Nonlinear Optics (NLO) Topical Meeting

15 - 19 July 2019

Waikoloa Beach Marriott Resort & Spa

Waikoloa Beach, Hawaii, USA

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Thank you to all the

Committee Members for contributing many hours to maintain the high technical quality standards of OSA meetings.

General Information

About the Waikoloa Beach Marriott Resort & Spa

Experience the beauty of Hawaii and explore the many activities afforded by this amazing natural setting on Hawaii's Big Island. Waikoloa Beach Marriott Resort & Spa is located on 15 oceanfront acres overlooking Anaeho'omalu Bay.

This resort offers a variety of recreational activities including family friendly pools and a golf course. Participants can enjoy the open air restaurants and unique oceanfront dining options or the full-service spa as well as the spectacular views.

Registration

Ali'i I/Indoor Garden

Sunday, 14 July	15:00 - 17:30
Monday, 15 July	07:00 - 12:00 19:00 - 20:00
Tuesday, 16 July	07:00 - 15:30
Wednesday, 17 July	07:30 - 16:30
Thursday, 18 July	07:30 - 15:00
Friday, 19 July	07:30 - 12:00

Online Access to the Technical Digest

To connect to the Meeting WiFi please go to:
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Full Technical Attendees have both EARLY and FREE continuous online access to the Meeting Technical Digest and Postdeadline papers through OSA Publishing's Digital Library. The presented papers can be downloaded individually or by downloading .zip files (.zip files are available for 60 days).

1. Visit the conference website at www.osa.org/NLO
2. Select the "Access digest papers" link on the right hand navigation.
3. Log in using your email address and password used for registration. You will be directed to the conference page where you will see the .zip file link at the top of this page. [Note: if you are logged in successfully, you will see your name in the upper right-hand corner.]

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Update Sheet 

All technical program changes will be communicated in the Meeting Program Update Sheet. All attendees receive this information with registration materials and we encourage you to review it carefully to stay informed of changes in the program.

Poster Presentation PDFs

Authors presenting posters have the option to submit the PDF of their poster, which will be attached to their papers in OSA Publishing's Digital Library no later than 2 August 2019 to cstech@osa.org. Your PDF should be named using your presentation number with "-1" added at the end (##final_id## -1.pdf.). If submitted, poster PDFs will be available about three weeks after the meeting. While accessing the papers in OSA Publishing's Digital Library look for the multimedia symbol shown above.

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Special Events

Conference Networking Reception

Sunday, 14 July, 17:30 - 19:00
Paniolo Ocean Terrace

Join your fellow attendees for networking a reception. The event is open to committee/presenting author/student and full conference attendees.

Poster Session

Tuesday, 16 July, 16:00 - 17:30
Naupaka IV

Poster presentations offer an effective way to communicate new research findings and provide a venue for lively and detailed discussion between presenters and interested viewers. Don't miss this opportunity to discuss current research one-on-one with the presenters. Each author is provided with a board to display the summary and results of his or her paper.

Poster Set-Up and Removal:

All posters must be set by the start of the poster session. The presenter must remain in the vicinity of their poster for the duration of the session. All presenters must remove their posters at the conclusion of the session. Management will remove and discard any remaining posters after the session has ended.

Fiber Modeling and Fabrication Technical Group Reception

Tuesday, July 16, 17:30 – 18:30 PM
Naupaka IV

Please join OSA's Fiber Modeling and Fabrication technical group for a networking opportunity to connect with fellow members of the design and fabrication community. Chair, Deepak Jain, University of Sydney will discuss existing problems and highlight the emergence of optical fiber technology.

Conference Luau

Wednesday, 17 July, 17:00 - 20:00
Luau Grounds

Join your OSA family, friends and colleagues in an authentic Polynesian Luau show unlike any other right at the Waikoloa Beach Marriott Resort & Spa Hotel. The Sunset Luau will be held Wednesday evening at the hotel's Luau grounds outside under the stars. The show includes Polynesian food, dancing and music. Arrive at the Luau Grounds early to accommodate group seating.

Because this Luau is a part of the Waikoloa Marriott program all persons wanting to attend **must reserve a ticket in advance**. This event is open to the general public and seating is limited. Please check at the registration desk for extra ticket availability.

Postdeadline Papers Session

Thursday, 18 July, 14:00 - 15:30
Naupaka III

The Program Committee may accept postdeadline papers for oral presentations. The purpose of postdeadline papers is to give participants the opportunity to hear new and significant material in rapidly advancing areas. Postdeadline information will be available on Program Update Sheet.

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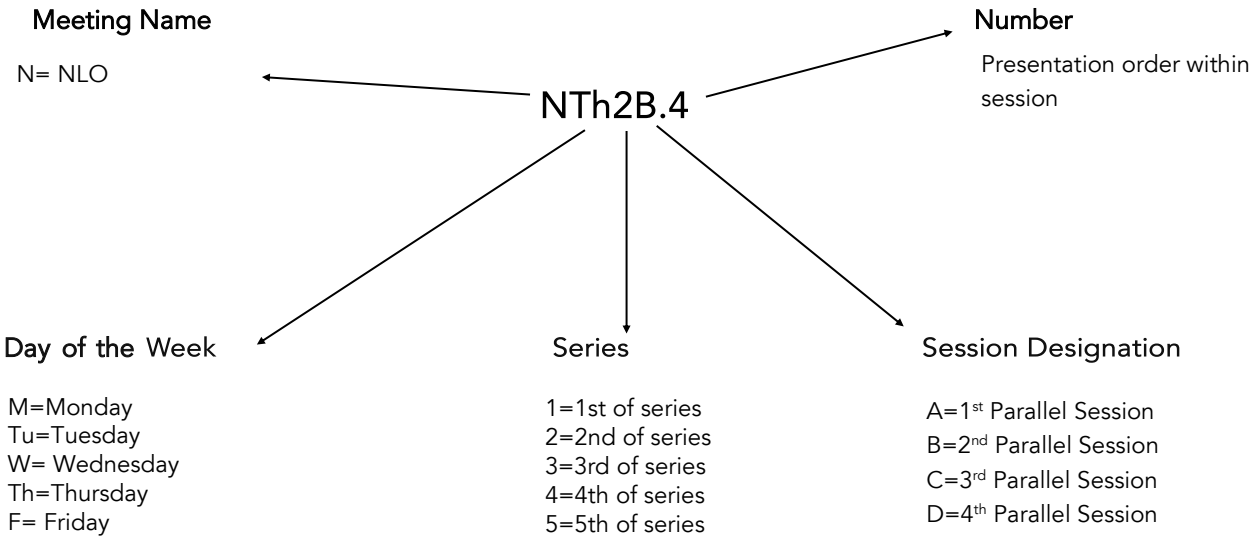
Explanation of Session Codes



The first letter of the code designates the meeting. The second element denotes the day of the week. The third element indicates the session series in that day (for instance, 1 would denote the first sessions in that day). Each day begins with the letter A in the fourth element and continues alphabetically through the parallel session. 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 NTh2B.4 indicates that this paper is being presented as part of the NLO meeting on Thursday (Th) in the second series of sessions (2), and is the second parallel session (B) in that series and the fourth paper (4) presented in that session.

Invited papers are noted with Invited

Plenaries are noted with Plenary

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If you need assistance with your login information, please use the "forgot password" utility or "Contact Help" link.

Agenda of Sessions

Sunday, 14 July	
15:00—17:30	Registration, *Ali'i I/Indoor Garden*
17:30—19:00	Networking Reception, *Paniolo Ocean Terrace*

Monday, 15 July		
	Naupaka III	*Naupaka V*
07:00—12:00	Registration, *Ali'i I/Indoor Garden*	
08:00—08:15	Opening Remarks, *Naupaka III*	
08:15—10:00	NM1A • Imaging and Spectroscopy I , *Naupaka III*	
10:00—10:30	Coffee Break, *Naupaka IV*	
10:30—12:30	NM2A • Femtosecond Frequency Combs	NM2B • New Concepts I
12:30—19:30	Free Afternoon	
19:00—20:00	Registration, *Ali'i I/Indoor Garden*	
19:30—21:30	NM3A • New concepts II	NM3B • Integrated Nonlinear Optics

Agenda of Sessions

Tuesday, 16 July		
	Naupaka III	*Naupaka V*
07:00—15:30	**Registration,** *Ali'i I/Indoor Garden*	
08:00—10:00	NTu1A • Fundamental Concepts and Multimodal Systems	NTu1B • Imaging and Spectroscopy II
10:00—10:30	**Coffee Break**, *Naupaka IV*	
10:30—12:30	NTu2A • Nonlinear Waves	NTu2B • THz Emission and Propagation
12:30—14:00	**Lunch Break** (on your own)	
14:00—16:00	NTu3A • Nonlinear Plasmonics and Ultrafast Charge Transport	NTu3B • New Sources and Materials
16:00—17:30	NTu4A • Poster Session, *Naupaka IV*	
17:30—18:30	Fiber Modeling and Fabrication Technical Group Reception, *Naupaka IV*	

Wednesday, 17 July		
	Naupaka III	*Naupaka V*
07:30—16:30	**Registration**, *Ali'i I/Indoor Garden*	
08:00—10:00	NW1A • Plenary Session, *Naupaka III*	
10:00—10:30	**Coffee Break**, *Naupaka IV*	
10:30—12:30	NW2A • Nonlinear Waves II, *Naupaka III*	
12:30—14:00	**Lunch Break** *(*on your own)	
14:00—15:30	NW3A • Lithium Niobate and Lithium Tantalate	NW3B • Chaos and Disorder
17:00—20:00	**Luau Reception**, *Luau Grounds*	

Agenda of Sessions

Thursday, 18 July		
	Naupaka III	*Naupaka V*
07:30—15:00	Registration, *Ali'i I/Indoor Garden*	
08:00—10:00	NTh1A • Machine Learning and Nonlinear Optics, *Naupaka III*	
10:00—10:30	Coffee Break, *Naupaka IV*	
10:30—12:30	NTh2A • Quantum	NTh2B • Fiber Lasers and Amplifiers
12:30—14:00	Lunch (on your own)	
14:00—15:30	NTh3A • Postdeadline Papers, *Naupaka III*	

Friday, 19 July	
Naupaka III	
07:30—12:00	Registration, *Ali'i I/Indoor Garden*
08:00—10:00	NF1A • 2D materials , *Naupaka III*
10:00—10:30	Coffee Break, *Naupaka IV*
10:30—12:30	NF2A • 2D Materials and Cavities , *Naupaka III*

CALL FOR PAPERS:

Nonlinear Optics 2019 Joint Feature Issue

Submission Opens: 15 September 2019
Submission Deadline: 15 October 2019

- Publish an account of your work as a peer-reviewed archival paper.
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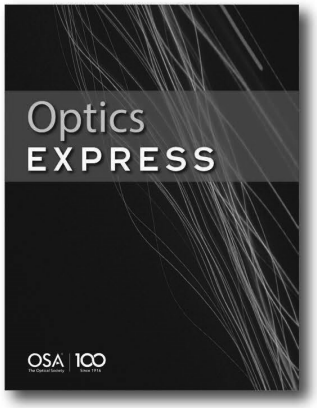

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Naupaka III

08:00 -- 08:15
Opening Remarks

08:15 -- 10:00
NM1A • Imaging and Spectroscopy I
Presider: Cornelia Denz; Westfaelische Wilhelms Univ Munster, Germany

NM1A.1 • 08:15 Invited
Terahertz Driven Electron and X-ray Sources, Franz X. Kaertner[1]; [1]*Universität Hamburg, Germany.* We develop a Terahertz driven accelerator technology with the goal to construct a compact, fully coherent, attosecond X-ray source suitable to outrun radiation damage effects due to high X-ray irradiance required for serial X-ray crystallography.

NM1A.2 • 08:45
Ultrafast All-Optical Detection of Chiral Degrees of Freedom by Symmetry Breaking High Harmonic Spectroscopy, Ofer Neufeld[1], David Ayuso[2], Piero Decleva[3], Mikhail Ivanov[2,4], Olga Smirnova[2,5], Oren Cohen[1]; [1]*Physics Dept. and Solid State Inst., Technion, Israel;* [2]*Max-Born Inst., Germany;* [3]*Dipartimento di Scienze Chimiche e Farmaceutiche, Università degli Studi di Trieste, Italy;* [4]*Dept. of Physics, Imperial College London, UK;* [5]*Technische Universität Berlin, Germany.* We theoretically explore a new all-optical chiroptical technique based on high harmonic generation, where the chiral signal is background-free and relies solely on electric-dipole interactions. We also demonstrate a similar approach for ultrafast ring-current detection.

NM1A.3 • 09:00 Invited
Half-Harmonic Generation: Enabling Photonic Solutions for Molecular Sensing and Non-Classical Computing, Alireza Marandi[1]; [1]*California Inst. of Technology, USA.* Half-harmonic generation is the inverse of second-harmonic generation. This talk overviews the concept, and how it is used for mid-IR frequency combs for molecular spectroscopy, and optical Ising machines, which can enable special-purpose nonclassical computing.

NM1A.4 • 09:30 Invited
Coherent spectroscopy of near-infrared materials for photonics , Ulrike K. Woggon[1]; [1]*Technische Universität Berlin, Germany.* Advanced heterodyne pump-probe techniques were developed and merged into broad-band 2D-coherent spectroscopy to study quantum state coupling within a wide energy range. We apply these NLO-techniques to NIR-materials like InAs QDs, PbS/CdS NCs and TMDs.

10:00—10:30 • Coffee Break, *Naupaka IV*

Naupaka III

10:30 -- 12:30
NM2A • Femtosecond Frequency Combs
Presider: To Be Announced

NM2A.1 • 10:30
Withdrawn

NM2A.2 • 10:45
Tunable Kerr frequency combs in an ultrahigh-Q hybrid microsphere cavity, Song Zhu[1], Lei Shi[1], Xinliang Zhang[1]; *[1]Huazhong Univ of Science and Technology, China.* We proposed and demonstrated tunable Kerr frequency combs based on an ultrahigh-Q hybrid microsphere cavity. An ultralow parametric threshold of 0.42 mW and a tuning range of 0.8 nm are realized.

