International Conference on Applied Physics & Imaging

(ICAPI)

20 - 21 September 2025 | Tartu, Estonia

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Abstract book

ICAPI 2025

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Programme Schedule

ICAPI - 2025 Programme

Day 1: Saturday, September 20, 2025 - Physicum, W. Ostwaldi 1, Tartu, Estonia

09:00 – 09:30	Registration		
Opening Ceremony (A106)			
Opening Talk	**Rector Prof. Toomas Asser**		
(09:30 -09:40)	*University of Tartu, Estonia*		
Introduction	**Prof. Vijayakumar Anand**		
(09:40 – 09:45)	*ERA Chair, CIPHR group, Institute of Physics, University of Tartu, Estonia*		
Welcome Note	**Prof. Indrek Jogi**		
(09:45 – 09:50)	*Deputy Director, Institute of Physics, University of Tartu, Estonia*		
Holography Award	**Dr. Jacob Mackenzie**, *Editor-in-Chief of Applied Physics B, Springer Nature & Professor, University of Southampton, Optoelectronics Research Centre, Southampton, United Kingdom*		
(09:50 – 10:10)	*Introduction & presentation of the Lohmann Holography Award*		
Plenary Talk	**Prof. Joseph Rosen**, *Ben-Gurion University of the Negev, Israel*		
(10:10 – 10:45)	*Advanced imaging tasks using phase-only spatial light modulators*		
Plenary Talk	**Prof. YongKeun (Paul) Park**, *KAIST, South Korea*		
(10:45 – 11:20)	*Holotomography and artificial intelligence: label-free 3D imaging, classification, and inference of live cells, tissues, and organoids*		
11:20 – 11:50	**Coffee break**		
Session	**Session 1 (A101)**	**Session 2 (A111)**	**Session 3 (B103)**
	Quantitative Phase Imaging (I)	**Material Science (I)**	**Structured Light (I)**
	Chair: Prof. Maciej Trusiak	**Chair: Prof. Rainer Pärna**	**Chair: Prof. Rakesh Kumar Singh**
Keynote talk	Prof. Malgorzata Kujawinska	Prof. Gerard Wysocki	Prof. Ibrahim Abdulhalim
(11:50 – 12:20)	*Quantitative Phase Imaging: metrological challenges and opportunities*	*3D chemical plume detection and localisation using UAV-assisted remote laser spectroscopic sensing*	*Liquid Crystal Devices for Photonic Applications: Fast Light Modulation, Imaging, and Energy Saving*
Invited talk	Prof. Natan T. Shaked	Prof. Vambola Kisand	Dr. Ravi Kumar
(12:20 – 12:50)	*Label-free 3D microscopy of highly dynamic biological cells*	*Photocatalytic antimicrobial coatings*	*Generation of Double-ring Perfect Optical Vortex beams by modulating Bessel-Gaussian phase with conical phase and its characteristics*
Invited talk	Prof. Balpreet Singh Ahluwalia	Prof. Marco Kirm	Prof. Shanti Bhattacharya
(12:50 – 13:20)	*Photonic chips microscopy platform: From Fluorescence to Label-Free Nanoscopy*	*Increasing Excellence in Utilizing X-ray Research and Neutron Scattering Techniques at the University of Tartu (EXANST)*	*Modified Bessel Beams and their applications*
13:20 – 13:30	**Group Photo**		
13:30 – 14:20	**Lunch break + Lab tour**		
Session	**Session 4 (A101)**	**Session 5 (A111)**	**Session 6 (B103)**
	Incoherent Holography (I)	**Material Science (II)**	**Structured Light (II)**
	Chair: Prof. Rakesh Kumar Singh	**Chair: Prof. Rainer Pärna**	**Chair: Dr. Ravi Kumar**
Invited talk	Prof. Yasuhiro Awatsuji	Dr. Shree Krishnamoorthy	Prof. Etienne Brasselet
(14:20 – 14:50)	*Parallel image-recording technique for high-speed 3-D imaging of dynamic object*	*Old windows, new light – Physiological biomarkers in the long wavelength near infrared region*	*Agile optical vortex coronagraphy: which future for agility still fragile today?*
Invited talk	Dr. Tatsuki Tahara	Prof. Taavi Repan	Prof. Gangi Reddy Salla

(14:50 – 15:20)	*Multidimension holography with daily-use light*	*Numerical analysis of light propagation in nanostructured black metal samples*	*Extracting spatial modes of light through auto-correlation*
Invited talk	Prof. Takanori Nomura	Prof. Siim Pikker	Dr. Angika Bulbul
(15:20 – 15:50)	*Decoupling depth and wavelength information in color incoherent digital holography*	*High throughput fabrication of Fabry-Pérot type cavities for strong coupling experiments using maskless grayscale UV lithography*	*3D Tracking Comparison of a Refractive vs. a Geometric Phase Plate and Accessing the Fluctuations in Optical Response of Molecules*
Contributed talk	Nao Sakiyama	Tadas Latvys	Prof. Mikhail Belogolovskii (Invited talk, 15:50 – 16:20)
(15:50 – 16:05)	*Sound field measurement by heterodyne digital holography*	*DLIP-Based Fabrication of High-Aspect Ratio Silicon Structures via KOH Etching*	*Transparent Superconductors: Hybridization of Two Quantum Platforms*
Contributed talk	Maria Josef Lopera Acosta	Hsin-Hui Huang	
(16:05– 16:20)	*Practical guide to analog holographic optical element recording and its application in digital lensless holographic microscopy.*	*External Magnetic Field Control of Ultrafast Terahertz Emission from Water Micro-Films*	
16:20 – 16:50	**Coffee break & Networking**		
Session	**Session 7 (A101)**	**Session 8 (A111)**	**Session 9 (B103)**
	Quantitative Phase Imaging (II)	**Incoherent Holography (II)**	**Microscopy and Tomography (I)**
	Chair: Prof. Balpreet Singh Ahluwalia	**Chair: Prof. Joseph Rosen**	**Chair: Dr. Ravi Kumar**
Invited talk	Prof. Osamu Matoba (Keynote talk)	Prof. Tomoyoshi Shimobaba	Prof. Enrique Tajahuerce
(16:50 – 17:20)	*Recent advances in holographic microscopy for neuroscience and biology*	*Hologram generation via deep-learning*	*Single-pixel microscopy: system design, enhancements, and applications*
Invited talk	Prof. Maciej Trusiak	Prof. Yoshio Hayasaki	Prof. Martin Booth
(17:20 – 17:50)	*Less is more: Advancing Large-Scale 2D and 3D Bioimaging with Lensless Digital Holographic Microscopy and Tomography*	*Holographic beam shaping for material fabric processing and volumetric display*	*Information-optimized adaptive optics for biomedical microscopy*
Contributed talk	Daniel Smith	Indre Meskelaite	Mufeeduzaman Chavilkkadan
(17:50 – 18:05)	*Extending 4-Pol Imaging to Skylight and Ocean Wave Analysis*	*Parity-time symmetric waveguide structures for passive and active control of light propagation*	*Topological shaping of light from structured materials*
Contributed talk	Marius Navickas	Manuel Montoya	Uday Pratap Singh Kushwah
(18:05 – 18:20)	*Photo initiator-driven complex formation in SZ2080 photoresist*	*Efficient simulations of partially coherent light using the Generalized Van Cittert-Zernike Schell Propagator*	*First principles studies of ternary hexafluorides as scintillators for medical imaging technologies*
19:00 – 22:00	**Gala dinner @ the Gunpowder Cellar**		
	End of Day 1		

