonseca, Eduardo-**QW3B.4**
- Foucar, Lutz-**HW4C.1, IW1D.2**
- Fourmaux, Sylvain-**IT4D.3**
- Fraine, Andrew-**QM3B.3**
- Frank, F.-**HM3C.8, JT2A.61**
- Franson, James-**QT3B.3, QW2B.4**
- Frassetto, Fabio-**HM1C.5, JT2A.43**
- Freeland, John W-**JT2A.36**
- Freeman, Richard-**HM2C.4**
- Frei, Franziska-**IM3D.4, JT2A.50**
- Freneaux, Antoine-**JT2A.57**
- Freyer, Benjamin-**IM2D.5, IT1D.2**
- Fritz, David M-**IW1D.2**
- Froud, Chris-**JT2A.43**
- Frucci, G.-**QW3A.4, QW4A.4**
- Frumker, Eugene-**HW4C.2**
- Fuchs, Matthias-**IW1D.2**
- Fuji, Takao-**HT3C, HW3C.3**
- Gaal, Peter-**IM1D.3, IM2D.4, JT2A.49**
- Gaggero, A.-**QW3A.4, QW4A.4**
- Galve, Fernando-**QW2B.1**
- Ganeev, Rashid-**HM3C.8**
- Gao, Meng-**IW1D.6**
- Garcia, Martin E.-**IW4D, JT2A.39**
- Garde, Mette-**JT2A.52**
- Garrido Alzar, Carlos L.-**JT2A.10**
- Gatti, Alessandra-**QT3A.1**
- Gaudin, J.-**HM2C.3**
- Gauthier, Daniel-**QT1B, QT4A.2**
- Geindre, Jean-Paul-**HW4C.7**
- Gerace, Dario-**QT3B.4**
- Gerard, Lea-**QW2B.3**
- Gerbig, Christian-**IT3D.3**
- Gerlin, Francesca-**JT2A.3, QT4A.3**
- Gerrits, Thomas-**QW1A.2**
- Ghosh, Joyee-**QM1B.4**
- Giacobino, Elisabeth-**QT3B.1**
- Giambruno, Fabio-**JT2A.57**
- Gilead, Yehonatan-**QT3A.6**
- Gillett, Geoff-**QW1A.2**
- Giovannetti, Vittorio-**QW1B.5**
- Giovannini, Daniele-**QW3A.2**
- Gisin, Nicolas-**QT3A.5, QW1A.6**
- Glasser, Ryan T-**QT1A.6**
- Glesson, A.j.-**HM2C.3**
- Gleyzes, Sebastien-**QM2A.2**
- Glickman, Yinnon-**QM2A.3, QW2A.5**
- Glorieux, Quentin-**QT1A.2**
- Godbout, Nicolas-**QM2A.5**
- Goldshteyn, Jevgenij-**IM1D.3, JT2A.49**
- Golla, Andrea-**QM1B.1**
- Gomis-Bresco, Jordi-**IW4D.3**
- Goodfellow, John-**IT1D.5**
- Goold, John-**QW2A.7**
- Gordon, Daniel-**HM1C.3**
- Gouliemakis, Eleftherios-**HW1C.2**
- Gräfe, Stefanie-**HW2C.4**
- Graham, Leigh-**HW4C.6**
- Granados, Eduardo-**HM3C.2**
- Greetham, Gregory M-**IW4D.6**
- Greif, Michael E-**IT3D.4**
- Grübel, Sebastian-**IM2D.2**
- Grün, Alexander-**HW2C.2**
- Gu, Wen-ju-**JT2A.29**
- Guerlin, Christine-**QM3A.7**
- Guichard, Roland-**HT4C.8, HW2C.3**
- Guilbert, Hannah-**QT4A.2**
- Gulde, Max-**HW1C.3**
- Guo, Jianchang-**IW2D.7**
- Hache, Francois-**IW1D.3**
- Hada, Masaki-**JT2A.47**
- Hädrich, Steffen-**HM3C.1, HT3C.1**
- Hage, Boris-**QW1B.6**
- Hagemeier, Jenna-**QT3B.4**
- Haglund, Richard-**IW4D.1**
- Hakuta, Kohzo-**QW4B.4**
- Halevy, Assaf-**QW4B.1**
- Hall, Michael J W-**QT3A.2**
- Hamm, Peter-**IM3D.7, IW3D, IW3D.5, IW3D.6, JT2A.40**
- Hammerer, Klemens-**QM3A.2**
- Hao, Shuhong-**QT1B.3**
- Haroche, Serge-**QM2A.2**
- Harth, Anne-**HT1C.5**
- Hartmann, Andreas-**IW1D.2**
- Hartmann, Robert-**IW1D.2**
- Hassan, Shabir-**IM3D.7**
- Hau-Riege, S.p.-**HM2C.3**
- Hauer, Juergen-**IM3D.2, IM3D.3**
