Optica ImageSense Congress and Exhibit Session Guide

Disclaimer: this guide is limited to technical program with abstracts and author blocks as of 09 July. For updated and complete information with special events, refer the online schedule or mobile app.

Monday, 13 July

0.5 Paris
08:30 -- 10:30
JM1A • Optical Fiber Sensors for Biomedical and Applied Sensing Virtual Room1

Presider: Marcelo Soto; Universidad Técnica Federico Santa María, Chile

JM1A.1 • 08:30 (Invited)
Forward Brillouin Scattering in Optical Fibers for Remote Sensing: Cases of Application in Harsh Environments, Carlos Alvarez-Ocampo[1], Aleksander S. Paterno[2], Antonio Díez[1], Martina Delgado-Pinar[1], Jose Luis Cruz[1], Miguel V. Andres[1]; *[1]Universitat de Valencia, Spain; [2]Santa Catarina State Univ., Brazil.* Hydrostatic pressure and hydrogen diffusion in silica are monitored using Forward Brillouin Scattering fiber sensors. Pressure is continuously measured up to 140 bar in water, and hydrogen diffusion is monitored for more than 50 days.

JM1A.2 • 09:00
Multiparameter Distributed Fiber Optical Sensor System Based on Three Backscattering Mechanisms, Korbinian Königsbauer[1], Xin Lu[1]; *[1]BAM, Germany.* A distributed fiber optic sensing system combining Raman, Rayleigh, and Brillouin scattering mechanisms is proposed for simultaneous strain, temperature, and vibration measurement. Preliminary experiments demonstrate its excellent sensing performance.

JM1A.3 • 09:15
Field Demonstration of Dual-Polarization TE-ΦOTDR for Distributed Curvature Sensing in a Power Cable, Julia Mateu-Comas[1], Maria Moreno-Maldonado[1], Elena Pascual-DeLaMorena[1], Pablo Fermoso[1], Alonso Romero-Barrueco[1], Miguel Soriano-Amat[2,1], Sonia M. Martin-Lopez[2], Miguel Gonzalez-Herraez[2], Joao M.B. Pereira[3], Kenny Hey Tow[3], Roberto Bozzano[4], Sara Pensieri[4], Zhiyuan Li[5], Ingvar Hagman[6], María Fernández-Ruiz[1]; *[1]Universidad de Alcalá, Spain; [2]Daza de Valdés Inst. of Optics, Spain; [3]Rise Research Inst.s of Sweden, Sweden; [4]National Research Council of Italy, Italy; [5]Chalmers Univ. of Technology, Sweden; [6]NKT (Sweden), Sweden.* We demonstrate distributed curvature recovery using dual-polarization TE-ΦOTDR in a multicore fiber embedded on a flexible (non-armored) 3.6 kV power cable deployed underwater, showing centimeter-scale resolution and robust performance under realistic operating conditions.

JM1A.4 • 09:30 (Invited)
Withdrawn.

JM1A.5 • 10:00
Magnetic Elastomeric Composites Enabled Miniature Fiber-Optic Magnetic Field Sensor, Zhi Li[1,2]; *[1]Univ. College of London, UK; [2]National Engineering Research Center for Fiber Optic Sensing Technology and Networks, Wuhan Univ. of Technology, China.* Here we proposed a compact design for a fibre-optic magnetic sensor based on highly responsive ME composites. It enables real-time measurement of small changes in magnetic fields (mT) using an interferometric interrogation scheme. It is cost-effective, simple in design, immune to EM

interference and well-suited to various biomedical applications.

JM1A.6 • 10:15
ULtrafast Single-Pixel Scanning LiDAR, Lei Gao[1]; [1]*Chongqing Univ., China.* We propose a high-speed road sign detection system based on ultrafast single-pixel scanning LiDAR based on serial time-encoded imaging, with a temporal response of ns-level, a point rate of 370M p/s, and a ranging error of 4 mm. This scheme may provide a potential scheme for the traffic environment perception of the future autonomous vehicle.

0.14 Singapore
08:30 -- 10:30
EM1B • Novel Sensing Techniques and Applications
Presider: Juha Toivonen; Tampereen Yliopisto, Finland

EM1B.1 • 08:30 (Invited)
Deep UV Raman and Fluorescence: From Signs of Life on Mars to Environmental Sensing, Rohit Bhartia[1]; [1]*Photon Systems, USA.* This paper will discuss the transition from compact and robust chemical sensing using Deep UV fluorescence/Raman on Mars to environmental sensing, focusing on micro/nanoplastics, PFAS, and pharmaceuticals.

EM1B.2 • 09:00
Ultralow-Volume Sensitive Spectroscopic Gas Detection Using a Fiber Fabry-Pérot Cavity, Yue Yan[1]; [1]*Chinese Univ. of Hong Kong, Hong Kong.* We demonstrate photothermal gas sensing using a high-finesse fiber Fabry–Pérot cavity. With a pump power of only 1 mW, we achieve a 42 ppb C_2H_2 detection limit from a few µL of sample.

EM1B.3 • 09:15 (Invited)
Chiral Sensing With Quantum Cascade Laser Vibrational Circular Dichroism, Bernhard Lendl[1], Georg Ramer[1]; [1]*Technische Universität Wien, Austria.* Chirality is a crucial property of molecules used in pharmaceutics. Our mid-infrared external cavity quantum cascade laser based vibrational circular dichroism approach enables high throughput analysis and quantitation of such molecules.

EM1B.4 • 09:45
MEMS Mirror-Based Line Scan Silhouette Imaging for Particle and Bubble Characterization, Marcus Baumgart[1], Povilas Smaliukas[1], Georg Brunnhofer[2], Andreas Tortschanoff[1]; [1]*PHOS Photonic Systems department - Sensor Systems division, SAL Silicon Austria Labs GmbH, Austria;* [2]*Nanophysics & Sensor Technology, AVL List GmbH, Austria.* We present a MEMS mirror-based line scan silhouette imaging system for bubble detection through an inspection window. Replacing the conventional polygon scanner with a MEMS mirror enables higher scan rates; single-digit micrometer precision is demonstrated.

EM1B.5 • 10:00
MIR Photonic Integrated Circuits: a Functional Monolithic Plasmonic Beam Combiner on Quantum Cascade Technology , Borislav Hinkov[1], Felix Jaeschke[1], Georg Marschick[2], Mauro David[2], Xaver Gsodam[2], Nikola Opacak[2], Dominik Koukola[2], Elena Arigliani[2], Axel Evirgen[3],

Virginie Trinite[3], Salvatore Pes[3], Stefania Isceri[2], Hermann Detz[4], Werner Schrenk[2], Aaron M. Andrews[2], Bernhard Lendl[2], Benedikt Schwarz[2], Gottfried Strasser[2]; *[1]Silicon Austria Labs GmbH, Austria; [2]TU Wien, Austria; [3]III-V Lab, France; [4]FH Technikum Wien, Austria.* MIR photonic integrated circuits (PICs) are still often limited to simple configurations with poor functionality. Here we demonstrate a novel fully functional monolithic beam combiner integrating quantum cascade technology, plasmonic waveguides and on-chip micro mirrors.

EM1B.6 • 10:15
Wavelet-Assisted UV Absorption Spectroscopy for Simultaneous Detection of SO_2 and NO in Gas Mixtures, MANISH CHANDRA[1]; *[1]Indian Inst. of Technology Madras, India.* A wavelet-assisted UV absorption spectroscopy technique is proposed for simultaneous SO_2 and NO detection. Wavelet decomposition isolates gas-specific spectral features from overlapping absorption signals, improving selectivity, noise suppression, and concentration estimation accuracy for industrial emission monitoring.

0.2 Berlin-0.3 Copenhagen
08:30 -- 10:15
OM1C • Wavefront Correction and Control
Presider: Qi Hu; Univ. of Oxford, UK

OM1C.1 • 08:30 (Invited)
MEMS Deformable Mirrors: Architecture, Performance, and Deployment, Paul Bierden[1]; *[1]Boston Micromachines Corporation, USA.* MEMS deformable mirrors have reshaped adaptive optics through high actuator density, stability, and scalability. This talk discusses how mature MEMS DM systems enable consistent system performance across research, industrial, and fielded applications, and considers future developments in scalability, packaging, and application-driven design.

OM1C.2 • 09:00 (Invited)
Withdrawn.

OM1C.3 • 09:30
Third Harmonic Feedback Loop for Highly Uniform Multi-Spot Processing, Lisa Ackermann[1], Chrysoula Stathaki[1], Yves Bellouard[1]; *[1]École Polytechnique Fédérale de Lausanne, Switzerland.* Multi-spot exposure accelerates laser processing by enabling parallelization, but requires high uniformity. We show that third harmonic emission correction measured at the interface enables higher precision compared to correction applied directly to the incoming beam.

OM1C.4 • 09:45
Asymmetric Bilayer Metasurfaces for Direction-Dependent Focusing in the Visible, Alfonso Palmieri[1], Davide Cassara[1], Luca Sacchi[1], Ahmed Dorrah[2,1], Federico Capasso[1]; *[1]Harvard Univ., USA; [2]Applied Physics and Science Education, Eindhoven Univ. of Technology, Netherlands.* Asymmetric bilayer metasurfaces break the single-layer symmetric-Jones limit. Cascading two reciprocal non-commuting layers—a spatial retarder and a 45-deg half-wave swap—creates Janus wavefronts: reversing illumination swaps the cross-polarized

phase. We experimentally demonstrate diffraction-limited direction-dependent metalensing in the visible.

OM1C.5 • 10:00
Deterministic Multi-Plane Wavefront Synthesis Using Optimal Communication Modes, Vinicius S. de Angelis[2,1], Maximilian Jeindl[3], Leonardo A. Ambrosio[2], David Miller[4], Federico Capasso[1], Ahmed Dorrah[3,1]; *[1]Harvard John A. Paulson School of Engineering and Applied Sciences, Harvard Univ., USA; [2]Department of Electrical and Computer, São Carlos School of Engineering Engineering, Univ. of São Paulo, Brazil; [3]Department of Applied Physics and Science Education, Eindhoven Univ. of Technology, Netherlands; [4]Stanford Univ., USA.* We experimentally demonstrate a versatile and deterministic modal framework for synthesizing arbitrary three-dimensional optical intensity and phase distributions, enabling high-fidelity speckle-free multi-plane wavefront control and physically consistent phase structures across depth.

0.4 Brussels
08:30 -- 10:30
CM1D • Digital Holography
Presider: Chao Zuo; Nanjing Univ of Science and Technology, China

CM1D.1 • 08:30 (Invited)
Numerical Recipies in Coherent Optics and Holography, Tatiana Latychevskaia[1]; *[1]Paul Scherrer Institut, Switzerland.* Simulation of plane and spherical waves propagation, holograms and diffraction patterns, and iterative reconstruction routines will be discussed. Cases of amplitude and phase-shifting objects, 3D objects, and resolution enhancement by extrapolation will be addressed.

CM1D.2 • 09:00 (Invited)
Lensless Imaging Applied to Ophthalmic Compensation of Refractive Error, Vicente Mico[1]; *[1]Universitat de Valencia, Spain.* Several solutions (ophthalmic lenses for eyeglasses, contact lenses and intraocular lenses) aimed at the compensation of refractive error are analyzed and characterized in the light of lensless imaging and digital image processing.

CM1D.3 • 09:30
Joint Event-Frame Phase Retrieval in Inline Holography, Chutian Wang[1], Shuo Zhu[1], Yanmin Zhu[1], Edmund Y. Lam[1]; *[1]Univ. of Hong Kong, Hong Kong.* We report a joint event-frame phase retrieval method for dynamic-range-limited in-line holography, where asynchronous events provide complementary feature-domain constraints that improve complex-field reconstruction over single-modality invert

CM1D.4 • 09:45
Lensless Holographic Detection of Circular Dichroism for High-Throughput High-Resolution Chiral Sensing, Bartosz Górski[1], Mateusz Zarzeczny[2], Wiktor Lewandowski[2], Maciej Trusiak[1]; *[1]Warsaw Univ. of Technology, Poland; [2]Faculty of Chemistry, Univ. of Warsaw, Poland.* We present a wide-field approach to observing circular dichroism via digital lensless

holography. Incorporating an interposed circular polarizer directly into the setup allows for the robust, lens-free detection of chiral phenomena in a compact architecture.

CM1D.5 • 10:00
Lensless Holotomography With Limited Angular Projections, Julia Dudek[1], Mikolaj Rogalski[1], Julianna Winnik[1], Piotr Arcab[1], Emilia Wdowiak[1], Piotr Zdankowski[1], Maciej Trusiak[1]; *[1]Warsaw Univ. of Technology, Poland.* We compare lensless holotomographic reconstructions of a multilayer phantom from reduced subsets of a full hologram dataset, finding that as few as 40 illumination angles preserve relevant three-dimensional information, whereas stronger undersampling causes accuracy loss.

CM1D.6 • 10:15
Holographic Focimetry for Dioptric and Prismatic Power Evaluation in Ophthalmic Solutions, Rosa Vila Andrés[1], Sara Ferrer-Altabás[1], José Ángel Picazo-Bueno[1,2], José J. Esteve-Taboada[1], Vicente Mico[1]; *[1]Universitat de València, Spain; [2]Biomedical Technology Center, Univ. of Muenster, Germany.* A holographic focimeter is proposed for non-contact measurement of back-vertex and prismatic powers through magnification and lateral-shift analysis of in-line holograms. Experimentally calibrated prediction functions and validation against a commercial lensmeter demonstrated strong metrological potential.

0.1 London
08:30 -- 10:30
FM1D • Space-borne FTS I: Instrumentation and Architectures
Presider: David Naylor; Univ. of Lethbridge, Canada

FM1D.1 • 08:30 (Invited)
30 Years of Space-Borne FTS Evolution at ABB, Alain Cournoyer[1], Frédéric Grandmont[1]; *[1]Measurement & Analytics Division, ABB Inc., Canada.* From niche research instruments in the late 70s, ABB's FTIR footprint grew to tens of thousand of analyzers deployed in industry globally to fuel innovation in industrial automation. ABB FTS know-how also made its way into orbit on landmark missions, collecting vital information about the Earth atmosphere from profiling and trending trace gas to enabling next generation numerical weather forecasting. Our FTIR has empowered educated decision making for humanity scale issues for decades.

FM1D.2 • 09:00
Canadian Contributions Towards the Future of Far-Infrared Space Astronomy, Locke D. Spencer[1], Chris S. Benson[3], Matthew A. Buchan[2], Nick Fortier[1], Brad G. Gom[4,1], Douglas Johnstone[5], Dave Leisawitz[2], Brenda Matthews[5], Lee Mundy[6], David A. Naylor[4,1], Berke Ricketti[7], Jeremy Scott[8], Gerard van Belle[9], David Wilner[10], Seyedmahdiar Ziaolhagh[1]; *[1]Univ. of Lethbridge, Canada; [2]Goddard Space Flight Center, USA; [3]School of Physics and Astronomy, Cardiff Univ., UK; [4]Bluesky Spectroscopy, Canada; [5]NRC, Canada; [6]Univ. of Maryland, USA; [7]Disruptive Technology Group, STFC, UK; [8]Stewart Observatory, Univ. of Arizona, USA; [9]Northern Arizona Univ., USA; [10]Center for Astrophysics, Harvard & Smithsonian, USA.* Many fundamental astrophysics questions are directly addressed through Far-Infrared (Far-IR) observations. We discuss short- and long-term opportunities for Canadian participation

in Far-IR space astronomy through the NASA PRIMA as well as Far-IR Space Interferometry.

FM1D.3 • 09:15
End-to-End Validation of a Cryogenic Far-Infrared Post-Dispersed Polarizing Fourier Transform Spectrometer, Matthew A. Buchan[1,2], David A. Naylor[1,2], Brad G. Gom[1,2], Adam Christiansen[1,2], Alicia Anderson[3], Alain Cournoyer[4], Éric Carbonneau[4], Martin Larouche[4], Hugo Bourque[4], Peter Ade[5,6], Carole Tucker[5,6]; *[1]Univ. of Lethbridge, Canada; [2]Blue Sky Spectroscopy Inc., Canada; [3]Cavendish Laboratory, Astrophysics Group, Univ. of Cambridge, UK; [4]Measurement & Analytics Division, ABB Inc., Canada; [5]School of Physics and Astronomy, Cardiff Univ., UK; [6]Celtic Terahertz Technology Ltd., UK.* The first light data of a cryogenic far-infrared post-dispersed polarizing Fourier transform spectrometer are presented. These results will help to guide the development of the PRIMA FIRESS instrument.

FM1D.4 • 09:30
Cryogenic Assessment of an Absorptive Baffle for Capturing Stray Photons From the PRIMA FIRESS Laser Displacement Metrology System, Adam Christiansen[1,3], Brad G. Gom[1,3], David A. Naylor[1,3], Alain Cournoyer[2], Martin Larouche[2], Éric Carbonneau[2], Hugo Bourque[2], Natalia Milaniak[2]; *[1]Blue Sky Spectroscopy Inc., Canada; [2]Measurement & Analytics Division, ABB Inc., Canada; [3]Physics & Astronomy, Univ. of Lethbridge, Canada.* Future far-infrared space observatories using FTS need precise laser displacement metrology, which risks stray photons reaching the science detectors. We present a cryogenic detection method to characterize a photon-trapping system for PRIMA FIRESS.

FM1D.5 • 09:45
A Filterbank-Dispersed Fourier Transform Spectrometer for a 10m-Class Submillimetre Telescope., Chris S. Benson[1], Peter S. Barry[1], Patrick Ashworth[1], Harry Gordon-Moys[1], Izaak Morris[1]; *[1]Cardiff Univ., UK.* We present a low-noise Fourier transform spectrometer concept study designed for a 10- to 15-metre class telescope, leveraging on-chip filterbank spectrometers. We also present our progress in the laboratory validation of the technique.

FM1D.6 • 10:00 (Invited)
MIR Sensing, Liquids, Gas Sensing, Dale J. Fixsen[1], Allen Kogut[1], Matthew A. Buchan[1], Len Seals[1], Bob Podgurski[1]; *[1]Univ. of Maryland at College Park, USA.* We report on the FIRESS instrument on the PRIMA observatory. The polarizing Fourier Transform Spectrometer allows high resolution of R ~ 4400 while the post FTS grating reduces the photon noise in each resolution band.

0.8 Rome
08:30 -- 10:30
IM1E • Advances in Imaging Systems I
Presider: Zeev Zalevsky; Bar-Ilan Univ., Israel

IM1E.1 • 08:30 (Invited)
Single-Cell Tomography: Redefining the Frontiers of Flow Cytometry in Biology and Medicine, Pietro Ferraro[1,2]; [1]*Inst. of Intelligent Systems ISASI, Italy;* [2]*TomoFlow srl, Italy.* Recent advancements in flow cytometry have enabled high-resolution single-cell tomography. This breakthrough offers unprecedented analytical depth, opening new frontiers for biological research and precision medicine through the detailed three-dimensional reconstruction of individual cells.

IM1E.2 • 09:00
Passive Super-Resolved Contour Imaging of Moving Targets in Natural Surveillance Scenarios, Gilad Stern[1], Zeev Zalevsky[1]; [1]*Bar-Ilan Univ., Israel.* We demonstrate passive super-resolution technique for moving targets contour identification, in real surveillance scenarios. Inter-cameras registration and robust tracking, are introduced and validated on synthetic and real electro-optical data, demonstrating feasibility for real-world deployment.

IM1E.3 • 09:15
Withdrawn.

IM1E.4 • 09:30
Topology of Image Distortion Fields Driven by Optical Misalignment, Yiming Liu[1], Sjoerd Stallinga[1]; [1]*Technische Universiteit Delft, Netherlands.* Using the Nodal Aberration Theory, we show that the optical image system distortion field is the gradient of a scalar field. Structural changes in the distortion field are characterized by a complex sequence of creation, annihilation and reorganization of up to five nodes driven by tilt and decenter misalignments of the optical components.

IM1E.5 • 09:45
Coaxial Digitally Directed Illumination Beams for Optical Inspection , Hiroshi Ohno[1]; [1]*Toshiba Corp, Japan.* Optical inspection requires optimized illumination directions depending on defect types. Therefore, coaxial digitally directed illumination beams are proposed, enabling rapid digital optimization of illumination direction while maintaining coaxial alignment with the optical imaging axis.

IM1E.6 • 10:00
MHz-Rate Large-Field Ultrafast Imaging via Spectrally-Encoded VIPA and Galilean Beam Expansion, Yu Long Cao1, Chen Peng1; 1Chinese Academy of Engineering Physics, China. This research develops an ultrafast 2D imaging system using VIPA and Galilean beam expansion, achieving 20x larger field of view and 7.75 MHz frame rate for high-speed dynamic measurements.

IM1E.7 • 10:15
Inverse Design of Phase-Change Metasurface for Single-Pixel Hyperspectral Imaging, Haitao Nie[1], Yaping Zhao[1], Edmund Y. Lam[1]; [1]*Univ. of Hong Kong, Hong Kong.* We propose a mechanical-scanning-free single-pixel hyperspectral imaging framework using a phase-change metasurface. A differentiable metasurface surrogate model enables joint optimization with a reconstruction network, improving hyperspectral reconstruction fidelity.

0.9 Athens
08:30 -- 10:30
AM1F • New Frontiers of Industrial Sensing I: On the Field
Presider: Amy Bauer; Ocean Optics BV, Germany

AM1F.1 • 08:30 (Invited)
Industrial Inspection Through High-Throughput Plasmonic Terahertz Imaging Systems, Mona Jarrahi[1]; [1]*Univ. of California Los Angeles, USA.* We present high-throughput hyperspectral terahertz imaging systems using plasmonic nanoantenna arrays for real-time extraction of structural and compositional information from various materials and products during manufacturing.

AM1F.2 • 09:00 (Invited)
Infrared Correlation Nanoscopy With Unprecedented Spectral Coverage, Andreas Huber[1]; [1]*attocube systems, Germany.* Correlation of nano-IR, that is nano-FTIR and AFM-IR, measurements with spectroscopic Raman imaging can provide complementary information for chemical analysis of specimens, enabling comprehensive characterization of functional nanostructures or fundamental properties of complex material systems.

AM1F.3 • 09:30 (Invited)
Chemical Kinetics Diagnostics With mid-Infrared Dual-Comb Spectroscopy, Nazanin Hoghooghi[1,2]; [1]*NIST Boulder, USA;* [2]*Univ. of Colorado Boulder, USA.* The application of a mid-infrared dual-comb spectrometer as a diagnostic tool for chemical kinetics will be presented. The dual-comb spectrometer has multi-species detection capability to reveal chemical pathways with accurate quantification of the species concentrations and high acquisition speed.

AM1F.4 • 10:00
Cross-Matrix Deoxynivalenol Detection Using Multimodal Spectroscopic Sensing, Wannes Luts de Martelaere[1], Indy Magnus[1,2], Francesca Venturini[3,4], Hugo Thienpont[1,2], Lien Smeesters[1,2]; [1]*Brussels Photonics (B-PHOT), Vrije Universiteit Brussel, Belgium;* [2]*BP&M, Flanders Make@VUB, Belgium;* [3]*ZHAW Zurich Univ. of Applied Sciences, Switzerland;* [4]*TOELT LLC, Switzerland.* We demonstrate the use of multimodal spectroscopic sensing for cross-matrix deoxynivalenol (DON) detection. Combining reflection and fluorescence spectroscopy with machine learning processing, a DON classification efficiency exceeding 92% is demonstrated, independent of the food matrix.

AM1F.5 • 10:15
Field Validation of a Dual-Band SWIR Imager for Methane Emission Mapping, Jayshri Sabarinathan[1], Aref Bakhtazad[1], Stephen Amey[1], Mohammad Rokhafrouz[1], James Voogt[1], Jinfei Wang[1]; [1]*Western Univ. (Canada), Canada.* A dual-band short-wave infrared imaging instrument is presented for the detection of methane plume. The instrument was implemented and experimentally validated using controlled methane release and landfill measurements. The results demonstrate two-dimensional plume detection consistent with TDLAS observations.

Auditorium 2

11:00 -- 12:30
JM2A • Joint Plenary Session I

JM2A.1 • 11:00 (Plenary)
Frequency Comb Sensing and Imaging, Nathalie Picqué[1]; [1]*Max-Born Institut, Germany.* Optical frequency combs have revolutionized time and frequency metrology and enabled powerful techniques such as dual-comb interferometry. Using two combs with slightly different line-spacings, these motion-free interferometers achieve exceptional accuracy, speed and resolution, enabling compact integrated devices and advanced applications in spectroscopy, sensing and imaging.

JM2A.2 • 11:00 (Plenary)
Beyond Static Optics: How Adaptive Optics Increase the Performance of an Optical System, Stefano Bonora[1]; [1]*Dynamic Optics S.r.l, Italy.* From laser communication to laser processing and subcellular imaging, deformable optical components enable a higher levels of performance. We explore the shared challenges across these fields and the techniques pushing beyond the limits of conventional, static optics.

0.5 Paris
14:00 -- 15:45
SM3A • Plasmonic Biosensing and SERS Technologies
Presider: Jennifer Morales; US Army Research Laboratory, USA

SM3A.1 • 14:00 (Invited)
Digital Bioassay Formats With Plasmonically Enhanced Optical Readout, Jakub Dostalek[1,2]; [1]*FZU - Inst. of Physics of the Czech, Austria;* [2]*Danube Private Univ., Austria.* Digital readout format of bioassays are used to detect extremely analyte concentrations by partitioning the sample in conjunction with enzymatic amplification. Concepts that hold potential to simplify such type of bioanalytical technology through enzyme and partitioning - free readout will be discussed. In particular, immunoassay-based detection at individual molecule level will be presented through plasmon-enhanced fluorescence in the context of liquid biopsy – based cancer diagnostics.

SM3A.2 • 14:30
Flexible one-Dimensional Periodically Patterned Nanocoloumns SERS Substrates With Ultrahigh Enhancement Factor for Urea Detection, ojasvi singh1, Sachin K. Srivastava1; 1Indian Inst. of Technology Roorkee, India. A flexible Surface-Enhanced Raman Scattering (SERS) substrate based on Al grating and Ag nanorods(Ag-NR) was fabricated, attaining enhancement factor of 3.03x1013. The sensor was utilized for urea detection, highlighting strong potential for sensing applications.

SM3A.3 • 14:45
Fabrication of a Periodic SERS Substrate for Cost-Effective Detection of Biomolecules, NIDHI MEHTA[1]; [1]*Indian Inst. of Technology Delhi, India.* An optical-disk based periodic SERS sensor has been fabricated for sensitive and reproducible detection of biomolecules such as uric acid. The sensor could detect 10^{-11} M of R6G (test molecule) and

complete physiological range of uric acid.

SM3A.4 • 15:00
Plasmon-Enhanced Optical Properties of Nanoprobes for Phototheranostics, Jinchang Yin[1]; [1]*Shenzhen Univ., China.* To improve tumor theranostic strategy, we designed a series of novel core-satellite/dumbbell nanoprobes integrating plasmonic gold nanorods, rare-earth oxides and photosensitizers and unraveled enhancement mechanism via calculations and ultrafast spectroscopy. The high-performance probes enable highly sensitive optical NIR tumor phototheranostics.

SM3A.5 • 15:15
Dumbbell-Structured Plasmonic-Enhanced Optical Nanoprobes Boosting Photo-Magnetic-Acoustic Multimodal Imaging-Guided Photodynamic-Photothermal Synergistic Treatment and Immunogenic Death in Nasopharyngeal Carcinoma, Baikang Zhuang[1], Jinchang Yin[1]; [1]*Shenzhen Univ., China.* We designed a dumbbell-shaped mesoporous silica-coated gold nanorod nanoprobe loaded with functional agents, achieving plasmon-enhanced imaging and PTT-PDT synergy. Integrated simulations and theoretical calculations reveal the in-depth enhancement mechanism. It realizes sensitive imaging, tumor inhibition and immune activation for theranostics.

SM3A.6 • 15:30
Tunable Plasmonic Cavities Using Gold Nanorod Arrays for Optical Biosensing Applications, Ahmed C. Kadhim[1], Ahmad Azzahrani[2], Ahmed Al sadi[1], Omar Alnaseri[3], Farah Essam[1]; [1]*Univ. of Technology-Iraq, Iraq;* [2]*Electrical Engineering Department, Northern Border Univ., Saudi Arabia;* [3]*Baden-Württemberg Cooperative State Univ., Germany.* Tunable plasmonic cavities based on gold nanorod arrays are designed and simulated using FDTD. The local electric field reached 171KV/m which is highly applicable for biomedical applications, particularly for photothermal therapy and surface-enhanced Raman scattering biosensing.

0.14 Singapore
14:00 -- 15:30
EM3B • Remote and Marine Sensing
Presider: Ryan Cole; Bates College, USA

EM3B.1 • 14:00 (Invited)
In Situ Raman Spectrometers for Deep Sea Environmental Monitoring, Tomoko Takahashi[1], Eiji Tasumi[1], Zonghua Liu[2], Thangavel Thevar[3], Dhugal Lindsay[1], Blair Thornton[4], Ken Takai[1]; [1]*Japan Agency for Marine-Earth Science and Technology, Japan;* [2]*Robert Gordon Univ., UK;* [3]*Aberdeen Univ., UK;* [4]*Univ. of Southampton, UK.* Raman spectrometers enable rapid, label-free direct analysis of targets in the ocean. This talk presents the application of Raman spectroscopy to in situ chemical measurements of deep-sea targets to enhance our understanding of marine biogeochemistry.

EM3B.2 • 14:30 (Invited)
Range-Resolved, Stand-Off Molecular Sensing Using Single-Photon 'Quantum' Raman Spectroscopy, David Stothard[1], Roman Spesyvtsev[1]; [1]*Fraunhofer Centre for Applied*

Photonics, UK. Single-photon Raman spectroscopy combined with pulsed laser excitation enables a molecular LiDAR platform capable of mapping chemical composition at range. The approach enhances sensitivity, suppresses background, and improves remote sensing performance in challenging operational environments.

EM3B.3 • 15:00 (Invited)
High-Resolution Observation of Ocean Water Dynamics Using Available Submarine Optical Fibers, Miguel Gonzalez-Herraez[1], Joana Vieira[2], Rogerio Nogueira[2], Ana M. Rocha[2], Maria R. Fernandez-Ruiz[3], Hugo F. Martins[1], Sonia M. Martin-Lopez[1], Ethan Williams[4]; *[1]Instituto de Óptica, CSIC, Spain; [2]Instituto de Telecomunicações, Campus Universitário de Santiago, Portugal; [3]Dpto. de Electrónica, Univ. of Alcalá, Spain; [4]Univ. of California, USA.* We show that distributed acoustic sensing (DAS) over available submarine optical fiber cables can provide new and valuable information on the spatiotemporal dynamics of ocean waves, including surface gravity waves, internal waves, and tides.

0.2 Berlin-0.3 Copenhagen
14:00 -- 15:15
OM3C • Wavefront Sensing
Presider: Szymon Gladysz; Fraunhofer IOSB, Germany

OM3C.1 • 14:00 (Invited)
Towards Improved Pyramid Wavefront Sensors: Polychromaticity and 3D Printing, Aurelie Magniez[1], Charlotte Z. Bond[2], Tim Morris[1], Kieran O'Brien[1], Peter Wizinowich[3]; *[1]Durham Univ., UK; [2]UK Astronomy Technology Center, UK; [3]W. M. Keck Observatory, USA.* Favoured for its high sensitivity, the pyramid wavefront sensor is chosen to be the wavefront sensor for the next generation of astronomical instruments. How can it be extended to polychromatic sensing? How can its size, cost, and design flexibility be improved? To push the limits, we investigate two new technologies: MKIDs and 3D-printed optics.

OM3C.2 • 14:30
Smartt Wavefront Sensor Performance With Machine Learning Phase Estimation, Erin Holdorf[1], Noelia Martinez-Rey[1], Jesse Cranney[1], Domenico Bonaccini Calia[2]; *[1]Australian National Univ., Australia; [2]Durham Univ., UK.* We will present the performance of the Smartt wavefront sensor (based on the Point Diffraction Interferometer), which is more resilient to scintillation than traditional wavefront sensors, with a machine learning reconstructor in both a laser guide star adaptive optics simulation and in lab bench testing.

OM3C.3 • 14:45
High-Resolution and High-Speed Wavefront Imaging via Random Phase Modulated Diffraction, Yu Long Cao[1], Chen Peng[1]; *[1]Chinese Academy of Engineering Physics, China.* Overcoming metasensors' angular resolution limits, we develop a random-coded diffractive optical element wavefront sensor. Calibrated diffraction-angle mapping and reconstruction algorithms achieve high-resolution wavefront measurement, enabling quantitative phase imaging for surface topography of static/dynamic samples.

OM3C.4 • 15:00

A Peristrophic Multiplexed Analog Holographic Wavefront Sensor, Emma Branigan[1], Kevin Murphy[1]; [1]*Centre for Industrial and Engineering Optics, Technological Univ. Dublin, Ireland.* Angularly multiplexing many aberration modes in a photosensitive medium for analog holographic wavefront sensing has numerous challenges, including high slants, inconsistent sensitivities and shrinkage-induced effects. Here we implement peristrophic multiplexing to alleviate these issues.

0.4 Brussels
14:00 -- 16:00
CM3D • Phase Retrieval and Compressive Imaging
Presider: Julia Alonso; Universidad de la Republica, Uruguay

CM3D.1 • 14:00 (Invited)
Cell Measurements With Propagation-Based Quantitative Phase Imaging, Jonathan Petruccelli[1], Alireza Sheikhsofla[1], Shane Carney[1], Alexander Khmaladze[1]; [1]*Univ. at Albany, USA.* Propagation-based QPI enables label-free measurement of cell volume and refractive index with minimal modifications to a bright-field microscope. I will discuss advances in propagation-based QPI and applications to measuring measure apoptotic cell volume changes.

CM3D.2 • 14:30
A Hybrid Computational Phase Retrieval Combining Transport of Intensity Equation and Angular Spectrum Propagation, Shubham Tiwari[1], Dalip S. Mehta[1]; [1]*Indian Inst. of Technology Delhi, India.* A hybrid phase recovery from intensity measurements is presented combining transport of intensity equation(TIE) and angular spectrum propagation concepts. The mixed approach is shown to overcome the limitations of the conventional TIE based phase recovery arising from Teague's assumption violation and other intensity related issues.

CM3D.3 • 14:45
Advancing TIE Phase Retrieval: Integrating GPU Optimization and Enhanced Regularization, Alejandro Silva[1], Julia Alonso[1]; [1]*Universidad de la República, Uruguay.* We present an integrated framework for Quantitative Phase Imaging based on a GPU-optimized matrix TIE solver. By decoupling regularization bandwidth from cutoff frequency, we significantly enhance low-frequency recovery and computational efficiency for biological samples.

CM3D.4 • 15:00
Spatiotemporal Decoupled Sensing for Compressive Imaging via Deep Learning, Xiaowen Hao[1,3], Jun Ke[2,3]; [1]*School of Optics and Photonics, Beijing Inst. of technology, China;* [2]*School of Optics and Photonics, Beijing Inst. of Technology, China;* [3]*Key Laboratory of Photo-electronic Imaging Technology and System, Ministry of Education of China; National Key Laboratory on Near-surface Detection, China.* We propose a spatiotemporal decoupled encoding strategy that eases the decoupling difficulty for deep-learning reconstruction networks, ultimately improving the fidelity of spatiotemporal compressive imaging (STCI).

CM3D.5 • 15:15

Hadamard-Based Statistical Compressive Sensing for Single-Pixel Microscopy, Samuel I. Zapata Valencia[1], Heberley Tobón[1], Marcos Obando[2], Felix Lucka[2], Enrique Tajahuerce[1], Jesus Lancis[1]; *[1]Universitat Jaume I, Spain; [2]Centrum Wiskunde & Informatica, Netherlands.* A statistical compressive sensing strategy for Hadamard-based single-pixel microscopy is presented. Kernel density estimation learned from 50,000 microscopy images guides pattern selection, reducing sampling requirements while preserving resolution and contrast compared with conventional TV/ZigZag sampling.

CM3D.6 • 15:30 (Invited)
Snapshot Compressive Imaging Reconstruction: From Conventional AI to Generative AI and Task-Driven Paradigms, Xin Yuan[1]; *[1]Westlake Univ., China.* We review the algorithm evolution for snapshot compressive imaging during the past 20 years, from the interative optimization to deep learning and then to the emerging generative AI. We will outlook the next step of computational imaging by discussing the task-deriven regime.

0.1 London
14:00 -- 15:45
JM3E • Fusion and High-Performance Diagnostics
Presider: David Naylor; Univ. of Lethbridge, Canada

JM3E.1 • 14:00 (Invited)
Fusion Developments and How FTS Fits in., Alan Costley[1]; *[1]Independent Reseacher, UK.* Recent substantial developments in the worldwide pursuit of Fusion Power are outlined. FTS plays a key role in the diagnosis of the high temperature plasmas involved and that role, which will likely become even more important for the next generation of fusion devices, is presented.

JM3E.2 • 14:30
A Synthetic Diagnostic for the ITER Fourier Transform Spectrometer, Johannes van den Berg[1,2], Stefan Schmuck[2], Udo Höfel[3], Jakob Svensson[3]; *[1]Technische Universiteit Eindhoven, Netherlands; [2]ITER Organization, France; [3]Seed eScience Research, UK.* We combine various formulae, models, and measurements into a wholistic model of ITER's Fourier Transform Spectrometer. Using it, we estimate the required calibration time, and showcase Bayesian inference of plasma parameters.

JM3E.3 • 14:45
Withdrawn.

JM3E.4 • 15:00 (Invited)
Advantages of Field-Widened Interferometry for High Spectral Resolution Applications, William Ward[1], Jeffery A. Langille[2], Samuel Kristoffersen[1]; *[1]Univ. of New Brunswick, Canada; [2]Physics and Atmospheric Science, Dalhousie Univ., Canada.* Field widening as a way to increase interferometer optical throughput was identified in the 1950's (Jacquinot et al.). Advances in fabrication and imaging technologies are allowing its full promise to be realized. Imaging performance of various high spectral resolution, high signal-to-noise interferometers will be reviewed. Increases in the useful angular field of field widened Michelson interferometers through imaging detectors will be discussed, illustrated and compared to similar

techniques.

JM3E.5 • 15:30
Free-Running Deep Ultraviolet Dual-Comb Spectroscopy for Fingerprinting Aromatic Hydrocarbons , Mithun Pal[1], Elias Ehl[1], Christoph Gruber[1], Armin Speletz[1], Clemens Hofmann[1], Rolf Breinbauer[1], Birgitta C. Bernhardt[1]; [1]*Technische Universität Graz, Austria.* A dual-comb spectrometer without any active stabilization operating at 263 nm with 1 GHz spectral resolution has been developed for highly element-specific electronic fingerprinting, showcased on several aromatic hydrocarbons and their isomers.

0.8 Rome
14:00 -- 16:00
IM3F • Sensors and Lightweight Imaging Systems
Presider: Nisan Ozana; Bar-Ilan Univ., Israel

IM3F.1 • 14:00 (Invited)
Lighting the Inside: the Path Toward Optical Radiography Through Next-Generation Single-Photon Detectors, Alberto Dalla Mora[1]; [1]*Dipartimento di Fisica, Politecnico di Milano, Italy.* Visible/near-IR sub-nanosecond pulses enable time-domain diffuse optics to non-invasively probe human tissues, revealing composition, microstructure and blood flow. Technological advances at Politecnico di Milano are reviewed, emphasizing single-photon detectors development within past and ongoing (fastMOT-G.A.101099291) research projects, stimulating new perspectives in several medical fields spanning from oncology to neurology, as well as in various non-medical fields.