NM2A.3 • 11:00
Phase-Matched Extreme-Ultraviolet Frequency-Comb Generation, Gil Porat[1], Christoph Heyl[1,2], Stephen Schoun[1], Craig Benko[1], Nadine Dörre[1,3], Kristan Corwin[1,4], Jun Ye[1]; *[1]JILA, Univ. of Colorado Boulder, USA; [2]Physics, Lund Univ., Sweden; [3]Univ. of Vienna, Austria; [4]Physics, Kansas State Univ., USA.* We achieve phase-matched high-harmonic generation at 77 MHz repetition rate, by using high-temperature gas mixtures to increase gas-jet velocity and reduce plasma accumulation. We generate record power of ~2mW at 97nm and ~0.9mW at 67nm.

NM2A.4 • 11:15 Invited
Octave-spanning Tunable Parametric Oscillation in Crystalline Kerr Microresonators, Miro J. Erkintalo[1]; *[1]Univ. of Auckland, New Zealand.* We experimentally demonstrate octave-spanning tunable parametric oscillation in crystalline Kerr microresonators using a standard low-power laser at 1550 nm.

NM2A.5 • 11:45
Resonant Electro-optic Frequency Comb Generation in Lithium Niobate Disk Resonator inside a Microwave Cavity, Alfredo Rueda[5,1], Florian Sedlmeir[3,4], Gerd Leuchs[3,1], Madhuri Kumari[1,2], Harald G. Schwefel[2,1]; *[1]Dept. of Physics, Univ. of Otago, New Zealand; [2]Dept. of Physics, The Dodd-Walls Centre for Photonic and Quantum Technologies, New Zealand; [3]Max Planck Inst. for the Science of Light, Germany; [4]Univ. Erlangen-Nuernberg, Inst. for Optics, Information and Photonics, Germany; [5]Inst. of Science and Technology Austria, Austria.* We demonstrate electro-optic frequency comb generation using a doubly resonant system comprising a whispering gallery mode disk resonator made of lithium niobate mounted inside a three-dimensional copper cavity. We observe 180 sidebands centred at 1550 nm.

Naupaka V

10:30 -- 12:30
NM2B • New Concepts I
Presider: Antonio Picozzi; Centre National Recherche Scientifique, France

NM2B.1 • 10:30 Invited
Topological Photonics in Momentum and Synthetic Spaces, Shanhui Fan[1], Avik Dutt[1], Cheng Guo[1], Qian Lin[1], Luqi Yuan[1], Meng Xiao[1], Momchil Minkov[1], D. A. B. Miller[1], Yu Guo[1]; *[1] Edward L. Ginzton Laboratory, Stanford University.* We experimentally demonstrate non-trivial topological physics in two synthetic dimensions. We also discuss skyrmion-related polarization textures in momentum space in the scattered light from a photonic crystal slab.

NM2B.2 • 11:00
Optical Temperature of a Soliton, Pawel Jung[1,2], Fan O. Wu[1], Absar U. Hassan[1], Demetrios N. Christodoulides[1]; *[1]Univ. of Central Florida, USA; [2]Warsaw Univ. of Technology, Poland.* We show that the zeroth law of thermodynamics can be used to measure a soliton's optical temperature in a nonlinear multimode system. Here, the modal gas plays the role of an optical thermometer.

NM2B.3 • 11:15
Demonstration of Flat-band Line States in Photonic Lattices, Shiqi Xia[1], Wenchao Yan[1], Daohong Song[1], Liqin Tang[1], Jingjun Xu[1], Zhigang Chen[1,2]; *[1]TEDA Applied Physics Inst. and School of Physics, Nankai Univ., China; [2]Dept. of Physics and Astronomy, San Francisco State Univ., USA. We demonstrate photonic Lieb and super-honeycomb lattices established with a cw-laser writing technique, thereby uncovering nontrivial flat-band line states that manifest noncontractible-loop-states in infinite flat-band systems arising from real-space topology.*

NM2B.4 • 11:30
A New Theoretical Formulation for the Nonlinear Pulse Propagation in Waveguide Geometries, Izzatjon Allayarov[1], Swaathi Upendar[1], Markus A. Schmidt[2,3], Thomas Weiss[1]; *[1]4th Physics Inst. and Research Center SCoPE, Univ. of Stuttgart, Germany; [2]Leibniz Inst. of Photonic Technology, Germany; [3]Otto Schott Inst. of Material Research, Friedrich Schiller Univ. of Jena, Germany.* We present and discuss a thorough theoretical formulation for the nonlinear pulse propagation in waveguide geometries that is capable of treating bound and leaky modes based on the so-called resonant state expansion with analytical mode normalization.

NM2B.5 • 11:45
Non-Hermitian Nonlinear Optics without Gain and Loss, Yanhua Zhai[1], Yue Jiang[2], Yefeng Mei[2], Ying Zuo[2], Shengwang Du[2], Jianming Wen[1]; *[1]Kennesaw State Univ., USA; [2]The Hong Kong Univ. of Science and Technology, Hong Kong.* We propose and demonstrate non-Hermitian but parity-time-symmetric four-wave mixing in cold atoms without linear gain and loss. Besides the occurrence of nontrivial phase transition, efficient nonlinear conversion without phase matching has also been observed.

Naupaka III

10:30 – 12:30
NM2A • Femtosecond Frequency Combs (Continued)

NM2A.6 • 12:00 Invited
Photonic Integrated Soliton Microcombs, Tobias J. Kippenberg[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland.* Abstract to be announced.

Naupaka V

10:30 – 12:30
NM2B • New Concepts I (Continued)

NM2B.6 • 12:00
Demonstration of simultaneous nonlinear polarization rotation and dispersive bistability, Drew N. Maywar[1], Saif Al Graiti[1]; [1]*Rochester Inst. of Technology, USA.* We experimentally demonstrate the simultaneous occurrence of two nonlinear optical phenomena --- nonlinear polarization rotation and dispersive optical bistabilty. The Stokes parameters exhibit bistable hystereses corresponding to a measured orthogonality of 30%.

NM2B.7 • 12:15
General Group Theory Derivation for Selection Rules in Nonlinear Light-Matter Interactions, Gavriel Lerner[1], Ofer Neufeld[1], Eliyahu Bordo[1], Liran Hareli[2], Georgiy Shoulga[2], Alon Bahabad[2], Daniel Podolsky[3], Avner Fleischer[4], Oren Cohen[1]; [1]*Physics Dept. and Solid State Inst., Technion, Israel;* [2]*Dept. of Physical Electronics, Tel Aviv Univ., Israel;* [3]*Physics Dept., Technion, Israel;* [4]*Chemistry Dept., Tel Aviv Univ., Israel.* We formulate a general group theory for the full symmetries of light-matter interactions, including macroscopic effects, deriving novel selection-rules for harmonic-generation in gas, liquids, and solids. We experimentally validate new selection-rules from an elliptical symmetry.

12:30—19:30 • Free Afternoon

Naupaka III

19:30 -- 21:30
NM3A • New concepts II
Presider: Ray-Kuang Lee; National Tsing Hua Univ., Taiwan

NM3A.1 • 19:30
Third-Order and Fifth-Order Optical Nonlinearities by Two-Dimensional Excitonics, Wei Ji[1]; *[1]National Univ. of Singapore, Singapore.* We present our two-dimensional excitonic models to quantitatively predict the giant optical nonlinearities in terms of Two- and Three-Photon Absorption, for monolayer transition-metal di-chalcogenides, or layered organic-inorganic hybrid perovskites. Our models are in agreement with the experimental measurements, within one order of magnitude.

NM3A.2 • 19:45
Femtosecond supercontinuum generation with noisy pumps in normal dispersion fibers with zero crossings , Shreesha Rao D. S.[1], Etienne Genier[2], Rasmus D. Engelsholm[1], Ivan B. Gonzalo[1], Binbin Zhou[1], Patrick Bowen[2], Peter M. Moselund[2], Thibault Sylvestre[3], John M. Dudley[3], Morten Bache[1], Ole Bang[1,2]; *[1]Dept. of Photonics Engineering, Danmarks Tekniske Universitet, Denmark; [2]NKT Photonics A/S, Denmark; [3]Institut FEMTO-ST, CNRS-Université de Franche-Comté, France.* We demonstrate surprising effects of technical pump laser fluctuations on the noise of a normal-dispersion fs-pumped supercontinuum and how the noise varies with power in fibers with a zero-dispersion at longer wavelengths.

NM3A.3 • 20:00
Beam Deflection Measurements of Transient Nonlinear Refraction in Air in the Mid-IR, Salimeh Tofighi[1], Natalia Munera[1], Munan Gao[1], David J. Hagan[1], Eric Van Stryland[1]; *[1]Univ. of Central Florida, CREOL, USA.* Using the Beam Deflection Technique, the bound-electronic and nuclear reorientation contributions to the nonlinear refraction of air are separately measured in the mid-infrared as a function of time below the ionization threshold.

NM3A.4 • 20:15
Ultrafast Nonlinear Refraction Measurements of Transparent Materials in the Mid-Infrared for Modeling Harmonic and Supercontinuum Generation, Trenton R. Ensley[1], Michael G. Hastings[2], Kevin Werner[3,4], Aaron Schweinsberg[5], Michael Tripepi[4,6], Noah Talisa[4], Brian L. Wilmer[7], Drake Austin[6,4], Christopher M. Wolfe[5], Miroslav Kolesik[2], Laura Vanderhoef[5], Anthony Valenzuela[5], Neal K. Bambha[1], Enam Chowdhury[4]; *[1]Sensors and Electron Devices Directorate, US Army Research Lab, USA; [2]College of Optical Sciences, Univ. of Arizona, USA; [3]BAE Systems, USA; [4]The Ohio State Univ., USA; [5]Weapons and Materials Research Directorate, US Army Research Lab, USA; [6]Materials and Manufacturing Directorate, US Air Force Research Lab, USA; [7]SURVICE Engineering, USA.* Nonlinear refraction coefficients are measured via the Z-scan technique in the mid-infrared spectral region for infrared transmitting materials. Harmonic and supercontinuum generation are modeled using the experimentally obtained values and compared to experimental observations.

NM3A.5 • 20:30
Nonlinear Photonic Jx Arrays as Saturable Absorbers and Optical Delimiters, Matthias Heinrich[1], Armin Kalita[2], Lukas Maczewsky[1], Max Ehrhardt[1], Alexander Szameit[1], Ramy El-Ganainy[2]; *[1]Univ. of Rostock, Germany; [2]Dept. of Physics, Michigan Technological Univ., USA.* We present a novel design for on-chip integrated saturable absorbers and optical limiters based on the so-called Jx lattice, and demonstrate its practical feasibility in realistic material platforms such as femtosecond laser-written waveguide arrays.

NM3A.6 • 20:45
Ultra-fast Kerr Switches on the Basis of Dielectric Multi-layer Films, Lars O. Jensen[1,2], Marco Jupé[1,2], Morten Steinecke[1], Detlev Ristau[1,2]; *[1]Laser Zentrum Hannover e.V., Germany; [2]PhoenixD - Leibniz Universität Hannnover, Germany.* By design of specific dielectric multi-layer films and with highly controllable coating processes, ultra-fast all-dielectric switches can be manufactured.

NM3A.7 • 21:00
Four-wave-mixing and its Application in Single-shot Temporal Contrast Measurement, Jun Liu[1]; *[1]Shanghai Inst of Optics and Fine Mech, China.* Clean 100-μJ-level laser pulses are generated by using single-stage cascaded four-wave-mixing process and then used as sampling pulses in single-shot cross-correlators. A dynamic-range of 10^{10} and temporal resolution of 160 fs are achieved simultaneously.

NM3A.8 • 21:15
High-efficiency radially-polarized pulses compression, Chunmei Zhang[1], Fanqi Kong[1], hugo larocque[2,3], Ebrahim Karimi[2], Paul Corkum[1,2]; *[1]Joint Attosecond Science Lab, Univ. of Ottawa and National Research Council of Canada, Canada; [2]Univ. of Ottawa, Canada; [3]Dept. of Electrical Engineering and Computer Science, MIT, USA.* We experimentally demonstrated the compression of a radially polarized vector beam with a central wavelength of 1.8μm in the same way that we compress Gaussian beams using a gas-filled hollow-core fiber.

Naupaka V

19:30 -- 21:30
NM3B • Integrated Nonlinear Optics
Presider: Majid Ebrahim-Zadeh; ICFO -Institut de Ciencies Fotoniques, Spain

NM3B.1 • 19:30
Withdrawn

NM3B.2 • 19:45
Second Harmonic Generation Induced by Longitudinal Components in Indium Gallium Phosphide Nanowaveguides, Nicolas Poulvellarie[1], Utsav Dave[6], Koen Alexander[2], Charles Ciret[5], Fabrice Raineri[4], Sylvain Combrié[3], Alfredo De Rossi[3], Gunther Roelkens[2], Simon-Pierre Gorza[1], Bart Kuyken[2], François Leo[1]; *[1]OPERA-photonique, Université libre de Bruxelles, Belgium; [2]Photonics Research Group, Ghent Univ.-IMEC, Belgium; [3]Thales Research and Technology, France; [4]Laboratoire de Photonique et de Nanostructures, France; [5]Laboratoire de Photonique d'Angers, Université d'Angers, France; [6]Columbia Univ., USA.* We experimentally demonstrate second harmonic generation in Indium Gallium Phosphide waveguides by mixing transverse and longitudinal components of the optical fields. We confirm the excitation of an antisymmetric second harmonic mode through modal imaging.

NM3B.3 • 20:00
Light, Sound and Microwave Induced Modulation in Microcavity Brillouin Laser, Jianfan Yang[1], Tian Qin[1], Wenjie Wan[1]; *[1]Shanghai Jiao Tong Univ., China.* We experimentally observe light, sound and microwave induced modulation in an optomechanical microcavity Brillouin laser system. Unique applications as dual-channel communication and microwave subwavelength imaging have been demonstrated in such hybrid platform.

NM3B.4 • 20:15
Sub-ps optical pulse compression in ultra-silicon-rich nitride waveguides, Ju Won Choi[1], Byoung-Uk Sohn[1], George F. Chen[1], Doris K. Ng[2], Dawn T. Tan[1]; *[1]Singapore Univ. of Technology & Design, Singapore; [2]A*STAR (Agency for Science, Technology and Research), Singapore.* We demonstrate the optical pulse compression of 2ps laser down to 230fs pulse resulting in 8.7 times compressed using a USRN waveguide. The process is facilitated by high-order soliton formation arising from a large nonlinear parameter and anomalous group velocity dispersion.