ICAPI - 2025 Programme

Day 2: Sunday, September 21, 2025 - Physicum, W. Ostwaldi 1, Tartu, Estonia			
Opening Session (A106)			
Opening word	**Prof. Dalia Kaškelytė**		
(09:15 – 09:30)	*Director, Vilnius University Laser Research Center (VU LRC), Lithuania*		
Plenary talk	**Prof. Aydogan Ozcan**, *University of California, Los Angeles, CA*		
(09:30 – 10:10)	*Programming Light Diffraction for Information Processing and Computational Imaging*		
Plenary talk	**Prof. Saulius Juodkazis**, *Swinburne University of Technology, Melbourne, Australia*		
(10:10 – 10:50)	*Femtosecond Laser Direct Write: tool of nanomaterials synthesis, lithography, and in situ characterization*		
(10:50 – 11:05)	**Dr. Ayesha Eduljee,** *Editor of Discover Imaging, Springer Nature*		
11:05 – 11:30	**Coffee break**		
Session	**Session 10 (A101)**	**Session 11 (A111)**	**Session 12 (B103)**
	Industry	**Structured Light (III)**	**Microscopy and Tomography (II)**
	Chair: Prof. Shanti Bhattacharya	**Chair: Dr. Darius Gailevičius**	**Chair: Prof. Rakesh Kumar Singh**
Invited talk	Prof. Heli Valtna	Prof. Robert Brunner	Prof. Piotr Zdańkowski
(11:30 – 12:00)	*Science Commercialization Trajectories*	*Nature as Blueprint: Anti-reflective Moth-Eye Principle for Tailored Optical Functionality*	*Common-path grating-based digital holographic microscopy and optical diffraction tomography for biomedical imaging*
Invited talk	Mr. Erik Karlsen (Karl Storz)	Dr. Gabrielius Kontenis	Dr. Gyanendra Sheoran
(12:00 – 12:30)	*Building the Future of Surgical Technology: How Karl Storz is Preparing for the Next Generation of Medical Device R&D*	*Generation of helical intensity beams and pulses for micromachining*	*Depth-Resolved Telecentric Microscopy Using Electrically Tunable Lens and Variable NA Controller*
Invited talk	Mr. Vitalij Glazkov (Light Conversion, 12:30 – 12:45)	Prof. Ahmed H. Dorrah	Dr. Lars Loetgering
(12:30 – 13:00)	*Ultrafast laser systems for scientific applications* Relika Alliksaar Williams *Knowledge Transfer, Science & Innovation at the University of Tartu*	*Volumetric Holography with Structured Light: From Light Sheets to Optimal Communication Modes*	*Ptychography and the principle of reciprocity*
13:00 – 14:00	**Lunch break**		
Session	**Session 13 (A101)**	**Session 14 (A111)**	**Session 15 (B103)**
	Microscopy and Tomography (III)	**Advanced Manufacturing**	**Holography and Microscopy**
	Chair: Prof. Maciej Trusiak	**Chair: Dr. Gabrielius Kontenis**	**Chair: Dr. Tatsuki Tahara**
Invited talk	Dr. Mikolaj Rogalski	Dr. Darius Gailevičius	Prof. Mariana Potcoava
(14:00 – 14:30)	*Hybrid Fourier ptychography and transport of intensity equation phase microscopy*	*Photonic crystals in Laue regime*	*Incoherent Holographic Lattice Light-Sheet Microscopy*

Invited talk	Prof. Rakesh Kumar Singh	Prof. Domas Paipulas	Dr. Egidijus Auksorius
(14:30 – 15:00)	*Polarization-Resolved Wide-Field Microscopy for Live Cell Imaging*	*Direct fabric writing with UV femtosecond pulses: Advancing Diffraction-Based Photonics in Transparent Dielectrics*	*High-Resolution Dynamic Full-Field Optical Coherence Microscopy: Illuminating Intracellular Activity in Deep Tissue*
Invited talk	Dr. Vinoth Balasubramani	Prof. Jyrki Saarinen	Dmytro Danilian **(15:00 – 15:15)**
(15:00 – 15:30)	*Adaptive Optics from Microscopy to Tomography: Illuminating the Brain*	*Rapid prototyping for imaging and beyond – 3D printed centimeter-scale optics*	*Reusable magnetic mixture of CuFe2O4–Fe2O3 and TiO2 for photocatalytic degradation of pesticides in water* Jawahar Desai **(15:15 – 15:30)** *Three-dimensional one-shot imaging for single or multiple in-focus planes*
Contributory talk	Paulius Zakarauskas	Edvinas Aleksandravičius	Yunhui Gao
(15:30 – 15:45)	*Micro processing of sapphire using femtosecond deep UV fabric pulses*	*Fabrication of optical phase elements in bulk sapphire by ultrashort UV pulses*	*Ultra-High-Resolution Computational Wavefront Sensing for Complex Optical Fields*
Contributory talk	Marta Berholts	Aditya Savio Paul	Sai Deepika Sure
(15:45 – 16:00)	*Quantum watch: tracking time without ticks*	*Chaos-Driven Event Characterization*	*Engineering the field of view dynamically with coded aperture imaging*
16:00 – 17:00	**Poster Session and Coffee break**		
Session	**Poster Session (***The Posters will be on display at Physicum Lobby from 10:00 – 18:00***)** **Chair: Dr. Tatsuki Tahara, Prof. Malgorzata Kujawinska, Prof. Enrique Tajahuerce, Prof. Shanti Bhattacharya**		
(16:00 – 17:00)	Samuel I. Zapata-Valencia	Manivel Rajan	Karolis Adomavičius
	Multispectral detection imaging validation for single-pixel microscope	*Luminescence properties and electronic excitations of Cs2HfF6 studied by excitation using 10 keV electrons and VUV photons*	*High-throughput spatio-temporal optical coherence tomography*
	Heberley Tobon	Amit Yadav	Amaljith Chandroth Kalliyadan
	Simultaneous reflection and transmission infrared single-pixel microscopy using adaptive optics and compressive sensing techniques	*Depth imaging through dynamic scattering media by synthetic wavelength*	*Tunable Si-based nano grating for sensing and light modulation applications*
	Francis Gracy Arockiaraj	Elizaveta Dmitrijeva	Austėja Trečiokaitė
	Quantitative Phase Imaging for Imaging through Scattering Media	*Characterisation of Fabry–Pérot resonators fabricated via grayscale UV lithography and their application to the investigation of strongly coupled systems*	*Full-field optical coherence tomography with a digital defocus correction*
	Eulalia Puig I Vilardell	Narmada Joshi	Kaisa Katre Lepmets
	Modeling 5D Information Encoding in I-COACH Using Spiral Phase Masks	*Coded Aperture Imaging with Polarization-Dependent Encoding*	*Fabrication of strongly coupled cavity arrays using grayscale UV litography*
	Tauno Kahro	Erikas Tarvydas	Aadil Shafi Bhat
	Preparation and characterization of diffractive optical lenses by grayscale maskless photolithography	*Dynamic full-field optical coherence microscopy for live tissue imaging*	*In-Pore Formation of Copper Oxide Nanoparticles via In-Situ Encapsulation of Copper Salts in Mesoporous Silica for Advanced Antimicrobial Applications*
	Alessandra Imbrogno	Gregory Oxley	
	Green energy storage: development of sustainable supercapacitors by direct laser writing of natural materials (SUPER-GREEN)	*From Isolated Tools to Organized Discovery: An AI Framework for Classifying Exoplanets by Evolutionary Stage*	

Session	3 MT Thesis competition (A106)		
	Chair: Dr. Jacob Mackenzie, Prof. Dalia Kaškelytė, Relika Alliksaar Williams, Prof. Rainer Pärna, Prof. Yasuhiro Awatsuji		
17:00 – 17:30	Manuel Montoya	Uday Pratap Singh Kushwah	Maria Josef Lopera Acosta
	Harleen Kaur	Nao Sakiyama	Eulalia Puig I Vilardell
	Yunhui Gao	Rajveer Kaur	
Conference Exhibitors (Physicum Lobby, 20-21 Sep 2025)			
10:00 – 18:00	**Light Conversion, Lithuania**	**Difrotec OÜ, Estonia**	**Axioma MS, Lithuania**
	Vitalij Glazkov	Prof. Nikolay Voznesenskiy & Maria Voznesenskaja	Vytautas Narbutas
18:00	**Closing ceremony and best presentation awards (A106)**		

Day 1: Saturday, September 20, 2025

Plenary Talk 1 - Prof. Joseph Rosen, ***Ben-Gurion University of the Negev, Israel***

Speech Title: *Advanced imaging tasks using phase-only spatial light modulators*

Abstract: Phase-only spatial light modulators (SLMs) positioned in the aperture of optical imaging systems can extend the missions of these systems. This review briefly describes the evolution of SLM-aided imaging systems from the well-known Fresnel incoherent correlation holography recorder to the most recent versions of interferenceless coded aperture holography systems.