- Hawkes, Steve-**HT1C.2**
- Hayat, Alex-**QM1A.1**
- Heber, Oded-**HW4C.6**
- Hegmann, Frank A-**IT4D.3**
- Hemmer, Michael-**HT3C.2**
- Henkel, Florian-**QW2B.3**
- Hentschel, Alexander-**QW1B.1**
- Herink, Georg-**HW1C.3**
- Hernandez-Garcia, Carlos-**HT4C.4**
- Hernandez-Gomez, Cristina-**HT1C.3**
- Herrmann, Joachim-**HM3C.3, HT4C.3**
- Herzog, Marc-**IM1D.3, IM2D.4, JT2A.42, JT2A.49**
- Heugel, Simon-**QM1B.1**
- Hickmann, Jandir-**QW3B.4**
- Hirscht, Julian-**JT2A.47**
- Ho, Phay J-**IW1D.5**
- Höckel, David-**QW4B.3**
- Hoelzer, Philipp-**HM3C.5, HW3C.6**
- Hofer, Helmuth-**QT1B.7**
- Höfling, S.-**QW3A.4**
- Hoffmann, David-**JT2A.61**
- Hofmann, Holger-**QM3B.2**
- Hofmann, Julian-**QW2B.3**
- Holloway, Greg-**IT4D.3**
- Hong, Wei-yi-**HT4C.5**
- Hooker, Chris J-**HT1C.2**
- Hooker, Simon Martin-**HM1C, HM3C.4**
- Hoskisson, Paul A-**IW4D.6**
- Howell, John-**QT3A, QT4B.5**
- Howland, Gregory-**QT4B.5**
- Hsieh, Wen-Feng-**JT2A.20**
- Hu, Jianbo-**JT2A.33**
- Huang, Shih-Wen-**IM2D.2**
- Huang, Shu-Wei-**HM3C.2, HT3C.5**
- Huang, Sumei-**QM3A.3**
- Hudelsit, Florian-**QT1A.3**
- Huening, Markus-**JT2A.47**
- Hunt, Neil T-**IW4D.6**
- Husakou, Anton-**HM3C.3, HT4C.3**
- Huse, Nils-**IW2D.2**
- Hutchison, C.-**HM3C.8**
- Huwer, Jan-**QM1B.4**
- Hyllus, Philipp-**QM1A.2**
- Igeta, Kazuhiro-**QT1B.6**
- Ighev, Hristo-**IM3D.6, JT2A.45**
- Ihlefeld, Jon-**JT2A.36**
- Ilchen, Markus-**IW1D.2**
- Ilchi-Ghazaani, Maryam-**JT2A.55**
- Imoto, Nobuyuki-**QT1B.6**
- Ingold, Gerhard-**IM2D.2, IM2D.3, IT1D.3**
- Israel, Yonatan-**QT4B.3**
- Istrati, Daniel-**JT2A.62, QW4B.1**
- Iwasaki, Atsushi-**HW1C.4, HW4C.4**
- Jahanmirinejad, S.-**QW3A.4**
- Jahanmirinejad, Saeedeh-**QW4A.4**
- Janousek, Jiri-**QW1B.6**
- Jaron-Becker, Agnieszka Anna-**HT4C.6**
- Jarón-Becker, Agnieszka-**HW2C.2**
- Jean-Ruel, Hubert-**IW1D.6**
- Jedrkwicz, Ottavia-**QT3A.1**
- Jeffers, John-**QW1A.5**
- Jennewein, Thomas-**QW3A.5**
- Jennings, Guy-**IW2D.7**
- Jesus-Silva, Alcenisio-**QW3B.4**
- Jian, Pu-**QT1B.1, QW4B.2**
- Jiang, Yuhai-**HW4C.1**
- Jing, Jietai-**QT1A.3**
- Johnson, Jeremy A-**IM2D.2**
- Johnson, Steven Lee-**IM2D.2, IM2D.3, IT1D.3, IW2D, IW2D.5**
- Joly, Nicolas Y-**HM3C.5, HW3C.6**
- Jones, Kevin-**QT4B.1**
- Jones, R Jason-**HM2C**
- Jonson, Mats-**QT3A.2**
- Joshi, Chaitanya-**QT3A.2**
- Juha, L.-**HM2C.3**
- Jullien, Aurélie-**HW4C.7**
- Jurek, M.-**HM2C.3**
- Kaiser, Stefan-**HM1C.5, JT2A.43**
- Kamp, M.-**QW3A.4**
- Kampermann, Hermann-**QW2A.1**
- Kanter, Elliot P-**IW1D.5**
- Karpinski, Michal-**QW3A.3**
- Kartashov, Daniil-**HW1C.4, HW2C.4, HW3C.1, HW3C.2, HW3C.4, HW4C.4**
- Kärtner, Franz-**HM3C.2, HT3C.5**
- Kasparian, Jerome-**HW3C.4**
- Kataura, Hiromichi-**IW4D.2**
- Kauffmann, Harald F-**IM3D.2, IM3D.3**