NM3B.5 • 20:30
Compact and low loss silicon carbide waveguide with high nonlinearity based on CMOS-compatible platform, Peng Xing[1], Danhao Ma[2], Kelvin Jian Aun Ooi[3], Ju Won Choi[1], Anuradha Murthy Agarwal[4], Dawn Tse Hui Tan[1]; *[1]Singapore Univ. of Technology and Design, Singapore; [2]Dept. of Materials Science & Engineering, MIT, USA; [3]Xiamen Univ. Malaysia, Malaysia; [4]Materials Research Lab, MIT, USA.* Silicon carbide ring resonator is demonstrated with intrinsic Q-factor of 160,000. Waveguide with nonlinear parameter $40W^{-1}/m$ is demonstrated. Material Kerr nonlinearity is measured to be $4.8 \times 10^{-14} cm^2/W$ and three photon absorption coefficient is around $0.01 cm^3/GW^2$.

NM3B.6 • 20:45
Phase-Matching Unsensitive to Waveguide Parameters Variations in χ^2 Based Nonlinear Integrated Optics Devices, Maxim Neradovskiy[1], Hervé Tronche[1], Xin Hua[1], Elizaveta Neradovskaia[1], Martin Richter[1], Ulrich Kuhl[1], Pierre Aschieri[1], Florent Doutre[1], Tommaso Lunghi[1], Pascal Baldi[1], Olivier Alibart[1], Sebastien Tanzilli[1], Marc D. Micheli[1]; *[1]Université Côte d'Azur, France.* Nonlinear interactions utilising modal phase-matching in waveguides can be unsensitive to waveguide parameters variations. This is due to a particular shape of the index profile and presents many advantages for device conception and fabrication.

NM3B.7 • 21:00 Invited
Brillouin-Based Nonreciprocity and Laser Cooling in Silicon Photonics, Peter T. Rakich[1], Eric Kittlaus[1], Nils Otterstrom[1], Ryan Behunin[2], Shai Gertler[1], Prashanta Kharel[1]; *[1]Yale Univ., USA; [2]Physics, Northern Arizona Univ. , USA.* We use strong and tailorable stimulated Brillouin scattering in silicon waveguides to demonstrate wideband nonreciprocity (>100GHz), silicon-based Brillouin laser oscillators, and laser-cooling of a continuum of phonon modes.

Naupaka III

08:00 -- 10:00
NTu1A • Fundamental concepts and multimodal systems
Presider: Nail Akhmediev; Australian National Univ., Australia

NTu1A.1 • 08:00
Passive Parabolic Pulse Generation in Tapered Multimode Fibers, Helena E. Lopez Aviles[1], Michael Buttolph[2], Frank W. Wise[2], Rodrigo Amezcua Correa[1], Demetrios N. Christodoulides[1]; *[1]Univ. of Central Florida , USA; [2]School of Applied and Engineering Physics, Cornell Univ., USA.* We propose a new technique for generating self-similar parabolic pulses in exponentially tapered multimode fibers. In such amplification-free settings, the input pulse evolves into a pulse with a parabolic profile and a high-quality linear chirp.

NTu1A.2 • 08:15
Spatial and Spectral Nonlinear Beam Control with Active Multimode Graded Index Fiber Taper, Alioune Niang[1], Tigran Mansuryan[2], Katarzyna Krupa[3,1], Alessandro Tonello[2], Marc Fabert[2], Philippe Leproux[2], Daniele Modotto[1], Guy Millot[3], Vincent COUDERC[2], Stefan Wabnitz[4]; *[1]Univ. of Brescia, Italy; [2]Université de Limoges, XLIM, UMR CNRS 7252, 123 Avenue A. Thomas, 87060 Limoges, France, France; [3]Université Bourgogne Franche-Comté, ICB, UMR CNRS 6303, 9 Avenue A. Savary, 21078 Dijon, France, France; [4]DIET, Sapienza Università di Roma, via Eudossiana 18, 00184 Rome, Italy, Italy.* We experimentally demonstrate spatial beam self-cleaning in tapered Ytterbium-doped multimode fiber with parabolic index and doping profile in passive and active configurations. We also obtained supercontinuum emission in the range 520 nm-2600 nm.

NTu1A.3 • 08:30
Thermal Decoherence and Laser Cooling of Kerr Solitons, Jordan Stone[1], Tara E. Drake[1], Travis C. Briles[1], Scott Papp[1]; *[1]NIST, USA.* We explore the regime of strong thermal-noise correlations between a Kerr soliton and its environment, including a thermal-noise-limited carrier-envelope phase. By passive photothermal backaction, we effectively laser cool the soliton to 84 K.

NTu1A.4 • 08:45
Experimental Realization of Riemann Problem in Nonlinear Fiber Optics, Stefano Trillo[1], Abdelkrim Bendahmane[2], Gang Xu[2], Matteo Conforti[2], Alexandre Kudlinski[2], Arnaud Mussot[2]; *[1]Universita degli Studi di Ferrara, Italy; [2]PhLAM - Physique des Lasers Atomes et Molecules, Univ. of Lille, France.* We experimentally and theoretically investigate the nonlinear evolution of an abrupt jump in frequency (Riemann problem), observing different phase transitions of the flow which agree quantitatively with predictions from Whitham modulation theory.

NTu1A.5 • 09:00 Invited
Optical Thermodynamics of Polarization Interactions in Nonlinear Multimode Systems, Fan O. Wu[1], Absar U. Hassan[1], Demetrios N. Christodoulides[1]; *[1]Univ. of Central Florida, USA.* We show that the optical internal energy of a nonlinear multimoded optical lattice involving two circular polarizations always flows from a hotter to a colder system– as expected from the second law of thermodynamics.

NTu1A.6 • 09:30 Invited
Disorder-Induced Acceleration of Thermalization in Multimode Optical Fibers, Adrien Fusaro[2], Josselin Garnier[3], Katarzyna Krupa[2,4], Guy Millot[2], Antonio Picozzi[1]; *[1]Centre National Recherche Scientifique, France; [2]Laboratoire Interdisciplinaire Carnot de Bourgogne, CNRS, Université Bourgogne Franche-Comté, France; [3]Ecole Polytechnique, France; [4]Uiversity of Brescia, Italy.* We show theoretically that disorder in multimode fibers is responsible for a dramatic acceleration of optical condensation, which can explain the spatial beam self-cleaning phenomenon. Experiments report the observation of the transition to light condensation.

Naupaka V

08:00 -- 10:00
NTu1B • Imaging and Spectroscopy II
Presider: Ulrike Woggon; Technische Universität Berlin, Germany

NTu1B.1 • 08:00
Enhance imaging depth in wide-field two-photon microscopy by extended detection and computational reconstruction, Yuanlong Zhang[1], Tiankuang Zhou[1], Xuemei Hu[2], Hao Xie[1], Qionghai Dai[1], Lingjie Kong[1]; *[1]Tsinghua Univ., China; [2]Nanjing Univ., China.* Line-scanning temporal focusing microscopy is competitive in high imaging speed but still suffers from tissue scattering. We propose the extended detection and computational reconstruction technique, to extract signals from scattering photons and enhance imaging depths.

NTu1B.2 • 08:15
Temporal structured illumination time-stretch microscopy, Yuhua Duan[1], Xin Dong[1], Ningning Yang[1], Chi Zhang[1], Kenneth Wong[2], Xinliang Zhang[1]; *[1]WNLO, China; [2]Dept. of Electrical and Electronic Engineering, The Univ. of Hong Kong, Hong Kong.* A temporal structured illumination concept is proposed, and realized by a sinusoidal driven electro-optic intensity modulator. It doubles the acquisition bandwidth to capture ultrafast optical signal, which is demonstrated in the time-stretch microscopy application.

NTu1B.3 • 08:30
Functional Nonlinear Spectroscopy using Phase Modulated Light Fields, Khadga J. Karki[1]; *[1]Lund Univ., Sweden.* Recent measurements have shown that different nonlinear contributions to photocurrent and fluorescence in molecules, semiconductors, and devices can be isolated by using phase modulated light fields. A brief overview of the recent developments is presented.

NTu1B.4 • 08:45
Studying Multielectron Excitation and Fragmentation with Ultrafast XUV-IR Spectroscopy, Alexander Plunkett[1], Nathan Harkema[1], Robert Lucchese[2], C. William McCurdy[2], Arvinder S. Sandhu[1]; *[1]Univ. of Arizona , USA; [2]Lawrence Berkeley National Lab, USA.* We used XUV-IR transient photoelectron spectroscopy to study excited state dynamics in oxygen and observed 4p excited atomic fragments, which are not an expected dissociation product. This fragment results from previously unexplored multielectron excitation pathway

NTu1B.5 • 09:00
Engineered generation of high order stimulated Raman scatterings, Chiaki Ohae[1,2], Weiyong Liu[1,2], Jian Zheng[1], Masaru Suzuki[1], Kaoru Minoshima[1,2], Masayuki Katsuragawa[1,2]; *[1]Univ. of Electro-Communications, Japan; [2]JST, ERATO, MINOSHIMA Intelligent Optical Synthesizer Project, Japan.* We discuss how we may have a wide freedom to engineer nonlinear optical phenomena by introducing arbitrary manipulation of relative phases among the relevant optical-fields. We show, as a typical example, engineered generation of high-order stimulated-Raman-scatterings.

NTu1B.6 • 09:15
First Observations of Ultrafast Magneto-electric Charge Separation and Induced Molecular Rotations, Tuan M. Trinh[1]; *[1]Univ. of Michigan, USA.* We report harmonic generation mediated by magneto-electric charge separation in pentacene and optically-induced magnetization in a series of liquid tetrahalides for the first time

NTu1B.7 • 09:30
Nonlinear Optics and Quantum Temporal Imaging, Mikhail I. Kolobov[1], Giuseppe Patera[1], Dmitri B. Horoshko[1,2]; *[1]Universite de Lille, France; [2]B. I. Stepanov Inst. of Physics, Belarus.* Temporal imaging enables manipulations of temporal optical signals in a manner similar to processing of optical images in spatial domain. In this talk we shall give an overview of the quantum temporal imaging and its application for noiseless manipulation of non-classical states of the light.

NTu1B.8 • 09:45
Noise and Sensitivity in Electric-Field-Sampled Infrared Frequency Comb Spectroscopy, Alexander Lind[1,2], Abijith Kowligy[1,2], Henry Timmers[1], Flavio Cruz[1,2], Jens Biegert[3], Scott A. Diddams[1,2]; *[1]NIST, USA; [2]Physics, Univ. of Colorado, Boulder, USA; [3]ICFO, Spain.* We report on the noise and sensitivity limitations in mid-infrared dual-comb spectroscopy that employs nonlinear electro-optic-sampling. Atmospheric propagation and detection is explored, exemplifying noise and sensitivity scaling.

Naupaka III

10:30 – 12:30
NTu2A • Nonlinear Waves
Presider: Claudio Conti, ISC-CNR Dep. Physics Univ. Sapienza Italy

NTu2A.1 • 10:30 Invited
New developments in the theory of rogue waves, Nail Akhmediev[1]; [1]*Australian National Univ., Australia.* Rogue waves are solutions of an evolution equations that are localised both in time and in space. There is a variety of solutions of the NLSE and other evolution equations that satisfy this criterion.

NTu2A.2 • 11:00
Akhmediev Breathers and Modulation Instability's Growth-Decay Cycle in Slab Waveguides, Roland Schiek[1], Frank Setzpfandt[2], Fabio Baronio[3]; [1]*Electrical Engineering, Ostbayerische Technische Hochschule, Germany;* [2]*Inst. of Applied Physics, Friedrich-Schiller-Universitaet Jena, Germany;* [3]*Universita di Brescia, Italy.* Optical film waveguides served as new platform for investigating Akhmediev Breathers. Using the interplay between third-order and cascaded second-order optical nonlinearities breathers and modulation instability cycles in a wide nonlinear regime were characterized.

NTu2A.3 • 11:15
Topological Control of Optical Extreme Waves, Giulia Marcucci[1], Davide Pierangeli[1], Aharon J. Agranat[2], Ray-Kuang Lee[3], Eugenio DelRe[1], Claudio Conti[1]; [1]*Physics Dept., Sapienza Univ. of Rome, Italy;* [2]*Applied Physics Dept., Hebrew Univ. of Jerusalem, Israel;* [3]*Inst. of Photonics and Technologies, National Tsing-Hua Univ., Taiwan.* We introduce the topological control, based on correspondences between phases and genus of toroidal surfaces associated with nonlinear Schroedinger equation. We prove it experimentally and report observations of controlled transitions from shock to rogue waves.

NTu2A.4 • 11:30
Kerr-breather-soliton classical time crystals, Scott Papp[1], Daniel C. Cole[1]; [1]*NIST, USA.* We describe Kerr-breather-soliton time crystals in which a breathing excitation is sub-harmonically locked to the repetition frequency. Nonlinear modeling explores the behavior of soliton time crystals, and we will report on progress towards their observation.

NTu2A.5 • 11:45
Observation of Fermi-Pasta-Ulam-Tsingou recurrence in spatial optical dynamics, Davide Pierangeli[2,1], Mariano Flammini[1], Lifu Zhang[2], Giulia Marcucci[1], Aharon J. Agranat[3], Piotr G. Grinevich[4], Paolo M. Santini[1], Claudio Conti[5,1], Eugenio DelRe[1]; [1]*Università di Roma La Sapienza, Italy;* [2]*ICL-2DMOST, Shenzhen Univ., China;* [3]*Hebrew Univ. of Jerusalem, Israel;* [4]*Landau Inst. for Theoretical Physics, Russia;* [5]*Inst. for complex systems (ISC-CNR), Italy.* We report the observation of more than three Fermi-Pasta-Ulam-Tsingou recurrences in nonlinear optical wave propagation and experimentally demonstrate that the recurrent behavior is governed by the exact solution of the nonlinear Schrodinger integrable dynamics.