About the Speaker: Joseph Rosen is the Benjamin H. Swig Professor of Optoelectronics in the School of Electrical and Computer Engineering, Ben-Gurion University of the Negev, Israel. He received his BSc, MSc, and DSc degrees in electrical engineering from the Technion - Israel Institute of Technology. He is a fellow of OPTICA (formerly The Optical Society of America, OSA) and SPIE (The International Society for Optics and Photonics). His research interests include holography, image processing, optical microscopy, diffractive optics, interferometry, biomedical optics, optical computing, and statistical optics. He has coauthored more than 300 scientific journal papers, book chapters, and conference publications.

Plenary Talk2 - Prof. YongKeun (Paul) Park, ***KAIST, South Korea***

Speech Title: *Holotomography and artificial intelligence: label-free 3D imaging, classification, and inference of live cells, tissues, and organoids*

Abstract: Holotomography (HT) is a powerful label-free imaging technique that enables high-resolution, three-dimensional quantitative phase imaging (QPI) of live cells and organoids through the use of refractive index (RI) distributions as intrinsic imaging contrast[1-3]. Similar to X-ray computed tomography, HT acquires multiple two-dimensional holograms of a sample at various illumination angles, from which a 3D RI distribution of the sample is reconstructed by inversely solving the wave equation. By combining label-free and quantitative 3D imaging capabilities of HT with machine learning approaches, there is potential to provide synergistic capabilities in bioimaging and clinical diagnosis. In this presentation, we will discuss the potential benefits and challenges of combining QPI and artificial intelligence (AI) for various aspects of imaging and analysis, including segmentation, classification, and imaging inference[3-6]. We will also highlight recent advances in this field and provide insights on future research directions. Overall, the combination of QPI and AI holds great promise for advancing biomedical imaging and diagnostics.

About the Speaker: YongKeun (Paul) Park is Endowed Chair Professor of Physics at KAIST. He earned a Ph.D. in Medical Science and Medical Engineering from Harvard-MIT Health Science and Technology. Dr. Park's area of research is optics, holography, and biophysics. He has published +160 peer-reviewed papers with +11K citations, including 4 Nat Photon, 4 Nat Comm, 4 PRL, 6 PNAS papers. He is a Fellow of the Optical Society of America (OSA) and the Society of Photo-Optical Instrumentation Engineers (SPIE). He received the Medal of Honour in Science and Technology (President of South Korea) and the JinkiHong Creative Award. Two start-up companies with +60 employees have been created from his research (Tomocube, The.Wave.Talk).

Session 1 (A102) - Quantitative Phase Imaging (I)

Chair: Prof. Maciej Trusiak

Keynote talk - Prof. Malgorzata Kujawinska (11:50 – 12:20)

Speech Title: *Quantitative Phase Imaging: metrological challenges and opportunities*

Abstract: Quantitative Phase Imaging (QPI) refers to a number of label-free 2D and 3D microscopy techniques that provide contrast by quantifying the phase shifts in the wavefront when light propagates through a transparent specimen. QPI has emerged as a powerful tool in advanced biomedical research. . In this talk I will discuss the recent progress and trends in development and applications of QPI systems. This includes improved algorithms and hardware for measurement of scattering objects, combining coherent and incoherent light QPI methods into , multimodal measurement systems, as well as applying AI solutions to support better reconstruction of biophysical parameters of cells and tissues. Emphasis will be given to metrology aspects of 2D and 3D QPI as this problem is most often overlooked in both research and commercial systems. Large variety of phantoms (produced by means of the two-photon polymerization) that strive to mimic biomedical specimens and their interaction with light will be presented, ultimately providing tool for validation and benchmarking a variety of QPI systems. The approach to metrology presented across this work is well-suited for rapidly progressing field of QPI and can be a catalyst for finding new ways of investigating biomedical and engineering specimens.

About the Speaker: Malgorzata Kujawinska, received her PhD degree in Applied Optics from Warsaw University of Technology (WUT), Poland. She is a professor and head of Quantitative Phase Imaging Team at WUT, international expert in applied optics and optical metrology for engineering, biomedical, and cultural heritage applications. She is SPIE and OPTICA Fellow, past SPIE President, recipient of SPIE Chandra S. Vikram Award in Optical Metrology and SPIE Denis Gabor Award in Diffractive Optics.

Invited talk - Prof. Natan T. Shaked (12:20 – 12:50)

Speech Title: *Label-free 3D microscopy of highly dynamic biological cells*

Abstract: Label-free optical imaging employs nondestructive approaches to visualize biomedical samples. It utilizes endogenous intrinsic signals, rather than specific exogenous markers (e.g., fluorescent markers) or genetic modifications. Exogenous labeling or genetic modifications perturbs the natural biological processes, dynamics and response of live cells, degrades the vitality of the sample and might be fatal in longer-term longitudinal studies. Typically, it is not allowed in cases where the cells need to be used for further treatments, such as inspection of drugs on the isolated cells for personalized medicine and treatment or on human sperm cells during in vitro fertilization (IVF). In general, label-free imaging spares the use of expensive labeling agents and is a more general and natural approach than label-based imaging, especially if for cases where specific exogenous markers characterizing the pathology of interest are not known or do not exist. Importantly, label-free imaging provides layers of information typically missed in regular imaging, potentially enabling new medical diagnosis tasks.

About the Speaker: Natan T. Shaked is a Full Professor and the Chair of the Department of Biomedical Engineering at Tel Aviv University, Israel. In 2011, he was a Visiting Assistant Professor in the Department of Biomedical Engineering at Duke University, Durham, North Carolina, USA. Prof. Shaked directs the Optical Microscopy, Nanoscopy and Interferometry (OMNI) research group. The group develops new experimental and analytical tools for 3D label-free imaging of biological cells, with focus on imaging flow cytometry, cancer cells, stem cells and sperm cells. Prof. Shaked is the author of more than 115 refereed journal papers and more than 190 conference papers, and several book chapters, patents, and an edited book on Biomedical Optical Phase Microscopy and Nanoscopy. He is the chair of the SPIE Label-Free Biomedical Imaging and Sensing (LBIS) annual conference in San Francisco, and a Fellow in the SPIE and OPTICA.

Invited talk - Prof. Balpreet Singh Ahluwalia (12:50 – 13:20)

Speech Title: *Photonic chips microscopy platform: From Fluorescence to Label-Free Nanoscopy*

Abstract: To overcome the diffraction limit of conventional optical microscopy, researchers have historically modified the photophysical properties of fluorophores and developed advanced laser engineering techniques. These efforts have significantly enhanced the microscope's optical setup, yet the fundamental sample support—glass slides or coverslips—has largely remained unchanged.