IM3F.2 • 14:30
Visualizing Structured Lubricants Under Pressure and Shear Using Polarized Imaging, Nikita Toropov[1], Monica Ratoi[1]; [1]*Univ. of Southampton, UK.* A polarized imaging method integrated with a ball-on-disc tribometer reveals pressure-induced radial alignment of liquid crystal lubricants and Maltese cross patterns in tribological contacts. An optical setup enables simultaneous liquid crystal observation and film measurement.

IM3F.3 • 14:45
in-Sensor Image Processing Using Biomimetic Graphene-Based Photodetector Arrays, Marina C. Homs[1], Shadi Nashashibi[1], Dmitrii Gavrilov[1], Daniel Rieben[1], Dominik Bisang[1], Yuriy Fedoryshyn[1], Wadood Haq[2], Stefan M. Koepfli[1], Juerg Leuthold[1]; [1]*ETH Zurich, Switzerland;* [2]*Inst. for Ophthalmic Research, Univ. of Tuebingen, Germany.* We demonstrate in-sensor image processing using a 3×3-pixel array of graphene-based photogating devices. By tuning the responsivity of each pixel, different kernels are implemented in hardware mimicking various properties of the biological retina.

IM3F.4 • 15:00
Non-Degenerate Two-Photon Absorption as a Universal Platform for Multidimensional Mid-Infrared Imaging: From Hyperspectral and 3D Imaging to Scalable Nanosecond Implementation, Evan P. Garcia[1], Yryx Palacios[1], Ryan Nguyen[1], David Knez[1], Aleksei I.

Noskov[1], Eric O. Potma[1], Dmitry Fishman[1]; *[1]Univ. of California Irvine, USA.* Non-degenerate two-photon absorption enables multidimensional mid-infrared imaging by mapping vibrational information from the sample onto semiconductor detectors. We present hyperspectral, volumetric, and nanosecond IR imaging, establishing NTA as scalable platform for chemically selective imaging across spatial, spectral, and temporal dimensions.

IM3F.5 • 15:15
Imaging Vortex DOEs on Azopolymer Thin Films via Polarization-Sensitive Digital Holographic Microscopy, Veronica Cazac[1], Contantin Loshmanskii[1], Elena Achimova[1], Vladislav Botnari[1], Vladimir Abashkin[1]; *[1]Moldova State Univ., Moldova (the Republic of).* We employ polarization digital holographic microscopy to quantify birefringence in vortex DOEs formed on azopolymer thin films. By implementing extracting the Jones matrix, we investigate the optical properties of vortex DOEs recorded through holographic recording and EBL.

IM3F.6 • 15:30
Forward Design of High Efficiency Metalenses Using PEC Bounded Meta-Atoms, Nevin C. Heeman[1], Davide Cassara[2], Federico Capasso[2], Israel De Leon[3], Ahmed Dorrah[1]; *[1]Applied Physics & Science Education (APSE), Technische Universiteit Eindhoven, Netherlands; [2]School of Engineering and Applied Sciences (SEAS), Harvard Univ., USA; [3]ASML Netherlands B.V., Netherlands.* We demonstrate a metalens design using metallic boundaries to mitigate crosstalk between neighbor nanostructures. This improves the absolute focusing efficiency by 14% for solid and hollow amorphous silicon nanopillars at 0.86 NA and 1550 nm wavelength.

IM3F.7 • 15:45
Achromatic Hybrid Metalens for Visible-NIR Wavelengths Using Inverse-Designed Bilayer Metasurfaces, Hanin Ayash[1], Jasper van der Weert[1,2], Jo de Wit[2], Irwan Setija[2], Jaime Gómez Rivas[1], Ahmed Dorrah[1]; *[1]TUe, Netherlands; [2]ASML Netherlands B.V., Netherlands.* We present a hybrid achromatic lens platform using inverse-designed broadband bilayer free-standing metasurfaces. It operates in the visible-NIR region with an average focusing efficiency of 64% and Strehl ratios above 0.7, enabling diverse optical applications.

0.9 Athens
14:00 -- 16:00
PM3G • Atmospheric Measurements I
Presider: Santasri Bose-Pillai; Air Force Inst. of Technology, USA

PM3G.1 • 14:00 (Invited)
Characterization of Refractive-Index Atmospheric Structural Parameter Using Miniature Fiber-Based Refractive-Index Sensors, Matej Njegovec[1], Simon Pevec[1], Vedran Budinski[1], Boris Macuh[1], Denis Donlagic[1]; *[1]Univerza v Mariboru, Slovenia.* This paper reports the design, characterization, and initial field testing of a fiber optic system for measuring refractive index atmospheric structural parameter, using a miniature all fiber, athermal refractive index sensor demonstrating better than 5×10^{-9} RIU resolution.

PM3G.2 • 14:30

Comparisons of Net Radiation Calculations to Measurements, Steven Fiorino[1], Laura Slabaugh[1], Melissa K. Beason[1], Santasri R. Bose-Pillai[1]; *[1]Air Force Inst. of Technology, USA.* Analysis shows net radiation at 2m can be diagnosed and/or predicted with a radiative transfer code for clear sky or overcast conditions.

PM3G.3 • 14:45
Building a Low-Cost Ultrasonic Anemometer-Thermometer for Atmospheric Turbulence Measurements, Arvin Sharma[1], Miranda van Iersel[1]; *[1]New Mexico State Univ., USA.* Sonic anemometer-thermometers measure the delay of ultrasonic pulses between a pair of transducers oriented along three axes. . A sonic anemometer-thermometer was built using off-the-shelf components for a total cost of under $300. The device measures temperature fluctuations at a sample rate of approximately 250 Hz by utilizing an FPGA for timing.

PM3G.4 • 15:00
High-Altitude Balloon Profiling of Atmospheric Refractive Index Structure Parameter Over a Tropical Location, Anand N. Sarma[1], Sunilkumar K[2], Ishaani R. Kamath[1], Devika Sunil[1], Satheesh S. K.[3], Krishna Moorthy[3]; *[1]IISER Thiruvananthapuram, India; [2]Univ. of California at Riverside, USA; [3]Indian Inst. of Science, India.* We present vertical profiles of the atmospheric refractive index structure parameter (C_n^2) measured using a series of high-altitude balloon flights from an urban location in the tropics.

PM3G.5 • 15:15
Measuring Turbulence Statistics in Delft From Star Focal Images, Marguerite Arvis[1], Jérôme Loicq[1], Rudolf Saathof[1]; *[1]TU Delft, Netherlands.* Known turbulence models may not generalize well to all locations, especially urban areas. In this study, a simple method based on star focal image analysis is applied for evaluating turbulence statistics over Delft (Netherlands).

PM3G.6 • 15:30 (Invited)
FATIMA: Fog and Turbulence Interactions in the Marine Atmosphere, Harindra Fernando[1], C. Dorman[2,3], Qing Wang[4], E. Pardyjak[5], L. Shen[6], E. Creegan[7], I. Gultepe[1]; *[1]Univ. of Notre Dame, USA; [2]Scripps Institution of Oceanography, USA; [3]Univ. of California, San Diego, USA; [4]Naval Postgraduate School, USA; [5]The Univ. of Utah, USA; [6]Univ. of Minnesota, USA; [7]Army Research Laboratory, White Sands Missile Range, USA.* This presentation will describe major findings of a five-year (2021-26) multidisciplinary, integrative project dubbed FATIMA on marine fog. It dived into fifteen decades of spatiotemporal scales undergirding the fog life cycle. Ship and land/platform-based field observations in Grand Banks, Sable Island and Hibernia Oil Platform in 2022 as well as multi-ship and aircraft observations in the Yellow Sea (off-coast of the Republic of Korea) in 2023, all accompanied by high-resolution and numerical weather prediction model simulations, indicate that extant concepts concerning the lifecycle of marine fog need a fundamental rethink.

0.5 Paris
16:30 -- 18:30
JM4A • Terahertz Sensing and Sensors for Tomorrow
Presider: Willie Padilla; Duke Univ., USA

JM4A.1 • 16:30 (Invited)
Terahertz Metamaterials: Biosensing and Other Applications, SaeJune Park[1,2]; [1]*School of Electronic Engineering and Computer Science, Queen Mary Univ. of London, UK;* [2]*Department of Physics, Ajou Univ., Korea (the Republic of).* This talk explores terahertz metamaterials for biosensing applications. We compare free-space spectroscopy with on-chip integration, examining how geometric design and fluidic channels enhance wave-matter interaction for novel, high-sensitivity sensing applications.

JM4A.2 • 17:00
Terahertz Differential Phase Imaging Using a Configurable Source Array, William Lillsebbas[1], Sarah Pilaar[1], Allison M. Marn[1]; [1]*Roger Williams Univ., USA.* In this paper we demonstrate terahertz differential phase contrast imaging using a compact continuous-wave system with a 64-pixel source array. The source array provides complementary-angle illumination, enabling referenceless phase contrast imaging without mechanical scanning.

JM4A.3 • 17:15 (Invited)
Terahertz Imaging for Art and Industry, David Citrin[1]; [1]*Georgia Inst. of Technology, USA.* In this talk I discuss our recent work on terahertz imaging of art and archaeological objects and for industrial applications. This approach enables 3D subsurface imaging of a range of materials and objects.

JM4A.4 • 17:45
Waveguide-Assisted Subwavelength Terahertz Imaging, Uzair Aalam[1], Amartya Sengupta[1], Aparajita Bandyopadhyay[1]; [1]*Indian Inst. of Technology Delhi, India.* Due to the longer wavelengths of the THz radiation, conventional imaging approaches yield poor spatial resolution, limiting non-destructive evaluation applications. Here we demonstrate waveguide-based nearfield THz imaging where modal field confinement produces subwavelength resolution.

JM4A.5 • 18:00 (Invited)
Incoherent Room-Temperature Fourier Spectrometry From the Ultraviolet to the THz, Lukasz Sterczewski[1]; [1]*Politechnika Wroclawska, Poland.* Fourier spectrometry is an indispensable optical technique for analyzing samples in all states of matter. Unfortunately, the typical room-temperature spectral coverage is limited. Here, we show an instrument operating from the UV to the THz range.

0.2 Berlin-0.3 Copenhagen
16:30 -- 18:00
OM4B • AO in Ophthalmology I
Presider: Serge Meimon; Office Natl d'Etudes Rech Aerospatiales, France

OM4B.1 • 16:30 (Invited)
From Hardware-Based to Computational Adaptive Optics in Ophthalmology, Dierck Hillmann[1], Pepijn Klooster[1], Sarvesh Thakur[1], Jory Hagen[1], Sophie Eggert[1], Ulysse Najar[1]; [1]*Vrije Universiteit Amsterdam, Netherlands.* Adaptive optics enables diffraction-limited retinal imaging and resolution of individual photoreceptors by compensating ocular aberrations. This talk reviews its role in retinal imaging and presents our latest fully digital and computational approaches for correcting aberrations in optical coherence tomography.

OM4B.2 • 17:00
Power-Efficient Two-Photon Adaptive Optics Scanning Laser Ophthalmoscopy via Scan-Synchronous Electro-Optic Modulation, Paul Gläser[1], Zhijian Zhao[1], Qiang Yang[2], Christina Schwarz[1,3]; [1]*Inst. for Ophthalmic Research, Germany;* [2]*National Eye Inst., USA;* [3]*Center for Optical Technologies, Aalen Univ., Germany.* We present a power-efficient 2P-AOSLO using synchronized electro-optic modulation to confine excitation to informative scan intervals. Forward-scan gating reduces retinal exposure, suppresses sinusoidal edge over-illumination, enables pixel-level stimulation, and enhances two-photon efficiency via pulse picking.

OM4B.3 • 17:15
Computational Aberration Correction in Volumetric Retinal OCT Data Sets, Robert J. Zawadzki[1], Jungmin Kim[2], Yao Cai[1], Hang Chan Jo[2], Ewelina Pijewska[3], Ratheesh K. Meleppat[1], Ravi S. Jonnal[1], Dae Yu Kim[2]; [1]*Univ. of California Davis, USA;* [2]*Electrical and Computer Engineering, Inha Univ., Korea (the Republic of);* [3]*Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus Univ. in Torun, Poland.* We presented a Computational Adaptive Optics (CAO) method for scanning SS-OCT that enabled aberration correction of volumetric retinal data. Ocular aberrations were estimated using a hybrid strategy of global Nelder–Mead and local Quasi-Newton optimization. The results showed enhanced visualization not only on en face but also on B-scan images.

OM4B.4 • 17:30
MEA-UNet: a Multi-Scale Edge-Aware Attention Framework for Retinal Fundus Vessel Segmentation, Rui LIU[1]; [1]*Duisburg Essen Univ., Germany.* Retinal vessel segmentation is important for automated ophthalmic screening. We propose MEA-UNet, a multi-scale edge-aware attention network that enhances vessel boundary representation and thin vessel detection. Experiments show improved performance compared with baseline models.

OM4B.5 • 17:45
Retinal and Choroidal Arterial Waveforms From High-to-Low Frequency Band Ratios in Real-Time Laser Doppler Holography at 37,000 Frames per Second, zacharie auray[2], yann fischer[2], maxime boy arnould[2], Michael Atlan[1]; [1]*CNRS, France;* [2]*espci, France.* We show that a high-to-low frequency spectral-band ratio measured from real-time laser Doppler holography interferograms acquired at 37 kHz sharpens retinal arterial waveform morphology compared with previous reverse-contrast low-frequency approaches and reveals pulsatile signals from

putative choroidal arteries.

0.4 Brussels
16:30 -- 18:30
CM4C • Imaging through Complex Media and Tomography I

Presider: Maciej Trusiak; Warsaw Univ. of Technology, Poland and Maciej Trusiak, Poland

CM4C.1 • 16:30 (Invited)
Reflection Matrix Approach to Deep Optical Imaging, Alexandre Aubry[1]; [1]*Institut Langevin, France.* **Label-free microscopy** faces penetration depth limits due to aberrations and multiple scattering. This study reports on a **reflection matrix** approach to overcome these fundamental issues in post-processing, thereby enabling 3D biological tissue imaging.

CM4C.2 • 17:00 (Invited)
Precision Imaging With Shaped and Shapeless Illumination, Allard Mosk[1]; [1]*Universiteit Utrecht, Netherlands.* We present recent results on imaging in complex media using adaptively shaped laser light as well as the most shapeless form of light, random laser speckle.

CM4C.3 • 17:30
Full-Field Vibrometry Through Scattering Media Using Synthetic Wavelength Imaging, Florian Dötzer[1], Muralidhar Madabhushi Balaji[2], Patrick Cornwall[2], Tianyi Wang[2], Stefan Sinzinger[1], Florian Willomitzer[2]; [1]*Fachgebiet Technische Optik, Technische Universität Ilmenau, Germany;* [2]*Wyant College of Optical Sciences, Univ. of Arizona, USA.* We propose a synthetic wavelength approach to bypass temporal bandwidth limitations in traditional full-field vibrometry and enable measurements through scattering media. Using this approach, we demonstrate spatially resolved measurements of vibrations with displacement amplitudes of several micrometers, even for samples obscured by a diffuser.

CM4C.4 • 17:45
Correlation Tomography for Reconstructing Velocities in Turbulent, Noncircular Jets, Tolga Gurcan[1], David Yan[1], Shaurya Aarav[2], Jason W. Fleischer[1]; [1]*Princeton Univ., USA;* [2]*Institut des NanoSciences de Paris, Sorbonne Universite, France.* We extend stereo-camera BOS correlation tomography to recover 3D fields in rectangular turbulent jets. By localizing refractive index gradients in space and time, we observe internal structures and speeds in both transverse directions.

CM4C.5 • 18:00
High-Scattering Intensity Diffraction Tomography and Multiple Scattering Model for Accurate 3D Refractive Index Tomography, Ankit Butola[1]; [1]*UiT The Arctic Univ. of Norway, Norway.* I present a high-scattering intensity diffraction tomography (HS-IDT) system that effectively incorporates high oblique multiple scattering and offers accurate refractive index (RI) reconstruction. This is crucial for the practical implementation of RI tomography methods.

CM4C.6 • 18:15
Imaging Through non-Ergodic Scattering Media Using Wavefront-Inversion Interferometry, Xiaohang Sun[1], Sultan Abdul Wadood[1], Jason W. Fleischer[1]; [1]*Princeton Univ.,*

USA. We demonstrate passive imaging through structured scattering media by measuring the inversion-symmetric mutual coherence function with a folded-wave interferometer. Unlike speckle-correlation imaging, object reconstruction does not require ergodic speckles.

0.1 London
16:30 -- 18:30
FM4D • Atmospheric Sensing and Field Deployable Instruments
Presider: Christoph Englert; US Naval Research Laboratory, USA

FM4D.1 • 16:30 (Invited)
Simultaneous Shipborne FTS–VIS and in Situ Observation of GHGs and Air Pollutants as a New Tool for Emission Monitoring and Satellite Validation, Astrid Müller[1], Matthias M. Frey[2], Vincent Enders[3], Ralph Kleinschek[4], Karolin Voss[4], Isamu Morino[1], Shin-ichiro Nakaoka[1], Hideki Nara[1], Prabir K. Patra[5,6], Takafumi Sugita[1], André Butz[4,7], Hiroshi Tanimoto[1]; *[1]National Inst. for Environmental Studies, Japan; [2]Karlsruhe Inst. of Technology, Germany; [3]Inst. for Materials Chemistry, TU Wien, Austria; [4]Inst. of Environmental Physics, Heidelberg Univ., Germany; [5]Japan Agency for Marine–Earth Science and Technology, Japan; [6]Research Inst. for Humanity and Nature, Japan; [7]Heidelberg Center for the Environment, Heidelberg Univ., Germany.* Using continuous cargo-ship observations with a coupled semi-automatic FTIR spectrometer – VIS grating spectrometer, we observe XCO_2, XCH_4, XCO, and NO_2 columns. Combined with simultaneous in situ observations, we aim to constrain anthropogenic emissions and validate satellites.

FM4D.2 • 17:00
Dual Comb Spectroscopy Water Vapor Measurements on an Aircraft to 12,000 m, Chad W. Hoyt[1], Kevin Cossel[2], Connor Frederick[1], Luke Horstman[1], Diana Ochoa-Mendoza[3], Colton Parks[1], Tim Rahmes[3], Sameer Vartak[1], Matt Wiebold[1], Brian R. Washburn[2]; *[1]Honeywell, USA; [2]National Inst. of Standards and Technology, USA; [3]Boeing, USA.* Water vapor and CO_2 concentration measurements were made on a commercial aircraft to 12,000 m using dual comb spectroscopy. Open-path and air ingestion modalities retrieved concentrations at all flight altitudes, demonstrating a sensitivity of 20 micromole/mole in 10 s.

FM4D.3 • 17:15
Universal Dual-Comb Platform for Fast, High Sensitivity, High Resolution Sensing , Mike Mirov[1], Roderik Krebbers[2], Mathieu walsh[3], Dmitrii Konnov[4], Igor Moskalev[1], Sergey Vasilyev[1], Andrey Muraviev[4], Jérôme Genest[3], Konstantin Vodopyanov[4], Simona M. Cristescu[2]; *[1]Mid-IR Laser Group, IPG Photonics Corp, USA; [2]Inst. for Molecules and Materials, Radboud Univ., Netherlands; [3]Centre d'Optique, Photonique et Laser, Université Laval, Canada; [4]CREOL, the College of Optics and Photonics, Univ. of Central Florida, USA.* We present a universal dual comb sensing platform spanning VUV to terahertz, achieving an order of magnitude sensitivity gains over state-of-the-art FTS through spectral multiplexing and scalable multi detector acquisition.

FM4D.4 • 17:30 (Invited)
From Development to Application: Using the EM27/SUN-FTIR Spectrometer for Atmospheric Observations in the Framework of the COllaborative Carbon Column

Observing Network COCCON, Matthias M. Frey[1], Frank Hase[1], Carlos Alberti[1], Darko Dubravica[1], Isamu Morino[2], Astrid Müller[2], Hirofumi Ohyama[2], Mahesh K. Sha[4], Kei Shiomi[3]; *[1]Karlsruher Institut für Technologie, Germany; [2]National Inst. for Environmental Studies, Japan; [3]Japan Aerospace Exploration Agency, Japan; [4]Royal Belgian Inst. for Space Aeronomy, Belgium.* We have developed a novel solar-viewing FTIR spectrometer for observing greenhouse gases and established a global network (COCCON) that utilizes these instruments. Here we present various applications, including long-term observation, emission estimation, and satellite validation.

FM4D.5 • 18:00
Robust Soliton Microcomb Generation Using Direct PMF-Coupled Microresonators for Field-Deployable Spectroscopy, Miezel Talara[1], Yudai Matsumura[1], Kodai Yamaji[1], Yu Tokizane[1], Naoya Kuse[1], Takeshi Yasui[1]; *[1]Tokushima Univ., Japan.* We demonstrate robust soliton microcomb generation using direct polarization-maintaining fiber–coupled microresonators with active temperature stabilization. The architecture achieves alignment-free operation and long-term stability, enabling reproducible microcomb sources suitable for compact and field-deployable spectroscopy systems.

FM4D.6 • 18:15
Validation Results for the Atmospheric Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS): Halogen-Containing and Other Long-Lived Greenhouse Gases, Kaley A. Walker[1], Laura N. Saunders[1], Patrick Sheese[1], Jiansheng Zou[1]; *[1]Univ. of Toronto, Canada.* This paper will describe current validation studies and overall mission status for the Atmospheric Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS). This will focus on validation of the newest data version for halogen containing species.

0.8 Rome
16:30 -- 18:30
IM4E • Advances in Imaging Systems II: Biomedical
Presider: Alejandra Consejo; Universidad de Zaragoza, Spain

IM4E.1 • 16:30 (Invited)
Extreme Ultraviolet Computational Imaging Systems, Stefan Witte[1]; *[1]Technische Universiteit Delft, Netherlands.* Computational imaging methods such as ptychography enable high-resolution microscopy at wavelengths for which optical components are limited, such as extreme ultraviolet (XUV) radiation. We will discuss lensless XUV imaging systems for transmission and reflection geometries, with a focus on table-top systems using high-harmonic generation as the light source, as well as applications in element-sensitive imaging and wavefront characterisation of ultrafast XUV sources.

IM4E.2 • 17:00
Time-Domain Speckle Contrast Optical Spectroscopy Using SPAD Gated Camera for Deep Tissue Blood Flow Monitoring, Marina Vasileva[1], Edoardo Charbon[2], Nisan Ozana[1]; *[1]Engineering, Bar Ilan Univ., Israel; [2]AQUA, EPFL, Switzerland.* We present a time-domain speckle contrast optical spectroscopy (SCOS) system based on a gated 512×512 single-photon avalanche diode (SPAD) camera and nearinfrared illumination. The time-gated

detection enables the isolation of late-arriving photons, providing enhanced sensitivity to cerebral blood-flow dynamics in deeper tissue layers.

IM4E.3 • 17:15
a Customized CNN–LSTM Framework for Spatiotemporal Analysis of Quantitative Phase Maps of Sperm Cells, Ankit Butola[1], sushmit Dhar[1], Mona Nystad[2]; *[1]UiT The Arctic Univ. of Norway, Norway; [2]Univ. Hospital of North Norway, Norway.* We propose a customized CNN–LSTM model for time-lapse spatiotemporal analysis of highly spatially sensitive quantitative phase maps of human spermatozoa. The model's performance is evaluated and compared with other CNN-based approaches.

IM4E.4 • 17:30
Multicolor Three-Photon Fluorescence Microscopy With Fiberized Mamyshev Oscillator at 1.7 µm, Xiaoxiao Wen[1], Jixiang Chen[1], Xin Dong[1], Beth W. L. So[2,3], Chiyi Wei[1], Yan Xie[1], Qiyu Zheng[2,3], Cora S. W. Lai[2,4], Kenneth K. Y. Wong[1,4]; *[1]Department of Electrical and Electronic Engineering, The Univ. of Hong Kong, China; [2]State Key Laboratory of Brain and Cognitive Sciences, The Univ. of Hong Kong, China; [3]Li Ka Shing Faculty of Medicine, School of Biomedical Sciences, The Univ. of Hong Kong, China; [4]Advanced Biomedical Instrumentation Centre, China.* A broadband 1.7 µm fiberized Mamyshev oscillator with 80-nJ, 65-fs pulses for three-photon fluorescence microscopy was demonstrated, enabling single-wavelength multicolor imaging of microglia and blood vessels, with the third harmonic generation signal in mouse brain.

IM4E.5 • 17:45
Spatial Router for Transforming Time-Varying Images Based on Erbium-Doped Multicore Fiber Amplifier, Lior Roth[1], Eyal Cohen[2], Zeev Zalevsky[1]; *[1]Bar-Ilan Univ., Israel; [2]CogniFiber, Israel.* We demonstrate pump-controlled spatial pixels routing in 13-core erbium-doped multicore-fiber. 1550nm modulated signal is injected into central core, while selective 980nm pumping of neighboring cores modifies the gain distribution and results with spatial signal routing.

IM4E.6 • 18:00
Influence of Overlying Layers on OCT Speckle Statistics: a Bi-Layer Phantom Study, Alejandra Consejo[1], Maria Miazdzyk[2]; *[1]Universidad de Zaragoza, Spain; [2]Wroclaw Univ. of Science and Technology, Poland.* This study investigates how overlying layers affect OCT speckle statistics using bi-layer phantoms. Results show that speckle metrics of deeper layers vary with upper-layer properties, with stronger effects in parametric descriptors, highlighting limitations in multilayer tissue interpretation.

IM4E.7 • 18:15
Experimental and Computational Assessment of Corneal Biomechanical Anisotropy and Localized Softening Using Cross-Meridian Air-Puff OCT and 3D Fluid-Structure Interaction Modeling, Judith S. Birkenfeld[1], Alejandra Varea[1], James A. Germann[2], Elena Redaelli[1], Eduardo Martinez Enriquez[1], Susana Marcos[2,1]; *[1]Consejo Sup Investigaciones Cientificas, Spain; [2]Univ. of Rochester, USA.* Cross-meridian air-puff OCT combined with 3D FSI modeling assessed corneal biomechanics in collagenase-weakened porcine eyes. Global

anisotropy was preserved, while deformation metrics detected localized, asymmetric softening, demonstrating sensitivity to early, spatially confined biomechanical alterations.

Tuesday, 14 July

0.5 Paris
08:30 -- 09:45
STu1A • Point Optical Fiber Sensors I
Presider: Jennifer Morales; US Army Research Laboratory, USA

STu1A.1 • 08:30 (Invited)
Optical Fiber Grating Biosensors: Practical Insights and Design Strategies, Cosimo Trono[1]; [1]*Istituto di Fisica Applicata "Nello Carrara", Consiglio Nazionale delle Ricerche, Italy.* This talk provides practical design insights for optical fiber grating biosensors, emphasizing microfluidic integration challenges, fluid handling limitations, and effective multiplexing strategies to enhance sensitivity, reliability, and simultaneous detection capabilities in complex biological environments and samples.

STu1A.2 • 09:00
Optical Fiber Functionalization Assisted by 3D Printing, Xin Lu[1], Mathias Breithaupt[1], Konstantin Hicke[1], Yicha Zhang[2]; [1]*Bundesanstalt für Materialforschung und, Germany;* [2]*Univ. Polytechnique Hauts-de-France, France.* A simple 3D printed mold method is proposed for functionalizing optical fibers by attaching polymer layers. The resulting fibers exhibit enhanced temperature and humidity sensitivity with unaffected response time, offering a promising approach for advanced fiber optic sensing.

STu1A.3 • 09:15
Low-Invasive Fiber-Optic Biosensor Using Light-Emitting Whispering-Gallery-Mode Biocompatible Microspheres, Nikita Toropov[1], Anton Starovoytov[2], Evgeniia Soloveva[2], Albert Rogachev[2], Daler Dadadzhanov[2,3]; [1]*Univ. of Southampton, UK;* [2]*ITMO Univ., Russian Federation;* [3]*Tel Aviv Univ., Israel.* Biocompatible light-emitting whispering-gallery-mode microspheres based on carbon dots, $AgInS_2$/ZnS quantum dots, and polymers are developed for biosensing, demonstrating protein, oligonucleotide, and refractive-index detection and enabling a low-invasive fiber-optic sensing platform.

STu1A.4 • 09:30
Characterization of an Improved Modular Fiber Coupled Laser Doppler Anemometer as Optical air Data Sensor, Peter Mahnke[1], Gerhard Geyer[1], Oliver Kliebisch[1], Thorsten Österle[1], Raoul-Amadeus Lorbeer[1]; [1]*Deutsches Zent f.Luft-u.Raumfahrt eV (K), Germany.* A modular wind-velocity optical air data sensor will be presented. It is based on a compact fiber coupled laser Doppler anemometer. Sensitivity limitations due to noise sources are investigated and system improvements will be explained.

0.14 Singapore
08:30 -- 10:15
ITu1B • Biomedical and Industrial Applications
Presider: Alejandra Consejo; Universidad de Zaragoza, Spain

ITu1B.1 • 08:30 (Invited)
Optical Overlay Metrology for the Semiconductor Industry, Elbert G. van Putten[1]; [1]*ASML Netherlands B.V., Netherlands.* The continuous shrinkage of semiconductor device size is a key driver of technological advancement. It allows placing more devices on a small chip and is essential for emerging technologies where computational density and energy efficiency are paramount. In this talk we will share the insights on the state-of-the-art overlay metrology and the challenges. We will explain the Digital Holographic Microscopy (DHM) concept and demonstrate some of the solutions with simulation and experimental data.

ITu1B.2 • 09:00
Polarization-Enhanced Feature Extraction for Improved Boundary Detection in low-Contrast Scenarios, Yebei Wen[1], Hanyu Zhan[1], Jingxi Jiang[1], Jizhou Lai[1]; [1]*Nanjing Univ Aeronautics & Astronautics, China.* We present a polarization-enhanced feature extraction method based on ORB framework for improved boundary localization in low-contrast scenes. Experiments with a handheld RGB-P system demonstrate more accurate boundary delineation compared with conventional RGB-based methods.

ITu1B.3 • 09:15
Audio Image Classification Based on Mel Spectrograms Using Deep Learning, Yossef Danan[1], Ariel Schwarz[1], Efraim Tirschwell[1], Ohad Savion[1], Amir Shemer[1]; [1]*JCE, Israel.* This study investigates audio image classification using Mel-spectrograms and a custom Convolutional Neural Network. The proposed model achieves strong performance and high accuracy at low computational cost, confirming the effectiveness of spectral features for diverse recognition tasks.

ITu1B.4 • 09:30
Phase-Reduced Sensitivity Imaging Through a Thin Diffuser, Shimon Elkabetz[1], Zeev Zalevsky[1]; [1]*Bar-Ilan Univ., Israel.* To overcome image-distortion due to scattering, we propose a dual-illumination holographic technique enabling phase imaging through thin diffusers. Our method requires no prior calibration or rear illumination, demonstrating accurate phase recovery in simulations and experiments.

ITu1B.5 • 09:45
Speckle Patterns Analysis Based Spatial-Temporal Directional Information Transmission, Yehor Krapovnytskyi[1], Sergey Agdarov[1], Yafim Beiderman[1], David Spirito[2], Rephael Halachmy[2], Marianna Beiderman[3], Zeev Zalevsky[3]; [1]*Bar-Ilan Univ., Israel;* [2]*Audiopixels, Israel;* [3]*Faculty of Engineering, Ruppin Academic Center, Israel.* This research demonstrates directional photonic data transmission using spatial-to-temporal frequency encoded speckle patterns from a MEMS-based speakers array. Such encoding enables high-throughput recovery of spatial-temporal information without high-magnification optics, overcoming traditional long-distance focal length limitations.

ITu1B.6 • 10:00
Rapid Red Blood Cell Morphology Extraction by Self Referenced Multispectral Holography, Arnab Saha[1], Amartya Roy[2], Raghwendra Mishra[2], Rik Chattopadhyay[1]; [1]*Electronics and Telecommunication Engineering, Indian Inst. of Engineering Science and Technology, Shibpur, India;* [2]*Physiology, Ananda Mohan College, India.* We

propose a self referenced multi spectral holographic technique for rapid red blood cell morphology extraction from unstained smears. Recovered phase maps enable pseudo three dimensional reconstruction of multiple cells simultaneously for screening of blood disorders.

lTu1B.7 • 10:15
Hybrid Quantum Network for Brain Edema Monitoring via Diffuse Optical Tomography, Gokul Manavalan[1], Shlomi Arnon[1]; *[1]Ben-Gurion Univ. of the Negev, Israel.* Diffuse optical tomography (DOT) with a hybrid quantum neural network detects post-operative brain edema. Monte-Carlo photon simulations generate detector signals from layered brain tissue, and the quantum-enhanced classifier achieves 94.6% accuracy distinguishing edema from normal tissue.

0.2 Berlin-0.3 Copenhagen
08:30 -- 10:30
ATu1C • Agriphotonics: The New Frontier
Presider: Francis Vanier; National Research Council Canada, Canada

ATu1C.1 • 08:45 (Invited)
Sensing the Future of Food: Photonics and AI Enable Industry 5.0 in Agrifoo, Chris Van Hoof[1]; *[1]OnePlanet Research Center, Netherlands.* This presentation will show how optical sensing, and photonic integrated circuits in particular, can become indispensable technologies for farmers, food processors and consumers. These technologies enable faster, more precise and more scalable decisions across the food chain, helping guide the transition to a more secure, sustainable and resilient agrifood ecosystem.

ATu1C.2 • 09:15
Diffuse Reflection Spectroscopy Offering a Non-Destructive Bimi Quality and Freshness Evaluation, Indy Magnus[1,2], Armand Gonzalez Lammers[3], Mari Carmen Garcia[3], Julie Verdood[1], Hugo Thienpont[1,2], Lien Smeesters[1,2]; *[1]Brussels Photonics (B-PHOT), Vrije Universiteit Brussel, Belgium; [2]BP&M, Flanders Make@VUB, Belgium; [3]ECO ESPANA BV, Netherlands.* Diffuse reflection spectroscopy and Linear Discriminant Analysis offer non-destructive Bimi® quality and freshness monitoring, demonstrating a classification between ecological and convential Bimi®, premium and second quality, and between fresh and stored products, with accuracies >89%.

ATu1C.3 • 09:30
Multimodal Imaging Techniques for Advancing Fish Microvilli Research Applications, Ankit Butola[1], Luis E. Villegas-Hernández[1], Dhivya B. Thiyagarajan[1], Bartlomiej Zapotoczny[2], Roy A. Dalmo[1], Balpreet Singh Ahluwalia[1]; *[1]UiT The Arctic Univ. of Norway, Norway; [2]Department of Biophysical Microstructures, Inst. of Nuclear Physics, Polish Academy of Sciences, Poland.* We present a comprehensive investigation of different optical (QPI, fluorescence, SIM, STED, TIRF), electron (SEM, TEM) and force microscopy (AFM) methods to quantify fish microvilli features, ranging from 1-2 µm to 10-100 nm surface details.

ATu1C.4 • 09:45
NIR Interaction Spectroscopy for Determining Total Soluble Solids in on-the-Plant Strawberries Under Daylight Conditions, Vilde Vraalstad[1], Anders H. Hansen[1], Marion O'Farrell[1], Jon Tschudi[1], Jens Petter Wold[2]; *[1]SINTEF, Norway; [2]Nofima, Norway.* In-field assessment of internal fruit quality is challenging under daylight conditions. We demonstrate non-contact NIR interaction spectroscopy for determining total soluble solids in on-the-plant strawberries, achieving robust measurements under strong and fluctuating ambient illumination.

0.4 Brussels
08:30 -- 10:30
CTu1D • Imaging through Complex Media and Tomography II
Presider: Esteban Vera; Pontificia Univ Catolica de Valparaiso, Chile

CTu1D.1 • 08:30 (Invited)
Computational Raman Imaging: Enabling Fast and Towards Deep Chemical Imaging, Hilton Barbosa de Aguiar[1]; *[1]Laboratoire Kastler Brossel, France.* Raman microscopy offers powerful label-free imaging but suffers from limited depth and speed. I will review our novel computational approaches overcoming these barriers, showcasing recent breakthroughs that drastically accelerate acquisition and potentially enhance deep chemical imaging.

CTu1D.2 • 09:00 (Invited)
Multi-Plane Wavefront Shaping: All-Optically Unscrambling Light to See Through Complex Media With Self-Configuring Diffractive Optical Networks, David B. Phillips[1], Jérôme A. Don Jayamanne[1,2], José C. Rocha[1,2], Une G. Butaite[1], J. Carpenter[1]; *[1]Univ. of Exeter, UK; [2]School of Electrical Engineering and Computer Science, The Univ. of Queensland, Australia.* When light propagates through complex scattering media, such as multimode optical fibres, transmitted images are unrecognisably distorted. Here we show how diffractive optical networks can be trained in-situ to all-optically reverse this scrambling process.

CTu1D.3 • 09:30
Detection of Simple Buried Objects in Soil Using THz Time-Domain Imaging, Mallam Eswar[1], Uzair Aalam[1], Amartya Sengupta[1], Aparajita Bandyopadhyay[1]; *[1]Indian Inst. of Technology Delhi, India.* We present the results of systematic study using THz time domain spectroscopy and imaging to understand the effect of the depth, the material composition, orientation of the objects, and soil type on the THz signal.

CTu1D.4 • 09:45
Leveraging Multiple Scattering for Optical Reflection Tomography, Thomas Wasik[1,2], Victor Barolle[3], Alexandre Aubry[1], Josselin Garnier[2]; *[1]Institut Langevin - CNRS, France; [2]CMAP, École polytechnique, France; [3]Owlo, France.* We present a reflection-mode Optical Diffraction Tomography algorithm that recovers spatial low-frequency refractive index information in biological samples. This optimization-based reconstruction exploits multiple scattering, enabling quantitative imaging despite the non-convexity of the inverse problem.

CTu1D.5 • 10:00
Subdiffraction Object Discrimination via Point Spread Function Rejection, Jacob Trzaska[1], Amit Ashok[1,2]; *[1]Wyant College of Optical Sciences, Univ. of Arizona, USA; [2]Department of Electrical and Computer Engineering, Univ. of Arizona, USA.* We present a coronagraphic-direct imaging measurement followed by machine learning for discriminating subdiffraction scale objects. Simulation results on the MNIST dataset show superior classification accuracy relative to direct imaging.

CTu1D.6 • 10:15
Minimally Invasive Optical Head Implants for Brain Sensing, Vytautas Gradauskas[1], Jemma Neil[1], Kevin J. Mitchell[1], Jack Radford[1], Daniele Faccio[1]; *[1]Univ. of Glasgow, UK.* Exponential attenuation limits optical brain sensing. We present a concept study of minimally invasive optical implants that increase light-brain interaction by up to 2-6 orders of magnitude and improve detection at the scalp.

0.1 London
08:30 -- 10:30
FTu1E • Space-borne FTS II: Missions and In-flight Performance
Presider: Christoph Englert; US Naval Research Laboratory, USA

FTu1E.1 • 08:30 (Invited)
Stratospheric Trends From ACE-FTS After the Hunga Tonga Eruption, Patrick Sheese[1], Kaley A. Walker[1]; *[1]Univ. of Toronto, Canada.* This study will discuss how measurements from the Atmospheric Chemistry Experiment–Fourier Transform Spectrometer (ACE-FTS) satellite instrument can be used to determine stratospheric background H_2O trends for periods that extend beyond the Hunga Tonga eruption, as well as the effects of the eruption on stratospheric O3 and temperature trends.

FTu1E.2 • 09:00 (Invited)
ESA's FORUM Mission Concept, Instrument and Mission Development Status, Fabien Marnas[1], David Buehler[1], Kotska Wallace[1], Dulce Lajas[1], Hilke Oetjen[1], Bram Sanders[1], Micael Miranda[1]; *[1]ESA European Space Research & Tech Ctr, Netherlands.* One of the two instruments on ESA's 9th Earth Explorer, the FORUM satellite, is an FTS to measure the far-infrared and part of the mid-infrared Top of Atmosphere spectrum. This presentation will provide an overview.