NTu2A.6 • 12:00 Invited
Nonlinear Modulational Instability: Recurrences, Broken Symmetry, and Breathers, Stefano Trillo[1], Corentin Naveau[2], Pascal Szriftgiser[2], Matteo Conforti[2], Alexandre Kudlinski[2], Francois Copie[2], Arnaud Mussot[2]; [1]*Universita degli Studi di Ferrara, Italy;* [2]*PhLAM, Physique des Lasers Atomes et Molécules, Université de Lille, France.* We investigate the nonlinear stage of modulational instability reporting experimental evidence for symmetry breaking of recurrent evolutions entailing growth and decay of sideband combs, and discussing its breakdown resulting from temporal confinement of the perturbation.

12:30—14:00 • Lunch (on your own)

Naupaka V

10:30 – 12:30
NTu2B • THz Emission and Propagation
Presider: To Be Announced

NTu2B.1 • 10:30
THz Emissions by Two-color Filaments in Air: Revisiting the Wavelength Scaling, Luc Berge[1], Alisée Nguyen[1], Korbinian Kaltenecker[2], Jean-Christophe Delagnes[3], Binbin Zhou[2], Eric Cormier[3], Nikita Fedorov[3], Rodrigue Bouillaud[3], Dominique Descamps[3], Illia Thiele[4], Stefan Skupin[5], Peter Uhd Jepsen[2]; [1]*Commissariat a l'Energie Atomique, France;* [2]*Dept. of Photonics Engineering, DTU Fotonik, Denmark;* [3]*Centre Lasers Intenses et Applications, France;* [4]*Dept. of Physics, Chalmers Univ. of Technology, Sweden;* [5]*Universite de Lyon, Institut Lumiere Matiere, France.* We report impressive growths in the terahertz energies supplied by air plasmas created by two-color laser pulses whose fundamental wavelength is increased. Comprehensive 3D simulations reveal the crucial role of the two-color relative phase.

NTu2B.2 • 10:45
High THz Field Emission Driven by Ionization-induced Ponderomotive Motions in Relativistic Plasmas Created by CO_2 lasers, Luc Berge[1], Jeremy Dechard[1]; [1]*Commissariat a l'Energie Atomique, France.* Terahertz generation by ultra-intense CO_2 (10.6 μm) laser fields is studied using particle-in-cell simulations. Photoionization is shown to catastrophically enhance relativistic plasma wakefields, causing a net downshift in the optical spectrum through stimulated Raman scattering.

NTu2B.3 • 11:00
Terahertz Photonics in Liquids, Qi Jin[1], Yiwen E[1], Jianming Dai[2], Liangliang Zhang[3], Cunlin Zhang[3], Anton Tcypkin[4], Sergey Kozlov[4], Xi-Cheng Zhang[1]; [1]*Univ. of Rochester, USA;* [2]*Tianjin Univ., China;* [3]*Capital Normal Univ., China;* [4]*ITMO Univ., Russia.* Water lines generate stronger THz signal than that from water films under the comparable laser excitation. Using the coherent control approach, modulated and unmodulated terahertz energy is quadratic and linearly on the laser energy, respectively.

NTu2B.4 • 11:15
Direct Nonlinear Refractive Index Coefficient Measurement of Water in THz Frequency Range, Anton N. Tsypkin[2], Maksim Melnik[2], Maria Zhukova[2], Irina Vorontsova[2], Sergey Putilin[2], Sergey Kozlov[2], Xi-Cheng Zhang[2,1]; [1]*The Inst. of Optics, Univ. of Rochester, USA;* [2]*International Lab of Femtosecond Optics and Femtotechnologies, ITMO Univ., Russia.* We measured n2 of liquid water in THz range by using the Z-scan method. The measured n2 is 3.5×10^(−10) cm^2/W which is six orders higher than the values for VIS and NIR spectral ranges.

NTu2B.5 • 11:30
Evidence for Terahertz Self-Starting Mirrorless Acoustic Phonon Parametric Oscillator with Distributed Feedback, Thomas E. Wilson[1]; [1]*Marshall Univ., USA.* Evidence is presented for a self-starting mirrorless 1.0-THz acoustic phonon parametric oscillator produced by acousto-optic phase-conjugate degenerate four-wave mixing in a THz laser-pumped silicon doping superlattice. Coherent nanosecond-pulsed THz compressional and shear waves were observed.

NTu2B.6 • 11:45
Nonlinear echelon slab based terahertz pulse sources, Gyorgy Toth[1], Priyo S. Nugraha[2,3], László Pálfalvi[1], József A. Fülöp[2,3], Gergo Krizsán[1,3], Levente Tokodi[1], Zoltán Tibai[1], Nicholas H. Matlis[4], Gábor Almási[1], János Hebling[1,2]; [1]*Inst. of Physics,Univ. of Pécs, Hungary;* [2]*MTA-PTE High-Field Terahertz Research Group, Hungary;* [3]*Szentágothai Research Centre, Hungary;* [4]*Center for Free-Electron Laser Science, Deutsches Elektronen Synchrotron, Germany.* Nonlinear echelon slab based energy-scalable lithium niobate terahertz sources were simulated and demonstrated experimentally. Both the plane-parallel and the imaging-free configurations enable to overcome earlier serious limitations and generate perfect beam quality with high efficiency.

NTu2B.7 • 12:00
High-Power Optical Parametric Generation and Amplification of Femtosecond Pulses at 2 Microns - Investigation of Pulse Duration Effects, Florian Elsen[1], Bernd Jungbluth[1], Sebastian Nyga[1], Jochen Wüppen[1], Dieter Hoffmann[1]; [1]*Fraunhofer ILT, Germany.* We investigate the evolution of the pulse duration with respect to the amplification in a highly efficient two-stage ultra-short pulse parametric frequency converter close to degeneracy at 2 micron wavelength without dedicated pulse-compression/stretching techniques.

NTu2B.8 • 12:15
Terahertz Spatial and Temporal Distribution in the Tilted-Pulse-Front Method, Lu Wang[1], Franz X. Kaertner[1]; [1]*Deutsches Elektronen-Synchrotron, Germany.* Detailed 2D+1 simulations imply that single-cycle terahertz generation using the tilted-pulse-front method leads to spatially and temporally inhomogeneous terahertz fields. This needs to be taken into consideration in follow on applications.

Naupaka III

14:00 – 16:00
NTu3A • Nonlinear Plasmonics and Ultrafast Charge Transport
Presider: Yuri Kivshar; Australian National Univ., Australia

NTu3A.1 • 14:00
Experimental Demonstration of Plasmon-Soliton Waves, Mathieu Chauvet[1,2], Tintu kuriakose[1,2], Gilles renversez[3], Mahmoud Elsawy[3], Virginie Nazabal[4], Tomas Halenkovič[5]; Petr Nemec[5]; *[1]Optics, FEMTO-ST Inst., France; [2]Univ. of Bourgogne Franche-Comté, France; [3]Fresnel Inst., France; [4]Université de Rennes I, France; [5]Univ. of Pardubice, Czechia.* We report the experimental observation of plasmon-soliton waves. The demonstration is performed in a chalcogenide-based four-layer planar geometry. It reveals a plasmon-enhanced Kerr self-focusing undergone by a TM polarized beam propagating inside the structure.

NTu3A.2 • 14:15
High power 2nd Stokes diamond Raman optical frequency conversion, Matthias Heinzig[1], Gonzalo Palma-Vega[1,2], Benjamin Yildiz[1,2], Till Walbaum[1], Thomas Schreiber[1], Ramona Eberhardt[1], Andreas Tünnermann[1,2]; *[1]Fraunhofer IOF, Germany; [2]Friedrich Schiller Univ. Jena, Germany.* We report the highest output-power from a diamond Raman oscillator in continuous-wave operation at 1478nm. An output power of 34W with 11% conversion efficiency was achieved. Furthermore, an effective suppression of Brillouin scattering is proposed.

NTu3A.3 • 14:30
Experimental observation of coherent population oscillation in graphene, Lei Gao[1]; *[1]Chongqing Univ. , China.* We demonstrate coherent population oscillation in graphene based on a phase-sensitive pump-probe system constructed with fiber-based Mach-Zehnder interferometer, where ground state population oscillates with a beat frequency equaling to pump and probe frequency difference.

NTu3A.4 • 14:45
Directed Two Photon Absorption and Quadratic Volume Scaling in Semiconductor Nanoplatelets, Riccardo Scott[1], Juan Climente[2], Jan Heckmann[1], Anatol Prudnikau[3], Artsiom Antanovich[3], Nina Owschimikow[1], Mikhail Artemyev[3], Ulrike K. Woggon[1], Nicolai Grosse[1], Joseph Planelles[2], Alexander Achtstein[1]; *[1]TU Berlin, Germany; [2]Univ. Jaume I, Spain; [3]Belorussian State Univ., Belarus.* Two photon k-space spectroscopy demonstrates highly directional two photon absorption in CdSe nanoplatelets. Based on the identified relevant transitions, the puzzling quadratic volume scaling of exceptionally high TPA and tunability is explained via excitonic correlation.

NTu3A.5 • 15:00
Ultrafast nonlinear dynamics of silver: a novel hydrodynamical approach, Andrea Marini[1], Alessandro Ciattoni[2], Claudio Conti[3,4]; *[1]Univ. of L'Aquila , Italy; [2]Consiglio Nazionale delle Ricerche, CNR-SPIN, Italy; [3]Dept. of Physics, Univ. Sapienza, Italy; [4]Inst. for Complex Systems (ISC-CNR), Italy.* We propose a novel set of hydrodynamical equations accounting for the dynamics of silver at ultrashort time scales demonstrating that absorption saturates owing to collision quenching, thus enabling novel plasmonic applications with reduced absorption.

NTu3A.6 • 15:15
Strong-Field Ultrafast Optics and Nanofabrication using Plasmonic Metasurfaces, Milutin Kovacev[1], Liping Shi[1], Uwe Morgner[1]; *[1]Leibniz Universität Hannover, Germany.* We present investigations on the enhancement and control of non-linear phenomena at nanoscales. Various types of metasurfaces show non-thermal ablation when exposed to intense light fields. We demonstrate applications in coherent frequency upconversion and nanofabrication.

NTu3A.7 • 15:30
Attosecond control of charged carriers and waveform sampling in solids, Dmitry Zimin[1,2]; *[1]Max Planck Inst. of Quantum Optics, Germany; [2]Dept. für Physik, Ludwig-Maximilians-Universität, Germany.* We demonstrate that non-linear excitation in solids can be used for the charge control with attosecond precision and for the sampling of optical waveforms in ambient conditions, covering spectral range from ultra-violet to far-infrared.

NTu3A.8 • 15:45
Strong Structural Nonlinearity from Plasmonic Metamaterials in the Infrared, Brian Wells[2], Anton Y. Bykov[3], Giuseppe Marino[3], Mazhar Nasir[3], Anatoly Zayats[3], Viktor A. Podolskiy[1]; *[1]Univ. of Massachusetts Lowell, USA; [2]Univ. of Hartford, USA; [3]Dept. of Physics and the London Centre for Nanotechnology, King's College London, UK.* We demonstrate the emergence of an effective bulk $\chi^{(2)}$ susceptibility in plasmonic composites and present an analytical description of this phenomenon. Geometrically tunable second harmonic response as well as strong infared nonlinearity are demonstrated.

Naupaka V

14:00 – 16:00
NTu3B • New Sources and Materials
Presider: Nathalie Vermeulen; Vrije Universiteit Brussel, Belgium

NTu3B.1 • 14:00 Invited
Optical Parametric Oscillators: New Breakthroughs in Mid-Infrared, M. Ebrahim-Zadeh[1,2]; *[1] ICFO-Institut de Ciencies Fotoniques, Spain, [2] Institucio Catalana de Recercai Estudis Avancats (ICREA), Spain.* The latest advances in nonlinear wavelength conversion sources and optical parametric oscillators based on a new generation of nonlinear materials covering spectral regions into the deep-infrared and novel applications in spectroscopy and imaging are described.

NTu3B.2 • 14:30
Z-scan and beam-deflection measurements of Indium-Tin-Oxide at epsilon-near-zero, Sepehr Benis[1], Natalia Munera[1], Eric Van Stryland[1], David J. Hagan[1]; *[1]Univ. of Central Florida, CREOL, USA.* We report Z-scan and beam-deflection measurements of Indium-Tin-Oxide at epsilon-near-zero. We observe near unity change in the index. Nondegenerate beam-deflection measurements at different incident angles are used to characterize the coupling efficiency to longitudinal plasmons.

NTu3B.3 • 14:45
Ultra flat mid-infrared supercontinuum source based on concatenation of Thulium and Germania doped silica fibers, Deepak Jain[1], Raghuraman Sidharthan[4], Patrick Bowen[2], Peter Moselund[2], Seongwoo Yoo[4], Ole Bang[3,2]; *[1]Univ. of Sydney, Australia; [2]NKT Photonics, Denmark; [3]DTU Denmark, Denmark; [4]NTU Singapore, Singapore.* We investigate the cascading scheme of Tm_2O_3-doped silica and highly GeO_2-doped silica fibers for ultra-flat mid-infrared supercontinuum generation. For optimum length of both fibers, an outstanding 4dB bandwidth from ~1.9μm to ~3μm can be obtained.

NTu3B.4 • 15:00
Nonlinear optical properties of ultra-rich silicon nitride, Byoung-uk Sohn[1], Ju Won Choi[1], Doris K. Ng[2], Dawn T. Tan[1]; *[1]Singapore Univ. of Technology and Design, Singapore; [2]Inst. of Microelectronics, A*STAR, Singapore.* Nonlinear optical properties of ultra-rich silicon nitride are investigated. The nonlinear refractive index and two-photo and three-photon absorption coefficients are measured in the range of 0.8μm–1.6μm covering the C- and L-bands.

NTu3B.5 • 15:15
Direct measurements of optical nonlinearity in indium tin oxide nanoparticles, Ananda Das[1], Connor Wolenski[1], Wounjhang Park[1]; *[1]CU Boulder, USA.* We present measurements of the nonlinear properties of indium tin oxide nanoparticles as we tune the excitation wavelength through the epsilon-near-zero region.