The diffraction limit of an optical microscope is surprased by altering the photophysical properties of the fluorophores and by performing laser beam shaping. The optical microscopy body has gone thorough major improvement, while the sample holder made of glass slide or glass coverslips remained unaltered. In this talk, an overview of photonic chip-based multi-modal super-resolution microscopy is presented. Instead of a glass coverslips, the sample is seeded directly on top of an optical waveguide, (photonic-chip), that delivers the evanescent field illumination directly to the sample via total internal reflection (TIR). The core of chip is made of high-refractive index material ensuring excellent optical sectioning via ultra-thin (decay <50nm), ultra-large and clean TIR illumination over entire length of the chip (centimeter scale) and supports broad spectral range. The photonic-chip based microscopy not only reduces the footprint, and complexity but enables integration of different microscopy platforms such as on-chip single molecule localization optical microscopy (SMLM) [1], on-chip TIRF-structured illumination microscopy (TIRF-SIM) [2], light intensity fluctuation based optical super-resolution microscopy [3] and its compatibility with correlative light-electron microscopy [4]. The chip-based SMLM enabled super-resolved images over millimetre field-of-view scale; a 100-fold increase in imaging area as compared to conventional SMLM platforms, thus opening the opportunities of high-throughput optical nanoscopy. The compatibility of photonic-chip for different biological applications have been demonstrated on living (5) and delicate cells such as neurons (6). Similarly, the photonic-chip withstands standard preparation protocols of histopathology (7). This makes photonic-chip optical microscopy an attractive platform for application looking for scanning large areas with super-resolution and ultra-high contrast.

In this talk, I will also present, recent development of harnessing dark-field alike TIR-illumination from a photonic-chip for label-free superior contrast imaging (8) and label-free super-resolution imaging (9) of nanosized extra-cellular vesciles and tissue sections. By exploiting the photoluminence of the silicon nitride waveguide platform in tandem with the autofluoroscence of tissue sections, we proposed novel incoherent label-free super-resolution optical microscopy.

About the Speaker: Balpreet Singh Ahluwalia is Professor at the Department of Physics and Technology, UiT The Arctic University of Norway and Professor at the Department of Physics, University of Oslo, Norway.. He is also affiliated with Department of Clinical Sciences, Intervention and Technology (CLINTEC), Karolinska Institute in Sweden. Ahluwalia has PhD in Electrical Engineering (majored in photonics) from Nanyang Technological University, Singapore in 2007.

Ahluwalia leads a cross-disciplinary advanced microscopy and photonics research group that focus on the development of photonics technologies, such as optical microscopy, spectroscopy and lab-on-a-chip platforms for biological and life science applications. His group operates at the cross-roads of physics and life sciences working closely in several physiologically and clinically relevant bio-applications such as fishery sciences, cancer, AMR, perinatology and pathology. Ahluwalia holds several international patents and is a co-founder of university spin-offs. He has led many national and international cross-disciplinary research projects funded by Research Council of Norway and European Union projects, including ERCs/ EICs.

Session 2 (A111) - Material Science (I)

Chair: Prof. Rainer Pärna

Keynote talk - Prof. Gerard Wysocki (11:50 – 12:20)

Speech Title: *3D chemical plume detection and localization using UAV-assisted remote laser spectroscopic sensing*

Abstract: Fast detection and the ability to locate the sources of volatile chemicals play a critical role in a variety of high priority sensing applications. Predicting 3D trace-gas flow in environmental chemical sensing applications, detecting emissions from plants or localized emissions of pesticides in agriculture, identifying dangerous emissions or gas spills, and assuring safety of first responders require versatile 3D chemical sensing and localization technology. We have already demonstrated and field-tested a set of techniques based on stand-off, open-path laser spectroscopic sensors with a capability of actively tracking a mobile retroreflector mounted on a UAV (a drone, or any other vehicle) that enabled tomographic-like reconstruction of trace-gas plumes. The early technology leveraged a single-frequency semiconductor laser tuned to a methane transition and it enabled methane plume source location to within 1 m as well as estimation of emission rates to within ± 30%. Unlike other localization approaches reported in the literature utilizing drones carrying point trace-gas sensors, the stand-off drone techniques are not restricted by the payload limits imposing severe constrains on the quality of point-sensors used. In the next development stage of this UAV-assisted remote sensing technology, we address the challenging problem of detecting, localizing and quantifying emissions of a multi-chemical gas plumes. To achieve sensitive multi-chemical detection we leverage a novel dual-comb spectroscopic (DCS) sensor platform based on chip-scale semiconductor quantum cascade laser frequency combs (QCL-FCs) operating in the mid-infrared (mid-IR) molecular fingerprint spectral region. This UAV-assisted multi-chemical trace-gas plume detection technology has a potential to enable three-dimensional (3D) tomographic plume localization of many chemicals simultaneously. In this talk, he will present drone-assisted stand-off spectroscopic 3D chemical plume detection using both single-frequency semiconductor lasers as well as mid-IR QCL-FCs coupled with drone-assisted plume reconstruction techniques to localize and estimate the flow rate of chemical leaks. A variety of controlled laboratory experiments and field tests will be presented, and recent progress and outlook for this sensing technology with potential real-world applications will be discussed**.**

About the Speaker: Gerard Wysocki is a Professor of Electrical and Computer Engineering at Princeton University. He received his PhD degree in physics in 2003 from Johannes Kepler University in Linz, Austria. Since 2008 he leads his Princeton University Laser Sensing (PULSe) research group in the areas of tunable mid-IR/THz lasers and applied spectroscopy. Wysocki conducts research that spans developments of modern mid-IR/THz laser sources, ultra-sensitive optical sensing techniques, advanced signal processing, and fundamental light-matter interactions. He pioneered 3D tomographic hard target LIDAR systems based on new molecular dispersion spectroscopy techniques, developed mid-IR remote spectroscopic detection and hyperspectral imaging systems based on frequency combs. For his scientific contributions and technical innovations Wysocki has received multiple awards including the NSF CAREER Award, the Masao Horiba Award for contributions to analytical science, and the Peter Werle Early Career Scientist Award. He is a Fellow of Optica (former OSA), and a member of APS, and SPIE. He also serves as an Associate Editor of Optica, and Co-editor of Applied Physics B.

Invited talk - Prof. Vambola Kisand (12:20 – 12:50)

Speech Title: *Photocatalytic antimicrobial coatings*

Abstract: High-touch surfaces are recognized as a significant source of infectious disease outbreaks. Copper, along with silver, belongs to the most widely used class of antimicrobial surfaces, where antimicrobial agents are continuously released from coatings. A drawback of these surfaces is the accumulation of fingerprint residues, dirt, and dead bacterial matter, which can block the active surface and impede the release of metal ions. This issue could be addressed by using reactive, in-situ photocatalytic surfaces. In addition to killing bacteria, such surfaces also facilitate the photooxidation of bacterial debris and organic contaminants. The mechanism of photocatalytic oxidation—and consequently, antibacterial activity—involves the production of reactive oxygen species (ROS). ROS production begins when a photocatalyst (such as TiO_2 or ZnO) absorbs high-energy photons, resulting in the excitation of electrons from the valence band to the conduction band. This talk discusses various aspects of the mechanism of action of photocatalytic antimicrobial coatings.

About the Speaker: Vambola Kisand is a Professor of Materials Science and Head of the Laboratory of X-Ray Spectroscopy at the Institute of Physics, University of Tartu. He obtained his PhD degree in 2001 at the University of Hamburg, with a thesis entitled „Creation of Free Excitons in Solid Krypton Investigated by Time-Resolved Luminescence Spectroscopy." Prof. Kisand has 25 years of international experience in materials science and physics, specializing in nanoparticles and antimicrobial coatings, nanostructured thin films, photocatalytic compounds, VUV and X-ray synchrotron spectroscopy, etc. He has published more than 170 articles in peer-reviewed journals. He also has experience in academia-industry cooperation, having served as CEO and as a member of the supervisory board of the Estonian Nanotechnology Competence Center.