FTu1E.3 • 09:30 (Invited)
Withdrawn.

FTu1E.4 • 10:00 (Invited)
Advancing Space Science With High-Resolution UV Spectroscopy: Innovations in Spatial Heterodyne Spectrometry at JPL, Sona Hosseini[1], Guillaume Gronoff[2], Bjorn Davidsson[1], Amanda Hendrix[3], Larry Paxton[4]; *[1]Jet Propulsion Laboratory, USA; [2]Science Systems and Applications, Inc (SSAI), USA; [3]Planetary Science Inst., USA; [4]Applied Physics Laboratory, USA.* Spatial Heterodyne Spectroscopy (SHS) provides the resolving power traditionally achievable only with large-aperture observatories, but in a substantially miniaturized form factor with no moving components and broad adaptability from the extreme-UV through the near-

infrared. At the Jet Propulsion Laboratory (JPL), we are advancing SHS through two complementary instrument architectures, compact Michelson-design SHS and monolithic all-reflective SHS, to address critical measurement gaps across planetary science, heliophysics, and astrophysics.

0.9 Athens
08:30 -- 10:15
OTu1G • AO in Microscopy I
Presider: Peter Kner; Univ. of Georgia, USA

OTu1G.1 • 08:30 (Invited)
Novel Approaches to Adaptive Optics in Nonlinear and Single-Molecule Microscopy, Alexander Jesacher[1], Simon Moser[1], Julian Maloberti[1], Eva Ernst[1], Juan Munoz-Bolanos[1], Florian Harrasser[1]; [1]*Inst. of Biomedical Physics, Medical Univ. of Innsbruck, Austria.* Adaptive optics (AO) enables deeper optical microscopy, with recent advances in computation and wavefront shaping opening new possibilities. I will present our latest AO developments in single-molecule localization microscopy (SMLM) and multiphoton microscopy. For SMLM, we combine efficient numerical aberration retrieval with correction via a transmissive phase modulator. For multiphoton microscopy, we demonstrate fast indirect wavefront sensing using a kilohertz Megapixel Piston mirror array.

OTu1G.2 • 09:00 (Invited)
Model-Based Aberration Correction in a Commercial two-Photon Microscope, Dylan Marques[1], Arnon B. A.B.[1], Swapnil Mache[1], Tom Knop[1], Ivo Vellekoop[1]; [1]*Univ. of Twente, Netherlands.* High-resolution microscopy of complex 3D structures is challenging, requiring sample-specific aberration compensation. Model-based compensation consumes low photon budget and is guide-star free. We provide an overview from proof-of-concepts to integration into a commercial microscope.

OTu1G.3 • 09:30
Depth-Adapted Adaptive Optics in Three-Photon Microscopy, Qi Hu[1], Jingyu Wang[1], Huriye Atilgan[1], Armin Lak[1], Martin J. Booth[1]; [1]*Univ. of Oxford, UK.* Depth-dependent illumination underfilling and weighted-Bessel adaptive optics modes optimize three-photon neural imaging. Simulation and in vivo mouse brain experiments demonstrate faster convergence and enhanced fluorescence at 600–1300 µm depths compared with conventional Zernike-based adaptive optics correction.

OTu1G.4 • 09:45
Multi-Focus Sensorless Adaptive Optics for Fast Aberration Correction in Multiphoton Microscopes, Adrian Enoae[1], Biwei Zhang[1], Jingyu Wang[1], Qi Hu[1], Martin J. Booth[1]; [1]*Univ. of Oxford, UK.* We use patterned multifocus illumination plus a CNN to infer sample aberrations from as few as two images, enabling rapid, low-photon-budget sensorless AO correction for multiphoton microscopes and supporting high-throughput, in vivo imaging.

OTu1G.5 • 10:00
Spherical Aberration Compensation for Two-Photon Microscopy Through Thick Layers, Arnon B. A.B.[1], Dylan Marques[1], Tom Knop[1], Ivo Vellekoop[1]; *[1]Universiteit Twente, Netherlands.* A novel single-parameter search method for compensating strong spherical aberrations caused by thick layers for two-photon microscopy is presented. Nearly-perfect aberration correction is demonstrated in simulations using a very coarse estimation of the layer's optical properties.

0.5 Paris
13:30 -- 15:30
HTu3C • Remote Sensing Algorithms and Applications
Presider: Andrea Vander Woude; NOAA Great Lakes Environmental Res Lab, USA

HTu3C.1 • 13:30 (Invited)
Emulating Expert Systems for Global Mineral Mapping: a Deep Learning Approach to EMIT Tetracorder Retrievals, Guillaume Hans[1]; *[1]Metaspectral, Canada.* USGS Tetracorder is gold standard for mineral identification but is also complex to deploy. We present a 1D-CNN emulator for satellite based mineral mapping from reflectance spectra. Its performance, successes, and inherent challenges are discussed.

HTu3C.2 • 13:45 (Invited)
Hyperspectral Remote Sensing for Agriculture: Crop Health Assessment and Precision Farming Case Studies, Stefanie Steinhauser[1]; *[1]Ludwig-Maximillians-Universität Munchen, Germany.* Hyperspectral remote sensing is essential for diverse agricultural applications, such as fertilizer management. This work presents an overview of developed algorithms, validated through quantitative case studies, demonstrating monitoring of crop seasonal dynamics using time-series data.

HTu3C.3 • 14:00 (Invited)
BioSCape: Advancing Global Biodiversity Monitoring Through NASA's First Biodiversity-Focused Airborne and Field Campaign, Erin L. Hestir[1], Anabelle Cardoso[2], Jasper Slingsby[3], Philip Brodrick[4], Adam Wilson[2]; *[1]Univ. of California Merced, USA; [2]Univ. at Buffalo, USA; [3]Univ. of Cape Town, South Africa; [4]Jet Propulsion Laboratory California Inst. of Technology, USA.* NASA's first biodiversity-focused field campaign integrates airborne, satellite and field data across southwestern South Africa. BioSCape collected an unprecedented combination of UV-thermal imaging spectroscopy, lidar, and novel field data to advance biodiversity remote sensing and inform conservation strategies.

HTu3C.4 • 14:15
Confocal Pushboom Hyperspectral Imager for Biological Imaging Applications, Chris Graham[1], Lai Zhang[1], John M. Girkin[1]; *[1]Durham Univ., UK.* We report on a novel confocal Hypersepctral Imaging camera providing high spectral resolution of 4-8nm from 500 to 1700nm. The compact instrument utilizes diamond machined optics and a range of biological applications will be shown.

HTu3C.5 • 14:30
Improved Hyperspectral Imagery Classification Using Adaptive Denoising and Multiscale Feature Fusion, Shen-En Qian[1]; [1]*Canadian Space Agency, Canada.* A new hyperspectral classification method is proposed. It adaptively reduces noises of a hyperspectral image followed by dimensionality reduction and multiscale feature fusion before applying support vector machine classification. It outperforms several comparative classification methods.

HTu3C.6 • 14:45
Realistic Hyperspectral Scene Simulation With MCScene, Paul Corlies[1], Robert L. Sundberg[1], Alexander Berk[1]; [1]*Spectral Sciences Incorporated, USA.* We present Spectral Science's MCScene, the Monte Carlo Scene simulator, a first-principles radiative transfer model capable of generating radiometrically accurate multi- and/or hyper-spectral imagery of three-dimensional scenes from the ultraviolet to the longwave infrared.

HTu3C.7 • 15:00 (Invited)
Forecasting Coastal Weather Hazards and Satelite Data Applications in the Great Lakes, Andrea Vander Woude[1]; [1]*NOAA Great Lakes Environmental Res Lab, USA.* OAA's Great Lakes Environmental Laboratory is developing an updated 5-lake hydrodynamic model uniquely able to resolve bays and harbors at finer scales than previous iterations. This has increased forecast accuracy, allowing prediction of flooding, coastal inundation, and thermal structure in the Great Lakes region. Validation data for flooding and inundation events along coastal regions is limited and sparse. Therefore, NOAA is moving toward using UAS outfitted with LiDAR and hyperspectral cameras to better resolve the presence and absence of water in the coastal zone, in addition to available satellite imagery. Efforts also include assimilating satellite data to nudge the model toward realistic and accurate forecasts.

HTu3C.8 • 15:15 (Invited)
Pushing the Limits of Aquatic Remote Sensing: Synthetic Data and Deep Learning for Hyperspectral Inverse Emulation of a Coupled Ocean-Atmosphere Radiative Transfer Model, Jeremy Kravitz[1]; [1]*Pixxel, USA.* Water quality monitoring is operationally critical yet constrained by cost, sensor compatibility, and retrieval accuracy. Our framework pairs physics-based optical modeling with deep learning to produce accurate, uncertainty-quantified biogeophysical estimates directly from satellite imagery. The framework is sensor-agnostic and computationally efficient, enabling deployment on government and commercial imagery alike. Key advantages include decoupled phytoplankton and sediment signals, global applicability, multiple phytoplankton groups represented, and per-pixel uncertainty. Preliminary results show our inversion framework able to decouple backscatter signals from inorganic and organic constituents which is expected to improve estimates of phytoplankton carbon stocks of coastal and inland systems, close gaps in global climate models and improving resource management decisions for water utilities, agriculture, and government agencies.

0.14 Singapore
13:30 -- 15:00
LTu3B • Advances in Nonlinear Optical Diagnostics
Presider: Dan Fries; Univ. of Kentucky, USA

LTu3B.1 • 13:30 (Invited)
Geometric Control of Spatiotemporal Phase in Femtosecond Coherent Raman Scattering, Ali Hosseinnia[1]; [1]*Luxembourg Inst. of Science and Tech, Luxembourg.* Ultrafast laser excitation creates coherent rotational motion in molecular gases. We demonstrate that femtosecond Raman signals can encode temporal molecular dynamics directly into spatial coordinates, enabling single-shot observation of hundreds of femtoseconds of coherent evolution. This space–time coupling reveals previously overlooked spatial organization of molecular coherence in gases.

LTu3B.2 • 14:00
Improved Spectral Selectivity of fs/ps CARS Using Phase-Modulated Excitation, Anna Stevenson[1], Chloe E. Dedic[1]; [1]*Univ. of Virginia, USA.* A novel, three-beam coherent anti-Stokes configuration using a single 4f pulse shaper to modulate both excitation pulses is presented for improved spectral selectivity. The effectiveness of dual-pulse shaping is evaluated using gas mixtures.

LTu3B.3 • 14:15
High-Speed Boundary Layer Velocimetry During Transpiration Cooling Using NO-LIF Imaging, Tianshu Wu[1,2], Xin Li[1], Jiwei Li[1], He Zhang[3], Yejun Wang[1], Qiu Wang[1], Yutao Huo[2], Wei Zhao[1]; [1]*Inst. of Mechanics CAS, China;* [2]*China Univ. of Mining and Technology, China;* [3]*Key Laboratory of Space Physics, China.* The characterization of the high-speed boundary layer of a flat-plate model under transpiration cooling was investigated. Coolant (CO_2) was injected through a porous-media plate, and streamwise velocity profiles were determined using NO laser-induced fluorescence (NO-LIF).

LTu3B.4 • 14:30
Multi-Spectroscopic Diagnostics of Near-Wall Flow Characteristics Over C/SiC Composites in Repetitive High-Enthalpy Plasmas, Xin Lin[1], Yifan Fu[1], Junjie Pan[1], Zezhong Wang[1], Yuan Hu[1]; [1]*State Key Laboratory of High Temperature Gas Dynamics, Inst. of Mechanics CAS, China.* Multi-spectroscopic diagnostic techniques are employed to measure the near-wall flow of C/SiC in repetitive high-enthalpy plasmas. These methods quantify ablation products, non-equilibrium temperature, and species density through laser absorption spectroscopy/optical emission spectroscopy/spectral imaging to investigate the gas-surface interaction.

LTu3B.5 • 14:45
Nitrogen S-Branch Raman Linewidth Determination in N_2-NH_3 Gas Mixtures, Jonas I. Hölzer[1,3], Mark Kuria[1,2], Henry Misoi[1,3], Nancy Karuri[2], Thomas Seeger[1,3]; [1]*Engineering Thermodynamics, Universität Siegen, Germany;* [2]*Chemical Engineering Department, Dedan Kimathi Univ. of Technology, Kenya;* [3]*Center for Sensor Systems (ZESS), Univ. of Siegen, Germany.* We report the determination of the S-branch Raman linewidths of nitrogen broadened

by ammonia up to 870 K, which are key parameters for accurate, non-intrusive coherent anti-Stokes Raman scattering (CARS) diagnostics in ammonia combustion systems.

0.2 Berlin-0.3 Copenhagen
13:30 -- 15:30
ATu3A • New Frontiers of Industrial Sensing II: Probing the Extreme Scale of Matters
Presider: Jayshri Sabarinathan; Western Univ. (Canada), Canada

ATu3A.1 • 13:30 (Tutorial)
Probing Ultrafast Nanoscale Terahertz Dynamics in Semiconductors, Frank Hegmann[1]; [1]*Univ. of Alberta, Canada.* This tutorial discusses how time-resolved terahertz spectroscopy (TRTS) and terahertz scanning tunneling microscopy (THz-STM) can be used to probe ultrafast nanoscale carrier dynamics in semiconductor materials all the way down to the atomic scale.

ATu3A.2 • 14:30
Hemispherical Emissivity Measurement of C-103 Alloy With Validation Using Inconel-718 Alloy at Elevated High Temperatures, Efe Kucukkeskin[1]; [1]*Roketsan Missiles Inc., Turkey.* FTIR-based approach under controlled thermal conditions with a wide wavelength-temperature range is practiced to measure hemispherical emissivity of C-103 and Inconel-718 alloys to evaluate the usability for thermal protection systems of aerospace applications.

ATu3A.3 • 14:45
Polarimetric-Hyperspectral Microscopy for Resolving Chemical and Structural Signatures, Yuxing Li[1], Jingyan Chen[1], Yanmin Zhu[1], Edmund Y. Lam[1]; [1]*The Univ. of Hong Kong, Hong Kong.* We present polarimetric-hyperspectral microscopy for resolving chemical composition and structural anisotropy in materials. By integrating complementary signatures, the approach mitigates morphology-induced spectral ambiguity, enabling physically grounded material characterization beyond conventional hyperspectral imaging.

ATu3A.4 • 15:00 (Invited)
Optical Fiber Sensors in Harsh Environments: From Nuclear Fuel Assemblies to Aerospace-Grade Conditions, Sidney Goossens[1,2], Ben De Pauw[1,2], Francis Berghmans[1,2]; [1]*Brussels Photonics (B-PHOT), Vrije Universiteit Brussel, Belgium;* [2]*BP&M, FlandersMake@VUB, Belgium.* Fiber Bragg grating spectra provide more than wavelength shifts: spectral deformation enables assessment of sensor installation quality and structural damage. Applications in nuclear and aerospace environments demonstrate how spectral features enhance reliability and damage detection capabilities.

0.4 Brussels
13:30 -- 15:30
JTu3D • Super-Resolution Imaging and Microscopy
Presider: Julia Alonso; Universidad de la Republica, Uruguay

JTu3D.1 • 13:30 (Invited)
***Computational Methods in Super-Resolution Microscopy*,** Sjoerd Stallinga[1]; [1]*Technische Universiteit Delft, Netherlands.* Surpassing the diffraction limit has become daily practice in the field of microscopy. This is made possible by methodological breakthroughs in which specific modifications to the optical hardware and labeling biochemistry are combined with computational advances in an integral approach. I will highlight recent results in our lab in information optimal Structured Illumination Microscopy, the impact of noise in deconvolution, and 4pi single molecule localization microscopy.

JTu3D.2 • 14:00
Widefield two-Photon Single-Pixel Microscopy, Heberley Tobón[1], Samuel I. Zapata Valencia[1], Gladys Minguez[1], Enrique Tajahuerce[1], Jesus Lancis[1]; [1]*Universitat Jaume I, Spain.* In this work cost-effective and versatile framework for widefield two-photon single-pixel microscopy is presented. Partially sectioning imaging is achieved through pattern design instead of temporal focusing approaches.

JTu3D.3 • 14:15
Performance Analysis of Super-Resolution Reconstruction in Space-Based Multi-Aperture Imaging Systems, Seokgi Han[1], Jun Ho Lee[1], Yeong Su Shin[1], JI YONG JOO[1], Ha Neul Yeon[1]; [1]*Kongju Natioal Univ., Korea (the Republic of).* Reduced-height space telescopes can preserve imaging capability through multi-image super-resolution synthesis. However, jitters, inter-channel misalignment, and detector noise significantly degrade reconstruction quality, indicating that successful implementation strongly depends on pointing stability, alignment accuracy, and detector performance.

JTu3D.4 • 14:30
Far-Field Super-Oscillatory Dielectric Metalens for Visible-Wavelength Super-Resolution Imaging via Direct Meta-Atom Optimization, Santanu Mandal[1], Tapajyoti D. Gupta[1]; [1]*Indian Inst. of Science, India.* We demonstrate a far-field, phase-only super-oscillatory dielectric metalens operating at 405 nm. Through direct meta-atom optimization via particle swarm algorithms, the metalens design achieves a 130 nm focal spot, breaking the diffraction limit.

JTu3D.5 • 14:45
Hyperspectral Microscopy Using Single-Pixel Acquisition and Data Fusion-Based Enhanced Spatial Resolution, Samuel I. Zapata Valencia[1], Heberley Tobón[1], Cosimo D'Andrea[2], Jesus Lancis[1], Enrique Tajahuerce[1]; [1]*Universitat Jaume I, Spain;* [2]*Politecnico di Milano, Italy.* A hyperspectral single-pixel microscopy approach is presented, combining a custom spectrometer for rapid spectral acquisition with a monochromatic camera-based data fusion implementation. Up to 73 spectral channels are acquired in 0.8 s, yielding a 3.8 fold spatial resolution improvement.

JTu3D.6 • 15:00
Smart Single-Pixel Microscopy With Adaptive Optics and Compressive Sensing, Heberley Tobón[1], Samuel I. Zapata Valencia[1], Lindsey Willstatter[2,3], Marcos Obando[4], John Rosses[5], Stefano Bonora[2], Felix Lucka[4], Pere Pérez-Millán[5], Salvador Torres-Peiró[5], Cosimo D'Andrea[3], Andrea Farina[3], Enrique Tajahuerce[1], Jesus Lancis[1]; [1]*Universitat Jaume I, Spain;* [2]*CNR - Inst. of Photonics and Nanotechnology, Italy;* [3]*Politecnico di Milano, Italy;* [4]*Centrum Wiskunde &*

Informatica (CWI), Netherlands; [5]R+D Research Department, FYLA LASER, Spain. We describe our last advances in computational microscopy, as part of the doctoral network "Computational Imaging as Training Network for Smart Biomedical Devices" (CONcISE), combining wide-field structured illumination, adaptive optics, single-pixel detection, and compressive sensing

JTu3D.7 • 15:15
Accelerated Terahertz Time-of-Flight Imaging Using Compressed Sensing, Zhangyue Wei[1], John Healy[2], Idelfonso Tafur Monroy[1], Min Wan[1,2]; *[1]Electrical Engineering, Eindhoven Univ. of Technology, Netherlands; [2]Univ. College Dublin, Ireland.* We experimentally demonstrate reconstructed terahertz time-of-flight imaging from under-sampling measurement using compressed sensing. Using only 10% spatial sampling, acquisition time is reduced from 56.78 to 7.05 min while preserving the main depth information.

0.1 London
13:30 -- 15:30
FTu3E • Advanced Architectures in Frequency Comb Spectroscopy
Presider: Lucile Rutkowski; Institut de Physique de Rennes, France

FTu3E.1 • 13:30 (Invited)
Adaptive Dual-Comb Spectroscopy Platform for Customized Step-Scan and Apodized Sampling Patterns, Fabrizio R. Giorgetta[1], Simon Potvin[2], Jean-Daniel Deschenes[3], Ian Coddington[1], Richard L. Lieber[4], Esther Baumann[1]; *[1]National Inst of Standards & Technology, USA; [2]Waxwing Instruments, Canada; [3]Octosig Consulting, Canada; [4]Shirley Ryan AbilityLab, USA.* We present an adaptive dual-comb spectroscopy platform using free-form sampling. By programming real-time compressive sensing, apodization, and recurrence sampling, we optimize SNR and resolution for diverse applications, including fast hyperspectral imaging and muscle health analysis.

FTu3E.2 • 14:00 (Invited)
Quantum Advantages in DCS?, Jérôme Genest[1], Mathieu Walsh[1], Daniel I. Herman[2], Scott Diddams[3]; *[1]Université Laval, Canada; [2]Sandia National Laboratories, USA; [3]Univ. of Colodado, USA.* The use of quantum states to improve sensitivity of dual-comb spectrometers has recently been proposed and demonstrated. Here we consider that some of these approaches use a quantum paradigm to exceed a limit that could otherwise be surmounted with purely classical means.

FTu3E.3 • 14:30
Operando Ultra-Broadband Spectroscopy on Methane Plasmas, Kees van Kempen[1], Jonas Kuijpers[1], Marjolein Schoonus[1], Steijn Vervloedt[1], Roderik Krebbers[1], Gerard van Rooij[2], Amir Khodabakhsh[2], Simona M. Cristescu[1]; *[1]Radboud Universiteit Nijmegen, Netherlands; [2]Plasmalab, Maastricht Univ., Netherlands.* Operando spectroscopy of methane-air discharge plasmas using an ultra-broad (2-12 µm) supercontinuum source reveals reaction products concentrations, identifying e.g. acetylene (C_2H_2), ethane (C_2H_6), and ammonia (NH_3) inside the active reactor, giving insights for plasma chemistry.

FTu3E.4 • 14:45
10^{-18} at 1 Second: High-Bandwidth Extra-Cavity Carrier-Envelope Offset Control, Gregory Sercel[1], Sergio Carbajo[1]; *[1]Univ. of California Los Angeles, USA.* We demonstrate a new carrier-envelope offset stabilization architecture using FM feedback control of an acousto-optic modulator, achieving 52.0 mrad integrated phase noise and 6.8 × 10^{-18} fractional stability at 1 s, a two-fold improvement over previous feedback systems.

FTu3E.5 • 15:00 (Invited)
Triple-Resonance Spectroscopy Using a Cavity-Enhanced Comb-Based Fourier Transform Spectrometer, Qinxue Nie[1], Vinicius S. de Oliveira[1], Adrian Hjältén[1], Isak Silander[1], Kevin K. Lehmann[2], Aleksandra Foltynowicz[1]; *[1]Umeå Univ., Sweden; [2]Departments of Chemistry and Physics, Univ. of Virginia, USA.* We report triple-resonance spectroscopy employing two-step pumping and a cavity-enhanced near-infrared frequency comb probe to measure sub-Doppler transitions to the unexplored highly excited states of methane around 12,000 cm^{-1}. Stepwise pumping is achieved using a novel frequency-comb-stabilized, double-seeded continuous-wave optical parametric oscillator. This is the first measurement of the $4\nu_3 \leftarrow 2\nu_3$ methane transitions allowing verification of theoretical predictions in this region.

0.8 Rome
13:30 -- 15:00
ETu3F • From Ground to Space
Presider: Kevin Cossel; NIST Boulder, USA

ETu3F.1 • 13:30
Toward Atmospheric Carbon Dioxide Sensing With Eye-Safe All-Fiber Coherent Lidar, Nikita Kikilich[1], Kim Kalmankoski[1], Aarni Akkala[1], Ewan O'Connor[2], Juha Toivonen[1]; *[1]Tampere Univ., Finland; [2]Finnish Meteorological Inst., Finland.* We present initial atmospheric carbon dioxide measurements from eye-safe all-fiber coherent lidar system at 1.57 µm wavelength. Our approach exploiting strong aerosol backscattering events yields good agreement between theoretical predictions and experimental statistical analysis.

ETu3F.2 • 14:00 (Invited)
A Field-Deployable, Fast, Sensitive Monitor for Hydrogen Leak Quantification, Elizabeth Lunny[1]; *[1]Aerodyne Research Inc, USA.* Quantifying leaks in hydrogen infrastructure is critical to securing the long-term climate benefits of a hydrogen economy. Until recently, field-deployable instrument lacked the necessary speed and sensitivity. We have developed an inlet system which couples to a Tunable Infrared Laser Direct Absorption Spectroscopy (TILDAS) to achieve sub-5 ppb precision with a two second time response. Results from laboratory experiments and recent mobile monitoring campaigns will be presented.

ETu3F.3 • 14:30 (Invited)
Terahertz Quantum-Cascade Laser Instrumentation for Atmospheric Gas Sensing, Nicholas K. North[1], Jonas Krakofsky[2], Jakob Holstein[3], Mohammed Salih[1], Sanchit Kondawar[1], Solomon Appekey[1], Nart Daghestani[4], Adam Brown[1], Simon Schmid[2], Iaroslav Lubianskii[2], Imon Kundu[1], Nick Brewster[4], Eleanor Nuttall[1], Yingjun Han[1], Byron Alderman[4], Hui Wang[4], Brian Ellison[4], Lianhe Li[1], Edmund Linfield[1], Giles Davies[1], Joshua Freeman[1], Daniel

Stone[1], Alvydas Lisauskas[3,5], Hartmut Roskos[3], Peter Huggard[4], Mikhail Belkin[2], Alex Valavanis[1]; *[1]Univ. of Leeds, UK; [2]Technical Univ. Munich, Germany; [3]Johann Wolfgang Goethe-Universitat Frankfurt, Germany; [4]STFC Rutherford Appleton Laboratory, UK; [5]Vilnius Univ., Lithuania.* Numerous atmospheric gases (e.g., H_2O, [O], NH_3) have distinctive fingerprints in the terahertz-band of the electromagnetic spectrum. We present instrumentation for satellite and laboratory gas sensing, based on THz quantum-cascade lasers and difference-frequency generation techniques.

ETu3F.4 • 15:00
Albatross: a Balloon–Borne Mid–IR Spectrometer for Water Vapor Measurements in the Upper Atmosphere, Simone Brunamonti[1], Béla Tuzson[1], Lukas Emmenegger[1]; *[1]EMPA, Switzerland.* Albatross is a lightweight mid–R spectrometer for upper atmosphere water vapor observations aboard meteorological balloons. It has been characterized by various laboratory and field campaigns and demonstrated a precision of 30 ppb at 1 Hz and an accuracy of 1.5% at 2.5 ppm H_2O.

0.9 Athens
13:30 -- 15:00
OTu3G • AO in Ophthalmology II
Presider: Serge Meimon; Office Natl d'Etudes Rech Aerospatiales, France

OTu3G.1 • 13:30 (Invited)
High Speed Adaptive Optics in Ophthalmology , Yan Liu[1,2], James Crowell[1], Donald Miller[1]; *[1]Indiana Univ., USA; [2]National Univ. of Singapore, Singapore.* AO ophthalmoscopy measures and corrects ocular wavefront aberrations, enabling cellular-resolution retinal imaging and stimulation. AO is a dynamic control system that must track and correct temporal changes in ocular aberrations on the fly. Here, I will overview the work on high-speed AO in ophthalmology and describe our development of an ultrafast AO system, which enables aberration dynamics measurement at 171 Hz and significantly improves retinal image quality in clinically challenging cases.

OTu3G.2 • 14:00 (Invited)
Influence of Partial Spatial Coherence and Aberrations in Full-Field Optical Coherence Tomography, Inès Loukili[2], Arthur Sureau[2], Laurent Mugnier[3], Vincent Michau[3], Kate Grieve[1], Pedro Mece[2], Serge Meimon[3]; *[1]Institut De La Vision Paris, France; [2]Institut Langevin, France; [3]ONERA, France.* We present an analytical model of full-field OCT imaging that accounts for aberrations and spatial coherence of the illumination, and enables the definition of quantitative metrics for lateral resolution and signal level. The goal is to optimize the optical design of full-field OCT systems, particularly for retinal imaging.

OTu3G.3 • 14:30
Adaptive Optics Based Multimodal Two-Photon Microscope for Imaging the Retina, Zhijian Zhao[1], Paul Gläser[1], Xin Xie[1,2], Xinyi He[1,2], Christina Schwarz[1,3]; *[1]Inst. for Ophthalmic Research, Germany; [2]The Graduate Trainng centre of Neuroscience, Germany; [3]Center for Optical Technologies, Germany.* We present an adaptive optics multimodal two-photon microscope that significantly enhances label-free imaging in isolated

retinas. Combining complementary contrasts enables depth-resolved visualization of retinal layers, providing new insights into neural structure and function without exogenous labeling.

OTu3G.4 • 14:45
Wide-Angle Ocular Aberrometry by High-Speed Digital Holography, zacharie auray[2], jules Guillou[3], Jonathan Fabrizio[3], edwin Carlinet[3], Michael Atlan[1,3]; *[1]CNRS, France; [2]ESPCI, France; [3]EPITA, France.* We report wide-field measurements of angle-dependent ocular aberrations by high-speed digital holography in the human retina. We extend aberration estimation to retinal fields approaching $\pm 30^\circ$. Local sub-image shifts are converted into wavefront slopes and fitted over overlapping regions to recover spatially-varying aberration maps.

Lobby North - Posters
15:30 -- 17:00
JTu4A • Joint Poster Session I

JTu4A.1
Hydrostatic Pressure Sensor Based on Forward Brillouin Scattering, Carlos Alvarez-Ocampo[1], Aleksander S. Paterno[2], Antonio Díez[1], Martina Delgado-Pinar[1], Jose Luis Cruz[1], Miguel V. Andres[1]; *[1]Universitat de Valencia, Spain; [2]Santa Caterina State Univ., Brazil.* We demonstrate a standard telecom optical fiber sensor for measuring hydrostatic pressure in air and in water environments. The working principle relies on the frequency shift of mechanical resonances generated by Forward Brillouin Scattering.

JTu4A.2
Modeling Wavelength-Dependent Optical Tunable Plasmonic Sources for Subsurface Biomedical Imaging Applications, Ahmad Azzahrani[2], Ahmed C. Kadhim[1], Ahmed Al sadi[1], Omar Alnaseri[3], Riham Jabbar[1]; *[1]Univ. of Technology-Iraq, Iraq; [2]Northern Border Univ., Saudi Arabia; [3]Baden-Wuerttemberg Cooperative State Univ., Germany.* This article presents a simulation-based analysis of wavelength-dependent optical responses in tunable plasmonic sources, highlighting their impact on penetration depth and spatial localization for subsurface imaging across the visible-to-near-infrared spectral range.

JTu4A.3
Design of PCF Based SPR Biosensor and Refractive Index Sensing, Akshat Agarwal[1], Ankur Saharia[1], Manish Tiwari[1]; *[1]Manipal Univ. Jaipur, India.* This manuscript intented to presents a novel photonic crystal fiber (PCF)–based biosensor with high sensitivity for detecting refractive index variations. The sensor demonstrates a significant confinement loss of 51.67 dB/cm at 725nm . The sensor also attained a peak amplitude sensitivity of 55.1 RIU−1, within the range of 1.35–1.38

JTu4A.4
Improving Spatial Resolution of Structured Illumination Microscopy via Narrow Point Spread Function of Bessel Beam Illumination, Swapnil Khurana[1], Sachin K. Srivastava[1]; *[1]Indian Inst. of Technology Roorkee, India.* This study employs Bessel beam illumination in structured illumination microscopy (SIM), achieving a remarkable spatial

resolution of 120 nm, surpassing diffraction limited (DL) image by 2.1 times and outperforming Gaussian-illuminated SIM by 1.2 times.

JTu4A.5
Decoding Non-Cooperative Drones: Micro-Doppler-Based Physical Profiling Using Coherent LiDAR, Taegyu Kim[1,2], Munhyun Han[2], Yongju Lee[1,2], Bongki Mheen[1,2]; *[1]Univ. of Science and Technology, Korea (the Republic of); [2]ETRI, Korea (the Republic of).* To overcome limitations of conventional micro-Doppler analysis for non-cooperative drone identification, we present a coherent LiDAR-based approach enabling physical profiling of drone propellers via high-resolution time-frequency analysis of optical micro-Doppler signatures.

JTu4A.6
Aberration-Compensated Reconstruction for 360° Holographic 3D Display via Concave Ellipsoidal Mirror Imaging, Yusuke Sando[1], Yutaro Goto[1]; *[1]Osaka Research Inst. of Industrial Science and Technology, Japan.* Concave ellipsoidal mirror reflection enables a surrounding field of view of 360°. However, its aberrations highly degrades reconstructed images. This study successfully compensates these aberrations by deforming input 3D images based on numerical simulation.

JTu4A.7
Contrast Sensitivity Function for Two-Photon AR Displays, Mateusz Grochalski[2,1], Nikodem Czechowski[1], Oliwia Kaczkos[1,3], Katarzyna Komar[2,1]; *[1]International Centre for Translational Eye Research, Inst. of Physical Chemistry (ICHF), Poland; [2]Inst. of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus Univ., Poland; [3]Faculty of Physics, Univ. of Warsaw, Poland.* AR glasses utilizing two-photon vision to display infrared-based augmented content address optical-path challenges in AR technology. The prototype generated perceivable stimuli even under bright ambient conditions. Preliminary contrast sensitivity (CS) data were collected.

JTu4A.8
Study on Extending the Longitudinal Measurement Range in a Digital Holographic Microscope Using a 3-LED Source, Ha-mong Shim[1], Hyun Woo Ko[2,3], Hogil Baek[4], Sanghoon Shin[5], Seon Kyu Yoon[1]; *[1]Korea Photonics Technology Inst., Korea (the Republic of); [2]Korea Inst. of Science and Technology, Korea (the Republic of); [3]Korea Univ., Korea (the Republic of); [4]Seokyeong Univ., Korea (the Republic of); [5]Daol Atonics, Korea (the Republic of).* We demonstrate synthetic-wavelength digital holographic microscopy (DHM) using three LEDs to overcome measurement limits. By generating a 122.7 μm synthetic wavelength, we successfully profiled 50 μm-deep through-silicon vias (TSVs) over the full field of view (FOV). Results show ~2% agreement with scanning electron microscopy (SEM).

JTu4A.9
Compact Microcontroller-Based Tip/Tilt Control System for Free Space Optical Communication With Refractive Pointing Corrector , Antonio Trevisanato[1]; *[1]Consiglio Nazionale delle Ricerche, Italy.* We present a compact, high-speed Tip-Tilt correction system for FSOC. Using an STM32-controlled Fast Steering Prism and lateral-effect PSD, the system enables precise beam stabilization, featuring programmable PI parameters and adaptable

sampling for optimized performance.

JTu4A.10
Dark-Field Multispectral Imaging Using Dome Illumination for Discriminating Removable Contaminants on Glass Substrates, yeeun kim[1], Hanjin Cho[2], Taeeun Kim[3], Hayeon Lee[3], Yoonchan Jeong[1]; *[1]Seoul National Univ., Korea (the Republic of); [2]Hongik Univ., Korea (the Republic of); [3]Samsung Electronics, Korea (the Republic of).* We propose a dark-field multispectral imaging system using dome illumination that suppresses specular reflection on glass substrates by placing illumination outside the lens acceptance angle, enabling extraction of scattering spectra from contaminants for surface inspection.

JTu4A.11
Optimization of Multi-Line-Scanning-Based Temporal Focusing Multiphoton Microscopy, Chia-Yuan Chang[1], Ping-Hua Shih[1], Jui-Chi Chang[1], Wei-Hsin Chen[1], Shih-Hui G. Chang[1], Lina Grinevičiute[2], Kestutis Staliunas[2,3]; *[1]National Cheng Kung Univ., Taiwan; [2]Department of Laser Technologies, Center for Physical Sciences and Technology, Lithuania; [3]Catalan Institution for Research and Advanced Studies, Spain.* A multi-line-excitation-based active compensation for optical-dispersion with a linear-deformable-mirror (MACOL) is integrated with MS-TFMPM. The multi-line-excitation yields broad fluorescence intensity information of the specimen, providing reliable feedback and greatly improving the AEC and image contrast.

JTu4A.12
High-Power SERDS Setup for Spatially Resolved Gas-Phase Raman Spectroscopy in Transient Processes, Nico Winkler[1,2], Konrad Koschnick[1,2], Andreas Dreizler[2], Dirk Geyer[1]; *[1]Optical Diagnostics and Renewable Energies, Univ. of Applied Sciences Darmstadt, Germany; [2]Reactive Flows and Diagnostics, Technical Univ. of Darmstadt, Germany.* A novel SERDS excitation approach for temporally and spatially resolved interference-resistant detection of gas-phase Raman spectra is presented. Two high-power cw lasers are combined and rapidly switched via their polarization using a Pockels cell to allow for experiments under challenging background and interference conditions.

JTu4A.13
Learnable Pseudo-Measurement Framework for Single-Shot 3D Phase Tomography, Nishant Goyal[1], Jasleen Birdi[1], Kedar Khare[1]; *[1]Indian Inst. of Technology Delhi, India.* We propose a single-shot, intensity-only 3D phase imaging framework that leverages deep learning to generate reliable pseudo-data augmenting single-shot data. Our approach enables robust, artifact-reduced tomographic reconstruction with simplified hardware.

JTu4A.14
Ambiguity in Multimode Fiber Spectral Encoding Under Thermal Perturbation, Kun Wang[1], Yosuke Mizuno[2]; *[1]Bundesanstalt für Materialforschung und -prüfung (BAM), Germany; [2]Yokohama National Univ., Japan.* We show that thermal perturbation induces distributed spectral distortions in multimode fiber systems, leading to non-unique wavelength encoding and decoding ambiguity. Incorporating temperature information reduces ambiguity and improves inference robustness.

JTu4A.15
Optical Computing of Zero-Knowledge Proof With Single-Pixel Imaging, Wei Huang[1], Shuming Jiao[1], Huichang Guan[2], Huisi Miao[3], Chao Wang[1]; *[1]Great Bay Univ., China; [2]BYD Auto Industry Co. Ltd., China; [3]Xiangtan Univ., China.* This paper proposes an optical zero-knowledge proof method based on single-pixel imaging. Secure and leakage-free solution verifications can be performed for Sudoku and Hamiltonian cycle problems.

JTu4A.16
A Tri-Modal Imaging System With 3D Gaussian Splatting SLAM for High-Fidelity Scene Reconstruction , Yebei Wen[1], Hanyu Zhan[1], Shenghong Xie[1], Jizhou Lai[1]; *[1]Nanjing Univ Aeronautics & Astronautics, China.* We present a lightweight tri-modal imaging system and 3D Gaussian Splatting-based SLAM framework for high-fidelity scene reconstruction and robust localization in GNSS-denied environments, enabling flexible deployment and improved structural detail for real-world inspection applications.

JTu4A.17
Automated Machine Learning Pipeline for Modelling the Spectral Response of a Tapered Optical Fibre Temperature Sensor, Jorge Cruz-Duarte[2], Jeroen Korterijk[3], Herman Offerhaus[3], Luis Fernando Granados-Zambrano[3], Daniel Jauregui-Vazquez[4], Enrique delaCruz[4], J. A. Alvarez-Chavez[1]; *[1]The Hague Univ. of Applied Sciences, Netherlands; [2]Centrale Lille, CRIStAL, Centre Inria de l'Université de Lille, France; [3]Optical Sciences, Univ. of Twente, Netherlands; [4]Optica, CICESE, Mexico.* An automated machine learning pipeline is proposed to model the spectral response of a tapered optical fibre temperature sensor by applying Bayesian hyperparametric optimisation to improve model performance. Accurate predictions along with closed-form analytical expressions facilitated both physical understanding and practical implementation.

JTu4A.18
Axial Structured Illumination Tomography (ASIT): a 3D Label-Free Phase Imaging Technique, Nishant Goyal[1], Kedar Khare[1]; *[1]Indian Inst. of Technology Delhi, India.* This work shows that on-axis structured illumination(s) with sparsity-driven reconstruction enables cross-talk–free 3D refractive index imaging, presenting the core idea and a complete practical guideline for building such a system without conventional multi-angle illumination(s).