- Kawai, Yuto-QW4B.4
 Keathley, Phillip-HM3C.2
 Kelkensberg, Freek-HM3C.3
 Kendon, Viv-QW4A.5
 Kerbach, Martin-QT3A.3
 Keselman, Anna-QM2A.3
 Khakhulin, Dmitry-IM1D.3
 Khoury, Antonio Zelaquett-JT2A.28
 Khuc, Mai-Thu-IW1D.3
 Kieffer, Jean-Claude-IT4D.3
 Kien, Fam L-QW4B.4
 Kilin, Sergei Ya.-JT2A.15, **QW2A, QW3B.1**
 Kim, Hyochul-QT3B.4
 Kim, Kwang-Hyon-HT4C.3
 Kim, Tae Kyu-IW2D.2
 Kimmel, Mark-HT4C.2
 Kirrander, Adam-JT2A.53
 Kitzler, Markus-HW1C.4, **HW2C.4, HW4C.4**
 Kling, Matthias-**HW1C.1**, HW4C.1
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 Knorr, Andreas-IW4D.3
 Koashi, Masato-QT1B.6
 Kobayashi, Takayoshi-IW4D.2, JT2A.25, QT3A.4
 Koch, Lars-QT3A.3
 Koehler, Christopher-IW4D.3
 Kok, Pieter-QM3B.6
 Koke, Sebastian-HW3C.5
 Kolenderski, Piotr-QW3A.5
 Kolkiran, Aziz-JT2A.30
 Kometa, Samuel T-QT1A.5
 Koschorreck, Marco-QT3B.2, QW1B.2
 Kotler, Shlomi-QM2A.3, QW2A.5
 Kovacev, Milutin-HM3C.6, HM3C.7, JT2A.52, JT2A.58
 Kraessig, Bertold-IW1D.5
 Krasniqi, Faton-IW1D.2
 Krebs, Manuel-HM3C.1, **HT3C.1**
 Kretschmar, Martin-HM3C.6, **JT2A.52**
 Krischek, Roland-QM1A.2
 Krol, Denise-JT2A.46
 Kröll, Stefan-QT1A.5
 Krug, Michael-QW2B.3
 Krumova, Marina-IT3D.2
 Krushelnick, Karl-JT2A.63
 Kück, Stefan-QT1B.7
 Kuhn, Tilmann-IW4D.5, JT2A.34
 Kühnel, Kai-Uwe-HW4C.1
 Kung, Andy-**HT3C.4**
 Kurka, Moritz-HW4C.1
 Kurtz, Charles-IW2D.7
 Kurz, Christoph-QM1B.4
 Kurz, Heiko G-**HM3C.7**
 Kwiat, Paul-QT4A.2, **QW1A.1, QW2B**
 Laflamme, Raymond-QW3A.5
 Lai, Chien-Jen-HM3C.2
 Laiho, Kaisa-QT1B.4
 Lam, Ping Koy-QW1B.6
 Lamas, Antia-QW1A.3
 Landragin, Arnaud-JT2A.10
 Lang, Bernhard-JT2A.44
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 Larsson, Jorgen-IW1D.2
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 Lederer, Sven-JT2A.47
 Lee, June H-JT2A.36
 Leifgen, Matthias-QW2A.2
 Lein, Manfred-HM3C.7
 Leitenberger, Wolfram-IM1D.3, JT2A.49
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 Lemke, Henrik-IW1D.2
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 Leuchs, Gerd-QM1B.1, **QM3A**
 Leung, Vanessa-QM2A.4
 Lev, Uri-HW4C.6
 Lewenstein, Maciej-HT4C.1, JT2A.54
 Li, Gao-xiang-JT2A.29
 Li, Jin-Feng-HT1C.4
 Li, Ruxin-HT1C.4, **HW4C**
 Li, Yuelin-JT2A.36
 Liang, Xiaoyan-**HT1C.4**
 Lima, Frederico Alves-IW2D.5, **IW2D.6**
 Lima, Manuela-IW3D.2
 Limpert, Jens-HM3C.1, HT3C.1
 Lincoln, Craig N-IM3D.5
 Lindenberg, Aaron-**IT1D.5**
 Lita, Adriana-QW1A.2
 Litvak, Alexander-JT2A.64
 Liu, Cunjin-QT1A.3
 Liu, Haiyun-HM1C.5, JT2A.43
 Liu, Kunlong-**HW1C.6**
 Liu, Yaxing-HW4C.3
 Lo, Hsin-Pin-JT2A.25, QT3A.4
 Lo Gullo, Nicola-QW2A.7
 Löchel, Bernd-QW1B.3
 Loeser, Markus-JT2A.59
 Löffler, Wolfgang-QW3A.6
 Lomb, Lukas-HM2C.1
 London, A.-HM2C.3
 López, Carlos E.-**JT2A.18**
 López-Carreño, Juan Camilo-JT2A.16
 Lopez-Martens, Rodrigo-**HW4C.7**
 Lopez-Tarifa, Pablo-JT2A.35
 Lörch, Niels-JT2A.2
 Lötstedt, Erik-HW1C.4
 Louchet-Chauvet, Anne-QM3A.7
 Lu, Peixiang-HT4C.5, HW1C.6
 Lu, Xiaoming-HT1C.4
 Lugiato, Luigi Alberto-QT3A.1
 Luiten, Jom-IW1D.7
 Lukeš, Vladimír-IM3D.3
 Luo, Chih-Wei-JT2A.25, QT3A.4
 Lupo, Cosmo-QW1B.5
 Lütkenhaus, Norbert-QT4A.1
 Ma, Guohong-JT2A.32
 Machinet, Guillaume-HT3C.3
 Maerten, Lena-JT2A.49