Invited talk - Prof. Marco Kirm (12:50 – 13:20)

Speech Title: *Increasing Excellence in Utilizing X-ray Research and Neutron Scattering Techniques at the University of Tartu (EXANST)*

Abstract: Twinning project EXANST, "Increasing Excellence in Utilizing X-ray Research and Neutron Scattering Techniques at the University of Tartu (UTARTU)" launched a year ago, is aimed for further raising the research profile of UTARTU in the field of materials science, by enabling researchers from UTARTU to take full advantage of the best European large-scale facilities for materials' characterization using the X-ray research and neutron scattering techniques. To extract as much as possible information from high-quality experimental data the complementary computational methods for materials' modelling and analyzing the data will be advanced. To achieve these objectives, UTARTU teams up with three advanced partners: MAX IV Lab (Sweden) in synchrotron science, Forschungszentrum Jülich (Germany) in neutron science, and Imperial College London (UK) in materials' modelling. Joint pilot research projects focus on the following topics: (i) solid-electrolyte-interfaces formed in energy storage devices based on ionic liquids, (ii) photoactive proteins that can serve as optical switches or tuneable fluorescence markers, and (iii) scintillator materials for radiation detection devices. For the study of ultrafast relaxation processes in scintillators (iii) an advance end station for luminescence kinetics studies (28 ps time resolution under the pulsed X-ray excitation) has been developed jointly at the FemtoMAX beamline by MAX IV and UTARTU staff. The first experimental results obtained in 2025 on sub-nanosecond ultrafast emissions in wide gap materials will be presented. Also, the achievements of other research topics (i, ii) will be discussed. EXANST will contribute to the growth of research community using synchrotron and neutron radiation in academia, at industrial partners and technology developers in Estonia.

About the Speaker: Marco Kirm is an Estonian physicist, professor of experimental physics at the University of Tartu, and a member of the Estonian Academy of Sciences (since 2018). Kirm has worked as a senior researcher at the Institute of Physics of the University of Tartu and as a fast-channel researcher at the Institute of Experimental Physics of the University of Hamburg. From 2004 to 2009, he was the Research Director of the Institute of Physics of the University of Tartu, and from 2009 to 2012, he was the Director. From 17 July 2012 to 30 June 2017, Marco Kirm was the Vice-Rector for Research of the University of Tartu. He is the Estonian representative in the European Synchrotron Radiation Users Organization (ESUO). His research interests include the electronic, optical and luminescent properties of solids (insulator materials) with a wide band gap and their various applications. The realization of broad scientific interests in both fundamental research and applied problems in physics and materials science has encouraged him to use various spectroscopy methods in conjunction with modern short-wavelength light sources based on contemporary scientific and technological achievements, such as synchrotrons, free electron lasers, and powerful laser systems with ultrashort femtosecond (fs) pulses. He has published over 300 scientific publications.

Session 3 (B103) - Structured Light (I)

Chair: Prof. Rakesh Kumar Singh

Keynote talk - Prof. Ibrahim Abdulhalim (11:50 – 12:20)

Speech Title: *Liquid Crystal Devices for Photonic Applications: Fast Light Modulation, Imaging, and Energy Saving*

Abstract: Several photonic non-display applications of liquid crystals require higher performance in terms of speed, wide tunability, and high contrast. However, achieving both fast response times and strong electro-optic effects is inherently challenging, as these two characteristics typically compete against each other—a limitation rooted in the linear response theorem. We have been developing several strategies to mitigate the problem lately: (i) tailored design to the specific application, (ii) combining LCs with metasurfaces, (iii) designing nanocavity resonant structures where the optical field is concentrated in a region where the LC responds faster to external perturbations. I will present the concepts and performance of several devices we have developed, which are suitable for fast spectral imaging, interferometric imaging, fast polarimetric imaging, optical telecommunications, smart windows for energy saving, and integrated photonics.

About the Speaker: Ibrahim Abdulhalim has been a Professor of Electrooptics and Photonics Engineering at Ben-Gurion University since 2005, where he also served as the Head of the Department from 2007 to 2015. He has held positions at several academic institutions and companies, including the OCSC at UC Boulder, the ORC at Southampton University, the Thin Films Center at the University of Western Scotland, KLA-Tencor, Nova, and GWS Photonics. His current research focuses on liquid crystal devices for photonic applications, tunable nanophotonic metamaterials for biosensing and energy conservation, and optical imaging. He has published over 300 articles, authored two books, contributed 13 book chapters, and holds 25 granted patents. Abdulhalim is a Fellow of the Institute of Physics (IoP) and SPIE, a Senior Member of OPTICA, and a member of the International Liquid Crystal Society (ILCS). He has served on the editorial boards of several journals and is currently an Associate Editor for the *Journals of Sensors and Biosensors* and a Topical Editor for *Applied Optics*. Abdulhalim has supervised over 50 graduate students throughout his career, including M.Sc., Ph.D., and postdoctoral researchers. He is also the founder of two companies: Photonicsys, specializing in miniature plasmonic sensors, and Photoliqsys, which develops advanced liquid crystal devices.

Invited talk - Dr. Ravi Kumar (12:20 – 12:50)

Speech Title: *Generation of Double-ring Perfect Optical Vortex beams by modulating Bessel-Gaussian phase with conical phase and its characteristics*

Abstract: Optical vortices have gained significant attention due to their potential to carry a well-defined orbital angular momentum (OAM) [1]. The size of these vortex beams depends on the embedded topological charge (TC), which limits their efficiency for several applications. To address this limitation, Ostrovsky and his co-workers introduced the concept of Perfect Optical vortex (POV) beams [2]. These POV beams exhibit a TC independent annular intensity profile. Later, Vaity et al demonstrated that these POV beams are the Fourier transform of the Bessel Gaussian (BG) beams [3], enabling a simpler generation method and resolving long-standing uncertainty by fulfilling the demand for a vortex beam immune to TC. Leveraging this concept, researchers produced a double-ring POV beams via the Fourier transform of azimuthally polarized BG beams [4]. The azimuthal polarization decomposes into right- and left-circularly polarized components with shifted TCs, yielding two concentric rings of identical intensity but different radii. Since optical vortices are renowned for their ability to trap particles, a double-ring POV can trap particles in the region between the two rings. However, this method lacks any parameter to control the spacing between two rings and requires precise polarization control,

complicating its implementation. To address this, here, we introduce and demonstrate a novel approach for generating double-ring POV beams by modifying the phase of a Bessel-Gaussian beam with a conical phase. Through both theoretical analysis and experimental validation, we demonstrate precise, independent control over the ring's radius and the spacing between the two rings, enhancing their versatility across a range of applications.

About the Speaker: Dr. Kumar is an Assistant Professor at the Department of Physics, SRM University-AP, Andhra Pradesh, India. He received his master's and PhD degree in Physics from IIT(ISM) Dhanbad in 2015 and June 2018, respectively. Before joining SRM-AP, he was a Postdoctoral Research Fellow at Electro-optics Laboratory, Ben-Gurion University of the Negev, Israel for two years (2020-2022). Prior to that, he was a postdoctoral research fellow at Smart Computational Imaging Laboratory, Nanjing University of Science and Technology, China, for one year (2019-2020) and National University of Singapore (NUS), Singapore for one year (2018-2019). He is a member of OPTICA (formerly OSA) and life fellow member of Optical society of India. He has authored or co-authored more than 50 papers in various international journals. His research interests include optical image encryption, digital holography, computational imaging, structured light beams, and biomedical optics.