JTu4A.19
Occlusion-Free Speckle-Scan Ptychography, Jan-Brian M. Heinisch[1], Allard Mosk[1]; *[1]Utrecht Univ., Netherlands.* When using speckled-illumination in ptychography, the high-frequency speckles increase the effective numerical aperture (NA) of the camera, resulting in high-quality reconstruction of 2D- and 3D-objects while circumventing occlusion, both in transmission and reflection.

JTu4A.20
Investigation of Sequence-Reversal-Induced Structural Changes in Dipeptides Using Raman Spectroscopy, Nidhi Dhillon[1], kanak goyal[1], kanika devi[1], vijay kumar goel[1], Shilpi Agarwal[1]; *[1]SPS, JAWAHARLAL NEHRU UNIV., India.* The present study demonstrated portable Raman Spectroscopy as a non-destructive, reliable and fast analytical technique for the structural analysis of dipeptides and in discriminating between the sequence-reversed

dipeptides, arginine-tryptophan (RW) and Tryptophan-arginine (WR).

JTu4A.21
Open-Path Dual-Comb Measurement of CO_2 and H_2O Over a 1.6 km Urban Link, Jiangtao Li[1]; [1]*Univ. of Science and Technologyof China, China.* For urban greenhouse-gas sensing, dual-comb spectroscopy is applied across a 1.6 km open-path, retrieving and near 1572 nm in 20 s with sub-ppm precision and 24-hour variation of in air.

JTu4A.22
Comparative Study of Fiber SPR Sensor for Enhanced Biosensing, Nitesh Mudgal[1], Arun Uniyal[5], Ankur Saharia[2], Kamal K. Choure[4], Manish Tiwari[2], GHANSHYAM SINGH[3]; [1]*Poornima College of Engineering Jaipur, India;* [2]*ECE, Manipal Univ. Jaipur, India;* [3]*ECE, Malaviya National Inst. of Technology, Jaipur, India;* [4]*Computer Science, UPES Dehradun, India;* [5]*ECE, Inst. of Technology, India.* This study focuses on the comparative analysis of fiber surface plasmon resonance (SPR) sensor using transfer matrix method (TMM) for enhanced sensitivity of biological analytes with varying refractive index (RI) from 1.33 to 1.41.

JTu4A.23
A High-Flatness Electro-Optic Dual-Comb Source for 3D Precision Atmospheric Remote Sensing of Greenhouse Gases, Yiwei Ding[1], Qin Yin[1], ruocan zhao[1], Xianghui Xue[1]; [1]*Univ. of Science and Technology of China, China.* This paper presents a cascaded electro-optic frequency comb for atmospheric CO_2 and CH_4 remote sensing. Phase optimization yields ≤1.5 dB power flatness across 20 central lines, providing a high-SNR multi-heterodyne source.

JTu4A.24
A Sample Learning Free φ-OTDR Pattern Recognition Method for PIG Tracking Based on Improved Hough Transform, Zheyuan Zheng[1], Hao Feng[1], Zhou Sha[1], Zhoumo Zeng[1]; [1]*Tianjin Univ., China.* Aiming at pipeline inspection gauge (PIG) tracking, an improved Hough transform based method is applied to recognize “invert-V” pattern generated by PIG in space-temporal graph of φ-OTDR system, which is free of sample learning.

JTu4A.25
High Performance Multilayer SPR Biosensor for Label-Free Detection of MCF-7 Breast Cancer Cells, Raonak Karim[1], Md Al Amin I. Utshob[1], Tasnim Ferdous Toha[1], Nahian Montasir[1], Maymona Binte Juwel[1], Nahyan Al Mahmud[1], Khandakar Mohammad Ishtiak[1]; [1]*Ahsanullah Univ. of Science & Tech, Bangladesh.* A high-performance SPR biosensor with a BK7/TiO_2/Ag/SiC/BP multilayer structure is proposed for the label-free detection of MCF-7 breast cancer cells. This design enhances plasmon excitation and improves sensing performance compared to conventional SPR biosensors.

JTu4A.26
Sensing by Hybrid Tamm-Waveguide Modes in Planar Metal–Dielectric Structures, Victor Taranenko[1]; [1]*Branch of Applied Optics, IP NASU, Ukraine.* We investigate hybrid optical modes in planar metal–dielectric stacks for tunable, high-contrast refractometric sensing. Silver-based structures exhibit controllable Rabi splitting of inverted Lorentzian resonances, while chromium-based structures support bright and dark Fano resonances.

JTu4A.27
Computational Optimization of a Multilayer SPR Biosensor for Highly Sensitive Detection of Blood Cancer, MD TAJRIAN BHUIYAN[1], Md Al Amin I. Utshob[1], Maymona Binte Juwel[1], Khandakar Mohammad Ishtiak[1]; [1]*Ahsanullah Univ. of Science & Tech, Bangladesh.* We present a computationally optimized highly sensitive multilayer SPR biosensing platform designed for blood cancer detection. The developed structure demonstrates improved sensitivity, reliable accuracy and enhanced sensing capability indicating strong potential for early stage leukemia diagnosis.

JTu4A.28
Metalens-Based Compact LWIR Imaging System Derived From Conventional Refractive Lens Design, Ishani Ghildiyal[1], Vinod Parmar[1,2]; [1]*OPI, CSIR-CSIO, India;* [2]*ACSIR, India.* Compact LWIR imaging systems are important for thermal sensing applications. We present a 10.6 µm LWIR optical system using a metalens-derived phase surface based on a conventional spherical lens design. Simulations show comparable MTF performance, demonstrating the potential of metalens phase engineering for compact infrared imaging systems.

JTu4A.29
Withdrawn.

JTu4A.30
Pipe Joint Masking: a Novel Data Augmentation for Sewer Defect Recognition, Jianghai He[2], Zegen Wang[2], Yongning Li[1]; [1]*Kunming Univ of Science and Technology, China;* [2]*Southwest Petroleum Univ., China.* DCNNs are vital for sewer defect recognition, but generic augmentation lacks domain prior. We propose Pipe Joint Masking (PJM), a novel method leveraging intrinsic features. PJM detects pipe joint parameters to create circular masks, augmenting training while preserving defect data. On Sewer-ML, PJM improves Recall by 16.03% and F2-CIW by 9.11%.

Wednesday, 15 July

0.5 Paris
08:30 -- 10:30
SW1A • Distributed Optical Fiber Sensors

Presider: Sonia Martin-Lopez; Instituto de Óptica Daza de Valdés. CSIC, Spain

SW1A.1 • 08:30 (Invited)
Fast Utraviolet-C Photonics: Generating and Sensing Laser Pulses on Femtosecond Timescales, Benjamin T. Dewes[1], Tim Klee[2], Nathan D. Cottam[1], Joseph J. Broughton[2], Mustaqeem Shiffa[1], Tin S. Cheng[1], Sergei V. Novikov[1], Oleg Makarovsky[1], John W. Tisch[2], Amalia Patane[1]; *[1]Univ. of Nottingham, UK; [2]Imperial College London, UK.* Photonic devices operating in the ultraviolet UV-C range (100-280 nm) have diverse applications from super-resolution microscopy to optical communications. However, detecting ultrafast UV-C signals remains a major challenge. This work combines the generation of femtosecond UV-C laser pulses with their detection by two-dimensional (2D) semiconductors for the first time. We exploit the 2D semiconductor gallium selenide, which exhibits strong absorption resonances in the UV-C, along with its oxide.

SW1A.2 • 09:00
Raman Signal Enhancement in Distributed Temperature Sensing Using a Specially Designed Fiber, Korbinian Königsbauer[1], Xin Lu[1]; *[1]BAM, Germany.* A special fiber provides nearly 100 % Raman signal enhancement relative to a standard optical fiber and preserves the proportional temperature dependence, paving a new way to SNR improvement in Raman based distributed temperature sensing.

SW1A.3 • 09:15
Signal Processing Algorithms for Improved OFDR-Based Distributed Fiber Sensing, Isey B. Meka[1,2], Javier Elaskar[1], Sebastian San Martin[1], Fabrizio Di Pasquale[1], Yonas Muanenda[1], Claudio J. Oton[1]; *[1]Scuola Superiore SantAnna, Italy; [2]Univ. of Trento, Italy.* In this work we demonstrate an Optical Frequency-Domain Reflectometry (OFDR) measurement using sub-band division of the probe frequency sweep for distributed strain measurements with reduced noise along 200-m fiber with 20-cm spatial resolution using a laser sweep spanning 8 GHz at sweep rate of 100 Hz.

SW1A.4 • 09:30
Distributed Fiber Optic Sensing via Nonlinear Fourier Transform, Donghan Jung[2,1], Haesung Lee[2,1], Yoonchan Jeong[2,1]; *[1]Inter-Univ. Semiconductor Research Center, Korea (the Republic of); [2]Seoul National Univ., Korea (the Republic of).* We demonstrate distributed sensing via nonlinear Fourier transform, by constructing an eigenvalue look-up table and solving the inverse problem. We numerically achieve robustness down to 20 dB SNR, exploiting soliton breathing for long-haul spatial sensitivity.

SW1A.5 • 09:45
Analysis of Signal Spectral Coherence and Its Impact on Beamforming-Based Near-Field Acoustic Imaging Using Fibre-Optic Distributed Acoustic Sensing, Sebastian San Martin[1], Felipe Mejias[1], Gonzalo Carrasco[1], Matías Zañartu[1], Marcelo A. Soto[1]; *[1]Universidad Técnica Federico Santa María, Chile.* This paper studies how signal spectral coherence in fibre-optic distributed acoustic sensing affects beamforming-based acoustic imaging. Results show that selecting spectrally coherent components yields high-quality images and can potentially enhance temporal resolution.

SW1A.6 • 10:00
Robust, Lightweight Phase Unwrapping and Adaptive Event Detection Algorithm for Long-Range Distributed Acoustic Sensing, Kishore S. Kumar[1], Sheetal Kalyani[1], Balaji Srinivasan[1]; *[1]Indian Inst. of Technology Madras, India.* We propose and demonstrate a data-driven event detection algorithm aided by a robust phase unwrapping algorithm for low signal to noise ratio (SNR) conditions corresponding to long-range distributed acoustic sensing (DAS).

SW1A.7 • 10:15
Long Term Distributed Fiber Sensing via Dark Fibers at an Urban Area in Ruhr Region, Xin Lu[1], Sebastian Chruscicki[1], Helge Wiethoff[2], Tobias Rudolph[2], Konstantin Hicke[1]; *[1]Bundesanstalt für Materialforschung und, Germany; [2]Research Center of Post-Mining, Technische Hochschule Georg Agricola, Germany.* Long term monitoring over an urban dark fiber using a distributed fiber sensing system is demonstrated. Human induced vibrations and environmental effects are detected, and position dependent spectral shifts indicate slow geological changes observable over several months.

0.14 Singapore
08:30 -- 10:30
LW1B • Biology and Geoscience Sensing
Presider: F Rabouw; Universiteit Utrecht, Netherlands

LW1B.1 • 08:30 (Invited)
Remote Laser Sensing of Insect Wing Micro- and Nanofeatures for *in Situ* Biodiversity Monitoring, Meng Li[1]; *[1]Lunds Universitet, Sweden.* Diffuse (scale-bearing) and clear (membranous) wings show physically interpretable, stable photonic signatures in their NIR-SWIR reflectance. Retrievable at stand-off distances, insect wing photonics form a powerful biometric layer for remote sensing and biodiversity monitoring.

LW1B.2 • 09:00 (Invited)
High-Performance Functionalized Persistent Luminescence Nanoparticles for Biosensing and Bioimaging, Encarnacion Arroyo[1,2], Beatriz Torres-Herrero[3], Roxana M. Calderon-Olvera[4], Enrique Valera[5], Jesus M. de la Fuente[3], Manuel Ocana[2], Ana I. Becerro[2]; *[1]Office Natl d'Etudes Rech Aerospatiales, France; [2]Inst. of Materials Science of Seville (ICMS), CSIC-US, Spain; [3]Inst. of Materials Science of Aragon (INMA), CSIC-Unizar, and CIBER-BBN, Spain; [4]National Autonomous Univ. of Mexico and Inst. of Materials Research (UNAM), Mexico; [5]Department of Bioengineering and Nick Holonyak Jr Micro and Nanotechnology Lab, Univ. of Illinois at Urbana-Champaign, USA.* Engineered persistent luminescence nanoparticles

with tailored surface functionalization enable background-free biosensing and deep-tissue bioimaging. Uniform Zn_2GeO_4:Mn^{2+} nanoprobes achieve ultrasensitive interleukin-6 detection, while Ga_2O_3:Cr^{3+} and $Y_3Al_2Ga_3O_{12}$:Ce^{3+}, Cr^{3+}, Nd^{3+} demonstrate biocompatible near-infrared imaging performance.

LW1B.3 • 09:30 (Invited)
Micro-Raman Spectroscopy and Optical Imaging in Microfluidic Chips for Real-Time Hydrogeochemical Analysis, Sophie Roman[1]; [1]*Université d'Orléans, France.* Microfluidics for geosciences enables the reproduction of geological environments within transparent microfluidic chips, mimicking pore-scale (µm-scale) structures and processes. Coupled with micro-Raman spectroscopy and optical imaging, this approach allows real-time hydrogeochemical analysis, providing precise visualization and quantification of flow, transport, and water–rock interactions, with applications to CO_2 sequestration, groundwater preservation, and decontamination.

LW1B.4 • 10:00 (Invited)
Characterizing Flow, Solute and Heat Transport, and Reactions in the Subsurface: Combining Optical Methods and Analog Lab Experiments, Yves Méheust[1,2]; [1]*Univ. of Rennes, France;* [2]*Institut Universitaire de France, France.* Laboratory analog experiments in transparent porous media enable optical measurement of coupled flow, transport, and reactive processes, providing quantitative insights into solute mixing, reaction rates, heat transfer, and bacterial dynamics relevant to groundwater, geothermal energy, and subsurface environmental applications.

0.2 Berlin-0.3 Copenhagen
08:30 -- 10:30
JW1C • Deep Learning in Photonics
Presider: Willie Padilla; Duke Univ., USA

JW1C.1 • 08:45 (Invited)
Phase Retrieval: Computational Imaging in the Machine Learning Era, Jonathan Dong[1]; [1]*École Polytechnique Fédérale de Lausanne, Switzerland.* Phase retrieval is a fundamental nonlinear inverse problem that appears across a wide range of computational imaging applications, from X-ray and electron ptychography to phase imaging in optical microscopy. In this talk, we will discuss a unified overview of phase retrieval models and algorithms, then present theoretical insights on reconstruction guarantees and explore recent practical implementations, to end with a deeper dive into robust machine learning regularization.

JW1C.2 • 09:15
Neural Network-Enhanced FMCW Spectroscopy for Multicomponent Gas Detection, xunzhou xiao[1], Zihuai Liu[2], Wei REN[1]; [1]*Department of Mechanical and Automation Engineering, Chinese Univ. of Hong Kong, Hong Kong;* [2]*School of Electronic Science and Engineering, Xiamen Univ., China.* We present an FMCW spectroscopy system with feedforward neural-network demodulation for mixed-gas sensing, achieving broadband spectral decoupling and accurate C2H2/CO2 quantification from strongly overlapping spectra.

JW1C.3 • 09:30
Application of Gradient-Consensus Richardson-Lucy Deconvolution to Noisy Undersampled Brightfield Microscopy Data, Yiming Liu[1], Sjoerd Stallinga[1]; [1]*Technische Universiteit Delft, Netherlands.* Gradient-Consensus Richardson–Lucy (GC-RL) deconvolution recovers details while limiting noise amplification. We analyze its performance under different SNR, readout noise, and OTF designs. An embedded upsampling scheme enables reconstruction for undersampled brightfield breast-tumour images.

JW1C.4 • 09:45
Deep Variational Autoencoder for Denoising Fluorescence Water Monitoring System , Tal Shwartz[1,2], David Mendlovic[2], Michael Borisover[1], Iftach Klapp[1]; [1]*Volcani Inst Agricultural Research Ctr, Israel;* [2]*EE, Tel-Aviv Univ., Israel.* The proposed method corrects the noised spectral signal of a low-cost fluorescence detector. Results show improvement of 17.8 dB between the noisy signal and the reconstructed one.

0.4 Brussels
08:30 -- 10:30
CW1D • Polarimetric Imaging, Vectorial Beam Shaping and Volumetric Microscopy
Presider: Chao Zuo; Nanjing Univ of Science and Technology, China

CW1D.1 • 08:30 (Invited)
Using Birefringence at the Service of Imaging, Miguel A. Alonso[1,2]; [1]*Fresnel Institut / Centrale MED, France;* [2]*The Inst. of Optics, Univ. of Rochester, USA.* This talk will present several applications in which spatially-varying birefringent elements help obtain extra information in imaging applications. Examples include techniques for single-shot polarimetry and wavefront sensing, structured light generation, and superresolution fluorescence microscopy.

CW1D.2 • 09:00
Polarization Multiplexing for High-Contrast Volumetric Two-Photon Microscopy, Minghui Shi[1], Xin Dong[1], Huajun Tang[1], Chiyi Wei[1], Beth W. L. So[1,2], Cora S. W. Lai[1,2], Hongsen He[3], Kenneth K. Y. Wong[1,2]; [1]*Univ. of Hong Kong, Hong Kong;* [2]*Advanced Biomedical Instrumentation Centre, Hong Kong;* [3]*Xiamen Univ., China.* A polarization multiplexing method is proposed for high-contrast two-photon microscopy based on axially complementary Bessel droplet beams. Full volumetric image can be acquired without subsequent processing within a continuous depth of field of 50 μm.

CW1D.3 • 09:15
DYnamic Spectroscopic Imaging Ellipsometry: Spatio-Spectral Ψ(λ,Y) and Δ(λ,Y) Extraction, JinHwan An[1,2], Daesuk Kim[1,2], Gukhyeon Hwang[1], Saeid Kheiryzadehkhanghah[1], Cheongsong Kim[1], Gbogbo Yatana[1], Jaemin Kim[1,2], Zehra Asifa[1,2]; [1]*Department of Mechanical System Engineering, Jeonbuk National Univ., Korea (the Republic of);* [2]*Graduate School of Mechanical-Aerospace-Electric Convergence Engineering, Jeonbuk National Univ., Korea (the Republic of).* This study describes a dynamic spectroscopic imaging ellipsometer combining a monolithic polarizing interferometer and hyperspectral imaging module, enabling simultaneous snapshot extraction of Ψ(λ,Y) and Δ(λ,Y).

Measurements on a thin-film sample demonstrate dynamic spatio-spectral ellipsometric capability.

CW1D.4 • 09:30
Polarimetric Light Field Imaging via Single Kaleidoscopic Image, Erqi Huang[1,3], Simeng Qiu[2], John Meshreki[1], Xun Cao[3], Ivo Ihrke[1]; *[1]Center for Sensor Systems (ZESS), Univ. of Siegen, Germany; [2]School of Mathematics and Computer Science, Swansea Univ., UK; [3]School of Electronic Science and Engineering, Nanjing Univ., China.* We propose a polarimetric light-field imaging model via a single kaleidoscopic plenoptic image. A thorough system calibration and simulation experiments are conducted to support the presented framework.

CW1D.5 • 09:45
Zernike-Based Simulation of Imaging Through Von Kármán Turbulence, Hongyang Wei[1], Hanyu Zhan[1], Haoxin Tian[1], Jizhou Lai[1]; *[1]Nanjing Univ Aeronautics & Astronautics, China.* We present a Zernike-based approach for simulating imaging through atmospheric turbulence using von Kármán turbulence spectrum. Simulation results reveal that accounting for finite inner and outer scales in the von Kármán model significantly alters the degree of image degradation compared with the Kolmogorov spectrum.

CW1D.6 • 10:00
Field of View Extension in 3x4 Mueller Matrix Microscopy, Roman Demczylo[1], Estefany Bica[1], Ariel Fernández[1]; *[1]Universidad de la Republica, Uruguay.* 3x4 Mueller matrix imaging enables comprehensive polarimetric characterization of tissues. By combining Division-of-Focal-Plane polarimetry with a tiling algorithm guided by polarimetric descriptors, we achieve wide-field Mueller matrix microscopy. This facilitates whole-slide imaging with high resolution and minimal data redundancy

CW1D.7 • 10:15
Revealing Topological Features of Fisher Information Flow in Optical Metrology, Thomas Grant[1], James Williamson[2], Huanli Zhou[1], Hadyn Martin[2], Andrew Henning[2], Kevin F. MacDonald[1], Xiangqian Jiang[2], Nikolay I. Zheludev[1]; *[1]Univ. of Southampton, UK; [2]Univ. of Huddersfield, UK.* We report the first spatial mapping of Fisher information flow in optical position metrology experiment with a nanoscale target, revealing its topological structure, including singularities, vortices, and regions of information backflow.

0.1 London
08:30 -- 10:30
PW1E • Atmospheric Measurements II
Presider: Dario Perez; Pontificia Univ Catolica de Valparaiso, Chile and Anand Sarma; IISER Thiruvananthapuram, India

PW1E.1 • 08:30 (Invited)
Generating a Database of Vertical Profiles of C_n^2 From Aircraft Measurements, Qing Wang[1], Ryan Yamaguchi[1]; *[1]Naval Postgraduate School, USA.* Vertical C_n^2 profiles in and above the atmospheric boundary layer,are critical for quantifying optical scintillation along slant paths. Aircraft measurements are used to generate these profiles, creating a database for future

modeling development.

PW1E.3 • 09:30
Withdrawn.

PW1E.4 • 09:45
Open Structures for Masts and Towers With Extreme Pointing Stability of Telescopes on top in Gusty Wind for Astronomical, Meteorological and Civil-Engineering Applications., Robert H. Hammerschlag[1,2], Felix Bettonvil[1,2], Oscar K. Hartogensis[3], Sander Deelen[4]; *[1]Leiden Observatory, Leiden Univ., Netherlands; [2]Foundation Dutch Open Telescope, Netherlands; [3]Wageningen Univ., Netherlands; [4]Utrecht Univ., Netherlands.* The structure top makes small translation forming counterforce against wind, however no tilt of top with telescope. Scintillation measurements between two telescopes on 10m high structures remained completely undisturbed during wind gusts up to 38m/sec.

PW1E.5 • 10:00 (Invited)
Atmospheric Remote Sensing: Ground-Based Observations in Montevideo, Erna M. Frins[1]; *[1]Universidad de la Republica, Uruguay.* We present some approaches for the detection and quantification of trace gases produced during fossil fuel combustion and for quantifying gas fluxes through the analysis of solar spectra.

0.8 Rome
08:30 -- 10:30
JW1F • Comb Spectroscopy for Atmospheric Sensing
Presider: Genevieve Plant; Univ. of Michigan, USA

JW1F.1 • 08:30
Open-Path Mid-Infrared Dual-Comb Spectroscopy for Understanding Emissions From Wastewater Treatment, Kevin Cossel[1], Ryan T. Rhoades[1], Roderik Krebbers[2], Brian R. Washburn[1], Ian Coddington[1]; *[1]Communications Technology Laboratory, National Inst. of Standards and Technology, USA; [2]Inst. for Molecules and Materials, Radboud Univ., Netherlands.* We use open-path mid-infrared dual-comb spectroscopy to measure CH_4, N_2O, CO_2, as well as H_2O and HDO for 3 months at an operating water resource recovery facility.

JW1F.2 • 09:00
Optical Path Difference Measurements Using Symmetric Dual-Comb Interferometry., Alonso Romero[2], Julia Mateu-Comas[1], Miguel Soriano-Amat[3], Clara Quevedo-Galán[4], Sonia M. Martin-Lopez[3], Miguel Gonzalez-Herraez[3], María Fernández-Ruiz[1]; *[1]Universidad de Alcalá, Spain; [2]Universidad de Alcalá, Spain; [3]Daza de Valdés Inst. of Optics, Spain; [4]CEMDATIC - E.T.S.I. Telecomunicación, Spain.* We demonstrate a common-path dual-comb ranging technique based on spectral phase retrieval, capable of largely extending the non-ambiguity range of conventional schemes while maintaining a high resolution and the high stability of symmetric dual-comb configurations.

JW1F.3 • 09:15 (Invited)
Mid-IR Cross Comb Spectroscopy for Multi-Compound Trace Gas Sensing Using an Optical Parametric Oscillator, Carolin P. Bauer[1,2], Matthew Singleton[2], Lukas Lang[1], Benjamin Willenberg[1], Justinas Pupeikis[1], Ursula Keller[3], Lukas Emmenegger[2], Béla Tuzson[2]; *[1]K2 Photonics AG, Switzerland; [2]Air Pollution / Environmental Technology, EMPA, Switzerland; [3]Inst. for Quantum Electronics, ETH Zurich, Switzerland.* We present single-cavity dual comb optical parametric oscillators for the analysis of multi-compound gas samples at trace-level concentrations by cross-comb spectroscopy in the mid-infrared. Different configurations of the optical parametric oscillators and their respective performance will be discussed.

JW1F.4 • 09:45
Electro-Optic Dual-Comb Spectroscopy for Broadband, High-Sensitivity Molecular Fingerprinting in the Long-Wave Infrared Region, Sergey Vasilyev[2], Roderik Krebbers[1], Selwin Hageraats[1], Mathieu walsh[4], Dmitrii Konnov[3], Igor Moskalev[2], Mike Mirov[2], Andrey Muraviev[3], Jerome Genest[4], Konstantin Vodopyanov[3], Simona M. Cristescu[1]; *[1]Radboud Universiteit Nijmegen, Netherlands; [2]IPG Photonics Corporation, USA; [3]Univ. of Central Florida, USA; [4]Univesite Laval, Canada.* Electro-optic sampling enables broadband long-wave infrared spectroscopy using near-infrared detectors. Simultaneous multi-species detection with 19- to 150-fold sensitivity improvement over conventional Fourier-transform spectroscopy is demonstrated, opening the door to sub-ppb trace gas sensing applications.

JW1F.5 • 10:00 (Invited)
Improving Optical Absorption Models With Precision Frequency Comb Spectroscopy, Ryan K. Cole[1], Zhaoyi Liu[1], Gregory Rieker[2]; *[1]Bates College, USA; [2]Mechanical Engineering, Univ. of Colorado Boulder, USA.* Accurate spectroscopic models are crucial for interpreting absorption spectra in sensing applications. I will present two efforts to improve the accuracy of absorption models for sensing in combustion and atmospheric systems.

0.9 Athens
08:30 -- 10:15
OW1G • AO in Microscopy II
Presider: Martin Booth; Univ. of Oxford, UK

OW1G.1 • 08:30 (Invited)
Adaptive Optics in Super-Resolution Fluorescence Microscopy, Ruizhe Lin[1,2]; *[1]SciLifeLab, Sweden; [2]Karolinska Inst., Sweden.* Sample-induced aberrations fundamentally limit super-resolution fluorescence microscopy in thick biological tissues, degrading resolution and corrupting illumination patterns critical to SIM and RESOLFT modalities. We integrate adaptive optics across SIM, RESOLFT, and parallelized RESOLFT to restore their performance at depth, demonstrating key advances in live-cell super-resolution fluorescence imaging.

OW1G.2 • 09:00
Imaging Through Scattering Tissue Using Near-Infrared Illumination and Convolutional Autoencoder Neural Network, Alon Silberschein[1], Amir Shemer[2], Chanan Berkovits[2], Yair Engler[2], Ariel Schwarz[2], Eliran Talker[1], Yossef Danan[2]; *[1]Ariel Univ., Israel; [2]JCE, Israel.* We

propose a non-invasive subsurface imaging method combining halogen-based NIR illumination and a convolutional autoencoder. Using paired MNIST-through-tissue data, the model reconstructs hidden digits, improving PSNR, SSIM, and FSIM, while enabling low-cost, annotation-efficient biomedical imaging.

OW1G.3 • 09:15
Single-Pixel Microscopy Supported by Sensor-Less Adaptive Optics, Heberley Tobón[1], Samuel Zapata-Valencia[1], Lindsey Willstatter[2], Stefano Bonora[3], Enrique Tajahuerce[1], Jesus Lancis[1]; *[1]Universitat Jaume I, Spain; [2]Politecnico di Milano, Italy; [3]CNR-Inst. of Photonics and Nanotechnology, Italy.* In this work a study of the inherent aberrations present single-pixel microscopy is presented. A sensor-less correction approach to correct those aberrations supported by a plug&play multiactuator lens is proposed and validated.

OW1G.4 • 09:30
Fast Volumetric Adaptive Optics Light Sheet Microscopy for Imaging a Zebrafish Seizure Model, Bingxi Liu[1], Yang Liu[1], Carly Duffy[1], James D. Lauderdale[1], Peter Kner[1]; *[1]Univ. of Georgia, USA.* We have developed a light sheet system incorporating an electrically tunable lens capable of capturing volumes up to 499 × 499 × 150 μm^3 at 4 volumes per second with near diffraction-limited resolution. The system employs sensorless adaptive optics to correct system aberrations, extending the usable field of view by fivefold.

OW1G.5 • 09:45
Fluorescence Lifetime Imaging With Fast IRF Correction for Accurate Tissue Analysis, Chih-Wei HSU[1], Chia-Yuan Chang[1]; *[1]National Cheng Kung Univ., Taiwan.* We integrated two-photon FLIM with TCSPC and proposed the PIMPLE method, using IRF mapping to correct the IRF influence. The lifetime estimation efficiency and the analysis contrast of pulmonary artery in tissue are improved.

OW1G.6 • 10:00
Deep Neural Network-Based Dispersion Identification and Compensation for Multi-Line TFMPM, Jui-Chi Chang[2], Ping-Hua Shih[2], Shih-Hui G. Chang[3], Lina Grinevičiute[1], Kestutis Staliunas[1,4], Chia-Yuan Chang[2]; *[1]Department of Laser Technologies, Center for Physical Sciences and Technology, Lithuania; [2]Department of Mechanical Engineering, National Cheng Kung Univ., Taiwan; [3]Department of Photonic, National Cheng Kung Univ., Taiwan; [4]Catalan Institution for Research and Advanced Studies (ICREA), Spain.* We propose a deep neural network-based dispersion mode identification for ultrashort pulse laser optimization. Furthermore, a dispersion-compensation approach based on mode identification is proposed to optimize multiphoton excitation efficiency for MS-TFMPM.

0.5 Paris
13:30 -- 15:30
SW3A • Chemical Biological Sensors I
Presider: Claudio Oton; Scuola Superiore Sant'Anna, Italy

SW3A.1 • 13:30 (Invited)

Enabling High-Resolution Gas Sensing With on-Chip THz Sources, Lalitha Ponnampalam[1]; [1]*Univ. College London, UK.* On-chip terahertz sources leveraging optical frequency combs and phase-locked loops enable the generation of high-resolution, tuneable THz radiation. These compact and stable sources hold strong potential to advance gas sensing by enhancing spectral precision, sensitivity, and supporting scalable integration across a wide range of applications.

SW3A.2 • 14:00
Bio-Optical gas Sensing & Imaging System for Skin Volatiles Derived From Blood Vessels, and the Testing by gas-Generators, Kenta Iitani[1], Geng Zhang[1], Kenta Ichikawa[1], Takahiro Arakawa[1], Yoshikazu Nakajima[1], Kohjji Mitsubayashi[1]; [1]*Inst. of Science Tokyo, Japan.* A bio-optical gas-sensing & imaging system with NAD-dependent alcohol dehydrogenase (ADH) was developed for real-time quantitative imaging of ethanol vapor from blood vessels. The system performance was evaluated using gas generators. The spatiotemporal transcutaneous ethanol (Tr-EtOH) was successfully imaged at various skin sites.

SW3A.3 • 14:15
Imaging and Quantifying Chemical and Biological Analytes by Hyperspectral Surface Plasmon Resonance Microscopy, Zhi-mei Qi[1]; [1]*State Key Laboratory of Transducer Technology, Aerospace Information Research Inst., Chinese Academy of Sciences, China.* Using the laboratory-developed hyperspectral SPR microscope, dielectric films and biological tissues were imaged, and 2D maps of their refractive indexes (RIs) were obtained, and quantitative identification of tumor tissue and normal tissue is achieved through RI comparison.

SW3A.4 • 14:30 (Invited)
Photothermal Recycling Biosensing for Sensitive, Continuous Biomolecular Quantification, Yongchen Tai[1], Yunshen Li[1], Wenting Wang[1], Yida Wang[1], Xinyi Zhou[1], Jacob Lee[1], Raymond Malanga[1], Jing Pan[1]; [1]*Univ. of Florida, USA.* Continuous optical biosensors face a trade-off between sensitivity and response time due to fundamental thermodynamic limitations. We propose photothermal recycling (PTR) sensing to resolve this issue. By coupling optical excitation with localized photothermal modulation, PTR enables rapid sensor resetting and frequent measurements over time. We demonstrate this light-driven mechanism achieves high-frequency, femtomolar detection over several hours in various biological matrices.

SW3A.5 • 15:00
ISCAT Nanoscopy for Rapid Detection of Airborne Biological Particles, Silvia M. Rotondi[1], Loredana Casalis[2], Pietro Parisse[3], Pascal Colpo[4], Cloé Desmet[4], Federica Armas[4], Ambra Maddalon[4], Vittorio Reina[4], Andrea Valsesia[4]; [1]*CERIC ERIC, Italy;* [2]*Elettra Sincrotrone, Italy;* [3]*CNR-IOM, Italy;* [4]*JRC, Italy.* Employing iSCAT microscopy, we present a "chemical nanoscopy" platform able to decouple particle size from refractive index via iPSF analysis. Validated by T-Matrix simulations, it enables label-free, multiplexed detection of pathogens within complex environmental matrices.

SW3A.6 • 15:15
Low-Cost Optical Light-Scattering Sensor for Rapid Detection of Foodborne Bacteria, Neha Neha[1]; [1]*Optics and Photonics Centre, Indian Inst. of Technology, India.* We

present a low-cost optical light-scattering sensor for rapid, label-free detection of foodborne bacteria. Time- and frequency-domain scattering signatures exhibit clear concentration-dependent trends, enabling sensitive, real-time quantification suitable for compact, on-site food safety diagnostics.

0.14 Singapore
13:30 -- 15:30
LW3B • Propulsion and Combustion Diagnostics
Presider: Paul Danehy; NASA Langley Research Center, USA

LW3B.1 • 13:30 (Invited)
Fast and in-Situ Diagnosis of Gas Turbine Engine Combustion Using Laser Absorption Tomography, Minqiu Zhou[1], Yikai Xia[1], Yuan Chen[1], Ihab Ahmed[2], Mohammed Pourkashanian[2], Michael Lengden[3], Chang Liu[1]; *[1]School of Engineering, Univ. of Edinburgh, UK; [2]Department of Mechanical Engineering, Univ. of Sheffield, UK; [3]Department of Electronic and Electrical Engineering, Univ. of Strathclyde, UK.* Laser absorption tomography enables non-intrusive, fast, in-situ diagnosis of gas turbine combustion by reconstructing two-dimensional temperature and concentration fields. Tomographic imaging of pilot- and large-scale aircraft engine exhaust captures transient, load-dependent nonuniformities, supporting early fault detection, improved combustion assessment, and practical engine health monitoring.

LW3B.2 • 14:00
Pulse-Burst 1-D Raman Spectroscopy for Spatiotemporally Resolved Multi-Scalar Measurements of Hydrogen Injection Dynamics, Bin Wu[1], Hao Wu[1], Emre Cenker[3], Yasser A. Qahtani[3], Gaetano Magnotti[2], William L. Roberts[1]; *[1]King Abdullah Univ of Sci & Technology, Saudi Arabia; [2]INSA Rouen Normandie, France; [3]Sustainable Transport R&D Division, R&DC, Saudi Aramco, Saudi Arabia.* This paper demonstrates a 20-kHz 1-D Raman spectroscopy system for multi-scalar H_2 jet characterization. The simultaneous measurement of n_{H2}, n_{H2}, and T enables rigorous derivation of x_{H2}, ρ, and P within highly transient, non-isobaric, and non-isothermal flow fields, providing unprecedented, quantitative datasets for H_2 injector optimization.

LW3B.3 • 14:15 (Invited)
Advancements in Laser Diagnostics in Highly Dynamic Rotating Detonation Engines, Austin Webb[2], Robert Wang[1], Venkat Athmanathan[1], James Braun[3], Chris Fugger[2], Mikhail Slipchenko[2,1], Terrence Meyer[1], Sukesh Roy[2]; *[1]Purdue Univ., USA; [2]Spectral Energies, USA; [3]North Carolina State Univ., USA.* State of the art diagnostics have enabled unprecedented insight into rotating detonation physics. The identification of mixed mode detonation behavior and shock induced combustion mechanisms fundamentally reshapes the understanding of RDE operation and provides a pathway toward optimized, high performance pressure gain propulsion systems. Optical access and high speed diagnostics allow a temporally and spatially resolved look at wave shape and injector dynamics such as recovery and refill.

LW3B.4 • 14:45
Reaction Zone Imaging of a Propagating Detonation Wave Using Laser Induced Fluorescence, Sean M. Sawaya[1], Chloe E. Dedic[1]; [1]*Univ. of Virginia, USA.* An optically-accessible narrow channel detonation facility was constructed to enable laser-based measurement implementation. Simultaneous schlieren and laser induced fluorescence are used to image the propagation of a detonation wave through this facility.

LW3B.5 • 15:00 (Invited)
Quenching-Free, Coherent Detection of Reactive Atomic Species Using Femtosecond Pulses, Matthew Hay[1], Adi Hardaya[1], Waruna Kulatilaka[1]; [1]*Texas A&M Univ., USA.* Femtosecond two-color, two-photon polarization spectroscopy (fs-TCPS) was demonstrated for collisional-quenching-free, quantitative measurement of reactive hydrogen atoms, detected sufficiently far away to avoid interference from luminescent reacting flow probe volumes.

0.2 Berlin-0.3 Copenhagen
13:30 -- 15:30
HW3C • Current and New Earth Observation Missions
Presider: Nicole Pinnel; DLR - Wessling, Germany

HW3C.1 • 13:30 (Invited)
ITRES SAVI: VIS to SWIR (400nm to 2500nm) Hyperspectral Imaging System Developed With a Single Detector and Single Spectrometer, Peter Liu[1], Jason Howse[1]; [1]*ITRES Research Limited, Canada.* Demand for high-performance hyperspectral imaging is surging, fueled by AI and advanced analytics. While many VIS-SWIR systems merge separate VNIR and SWIR sensors leading to spectral/spatial misalignment and radiometric discontinuity, ITRES has engineered a superior solution. Our single detector/spectrometer design provides contiguous data across the entire 400–2500nm range. Validated through co-incident missions with AVIRIS (operated by NEON), this innovation eliminates the "two-cube" problem.

HW3C.2 • 13:45 (Invited)
Wyvern's Hyperspectral Satellite Constellation: From Dragonette to Rosette, Kristen Cote[1], Ellie Jones[1], Kurtis Broda[1]; [1]*Wyvern, Canada.* Wyvern has collected commercial VNIR hyperspectral imagery since 2024 with its first-generation Dragonette constellation, proving effective for agriculture and forestry applications. This presentation describes the Dragonette program and introduces Rosette, Wyvern's next-generation VNIR+SWIR system.