 Mahler, Dylan-QM1A.1
 Maiwald, Robert-QM1B.1
 Mak, KaFai-HM3C.5
 Malic, Ermin-IW4D.3
 Malik, Mehul-QW2A.3
 Malka, Victor-HM1C.4
 Malvache, Arnaud-HW4C.7
 Mancal, Tomas-IM3D.2, **IM3D.3**
 Mancini, Stefano-QW1B.5
 Manz, Stephanie-JT2A.47
 Manzoni, Cristian-**HT3C.5**
 Marangos, J. P-HM3C.8, JT2A.61, **HM2C, HT1C**
 March, Anne Marie-IW1D.5
 Marco, Candelaresi-IW4D.6
 Mariager, Simon O-IM2D.2, **IM2D.3**
 Marino, Alberto-QT1A.2, QT4B.1
 Martin, John-QW4A.3
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 Mason, Paul D-HT1C.3
 Mataloni, Paolo-QM3B.5
 Mattioli, F.-QW3A.4, QW4A.4
 Maultzsch, Janina-IW4D.3
 Mayburov, Sergey-JT2A.22
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 McCusker, Kevin-QT4A.2
 McLaren, Melanie-QW2B.2
 Medeiros de Araújo, Renné-QW4B.2
 Megidish, Eli-QW4B.1
 Mendonça, Lucille-IW1D.3
 Mennerat, Gabriel-JT2A.57
 Mercuri, Maria Laura-IM3D.4
 Merdji, Hamed-**IM1D.4**
 Merlet, Sébastien-QM3A.7
 Miatto, Filippo M-QW3A.2
 Mikhalychev, Alexander B.-**JT2A.15, QW3B.1**
 Milburn, Gerard J-QM3A.6
 Miller, Dwayne-IT3D.2, IW1D.6, IW3D.2, JT2A.47
 Milne, Christopher J-IM2D.2
 Milne, Christopher Jackson-IM2D.3
 Milne, Christopher J-IT1D.3
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 Milota, Franz-IM3D.2, IM3D.3
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 Minns, Russell-HM1C.5
 Mirhosseini, Mohammad-QW2A.3
 Mironov, Vyacheslav-JT2A.64
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 Mitchell, Morgan W.-QM1B.2, QM2A.5, QT1B.5, QT3B.2, QW1B.2
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 Moeller, S.-HM2C.3
 Mogilevtsev, Dmitri S-JT2A.15
 Möhr-Vorobeva, Ekaterina-IM2D.2, IM2D.3, IT1D.3
 Montant, Sébastien-HT3C.3
 Morgenstern, Silvio-IT3D.3
 Morgner, Uwe-HM3C.6, HM3C.7, HT1C.5, JT2A.52, JT2A.58
 Moriena, Gustavo-IT3D.2, IW1D.6, JT2A.47
 Morizur, Jean-Francois-QW1B.6
 Moses, Jeffrey-HT3C.5
 Moshhammer, Robert-**HW1C, HW2C.2, HW4C.1**
 Mourou, Gérard-HW4C.7
 Mueller, Christina-JT2A.47
 Müller, Philipp-QM1B.4
 Munoz-Tapia, Ramon-QW4A.6
 Munro, William J-QW4A.5
 Nabekawa, Yasuo-**HM3C**
 Nag, Joyeeta-IW4D.1
 Nahum, Eyal-HM1C.3
 Nakajima, Kiyomi-QW4B.4
 Nakamura, Kazutaka G-JT2A.33
 Nam, Sae Woo-QW1A.2
 Napolitano, Mario-QM1B.2, QT3B.2, **QW1B.2**
 Natan, Adi-HW4C.6
 Nayak, Kali Prasanna-QW4B.4
 Nelson, Keith A-**IT4D.1**
 Nibbering, Erik-IW3D.4
 Nie, Zhaogang-IW4D.2
 Nillon, Julien-**HT3C.3**
 Nomura, Yutaka-HW3C.3
 Norris, Hannah-JT2A.13
 Nozawa, Shunsuke-IW2D.4
 O'Brien, Jeremy-QM3B.1
 O'Keeffe, Kevin-**HM3C.4**
 O'Sullivan, Malcolm-QW2A.3
 Odeh, Ahmad-IM3D.4
 Ohberg, Patrik-QT3A.2
 Okel, W. A-HM3C.8
 Okino, Tomoya-HW4C.4
 Olivares, Stefano-QT1B.2
 Olivares Renteria, Georgina A-QW4A.6
 Olschewski, Martin-IW3D.3
 Oosten, Dries-JT2A.46
 Oppel, Steffen-QM3B.6
 Ortelge, Norbert-QW2B.3
 Osellame, Roberto-QM3B.5
 Osorio, Clara I-QW1A.6
 Ou, Z. Y-QT1A.3
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 Ozeri, Roece-QM2A.3, QW2A.5
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 Padgett, Miles J-QW3A.2
 Palacios Á lvarez, Silvana-QM1B.2
 Papenkort, Thomas-JT2A.34
 Paris, Matteo G. A.-QT1B.2
 Parker, Anthony W-IW4D.6
 Parry, Bryn-HT1C.2