NTu3B.6 • 15:30
High-quality factor, nonlinear indium tin oxide nanoparticle-coated silica microsphere, Kyuyoung Bae[1], Jiangang Zhu[1], MIchael B. Grayson[1], Mo Zohrabi[1], Connor Wolenski[1], Thomas M. Horning[1], Juliet Gopinath[1], Wounjhang Park[1]; *[1]CU Boulder, USA.* We report an Indium Tin Oxide (ITO) nanoparticle-coated silica microsphere with a high nonlinear refractive index and quality factor. The nonlinear index of the coated microresonator is 5 times higher than the uncoated ones.

NTu3B.7 • 15:45
Frequency upconverted single-mode subwavelength perovskite nanolaser, Zhengzheng Liu[1], Xin Xing[1], Jie Yang[2], Juan Du[1], Xiaosheng Tang[2], Yuxin Leng[1], Ruxin Li[1]; *[1]Shanghai Inst of Optics and Fine Mech, China; [2]Chongqing Univ., China.* We report the single-mode, high-quality, picosecond pulses laser from an individual subwavelength scaled perovskite nanocuboid. The upconverted lasing threshold is as low as 374 μJ/cm² with temperature-insensitive optical gain and high characteristic temperature.

16:00 -- 17:30
NTu4A • Poster Session

NTu4A.1
Withdrawn

NTu4A.2
Terahertz nanospectroscopy of surface carrier dynamics in metal-nanopatterned semiconductors, Geunchang Choi[4,1], Taehee Kang[4], Minah Seo[2], Dai-Sik Kim[4], Young-Mi Bahk[3]; *[1]Dept. of Energy Science, Sungkyunkwan Univ., Korea (the Republic of); [2]Sensor System Research Center, Korea Inst. of Science and Technology, Korea (the Republic of); [3]Incheon National Univ., Korea (the Republic of); [4]Seoul National Univ., Korea (the Republic of).* We suggest a novel terahertz nanospectrosocpy for studying surface properties of bulk semiconductor (InP) where terahertz field enhancement and confinement by metallic nanogap enable to probe photoexcited surface carrier dynamics.

NTu4A.3
Conversion efficiency of high harmonic generation in diamond for 800 nm wavelength, Boyan Obreshkov[1], Tzveta Apostolova[1,2]; *[1]INRNE-BAS, Bulgaria; [2]Inst. for Advanced Physical Studies, New Bulgarian Univ., Bulgaria.* We investigate the time-evolution of electron excitation and high-harmonic generation in diamond bulk subjected to intense 800 nm laser pulse. We report the conversion efficiency of near-infrared to ultraviolet radiation and discuss aspects of the transient photoelectron distribution.

NTu4A.4
Nonlinear Optical Frequency Conversion Controlled by the Linear Electro-optic Effect, Cui Zijian[1], Jlangtao Guo[1,3], Xue Pan[1], Jle Miao[1], Lailin Ji[2], Mingying Sun[1], Dean Liu[1], Jianqiang Zhu[1]; *[1]Shanghai Inst of Optics and Fine Mech, China; [2]Shanghai Inst. of Laser Plasma, China; [3]Univ. of Chinese Academy of Sciences, China.* By introducing an external electric field in a KH_2PO_4 crystal, we demonstrated a frequency conversion scheme with wide prospect of application, which can drastically reduce the sensitivity of the phase-matching condition on angle and temperature.

NTu4A.5
Wide-field Polarimetric Second Harmonic Generation Microscopy of Biological Tissues, Leonardo J. Uribe Castano[1,2], Kamdin Mirsanaye[1,2], Ahmad Golaraei[1,3], Lukas Kontenis[4,5], Richard Cisek[1], Haitao Zhao[1], Virginijus Barzda[1,4]; *[1]Dept. of Physics, Univ. of Toronto, Canada; [2]Dept. of Chemical and Physical Sciences, Univ. of Toronto, Canada; [3]Princess Margaret cancer centre, Canada; [4]Physics, Vilnius Univ., Lithuania; [5]Light Conversion, Lithuania.* Structural properties of collagen fibers in biological tissue are studied with a wide-field microscope using a complete polarimetric second harmonic generation microscopy technique called double Stokes Muller polarimetry (DSMP).

NTu4A.6
The Study on the Mode Competition in GaN-based Hexagonal Microcavity, Menghan Liu[1], Peng Chen[1], Jing Zhou[1], Ru Xu[1], Yimeng Li[1], Cheng Ge[1], Haocheng Peng[1], ZiLi Xie[1], Xiangqian Xiu[1], Dunjun Chen[1], Ping Han[1], Yi Shi[1], Rong Zhang[1], Youdou Zheng[1]; *[1]School of Electronic Science and Engineering, Nanjing Univ., China.* The GaN-based hexagonal microcavities with 7.2 μm diameters have been demonstrated on Si substrate, and the lasing action have been attained by optical pumping at room temperature. The stimulation indicates the mode competition and the winner.

NTu4A.7
Femtosecond Laser Writing Waveguide in $KZnF_3:Ni^{2+}$, Heng Yin[1], Junli Wang[1], Jiabei Tang[1], Quan Hu[1], Changgui Lin[2], Shixun Dai[2], Zhiyi Wei[3]; *[1]Xidian Univ., China; [2]Ningbo Univ., China; [3]Chinese Academy of Sciences, China.* We report on the use of femtosecond laser to inscribe waveguide in 25KF-25ZnF_2-50SiO_2+0.5NiO ($KZnF_3:Ni^{2+}$) glass-ceramics (GCs), the minimum propagation loss (1.68 dB/cm) of the waveguide is determined at 1568 nm wavelength.

NTu4A.8
Fabricating Nanogap for SERS by Combing Laser Printing with Capillary-Force Self-Assembly on Soft Base, Zhaoxin Lao[1,2], Yanlei Hu[1], Dong Wu[1]; *[1]Univ. of Science and Technology of China, China; [2]The Chinese Univ. of Hong Kong, China.* Nanogap structure for plasmonic or optical application (*e.g.* SERS) is difficult to be manufactured with traditional top-down strategies. Here, a mechanical-tuning Capillary-force self-assembly method on soft base is proposed for the fabrication of nanogap

NTu4A.9
Higher Order Raman Amplification at Transmitter End in Non-Repeatered Coherent Fiber Optic Systems, Yasuhiro Aoki[1]; *[1]Saitama Inst. of Technology, Japan.* The effective maximum input power set by fiber nonlinearities in non-repeatered single-channel 120Gbps DP-16QAM fiber transmission systems has been shown to increase by values of as large as 9.0 dB, compared with that of without amplification, by applying cascaded Raman amplification at transmitter end.

NTu4A.10
Synchronization of Pairs of Nanosecond Pulses from a Laser with Two Gain Crystals Pumped with Two Different Sources, Daniel Staufert[1], Roger Cudney[1]; *[1]CICESE, Mexico.* A Q-switched laser emitting two pulses at 1047 and 1064 nm using two Nd:YLF and Nd:YVO_4crystals inside the same cavity, and pumped with two different wavelengths. A pre-study to generate THz radiation using DFG.

NTu4A.11
Numerical evaluation of thermal performance in high-power CW second harmonic generation, Susumu Kato[1], Sunao Kurimura[2], Norikatsu Mio[3]; *[1]Natl Inst of Adv Industrial Sci & Tech, Japan; [2]National Inst. for Materials Science, Japan; [3]School of Science, Univ. of Tokyo, Japan.* Nonlinear propagation equations and thermal conduction equation are numerically solved to investigate the laser-induced thermal effects on the laser propagation. The thermal performance of modules is evaluated by comparing the numerical and experimental results.

NTu4A.12 • 16:00
Photoresponse of Bulk Single-Crystal Perovskite $CH_3NH_3PbBr_3$ with Below-Bandgap Light Excitation, Yingxin Wang[1], Meng Chen[1], Jie Ding[1], Qingfeng Yan[1], Ziran Zhao[1]; *[1]Tsinghua Univ., China.* We report on the photoresponse of bulk single-crystal perovskite $CH_3NH_3PbBr_3$ under below-bandgap terahertz wave (10.44 meV) and visible light (1.95 eV) illuminations. Different photothermal and photoelectric responses to these two photon energies were observed.

NTu4A.13 • 16:00
Optimizing Contact Area Geometry and Taper Composition in Microknot Resonators, Alexandra Blank[1], Yoav Linzon[1]; *[1]Tel Aviv Univ., Israel.* We present a comprehensive Finite Element Method-based numerical study of microstructures defined on adiabatic tapered fibers. A practical recipe for the experimental realization of the significant Q -factor values improvement in microknot resonators is demonstrated.

NTu4A.14
Two types of femtosecond writing at thermal regime in phosphate glass, Nikolay Skryabin[1,2]; [1]*Moscow Inst. of Physics and Technology, Russia;* [2]*Quantum Technologies Centre, M. V. Lomonosov Moscow State Univ., Russia.* We report on investigation of femtosecond writing in phosphate glass at thermal regime. Two different types of written tracks are demonstrated for a wide range of laser repetition rates (< 2 MHz) and pulse energies (< 400 nJ).

NTu4A.15
Optical Kerr Effect in Organic Ultrastrongly Coupled Cavity Polaritons: Theory and Experiment, Michael J. Crescimanno[1]; [1]*Youngstown State Univ., USA.* We summarize the materials, experiments, the most revealing findings and describe the extensions of previous theory approaches to NLO processes in polaritonic matter as they relate to recent experiments in organic ultrastrongly coupled cavity polaritons.

NTu4A.16
Nearly complete survival of entangled biphoton through bound states in continuum in disordered photonic lattices, Huali Chen[2], Gang Wang[2], Ray-Kuang Lee[1]; [1]*National Tsing Hua Univ., Taiwan;* [2]*School of Physical Science and Technology, Soochow Univ., China.* We report that the persistence of the bound states in disordered photonic lattices leads to an interplay between the bound states in the continuum (BICs) and disorder-induced Anderson localized states.

NTu4A.17
Femtosecond Transient Absorption and Nonlinear Optical Studies of a Novel Zinc Phthalocyanine, Somdatta Bhattacharya[1], Chinmoy Biswas[2], Sai Santosh K. Raavi[2], Giribabu Lingamallu[3], Soma V. Rao[1]; [1]*ACRHEM, Univ. of Hyderabad, India;* [2]*Physics, IIT Hyderabad, India;* [3]*Polymers & Functional Materials Division, CSIR-Indian Inst. of Chemical Technology, India.* We investigate the photo physical properties of a novel Zinc phthalocyanine, PBI-Pc, employing femtosecond transient absorption technique and broadband third order nonlinear optical properties of PBI-Pc using the Z-scan technique with 1 kHz femtosecond pulses.

NTu4A.18
Quadratic soliton combs in doubly resonant half-harmonic generation, Aiguo Sheng[1], Yilong Zhao[1], Guangqiang He[1]; [1]*Shanghai Jiao Tong Univ., China.* We present the quadratic soliton-like combs in a half-harmonic generation regime by optical parametric oscillator configurations with a continuous pump.

NTu4A.19
Terahertz Photothermoelectric Detection Based on Three-Dimensional Microporous Graphene p-n Junction, Meng Chen[1], Yingxin Wang[1], Yi Huang[2], Ziran Zhao[1]; [1]*Tsinghua Univ., China;* [2]*Nankai Univ., China.* A three-dimensional microporous graphene-based terahertz detector with a p-n junction configuration was fabricated by the simple annealing method, and significantly enhanced photothermoelectric response due to the formation of the p-n junction was demonstrated experimentally.

NTu4A.20
A Spatial Gain Modulation Phenomenon in Brillouin Optical Time Domain Analysis Using a Couple of Pump and Probe Lights with Small Channel Spacing, Kenichiro Tsuji[1], Tomoyuki Uehara[1]; [1]*National Defense Academy, Japan.* We report a spatial gain modulation phenomenon in two-wavelength Brillouin optical time domain analysis for distributed optical fiber sensing. The dependence of modulation characteristics on channel spacing and power of pump lights is experimentally investigated.

NTu4A.21
Observation of Rogue Waves in Stretched Pulse Train from a Linear Cavity Mode-locked Fiber Laser, Sourav Das Chowdhury[1], Bhaswar Dutta Gupta[2], Mrinmay Pal[1]; [1]*CSIR-Central Glass & Ceramic Res. Inst., India;* [2]*Dept. of Applied Physics, Defence Inst. of Advanced Technology, India.* Experimental observation of rogue waves in temporally stretched optical pulse train from a linear cavity mode-locked fiber laser has been reported. Rogue waves appeared when the output spectral width was comparable to the filter bandwidth.

NTu4A.22
2-Beam Action Spectroscopy for Probing Multiphoton Absorption Processes in Photonic Materials, Nikos Liaros[1], Zuleykhan Tomova[1], Sandra A. Gutierrez Razo[1], Samuel R. Cohen[1], John T. Fourkas[1]; [1]*Univ. of Maryland at College Park, USA.* We employ a new methodology, based on excitation with two independent beams, for determining the order of absorptive nonlinearity and probing multiphoton photophysics in different materials, using polymerization, photocurrent, or fluorescence as proxies for absorption.

NTu4A.23
Polarization-resolved *Z*-scan measurements to discriminate two distinct mixed refractive nonlinearities, Marlon d. Melhado[1], Tiago G. de Souza[1], Emerson C. Barbano[2], Sergio C. Zilio[1], Lino Misoguti[1]; [1]*Instituto de Física de São Carlos, USP, Brazil;* [2]*Fisica, Universidade Federal do Parana, Brazil.* Different nonlinear optical processes may occur during light-matter interaction such as electronic, orientational and thermal. We investigated polarization-resolved Z-scan to distinguish two of these processes occurring simultaneously. Analytical equations were derived to quantify the contributions.

NTu4A.24
Withdrawn

NTu4A.25
Ultrafast laser plasma wake-field determination, Yan Peng[1], Shiwei Zhou[1], Yiming Zhu[1]; [1]*Univ of Shanghai for Science & Tech, China.* We have proposed an effective method for determining the laser plasma wake-field basing on the mutual offset resulting from positive laser plasma wake-field and external negative electric field. The measurement system is simple and stable.

NTu4A.26
Rogue Waves in Pulse Transition due to Spectral Filtering Effect in a Mode-Locked Fiber Laser, Bhaswar Dutta Gupta[2], Sourav Das Chowdhury[1], Mrinmay Pal[1]; [1]*CSIR-Central Glass & Ceramic Res. Inst., India;* [2]*Dept. of Applied Physics, Defence Inst. of Advanced Technology, India.* Spectral filtering induced state transitions in all-normal dispersion mode-locked fiber laser have been numerically studied. Rogue waves were obtained in chaotic state near stable multi-pulsing regime depending on spectral filter bandwidth.