HW3C.3 • 14:00 (Invited)
Four Years in Orbit: Data From the EnMAP Mission, Martin Habermeyer[1], Sabine Baumann[1], Emiliano Carmona[1], Sabine Chabrillat[2], Sabine Engelbrecht[1], Rupert Feckl[3], Sebastian Hartung[1], Lukas Hoffmann[4], Vera Krieger[5], Laura La Porta[5], Akpona Okujeni[2], Miguel Pato[6], Nicole Pinnel[6], Mathias Schneider[6], Daniel Schulze[4], Peter Schwind[6]; [1]*German Remote Sensing Data Center, DLR, German Aerospace Center, Germany;* [2]*GFZ German Research Center for Geosciences, Helmholtz Center Potsdam, Germany;* [3]*OHB System AG, Germany;* [4]*German Space Operations Center, DLR - German Aerospace Center, Germany;* [5]*Space Administration, German Space Agency, DLR – German Aerospace Center, Germany;* [6]*Remote Sensing*

Technology Inst., DLR - German Aerospace Center, Germany. The German hyperspectral mission EnMAP has been in orbit for four years. This talk covers statistics from the Ground Segment as well as information on how to acquire and obtain data over the User Portals.

HW3C.4 • 14:30 (Invited)
GALENE: a Future Satellite Mission for Observing Coastal and Inland Aquatic Ecosystems and Wetlands, Malik Chami[1,2], Astrid Bracher[3], Xavier Briottet[4], Maycira Costa[5], Alexander Damm-Reiser[6], Arnold Dekker[7], Shungudzemwoyo Garaba[8], Peter Gege[9], Claudia Giardino[10], Els Knaeps[11], Tiit Kutser[12], Richard Lucas[13], Daniel Odermatt[14], Gerard Otter[15], Nima Pahlevan[16], Nicole Pinnel[9], Sindy Sterckx[11], Kevin Turpie[17]; *[1]Sorbonne Université, France; [2]Observatoire Cote d'Azur, France; [3]Alfred Wegener Inst. - Helmholtz Center for Polar- and Marine Research, Germany; [4]ONERA, France; [5]Univ. of Victoria, Canada; [6]Univ. of Zurich, Switzerland; [7]CSIRO, Australia; [8]Carl von Ossietzky Universität Oldenburg, Germany; [9]German Aerospace Center (DLR), Germany; [10]National Research Council (CNR)-IREA, Italy; [11]VITO, Belgium; [12]Univ. of Tartu, Estonia; [13]Aberystwyth Univ., UK; [14]EAWAG, Switzerland; [15]TNO, Netherlands; [16]NASA, USA; [17]Univ. of Maryland Baltimore County, USA.* GALENE is an innovative mission which consists of a synergy of three instruments, namely a hyperspectral sensor, a panchromatic camera and a polarimeter, to respond to future challenges linked to coastal and inland aquatic ecosystems.

HW3C.5 • 14:45
The Thermal Infrared Multi-Spectral Imager of Harmony: Design Overview, Louis Moreau[1], Frederic Doyon[1], Michel Roux[1]; *[1]ABB Inc, Canada.* This paper presents an overview of the design and estimated performance of the thermal infrared imager of the Harmony mission, an ESA Earth Explorer mission dedicated to the observation of small-scale motion and deformation fields of the ocean surface, glaciers and ice sheets, and solid Earth.

HW3C.6 • 15:00 (Invited)
Designing Earth Observation Systems for AI: EarthDaily's Approach to Daily Global Sensing and Foundation Models for a Changing Planet, Chris Rampersad[1], Robin Cole[1]; *[1]EarthDaily Analytics, Canada.* Designing remote sensing systems for AI requires balancing data quality, diversity, and temporal cadence. We present a superspectral daily global monitoring constellation and its design trade-offs for large-scale foundation models. Results show how AI-ready data and multimodal learning improve environmental monitoring and agricultural forecasting across diverse conditions.

HW3C.7 • 15:15 (Invited)
Balloon-Based Performance Characterization of an Imaging FTS Designed to Make High Spatial Resolution Measurements of Greenhouse Gases Over the Arctic From a Highly Eliptical Orbit, Doug Degenstein[1]; *[1]Univ. of Saskatchewan, Canada.* In 2022 our Canadian team ran a stratospheric balloon demonstration flight of the imaging Fourier Transform Spectrometer (iFTS) prototype being developed to measure greenhouse gases from highly elliptical orbit as part of the Arctic Observing Mission (AOM). This talk will detail the challenges of imaging earth reflected sunlight to measure gases like CO2, CH4 and oxygen with high spatial resolution while the successes of the demonstration will be highlighted.

0.4 Brussels
13:30 -- 15:00
CW3D • Spectral Imaging and Analysis

Presider: Hilton Barbosa de Aguiar; Laboratoire Kastler Brossel, France

CW3D.1 • 13:30 (Invited)
Spectral Unmixing Algorithms for Ultra-Multiplex Fluorescence Microscopy, Lars Loetgering[1]; [1]*ZEISS Research Microscopy Solutions, Germany.* Ultra-multiplex fluorescence microscopy plays a key role in future personalized medicine, but poses the challenge how to disentangle overlapped fluorescence spectra. We give an overview of algorithmic developments for spectral unmixing used in fluorescence microscopy.

CW3D.2 • 14:00
Conditional Diffusion Model-Based High-Performance Hyperspectral Imaging for Video Stream Generation, Jiajun Li[1], Jiewen Nie[1], Tao Chen[1], Haining Yang[1]; [1]*Southeast Univ. (China), China.* We present a conditional diffusion model to reconstruct hyperspectral images from multispectral filter array (MSFA) snapshots, achieving a PSNR of 37.86 and SSIM of 0.93, with a 20.5 Hz video processing rate in deployment.

CW3D.4 • 14:15
Analysis of Irregular Sphere Packing for Compressive Spectral Imaging, Alejandro Alvarado[1], Nelson Díaz[1], Pablo Meza[2], Esteban Vera[1]; [1]*PUCV, Chile;* [2]*Universidad de la Frontera, Chile.* We extended the 3D Sphere Packing to design a Multiplexed Multispectral Filter Array allowing high number of spectral bands with a strong signal-to-noise ratio and approaching the spectral resolution expected for hyperspectral imaging systems.

CW3D.5 • 14:30
A Single Pixel Hyperspectral Imaging System With Optimized Color Coded Patterns, Yin Cheng[1], Zhen Fang[1], Jun Ke[1], Xu Ma[1]; [1]*Beijing Inst. of Technology, China.* We propose a low cost color coded single pixel hyperspectral imaging system that adopts a set of optimized color coded patterns to generate compressive measurements. Using a learning-based reconstruction, our system recovers the simulated hyperspectral image under both turbulence and turbulence-free conditions.

CW3D.6 • 14:45
Investigating and Designing Hyperchromatic Axial Spectrometers for NIR Applications, Lukas Werner[1], Hans-Jürgen Dobschal[1], Hartmut Hillmer[2], Robert Brunner[1]; [1]*Ernst- Abbe- Hochschule Jena, Germany;* [2]*Inst. of Nanostructure Technologies and Analytics (INA), Univ. of Kassel, Germany.* A hybrid axial spectrometer operating from 1000–2200 nm is presented. Its architecture with an axially movable lens enables spectral scanning using a point detector, providing strong hyperchromatic separation and resolutions of 54–93 nm.

0.1 London
13:30 -- 15:30
PW3E • Free Space and Underwater Communications
Presider: Jason Schmidt; MZA Associates Corporation, USA

PW3E.1 • 13:30 (Invited)
Atmospheric Turbulence in Free-Space Optics for Non-Terrestrial Networks, Giulio Cossu[1], Sujit Basu[1], Luca Oliviero[1], Ernesto Ciaramella[1]; *[1]Scuola Superiore Sant'Anna, Italy.* We describe the atmospheric turbulence effects on Free-Space Optics for Non-Terrestrial Networks, which will play a key role in 6G scenario. We discuss physical impairments like scintillation and beam wander, evaluating the different mitigation strategies to enhance the link reliability and the overall performance in satellite communications.

PW3E.2 • 14:00
Physics-Informed Surrogate Modelling of Turbulence-Induced Intensity Variance in Free-Space Optical Links, India Walford[1], Justin Dauwels[1], Rudolf Saathof[1]; *[1]TU DELFT, Netherlands.* Physics-informed machine learning surrogates are developed to predict the scintillation index in free-space optical links. Input model features, engineered based on Kolmogorov turbulence theory, enable accurate prediction across regimes - log-space $R^2\approx0.95$ on simulated propagation data.

PW3E.3 • 14:15
A Global Statistical Model for Liquid Cloud Attenuation in Satellite-to-Earth Free-Space Optical Communication, Ishaani R. Kamath[1], Anand N[1]; *[1]IISER Thiruvananthapuram, India.* Atmospheric attenuation remains a major challenge for reliable Free-Space Optical (FSO) communication. We have developed a global statistical model of liquid-cloud attenuation that would be helpful in the link budgeting of satellite-to-Earth FSO communication links.

PW3E.4 • 14:30
Turbulence Estimations for Laser Satellite Links Supported by Machine Learning., Rudolf Saathof[1], Muhsin C. Gökçe[1], Marguerite Arvis[1], India Walford[1], Maximilian Pierzyna[1], Carlos Saccardi[1], Jérôme Loicq[1]; *[1]Technische Universiteit Delft, Netherlands.* We present estimation of turbulence strength, its measurement, and optical beam propagation through turbulence. We highlight how machine learning supports these tasks in the context of applications in laser satellite communications

PW3E.5 • 14:45
Fiber-Coupling Efficiency of a Gaussian Beam for Uplink Laser Satellite Communication, Muhsin C. Gökçe[1,2], Rudolf Saathof[1]; *[1]Space Engineering, Delft Univ. of Technology, Netherlands; [2]Electrical-Electronics Engineering, TED Univ., Turkey.* The fiber-coupling efficiency of a partially coherent Gaussian beam propagating through atmospheric turbulence along an uplink slant-path toward a LEO satellite is investigated for a laser satellite communication system under varying system parameters.

PW3E.6 • 15:00 (Invited)
Underwater Quantum Key Distribution in Realistic Environmental Conditions, Szymon Gladysz[1,2], Pietro Paglierani[2]; *[1]Fraunhofer IOSB, Germany; [2]NATO STO Centre for Maritime Research and Experimentation, Italy.* Previous papers have presented theoretical analyses of quantum key distribution's error rates in underwater communications based on heuristic or empirical models. Here, we provide a guide to relevant computations, based on the measured environmental parameters and realistic receivers.

0.8 Rome
13:30 -- 15:30
QW3F • Nonclassical Light Sources for Sensing and Metrology I
Presider: Tatevik Chalyan; Vrije Universiteit Brussel, Belgium

QW3F.1 • 13:30 (Invited)
Quantum Advantage in Learning, Ulrik Lund Andersen[1]; *[1]Danmarks Tekniske Universitet, Denmark.* We will present a demonstration of massive quantum advantage in optical quantum learning of a random displacement operation using continuous variable entanglement and homodyne detection – and discuss the results implications in quantum sensing.

QW3F.2 • 14:00 (Invited)
Gravitational-Wave Detection Beyond the Shot-Noise Limit, Sebastian Steinlechner[1,2]; *[1]Maastricht Univ., Netherlands; [2]Nikhef, Netherlands.* Gravitational-wave detectors (GWDs) are the most sensitive strain measurement devices ever built. Already in the early 1980s, long before GWDs saw their first light, Carlton Caves envisaged how squeezed states of light improves their performance. It was not until 2010 that the technology of GWDs and of squeeze sources had come far enough for a first implementation in the GEO600 detector, and has since become a staple of current detectors, such as LIGO and Virgo, and future detectors CE and ET.

QW3F.3 • 14:30 (Invited)
Towards on-Chip Squeezed Light Sources for Quantum Enhanced Sensing and Communication, Vaishali Adya[1]; *[1]Kungliga Tekniska Hogskolan, Sweden.*
Squeezed light technology has improved the sensitivity of precision measurement experiments ranging from gravitational wave detection to microscopy. Fom its conception in 1950 to its implementation in the LIGO, squeezed light generation has come a long way. In this talk today, I will discuss the principles of squeezed light generation generated through integrated devices and present some of the progress we have made on experiments that use these sources.

QW3F.4 • 15:00 (Invited)
Precision Quantum Metrology in Trapped Ions for Tests of Fundamental Physics, Laura Dreissen[1]; *[1]Vrije Universiteit Amsterdam, Netherlands.* The Standard Model (SM) explains fundamental interactions extremely well but leaves key questions unanswered, such as dark matter and matter–antimatter asymmetry. This talk shows how precision quantum metrology with trapped cold Ba+ ions enables competitive tests of the SM and searches for new physics. In particular, I will show that entangled states can be used to probe a possible boson-mediated fifth force and atomic parity violation.

0.9 Athens
13:30 -- 15:30
FW3G • VUV Sensing and New Comb Approaches
Presider: Lucile Rutkowski; Institut de Physique de Rennes, France

FW3G.1 • 13:30 (Invited)
15 Years of Operation for the VUV-FTS Endstation at the Synchrotron SOLEIL Facility, Nelson de Oliveira[1], Denis Joyeux[2], Laurent Nahon[1]; [1]*Synchrotron SOLEIL, France;* [2]*Retired, France.* The VUV-FTS has been developed in the early 2000's. For more than 15 years, the instrument has welcomed a broad community of users working in various fields such as astrophysics, plasma science or fundamental physics.

FW3G.2 • 14:00
Dual-Comb Spectroscopy in the Near-IR and UV Spectral Ranges Using a Bidirectional Ti:Sapphire Laser Source, Sandrine Galtier[1,2], ABEL FEUVRIER[1,2], Huut-Dat NGUYEN[1,2], Clément Pivard[1,2], Jérôme Morville[1,2], Jesus Garduno-Mejia[3], Catalina Ramirez-Guerra[3], Patrick Rairoux[1,2]; [1]*Institut Lumière Matière, France;* [2]*Universite Claude Bernard Lyon 1, France;* [3]*Universidad Nacional Autonoma de Mexico, Instituto de Ciencas Aplicadas y Tecnologia, Mexico.* Dual-comb spectroscopy enables broadband molecular spectroscopy with rapid acquisition. We present a DCS system based on a bidirectional Ti:Sapphire cavity generating two free-running combs. After presenting IR and UV spectroscopy with this cavity, we show that the asynchronicity between the two combs is determined by cavity chromatic dispersion.

FW3G.3 • 14:15
Advancing Dual-Comb Spectroscopy to the VUV, John McCauley[1], Dylan Tooley[1], R. Jason Jones[1]; [1]*Univ of Arizona, Coll of Opt Sciences, USA.* Dual-comb spectroscopy in the vacuum ultraviolet is demonstrated using intra-cavity high harmonic generation. The multi-harmonic source is used for absolute frequency measurements of molecular absorbance spectra down to λ = 149 nm.

FW3G.4 • 14:30 (Invited)
Dual Comb Spectroscopy Across the Visible and Ultraviolet Spectral Regions, Birgitta C. Bernhardt[1]; [1]*Technische Universität Graz, Austria.* Dual-comb spectroscopy (DCS) enables rapid, high-precision studies of molecular gas species. DCS has been recently extended across the visible into the UV enabling high resolution spectroscopy of environmentally crucial gases like nitrogen dioxide and formaldehyde.

FW3G.5 • 15:00 (Invited)
Optical Frequency Comb Spectroscopy With Enhanced Sensitivity, Ming Yan[1], Zhuoren Wan[1]; [1]*East China Normal Univ., China.* We report broadband comb generation and dual-comb spectroscopy with enhanced sensitivity, enabling simultaneous wideband molecular detection and trace analysis.

Lobby North - Posters
15:30 -- 17:00
JW4A • Joint Poster Session II

JW4A.1
Stochastic Label Perturbation for Robust Machine Learning Models in Raman Spectroscopic Wine Analysis, Francesca Venturini[1], Umberto Michelucci[2,3]; *[1]School of Engineering, Zurich Univ. of Applied Sciences, Switzerland; [2]Computer Science, Lucerne Univ. of Applied Sciences and Arts, Switzerland; [3]Rsearch and Development, TOELT LLC, Switzerland.* Small datasets and uncertainty in reference measurements often cause poor performance and overfitting in spectroscopic ML. We introduce label-uncertainty augmentation with Gaussian perturbations and demonstrate it for wine quality analysis using Raman spectroscopy. The models show improved stability and accuracy in predicting selected parameters.

JW4A.2
Activation-at-Use Topical Vitamin C vs Conventional Systems: FTIR Insights Into Oxidative Stability, Fernando T. Gonçalves[1], Carolina S. Mioto[1], Sara J. Michalopoulos[2], Rosangela Z. Vitor[3], Rogerio L. Romeiro[1], Luis F. Carvalho[2], Sheila C. Cortelli[1,2]; *[1]São Leopoldo Mandic Faculty, Brazil; [2]Dental School, Unitau, Brazil; [3]Farmacia Rhaizes, Brazil.* ATR-FTIR compared conventional and activation-at-use topical vitamin C systems after 30 days of simulated use. The conventional formulation showed greater loss of lactone-associated bands, whereas the activated system preserved spectral features, indicating higher oxidative stability.

JW4A.3
Dynamical Optical Measurements of Temperature in Geological Media, Arwa Rashed[1], Benoit Fond[4], Sergey Borisov[2], Gauthier Rousseau[3], Yves Méheust[1], Maria Klepikova[1]; *[1]Univ. Rennes, CNRS, Geosciences Rennes - UMR 6118, France; [2]Inst. of Analytical Chemistry and Food Chemistry, Graz Univ. of Technology, Stremayrgasse 9, Austria; [3]Inst. of Hydraulic Engineering and Water Resources Management, TU Wien, Karlsplatz 13, Austria; [4]ONERA - The French Aerospace Lab, Department of Aerodynamics, Aeroelasticity and Acoustics (DAAA), Paris-Saclay Univ., France.* Heat transport in the subsurface geological media has become an active field of research over the last 15 years. We apply lifetime-based luminescence thermometry to investigate pore-scale heat transport during heat transport experiments performed in an optically transparent flow cell containing a synthetic quasi-2D porous medium.

JW4A.4
Highspeed Schlieren Diagnostic of Gaseous and Liquid Ammonia Injection in Preparation for Laser Induced Grating Spectroscopy, Fabian Rösner[1,2], Ingo Schmitz[1,2], Jonas I. Hölzer[1,2], Thomas Seeger[1,2]; *[1]Engineering Thermodynamics Siegen, Universität Siegen, Germany; [2]Center for Sensor Systems ZESS, Universität Siegen, Germany.* Laser induced grating spectroscopy is used for simultaneous investigation of concentration and temperature in gaseous ammonia injection. It is noninvasive, high spatial and time resolved technique. To determine interesting regions, highspeed schlieren imaging is used.

JW4A.5
Determination of the Collisional Broadening Effect of CO_2 on the S-Branch Raman Linewidth of O_2, Henry K. Misoi[2,1], Stella Kemboi[2,3], Jonas I. Hölzer[2,1], Nancy Karuri[3], Thomas Seeger[2,1]; *[1]Center for Sensor Systems, Univ. of Siegen, Germany; [2]Technical Thermodynamics, Univ. of Siegen, Germany; [3]Chemical engineering, Dedan Kimathi Univ. of Technology, Kenya.* S-branch Raman linewidths of O_2 in different O_2/CO_2 mixtures were investigated. The linewidths increase significantly with CO_2 concentration, demonstrating the need to incorporate them into rotational coherent anti-Stokes Raman scattering (RCARS) diagnostics of oxyfuel systems.

JW4A.6
1.7 µm Gain-Switched Fiber Laser for Photoacoustic Microplastic Detection in Water, Ji-Xiang Chen[1], Ningbo Chen[1], Yang Xiao[1], Xiaoxiao Wen[1], Jiqiang Kang[1], Kenneth Kin Yip Wong[1,2]; *[1]Univ. of Hong Kong, Hong Kong; [2]Advanced Biomedical Instrumentation Centre, China.* A compact 1.7 µm gain-switched fiber laser system delivering 10 ns, 100 kHz, 10 µJ pulses enables high-contrast, label-free photoacoustic imaging of microplastics in water by targeting the C-H overtone and local water-absorption minimum.

JW4A.7
Detection and Quantification of Honey Adulteration Using Hyperspectral Imaging, indrajeet maurya[1], umesh garnaik[1], vishnupriya R[1], Nidhi Dhillon[1], Shilpi Agarwal[1]; *[1]Jawaharlal Nehru Univ., India.* In this work, hyperspectral imaging (HSI) was used as a rapid and non-destructive technique for detecting adulteration in honey. Reflectance spectra obtained from the hyperspectral data showed noticeable spectral variations between pure and adulterated honey, especially in the near-infrared region.

JW4A.8
SiC Wafer Internal/External 3D Defect Inspection Using Swept-Source Optical Coherence Tomography, Jonghyun Eom[1], YoonOh Tak[1], Jang Hoon Choi[1], Young Gue Kim[1], Jeong Min Ko[1], Hwee-Kwon Jung[1], Jun-Guen Shin[1]; *[1]Korea Photonics Technology Institure, Korea (the Republic of).* We developed a high speed SS-OCT system for non-destructive 3D imaging and defect detection in SiC wafers. This system achieves 20 µm lateral resolution and 10 µm axial resolution, enabling real-time internal and external defect identification. The defect mapping demonstrates industrial feasibility for high-quality SiC semiconductor manufacturing.

JW4A.9
Quantitative Analysis of Inter-Aperture Stray Light in a Volume-Sharing Multi-Aperture Imaging System, Ha Neul Yeon[1], Seokgi Han[1], JI YONG JOO[1], Yeong Bin Kwon[1], Yeong Su Shin[1], Jun Ho Lee[1]; *[1]Kongju National Unversity, Korea (the Republic of).* Inter-aperture stray light in a volume sharing multi aperture imaging system (VMAI) is quantitatively analyzed using non-sequential ray tracing, characterizing stray light propagating to sensor associated with other cameras.

JW4A.10
Design of a Single-Shot Complex Field Wavefront Sensor for Physical Layer Authentication in Laser Links, Bastian A. Romero[1], Nelson Díaz[1], Esteban Vera[1]; *[1]Electrical Engineering, Pontificia Universidad Catolica de Valparaiso, Chile.* We propose a physical-layer

security mechanism for Free Space Optical Communications using Phase Retrieval. By requiring a complex-field key for signal convergence, we exploit phase ambiguity to ensure data remains undecipherable to unauthorized interceptors.

JW4A.11
Optimization and Experimental Validation of Defocus Holographic Wavefront Sensor, Raveena Koliyatan Manamparambil[2], Nicholas Devaney[2], Emma Branigan[1], Kevin Murphy[1]; *[1]Center for Industrial and Engineering Optics, TU Dublin, Ireland; [2]School of Natural Science, Univ. of Galway, Ireland.* This study optimizes a Modal Holographic Wavefront Sensor using numerical simulation and analyzes intensity variations in selected focal-plane regions of interest. The optimized design is validated through experiments confirming accurate and reliable wavefront sensing performance.

JW4A.12
A Simple, Novel Approach to Model Optical Turbulence for the Unstable Boundary Layer at Cabauw (NL), Ariadna I. Huerta Viso[1,2], Oscar K. Hartogensis[2], A.M.J. van Eijk[1,3], Jordi Vilà-Guerau de Arellano[2]; *[1]Electromagnetic signatures and Propagation, TNO, Netherlands; [2]Meteorology and Air Quality, Wageningen Univ. and Research, Netherlands; [3]LHEEA Ecole Centrale de Nantes, France.* We propose an efficient, physics-based framework for estimating Cn2 timeseries and vertical profiles in the convective boundary layer. We use CLASS-simulated surface heat fluxes and the boundary layer height. After validation against turbulence data at Cabauw (NL), we present a sensitivity study of Cn2 to surface and boundary layer properties.

JW4A.13
Reflection-Mode Fiber-Optic LSPR Sensor With FONLISA Amplification for Ara h 1 Detection, Chang-Yue Chiang[1], Chien-Hsing Chen[2], Ting-Chou Chen[2], Ruei-Lin Hsu[1], Yi-Hong Li[1]; *[1]Department of Chemistry, National Changhua Univ. of Education, Taiwan; [2]Department of Biomechatronics Engineering, National Pingtung Univ. of Science and Technology, Taiwan.* A reflection-mode fiber-optic localized surface plasmon resonance (LSPR) sensor is demonstrated for peanut allergen Ara h 1 detection. The Ag-mirror-assisted reflective probe improves signal collection, enabling sensitive detection with good linearity and a detection limit of 21.8 pg/mL.

JW4A.14
Measurement Optimization and Sensitivity Analysis of a Real-Time non-Contact bio-Signal Measurement Device Using Camera-Based IPPG Signals., Joo Beom Eom[1]; *[1]Dankook Univ., Korea (the Republic of).* Imaging photoplethysmography (IPPG) is a non-contact technique that measures vital signs, including oxygen saturation (SpO2), heart rate (HR), and respiratory rate (RR). To reduce measurement time and improve accuracy, we evaluated the impact of key acquisition parameters, including (1) image scaling, (2) acquisition time (5 to 30 seconds).

JW4A.15
Design and Experimental Realization of Enhanced Azimuthal Depletion Beams, Costanza Agazzi[1], Nick Toledo García[1], Estela Martín-Badosa[1], Mario Montes Usategui[1], David Maluenda[1], Jordi Tiana-Alsina[1], Rosario Martínez Herrero[2], Artur Carnicer[1]; *[1]Universitat de Barcelona, Spain; [2]Universidad Computense de Madrid, Spain.* We present the design,

analysis, and experimental realization of an azimuthally polarized depletion beam with enhanced central confinement, achieved through pupil engineering and vectorial control on a reconfigurable SLM.

JW4A.16
Spectroscopic Analysis of DDS Nanoparticles Using a Polarization-Interferometric Nonlinear Confocal Microscope, Chikara Egami[1]; [1]*Shizuoka Univ., Japan. We have been focusing on the spectroscopic analysis of a single polymer DDS nanoparticle using a polarization-interferometric nonlinear confocal microscope to investigate the nanoparticle. The microscopy is a label free imaging technique that allows visualization of transparent single nanoparticles using CW oscillators and simple optical elements.*

JW4A.17
Soliton Radar, Mohamed H. Said[1]; [1]*Helwan Univ., Finland.* We present a solitonic radar using phase-locked, non-dispersive bursts. This operational model maintains phase-coherence over distance, enabling robust detection under clutter and jamming. It offers a path for high-precision imaging in autonomous navigation and remote sensing

JW4A.18
Microring Resonator-Based Ring Oscillator for Quantum Photonic Circuits, Ankur Saharia[1], Kamal K. Choure[2], GHANSHYAM SINGH[3], Manish Tiwari[1]; [1]*Manipal Univ. Jaipur, India;* [2]*SCHOOL OF COMPUTER SCIENCE, UPES, India;* [3]*ECE, Malaviya National Inst. of Technology jaipur, India.* This work presents a unique a unique all-optical ring oscillator chip using Optical microring resonator.The capability of the proposed device is validated by the evaluated figure of merits like a quality factor of 7750, and extinction ratio of 20.29 dB. The proposed three bit ring oscillator has a response time of nearly 6ps

JW4A.19
Temperature and Magnetic Field Effects on NV Center Quantum State Transitions, Shahriar Esmaeili[1]; [1]*Houkan LFG, USA.* This study simulates the effects of temperature and magnetic field orientation on NV center quantum state transitions. Results highlight significant thermal and magnetic dependencies, offering insights for quantum computing and precision magnetic sensing applications.

JW4A.20
Withdrawn.

JW4A.21
Withdrawn.

JW4A.22
Freestream Velocimetry in an Inductively Coupled Plasma (ICP) Wind Tunnel Using FLEET and Langmuir Probe, Yupeng Li[1,2], Yuzhi Luo[1], Hui Zhang[1], Zhuang Yu[1], Jiwei Li[1], Jinwen Cao[1], Yejun Wang[1], Heji Huang[1], Qiu Wang[1], Chenglong Guo[2], Wei Zhao[1]; [1]*Inst. of Mechanics CAS, China;* [2]*China Univ. of Mining and Technology, China.* Femtosecond laser electronic excitation tagging (FLEET) was employed to investigate freestream velocity profiles in an inductively coupled plasma (ICP) wind tunnel, and the results were further compared with

those obtained by the Langmuir probe.

JW4A.23
a Tunable Difference-Frequency-Generated Mid-Infrared Dual-Comb Spectrometer for Ambient-Air Spectroscopy, Xun Liu[1], ruocan zhao[1], Xianghui Xue[1]; [1]*Univ. of Science and Technology of China, China.* We present a difference-frequency-generated mid-infrared dual-comb spectrometer for indoor-air methane measurement. The system records interferograms, generates spectra near 3.3 μm, and observes methane and water-vapor absorption features in spectrum after propagation through a 30-m Herriott cell.

JW4A.24
Fluorescent Zn-MOF Optical Sensor for Enzyme-Free Tetracycline Detection, Mai Tran[1], Son H. Nguyen[2]; [1]*VinUniv., Viet Nam;* [2]*Hanoi Univ. of Science and Technology, Viet Nam.* Amino-functionalized Zn-MOF was synthesized for enzyme-free fluorescence detection of tetracycline. The sensor shows concentration-dependent emission at 510 nm, achieving a 90.2 nM detection limit and good selectivity against antibiotics and glucose, demonstrating potential for rapid optical monitoring of antibiotic residues.

JW4A.25
Spectroscopic Investigation of Aerosol and Microplastic Loadings During Firecracker Emissions, Salma Jose[1]; [1]*National Inst. of Technology Calicut, India.* Aerosol and microplastic emissions generated during fire cracking were investigated using optical techniques including an Aethalometer, IBBCEES, Mini–Laser Absorption Spectrometer, fluorescence microscopy, and Raman spectroscopy. The findings highlight enhanced presence of these particles which can cause potential health and climate impacts.

JW4A.26
Compact Fluorescence Imaging Platform for Bioinspired Optical Flow Sensing, Dongmin Seo[2], Jaemin Park[2], Sangwoo Oh[1]; [1]*Ocean and Maritime Digital Technology Research Division, KRISO, Korea (the Republic of);* [2]*Department of Electrical and Electronic Engineering, Semyung Univ., Korea (the Republic of).* We present a compact fluorescence imaging platform for bioinspired optical flow sensing. Flow-induced deformation of a flexible pillar produces measurable changes in fluorescence intensity and spatial distribution, enabling image-based estimation of flow magnitude and direction.

JW4A.27
Quantitative Retinal Vascular Analysis for Diabetic Retinopathy Detection, Ouafa Sijilmassi[1]; [1]*Universidad Complutense de Madrid, Spain.* Retinal vascular features (density, length, bifurcations, fractal dimension) from HRF images were classified using a Support Vector Machine (SVM) with a radial basis function (RBF), yielding 88.9% accuracy, 75% sensitivity, and 100% specificity.

JW4A.28
Aerosol Extinction Measurements Using a Multi-Reflection Folded Cavity-Enhanced Extinction Spectrometer, Salma Jose[1]; [1]*National Inst. of Technology Calicut, India.* A multi-reflection folded incoherent broadband cavity-enhanced extinction spectrometer was applied to measure aerosol extinction using ~400 nm diameter polystyrene particles. Experimental results

agreed with Mie-theory calculations from Mini-LAS size distributions, validating the system for compact, field-deployable aerosol monitoring applications.

JW4A.29
Real-Time Liquid Refractive Index Measurement Using Common-Path Wedge Interferometry and Fourier Spectral Analysis, Yun Pan[1], Guoqing Gu[2]; *[1]College of Electronics and Information Engineering, Nanjing Vocational Inst. of Transport Technology, China; [2]School of Civil Engineering, Yancheng Inst. of Technology, China.* A compact common-path interferometer enables real-time liquid refractive index measurement using wedge interference and Fourier spectral analysis. FFT and spline interpolation achieve ~3.1×10^{-5} RIU resolution on a Raspberry Pi. Tests show errors ≤0.48%, demonstrating stable, portable, non-immersive sensing in flow.

0.14 Singapore
17:00 -- 18:15
EW5A • Cavity and Photoacoustic Sensing
Presider: Caroline Kistner; Nanoplus Nanosystems and Tech GmbH, Germany

EW5A.1 • 17:00 (Invited)
Exploring the Sensitivity and Resolution of Cavity-Enhanced Photoacoustic Sensors, Jacopo Pelini[1], Stefano Dello Russo[2], Zhen Wang[3], Iacopo Galli[1], Pablo Cancio Pastor[1], Marica Canino[4], Alberto Roncaglia[4], Wei Ren[5], Paolo De Natale[1], Mario Siciliani de Cumis[2], Simone Borri[4]; *[1]Istituto Nazionale di Ottica, CNR-INO, Italy; [2]ASI, Italy; [3]Harbin Inst. of Technology, China; [4]CNR-ISMN, Italy; [5]CUHK, China.* The combination of photoacoustic sensor with high-finesse optical cavities opens unexplored perspectives for photoacoustic sensors, allowing to exploit unconventional regimes bringing together sensitivity and resolution. Our latest results are here presented and discussed.

EW5A.2 • 17:30
Integrating Cavity Optical Absorption Spectroscopy for Broadband Absorbers Using Superluminescent Diodes, Benjamin Lang[1]; *[1]Technische Universität Graz, Austria.* Absorption spectroscopy with integrating cavities suffers from speckle noise when using narrow-linewidth, long coherence length sources. By optically bandpass-filtering the output of superluminescent diodes this noise can be reduced drastically to accurately measure broadband absorbers.

EW5A.3 • 17:45 (Invited)
Cantilever-Enhanced Photoacoustics in in-Situ Aerosol Sensing, Juho Karhu[1]; *[1]Helsingin Yliopisto, Finland.* Cantilever enhanced photoacoustic spectroscopy can measure aerosol light absorption with high sensitivity. The method is demonstrated in laboratory studies and in black carbon field monitoring from low concentration in urban background air.

0.2 Berlin-0.3 Copenhagen
17:00 -- 18:30

HW5B • Panel: From Sensor to Science: What Is Limiting the Impact of Remote Sensing Today?

0.4 Brussels
17:00 -- 18:30
JW5C • High Speed Imaging Systems
Presider: Olivier Francois; Huawei Technologies, Finland

JW5C.1 • 17:00 (Invited)
High Speed Cuffless Blood Pressure Measurement With the Iso-Pathlength (IPL) Point, Dror Fixler[1]; [1]*Tel Aviv Univ., Israel.* Here we present a rapid optical approach for cuffless blood pressure estimation based on the iso-pathlength (IPL) point, a location around a cylindrical medium where detected light intensity is minimally affected by scattering and is therefore dominated by absorption-related changes.

JW5C.2 • 17:30
Interferometric Speckle Contrast Spectroscopy Modelling, Victoria Tarle[2], Xiaojun Cheng[1], Nisan Ozana[2]; [1]*Neurophotonics Center, Department of Biomedical Engineering, Boston Univ., USA;* [2]*Faculty of Engineering, The Gonda Multidisciplinary Brain Research Center and The Inst. of Nanotechnology and Advanced Materials, Bar-Ilan Univ., Israel.* We present a spatial speckle evolution simulation incorporating camera noise for interferometric systems. Analyzing the Contrast to Noise Ratio dependence on reference to sample arm ratios, read noise, exposure time and photon flux provides an optimization framework.

JW5C.3 • 17:45
High-Speed Single-Pulse Diffraction fly-Scan Ptychography Enabled by Timepix3 Detector, Augustas Karpavicius[2], Aaron R. Sanchez[2], Matthias Gouder[1], Jacob Seifert[3], Stefan Witte[2]; [1]*ARCNL, Netherlands;* [2]*ImPhysics, TU Delft, Netherlands;* [3]*Utrecht Univ., Netherlands.* Fly-scan ptychography using an event-driven Timepix3 detector enables multi-kilohertz single-pulse diffraction acquisition. This setup allows achieving 166 ms measurements over 0.95 mm^2 FoV with diffraction-limited resolution, reaching 2.3 Gpix/h throughput.

JW5C.5 • 18:00
Ultrafast Imaging of Surface Defects of Mirrors Based on a Virtually Imaged Phased-Array, Lei Gao[1]; [1]*Chongqing Univ., China.* We demonstrate high-speed surface defects measurement of mirrors based on single-pixel imaging assisted by a virtually imaged phased-array, with a frame rate of 7.6 MHz, and a spatial resolution of 140 μm.

JW5C.6 • 18:15
THz Imaging of Painted Canvases: Complementary Absorption, Correlation, and Label-Free PCA for Hidden Underdrawings, Valentina Di Sarno[1], emma vannini[2,3], Alice Del Fovo[2], raffaella fontana[2], ilaria catapano[4], alessandra rocco[1], roberto Aiello[1], Pasquale Maddaloni[1]; [1]*CNR-INO Pozzuoli, Italy;* [2]*CNR-INO, Florence, Italy;* [3]*Department of Physics and Astronomy, Univ. of Florence, Italy;* [4]*CNR-IREA, Italy.* We compare absorption spectroscopy, Pearson correlation, and label-free PCA for THz imaging of painted canvases. These complementary methods robustly reveal hidden graphite underdrawings, remaining effective

even when thin-film interference suppresses single-frequency absorption contrast.

0.1 London
17:00 -- 18:30
PW5D • Laser Propagation Through Atmosphere I
Presider: Santasri Bose-Pillai; Air Force Inst. of Technology, USA

PW5D.1 • 17:00 (Invited)
Black Holes and Lasers Through Different Optics, Roderik Overzier[1,2]; [1]*TNO, Netherlands;* [2]*Leiden Observatory, Leiden Univ., Netherlands.* In this talk I will highlight recent work at TNO related to applications of lasers in the civil and defense domains, including laser communication, the Einstein Telescope gravitational wave observatory, and laser weapon systems.

PW5D.2 • 17:30
Experimental Invariance of Degree of Polarization in Vector Vortex Beams Propagating Through Underwater Optical Turbulence, Thomas Kelly[1], Svetlana Avramov-Zamurovic[1], Charles Nelson[1], Cade Peters[2], Andrew Forbes[2]; [1]*USA Naval Academy, USA;* [2]*Univ. of Witwatersrand, South Africa.* Vector vortex beams demonstrate robust underwater propagation. While mean intensity degrades by 11.6%, the statistical variance of the degree of polarization remains topologically invariant ($\sigma \approx 0.013$), validating resilient polarization-based communication.

PW5D.3 • 17:45
The Closed-Form Beam-Width in Turbulence: Role of Emergent Optical Vortices, Luat Vuong[1], Sunilkumar Kudilil[1], Travis M. Crumpton[1]; [1]*Univ. of California at Riverside, USA.* We reanalyze the beam width expansion in closed form with second-moment equations. Our analysis is not limited to the low-fluctuation regime, and we identify the impact of tilt and emergent vortices on the beam width expansion.

PW5D.4 • 18:00
Effect of Spatial Partial Coherence on Scintillation of OAM and Gaussian Beams in Turbulence, Stefan Zamurovic[1], David G. Voelz[1], Matthew Spotnitz[2], Stephen Rose[2], Miranda van Iersel[1]; [1]*New Mexico State Univ., USA;* [2]*Sandia National Labs, USA.* Wave optics simulations compare partially coherent orbital angular momentum beams and spatially partially coherent Schell-model beams propagating through a fixed strength turbulence phase screen. Scintillation averaged over cross sections quantify coherence driven suppression and redistribution.

PW5D.5 • 18:15
Speckle Reduction for Atmospheric Turbulence Channel Using Stress-Engineered Optical Element, Sakshi Dubey[1], Abhishek Dixit[1], Kedar Khare[1]; [1]*Indian Inst. of Technology Delhi, India.* Atmospheric turbulence degrades free-space optical links through scintillation and speckle. We demonstrate speckle reduction via stress-engineered optical elements, producing C-point polarization singularities, which suppress scintillation compared to Gaussian beams,

enabling turbulence-resilient optical communication.

0.8 Rome
17:00 -- 18:15
QW5E • Nonclassical Light Sources for Sensing and Metrology II
Presider: Quntao Zhuang; Univ. of Southern California, USA

QW5E.1 • 17:00 (Invited)
Nonlinear Photonics in TFLN for Quantum Light Sources, Visible-Light Quantum Control, and Perspectives on Sensing, Hansol Kim[1]; [1]*Department of Quantum Information Science and Engineering, Sejong Univ., Korea (the Republic of).* We demonstrate entangled photon generation and cascaded telecom-to-visible conversion in thin-film lithium niobate (TFLN), including milliwatt-level green light for quantum system control, enabling integrated quantum photonics and sensing.