Invited talk - Prof. Shanti Bhattacharya (12:50 – 13:20)

Speech Title: *Modified Bessel Beams and their applications*

Abstract: Bessel beams are well known for their diffraction-free and self-healing nature. These properties make them useful in a variety of applications. Bessel beams do however, have some characteristics that impact performance, such as a variation of the intensity of the beam along the axis and the presence of strong sidelobes. In this talk, a brief introduction to Bessel beams will be made. This will be followed by a discussion on how phase elements can be used to overcome these problems. While spatial light modulators are useful tools for creating such phase variations, in our group we study ways to design and fabricate suitable diffractive and meta-optical elements for this and other purposes. Imaging of biological samples, obtained using multiplexed Bessel beams, will be presented.

About the Speaker: Shanti Bhattacharya obtained her PhD in Physics from the Indian Institute of Technology, Madras, in 1997. She was awarded the Alexander von Humboldt award in 1998 and worked at the Technical University of Darmstadt, Germany, for several years. She subsequently joined Analog Devices, Cambridge, USA, where she worked as a design engineer. She is currently a professor at and head of the Department of Electrical Engineering, IIT Madras. She has served on the board of OSA (now called Optica) and is currently an Associate Editor of Optical Engineering and the Journal of Optical Microsystems. Her current research interests are meta and diffractive optics, and studies relating to imaging techniques.

Session 4 (A102) - Incoherent Holography (I)

Chair: Prof. Rakesh Kumar Singh

Invited talk - Prof. Yasuhiro Awatsuji (14:20 – 14:50)

Speech Title: *Parallel image-recording technique for high-speed 3-D imaging of dynamic object*

Abstract: The authors review the recent advances of the parallel phase-shifting digital holography (P-PSDH) and the parallel transport of transport-of-intensity equation (P-TIE). To obtain complex amplitude images, it is generally necessary to record multiple images. Both P-PSDH and P-TIE, on the other hand, record these multiple images in parallel. Three-dimensional (3D) imaging of refractive index distribution of dynamic gas flow and the 3D imaging of the temperature distribution of heated air have been demonstrated by P-PPSD. Furthermore, movies of sound wave propagation with 100,000 frames per second (fps) have been obtained. Also, high-speed multiplane imaging and quantitative phase imaging of dynamic air induced by air discharge was demonstrated by P-TIE using incoherent light. In both techniques, complex amplitude images are recorded at 1,000,000 fps each.

About the Speaker: Yasuhiro Awatsuji received the BE, ME and DE degrees in applied physics from Osaka University, in 1992, 1994 and 1997, respectively. He has been a Professor with Faculty of Electrical Engineering and Electronics, Kyoto Institute of Technology since 2014. His research interests are in the area of information optics with emphasis on holography. He is also interested in the area of 3D display, 3D measurement, quantitative phase imaging, microscopy, visualization of invisible objects, high-speed imaging, and ultrafast imaging. He is a senior member of Optica and SPIE.

Invited talk - Dr. Tatsuki Tahara (14:50 – 15:20)

Speech Title: *Multidimension holography with daily-use light*

Abstract: We present digital holography techniques with daily-use light in which multidimensional information such as three-dimensional (3D) space, time, phase, and wavelength are obtained as speckleless holograms. Exploiting self-interference incoherent digital holography, single-shot phase-shifting interferometry, and a polarimetric image sensor, we have proposed fully-passive single-shot full-color digital holography, developed portable natural-light digital holography systems, and performed natural-light full-color digital motion-picture holographic imaging. We also developed speckleless holography in which self-reference holography, a commercially available light-emitting diode, and the designed coded phase aperture are utilized for quantitative phase imaging of transparent objects in 3D space. We show these digital holography techniques and experimental results obtained with the holography techniques.

About the Speaker: Dr. Tatsuki Tahara received the B.E., M.E., and D.E. degrees in electronics and information science from Kyoto Institute of Technology, Kyoto, Japan, in 2007, 2009, and 2013, respectively. He was a Research Fellow with Japan Society for the Promotion of Science (JSPS), from 2011 to 2013; an Assistant Professor with the Faculty of Engineering Science, Kansai University, Osaka, Japan, from 2013 to 2018; a Specially-Appointed Associated Professor with the National Institute of Informatics (NII), Tokyo, Japan, from 2018 to 2019; and a Researcher with Precursory Research for Embryonic Science and Technology (PRESTO), Japan Science and Technology Agency (JST), from 2016 to 2020. He was also a Researcher with the National Institute of Information and Communications Technology (NICT), Tokyo, from 2019 to 2021, where he has been a Senior Researcher, since 2021. His research interests include incoherent digital holography, fully-passive natural-light holography, phase-shifting interferometry, digital holography, and development of digital holography apparatus. He was a Topical Editor of *Applied Optics (OPTICA)* from 2017 to 2023. He is an editorial board of *Journal of Optics (IOP Publishing)* since 2021.

Invited talk - Prof. Takanori Nomura (15:20 – 15:50)

Speech Title: *Decoupling depth and wavelength information in color incoherent digital holography*

Abstract: Color incoherent digital holography is a technique that enables the acquisition of three-dimensional spatial information of color objects. However, if this technique employs a monochrome image sensor, it requires capturing holograms separately for each wavelength, making it unsuitable for dynamic color objects. To reconstruct images of dynamic color objects, it is necessary to capture holograms of all wavelengths simultaneously. In such cases, however, reconstructed images at different wavelengths overlap, resulting in unwanted wavelength components appearing in the reconstructed image for the desired wavelength. This leads to a new problem: it becomes difficult to separate wavelength information from depth information. To address this issue, a method is proposed in which two reconstructed images are obtained under different conditions, and the inner product between these images is used to suppress the undesired wavelength components. The effectiveness of the proposed method is demonstrated through a proof-of-principle optical experiment.

About the Speaker: Takanori Nomura is a professor and the executive director at Wakayama University, Japan. He received his B.E. and M.E. degrees in Applied Physics from Osaka University in 1986 and 1988, respectively, and his Ph.D. in Applied Physics from the same university in 1991. From 1991 to 1995, he was a research associate at Kobe University, Japan. Since 1995, he has been with Wakayama University. Dr. Nomura has over 35 years of experience in the field of optics. He has made significant contributions to information optics, particularly in digital holography, computational imaging, optical data storage, and optical information security. He has authored more than 100 journal articles and conference papers in these areas. His current research interests include 3D image sensing, information optics, computational imaging, and digital optics. He is a Fellow of SPIE and OPTICA.

Contributed talk - Nao Sakiyama (15:50 – 16:05)

Speech Title: *Sound field measurement by heterodyne digital holography*

Abstract: Visualization of sound fields gives us new information for defect detection and the development of acoustic devices such as ultrasonic medical equipment. Digital holography enables noninvasive observation of sound fields by measuring the phase modulation of light induced by acoustic pressure. However, conventional digital holographic techniques require high-speed image acquisition to satisfy the sampling theorem, leading to increased system costs and a reduced field of view (FOV) due to limitations in image sensor memory and readout speed. We have proposed a method to increase FOV and restore the frequency of sound field even in undersampling frame rate by determining the frequency of sound wave from the wavelength of visualized sound field [1].

Heterodyne holography [2, 3] can record the sound field by decreasing the recording frame rate by frequency down-shift between the object and reference beams using optical modulators, such as acousto-optic modulators (AOMs) and piezoelectric devices. This technique allows the detection of high-frequency acoustic fields beyond the frame rate of the sensor by utilizing beat signals.

In this presentation, we demonstrate the successful reconstruction of sound fields that were previously unmeasurable due to frame rate limitations, highlighting the advantages of heterodyne digital holography over conventional methods.