16:00 – 17:30
NTu4A • Poster Session– Continued

NTu4A.27
Quantum correlated photon-pair generation in silicon waveguides with on-chip notch filtering of pump laser, Jung Jin Ju[1]; [1]*ETRI, Korea (the Republic of).* We integrate a silicon waveguide spiral followed by on-chip cascaded Mach-Zehnder interferometers(MZIs) on a single chip. The silicon waveguide generates photon pairs by spontaneous four-wave mixing and the MZI filters separate the co-propagating pump

NTu4A.28
Experimental Characterisation of the Ultrafast Kerr Nonlinearity in Graphene, Siddharatha Thakur[1], Behrooz Semnani[1], Safieddin Safavi-Naeini[1], Amirhamed H. Majedi[1]; [1]*Electrical and Computer Engineering, Univ. of Waterloo, Canada.* In this study we systematically measure the near-infrared spectral dependence, the sub-picosecond temporal evolution and pulse-width dependence of the effective Kerr coefficient ($n_{2,eff}$) of graphene in hundreds of femtosecond regime. Throughout our study the $n_{2,eff}$ remains positive.

NTu4A.29
Chirped Periodically Poled $LiNbO_3$ Ridge Waveguide Device for Broadening of Quasi-Phase-Matching Bandwidth, Tadashi Kishimoto[1], Hitoshi Murai[1]; [1]*Oki Electric Industry Co., Ltd., Japan.* We designed and developed a chirped periodically poled $LiNbO_3$ ridge waveguide device to broaden a quasi-phase-matching bandwidth. We achieved a broad bandwidth of second harmonic generation of 4.6 nm in a telecommunication band.

NTu4A.30
Layer-dependent Third-Harmonic Generation in Multi-layer $SnSe_2$, Rabindra Biswas[1], Medha Dandu[1], Keshav K. Jha[1], Sruti Menon[1], Jyothsna KM[1], Kausik Majumdar[1], Varun Raghunathan[1]; [1]*Electrical Communication Engineering, Indian Inst. of Science Bangalore, India.* We report the layer-dependent third-harmonic generation from $SnSe_2$ and deduce the magnitude of effective $\chi^{(3)}$ in $SnSe_2$ from the measured third-harmonic generation using an analytical model.

NTu4A.31
Second harmonics enhancement by nanostructures, Ekaterina V. Ponizovskaya Devine[1]; [1]*Univ. of California Davis, USA.* The study shows numerical simulations of the second harmonic generation in nanostructures. We consider structures with Sn cylinders embedded into Si. The second harmonic generation was enhanced compared with flat layers of Si on Sn.

NTu4A.32
Observation of strong local inhomogeneity of the optical nonlinearities on polycrystalline zincblende semiconductors, Jorge A. Gomes[1], Emerson C. Barbano[2], Sergio C. Zilio[1], Lino Misoguti[1]; [1]*Instituto de Física de São Carlos, USP, Brazil;* [2]*Fisica, Universidade Federal do Parana, Brazil.* We observed that polycrystalline zincblende semiconductors such as ZnSe present strong inhomogeneity on their local nonlinearity. This inhomogeneity is related to the presence of grains and their random crystallographic orientation relatively to laser polarization.

NTu4A.33
New Heteroepitaxially Grown Materials for Frequency Conversion in the Mid and Longwave Infrared, Vladimir Tassev[1], Shivashankar Vangala[1]; [1]*Air Force Research Lab, USA.* Novel binary and ternary nonlinear optical materials such as ZnSe, GaSe and GaAsP have been grown heteroepitaxially on foreign substrates and on orientation-patterned templates by hydride vapor phase epitaxy for frequency conversion devices.

NTu4A.34
Synchronously Pumped Raman Lasers Based on Yttrium, Gadolinium, and Calcium Orthovanadate Crystals Generating at Combined Stretching and Bending Raman Modes, Milan Frank[1], Sergei Smetanin[2], Michal Jelinek[1], David Vyhlídal[1], Lyudmila Ivleva[2], Elizaveta Dunaeva[2], Irina Voronina[2], Vladislav Shukshin[2], Petr Zverev[2], Vaclav Kubecek[1]; [1]*Czech Technical Univ. in Prague, Czechia;* [2]*Prokhorov General Physics Inst., Russian Academy of Sciences,, Russia.* Synchronously-pumped Raman lasers based on YVO_4, $GdVO_4$, and $Ca_3(VO_4)_2$ crystals generating on both stretching and bending Raman modes with more than 30 times pump pulse shortening down to 0.8-1.2 ps are demonstrated.

NTu4A.35
Characterization of Tensorial Second Order Optical Nonlinearity of Epitaxial Barium Titanate Thin Films, Pao T. Lin[1], junchao zhou[1]; [1]*Texas A&M Univ., USA.* The tensorial second order optical nonlinearity of the epitaxial $BaTiO_3$ thin films was characterized by second harmonic generation (SHG). The thin film was prepared by pulsed laser deposition (PLD). From the azimuthal-dependent SHG intensity, the ferroelectric a/c domain fraction ratio was resolved.

NTu4A.36
Observation of eleven-photon absorption and four-photon absorption excited photoluminescence in GeSbS chalcogenide glass, Byoung-uk Sohn[1], Myungkoo Kang[2], Ju Won Choi[1], Anuradha Murthy Agarwal[3], Kathleen Richardson[2], Dawn T. Tan[1]; [1]*Singapore Univ. of Technology and Design, Singapore;* [2]*Univ. of Central Florida, USA;* [3]*MIT, USA.* The nonlinear optical properties of GeSbS chalcogenide glass are characterized in the wavelength range from 1.1-5.5μm. High order multi-photon up to the 11th order, multi-photon induced photoluminescence and nonlinear refractive indices are experimentally measured.

NTu4A.37
Dirac-like Degeneracy Points of Exceptional Surface in 4D Non-Hermitian Synthetic Space, Hui Liu[1]; [1]*Nanjing Univ., China.* In this work, we investigate the topological properties of Dirac-like degeneracy points of exceptional surfaces in non-Hermitian systems, which is very sensitive to the tiny environmental perturbation with PT-symmetry breaking.

NTu4A.38
Withdrawn

NTu4A.39
10-μJ Level, 20-Picosecond Difference-Frequency Generation at 9.21 μm in $LiGaS_2$ Pumped by 1.064/1.203 μm Nd:YAG/$CaCO_3$ Raman Laser, Sergei Smetanin[2,3], Michal Jelinek[1], Vaclav Kubecek[1], Aleksey Kurus[4,5], Kirill Zheltov[3], Sergey Lobanov[4,5], Lyudmila Isaenko[4,5]; [1]*Czech Technical Univ. in Prague, Czechia;* [2]*Prokhorov General Physics Inst., Russian Academy of Sciences, Russia;* [3]*National Univ. of Science and Technology MISiS, Russia;* [4]*Sobolev Inst. of Geology and Mineralogy, Russia;* [5]*Novosibirsk State Univ., Russia.* Single-pass frequency conversion of 20-picosecond 1.064/1.203 μm Nd:YAG/$CaCO_3$ Raman laser radiation into the wavelength of 9.21 μm with a 10-μJ level of output pulse energy by difference-frequency generation in a $LiGaS_2$ crystal is demonstrated.

16:00 – 17:30
NTu4A • Poster Session– Continued

NTu4A.40
Thick Heteroepitaxial Growth of ZnSe on GaAs Substrates for Frequency Conversion in the MLWIR, Shivashankar Vangala[1], Vladimir Tassev[1], Michael Snure[1]; *[1]Air Force Research Lab, USA.* Over 100 μm thick single crystalline ZnSe layers have been produced by hydride vapor phase epitaxy on GaAs substrates. Thick growth on OP-GaAs templates is a step closer for realizing frequency conversion in the MLWIR.

NTu4A.41
Measurement of Effective Four-Photon Absorption in Semiconductors, Gyula Polonyi[1,2], Balázs Monoszlai[1,3], Priyo S. Nugraha[1], Gyorgy Toth[2], László Pálfalvi[1], Luis Nasi[1], Zoltan Ollmann[1,4], Egmont Rohwer[4], Gregory Gaumann[4], Thomas Feurer[4], János Hebling[1,2], József A. Fülöp[1,2]; *[1]Inst. of Physics and Szentágothai Research Centre, Univ. of Pécs, Hungary; [2]MTA-PTE High-Field Terahertz Research Group, Hungary; [3]ELI-ALPS, ELI-Hu Nonprofit Ltd., Hungary; [4]Inst. of Applied Physics Univ. of Bern, Switzerland.* Intensity-dependent four-photon absorption coefficients of Gallium-Phosphide (GaP) and Zink-Telluride (ZnTe) have been measured by the z-scan method at 1.75 μm pump wavelength. Anisotropy in the effective four-photon absorption has been shown in GaP.

NTu4A.42
Withdrawn

NTu4A.43
Withdrawn

NTu4A.44
Research on Growth and Properties of YCOB NLO Crystal, xiaoniu Tu[1,2], Sheng Wang[1], Xiaoyang Guo[3], Kainan Xiong[1], Erwei Shi[1], Yanqing Zheng[1]; *[1]Shanghai Inst. of Ceramics, Chinese Academy of Sciences, China; [2]Univ. of Chinese Academy of Sciences, China; [3]Shenzhen Technology Univ., China.* YCOB were grown by the Bridgman method and a element of 100 mm aperture was harvested. Rocking curve, transmittance, damage threshold and Type-I phase-matched SHG were studied. The maximum SHG conversion efficiency is 61.5%.

NTu4A.45
Optical Mode Conversion Through Nonlinear Two-Wave Mixing, Danilo G. Pires[1], José Carlos A. Rocha[1], Alcenísio José Jesus-Silva[1], Eduardo Jorge Silva Fonseca[1]; *[1]Universidade Federal de Alagoas, Brazil.* Two-wave mixing under second harmonic generation is used to convert Hermite-Gaussian modes into other modes. The nonlinear medium selects the basis needed and the second harmonic superposition is then converted into another mode.

NTu4A.46
Controlling electron quantum paths for generation of circularly polarized high-order harmonics by H_2^+ subject to tailored (ω, 2ω) counter-rotating laser fields, John T. Heslar[1], Shih-I Chu[1,2]; *[1]National Taiwan Univ., Taiwan; [2]Univ. of Kansas, USA.* We demonstrate the feasibility to control electron recollisions giving three returns per fundamental frequency cycle for generating circularly polarized (CP) attosecond pulse using tailored bichromatic (ω, 2ω) counter-rotating CP laser fields with molecular target.

NTu4A.47
Revealing the Entire Behavior of Buildup of Soliton Molecule in a Mode-locked Fiber Laser, Xueming Liu[1], Xiankun Yao[1], Yudong Cui[1]; *[1]Zhejiang Univ., China.* The entire buildup process of soliton molecules (SMs) in a mode-locked laser is observed. We found that the birth dynamics of a stable SM is complicated and can be divided into five different stages.

07:30—16:30 • Registration, *Ali'i I/Indoor Garden*

Naupaka III

08:00 -- 10:00
NW1A • Plenary Session

NW1A.1 • 08:00 Plenary
Harnessing Extreme Quantum Light Science for understanding Quantum Materials, Margaret M. Murnane[1]; [1]*Univ. of Colorado at Boulder, USA.* Most advanced applications of visible lasers require precise control over light – including the wavelength, polarization, waveform and coherence. However, until recently, there were no widely available coherent light sources at wavelengths shorter than the UV. Moreover, EUV and x-ray optics are expensive and challenging to manufacture, when available at all. The extreme quantum coherence of high harmonic (HHG) light sources is enabling exquisite control x-ray light using visible lasers - allowing full control over the waveform, polarization state, orbital and spin angular momenta, and divergence of HHG beams. Important applications include imaging and spectroscopy of quantum materials, as well as metrologies in support of next-generation nanotechnologies. A host of use cases in materials and nano science have now been demonstrated, including engineering energy flow in nanostructures, uncovering the microscopic mechanisms for manipulating the electronic or magnetic state of a material, and directly visualizing the dynamic band structure of materials on femtosecond time scales. Finally, the high spatial coherence of EUV sources makes it possible to implement diffraction-limited imaging at short wavelengths for the first time. This is paving the way for the development of commercial tools for EUV imaging that will provide easy access to these advanced techniques in the Lab setting.

NW1A.2 • 08:45
Femtosecond Laser-Induced Nonlinear Photonic Structures in Lithium Niobate, Jorg Imbrock[1], Haissam Hanafi[1], Mousa Ayoub[1], Cornelia Denz[1]; [1]*Westfaelische Wilhelms Univ Munster, Germany.* We compare the performance of two methods to create nonlinear photonic structures for quasi-phase-matched second-harmonic generation. Focused femtosecond-laser pulses are used to deplete the $\chi^{(2)}$-nonlinearity on the one hand or to excite pyroelectric field-assisted poling.

NW1A.3 • 09:00
Spatio-temporal lasing dynamics in wave-chaotic and disordered microcavities, Hui Cao[1]; [1]*Yale Univ., USA.* We propose and demonstrate a simple but powerful approach to suppress spatiotemporal instabilities of semiconductor lasers using wave-chaotic or disordered cavities. The stabilization of lasing dynamics is attributed to the modifications of nonlinear light-matter interactions.

NW1A.4 • 09:15 Plenary
High Harmonic Generation with Structured Light Beams, Paul Corkum[1]; [1]*Univ. of Ottawa, Canada.* We use intense vector beams to generate high harmonics or to create solenoidal currents in solids or gases. We predict THz magnetic fields reaching the scale of those only available at user facilities.

10:00—10:30 • Coffee Break, *Naupaka IV*

10:30 – 12:30
NW2A • Nonlinear Waves II
Presider: Stefano Trillo; Universita degli Studi di Ferrara, Italy

NW2A.1 • 10:30
Long-wave Infrared Megafilaments in Air, Sergei Tochitsky[1]; [1]*Univ. of California Los Angeles, USA.* We demonstrate self-channeling of a terawatt picosecond CO_2 laser beam in air. A single centimeter-diameter *megafilament* guiding multi-Joule pulse over ~35m is observed. This self-guiding is described by a novel nonlinear propagation and ionization model.