QW5E.2 • 17:30 (Invited)
Bounding the Effect of Idler Noise in Quantum Metrology, Jason L. Pereira[1], Sean W. Moore[1], Majid Hassani[2,3], Jacob A. Dunningham[4], Damian Markham[1]; [1]*Sorbonne Université, France;* [2]*Universiteit Leiden, Netherlands;* [3]*Applied Quantum Algorithms, Netherlands;* [4]*Univ. of Sussex, UK.* Noise affecting the idler system is an issue in quantum metrology that can destroy any advantage gained by using entangled probes. We study and bound the negative effect of idler noise on quantum sensing protocols.

QW5E.3 • 18:00
Entanglement-Enhanced Polarimetry With Two-Photon Probing, Jinliang Ren[1], Vira Besaga[2], Ivan Lopushenko[3], Jinyong Ma[1,4], Alexander Bykov[3], Igor Meglinski[5], Frank Setzpfandt[2,6], Andrey Sukhorukov[1]; [1]*ARC Centre of Excellence for Transformative Meta-Optical Systems (TMOS), Department of Electronic Materials Engineering, Research School of Physics, The Australian National Univ., Australia;* [2]*Inst. of Applied Physics, Abbe Center of Photonics, Friedrich Schiller Univ. Jena, Germany;* [3]*Opto-Electronics and Measurement Techniques, Advanced Electronics Centre, Faculty of Information Technology and Electrical Engineering, Univ. of Oulu, Finland;* [4]*Inst. of Quantum Precision Measurement, State Key Laboratory of Radio Frequency Heterogeneous Integration, College of Physics and Optoelectronic Engineering, Shenzhen Univ., China;* [5]*College of Engineering and Physical Sciences, Aston Univ., UK;* [6]*Fraunhofer Inst. for Applied Optics and Precision Engineering IOF, Germany.* We present two-photon probing quantum polarimetry, in which both photons of a polarization-entangled pair interact with a sample. This approach surpasses one-photon probing schemes, enabling enhanced sensitivity and potential single-shot Mueller matrix reconstruction.

0.9 Athens
17:00 -- 18:15
OW5F • Wavefront and Turbulence Measurement
Presider: Alexander Jesacher; Innsbruck Medical Univ., Austria

OW5F.1 • 17:00 (Invited)
The Photonic Lantern Wavefront Sensor and Imager: Beyond-Diffraction-Limited Imaging Through Earth's Turbulent Atmosphere, Barnaby Norris[1]; [1]*Univ. of Sydney, Australia.* In this talk I will introduce photonic lanterns as compact, fibre-based optical sensors, and explain how they can be combined with neural-network reconstruction to measure and correct aberrations. I will then describe recent work extending this idea beyond wavefront sensing, using oversampled photonic lanterns to recover richer information about the focal-plane electric field.

OW5F.2 • 17:30
Field Selection Method for High-Precision Optical System Alignment Guided by First-Order Differential Characteristics, Qiran Shi[1], Jun Zhu[1,2]; [1]*Tsinghua Univ., China;* [2]*Tsinghua-Foxconn Nanotechnology Research Center, China.* An optimal field-selection method based on first-order differential characteristics of the optical system is proposed to improve alignment precision and efficiency, enabling image quality, focal length, and distortion to more closely approach their nominal values.

OW5F.3 • 17:45
ASSEMBLY and ALIGNMENT for OPTICAL-STRUCTURAL ERROR DECOUPLING in RECTANGULAR-APERTURE OPTICAL SYSTEMS, Yeong Su Shin[1], Seokgi Han[1], Ha Neul Yeon[1], JI YONG JOO[1], Jun Ho Lee[1]; [1]*Kongju National Univ., Korea (the Democratic People's Republic of).* Rectangular-aperture optical systems are difficult to align due to their sensitivity to rotational and structural errors. We propose a module-verification-based assembly and alignment method that separates optical and structural errors. Enabling reliable alignment of rectangular- aperture optical systems.

OW5F.4 • 18:00
Analysis of Indoor Turbulence on Interferometric Measurements of a 1-m-Class Mirror Characterized With INTENSE, JI YONG JOO[1], Jae Woo Lee[1], Seokgi Han[1], Ha Neul Yeon[1], Jun Ho Lee[1], Sang-Won Park[2], Ho-Soon Yang[2]; [1]*Kongju National Univ., Korea (the Republic of);* [2]*Korea Research Inst. of Standard and Science (KRISS), Korea (the Republic of).* Indoor turbulence in a large optical metrology laboratory was characterized using the INTENSE method, and its impact on interferometric measurements of a 1-m-class mirror was experimentally evaluated in controlled airflow conditions.

Thursday, 16 July

0.5 Paris
08:30 -- 10:15
STh1A • Point Optical Fiber Sensors II
Presider: Xin Lu; Bundesanstalt für Materialforschung und, Germany

STh1A.1 • 08:30 (Invited)
Optical Sensors in Point-of-Care Tests for Biomedical Applications, Francesco Arcadio[1]; [1]*Engineering, Università della Campania Luigi Vanvitelli, Italy.* Several developed low-cost, highly sensitive, and simple-to-realize optical sensor configurations implemented in point-of-care tests for biomedical application field will be here recalled. These platforms are combined with chemical and biological receptors to achieve ultra-high selectivity.

STh1A.2 • 09:00
Brillouin Spectrum Denoising Based on Singular Value Decomposition, Xin Lu[1], Konstantin Hicke[1]; [1]*Bundesanstalt für Materialforschung und, Germany.* Singular value decomposition is applied to denoise Brillouin gain spectra and improve Brillouin frequency retrieval. Experiments over 53 km validate the effectiveness of the denoising method with an improved measurement accuracy.

STh1A.3 • 09:15
Real Time Characterization of Nanoparticles in Solution Using Fiber-Tip Photonic Crystal Cavities, Hasan Yalcinoglu[1], René van Veldhoven[1], Ewold Verhagen[1,2], Andrea Fiore[1]; [1]*Technische Universiteit Eindhoven, Netherlands;* [2]*AMOLF, Netherlands.* We demonstrate real time nanoparticle monitoring with fiber-tip sensing platform based on localized highly sensitive photonic crystal cavity modes. Nanoparticles with different sizes and concentrations (down to 80nm) in aqueous solutions were characterized.

STh1A.4 • 09:30 (Invited)
Recent Progress in Fiber Optic Sensors for Biochemical Sensing: From Grating- to Nanomaterial-Based Devices, Flavio Esposito[1], Amin Moslemi[1], Andrea De Luca[1], Lucia Sansone[2], Michele Giordano[2], Carlos Marques[3], Stefania Campopiano[1], Agostino Iadicicco[1]; [1]*Department of Engineering, Univ. of Naples Parthenope, Italy;* [2]*Inst. for Polymers, Composites, and Biomaterials (IPCB), CNR, Italy;* [3]*CICECO – Aveiro Inst. of Materials, Physics Department, Univ. of Aveiro, Portugal.* In this work, we report recent progress in fiber optic sensors for biochemical sensing. Specifically, we present different sensing configurations for the detection of a variety of chemical and biological analytes. These approaches are based on grating configurations, such as long period gratings, as well as nanomaterial-based devices, including those exploiting localized surface plasmon resonance of gold nanostructures. These platforms enable highly sensitive and selective detection.

STh1A.5 • 10:00
Plane-by-Plane fs FBG Writing With an Elliptical Beam for Reduced Polarization Dependence, Rana M. Ayaz[1], Riccardo Funari[1], Fabrizio Di Pasquale[1], Claudio J. Oton[1]; *[1]Scuola Superiore Sant'Anna, Italy.* In this work, we demonstrate plane-by-plane femtosecond direct writing of fiber Bragg gratings using an elliptical laser beam. The beam shape was changed from circular to elliptical using a 4× anamorphic prism pair. The gratings show a 5-fold improvement in polarization dependence of the Bragg wavelength compared to point-by-point gratings.

0.14 Singapore
08:30 -- 10:30
JTh1B • Atmospheric and Environmental Chemistry Applications
Presider: Aamir Farooq; King Abdullah Univ of Sci & Technology, Saudi Arabia

JTh1B.1 • 08:30 (Invited)
High-Resolution Time-Resolved Dual-Comb Spectroscopy for Atmospheric Chemistry Applications, Pei-Ling Luo[1]; *[1]Inst. of Atomic and Molecular Sciences, Academia Sinica, Taiwan.* We demonstrate mid-infrared dual-comb spectroscopy with high spectral and microsecond temporal resolution to quantify transient free radicals and study gas-phase reaction kinetics relevant to atmospheric chemistry. Our work provides precise spectral and kinetic data that are valuable for refining existing spectral and kinetic databases.

JTh1B.2 • 09:00
Remote Measurement of Water Vapour Profiles in the Atmospheric Column Based on Laser Heterodyne Radiometer, Aditya Saxena[1], Marie Thérèse El Kattar[1], Tingting Wei[1], Mélanie Ghysels-Dubois[2], Georges Durry[3], Nadir Amarouche[4], Michel Chartier[5], Gisèle Krysztofiak[5], Jean-Christophe Samake[4], Stéphane Chevrier[5], Thomas Lecas[5], Constance Paquet[6], Hervé Herbin[7], Weidong Chen[1]; *[1]Universite du Littoral, France; [2]Sorbonne Univ., France; [3]Université de Reims, France; [4]INSU Division Technique, France; [5]Université d'Orléans, France; [6]Centre national d'études spatiales, France; [7]Université de Lille, France.* Ground-based remote measurement of water vapour (H2O) in the atmospheric column has been performed using a near-infrared laser heterodyne radiometer (LHR). Retrieved vertical H2O concentration profiles were validated against high-spatial resolution balloon-borne in situ measurements.

JTh1B.3 • 09:15
A Miniaturized Calibration-Free NOx Sensor Based on TDLAS With a Multilayer Perceptron, Mhanna Mhanna[1], Jalal Norooz Oliaee[1], Haydn Sims[1], Meghan N. Beattie[1], Joel Corbin[1]; *[1]National Research Council Canada, Canada.* A miniaturized calibration-free multi-species TDLAS sensor is built with embedded MLP retrieval for real-time NO, NO2, CO2, and H2O sensing using a 1-m 10-pass cell. The sensor supports future test-bed and airborne emissions measurements.

JTh1B.4 • 09:30
Consideration of Correlations in Radiometric Measurements of the Environment, Natalie J. Hall[1], Steven W. Brown[2], David W. Allen[2], Julia K. Marrs[2], Christopher J. Crawford[1]; [1]*USGS, USA;* [2]*NIST, USA.* Considering temporal correlations, significant reductions of uncertainties in reflectance measurements are achieved with near simultaneous measurements of a region of interest and a reference target. Implications for the vicarious calibration of satellite sensors are considered.

JTh1B.5 • 09:45
Comparative Study of 532 nm and 450 nm Non-Dispersive Raman Systems for Hydrogen Detection, Fabio Melison[1], Lorenzo Cocola[1], Luca Poletto[1]; [1]*CNR - IFN, Italy.* Hydrogen detection is addressed using two compact non-dispersive Raman systems based on 532 nm (DPSS) and 450 nm (diode) excitation. The trade-off between Raman efficiency and beam quality is investigated. Results show linear response and LODs below 400 ppm within 5 seconds, enabling fast, contactless sensing.

JTh1B.6 • 10:00 (Invited)
Scalable Dual-Comb Atmospheric Spectroscopy: From Field Deployment to Space-Ground Networks, Ruocan Zhao[1]; [1]*Univ. of Science and Technology of China, China.* Dual-comb spectroscopy (DCS) enables high-precision, broadband atmospheric sensing with intrinsic frequency traceability. We present scalable, field-deployable DCS for long-path measurements of CO2, CH4, and H2O, and outline its extension to networked and space–ground architectures for global, SI-traceable atmospheric monitoring.

0.2 Berlin-0.3 Copenhagen
08:30 -- 10:30
ATh1C • Applied Industrial Sensing and Imaging
Presider: Amartya Sengupta; Indian Inst. of Technology Delhi, India

ATh1C.1 • 08:30 (Invited)
Optical Sensing and Metrology for Material Characterization and Non-Destructive Testing in Aerospace, Andrei Anisimov[1]; [1]*Technische Universiteit Delft, Netherlands.* In this presentation an overview is given on full-field non-destructive testing (NDT) techniques and local fibre-based sensors that are being developed to support new aviation and space developments. From the industrial point of view, two main application cases are presented: monitoring of a liquid hydrogen tank for future aviation, and on-orbit inspection of large space structures.

ATh1C.2 • 09:00
Real-Time Detection of Trace Elements in Bulk Ore Using a High-Sensitivity Spectrometer in the LIBS Lumine Platform, Francis Vanier[1], Paul Bouchard[1], André Beauchesne[1], Antoine Hamel[1], Simon Dallaire[1], Christian Padioleau[1], Véronique Larche[1], Daniel Gagnon[1], Aïssa Harhira[1]; [1]*Clean Energy Innovation Research Centre, National Research Council Canada, Canada.* We present the integration of a high resolution and high sensitivity

spectrometer in the LIBS-based Lumine platform for online bulk ore measurement on conveyor. This technology development is expected to allow trace element detection in ore.

ATh1C.3 • 09:15
Assessment of Online LIBS Technology for Real-Time Quantification of Graphite in Bulk Ore, Francis Vanier[1], David Petitclerc[1], Antoine Hamel[1], Christian Padioleau[1], Daniel Gagnon[1], Dave Marsh[2], Aïssa Harhira[1]; *[1]Clean Energy Innovation Research Centre, National Research Council Canada, Canada; [2]Northern Graphite, Canada.* We show the performance assessment of the LIBS-based Lumine technology for real-time quantification of graphite in bulk ore on the conveyor. The results from this work show promising quantification performances to support a more efficient graphite extraction and processing.

ATh1C.4 • 09:30
Coherent 294-GHz Fourier-Domain Transmission Imaging of Glass- and Carbon-Fiber Reinforced Composites, Hui Yuan[1], Jakob Holstein[1], Nan Zhang[2], Alvydas Lisaukas[3,4], Hartmut Roskos[1]; *[1]Physikalisches Institut, Goethe-Universit at Frankfurt am Main, Germany; [2]Anor Technologies, Singapore; [3]Inst. of Applied Electrodynamics and Telecommunications, Vilnius Univ., Lithuania; [4]Center for Physical Sciences and Technology, Lithuania.* We present a 294-GHz coherent imaging system with a two-stage IF amplification scheme, increasing dynamic range to 80 dB. Testing on glass fiber reinforced polymer (GFRP) and carbon fiber reinforced polymer (CFRP) shows phase-sensitive imaging significantly improves damage localization and contrast.

ATh1C.5 • 09:45
Super-Resolution of Spectroscopy System for Water Monitoring, Omer Haleli[1,2], David Mendlovic[2], Michael Borisover[1], Iftach Klapp[1]; *[1]Volcani Inst Agricultural Research Ctr, Israel; [2]EE, Tel Aviv Univ., Israel.* The proposed method enables irrigation monitoring using low-cost sensors. We develop a deep-learning model achieving spectral super-resolution to increase real-time sampling of fluorescence excitation-emission matrix, while effectively mitigating noise inherent in field-deployable systems.

ATh1C.6 • 10:00
Skin Melanin Estimation Enhanced by Uncalibrated Capillary Refill Time Imaging, Raquel P. Bachour[1], Vanessa F. Lima[1], Eduardo L. Dias[1,2], George Cardoso[1]; *[1]Universidade de Sao Paulo, Brazil; [2]Biomedical Engineering, Technion, Israel.* We experimentally show improved skin pigmentation assessment by adding skin compression, measured through capillary refill time, to uncalibrated video, enabling low-cost, calibration-free estimation of skin melanin content through dynamic microvascular response.

ATh1C.7 • 10:15
Depth-Resolved Beam Profiling and Effective Spot Size Characterization of a 785-nm Laser Needle in an Optical Tissue Phantom, Donghwan Ko[1], Seyoung Lee[1], Hyunseon Yu[1], Byungjo jung[1]; *[1]yonsei Univ., Korea (the Republic of).* Depth-resolved light distribution and effective spot size of a 785 nm laser needle are characterized using camera-based beam profiling in an optical tissue phantom, demonstrating a stable, narrowly confined irradiance profile suitable for interstitial phototherapy planning.

0.4 Brussels
08:30 -- 10:30
JTh1D • Microscopy and Biomedical Imaging
Presider: Ashley Lyons; Univ. of Glasgow, UK

JTh1D.1 • 08:30 (Invited)
Liquid Crystal Adaptive Coherence Control for Microscopy and Metrology, Tianxin Wang[1], Nathan Spiller[1], Steve Elston[1], Stephen Morris[1], Martin J. Booth[1]; [1]*Univ. of Oxford, UK.* Liquid crystal coherence modulators enable adaptive coherence control by tailoring spatio-temporal decorrelation statistics of illumination fields. Applications span super-resolution random illumination microscopy, holographic speckle suppression, and interferometric sensing within a programmable and robust imaging platform.

JTh1D.2 • 09:00 (Invited)
Raman Spectroscopy for Cancer Surveillance: Translating a Multi-Molecular Signal Into a Clinically Actionable Test, Maria Navas Moreno[1]; [1]*Univ. of Utah, USA.* Reading a multi-molecular biosignature, rather than one analyte, suits biologically heterogeneous cancers. Drawing on allumbra's experience building a Raman liquid biopsy for head and neck cancer surveillance, this talk examines what clinical translation actually demands.

JTh1D.3 • 09:30
AI-Driven Lensless Fiber Endomicroscopy Towards all-Optical Reconstruction, Jiawei Sun[1,2], Tianyu Han[2,1], Hanlu Tang[1], Juergen Czarske[3], Xibin Yang[1,2]; [1]*Chinese Academy of Sciences, SIBET, China;* [2]*School of Biomedical Engineering(Suzhou), Division of Life Sciences and Medicine, Univ. of Science and Technology of China, China;* [3]*Laboratory of Measurement and Sensor System Technique, TU Dresden, Germany.* We demonstrate a lensless fiber endomicroscopy phase reconstruction method using a diffractive optical network. The network maps speckles to phase images through a multicore fiber at light speed, overcoming traditional electronic computation bottlenecks.

JTh1D.4 • 09:45
Diffractive Deep Neural Networks for Colonoscopy Polyp Detection, David Schipf[1], Colin Fairborn[1], Joshua Rivera[1]; [1]*Whitworth Univ., USA.* Diffractive deep neural networks process images passively at the speed of light, making them attractive for edge computing applications. This study describes numerical simulations of diffractive networks that detect and locate polyps for colonoscopy imaging.

JTh1D.5 • 10:00 (Invited)
Towards in Vivo Human Microscopy via the Human Eye: From 3D Imaging to Quantification, Kristina Irsch[1]; [1]*Institut De La Vision Paris, France.* The eye offers unique access to living human tissue, yet real patients challenge idealized imaging conditions. This talk presents advances from three-dimensional corneal imaging to quantitative transparency characterization, towards in vivo microscopy via the eye.

0.1 London
08:30 -- 10:00
PTh1E • Laser Propagation Through Atmosphere II
Presider: Jason Schmidt; MZA Associates Corporation, USA

PTh1E.1 • 08:30
Impact of Beam Quality on Uplink Scintillation, Mark F. Spencer[1], Anna L. Broom[2], Adriana M. Stohn[2], Seth Melgaard[2], Cameron J. Radosevich[2]; [1]*Univ. of Arizona, USA;* [2]*Sandia National Laboratories, USA.* We use computational wave-optics simulations to quantify the impact of beam quality on uplink scintillation. We do so as a function of the number of beams employed. In practice, these beams propagate through independent channels of atmospheric turbulence with different beam qualities specified in terms of M^2.

PTh1E.2 • 08:45
Modification of Orbital Angular Momentum of Vortex Beams by Thermal Blooming, Jeremiah S. Lane[1], Patrick McCaw[2], Benjamin Akers[1]; [1]*Air Force Inst. of Technology, USA;* [2]*Department of Mathematics, Univ. of North Carolina at Chapel Hill, USA.* The steady thermal blooming of a beam carrying orbital angular momentum (OAM) is considered in seawater. Simulations reveal that, even for low power beams, thermal blooming can induce OAM crosstalk without significantly modifying the intensity.

PTh1E.3 • 09:00 (Invited)
Applications of Laser Filamentation in the Atmosphere, Aurelien Houard[1]; [1]*Ecole Polytechnique, France.* Laser filamentation occurs during the propagation of an ultrashort gigawatt laser beam through air. The beam self-contracts to form a long, thin ionizing light channel that could be very useful for various remote applications.

PTh1E.4 • 09:30
Multi-Parameter Analysis of Structured-Beam Global Coherence in Atmospheric Turbulence, Sunilkumar Kudilil[1], Travis M. Crumpton[1], Luat Vuong[1]; [1]*Univ. of California Riverside, USA.* We present multi-parameter analyses of Laguerre-Gaussian (LG) beams in weak atmospheric turbulence and quantify the influence of wavelength, turbulence strength, and beam geometry on global beam coherence that exponentially increases for long wavelength propagation.

PTh1E.5 • 09:45
Machine Learning Forecasts of Laser Intensity Evolution Through Maritime Turbulence, Svetlana Avramov-Zamurovic[1], Kenzie Fleming[1], Erin Kincade[1], Gavin Taylor[1], Peter Judd[2]; [1]*US Naval Academy, USA;* [2]*Naval Research Lab, USA.* We study thermally driven optical turbulence using two machine-learning forecasting approaches: a 3D spatiotemporal attention network for pupil-plane data and an autoencoder with convolutional recurrent prediction (ConvLSTM) for focal-plane data, predicting the next three intensity frames under varying turbulence.

0.8 Rome
08:30 -- 10:00
QTh1F • Nonclassical Light Sources for Sensing and Metrology III
Presider: Tatevik Chalyan; Vrije Universiteit Brussel, Belgium

QTh1F.1 • 08:30 (Invited)
QuantumXsense: Quantum Environmental Sensing From Lab to Field, Stefano Tondini[1,2], Roberto Monsorno[2]; *[1]Technische Universiteit Eindhoven, Netherlands; [2]Center for Sensing Solutions, Eurac Research, Italy.* This talk addresses a set of quantum sensing technologies with realistic pathways from laboratory to field deployment, presenting the quantumXsense vison and case studies for application of quantum spectroscopy, magnetometry and LiDAR in environmental monitoring.

QTh1F.2 • 09:00 (Invited)
Magnetic Field Learning for Novel Quantum Technologies, Sebastian Knauer[1]; *[1]AIT-Austrian Inst. of Technology, Austria.* Bayesian machine learning enables high-sensitivity, room-temperature nitrogen-vacancy (NV) center diamond magnetometry, successfully overcoming standard ambient readout noise without requiring impractical cryogenic cooling or lengthy measurement times. By utilizing down to just a single collected photon per algorithm step, this unique framework achieves Heisenberg-limited scaling and absolute sensitivities near ~60 $nT/s^{1/2}$, directly matching state-of-the-art cryogenic performances. Additionally, this highly flexible approach allows simultaneous multi-parameter estimation, tracking vital dephasing times during active magnetometry. Crucially, the method demonstrates highly successful real-time, dynamic tracking of time-dependent fields under ambient conditions, explicitly paving the way for deploying practical, single-spin quantum sensors in delicate biological samples.

QTh1F.3 • 09:30
Parameter-Decoupled Superresolution of the Double Nucleus Galaxy NGC 4486B, James Qu[1,2], Abdelali Sajia[1], Isabella Lee[1], Kathryn Flannery[1], Ayyoob Saeed[1], Yashashree Jadhav[1], Xiao-Feng Qian[1]; *[1]Stevens Inst. of Technology, USA; [2]Syosset High School, USA.* We extend parameter-decoupled quantum superresolution to analyze the double nucleus galaxy NGC4486B, measuring a separation of between 9.8 to 13.6 pc compatible with the previous 12 pc result with Lucy–Richardson method, demonstrating our approach's accuracy for astrophysical source separation.

QTh1F.4 • 09:45
Fast Single-Photon SPAD-Based Spectrometer Near Heisenberg-Gabor Limit for Quantum Applications, Sergei Kulkov[1], Ondrej Matousek[1], Dmitrij Sevaev[1], Yury Kurochkin[2], Stephen Vintskevich[2], Claudio Bruschini[3], Tommaso Milanese[3], Edoardo Charbon[3], Peter Svihra[1,4], Andrei Nomerotski[1,4]; *[1]Czech Technical Univ. in Prague, Czechia; [2]Quantum Research Center, Technology Innovation Inst., United Arab Emirates; [3]EPFL, Switzerland; [4]Czech Academy of Sciences, Czechia.* Using a fast single-photon spectrometer built with a SPAD array with 40 ps temporal and 40 pm spectral (rms) resolution, we resolve temporal-spectral two-photon correlations, enabling high-speed, frequency-multiplexed quantum-assisted interferometry and related quantum applications.

QTh1F.5 • 10:00
Resolution of SPAD-Based Ghost Imaging, Yishai Albeck[1], Lior Cohen[2]; *[1]NRC soreq, Israel; [2]HUJI, Israel.* We review the challenges that are involved in a structured detection configuration of Ghost-Imaging combined with a single-photon avalanche detector. We find a strict constraint on imaging resolution and field of view, and map the alternatives and solutions to overcome these and other challenges

0.9 Athens
08:30 -- 10:30
DTh1F • Advances in Light-field and Integral Imaging: Display, Perception, and Computational Reconstruction
Presider: Julia Alonso; Universidad de la Republica, Uruguay

DTh1F.1 • 08:30 (Invited)
Large Field-of-View Imaging and Display: From Aberration-Tolerant Objective Lens to Arbitrary Spatial Transformation, Atsushi Shibukawa[1]; *[1]Tokushima Univ., Japan.* We first present a large field-of-view two-photon microscope using an aberration-tolerant custom objective lens. We next present 1D-to-2D spatial pattern transformation for wide-field panoramic displays using diffraction grating arrays.

DTh1F.2 • 09:00
Aerial-Imaging Light-Field Camera Using Geometric Phase Lens Array for Convertible 2D/3D Imaging, JIAYING RUAN[1], Masahiro Kawakita[1]; *[1]Osaka Inst. of Technology, Japan.* This study proposes an aerial-imaging light-field camera using a compound lens array composed of a convex lens array and a geometric phase lens array. By controlling polarization, the system switches between high-resolution 2D imaging and light-field elemental image capture, enabling multi-view observation and depth perception.

DTh1F.3 • 09:15 (Invited)
Ray Tracing Applied to Binocular Perception and Modeling Visual Aberrations in 3D-LF Display, Simon Thibault[1,2], Sédick Rabia[1]; *[1]Université Laval, Canada; [2]Immervision Inc., Canada.* We present a simulation-based framework to evaluate how field-dependent aberrations affect binocular response in 3D LFD. Ray tracing estimates effective axial positions from elemental image wavefront curvature to build field-dependent visual surfaces for each eye. Derived monocular and binocular metrics quantify interocular behavior across angles and depths, define an acceptability zone for preserved performance, and show aberrations mainly alter disparities rather than accommodation.

DTh1F.4 • 09:45
Super-Multiview Integral 3D Display With Expanded Viewing-Zone Angle Using Eye Tracking, Hayato Watanabe[1], Naoto Okaichi[1], Yasutaka Maeda[1], Hisayuki Sasaki[2], Takuya Handa[1], Kimihiro Tomiyama[1]; *[1]Japan Broadcasting Corporation (NHK), Japan; [2]NHK Foundation, Japan.* We propose an integral three-dimensional display that reproduces high-density light rays around an observer's pupils to satisfy the super-multiview condition, while expanding the viewing-zone angle using eye tracking.

DTh1F.5 • 10:00
Render-Aware Restoration of Elemental Image Arrays for Consistent Light-Field and Integral Imaging, Hyun Woo Ko[1,2], Sunghyun Han[1,2], Suyeon Jo[1,3], Dae-Yeon Kim[4], Paul Hongsuck Seo[2], Seon Kyu Yoon[5], Min-Chul Park[1,2]; *[1]Center for Quantum Technology, Korea Inst. of Science & Technology, Korea (the Republic of); [2]Department of Computer Science and Engineering, Korea Univ., Korea (the Republic of); [3]School of Electrical Engineering, Korea Univ., Korea (the Republic of); [4]Department of Electronics and Computer Engineering, Seokyeong Univ., Korea (the Republic of); [5]Spatial Optical Information Research Center, Korea Photonics Technology Inst., Korea (the Republic of).* Light-field and integral imaging require spatial-angular consistency, yet small inter-view errors cause severe rendering artifacts. We propose a render-aware restoration framework for elemental image arrays that reconstructs coherent views and reduces holes and tearing.

DTh1F.6 • 10:15
Integral Imaging of Mueller Matrix Related Indices in Turbid Media, Iago Pardo[1], David Maluenda[1], Bahram Javidi[2], Artur Carnicer[1], Oriol Arteaga[1]; *[1]Universitat de Barcelona, Spain; [2]Univ. of Connecticut, USA.* We investigate how combining polarimetric parameters derived from the Mueller matrix —- such as the depolarization index and the magnitude of linear birefringence —- with integral imaging can improve the analysis of turbid media

Auditorium 2
11:00 -- 12:30
JTh2A • Joint Plenary Session II

JTh2A.1 • 11:00 (Plenary)
Moon to Mars: Contributions of Optical Measurements to NASA's Artemis Program, Paul M. Danehy[1]; *[1]NASA Langley Research Center, USA.* NASA and partners have embarked on a series of space missions to the moon and Mars, collectively known as the Artemis Program. This talk overviews the Artemis missions and details laser and optical measurement technique development and application to ground and flight tests related to, or inspired by, the Artemis program. Three measurement techniques have been applied to study vehicle launch, Earth and Mars entry, and lunar and Martian landing. Such optical instrumentation provides unique information to inform the underlying physics of space flight while also providing benchmark data for validating ever advancing predictive codes.

JTh2A.2 • 11:00 (Plenary)
From Probing Quantum Materials to in Vivo Imaging of Animals With Quantitative Phase Microscopy, Renjie Zhou[1]; *[1]Chinese Univ. of Hong Kong, Hong Kong.* Quantitative phase microscopy (QPM) has emerged as an important label-free imaging technique for bioimaging and material metrology. We recently pushed the performance limits of QPM to allow for probing the hidden electronic-behaviors in sub-atomic structures and imaging deep into live animals *in vivo*

0.5 Paris
14:00 -- 15:45
STh3A • Chemical Biological Sensors II
Presider: Koji Masuda; Univ. of Exeter, UK

STh3A.1 • 14:00 (Invited)
Improved Photonic Integrated Sensors for Biomedical Applications, Inigo Molina-Fernandez[1], Gonzalo Wangüemert-Pérez[1], Robert Halir[1], Ana Sánchez Ramírez[1], Ayesha Arshad[1], Jonas Leuermann[2], Laura Perez-Sanchez[2]; *[1]Universidad de Malaga, Spain; [2]BIOHERENT S.L., Spain.* This work presents a comprehensive review of interferometric photonic biosensors with coherent readout. Crucially, it demonstrates for the first time a novel bimodal sensing platform based on concurrent TE and TM mode propagation. This dual-signal interrogation scheme successfully distinguishes localized surface interactions from bulk background variations.

STh3A.2 • 14:30
a Compact Spectroscopic Ellipsometer Sensor With Real-Time Monitoring Capability, Jaemin Kim[2,1], JinHwan An[2,1], Zehra Asifa[1,2], Cheongsong Cheongsong Kim[1], Gbogbo Yatana[1], Yushin Bae[3], Taein Shin[1], Changsug Lee[4], Youngmin Kim[4], Daesuk Kim[1,2]; *[1]Department of Mechanical System Engineering, Jeonbuk National Univ., Korea (the Republic of); [2]Graduate School of Mechanical-Aerospace-Electric Convergence Engineering, Jeonbuk National Univ., Korea (the Republic of); [3]Department of Physics Jeonbuk, Jeonbuk National Univ., Korea (the Republic of); [4]Korea Spectral Products, Korea (the Republic of).* We propose a compact, portable spectroscopic ellipsometer sensor that enables real-time monitoring, unlike conventional SE systems, which require seconds per acquisition and complex optical system architecture for active polarization modulation.

STh3A.3 • 14:45
Estimation of Total Hematocrit Using Multi-Wavelength Scattering in Whole Blood Suspensions, Neelam Verma[1], Soumyajit Mahato[1], Sai Siva Gorthi[1]; *[1]Indian Inst. of Science, India.* We present an optical framework for hematocrit (Hct) estimation using spectrophotometry from 10 µL of whole blood. By using the polynomial dependence of intact erythrocyte scattering, we can estimate hematocrit within ± 6% error.

STh3A.4 • 15:00
Ultra-low-Cost Multispectral System for Apple Chlorophyll Monitoring, ANKITA GANGULY[1,2]; *[1]ams Sensors Germany GmbH (ams OSRAM grou, Germany; [2]Physics, Astrophyics and Applied Physics, Univ. of Milano, Italy.* A compact AS7343-based multispectral device with controlled excitation, calibrated signal processing and fluorescence correction algorithm accurately detects chlorophyll-related optical indices in apples. The system reproduces laboratory-grade spectral trends, enabling ultra-low-cost, portable, and field-deployable multispectral sensing.

STh3A.5 • 15:15
Printed Photothermoelectric Sensor Arrays for Non-Contact Human-Machine Interaction, Zirui Wang[1], Amrutha Bose[2], Muhammad I. Khan[1], Nan Luo[1], Jiayi Liu[1], Leonard Franke[1], Ulrich Lemmer[1,3], Mofasser Mallick[1]; *[1]Light Technology Inst., Karlsruhe Inst. of*

Technology, Germany; [2]Abbe School of Photonics, Friedrich Schiller Univ. Jena, Germany; [3]Inst. of Microstructure, Karlsruhe Inst. of Technology, Germany. We print a flexible photothermoelectric sensor array and obtain a sensitivity of 0.67 V/W for single pixel. By printing the reflector, the temperature difference is kept. It is demonstrated as an interface for non-contact human-machine interaction.

STh3A.6 • 15:30
Image Feature-Assisted Robotic Optical Coherence Tomography System for Ophthalmic Applications, Hang Su[1], Jie Zhang[2], Maoyuan Qu[2], Xiru Gao[2], Hongqin Chen[2], Congyu Hu[1], Pengfei Song[3], Xingchen Ji[4], Yikai Su[1]; *[1]State Key Laboratory of Photonics and Communications, Department of Electronic Engineering, Shanghai Jiao Tong Univ., China; [2]Clairvo (Wuxi) Medical Technology Co., LTD, China; [3]Department of Mechatronics and Robotics, Xi'an Jiaotong-Liverpool Univ., China; [4]John Hopcroft Center for Computer Science, Shanghai Jiao Tong Univ., China.* We present an image feature-assisted ophthalmic robotic optical coherence tomography (OCT) system that achieves low-latency depth estimation using a single two-dimensional pupil camera. Our design facilitates broader clinical applicability of OCT technology.

0.14 Singapore
14:00 -- 16:00
JTh3B • Gas Analysis and Environmental Sensing
Presider: Weidong Chen; Universite du Littoral, France

JTh3B.1 • 14:00 (Invited)
A Tale of Two Emission Sources: Long-Term, Open-Path Methane Monitoring of Permafrost in Alaska and a Landfill in California, Sean Coburn[1]; *[1]Univ. of Colorado Boulder, USA.* We present the status of a multi-year effort in measuring methane fluxes using open-path laser spectroscopy from two distinctly different sources – a region of thawing permafrost in Alaska and a solid waste landfill in California.

JTh3B.2 • 14:30
Open-Path Multi-Species Gas Detection Using Laser Absorption Spectroscopy for C_1-C_5 Alkanes, CO_2, and H_2, Viacheslav Meshcherinov[1], Muhammad Shoaib Ijaz[1], Mohamed Sy[1], Mohammed Sait[2], Nizar Jaber[2], Damian San Roman Alerigi[2], Aamir Farooq[1]; *[1]King Abdullah Univ of Sci & Technology, Saudi Arabia; [2]Saudi Aramco, Saudi Arabia.* This work presents a laser absorption spectroscopy system for the selective, simultaneous open-path detection of C1–C5 alkanes, CO2, and H2S. The system employs multiple lasers targeting spectrally distinct absorption regions, enabling high-selectivity multi-species identification within a single open-path measurement platform.

JTh3B.3 • 14:45
Open-Path Hydrogen Leak Detection Using Multi-Pass Raman Spectroscopy, Zhenhai Wang[1], Shaker Alshehri[1], Abdullah AlAmoudi[1], Mohamed Dridi[1], Bin Wu[1], Aamir Farooq[1]; *[1]Clean Energy Research Platform, Saudi Arabia.* We present a multi-pass Raman spectrometer for open-path hydrogen leak detection. High spectral resolution enables identification of atmospheric species and isotopic features, and trace hydrogen detection is

demonstrated at 100 ppm.

JTh3B.4 • 15:00
Source Localization of Gas Leaks Using Gaussian Plume Modeling and Path-Integrated Laser Measurements, Muhammad Shoaib Ijaz[1], Mohamed Sy[1], Viacheslav Meshcherinov[1], Aamir Farooq[1]; [1]*King Abdullah Univ of Sci & Technology, Saudi Arabia.* We present a framework for gas leak localization using path-integrated laser absorption measurements with a Gaussian plume model. Beam configuration strategies are evaluated, demonstrating that an angular beam configuration provides the most accurate source localization.

JTh3B.5 • 15:15
Mid-IR ICL-Based Sensor for Simultaneous CO_2 and H_2S Detection in Natural Gas, SK Aman Ali[1], Mohamed Sy[1], Pan Luo[2], Ibrahim Atwah[2], Aamir Farooq[1]; [1]*Mechanical Engineering, King Abdullah Univ. of Science & Technology, Saudi Arabia;* [2]*Saudi Aramco, Saudi Arabia.* Simultaneous CO_2 and H_2S detection using a single interband cascade laser in the 3702-3708 cm^{-1} window is demonstrated. Pressure dependent measurements of 36 mixtures show optimal retrieval at 50 Torr, achieving sub-1\% mean absolute percentage error for CO_2 and ~2% for H_2S.

JTh3B.6 • 15:30
Visualizing Transparent Gas Leaks With Inverse Backscatter Absorption Gas Imaging (IBAGI), Joseph C. Klug[1], Matthias Beuting[1], Saad Ahmed[1], Jacob Zorea[1], Lily M. Margoshes[1], Scott T. Sanders[1]; [1]*Univ. of Wisconsin-Madison, USA.* We present an inverse backscatter absorption gas imaging (iBAGI) system for visualizing gas plumes of, for practical purposes, fully transparent gases such as H_2. This indirect method uses diode laser absorption spectroscopy to measure the displacement of ambient water vapor.

0.2 Berlin-0.3 Copenhagen
14:00 -- 16:00
HTh3C • Atmospheric Remote Sensing and Radiative Transfer Modeling
Presider: Robert Sundberg; Spectral Sciences Incorporated, USA

HTh3C.1 • 14:00 (Invited)
MODTRAN6 Radiometric DISORT and MODTRAN7 Polarimetric VDISORT Path Segment Scattering Contributions, Alexander Berk[1]; [1]*Spectral Sciences Incorporated, USA.* Publically available radiometric-DISORT & polarimetric-VDISORT discrete ordinate models solve the scalar & vector radiative transfer equations, respectively, for a plane-parallel atmosphere. Radiometric MODTRAN6 & polarimetric MODTRAN7 compute path radiances for a locally spherical atmosphere including refractive bending, utilizing the DISORT models to compute thermal scattering & solar/lunar multiple scattering. DISORT restructuring to conform with spherical refractive geometry is described.