About the Speaker: Graduate School of System Informatics, Department of System Science, Kobe University

Contributed talk - Maria Josef Lopera Acosta (16:05– 16:20)

Speech Title: *Practical guide to analog holographic optical element recording and its application in digital lensless holographic microscopy*

Abstract: Holography, originally developed by Dennis Gabor in 1948, was conceived as a technique to record the complete complex wavefield of a given wavefront —a revolutionary step that laid the foundation for many interference and diffraction-based imaging techniques. While modern holography often relies on digital sensors and computation, early holograms were recorded entirely on analog photosensitive materials, offering unmatched spatial resolution and optical fidelity. This analog approach gave rise to what we now call holographic optical elements (HOEs)—a subclass of diffractive optical elements (DOEs) that shape light through interference and diffraction. Today, DOEs are fabricated through a variety of methods, including lithography, nanoimprint, and laser writing. However, analog holographic recording still offers unique advantages: ultra-high resolution (exceeding 5000 lines/mm with ultra-fine-grained materials), full-field wavefront capture, and low-cost fabrication with minimal infrastructure. This contribution provides a practical guide to recording transmission and reflection HOEs, reviewing the most common materials, setups, and alignment strategies for successful implementation. As a case study, we demonstrate the recording of a Fresnel-type diffractive lens on photopolymer material for use as spherical wavefront source generator in digital lensless holographic microscopy (DLHM). Integrating HOEs into DLHM enables the creation of compact, cost-effective, and alignment-free imaging systems, making this technique especially appealing for portable biomedical devices and educational tools.

About the Speaker: PhD candidate in Photonics Engineering, Vrije Universiteit Brussels

Session 5 (A111) - Material Science (II)

Chair: Prof. Rainer Pärna

Invited talk - Dr. Shree Krishnamoorthy – (14:20 – 14:50)

Speech Title: *Old windows, new light – Physiological biomarkers in the long wavelength near infrared region*

Abstract: The clinical need for hypoxia monitoring can only be met by continuous monitoring of physiological biomarkers. For the continuous, non-invasive monitoring, spectroscopy in the wavelength region 1350-2500 nm (long wavelength near infrared region) provides the most viable solution. In this talk, we look at the challenges of measuring in this window and discuss the research opportunities arising from it.

About the Speaker: Dr. Shree Krishnamoorthy believes in her vision for improved women's and children's healthcare. To make her vision come true, she uses her skills as an engineer in BioPhotonics to develop novel spectroscopy to address the clinical needs. She has been trained in India through her PhD and Master's, which focused on building lasers and studying systems. Currently, she is developing a new spectroscopic technique in the long-wavelength near-infrared window to measure biomarkers of clinical relevance.

Invited talk - Prof. Taavi Repan (14:50 – 15:20)

Speech Title: *Numerical analysis of light propagation in nanostructured black metal samples*

Abstract: Nanoporous metal structures exhibit very high absorption, leading to a black appearance under visible light. We present finite-element analysis of two distinct systems, investigating the mechanisms of light propagation within these structures. For pristine nanoporous structures, we show that the dominant mechanism of absorption enhancement is due to light trapping effects. However, once the sample is subjected to thermal effects, via annealing or direct laser writing (DLW), it tends towards a collection of isolated nanoparticles. We analyse DLW-treated samples in depth, investigating how varying laser powers affect the formation of these nanoparticles.

About the Speaker: Dr. Taavi Repän is an Associate Professor of Computational Nanophotonics. His primary expertise lies in finite element simulations of nanoscale optical systems. He completed his PhD studies from 2015 to 2019 at the Technical University of Denmark, focusing on plasmonics and metamaterials. Following that, he worked as a post-doctoral researcher at the Karlsruhe Institute of Technology, specializing in machine learning for computational nanophotonics. Since the end of 2021, Dr. Repän has held the associate professor position at the Institute of Physics, University of Tartu. His current research interest revolves around machine learning methods for designing photonic nanostructures.

Invited talk - Prof. Siim Pikker (15:20 – 15:50)

Speech Title: *High throughput fabrication of Fabry-Pérot type cavities for strong coupling experiments using maskless grayscale UV lithography*

Abstract: Molecular polaritons and strong light–matter coupling systems underpin many potential emerging technologies in the field of photonics, photochemistry and fundamental physics. However, scalable fabrication methods of dye-doped Fabry-Pérot type cavity resonators remain limited. Applications of such cavities need dye type, concentration and cavity thickness optimizations. Traditional single cavity fabrication methods form a bottleneck for research and innovation. We report our efforts to employ maskless grayscale UV lithography to fabricate arrays of

Fabry-Pérot type cavities highly doped with organic dyes. To our knowledge there has not yet been a systematic effort to utilize maskless grayscale UV lithography for such purpose. We analyze how dye concentration impacts photoresist performance, identify and mitigate fabrication defects, and implement Fourier-plane imaging spectroscopy to characterize cavity modes in ~10 × 10 μm^2 resonators. These findings establish maskless grayscale lithography as a practical platform for the scalable fabrication and to accelerate thickness optimization of organic polaritonic devices.

About the Speaker: Professor Siim Pikker is an Associate Professor and Head of Laboratory at the Institute of Physics at the University of Tartu, specializing in micro and nanooptics, with research focused on plasmonic and polaritonic systems and light-matter interactions.

Contributed talk - Tadas Latvys (15:50 – 16:05)

Speech Title: *DLIP-Based Fabrication of High-Aspect Ratio Silicon Structures via KOH Etching*

Abstract: Periodic surface structures on silicon have broad applicability in metasurfaces, sensing, and light management. Direct Laser Interference Patterning (DLIP) enables rapid and uniform sub-micron surface structuring but is typically limited in height when operating in the amorphization regime. In this work, we demonstrate a post-processing technique using 20 wt% KOH etching to significantly increase the height of amorphous silicon gratings without compromising their uniformity. Structures initially formed with 15 nm height were increased to over 200 nm after 30 minutes of chemical etching, while retaining their periodicity and quality. Our results suggest that this hybrid DLIP–etching method offers a scalable path for fabricating high-aspect-ratio silicon microstructures, without the drawbacks associated with ablation-based techniques.

About the Speaker: Laser Research Center, Faculty of Physics, Vilnius University, Lithuania

Contributed talk - Hsin-Hui Huang (16:05– 16:20)

Speech Title: *External Magnetic Field Control of Ultrafast Terahertz Emission from Water Micro-Films*

Abstract: This study demonstrates the active control of terahertz (THz) radiation using external magnetic fields during femtosecond laser excitation (800 nm) of plasma generated on thin water layers. THz generation is attributed to ultrafast current transients arising from asymmetric charge displacement within the sharp density gradients at the water–air interface. Applied static magnetic fields up to 0.6 T are found to distinctly modulate the THz emission, impacting its amplitude, inducing polarisation rotation, and leading to spectral narrowing and temporal broadening of the waveforms. These observations directly highlight the magnetic field's influence on the directionality and the spatial configuration of transient charge dynamics. Our results contribute to understanding ultrafast charge carrier behaviour in laser-generated plasmas and establish the viability of external magnetic fields for precise manipulation of THz emission from liquid targets.

About the Speaker: Optical Sciences Centre, SEAM, School of Science, Swinburne University of Technology, Australia

Session 6 (B103) - Structured Light (II)

Chair: Dr. Ravi Kumar

Invited talk - Prof. Etienne Brasselet (14:20 – 14:50)

Speech Title: *Agile optical vortex coronagraphy: which future for agility still fragile today?*

About the Speaker: Etienne Brasselet is Research Director at CNRS, Laboratoire Ondes et Matière d'Aquitaine, University of Bordeaux, France. His scientific interests cover wave-matter interactions in the framework of multidisciplinary environment including nonlinear phenomena, optics and photonics, acoustics, mechanical effects of waves using either solid or soft matter systems such as liquid crystals. His research activities mainly focus on situations where structured fields meet structured matter, which makes topology and vector fields at play.