- Parvin, Parviz-JT2A.55
Pascasio, Saverio-QM1A
Pascual Winter, María Florencia-QW2A.6
Patchkovskii, Sergeui-HM2C.2
Paternostro, Mauro-QW2A.7
Pattathil, Rajeev-HT1C.2
Pavicic, Mladen-QT4A.5
Peaudecerf, Bruno-QM2A.2
Pechen, Alexander-JT2A.23, QW2A.8
Pedrini, Bill-IM1D.2
Penfold, Thomas-IW2D.3, IW2D.5, IW2D.6
Peng, Kunchi-QT1B.3
Perakis, Fivos-IW3D.5, JT2A.40
Pereira Dos Santos, Franck-QM3A.7
Pérez-Hernández, José Antonio-HT4C.8
Persson, Emil-HW2C.4
Peters, Silke-QT1B.7
Petersen, Jesse-HM1C.5, JT2A.43
Petrarca, Massimo-HW3C.4
Petroff, Pierre M-QT3B.4
Petruccione, Francesco-QW4A.1
Pezze, Luca-QM1A.2
Pflüger, Thomas-HW2C.2
Pfullmann, Nils-JT2A.58
Pham, Van Thai-IW2D.5
Phillips, Paul J-HT1C.3
Pichugin, Kostyantyn-JT2A.47
Pilia, Luca-IM3D.4
Pinel, Olivier-QT1B.1, QW4B.2
Pirandola, Stefano-QW1B.5
Piro, Nicolas-QM1B.4
Pittman, Todd-QT3B.3
Plaja, Luis-HT4C.4, HT4C.8
Poem, Eilon-QT3A.6
Poletto, Luca-HM1C.5, JT2A.43
Pomarico, Enrico-QW1A.6
Pomerantz, Ishay-HM1C.3
Poole, Patrick-HM2C.4
Prabhudesai, Vaibhav S-HW4C.6
Pressacco, F-IM2D.3
Probst, Jürgen-QW1B.3
Pryde, Geoff J-QM3B.2, QT4A.4
Pugzlys, Audrius-HW3C.1, HW3C.2, HW3C.4
Quere, Fabien-HM1C.1, HW4C.7
Quidant, Romain-HT4C.1, JT2A.54
Quitmann, Christoph-IM2D.3
Radzewicz, Czeslaw-QW3A.3
Rai, Amit-QT4B.6
Raimond, Jean-Michel-QM2A.2
Rambo, Patrick-HT4C.2
Ramponi, Roberta-QM3B.5
Rausch, Stefan-HT1C.5
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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. Cireasa², 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 Chalus^{1,2}; 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. Halevy¹, E. Megidish¹, L. Dovrat¹, H. Eisenberg¹, P. Becker², L. Bohaty²; ¹Racah Inst. of Physics, The Hebrew Univ. of Jerusalem, Israel; ²Instit. 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. Kang¹, B. Kim¹, Y.*