HTh3C.2 • 14:30 (Invited)
Passive and Active Remote Sensing of the Environment: Challenges and Opportunities in Radiative Transfer Modeling, Knut Stamnes[1]; [1]*Stevens Inst. of Technology, USA.* A unified approach to passive (solar) and active (lidar) remote sensing problems is provided. A forward/inverse modeling framework is presented for deriving important environmental parameters from satellite data and for consistent validation using ground-truth data.

HTh3C.3 • 15:00
Remote Sensing and Modeling of Melt Ponds on Sea Ice – Preliminary Results, Wesley Moses[1], David Hebert[1], Gleb Panteleev[1], Andrei Abelev[1], Yanting Wang[1], Ahmed El-Habashi[1]; [1]*US Naval Research Laboratory, USA.* We present preliminary results from a research endeavor to use an integrated approach involving modeling and remote sensing to characterize melt processes on landfast sea ice off the coast of Barrow, Alaska.

HTh3C.4 • 15:15
Non-Local Thermodynamic Equilibrium Emission of the Upper Atmosphere, Raphael Panfili[1]; [1]*Spectral Sciences, Inc., USA.* Atmospheric characterization through an analysis of remotely obtained spectral data requires rapid and robust radiation transport algorithms. This paper highlights spectral radiance and transmission simulations from a line-by-line model which considers the nonlocal thermodynamic equilibrium conditions of the upper atmosphere.

HTh3C.5 • 15:30
Thin Layer Defects Characterization Through Compressive Hyperspectral Imaging, Lukas Klein[1,2], Karel Zidek[2]; [1]*Technical Univ. of Liberec, Czechia;* [2]*Regional Centre for Special Optics and Optoelectronic Systems (TOPTEC), Inst. of Plasma Physics of CAS, Czechia.* Thin-layer stacks can greatly influence the spectral characteristics of the optical element. Any damage to them can influence a precisely designed architecture and change the transmission and reflection. In this work, we characterize delaminations in thin layers using a single-pixel hyperspectral system both in transmission and reflection.

HTh3C.6 • 15:45
Adaptive Hyperspectral Imaging Based on Birefringence Induced Dispersion, Zi-Qing Zhao[1], Jiaqi Song[1], Ling-An Wu[1], Ming-Fei Li[1]; [1]*Inst of Physics,Chinese Acad of Sciences, China.* We present a spectrometer based on a polarization-tunable 100μm thick birefringent polymer filter and a quarter-wave plate. A high spectral resolution of 31 channels at 10nm intervals is obtainable with 1.4nm precision, while a high spatial resolution of 57 lp/mm can be realized. Fabrication and operation are both simple.

0.4 Brussels
14:00 -- 16:00
CTh3D • Quantitative Phase Imaging
Presider: Lars Loetgering; ZEISS Research Microscopy Solutions, Germany

CTh3D.1 • 14:00 (Invited)
Quantitative Zernike Phase-Contrast Microscopy, Chao Zuo[1]; [1]*Nanjing Univ of Science and Technology, China.* We introduce quantitative Zernike phase-contrast microscopy (QZPCM), which transforms classical phase-contrast microscopy into a quantitative phase imaging modality using a programmable LCD condenser for precise illumination control. QZPCM achieves 280 nm spatial resolution, 100 fps imaging speed, ~0.05 rad phase sensitivity, and ~0.006 rad temporal phase noise, enabling high-resolution, high-speed, and highly stable quantitative phase imaging.

CTh3D.2 • 14:30
Quantitative Phase Imaging With Deep Coded Wavefront Sensing, Syed Muhammad Kazim[1], Patrick Müller[1], Ivo Ihrke[1]; [1]*Universität Siegen, Germany.* We present a deep learning-based quantitative phase reconstruction method for coded wavefront sensing. A new dataset is introduced to enable supervised learning. The results demonstrate improved performance on synthetic data and successful generalization to experimental data.

CTh3D.3 • 14:45
Wavelength-Multiplexed Common-Path Self-Reference in-Line Digital Holographic Microscopy System, Tatsuki Tahara[1]; [1]*National Inst of Information & Comm Tech, Japan.* I propose a common-path self-reference in-line digital holographic microscopy system to simultaneously obtain complex amplitude distributions of multiwavelength object waves with a monochrome image sensor. The validity of the proposed system is experimentally confirmed.

CTh3D.4 • 15:00
Fourier Neural Operators and Tailored Dataset Design for Robust FPM Reconstruction, Zavush S. Ataei[1], Guillaume Graciani[1], Bernadette Dorizzi[1], Yaneck Gottesman[1]; [1]*Samovar, Telecom SudParis, Institut Polytechnique de Paris, France.* We propose a physics-informed framework for FPM reconstruction. Lever- aging a Fourier Neural Operator and a spectrally uniform dataset, our continuous function representation achieves resolution-invariant, high-quality recovery with reduced amplitude- phase crosstalk compared to conventional architectures.

CTh3D.5 • 15:15
Fourier Ptychographic Microscopy Under Spherical Illumination Conditions, Mikolaj Rogalski[1], Maksymilian Chlipala[1], Maciej Trusiak[1], Piotr Zdankowski[1]; [1]*Warsaw Univ. of Technology, Poland.* We analyze the impact of illumination wavefront curvature on Fourier ptychographic microscopy. Results show the validity range of conventional plane-wave model and demonstrate accuracy improvement with the spherical-illumination-aware rdFPM formulation.

CTh3D.6 • 15:30
Fast Multi-Slice FPM for Extended-Depth-of-Field QPI of Thick Biological Specimen, Jiasong Sun[1], Anqi Tang[1], Yefeng Shu[1], Chao Zuo[1]; [1]*Nanjing Univ of Science and Technology, China.* We propose a parallel multi-slice FPM framework for efficient extended-depth-of-field quantitative phase imaging of thick samples. Our method achieves ~10 μm depth of field (10×/0.4 NA) using only 12 low-resolution images. Experiments on microlens arrays and living HeLa cells demonstrate accurate phase reconstruction beyond the intrinsic limit.

CTh3D.7 • 15:45
Neural Pupil Engineering for off-Axis Fourier Ptychography, Shuhe Zhang[1], Liangcai Cao[1]; [1]*Tsinghua Univ., China.* We propose neural pupil engineering Fourier ptychography, that dynamically shifts the pupil function position during reconstruction. By optimizing a feature-domain loss function, the proposed method achieves accurate off-axis reconstruction without modeling off-axis propagation.

0.1 London
14:00 -- 15:45
PTh3E • Turbulence Characterization and Modeling
Presider: Dario Perez; Pontificia Univ Catolica de Valparaiso, Chile

PTh3E.1 • 14:00 (Invited)
Optical Turbulence and Land-Atmosphere Interactions, Oscar K. Hartogensis[1]; [1]*Meteorology and Air Quality, Wageningen Univ., Netherlands.* The aim of this contribution is to link concepts from land-atmosphere interactions, notably micro- and boundary layer meteorology, with those from optical sensing through the lens of optical turbulence, following the idea that “noise for one is signal for another.” We present a simple, well mixed boundary layer model that yields robust estimates of Cn2 profiles. Conversely, we show how Cn2 measurements from scintillometers can be used to infer land-atmosphere fluxes for different applications.

PTh3E.2 • 14:30
Modeling Atmospheric Optical Anisotropy From Slowly Varying Temperature Gradients and Isotropic Turbulence, Victor A. Kulikov[1]; [1]*Univ. of Dayton, USA.* Atmospheric optical anisotropy can arise in a physics-based alternative to fit-based spectra. The refractive-index field is modeled as isotropic turbulence superimposed on a slowly varying refractivity term derived from a temperature profile. At 0.5 km, simulations show γ rises from 1.3 to 1.8 as the initial beam size grows from 2 to 20 mm.

PTh3E.3 • 14:45
The Spectrum of Steady, Laser-Driven Convective Flows, Benjamin Akers[1]; [1]*Air Force Inst. of Technology, USA.* It has recently been shown that continuous wave lasers can generate steady, laser-driven convective fluid flows (Lane 2021, Lane 2024). We investigate the stability of these flows, by calculating their spectral data.

PTh3E.4 • 15:00
Amplitude Fluctuation Sensitivity to Outer Scale Turbulence Models in Atmospheric Optical Propagation, Jeremy P. Bos[1]; [1]*Michigan Technological Univ., USA.* Amplitude fluctuation sensitivity to outer scale turbulence model is evaluated in the weak fluctuation regime using Ishimaru's filter function approach. Von Karman, exponential, and finite integral models are compared as functions of propagation distance and outer scale size.

PTh3E.5 • 15:15
Similarity Functions and Turbulence Lapse Rate, Melissa K. Beason[1], Santasri R. Bose-Pillai[1], Laura Slabaugh[1], Steven Fiorino[1], Johnpaul Stolle[1]; [1]*Air Force Inst. of Technology, USA.* Data from three stacked ultrasonic anemometers are used to generate similarity functions at each height. We demonstrate that empirical similarity functions well represent the measured near-surface optical turbulence lapse rate.

PTh3E.6 • 15:30
Beyond Hufnagel--Valley: Estimating High-Resolution Profiles of Optical Turbulence Using Deep Learning, Maximilian Pierzyna[1], Sukanta Basu[2,3], Rudolf Saathof[1]; [1]*Technische Universiteit Delft, Netherlands;* [2]*Atmospheric Sciences Research Center, Univ. at Albany, USA;* [3]*Department of Environmental and Sustainable Engineering, Univ. at Albany, USA.* We present a deep learning model to estimate high-resolution C_n^2 profiles over the Netherlands from low-resolution ERA5 data. Our estimated profiles are more accurate and exhibit more realistic vertical structure than the widely used Hufnagel-Valley model, manifesting particularly in integrated parameters such as r_0, although residual errors remain

0.8 Rome
14:00 -- 15:45
QTh3F • Quantum Engineering with Optical Systems
Presider: Quntao Zhuang; Univ. of Southern California, USA

QTh3F.1 • 14:00 (Invited)
Transduction and Sensing With Quantum Optomechanical Systems, David Vitali[1]; [1]*Universita di Camerino, Italy.* Mechanical resonators can be capacitively coupled to rf/microwave circuits and to optical fields, and they are natural candidates for the transduction of quantum signals. Here we characterize opto-electromechanical setups based on metallized SiN membranes with an on-chip loss shield. They can be used for rf/optical sensing and transduction down to the quantum regime, for exploring the gravitational interaction of quantum objects, and for establishing if gravity must be quantized or not.

QTh3F.2 • 14:30 (Invited)
Chernoff Information Bottleneck for Covert Quantum Target Sensing, Leonardo Banchi[1]; [1]*Universita degli Studi di Firenze, Italy.* Quantum metrology and sensing study quantum advantage in precision at fixed probe energy, yet high-energy classical probes are often simpler for pratical purposes. We introduce a general framework to quantify quantum

advantage in covert sensing scenarios, where detection must be done while avoiding discovery by an adversary and increasing energy unduly facilitates the adversary. We show how entangled photonic probes often representing the only option for secrecy.
Ref. PRL 136, 060801 (2026)

QTh3F.3 • 15:00
Quantum Limit for Phase Estimation Precision in Squeezing-Enhanced Interferometry With a Single-Mode Readout, Dmitri Horoshko[1], Fedor Jelezko[1]; *[1]Universitat Ulm, Germany.* We consider an optical interferometer with coherent light in one input and a squeezed vacuum in another. We calculate quantum Fisher information on the difference phase when only one output mode is measured and show that it coincides with that for the two-mode measurement in the vicinity of the black fringe.

QTh3F.4 • 15:15
Measuring Gravitational Lensing Time Delays With Quantum Information Processing, Zhenning Liu[1], William DeRocco[1], Shiming Gu[3], Emil Khabiboulline[1,2], Soonwon Choi[4], Andrew Childs[1], Anson Hook[1], Alexey Gorshkov[1,2], Daniel Gottesman[1]; *[1]Univ. of Maryland College Park, USA; [2]National Inst. of Standards and Technology, USA; [3]Univ. of British Columbia, Canada; [4]Massachusetts Inst. of Technology, USA.* We propose a novel quantum approach to measuring astrophysical time delays. Our method uses exponentially fewer photons than previous schemes and saturates a provable lower bound. We explore its use both in calibrating optical interferometric telescopes and in making direct mass measurements of ongoing microlensing events.

QTh3F.5 • 15:30
Secure Quantum-Enhanced Measurements on a Network of Sensors, Sean W. Moore[1], Jacob A. Dunningham[2]; *[1]Sorbonne Université, France; [2]MPS, Univ. of Sussex, UK.* A source producing an encoded mixture of separable and entangled states can be used for the private quantum enhanced estimation of functions of remote parameters with minimal shared randomness. The privacy proof uses an optimisation of the information gain using limited data on subsets of the function of parameters.

QTh3F.6 • 15:45
Fault Tolerant Heisenberg-Limited Quantum Sensing, Lorcan Conlon[1,2], Yu-Xin Wang[1,2], Erfan Abbasgholinejad[1,2], Victor Albert[2], Michael Gullans[2], Alexey Gorshkov[1,2]; *[1]Joint Quantum Inst., NIST/ Univ. of Maryland, USA; [2]Joint Center for Quantum Information and Computer Science, NIST/Univ. of Maryland, USA.* Quantum sensors hold great promise for achieving better sensitivity compared to their classical counterparts. Most quantum enhancements in sensing are lost in the presence of noise, errors, or a poorly calibrated system. To get around this, we apply ideas from fault tolerant quantum computing to quantum sensing.

0.9 Athens
14:00 -- 16:00
DTh3G • Frontiers in Holography, Lensless Microscopy, and 3D Computational Imaging
Presider: Rakesh Singh; Indian Inst of Technology (BHU) Varanasi, India

DTh3G.1 • 14:00 (Invited)
Holographic and Lensless Imaging: From Resource-Limited Disease Screening to in-Situ Microplastic Classification, Carlos A. Trujillo[1], Karina Ortega-Sanchez[1,2], Maria Lopera[1,3]; *[1]Universidad EAFIT, Colombia; [2]Universidad Politécnica de Tulancingo, Mexico; [3]Vrije Universiteit Brussel, Belgium.* Holographic imaging and lensless computational imaging are often discussed as separate optical directions, yet both rely on the same principle: encode sample-dependent amplitude/phase signatures. In this contribution, two recent case studies are articulated: deoxygenation-free digital holographic microscopy for sickle-cell disease screening in Colombia, and a submersible single-shot polarimetric off-axis lensless platform for microplastic detection in field-collected water.

DTh3G.2 • 14:30 (Invited)
From Deep-UV Chemical Contrast to Near-IR Scattering Reduction: High-Content Lensless Holographic Microscopy and Tomography on a Standard CMOS Camera, Maciej Trusiak[1]; *[1]Warsaw Univ. of Technology, Poland.* Lensless holography can deliver high-content 2D/3D imaging, yet often lacks intrinsic chemical specificity, and multiple scattering limits performance in thick samples. In this talk, I present a unified lensless framework on a standard CMOS camera spanning deep-UV (~240 nm) to the silicon cutoff (~1100 nm), enabling wide-field UV absorption-based chemical contrast, near-IR complex-field imaging of turbid samples with reduced scattering, and gigavoxel multiple-scattering-aware phase tomography.

DTh3G.3 • 15:00
Spatiotemporally Regularized Inversion for Dynamic Lensless Computational Microscopy, Yunhui Gao[1], Liangcai Cao[1]; *[1]Tsinghua Univ., China.* We present spatiotemporally regularized inversion (STRIVER) as a versatile inverse problem framework for achieving motion-resolved video reconstruction in multi-shot computational microscopy. As an example, we demonstrate STRIVER on high-speed lensless microscopy of freely moving organisms.

DTh3G.4 • 15:15
Single-Shot 3-D Imaging Using Digital Holography, Ganesh D. Petterson[1], James R. Fienup[1]; *[1]Univ. of Rochester, USA.* Using multiplexed digital holography, a depth image of a distant scene is obtained using a single shot. We present simulated results and compare the single-shot approach to the more conventional pilot tone technique.

DTh3G.5 • 15:30
Fringe Stabilizer for Holography Using a CMOS Camera, Emanuel Istrate[1]; *[1]Victoria College, Univ. of Toronto, Canada.* A novel fringe stabilizer is presented, based on a CMOS camera and with reduced parts count, intended for photopolymer holograms. This presentation describes the design, including speckle and noise mitigation, and characterizes its performance.

DTh3G.6 • 15:45
3D Dynamic Microswarm Imaging and Manipulation via Opto-Hydrodynamic Effect, Xing Li[1,2], Liangcai Cao[1], Hongbao Xin[2]; *[1]Tsinghua Univ., China; [2]Jinan Univ., China.* We demonstrate 3D dynamic microswarm imaging and manipulation via opto-hydrodynamic effect. Photothermal gradient-induced Marangoni flow enables real-time 3D visualization of firework-like microswarms with reconfigurable petals, facilitating dynamic tracking and bio-regulation of

microorganisms.

0.5 Paris
16:30 -- 18:15
STh4A • Chips and Metasurfaces I
Presider: Yoonchan Jeong; Seoul National Univ.

STh4A.1 • 16:30 (Invited)
Modular Multiparameter Sensing Using WGM Microresonators Enabled by Hybrid AI Frameworks, Anton Saetchnikov[1]; [1]*Ruhr Universitat Bochum, Germany.* This paper presents a modular optical microresonator-based platform designed for multiparameter sensing. The platform integrates numerous of high-Q microresonators for multiplexed imaging and AI-driven computational techniques to enable study of various physical and biochemical parameters.

STh4A.2 • 17:00
From Near- to mid-Infrared Combining Optomechanics With Self-Mixing Interferometry, Paolo Vezio[1], Chenghong Zhang[1], Francesco Cappelli[1], Iacopo Galli[1], Paolo De Natale[1], Andrea Ottomaniello[2], Alessandro Tredicucci[3], Alessandro Pitanti[3], Jérôme Faist[4], Simone Borri[1], Tecla Gabbrielli[1]; [1]*CNR-INO, Italy;* [2]*IIT, Italy;* [3]*UNIPI, Italy;* [4]*ETH- Zurich, Sweden.* Affordable, compact sensors are emerging as cutting-edge technologies for daily life pivotal applications. We propose here a new self-mixing-based optomechanics system capable of bridging together the near- and mid-infrared spectral regions for communication and sensing applications.

STh4A.3 • 17:15
Microring Quantum Cascade Lasers With Low Dissipation and Mode Control for Sensing, Killian Keller[2,1], Réka-Eszter Vass[1], Alessio Cargioli[1], Mattias Beck[1], David Stark[2,1], Jérôme Faist[1]; [1]*ETH Zurich, Switzerland;* [2]*SCALE Lasers AG, Switzerland.* We demonstrate single-mode, low-dissipation QCLs on a small footprint, with power output of >2 mW. Mode control is demonstrated both with cavity-size scaling and feedback, with SMSR of > 20dB.

STh4A.4 • 17:30
Oblate-Capped TiO2 Metasurfaces for Strain-Tolerant, High-Q Optical Notch Filtering, Santanu Mandal[1], Tapajyoti D. Gupta[1]; [1]*Indian Inst. of Science, India.* We demonstrate a highly tunable, stretchable TiO2 dielectric metasurface notch filter. Utilizing a strain-coupled surface lattice resonance, a 14% biaxial tensile strain shifts the reflection notch by 70 nm while maintaining a high Q-factor.

STh4A.5 • 17:45
Etch-Free Photoluminescence Enhancement of InSe With an Epsilon-Near-Zero TiN Film, Haesung Lee[1,2], Yoonchan Jeong[1,2]; [1]*Department of Electrical and Computer Engineering, Seoul National Univ., Korea (the Republic of);* [2]*Inter-Univ. Semiconductor Research Center, Seoul National Univ., Korea (the Republic of).* We propose an etch-free InSe/TiN ENZ stack for photoluminescence enhancement by coupling the vertical dipole of InSe to the Berreman mode of TiN. TM-TMM optimization gives TiN(30 nm)/Al_2O_3(16 nm)/InSe(12 nm), with estimated PL

enhancement exceeding 10x.

STh4A.6 • 18:00
Sacrificing Organics for Increased Sensitivities - a Novel Fabrication Technique for Inverted Photonic Crystal Slabs?, Fabio A. Kraft[1,2], Jan Schardt[1,2], Markus Köpke[1], Martina Gerken[1,2]; [1]*Christian-Albrechts Universität zu Kiel, Germany;* [2]*Kiel Nano, Surface and Interface Science KiNSiS, Germany.* Photonic crystal slabs (PCS) are powerful platforms for sensing applications. Yet, the extent of their evanescent field determines their sensitivity. We report on a fabrication technique for PCS, which increased the sensitivity three-fold.

0.14 Singapore
16:30 -- 18:30
LTh4B • Combustion and Fire Diagnostics
Presider: Chang Liu; Univ. of Edinburgh, UK

LTh4B.1 • 16:30 (Invited)
Resolving Barriers of Knowledge in Fire Science Using a Suite of Laser Diagnostics, Brian Peterson[1]; [1]*Univ. of Edinburgh, UK.* Flame spread over solid fuels is controlled the by coupling of gas-solid-phase phenomena such as heat transfer, chemical kinetics, fluid mechanics, and flame dynamics. The ability to predict flame spread is poor due to a lack of non-intrusive measurements that resolve the physical/chemical processes that govern flame spread. This work utilizes a suite of spectroscopic laser diagnostics that unpack the coupling of heat transfer and chemical kinetic behaviour between the gas-solid phases.

LTh4B.2 • 17:00
Two-Line Atomic Fluorescence Thermometry: in-Situ Laser Ablation of Gallium Nanoparticle and its Effect on Temperature Measurement, Sonu Kumar[1], Bassam B. Dally[1]; [1]*King Abdullah Univ of Sci & Technology, Saudi Arabia.* The paper reports on the effect of in-situ laser ablation of gallium (Ga) nanoparticles cum excitation via excitation laser on temperature measurements. Temperature fields show negligible deviation of < 20 K.

LTh4B.3 • 17:15
Unsupervised Learning for Multispecies Detection in Combustion Experiments, Mohamed Sy[1], Aamir Farooq[1]; [1]*King Abdullah Univ of Sci & Technology, Saudi Arabia. We present ST-UnblindMix and ST-SIMNet, two unsupervised frameworks for multispecies quantification in shock-tube experiments, enabling reference-free spectral unmixing and unknown interference mitigation during transient n-butane pyrolysis at 1200–1600 K.*

LTh4B.4 • 17:30
Tunable Diode Laser Absorption Tomography in a Flat Flame Burner Using Wavelength Modulation Spectroscopy, Claire Birot[1], Gautier Vilmart[1], Christophe Brossard[1], Aurélien Plyer[1], Frédéric Champagnat[1], Myriam Raybaut[1]; [1]*ONERA, France.* Tunable Diode Laser Absorption Tomography is performed using Wavelength Modulation Spectroscopy in a configuration of 5x10 fan beams around a flat flame burner to obtain water concentration and temperature maps.

LTh4B.5 • 17:45
On the Influence of the Heat Release Rate on Operating Range & NOx Formation in Additively Manufactured Hydrogen Burners, Sebastian Faderl[1,2], Fabian Töpfer[1], Florian J. Bauer[1,2], Stefan Will[1,2]; *[1]Lehrstuhl für Technische Thermodynamik, FAU Erlangen-Nürnberg, Germany; [2]Erlangen Graduate School in Advanced Optical Technologies, FAU, Germany.* Additively manufactured burner nozzles are investigated with respect to stability, flexibility and pollutants using multiple optical diagnostics. These include IR-emission thermometry, OH/CH2O planar laser-induced fluorescence and OH*-chemiluminescence for heat release zones.

LTh4B.6 • 18:00 (Invited)
Thermometry for High Temperature Combustion Processes of Hydrogen, Ammonia and Methane Based on Emission Spectroscopy, Florian J. Bauer[1], Phillipp Braeuer[1], Maurus Bauer[2], Stefan Will[1]; *[1]FAU Erlangen-Nürnberg, Germany; [2]KIT / EBI, Germany.* Emission-spectroscopic thermometry for H2, NH3, and CH4 flames, focusing on near-IR H2O transitions is demonstrated from lab scale flames to a 100kW H2 burner. We further investigate NO/OH/NH chemiluminescence, informing temperature and other field quantities.

0.2 Berlin-0.3 Copenhagen
16:30 -- 18:30
ATh4C • System-level Translation of Techniques to the Field
Presider: Aparajita Bandyopadhyay; Indian Inst. of Technology Delhi, India

ATh4C.1 • 16:30 (Invited)
Raman Spectroscopy Based Chemical Identification Using an Interferometric Spatial Heterodyne Spectrometer System, Jay Giblin[1], Rusha Chatterjee[1]; *[1]Physical Sciences Inc, USA.* This talk demonstrates the use of an interferometric Spatial Heterodyne Raman Spectrometer (SHRS) system for chemical identification. The advantages of SHRS over conventional dispersive slit-based spectrometers are discussed, and representative performance evaluation is presented.

ATh4C.2 • 17:00 (Invited)
Agrifood Applications for Spectral Sensing Using on-Chip Tuneable Lasers, Lex Oosterveld[1], Peter Offermans[1]; *[1]Stichting imec Nederland (OnePlanet Rese, Netherlands.* Use of spectroscopic technologies for real-time process control in agrifood is hampered by its cost and size. We present novel developments of measuring systems based on on-chip tuneable lasers with a small size and low cost.

ATh4C.3 • 17:30
A Dynamic Warping Protocol for a Low-Cost Smartphone Spectrometer Calibration, Edgar E. Salazar[1], Sarah Aranibar[1], Facundo Aliaga[1], Marco De la Fuente[1]; *[1]Universidad Privada Boliviana, USA.* We propose a low-cost smartphone spectrometer calibration protocol adapting Dynamic Time Warping. The algorithm generalizes to arbitrary white LEDs, reducing alignment errors to a validation Mean Squared Error (MSE) of 0.1402 on independent test sources.

ATh4C.4 • 17:45
How Few Optical Channels Does a Natural-Gas Raman Wobbe-Index Sensor Need?, Amine Haboub[1], Brahim Aissa[1]; *[1]HBKU, Hamad bin khalifa Univ., Qatar.* In-line natural-gas quality sensing needs few optical channels, not a full spectrometer. A validation-driven search selects eight narrow Raman windows (16% of the spectrum) matching full-spectrum Wobbe-index accuracy (11.73 vs 11.69 BTU/scf) and beating interval-PLS. The bands cluster into two groups realizable as a few fixed interference filters.

ATh4C.5 • 18:00 (Invited)
Fielded Optical Frequency Combs: Robust Dual-Comb Hardware and Applications, Ryan T. Rhoades[1], Andrew Attar[1], Henry Timmers[1], Kurt Vogel[1], Kevin Knabe[1]; *[1]Vescent Technologies, USA.* The increasing maturity of commercial optical frequency comb sources has expanded accessible performance and robustness. These advances enable practical demonstrations of dual-comb spectroscopy in field environments, using commercially available systems to explore real-world sensing applications.

0.4 Brussels
16:30 -- 18:00
CTh4D • Unconventional Imaging
Presider: Esteban Vera; Pontificia Univ Catolica de Valparaiso, Chile

CTh4D.1 • 16:30
Quantum Limits of Incoherent Imaging, Nicolas J. Deshler[1], Sara Parag Ahire[2], Amit Ashok[1], Saikat Guha[3]; *[1]Univ. of Arizona, USA; [2]Physics, Indian Inst. of Technology Bombay, India; [3]Electrical and Computer Engineering, Univ. of Maryland, USA.* We show that spatial mode sorting followed by photon counting saturates the quantum Fisher information matrix for jointly estimating the mean-photon numbers of multiple thermal emitters, thus constituting a quantum-limited receiver for subdiffraction incoherent imaging.

CTh4D.2 • 16:45
Soft Decoding of Time-of-Flight Multiplexed Readouts From Single--Photon Detector Arrays, Shashwath S. Bharadwaj[1], Vivek K. Goyal[1]; *[1]Boston Univ., USA.* A novel soft decoder resolves ambiguities from multiphoton coincidences in time-of-flight single-photon detector array readouts. This method exploits array geometry to achieve 3 to 8 dB improvement in peak signal-to-noise ratio of reconstructed images over baselines.

CTh4D.3 • 17:00
Enabling Extended Axial Ranges in Ultrafast Topographic Imaging Using Confocal Encoded Search Focal Scan, Mireia Torres Junyent[1], Narcís Vilar[1], Guillem Carles[1], Martí Duocastella[2]; *[1]Sensofar Tech SL, Spain; [2]Univ. of Barcelona, Spain.* Encoded Search Focal Scan enables ultrafast topographic imaging, but its measurement range can be limited by signal decay with increasing depth. We adapt a confocal microscope to achieve long-range measurements while preserving diffraction-limited lateral resolution.

CTh4D.4 • 17:15
Joint Image Reconstruction for a Compact Instrument Combining Interferometric and Focal-Plane Data for Inter-Satellite Observation, Noé Hirschauer[1], Yann Lai-Tim[1], Vincent Michau[1], Laurent Mugnier[1]; *[1]DOTA, ONERA, Université Paris-Saclay, France.* We present a joint MAP reconstruction algorithm for a compact hybrid imager. By coupling PIC-based interferometry with a small telescope, we demonstrate superior image quality and relaxed circuit constraints for inter-satellite observation.

CTh4D.5 • 17:30
Flat Space Fibre Telescope, Erez N. Ribak[1], Tzachi Levin[2]; *[1]Technion Israel Inst. of Technology, Israel; [2]Rafael, Israel.* We construct a telescope made of fibres, spread over a wide aperture, while having a small volume and mass. Sparse small lenses feed equal-length optical fibers, interfering onto a focal plane IR camera.

CTh4D.6 • 17:45
Achieving Atomic-Scale Precision in Optical Metrology by Engineering the Object Environment, Thomas Grant[1], Cheng-Hung Chi[1], Kevin F. MacDonald[1], Nikolay I. Zheludev[1]; *[1]Univ. of Southampton, UK.* Precision in light scattering metrology can be enhanced manifold by designing a target object's environment to control Fisher Information flow. In nanowire localization experiments at λ=640nm, we achieve ~61pm (<λ/10,000) precision using this approach.

CTh4D.7 • 18:00
Hybrid Classical–Quantum Neural Networks for OAM Beam Classification, Gokul Manavalan[1], Shlomi Arnon[1]; *[1]Ben-Gurion Univ. of the Negev, Israel.* We compare classical CNNs and hybrid classical–quantum neural networks (QNNs) for classification of distorted orbital angular momentum (OAM) beams. Results show QNNs achieve competitive accuracy with ~8–9× fewer parameters, particularly in low-resolution scenarios.

0.1 London
16:30 -- 18:15
PTh4E • Wavefront Sensing and Adaptive Optics
Presider: Rudolf Saathof; Technische Universiteit Delft, Netherlands

PTh4E.1 • 16:30 (Invited)
Adaptive Optics for Satellite-to-Ground Laser Communications at NICT in Japan, Yoshihiko Saito[1]; *[1]NICT, Japan.* NICT is advancing adaptive optics technologies for statellite-to-ground laser communications, developing turbulence compensation systems to enhance link stability and performance for future high-capacity optical networks.

PTh4E.2 • 17:00
Laser Propagation System Tunnel Testing Using a Digital-Holographic Wavefront Sensor, Matthew Kalensky[1], Evan Bates[1], Thomas Miletich[3,1], Larry Myers[1], Timothy Bukowski[2,1], Maximilian Rowe[1]; *[1]NAVSEA NSWC Dahlgren Division, USA; [2]Univ. of Notre Dame, USA; [3]AI Signal Research Inc., USA.* We have developed a simple laser propagation system purposed with exploring a variety of beam-control-related research problems. In this

short paper, we introduce the system that we developed as well as discuss preliminary testing results which used the system.

PTh4E.3 • 17:15
Introduction to the Beam Control and Propagation Lab, Mark F. Spencer[1], Justin Barnes[1], Nicolas Malamug[1], Kyle Ettinger[1], Ian Kingsolver[1], Ryan McCrory[1], John Cobes[1], Trevor Owens[1], Mehmetcan Akbulut[1]; [1]*Univ. of Arizona, USA.* We introduce a new laboratory at the Univ. of Arizona within the James C. Wyant College of Optical Sciences. In support, we highlight current projects and recent collaborations, as well as new courses that are enabling groundbreaking results in beam control and propagation.

PTh4E.4 • 17:30 (Invited)
Overcoming Latency in Adaptive Optics With Event-Based Centroiding and Predictive Algorithms, Harshil Dave[1], Mel White[1], Abbie T. Watnik[1]; [1]*US Naval Research Laboratory, USA.* This talk presents recent methods on accelerating wavefront sensing and wavefront correction. We discuss an approach for a closed loop adaptive optics system with an event-based camera and their compatibility with closed loop systems.

PTh4E.5 • 18:00
Branch-Point-Tolerant Adaptive Optics Spatial Resolution Analysis, Matthew Kalensky[1], Matthias Banet[2]; [1]*NAVSEA NSWC Dahlgren Division, USA;* [2]*AFRL, USA.* Scintillation introduces a variety of problems for adaptive-optics (AO) system designers; one of which is the formation of branch points. Recently, researchers experimentally demonstrated a branch-point-tolerant AO approach. Here, we conduct wave-optics simulations to investigate the effect of spatial resolution on the efficacy of this approach.

0.8 Rome
16:30 -- 18:30
QTh4F • Quantum Timekeeping and Interferometry
Presider: Jan Jeske; Fraunhofer IAF, Germany

QTh4F.1 • 16:30 (Invited)
Towards Next Generation Chip-Scale Atomic Clocks Using Photonic Integrated Circuits, Jeremi Januszewicz[1], Euegnio D. Gaetano[1], Ross Cassells[1], Steven Thomson[1], Sean Dyer[2], James P. McGilligan[2], Paul F. Griffin[2], Erling Riis[2], Marc Sorel[1], Douglas J. Paul[1], Kevin F. Gallacher[1]; [1]*Univ. of Glasgow, UK;* [2]*Department of Physics, Univ. of Strathclyde,, UK.* We present a silicon nitride photonic platform tailored for Rubidium atomic sensors. By integrating ultra-narrow linewidth lasers, on-chip polarization control, high-extinction switches, and MEMS vapor cells, we provide the foundational architecture for a next-generation ≤10-litre Rb 2-photon optical clock.

QTh4F.2 • 17:00 (Invited)
Testing Timing Technologies at NPL: Supporting the UK's Quantum Programme, Jacob Tunesi[1]; [1]*National Physical Laboratory (UK), UK.* We will present NPL's new optical frequency metrology capabilities for testing timing and timing-adjacent technologies in support of the UK's Quantum Programme. The underpinning infrastructure will be shown alongside some case

studies with our collaborators.

QTh4F.3 • 17:30
Technology Demonstration of a Quantum Gyroscope for Space Applications, Eszter Szabo[2], Nicolas Manrique[1], Lara Torralbo Campo[1], Edward Necsulescu[2], Henning Heibrok[2], Martin Brinz[1], Francesca Ferrulli[2], Hari Gunasekar[1], Ilya Weis[1], Jorge Luis Saez de Teresa[2], Dimitrij Erbis[1], Marko Schmidt[2]; [1]*Arda Atomics GmbH, Germany;* [2]*Deutsches Zentrum für Luft- und Raumfahrt (DLR), Germany.* QYRO is a Nuclear Magnetic Resonance gyroscope addressing the performance gap between MEMS and fiber optic gyroscopes for space applications. Allan deviation measurements of the prototype demonstrate promising performance, although further optimization is required.

QTh4F.4 • 17:45
Avocet Photonics Module: a CubeSat Payload for in-Orbit Qualification of PICs, Brett Poulsen[1], Stephen Amey[1], Purvaja Karthikeyan[1], Vlad Pac[1], Jayshri Sabarinathan[1]; [1]*The Univ. of Western Ontario, Canada.* We present the Avocet Photonics Module, a CubeSat payload to qualify an active photonic integrated circuit (PIC) assembly with hybrid integrated laser diodes, through future in-orbit operation, establishing spaceflight heritage for optical communication payloads.

QTh4F.5 • 18:00
Two-Photon Doppler-Free Spectroscopy of the 6s6s 1S0 → 6s23s 1S0 Rydberg Transition for Quantum Sensing in Ytterbium, Benjamin D. Hunt[1], Kyle Beloy[1], Roger Brown[1], Tobias Bothwell[1], Harikesh Ranganath[1], Tanner Grogan[1], Andrew Ludlow[1]; [1]*National Inst of Standards & Technology, USA.* We explore the two-photon 6s6s 1S0 → 6s23s 1S0 transition in Yb as a potential two-photon clock. Using configuration interaction theory, we compute relevant Rydberg state properties and demonstrate Doppler-free spectroscopy, estimating a 90 kHz natural linewidth.

QTh4F.6 • 18:15
Precision Timing Control for Interferometric Phase Stability in Quantum Gravimeters for Gravity-Assisted Navigation, Harish K. Rathore[1], Aishik Acharya[1]; [1]*TCG CREST, India.* Gravity-assisted navigation using quantum gravimeters requires stable micro-Gal measurements to resolve spatial gravity variations. Achieving this sensitivity demands precise timing control of measurement cycles and Raman atom interferometry. We present a deterministic timing system enabling navigation-grade quantum gravimeters.

0.9 Athens
16:30 -- 18:15
DTh4G • Frontiers in Quantitative, Tomographic, and Multimodal Microscopy
Presider: Carlos Trujillo; Universidad EAFIT, Colombia

DTh4G.1 • 16:30 (Invited)
Polychromatic Digital Holographic Microscopy for Robust Quantitative Phase Imaging and Disease-Relevant Cellular Phenotyping, Pierre M. Marquet[1,2], Céline Larivière-Loiselle[2], Corentin Soubeiran[2], Paul Parant[2], Mohamed Haouat[2], Emile Rioux-Pellerin[2], François Paquet-

Mercier[2], Gernot Scheerer[1], Carine Ben-Adiba[1], Erik Bélanger[2], Pascal Jourdain[1]; [1]*Center for Psychiatric Neuroscience, Lausanne Univ. Hospital, Switzerland;* [2]*CERVO Center, Université Laval, Canada.* Digital holographic microscopy enables label-free quantitative phase imaging of living cells. We introduce polychromatic DHM to suppress coherent noise, enabling robust extraction of biophysical cellular parameters and dynamic processes from quantitative phase signals, opening the way to label-free high-content screening for disease-relevant cellular phenotyping. We also explore AI-driven virtual implementations.

DTh4G.2 • 17:00 (Invited)
Enhancing the Capabilities of Single-Cell Holotomographic Imaging Flow Cytometry via Artificial Intelligence and Virtual Reality, Pasquale Memmolo[2], Daniele Pirone[1], Giusy Giugliano[1], Vittorio Bianco[1], Lisa Miccio[1], Pietro Ferraro[1]; [1]*Inst. of Applied Sciences and Intelligent Systems "Eduardo Caianiello", Italy;* [2]*Inst. for Microelectronics and Microsystems, Italy.* We report about Holotomographic imaging flow cytometry enhancing single-cell analysis through AI and VR. Topics including advanced 3D cells imaging and inspection, intelligent tomographic processing and single-cell diagnostics, immersive tomographic visualization are described.

DTh4G.3 • 17:30
High-Speed 3D Tomographic Microscopy via Symmetric Multi-GHz Comb Sweep and Fourier Fringe Analysis, Shivam K. Chaubey[1], Souta Miura[2], Rakesh K. Singh[1], Samuel Choi[2]; [1]*Indian Inst of Technology (BHU) Varanasi, India;* [2]*Graduate School of Science and Technology, Niigata Univ., Japan.* We demonstrate high-speed full-field 3D tomographic profiling using symmetric multi-GHz comb spacing sweep combined with Fourier fringe analysis. Absolute surface reconstruction of an IC wafer was achieved using 50 frames within 57.8 ms over a 614-µm depth range.