NW2A.2 • 10:45
Attosecond, High-Harmonic Optical Vortices with Tailored Spin and Orbital Angular Momentum, Kevin Dorney[1], Laura Rego[2], Nathan J. Brooks[1], Julio San Roman[2], Emilio Pisanty[3], Chen-Ting Liao[1], Jennifer Ellis[1], Dmitriy Zusin[1], Christian Gentry[1], Quynh Nguyen[1], Justin Shaw[4], Antonio Picon[5], Luis Plaja[2], Maciej Lewenstein[3,6], Henry C. Kapteyn[1], Margaret M. Murnane[1], Carlos Hernandez-Garcia[2]; [1]*JILA - Univ. of Colorado at Boulder, USA;* [2]*Grupo de Investigacion en Aplicaciones del Laser y Fotonica, Univ. of Salamanca, Spain;* [3]*ICFO, Inst. en Aplicaciones del Laser y Fotonica, Spain;* [4]*Quantum Electromagnetics Division, National Inst. of Standards and Technologoy, USA;* [5]*Dept.o de Quimica, Universidad Autonoma de Madrid, Spain;* [6]*ICREA, Spain.* Extreme-ultraviolet, attosecond beams with custom spin and orbital angular momentum are produced via high-harmonic generation, for the first time. Entwined angular momentum conservation rules yield exquisite control over their polarization, divergence, and vortex charge.

NW2A.3 • 11:00
Kerr Solitons with Tantala Ring Resonators, Hojoong Jung[1,2], Su-Peng Yu[1,3], David R. Carlson[1], Tara E. Drake[1], Travis C. Briles[1,3], Scott B. Papp[1,3]; [1]*NIST, USA;* [2]*Korea Inst. of Science and Technology, Korea (the Republic of);* [3]*Univ. of Colorado, USA.* We report Kerr soliton frequency combs, using tantala (Ta_2O_5) microring resonators. The low loss, high Q, low tensile stress, and high nonlinear refractive index (n_2) of tantala enable a new platform for integrated nonlinear nanophotonics .

NW2A.4 • 11:15
Mid-IR supercontinuum generation in chalcogenide fibers pumped by a soliton self-frequency shifted source, Martin Bernier[1], Louis-Rafael Robichaud[1,2], Simon Duval[1,2], Jean-Christophe Gauthier[1], Louis-Philippe Pleau[1], Pascal Paradis[1], Vincent Fortin[1], Stephane Chatigny[3], Real Vallee[1]; [1]*Universite Laval, Canada;* [2]*Femtum inc., Canada;* [3]*Coractive High-Tech inc., Canada.* We report mid-infrared supercontinuum generation from a single-mode chalcogenide fiber pumped in all-normal dispersion by a soliton self-frequency shifted Er:ZrF4 fiber laser system generating high-energy femtosecond pulses at 3.6 μm.

NW2A.5 • 11:30
Anisotropic Optical Shock Waves in M-Cresol/Nylon Highly Nonlocal Nonlinearity, Giulia Marcucci[1], Phillip Cala[2], Graham Siggins[2], Weining Man[2], Claudio Conti[1], Zhigang Chen[2,3]; [1]*Physics Dept., Sapienza Univ. of Rome, Italy;* [2]*Dept. of Physics and Astronomy, San Francisco State Univ., USA;* [3]*The Key Lab of Weak-Light Nonlinear Photonics, Nankai Univ., China.* In optics, nonlinear Schroedinger equation rules many phenomena, including dispersive shock waves (DSWs). We report experimental evidence of optical DSWs with an anisotropic zero-singularity in m-cresol/nylon, and theoretical describe it by time asymmetric quantum mechanics.

NW2A.6 • 11:45
Resonance in Modulation Instability from Non-instantaneous Nonlinearities, Ray-Ching Hong[1], Chun-Yan Lin[1], You-Lin Chuang[1], Chien-Ming Wu[1], Jeng-Yi Lee[1], Chien-Chung Jeng[2], Ming-Feng Shih[3], Ray-Kuang Lee[1]; [1]*National Tsing Hua Univ., Taiwan;* [2]*Physics, National Chung-Hsing Univ., Taiwan;* [3]*Physics, National Taiwan Univ., Taiwan.* To explore resonance phenomena in the nonlinear region, we show by experimental measurements and theoretical analyses that resonance happens in modulation instability from non-instantaneous nonlinearities in photorefractive crystals.

NW2A.7 • 12:00 Invited
Nonlinear Mie-resonant Meta-optics and Nanophotonics, Yuri S. Kivshar[1]; [1]*Australian National Univ., Australia.* We discuss the recent advances in nonlinear meta-optics and nanophonics driven by electric and magnetic Mie resonances and interference effects. We report the record-high SHG efficiency for AlGaAs nanoantennas due to bound states in the continuum.

12:30—14:00 • Lunch Break *(on your own)*

Naupaka III

14:00 – 15:30
NW3A • Lithium Niobate and Lithium Tantalate
Presider: Peter Rakich; Yale Univ., USA

NW3A.1 • 14:00
Ultrabroadband Nonlinear Optics in Dispersion Engineered Periodically Poled Lithium Niobate Waveguides, Marc Jankowski[1], Carsten Langrock[1], Boris Desiatov[2], Alireza Marandi[3], Cheng Wang[2], Mian Zhang[2], Chris Phillips[4], Marko Loncar[2], Martin Fejer[1]; *[1]Stanford Univ., USA; [2]Harvard Univ., USA; [3]Caltech, USA; [4]ETH Zurich, Switzerland.* We experimentally demonstrate the first generation of dispersion-engineered periodically poled lithium niobate (PPLN) waveguides. These waveguides achieve ultra-broadband second-harmonic generation (SHG) and multi-octave supercontinuum generation (SCG) with record-low pulse energies.

NW3A.2 • 14:15
Over-30-dB phase-sensitive amplification using a fiber-pigtailed PPLN waveguide module, Takahiro Kashiwazaki[1], Koji Enbutsu[1], Takushi Kazama[1], Osamu Tadanaga[1], Takeshi Umeki[1], Ryoichi Kasahara[1]; *[1]NTT Corporation, Japan.* We achieved degenerate phase-sensitive amplification with the gain of over 30 dB under a CW condition using a periodically poled $LiNbO_3$ waveguide module, which uses second-harmonic pump light to directly amplify the signal.

NW3A.3 • 14:30
Optimization of Second Order Nonlinear Frequency Conversion in Lithium Niobate Microrings, Joshua B. Surya[1], Alexander Bruch[1], juanjuan Lu[1], Zheng Gong[1], Yuntao Xu[1], Risheng Cheng[1], Sihao Wang[1], Hong Tang[1]; *[1]Yale Univ., USA.* This work discusses the mode-matching of second order nonlinear frequency conversion in lithium niobate microrings. We propose optimized design and fabrication approaches to overcome current challenges in the field.

NW3A.4 • 14:45
A Lithium Niobate Soliton Microcomb, Yang He[1], Qi-fan Yang[2], Jingwei Ling[3], Rui Luo[3], Hanxiao Liang[1], Mingxiao Li[1], Boqiang Shen[2], Heming Wang[2], Kerry Vahala[2], Qiang Lin[1,3]; *[1]Dept. of Electrical and Computer Engineering, Univ. of Rochester, USA; [2]T. J. Watson Lab of Applied Physics, California Inst. of Technology, USA; [3]Inst. of Optics, Univ. of Rochester, USA.* We demonstrate a soliton microcomb in a monolithic high-Q lithium niobate resonator. Second-harmonic generation of the soliton spectrum is also observed.

NW3A.5 • 15:00 Invited
Integrated Lithium Niobate Photonics and Applications, Marko Lončar[1]; *[1]John A. Paulson School of Engineering and Applied Sciences, Harvard University, USA*. I will present integrated LN photonics platform and its application in EO and Kerr frequency comb generation, super continuum generation, frequency conversion, and efficient EO modulation.

Naupaka V

14:00 – 15:30
NW3B • Chaos and Disorder
Presider: Kathy Luedge; Univ. of Berlin, Germany

NW3B.1 • 14:00 Invited
Nonlinear Dynamics of Complex Lasers, Hui Cao[1]; *[1]Yale Univ., USA.* We conduct experimental and numerical studies on spatio-temporal dynamics of highly multimode semiconductor lasers. The nonlinear interactions of the lasing modes with the gain medium can be controlled by tailoring the complex cavity geometry.

NW3B.2 • 14:30
Enhanced optical rogue waves by scattering caustic networks in tailored disorder, Alessandro Zannotti[1], Daniel Ehrmanntraut[1], Cornelia Denz[1]; *[1]Univ. of Muenster, Germany.* We demonstrate optical rogue waves as a consequence of enhanced focusing of caustic networks due to linear propagation in weakly scattering 2D tailored disorder in nonlinear photorefractive systems, and discuss the conditions for extreme amplitudes.

NW3B.3 • 14:45
Nonlinear transmission matrices of random optical media, Adam Fleming[2], Claudio Conti[1], Andrea Di Falco[2]; *[1]ISC-CNR Dep. Physics Univ. Sapienza, Italy; [2]Univ. St Andrews, UK.* We report the direct measurement of the nonlinear transmission matrix of complex materials, exploiting the strong opto-thermal nonlinearity of scattering Silica Aerogel. This opens the road to applications of the nonlinear response of random media.

NW3B.4 • 15:00
Temporal Instability and Random Lasing in a Brillouin Fiber laser, Amirhossein Tehranchi[1], Victor Lambin Iezzi[1], Raman Kashyap[1]; *[1]Ecole Polytechnique de Montreal, Canada.* We show for the first time power fluctuations from temporal interference considering correlation over replicas and investigate experimentally and theoretically that the output of a Brillouin fiber laser has the signature of a random lasing.

NW3B.5 • 15:15
Soret reverse saturable absorption of graphene oxide and its application in random lasers, Neda Ghofraniha[1], Claudio Conti[2], Radivoje Prizia[2]; *[1]Istituto dei sistemi complessi-CNR, Italy; [2]Dipartimento di Fisica, Università La Sapienza, Italy.* We demonstrate the thermal diffusion of graphene oxide flakes in dispersion as a not yet explored nonlinear effect and leading to a damping of 50% in the transmission and we follow its dynamics in time.

17:00—20:00 • Luau Reception, *Luau Grounds*

07:30—12:00 • **Registration**, *Alii I/Indoor Garden*

Naupaka III

08:00 – 10:00
NTh1A • Machine Learning and Nonlinear Optics
Presider: To Be Announced

NTh1A.1 • 08:00 Invited
Machine learning for self-tuning optical systems, J. N. Kutz[1], Steven Brunton[1]; [1]*Univ. of Washington, USA.* We demonstrate that emerging innovations in machine learning and adaptive control provides an ideal integration platform for self-tuning optics. We show they can achieve self-tuning and near-optimal performance in mode-locked lasers.

NTh1A.2 • 08:30 Invited
Reinforcement Learning in a Large Scale Photonic Network, Louis Andreoli[1], Sheler Maktoobi[1], Laurent Larger[2], Maxime Jacquot[2], Xavier Porte[1], Daniel Brunner[1]; [1]*CNRS - FEMTO-ST, France;* [2]*FEMTO-ST, Univ. Bourgogne Franche-Comté, France.* Photonic neural networks are considered as a future breakthrough technology for computing. We have implemented the first large scale photonic neural network, demonstrate reinforcement learning fully in hardware and report excellent scalability.

NTh1A.3 • 09:00
Optical neural network for cancer morphodynamics sensing, Davide Pierangeli[1,2], Valentina Palmieri[3], Giulia Marcucci[1,2], Chiara Moriconi[4], Giordano Perini[3], Marco De Spirito[3], Massimiliano Papi[3], Claudio Conti[2,1]; [1]*Università di Roma La Sapienza, Italy;* [2]*Inst. for complex systems (ISC-CNR), Italy;* [3]*Universita Cattolica del Sacro Cuore, Italy;* [4]*Cardiff Univ., UK.* We employ living three-dimensional tumour brain models to demonstrate a bio-inspired optical neural network trained via image transmission to detect cancer morphodynamics inaccessible by optical imaging.

NTh1A.4 • 09:15 Invited
Laser networks for reservoir computing: How can we optimize the performance?, André Röhm[1], Kathy Lüdge[1]; [1]*Inst. of Theoretical Physics, Technische Universität Berlin, Germany.* We explore fundamental aspects of reservoir computing with laser networks from the perspective of nonlinear dynamics. The role of the effective phase-space dimension as well as the information injection routine are investigated with numerical methods.

NTh1A.5 • 09:45
Spatial photonic Ising machine with thousands of interacting spins, Davide Pierangeli[1,2], Giulia Marcucci[1,2], Claudio Conti[2,1]; [1]*Università di Roma La Sapienza, Italy;* [2]*Inst. for complex systems (ISC-CNR), Italy.* We propose and experimentally demonstrate the use of spatial light modulation for calculating the ground state of an Ising Hamiltonian. We realize configurations with thousands of interacting spins that settle in a low-temperature ferromagnetic-like phase.

10:00—10:30 • **Coffee Break**, *Naupaka IV*

Naupaka III

10:30 – 12:30
NTh2A • Quantum
Presider: To Be Announced

NTh2A.1 • 10:30
Sub-Hertz Resonance by Weak Measurement, Jianming Wen[1], Weizhi Qu[2], Jian Sun[2], Shencao Jin[2], Yanhua Zhai[1], Yanhong Xiao[2], Liang Jiang[3]; [1]*Kennesaw State Univ., USA;* [2]*Physics, Fudan Univ., China;* [3]*Yale Univ., USA.* Here we propose and demonstrate a novel weak-measurement-enhanced spectroscopy technique, which allows narrowing the resonance to 0.1 Hz and high sensitivity 7 fT/Hz$^{1/2}$ near DC in a room-temperature atomic-vapor cell, by designing a non-Hermitian Hamiltonian.