Park¹; ¹GIST, 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. Zavatta¹, C. Polycarpou¹, M. Bellini¹, A. Zavatta², C.*

Polycarpou², G. Venturi², M. Bellini², K.N. Cassemiro³, K.N. Cassemiro⁴; ¹Istituto Nazionale di Ottica (INO-CNR), Italy; ²Università di Firenze, Italy; ³Universidade Federal de Pernambuco, Brazil; ⁴Max Planck Institut. 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. Zielinska¹, F.A.*

Beduini¹, M. Mitchell¹, N. Godbout², M. Mitchell³; ¹ICFO - Institut de Ciències Fòniques, Spain; ²École Polytechnique de Montréal, Canada; ³ICREA, 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. Kaiser¹, L. Ngh¹, A. Issautier¹, O. Alibert¹,*

A. Martin¹, T. Sébastien¹, ¹Univ. 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. Pomeranz¹, Y. Shaked¹, A. Pe'er¹, ¹Bar 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. Frucci¹, ¹Univ. 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. Gundogan¹, P.M. Ledingham¹, A. Almasi¹, M. Cristiani¹, H. de Riedmatten¹, H. de Riedmatten²; ¹ICFO-Institut de Ciències Fòniques, Spain; ²ICREA-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. Megidish¹, A. Halevy¹, T. Shacham¹, T. Dvir¹, L. Dvrat¹, H. Eisenberg¹; ¹Hebrew 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.

Research in Optical Sciences: OSA Optics and Photonics Congress Update Sheet 2012

Postdeadline Sessions

HILAS Postdeadline Session

Tuesday, 20 March 2012
19:00-20:30
Hong Kong

QIM Postdeadline Session

Tuesday, 20 March 2012
18:45-21:00
Madrid

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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Hall 12, Hall 13 and Hall 14

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Network SSID: Laser Optics Berlin

Password: LOB2012