DTh4G.4 • 17:45
Towards 3D Mueller Matrix Microscopy for Whole-Slide Imaging, Ariel Fernández[1], Roman Demczylo[1], Julia Alonso[1]; [1]*Universidad de la Republica, Uruguay.* We present advances in volumetric visualization for Mueller matrix microscopy. By integrating Fourier-domain processing of multifocus stacks with stereo-matching, our pipeline enables 3D reconstruction of polarimetric parameters across whole-slide samples. This yields high-resolution topographical maps with enhanced polarimetric contrast.

DTh4G.5 • 18:00
Neural Network-Enhanced Quantitative Phase Imaging of Epithelial Cells Using a Custom Built 3D-Printed DHM, Juan M. Llaguno[1], Federico Lecumberry[1], Julia Alonso[1]; [1]*Universidad de la Republica, Uruguay.* We present a custom 3D-printed digital holographic microscope (DHM) enhanced by deep learning for high-fidelity wavefront reconstruction. A two-stage U-Net, trained on synthetic and experimental data, reduces artifacts and background noise, improving phase recovery, morphological analysis, and dry mass quantification in low-cost systems.

Friday, 17 July

0.5 Paris
08:30 -- 10:30
SF1A • Chips and Metasurfaces II & Laser-based Sensors
Presider: Yoonchan Jeong; Seoul National Univ.

SF1A.1 • 08:30 (Invited)
Distributed Brillouin Sensing With Plastic Optical Fibers: Recent Advances and Future Directions, Yosuke Mizuno[1]; [1]*Yokohama National Univ., Japan.* Brillouin scattering in plastic optical fibers (POFs) offers unique possibilities for distributed sensing because of their high strain tolerance, flexibility, and characteristic material responses. However, practical use has been limited by high loss, weak signals, and multimode effects. This invited talk reviews recent progress in POF-based distributed Brillouin sensing, discusses challenges such as large-strain behavior, and considers future directions toward practical sensing systems.

SF1A.2 • 09:00
Single-Molecule Protein Mass Distribution Sensing With High-Q Silicon Nitride Microresonators, Koji Masuda[1,2], Abdullah Alabbadi[3], Pascal Del'Haye[3], Frank Vollmer[1,2]; [1]*Living Systems Inst., Univ. of Exeter, UK;* [2]*Dept. of Physics and Astronomy, Univ. of Exeter, UK;* [3]*Max Planck Inst. for the Science of Light, Germany.* We demonstrate label-free single-molecule detection of IgM antibodies using high-Q silicon nitride microring resonators. Individual binding events are observed as discrete resonance shifts, with a multimodal step-height distribution revealing distinct oligomeric species.

SF1A.3 • 09:15
Photonic Integrated Circuits With Protein Catalyzed Capture Agents for Low Limit of Detection Biosensing, Grace M. McLeod[1], Jennifer M. Morales[1], Alexander Winton[1], Sanchao Liu[1], Matthew Coppock[1], Pak Cho[2], Justin R. Bickford[1]; [1]*US Army Research Laboratory DEVCOM, USA;* [2]*General Technical Services, LLC, USA.* An overview of integrated photonic circuit biosensors and target-specific peptides for the recognition of streptavidin and interleukin-6 in 10% fetal bovine serum from attomolar to nanomolar concentrations.

SF1A.4 • 09:30 (Invited)
Non-Destructive Inspection of Semiconductor Materials and Devices Using Photoconductive THz Near-Field Microprobes, Michael Nagel[1]; [1]*Protemics GmbH, Germany.* This talk introduces photoconductive Terahertz near-field microprobes (PC-NFM) as a transformative, contact-free solution for the non-destructive testing (NDT) and quality assurance of highly complex materials and devices. By capturing evanescent THz fields at sub-wavelength distances, PC-NFMs bypass the fundamental diffraction limit, enabling broadband Terahertz Time-Domain Spectroscopy with micrometer-scale spatial resolution.

SF1A.5 • 10:00
Smartphone-Integrated Optoelectronic Analyzer for Point-of-Care Sickle Cell Anemia Screening, Biplab Nath[1], Neelam Verma[1], Sai Siva Gorthi[1]; [1]*Indian Inst. of Science, India.* A smartphone-integrated dual-LED biochemical analyser for sickle cell anemia screening is demonstrated. Featuring high absorbance linearity (R^2>0.999) and high sensitivity to abnormal

hemoglobin, the portable system demonstrates 98% diagnostic accuracy, validated through multi-centric clinical studies.

SF1A.6 • 10:15
Versatile High-Performance Sensing Platform for Bulk and Surface Analytes Using Accidental Quasi-Bound State in the Continuum in a Symmetric Si_3N_4 Metagrating, Swapnil Khurana[1], Sachin K. Srivastava[1]; [1]*Indian Inst. of Technology Roorkee, India.* A symmetric Si_3N_4 metagrating supporting an accidental quasi-bound state in the continuum has been utilized for creating a versatile platform with high sensitivities, excellent *Q*-factors, and figures of merit for both bulk and surface detection.

0.14 Singapore
08:30 -- 10:30
LF1B • Diagnostics for Reacting Systems and Plasmas
Presider: Brian Peterson; Univ. of Edinburgh, UK

LF1B.1 • 08:30 (Invited)
Luminescence Thermometry of Catalytic Reactions, F T. Rabouw[1]; [1]*Universiteit Utrecht, Netherlands.* This presentation will overview our efforts at luminescence thermometry in complex samples. Even if the sample is non-absorbing, spectral distortions due to scattering and reflections can cause temperature errors of up to 100°C. In catalytic-reactor experiments, we encounter spatially or temporally varying optical properties of the sample environments. I will discuss the experiment design allowing for in-situ calibration of the distortions and correction procedures in the data analysis.

LF1B.2 • 09:00
Gas Thermometry in Iron Flames Using O2-LIF, Giliam van der Wielen[1,2], Calvin Wong[1], Kai Hurks[1], Nico Dam[1,2], Conrad Hessels[1,2]; [1]*Technische Universiteit Eindhoven, Netherlands;* [2]*Eindhoven Inst. for Renewable Energy Systems, Netherlands.* Multi-line excitation oxygen laser induced fluorescence (O_2-LIF) is employed to study iron dust flames. This work outlines the diagnostic approach and presents initial results showcasing the potential of O_2-LIF for line-resolved temperature and concentration measurements.

LF1B.3 • 09:15
N_2 Rotational and Vibrational Temperature Dynamics Monitoring in a Pulsed Non-Equilibrium Plasma Using Hybrid fs/ps-CARS., Michael Scherman[1], Thomas Vazquez[2], Laila Dakroub[1,2], brigitte tretout[1], christophe laux[2], sean McGuire[2]; [1]*Office Natl d'Etudes Rech Aerospatiales, France;* [2]*EM2C, Université Paris-Saclay, France.* Hybrid fs/ps-CARS was used on N_2 Q-branch to measure rotational and vibrational temperatures in a nanosecond repetitively pulsed discharge in air. Strong nonequilibrium was revealed and relaxation dynamics were tracked over a large timescale.

LF1B.4 • 09:30
Insights Into Automotive Fuel Cell Operation Through Raman Spectroscopy of Gas Streams, Bastian W. Rüppel[1,2], Elias Schmauß[1], Johanna Lützenkirchen[1], Katharina Braun[1], Michael Wensing[1,2]; [1]*Professorship for Fluid Systems Technology, Friedrich-Alexander-*

Universität Erlangen-Nürnberg (FAU), Germany; [2]Erlangen Graduate School in Advanced Optical Technologies (SAOT), Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany. A Raman spectroscopy sensor monitored gas compositions inside cathode exhaust and anode recirculation lines during operation of an automotive fuel cell system in real-time. The results support mass balancing and identification of noteworthy processes.

LF1B.5 • 09:45
H-C-N Chemistry in Low-Temperature Molecular Plasmas Revealed by Frequency Comb and Quantum Cascade Laser Absorption Spectroscopy, Ibrahim Sadiek[1], Simona Di Bernardo[3], Uwe Macherius[2], Jean-Pierre H. van Helden[1]; *[1]Faculty of Physics and Astronomy, Ruhr Univ. Bochum, Germany; [2]Leibniz Inst. for Plasma Science and Technology (INP), Germany; [3]Department of Mathematics and Physics, Univ. of Campania "Luigi Vanvitelli", Italy.* We report on the detection and quantification of both hydrogen cyanide (HCN) and hydrogen isocyanide (HNC) isomers in low-temperature molecular plasmas generated from $N_2/H_2/CH_4$ mixtures using quantum cascade laser and frequency comb absorption spectroscopy.

LF1B.6 • 10:00 (Invited)
Advanced Laser Diagnostic Measurements in Plasma Environments, Dan Fries[1]; *[1]Univ. of Kentucky, USA.* Low-temperature and warm plasma facilities are of increasing importance in fundamental physical chemistry studies, the electrification of industrial processes and testing in environments representative of hypersonic atmospheric flight. Progress in the application of Coherent Anti-Stokes Raman Scattering to probe molecular and atomic species has opened new opportunities to characterize these environments and to develop a more detailed understanding of processes at gas-material interfaces.

0.2 Berlin-0.3 Copenhagen
08:30 -- 10:30
JF1C • Turbulence Sensing and Compensation
Presider: Peter Kner; Univ. of Georgia, USA

JF1C.1 • 08:30 (Invited)
Atmospheric Turbulence Profiling Using Adaptive Optics for Free-Space Optical Communications, Florian Quatresooz[1]; *[1]ONERA, France.* Adaptive optics telemetry can be exploited to retrieve atmospheric turbulence profiles along the line of sight during free-space optical communication links. Such information is valuable for real-time performance estimation and enhanced adaptive optics correction. This work details the approach we developed and its application to data acquired with ONERA's optical ground station.

JF1C.2 • 09:00
Simulation-Based Wavefront-Sensor Atmospheric Turbulence Estimation for Uplink Laser Satellite Communications at NICT's KgOGS-1, Yoshimi Rokugawa[2,1], Kenta Sakabe[2], Hideki Takami[2,3], Yoshihiko Saito[2,1]; *[1]Informatics, The Univ. of Electro-Communications, Japan; [2]National Inst. of Information and Communications Technology, Japan; [3]National Astronomical Observatory of Japan, Japan.* NICT aims to achieve bidirectional laser satellite communications exceeding 10 Gbps. For this goal, uplink adaptive optics must account for the

point-ahead angle. This presentation proposes a method to estimate transmit-direction fluctuations from received wavefront information and reports simulation results demonstrating its effectiveness.

JF1C.3 • 09:15
a Real Time Control AO System for SMF Coupling in a FSOC Downlink Channel, Luca Massaro[1], Michele Suman[1], Simone Bregolato[1], Riccardo Mincigrucci[1], Stefano Bonora[2,1]; *[1]Dynamic Optics S.r.l, Italy; [2]CNR-IFN, Italy.* In the context of the European Space Agency (ESA) founded Generic Adaptive Optics Module (GAOM) project, a Woofer-Tweeter AO system with a Real Time Controller for improving SMF coupling efficiency was developed and tested.

JF1C.4 • 09:30
Refractive Adaptive Optics for Beam Wandering Correction on a 270-Meter Urban Free-Space Optical Link, Lorenzo Borsoi[1,2], Antonio Vanzo[3,4], Luca Massaro[2,3], Francesco Basso Basset[5], Alessandro Laneve[6], Paolo Barigelli[6], Gonzalo Garvacho[6], Nicolò Spagnolo[6], Fabio Sciarrino[6], Rinaldo Trotta[6], Stefano Bonora[2,3]; *[1]CISAS Univ. of Padova, Italy; [2]Dynamic Optics srl, Italy; [3]CNR-Inst. of Photonics and Nanotechnology, Italy; [4]DEI, Univ. of Padova, Italy; [5]Dipartimento di Fisica, Politecnico di Milano, Italy; [6]Dipartimento di Fisica, Sapienza Università di Roma, Italy.* We report field measurements of a fully refractive adaptive optics receiver on a 270-meter urban free-space link, demonstrating beam wandering correction and a 2.3x pre-fiber collected power gain over de-collimated operation.

JF1C.5 • 09:45
AO4FEELINGS: Design of a Compact Adaptive Optics Testbench for Satellite Communications and Wide-Field Astronomy, Benjamin A. Gonzalez[1], Rodrigo Muñoz[1], Matteo Pasinetti[2], Andrew Reeves[3], Perrine Lognoné[3], Morgan Gray[2], Nicolas Vedrenne[4], Cyril Petit[4], Pierre L. Mayeur[4], Thierry Fusco[2], Francisco Oyarzun[2], Benoit Neichel[2], Esteban Vera[1]; *[1]PUCV, Chile; [2]Laboratoire d'Astrophysique de Marseille, France; [3]Durham Univ., UK; [4]ONERA, France.* This work presents an adaptive optics bench for satellite-tracking telescope using classical reconstructors, neuronal networks, and novel wavefront sensors to compensate atmospheric turbulence, improve optical link quality, and evaluate real-time correction for future space communications systems.

JF1C.6 • 10:00
Extended Beacon Turbulent Testbed, Jason D. Schmidt[1], Richard Drye[1], Cyril Otieno[2], Jie Qiao[2]; *[1]MZA Associates Corporation, USA; [2]Chester F. Carlson Center for Imaging Science, Rochester Inst.d of Technology, USA.* We present a laboratory system for emulating extended laser beacons in an uplooking geometry. The sources include surrogates for a star, sodium beacon, and Rayleigh beacon. The turbulent path is designed for correct focal anisoplanatism.

JF1C.7 • 10:15
Image-Plane Scintillation From Event-Based Sensing Under Controlled Optical Turbulence, MARCO A. SEPÚLVEDA[1], Pablo A. Garrido[1], Pablo Scherz[1], Dario Perez[1]; *[1]P. UNIVERSIDAD CATÓLICA DE VALPARAÍSO, Chile.* Frame cameras undersample high-frequency scintillation, biasing Cn2 and r0 estimates. Event-based sensors resolve log-irradiance fluctuations at microsecond timescales but lack physical calibration. Cross-calibration

against ultrafast CMOS imaging reveals a power-law relationship that enables accurate retrieval of Cn2 and r0.

0.4 Brussels
09:00 -- 10:30
CF1D • Computational Microscopy and Ptychography
Presider: Maciej Trusiak; Warsaw Univ. of Technology, Poland and Maciej Trusiak, Poland

CF1D.1 • 09:00 (Invited)
Computational Optical Imaging With Physics-Guided Learning and Learned Optical Design, Seung Ah Lee[1]; [1]*Seoul National Univ., Korea (the Republic of).* We present computational imaging methods that jointly optimize optics and reconstruction algorithms by embedding accurate physical models into deep learning. Examples include Fourier ptychographic microscopy and lensless cameras, demonstrating task-specific high-performance imaging and sensing systems.

CF1D.3 • 09:30
High Throughput Material-Resolved Surface Metrology Enabled by Tabletop EUV Reflection Ptychography, Daniel S. Penagos Molina[1,2], Mahmoud Abdelaal[2], Wilhelm Eschen[1,2], Chang Liu[1,2], Leona Licht[1,2], Themistoklis Sidiropoulos[1,2], Robert Klas[2,3], Lars Loetgering[4], Richard Busch[5], Thomas Höche[5], Jens Limpert[2,3], Jan Rothhardt[1,3]; [1]*Helmholtz Inst. Jena, Germany;* [2]*Inst. of Applied Phyisics - FSU Jena, Germany;* [3]*Fraunhofer IOF, Germany;* [4]*Carl Zeiss AG, Germany;* [5]*Fraunhofer IMWS, Germany.* We demonstrate table-top nanoscale material identification from polarization-resolved EUV reflection imaging with record ~100 Mpx/h throughput, a performance level that has so far been exclusive to synchrotron facilities, opening up many new application fields.

CF1D.4 • 09:45
Thin-Sample Limits in Reflection Ptychography: When 2D Models Fail and how to fix Them, Sander Senhorst[1], Stefan Witte[1], Wim Coene[1,2]; [1]*Technische Universiteit Delft, Netherlands;* [2]*ASML Netherlands B.V., Netherlands.* We show that reflection ptychography can fail at much smaller thicknesses than predicted by the theory for transmission ptychography, but manage to recover expected reconstruction contrast and solve for the thickness in a depth-aware model.

CF1D.5 • 10:00
Quantitative Nanoscale Material Mapping Based on EUV Ptychography, Leona Licht[1,2], Wilhelm Eschen[1,2], Chang Liu[1,2], Johannes Reents[2], Daniel S. Penagos Molina[1,2], Themistoklis Sidiropoulos[2], Jens Limpert[2], Jan Rothhardt[1,2]; [1]*GSI Helmholtz für Schwerionenforschung, Germany;* [2]*Friedrich Schiller Universität, Germany.* We present tabletop EUV imaging as a quantitative method for high-resolution material mapping. Demonstrated with both single- and dual-wavelength approaches, it opens new possibilities particularly for the identification of light elements, such as lithium.

CF1D.6 • 10:15
Side-Lobe-Free and Denoised Volumetric Two-Photon Microscopy With Adaptive Reconstruction Method, Xin Dong[1], Minghui Shi[1], Yuanjia Wang[1], Canice C. Yiu[2], Beth W. L. So[1,4], Cora S. W. Lai[1,4], Hongsen He[3], Kenneth K. Y. Wong[1,4]; *[1]Univ. of Hong Kong, Hong Kong; [2]School of Chemical Engineering, Univ. of New South Wales, Australia; [3]Xiamen Univ., China; [4]Advanced Biomedical Instrumentation Centre, Hong Kong.* Bessel-beam-based volumetric two-photon imaging suffers from contrast degradation. We perform a Richardson-Lucy reconstruction method with point-spread-function-adaptive low-pass filtering in numerical simulations to realize side-lobe-free and denoise imaging with a structural similarity index of 0.8061.

0.8 Rome
08:30 -- 10:30
QF1E • Solid-state and Cavity-Enhanced Quantum Sensing Platforms
Presider: Peter Maurer; , USA

QF1E.1 • 08:30 (Invited)
Laser-Cavity-Enhanced Magnetometry With Nitrogen-Vacancy Centres in Diamond, Jan Jeske[1], Florian Schall[1], lukas lindner[1], Yves Rottstaedt[1], Marcel Rattunde[1], Florentin Reiter[1], Rüdiger Quay[1], Roma Bek[2], Alexander Zaitsev[3], Joachim R. Sacher[6], Takeshi Ohshima[4], Andrew Greentree[5]; *[1]Fraunhofer IAF, Germany; [2]21 Semiconductors, Germany; [3]CUNY, USA; [4]QST, Japan; [5]RMIT Univ., Australia; [6]Sacher Lasertechnik GmbH, Germany.* Magnetometry with nitrogen-vacancy (NV) centres in diamond can be significantly enhanced by integrating the NV diamond into an optical laser cavity. We found absorption optically-detected magnetic resonance (ODMR) over the entire wavelength range from ~800nm to 1042nm. Combining the NV diamond with a second gain medium we achieved a regime with 100% optical contrast and strong signal intensity (~16mW) and a 2-3 order of magnitude improvement in sensitivity and/or dynamic range.

QF1E.2 • 09:00 (Invited)
Time-Resolved Materials Science With a Quantum Electrometer in Diamond, Tim Schröder[1,2]; *[1]Humboldt Universität zu Berlin, Germany; [2]Ferdinand-Braun-Institut, Germany.* We present our work on materials science using a quantum electrometer based on an optically active spin defect in diamond with a nonlinear Stark response, enabling MHz-scale temporal resolution and lattice scale local resolution.

QF1E.3 • 09:30
Fisher-Glass Metrology: the Illusion of Average-Certified Quantum Enhancement in Non-Self-Averaging Environments, El Mustapha Mansouri[1], Keigo Arai[1]; *[1]Inst. of Science Tokyo, Japan.* Average quantum Fisher information falsely certifies frozen-disorder quantum sensors. Fisher-glass metrology introduces a quenched-tail certificate and intrinsic repairs, reversing certified rankings by up to 3100 in finite-shot Ramsey sensing with shallow nitrogen-vacancy centers.

QF1E.4 • 09:45
Withdrawn.

QF1E.5 • 10:00
Optical Intracavity Feedback for Boosting Magnetic Sensitivity, Jonas M. Wollenberg[1], Felipe Perona[2], Anil Palaci[1], Hans Wenzel[2], Heike Christopher[2], Andrea Knigge[2], Wolfgang Knolle[3], Julian M. Bopp[1,2], Tim Schröder[1,2]; *[1]Humboldt Universität zu Berlin, Germany; [2]Ferdinand-Braun-Institut (FBH), Germany; [3]Leibniz-Institut fü Oberflächenmodifizierung e.V, Germany.* The principle of laser intracavity absorption spectroscopy is extended to magnetometry with nitrogen-vacancy color centers in diamond. We demonstrate a 180-fold improvement of magnetic sensitivity while measuring a 475-fold enhancement of spin contrast.

QF1E.6 • 10:15
Miniature Scanning Fiber Fabry-Perot Cavity Device Made in a Monolithic Glass Substrate, Antoine Duret[1,2], Jakob Reichel[3,4], Romain Long[3,4], Yves Bellouard[1,2]; *[1]EPFL, Switzerland; [2]Laboratoire Galatea, Switzerland; [3]ENS-PSL, Sorbonne Univ., CNRS, France; [4]Atom Chips Group, Laboratoire Kastler Brossel, France.* We report on a monolithic fiber Fabry-Perot cavity glass substrate made by femtosecond laser manufacturing that achieves finesse exceeding 70'000. It enables sub-micron fiber alignment capabilities and active cavity scanning over one free spectral range.

0.9 Athens
09:00 -- 10:30
DF1F • Emerging Methods in Super-Resolution and 3D Single-Molecule Microscopy
Presider: Carlos Trujillo; Universidad EAFIT, Colombia

DF1F.1 • 09:00 (Invited)
Super-Resolution Microscopy of Limited-Size Objects, Giorgio Adamo[1,2], Taeyong Chang[2], Eng AIk Chan[2], Nikolay I. Zheludev[1]; *[1]Univ. of Southampton, UK; [2]Nanyang Technological Univ., Singapore.* By imaging subwavelength objects with our new microscopy technique, we experimentally demonstrate and explain by Fisher information analysis that a multi-fold enhancement of resolution over the Abbe-Rayleigh limit can be achieved in smaller objects

DF1F.3 • 09:30 (Invited)
SMOLM-LFM : 3D Single-Molecule Orientation Imaging With Light Field Microscopy, Luis Aleman-Castaneda[5], Arturo Vesga[1], Hannah Heil[2], Sam Daly[3,4], Ezra Bruggeman[3], Steven Lee[3], Sophie Brasselet[5], Ricardo Henriques[1]; *[1]Gulbenkian Inst. for Molecular Medicine, Portugal; [2]Clinical Sciences, Division of Infection Medicine, Sweden; [3]Yusuf Hamied Department of Chemistry, Univ. of Cambridge,, UK; [4]Cambridge Inst. for Medical Research, Univ. of Cambridge, UK; [5]Aix Marseille Univ, CNRS, Centrale Med, Institut Fresnel, France.* SMOLM-LFM extends Fourier Light Field Microscopy to jointly estimate single-molecule position and orientation using microlens-based BFP segmentation. It achieves high-throughput, accurate 3D localization, large depth-of-field, and simplified analysis without complex PSF fitting

or additional optical elements.

DF1F.4 • 10:00 (Invited)
Single-Pixel Microscopy: From Compressive Sensing to Wide-Field 2P-Imaging, Samuel I. Zapata Valencia[1], Heberley Tobón[1], Luis Ordóñez[1], Gladys Minguez[1], Jesus Lancis[1], Enrique Tajahuerce[1]; [1]*Universitat Jaume I, Spain.* We review wide-field single-pixel microscopy techniques, from early compressive imaging to recent advances in 2P-microscopy. We focus in an innovative open-source platform developed by our research group, featuring new capabilities for high-performance biomedical imaging.

0.14 Singapore
13:30 -- 15:00
LF3A • Nonreacting Flow Diagnostics
Presider: Paul Danehy; NASA Langley Research Center, USA

LF3A.1 • 13:30 (Invited)
Boundary Layer Transition Imaging on Airfoils Using Carbon Nanotube Temperature-Sensitive Paints, Tsubasa Ikami[1]; [1]*Tohoku Univ., Japan.* Carbon nanotube temperature-sensitive paint (cntTSP) enables global imaging of boundary-layer transition on airfoils. Steady and unsteady low-speed experiments demonstrate quantitative transition detection via temperature-based analysis, highlighting the role of optical surface sensing in aerodynamic diagnostics.

LF3A.2 • 14:00
Single-Camera Tomo-PIV for Confined Flow Measurement Based on Flexible Fiber Bundles and Endoscopic Imaging, Xianghu Dong[1], Wensai WU[1], Linghao Wu[1], Qingchun Lei[1], wei Fan[1]; [1]*Northwestern Polytechnical Univ., China.* The paper presents a tomographic particle image velocimetry (Tomo-PIV) technique based on the integration of flexible fiber bundles and endoscopic optics, enabling a single camera sensor to measure three-dimensional flow field characteristics within confined spaces.

LF3A.3 • 14:15
Characterization of an Over-Expanded Supersonic Hot Air Flow Using Spontaneous Raman Thermometry and FLEET Velocimetry, rosa santagata[1], Clément Pivard[1], Lea Bernardot[1], renaud jalain[1], nicolas lupoglazoff[1], Adrien langenais[1], Michael Scherman[1]; [1]*Office Natl d'Etudes Rech Aerospatiales, France.* Laser-based Raman spectroscopy and FLEET velocimetry were used to retrieve co-located temperature and velocity maps in a Mach 3 over-expanded hot air jet, enabling detailed shock characterization and offering benchmark data for CFD validation.

LF3A.4 • 14:30
Near-Wall Phenomena Associated With Cavitation Bubbles Imaged by Total Internal Reflection Fluorescence, Sebastian Kaiser[1], Fangyi Wang[1]; [1]*Universität Duisburg-Essen, Germany.* Total internal reflection fluorescence (TIRF) imaging was developed into high-frame-rate imaging for visualizing near-wall interface dynamics and shock waves associated with

collapsing laser-induced cavitation bubbles in rhodamine-dyed water.

LF3A.5 • 14:45
Design of a Structured Illumination Measurement System for Lunar Plume-Surface Interactions, Olivia Tyrrell[1], Tylor Takahashi[1], Joshua Weisberger[1], Paul M. Danehy[1]; [1]*NASA Langley Research Center, USA.* A structured dot grid illumination system is under development for an upcoming mission to the lunar south pole. Simulations and laboratory testing were performed to optimize the diffractive optic patterns for the multi-camera photogrammetric measurement system.

0.2 Berlin-0.3 Copenhagen
13:30 -- 14:30
JF3B • Imaging Through the Atmosphere
Presider: Anand Sarma; IISER Thiruvananthapuram, India

JF3B.1 • 13:30
Tilt-Definition Effect in Short-Exposure Turbulence Imaging, Hongyang Wei[1], Hanyu Zhan[1], Jizhou Lai[1]; [1]*Nanjing Univ Aeronautics & Astronautics, China.* We investigate the tilt parameter α in the short-exposure optical transfer function by using split-step wave optics simulations with Z-tilt and G-tilt removal. The resulting α values differ markedly between the two tilt definitions, indicating that the choice of tilt definition has a significant impact on short-exposure imaging simulations.

JF3B.2 • 13:45
Effect of TUrbulence OUter SCale on Short- and Long-EXposure Ray-Traced aTmospheric IMaging, Haoxin Tian[1], Hongyang Wei[1], Hanyu Zhan[1], Jizhou Lai[1]; [1]*Nanjing Univ Aeronautics & Astronautics, China.* We investigate the effect of turbulence outer scale on short-exposure and long-exposure incoherent imaging using ray-tracing simulations. Results across various turbulence strengths show similar overall degradation trends, but the von Kármán model produces reduced image blurring compared to the Kolmogorov spectrum.

JF3B.3 • 14:00
Investigating Image Blur due to Aerosols Using Short- Exposure Modulation Transfer Functions, Santasri R. Bose-Pillai[1], Kevin Keefer[1], Steven Fiorino[1]; [1]*Air Force Inst. of Technology, USA.* Effects of aerosols on image blur was investigated by extracting short-exposure Modulation Transfer Functions (MTFs) from field images. By dividing out the short-exposure turbulence MTF, the aerosol contribution could be analyzed, along with measured aerosol loading.

JF3B.4 • 14:15
Image-Plane Scintillation From Event-Based Intensity Reconstruction for Ground-Layer Turbulence Characterization., Pablo A. Garrido[1], MARCO A. SEPÚLVEDA[1], Eduardo LLantén[1], Darío Pérez[1]; [1]*Pontificia Univ Catolica de Valparaiso, Chile.* Frame-based cameras undersample image-plane scintillation along near-ground paths. Using event-based sensors and continuous intensity reconstruction over a 200 m horizontal link, we recover path-averaged

C_n^2 estimates consistent with colocated sonic anemometer measurements.

0.4 Brussels
13:30 -- 15:30
CF3C • Learning-based Computational Imaging
Presider: Ashley Lyons; Univ. of Glasgow, UK

CF3C.1 • 13:30
Design of a Physics-Inspired Diffractive Optical Element Optimization for Achromatic Extended Depth-of-Field, Exequiel E. Oliva[1], Nelson Díaz[1], Pablo Meza[2], Esteban Vera[1]; *[1]PUCV, Chile; [2]UFRO, Chile.* This work presents a multispectral-aware diffractive optical element design for achromatic extended depth-of-field imaging. By using a physics model based optimization approach, the proposed method achieves a complete spectral fidelity and depth invariance.

CF3C.2 • 13:45
Event-Driven Ptychography: A Threshold-Based Approach to High-Speed Computational Imaging, Aaron Rivera Sanchez[1], Jacob Seifert[2], Augustas Karpavicius[1], Matthias Gouder[3], Stefan Witte[1]; *[1]Technische Universiteit Delft, Netherlands; [2]Utrecht Univ., Netherlands; [3]ARCNL, Netherlands.* We introduce threshold-based event-driven ptychography, replacing frame-based intensity measurements with binary event maps. Simulations and experiments with a Timepix3 detector demonstrate high-quality ptychographic reconstructions with event-triggered data, with reduced data bandwidth and higher acquisition speed.

CF3C.3 • 14:00
Optical Transformations for Removing Background Activity in Event Camera Data, Adrian Stern[1], Raviv Ilani[1]; *[1]Ben-Gurion Univ. of the Negev, Israel.* We review a recently introduced opto-algorithmic background activity removal method for event camera data, achieving outstanding denoising performance. We discuss various spatial encoding transformations that can be used with it.

CF3C.4 • 14:15
Real-World Physical Attacks on Spiking Neural Networks Exploiting the Vulnerabilities of Dynamic Vision Sensors, Adir Hazan[1], Ido Avrahami[1], Adrian Stern[1]; *[1]Ben-Gurion Univ. of the Negev, Israel.* We present a physical attack on dynamic vision sensors, inducing adversarial events via designed light-pulse sequences and fooling spiking neural networks. Simulations and optical experiments reveal high attack success, exposing a robustness gap in neuromorphic vision.

CF3C.5 • 14:30
Deep Learning Based Reconstruction of Degraded Dead Sea Scroll Fragments From Visible-Light Images, Ariel Schwarz[1], Yossef Danan[1], Amir Shemer[1], Nisan Atiya[1], Esther Eshel[2]; *[1]JCE, Israel; [2]Bar-Ilan Univ., Israel.* This study proposes a supervised image-to-image reconstruction method for enhancing degraded manuscript fragments. An attention-residual U-Net trained with reconstruction and structural objectives improves readability and contrast,

approximating professional imaging outputs while preserving authentic textual features.

CF3C.6 • 14:45
Multilayer Optoelectronic Neural Networks for Computational Sensing, Sai Nikhilesh Murty Kottapalli[1,2], Alexander Song[1,2], Zili Yu[3], Steffen Epple[3], Peer Fischer[1,2]; *[1]Micro, Nano and Molecular Systems Group, Max Planck Inst. for Medical Research, Germany; [2]AG Fischer, Inst. for Molecular Systems Engineering and Advanced Materials, Universität Heidelberg, Germany; [3]Inst. for Microelectronics Stuttgart, Germany.* Conventional optical sensors separate front-end signal acquisition from downstream processing, introducing latency and energy inefficiencies. We demonstrate an optoelectronic neural network combining optical interconnects with analog electronic nonlinearities, enabling in-hardware processing and reduced read-in/read-out overhead for sensing.

CF3C.7 • 15:00
Transformer-Based Enhancement for Low-Light Terahertz Focal Plane Imaging, Junfei Cao[1], Zehao He[1,2], Yan Zhang[1,2]; *[1]Department of Physics, Capital Normal Univ., China; [2]Key Laboratory of Terahertz Optoelectronics, Ministry of Education, China.* Current Terahertz sources often have insufficient energy. A learning-based algorithm, called THz-Retinexformer, is proposed to promote the image brightness of Terahertz focal-plane imaging. It serves as an effective tool in low-light Terahertz imaging enhancement.

CF3C.8 • 15:15
Deep Learning Meets Phase Diversity for Single-Shot Robust Imaging Inverse Problem Solutions, Jasleen Birdi[1], Tamal Majumder[1], Debanjan Halder[1], Muskan Kularia[1], Kedar Khare[1]; *[1]Indian Inst. of Technology Delhi, India.* We introduce a deep learning-based data augmentation framework that enhances inverse problem robustness via phase-diversity. We report results for image deblurring and Fourier phase retrieval, achieving superior reconstructions over single-data baselines without additional hardware.

0.8 Rome
13:30 -- 15:00
QF3D • Quantum Enhanced Bio-sensing and Imaging
Presider: Tim Schröder; Humboldt Universität zu Berlin, Germany

QF3D.1 • 13:30 (Invited)
From Diamond Defects to Protein-Based Qubit Sensors, Peter Maurer[1]; *[1]Univ. of Chicago, USA.* Quantum metrology promises ultrasensitive measurements for the life sciences, but practical biological deployment remains challenging. I present strategies combining quantum engineering and molecular biology to create sensors for living systems, including biocompatible diamond sensors, engineered core–shell nanodiamonds, and genetically encodable protein qubits—optically addressable spins in fluorescent proteins with solid-state–like coherence and readout.

QF3D.2 • 14:00 (Invited)
Engineering Protein-Based Quantum Sensors for Bio-Imaging, Sensing and Control, Gabriel Abrahams[1], Ana Štuhec[1], Vincent Spreng[1], Robin Henry[1], Idris Kempf[1],

Jessica James[1], Kirill Sechkar[1], Scott Stacey[1], Vicente Trelles-Fernandez[1], Lewis Antill[4], Christiane Timmel[1], Jack Miller[2], Maria Ingaramo[3], Andrew York[5], Jean-Philippe Tetienne[6], Harrison Steel[1]; *[1]Univ. of Oxford, UK; [2]Aarhus Univ., Denmark; [3]Nonfiction Labs, USA; [4]POSTECH, Korea (the Republic of); [5]Chan Zuckerberg Inst., USA; [6]RMIT, Australia.* MagLOV is a magnetically sensitive fluorescent protein, which exhibits optically detected magnetic resonance (ODMR) in living bacterial cells at room temperature, with signal-to-noise sufficient for single-cell detection. MagLOV unlocks numerous applications, including spatial localization of fluorescence signals using gradient fields, biosensing, multiplexing of bio-imaging, and lock-in detection, mitigating typical biological imaging challenges such as light scattering and autofluorescence.

QF3D.3 • 14:30
Coincidence of Entangled Photon Pairs in Visible Range for Fluorescence Lifetime Measurement, Kesini Chumphuthong[1], Daniele Faccio[1], Ashley Lyons[1]; *[1]School of Physics and Astronomy, Univ. of Glasgow, UK.* We extend fluorescence lifetime detection with entangled photon pairs down to visible wavelengths. The approach allows probing of molecules at the single-photon level using CW lasers, thereby avoiding damage to biological samples within microscopy.

QF3D.4 • 14:45
Hermite–Gaussian Spatial Mode Demultiplexing for Imaging and Spectroscopy in the Single-Photon Regime, Luigi Santamaria Amato[1], Francesco Di Lena[2], Fabrizio Sgobba[3], Danilo Triggiani[4], Cosmo Lupo[4]; *[1]Agenzia Spaziale Italiana, Italy; [2]Inrim, Italy; [3]Univ. of Bari, Italy; [4]Politecnico di Bari, Italy.* We report our experimental results on spatial mode demultiplexing–based imaging in the single-photon regime, a novel “quantum-inspired” super-resolution technique valid also for remote observations. We further extend this technique to the spectroscopy domain.

0.9 Athens
13:30 -- 15:30
DF3E • Optical Sensing and Computational Imaging for Measurement, Reconstruction and Inference
Presider: Yuzuru Takashima; Univ of Arizona, Coll of Opt Sciences, USA

DF3E.1 • 13:30 (Invited)
Separating Partially Coherent Light, Charles Roques-Carmes[1,2]; *[1]Inst. Science & Technology Austria, Austria; [2]Stanford Univ., USA.* Optical fields are naturally described by modes, but extracting those modes usually requires projective tomography. I will present a variational optical processor based on self-configuring Mach–Zehnder interferometer meshes that adaptively separates multimode classical and quantum light into orthogonal components on chip.

DF3E.2 • 14:00
Near-Field Goniophotometer With Neural Radiance Field, Shuhe Zhang[1], Liangcai Cao[1]; *[1]Tsinghua Univ., China.* We proposed the neural near-field goniophotometer (N^{2}FG) that uses neural radiance field for recovering the 3D radiance data of a luminarie collected by a

near-field goniophotometer. The N^{2}FG reduces the amount of data required by over 10-fold, and cuts long-term storage costs by more than 100-fold, all while preserving accuracy.

DF3E.3 • 14:15
Optical Interferometric Imaging of a Pulsed Wave Propagation in Solids for Nondestructive Testing, Nao Sakiyama[1], Naru Yoneda[1,2], Osamu Matoba[1,2]; *[1]Kobe Univ., Japan; [2]Center of Optical Scattering Image Science, Japan.* Ultrasonic nondestructive testing is vital for detecting internal defects in structures, but visualizing pulse propagation in solids is difficult. In this study, high-speed optical interferometric imaging was used to measure ultrasonic pulses in solids. A 100 kHz pulse in glass was successfully captured at 1.1 Mfps.

DF3E.4 • 14:30
DOE-Based Spatial Encoding for Stereo Event Imaging Using a Single Static Event Camera, Adrian Stern[1], Gilad Biton[1]; *[1]Ben-Gurion Univ. of the Negev, Israel.* We propose a DOE-based design for use with a recently introduced method for 3D event imaging. The method is able to capture stereo event data with a single static event camera.

DF3E.5 • 14:45 (Invited)
Spatial Photonic Ising Machines With Enhanced Optimization Performance, Yusuke Ogura[1]; *[1]Univ. of Osaka, Japan.* Spatial photonic Ising machines are free-space optical systems for combinatorial optimization. We present strategies to enhance optimization performance using single-DMD encoding, multiplexing, and image processing, resulting in improved efficiency.

DF3E.6 • 15:15
Ambiguity-Aware Hybrid Graph MLP for Monocular 3D Human Pose Estimation, Lin Nai[1], Chang Liu[1], Huazhen Chen[2], Jun Qiu[1]; *[1]Beijing Info Science & Technology Univ, China; [2]Tianjin Univ., China.* We propose Ambiguity-Aware Hybrid Graph MLP (AHG-MLP) for monocular 3D pose lifting, which adaptively combines static skeletal priors with pose-adaptive relations and integrates graph features through a stable residual design.