NTh2A.2 • 10:45
Unconventional Photon Pair Generation near the Pump in the Normal Group-Velocity-Dispersion Regime, Kyungdeuk Park[1], Heedeuk Shin[1]; [1]*Pohang Univ. of Science and Technology, Korea (the Republic of).* We present photon pairs generated near the pump wavelength in the normal GVD regime by spontaneous four-wave mixing. The generated photons have temporal and spectral correlations and can be exploited as telecom-band quantum light sources.

NTh2A.3 • 11:00 Invited
Unclonable Physical Keys using Nonlinear Silicon Photonics, [1]Brian C. Grubel, [1]Bryan T. Bosworth, [1]Jasper R. Stroud, [1]Neil MacFarlane, [1]Iskandar Atakhodjaev, [1]Michael R. Kossey, [1]A. Brinton Cooper, [1]Amy C. Foster, and [1]Mark A. Foster; [1]*Johns Hopkins University. USA.* Physical keys have existed for millennia, however modern keys are predominately digital and thus prone to duplication. Here we will discuss our recent research on nonlinear silicon photonic physical keys that cannot be copied.

NTh2A.4 • 11:30
Transforming photon statistics via second-harmonic generation, Giovanni Chesi[2], Alessia Allevi[2], Maria Bondani[1]; [1]*CNR - Consiglio Nazionale delle Ricerche, Italy;* [2]*Univ. of Insubria, Italy.* We investigate the transformation of light statistics under second-harmonic generation.
We demonstrate that classical thermal light becomes superthermal and that any quantum initial distribution is modified by the process.

NTh2A.5 • 11:45 Invited
Probing Entanglement in a Many-Body-Localized System, Alexander Lukin[1]; [1]*Physics, Harvard Univ., USA.* We realize a many-body-localized system in a disordered Bose-Hubbard chain and characterize its entanglement properties. We measure the development of non-local correlations, whose evolution is consistent with a logarithmic growth of entanglement entropy.

NTh2A.6 • 12:15
Efficient generation of high-order orbital angular momentum in a periodically-poled $LiTaO_3$ crystal, Xiaopeng Hu[1], yong zhang[1], Shining Zhu[1]; [1]*Nanjing Univ., China.* We realized efficient second harmonic conversion of orbital angular momentum (OAM) in a periodically-poled $LiTaO_3$ crystal, and the conversion efficiency reached 3.2% even when the OAM index of the fundamental wave was 15.

Naupaka V

10:30 – 12:30
NTh2B • Fiber Lasers and Amplifiers
Presider: To Be Announced

NTh2B.1 • 10:30
Polarization dynamics of dissipative soliton fiber laser, Lei Gao[1]; [1]*Chongqing Univ., China.* We characterize the probabilistic polarization dynamics in dissipative solitons fiber laser, where the polarization in the central wavelength region evolves linearly across its spectrum, while those in the two fronts are spatially varying.

NTh2B.2 • 10:45
Generation of octave bandwidth solitons with compact semiconductor lasers at ultralow powers, Travis C. Briles[1], Su-Peng Yu[1], Tara E. Drake[1], Jordan Stone[1], Scott Papp[1]; [1]*NIST-Boulder, USA.* We report octave-spanning, single-soliton frequency combs at both 1550 nm and 1064 nm with less than 40 mW of on-chip power. We also demonstrate soliton generation at 1064 nm with a standard DBR laser.

NTh2B.3 • 11:00
Acousto-optic tunable soliton fiber laser with mode-coupling-induced polarization conversion, Yujia Li[1], Ligang Huang[1], Haonan Han[1], Tao Zhu[1]; [1]*Chongqing Univ., China.* Assisted with the laser gain regulation based on the polarization conversion induced by vector mode coupling during acousto-optical interactions, the wavelength of near-transform-limited soliton laser can be widely tuned by controlling the acoustical wave frequency.

NTh2B.4 • 11:15
Dissipative soliton fiber laser mode-locked by Cesium lead halide perovskite quantum dots, Lei Gao[1]; [1]*Chongqing Univ. , China.* We demonstrate a dissipative soliton fiber laser mode-locked by Cesium lead halide perovskite quantum dots, whose linear chirped phase is compensated by 25 m single mode fiber, resulting into a compressed duration of 1.046 ps.

NTh2B.5 • 11:30
Fiber-Optical Parametric Amplifier tunable around 900 nm and 1300 nm pumped by Chirped-Femtosecond Pulses, Robert Herda[1]; [1]*TOPTICA Photonics AG, Germany.* We present a novel Fiber Optical Parametric Amplifier (FOPA) setup that is pumped by chirped femtosecond pulses from an Ytterbium fiber laser. We use this scheme to generate a power of 440 mW around 1280 nm and 600 mW around 900 nm. The idler wavelength can be tuned by 135 nm. The spectra support pulse durations down to 50 fs.

NTh2B.6 • 11:45
Gain-Phase Modulation in Chirped-Pulse Amplification, Yijie Shen[1], Gan Gao[1], Yuan Meng[1], Xing Fu[1], Mali Gong[1]; [1]*Tsinghua Univ., China.* A new cross-modulation effect between the gain and phase of chirped pulses is theoretically proposed. The gain-phase modulation theory was well verified by chirped-pulse amplification experiments, showing great potential in pulse propagation analyzation.

NTh2B.7 • 12:00
High energy, high average power, nonlinear frequency conversion and parametric amplification of picosecond pulses in vacuum, Zbyněk Hubka[1,2], Robert Boge[1], Roman Antipenkov[1], Jakub Novák[1], Frantisek Batysta[1,2], Michael Greco[1], Emily Erdman[1,3], Alexandr Špaček[1,2], Lukáš Indra[1,2], Karel Majer[1], Jonathan T. Green[1], Jack A. Naylon[1], Pavel Bakule[1], Bedrich Rus[1]; [1]*Inst. of Physics ASCR, ELI Beamlines, Czechia;* [2]*Dept. of Physical Electronics, CTU in Prague, FNSPE, Czechia;* [3]*Charles Univ. in Prague, Faculty of Mathematics and Physics, Czechia.* We discuss the performance of several stages of high energy, high average power SHG and OPCPA with picosecond pulses in vacuum as part of the ALLEGRA laser at ELI-

12:30—14:00 • Lunch Break *(on your own)*

14:00—15:30 • Postdeadline Session*, Naupaka III*

07:00—12:00 • Registration, *Ali'i I/Indoor Garden*

Naupaka III

08:00 – 10:00
NF1A • 2D materials
Presider: Rupert Huber; Universität Regensburg, Germany

NF1A.1 • 08:00
Four-wave Mixing of Topological Edge Plasmons in a Graphene Metasurface, Jian Wei You[1], Zhihao Lan[1], Nicolae C. Panoiu[1]; [1]*Univ. College London, UK.* Using a specially engineered topological bandgap and strong third-order nonlinearity of certain graphene metasurfaces, we demonstrate that it is possible to achieve net optical gain in four-wave-mixing of topologically-protected plasmon edge modes.

NF1A.2 • 08:15
Phase-matching-free parametric oscillation mediated by monolayer transition metal dichalcogenides, Alessandro Ciattoni[2], Andrea Marini[1], Claudio Conti[3,4]; [1]*Univ. of L'Aquila , Italy;* [2]*Consiglio Nazionale delle Ricerche, CNR-SPIN, Italy;* [3]*Dept. of Physics, Univ. Sapienza, Italy;* [4]*Inst. for Complex Systems (ISC-CNR), Italy.* We propose a novel kind of parametric micro-resonators adopting monolayer transition metal dichalcogenides as quadratic nonlinear media, demonstrating that they are free of phase-matching requirements thanks to their atomic-layer thickness implying a surface-like nonlinear interaction.

NF1A.3 • 08:30 Invited
Demystifying the Nonlinear-Optical Physics of Graphene, Nathalie Vermeulen[1], David Castelló-Lurbe[1,2], Mulham Khoder[1], Iwona Pasternak[3], Aleksandra Krajewska[4], Tymoteusz Ciuk[4], Wlodek Strupinski[3], JinLuo Cheng[5], Hugo Thienpont[1], Jürgen Van Erps[1]; [1]*Brussels Photonics, Vrije Universiteit Brussel, Belgium;* [2]*Institut Universitari de Ciències dels Materials, Universitat de València, Spain;* [3]*Faculty of Physics, Warsaw Univ. of Technology, Poland;* [4]*Inst. of Electronic Materials Technology, Poland;* [5]*The Guo China-US Photonics Lab, Changchun Inst. of Optics, fine Mechanics and Physics, China.* The physics of nonlinear-optical refraction in graphene has remained unclear for almost a decade now. We solve this issue through self-phase modulation experiments in graphene-covered waveguides, revealing the extra-ordinary free-carrier interactions that underpin the refraction process.

NF1A.4 • 09:00 Invited
Aluminium Gallium Arsenide on insulator platform for efficient nonlinear processes, Lin Chang[1], John E. Bowers[1]; [1]*Univ. of California Santa Barbara, USA.* In this talk, we will present our recent progress in (Aluminium) Gallium Arsenide on insulator platform for nonlinear applications, including efficient second harmonic generation, low threshold frequency comb generation and high-Q cavities.

NF1A.5 • 09:30 Invited
Attosecond Soft-X-Ray Spectroscopy of a Transition Metal Dichalcogenide Material, Barbara Buades[1], Iker Leon[1], Daniel Rivas[1,3], Themistoklis Sidiropoulos[1], Stefano Severino[1], Maurizio Reduzzi[1], Seth Cousin[1], Michael Hemmer[1], Caterina Cocchi[4], Eric Pellegrin[5], Javier Herrero Martin[5], Samuel Manas-Valero[6], Eugenio Coronado[6], Thomas Danz[7], Claudia Draxl[4], Mitsuharu Uemoto[8], Kazuhiro Yabana[8], Martin Schultze[9], Simon Wall[1], Antonio Picon[1,10], Jens Biegert[1,2]; [1]*ICFO-The Inst. of Photonic Sciences, Spain;* [2]*ICREA, Spain;* [3]*XFEL GmbH, Germany;* [4]*Institut für Physik and IRIS Adlershof, Humboldt-Universität zu Berlin, Germany;* [5]*ALBA Synchrotron Light Source, Spain;* [6]*Instituto de Ciencia Molecular (ICMol), Universitat de València, Spain;* [7]*4th Physical Inst. - Solids and Nanostructures, Univ. of Göttingen, Germany;* [8]*Center for Computational Sciences, Univ. of Tsukuba, Japan;* [9]*Fakultät für Physik, Ludwig-Maximilians- Universität, Germany;* [10]*Departamento de Química, Universidad Autónoma de Madrid, Spain.* We use attosecond soft X-ray pulses between 284 eV to 543 eV for orbital-selective and real-time probing of the opto-electronic response of semi metallic TiS_2.

10:00—10:30 • Coffee Break, *Naupaka IV*

10:30 – 12:30
NF2A • 2D Materials and Cavities
Presider: Hui Cao; Yale Univ., USA

NF2A.1 • 10:30 Invited
Lightwave Control of Dirac Electrons and the Valley Pseudospin, Johannes Reimann[2], Christoph P. Schmid[1], Stefan Schlauderer[1], Fabian Langer[1], Christoph Lange[1], Peter Hawkins[2], Johannes Steiner[2], Ulrich Huttner[2], Stephan W. Koch[2], Mackillo Kira[3], Jens Güdde[2], Ulrich Höfer[2], Rupert Huber[1]; *[1]Dept. of Physics, Univ. of Regensburg, Germany; [2]Dept. of Physics, Univ. of Marburg, Germany; [3]Dept. of Electrical Engineering and Computer Science, Univ. of Michigan, USA.* We observe terahertz-driven all-ballistic Dirac currents on the topological insulator Bi_2Te_3 and subcycle switching of the valley pseudospin in monolayer WSe_2. The results encourage practical electronic and valleytronic devices operating at optical clock rates.

NF2A.2 • 11:00 Invited
Cavity electro-optic circuit for microwave-to-optical frequency conversion, Hong Tang[1]; *[1]Yale Univ., USA.* We report on the realization of coherent transduction between superconducting and photonic circuits based on triple-resonance electro-optics principle, with integrated devices incorporating both superconducting and chi2 optical cavities on the same chip. Electromagnetically induced transparency is observed, indicating the coherent interaction between microwave and optical photons.

NF2A.3 • 11:30
A MHz-Repetition-Rate VUV Source via Cascaded Four-Wave-Mixing in Negative-Curvature Fibers, David E. Couch[1], Daniel D. Hickstein[2], Matthew S. Kirchner[2], Jessica Ramirez[2], Margaret M. Murnane[1,2], Henry C. Kapteyn[1,2], Sterling Backus[2]; *[1]JILA, Univ. of Colorado, USA; [2]KMLabs, USA.* Using a cascaded four-wave-mixing process in negative-curvature fibers, we produce high-flux, high-rep-rate femtosecond pulses of UV and VUV light with wavelengths as short as 115 nm, with applications in spectroscopy and materials science.

NF2A.4 • 11:45
Photosensitive Writing and Erasing of Gratings in an As_2S_3 Chalcogenide Microresonator, Jiangang Zhu[1], Mo Zohrabi[1], Thomas M. Horning[1], Wounjhang Park[1], Juliet Gopinath[1]; *[1]Univ. of Colorado Boulder, USA.* We report observation of cavity-enhanced photo-induced writing of gratings, and Kerr nonlinearity-induced symmetry breaking and erasing of selective grating in an As_2S_3 microsphere.

NF2A.5 • 12:00
Efficient third harmonic generation in optical thin films, Marco Jupé[1], Morten Steinecke[1], Holger Badorreck[1], Lars O. Jensen[1], Detlev Ristau[1], Amir Khabbazi Oskouei[2], Wolfgang Rudolph[2]; *[1]Laser Zentrum Hannover e.V., Germany; [2]Dept. of Physics and Astronomy, Univ. of New Mexico, USA.*
With respect to the material dispersion, the phase matching is difficult to realize for a direct THG. On the basis of thin film stacks, an approach is demonstrated on the theoretical and experimental level.

NF2A.6 • 12:15
Observation of cavity nano-optomechanical nonlinearity in silicon nanowire microring, Junqiang Sun[1]; *[1]Wuhan National Lab for Optoelectronics, China.* We experimentally demonstrate the cavity nano-optomechanical nonlinearity in silicon nanowire microrings. The mechanical frequency shift is conveniently varied by the changes of the launched laser power and wavelength.

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