Invited talk - Prof. Gangi Reddy Salla (14:50 – 15:20)

Speech Title: *Extracting spatial modes of light through auto-correlation*

Abstract: Here, I will discuss the recent developments of our lab to find the topological charge (TC) of the perturbed optical vortex beams using auto-correlation profiles. Further, we discuss the beam waist independent methodology along with the determination of TC of open vortex beams i.e., the obstructed vortex beams. We have utilized the divergence of auto-correlation profiles for finding the TC.

About the Speaker: Salla Gangi Reddy is an Associate Professor at the Department of Physics, SRM University - AP, India. He obtained his master's degree from the SVU Tirupathi and his Ph.D degree from the Physical Research Laboratory, Ahmedabad. After completing his Ph.D. thesis, he worked as a post-doctoral researcher at the University of Electro-Communications (UEC), Tokyo, Japan. His research work is in the area of Optics and Photonics, such as Singular Optics, Polarization optics, Optical Metrology, coherence optics, digital holography, laser speckle, etc. He is a life member of the Optical Society of India.

Invited talk - Dr. Angika Bulbul (15:20 – 15:50) – Online talk

Speech Title: *3D Tracking Comparison of a Refractive vs. a Geometric Phase Plate and Accessing the Fluctuations in Optical Response of Molecules*

Abstract: The talk will present methods on tracking biological objects in three dimensions (3D) for a better understanding of the dynamic behavior of cellular components. It can be achieved by multifocal imaging with diffractive optical elements (DOEs) converting depth (z) information into a modification of the 2D image. A quantitative comparison of the performance of a DOE (3rd-generation refractive phase plate (RPP)) to a 4thgeneration multifocal element that is a geometric phase plate (GPP) will be presented. Both phase plates are based on a theoretical 7-zone spiral-phase design that is optimized for the RPP to localize point emitters along the z-axis in a narrow wavelength range. In contrast to the RPP, the GPP is an inherently wideband phase plate. The second part of the talk will be focused on a photon-counting technique to access fluctuations in molecular optical response beyond conventional spectroscopy. While the Beer–Lambert law quantifies average absorbance based on concentration, extinction coefficient, and path length, it cannot capture intrinsic fluctuations. These arise from dipole–field interactions and the molecular environment during photon absorption. Photon-counting directly reveals these quantum fluctuations, offering insight inaccessible to classical intensity-based absorption measurements.

About the Speaker: Dr. Angika Bulbul is a distinguished researcher in the field of imaging, digital holography and known for pioneering contributions in incoherent synthetic aperture imaging methods. Currently, she is working as teaching co-research postdoctoral associate at Wake Forest University (WFU), Winston-Salem, NC in the Department of Physics. Prior to joining WFU, she did short-term postdoctoral research in optogenetics and lens-less imaging at the University of North Carolina at Chapel Hill, USA. Dr. Bulbul was honored Summa cum Laude during her doctoral degree in the School of Electrical and Computer Engineering from the Ben Gurion University of the Negev, Israel under the supervision of Prof. Joseph Rosen (https://en.wikipedia.org/wiki/Joseph_Rosen_(professor)). She earned her master's degree in Applied Optics from the Indian Institute of Technology Delhi, India where she developed deep interest in optics, imaging and holography. She has co-authored several scientific journal papers, book chapters, conference publications, US patent approved and numerous awards including 'excellence from the Dean for outstanding academic achievements.

Invited talk - Prof. Mikhail Belogolovskii (15:50 – 16:20) – Online talk

Speech Title: *Transparent Superconductors: Hybridization of Two Quantum Platforms*

Abstract: Due to their ability to maintain coherent quantum states with minimal energy loss, superconductors are essential for building quantum components, while photons are ideal carriers of quantum information, offering high-speed and low-loss transmission capabilities. However, integrating the two quantum platforms poses significant challenges due to the inherent damping of photonic states when interacting with conventional superconductors. Therefore, creating transparent superconductors would be an ideal solution to improve the overall performance of a hybrid system minimizing photonic attenuation. This field is in its infancy, but some basic principles that allow the coexistence of quite satisfactory transparency for visible light with the superconductivity of itinerant electrons have been developed. In this contribution, I present the strategy for reaching the best compromise which involves two steps - creating a transparent conductor with a sufficiently high concentration of mobile carriers and transferring it to a superconducting state. Our studies focused on doped indium-tin oxide (ITO) layers have used two ways leading to the superconducting state: electrochemical intercalation and synthesis of oxygen-deficient ITO films. Both methods enable precise tuning of the superconducting onset temperature T_c over a wide range of 1 - 5 K, while maintaining optical transparency between 30 and 85%. Two-dimensional superconductivity was found in electrochemically reduced ITO strips while ITO films sputtered under oxygen-deficient conditions exhibited three-dimensional characteristics. The dome-shaped behavior of T_c and the decrease in transparency with increasing charge carrier concentration allow the selection of the necessary combination of the two factors for specific applications.

About the Speaker: Prof. Mikhail Belogolovskii, Candidate of Phys. & Math. Sci. (PhD) in Solid State Physics, 1976, Doctor of Phys. & Math. Sci. (Dr. Honor.) in Solid State Physics, 2013, both from the Donetsk Institute for Physics and Engineering, Donetsk, Ukraine; Professor in Applied Physics and Nanomaterials, 2017, Institute for Metal Physics, Kyiv, Ukraine. Since 2022, he has been a leading researcher at the Kyiv Academic University, Kyiv, Ukraine. In 2023, he was awarded a three-year European Union grant to work as a researcher at the Centre for Nanotechnology and Advanced Materials, Comenius University Bratislava, Slovakia. According to the Scopus database, he is the author of 167 papers in the fields of superconductivity, quantum transport, and quantum materials. He actively collaborates with colleagues from the Friedrich Schiller University Jena, Germany, Northwestern University, Evanston, USA, and the University of Texas at Dallas, TX, Richardson, USA. He is Vice-President of the Ukrainian Physical Society and a member of the American Physical Society.

Session 7 (A102) - Quantitative Phase Imaging (II)

Chair: Prof. Balpreet Singh Ahluwalia

Keynote talk - Prof. Osamu Matoba (16:50 – 17:20)

Speech Title: *Recent advances in holographic microscopy for neuroscience and biology*

For neuroscience and biology, fluorescence protein and photosensitive protein for optogenetics are two major tools.

Abstract: As neurons and cells in biological tissues are distributed in three-dimensions (3D), manipulation of cellular activity by optical stimulation of multiple cells with 3D light spots and the development of high-speed 3D fluorescence imaging are essential to reveal the structure of neural networks and signal transduction between cells. For this purpose, we have proposed holographic microscopes. The holographic microscopes are equipped with a light-stimulation system that produces 3D multiple spots and a 3D high-speed fluorescence imaging system using incoherent digital holography or the transport of intensity equation. Numerical refocusing is operated in a computer. For deeper observation, it is necessary to eliminate the effects of scattering in both light stimulation and observation of cell activity. Experimental results using mouse brain and plant cells will be presented. For advanced systems, we will present a system using a giant objective lens to achieve wide field-of-view with a single-cell resolution.

About the Speaker: Osamu Matoba received the Ph.D. degree in Applied Physics from Osaka University, Osaka, Japan, in 1996. He was a Research Associate at Institute of Industrial Science, University of Tokyo, from 1996 to 2002. From 2002 to 2009, he was an Associate Professor in the Department of Computer Science and Systems Engineering in Kobe University. He is now a Professor in the Center of Optical Scattering Image Science (OaSIS), Kobe University. His research interests are in optical computational imaging including digital holography, the transport of intensity equation, imaging through scattering medium, and holographic microscopy in neuroscience and biology. Dr. Matoba has published over 150 technical articles in major peer reviewed journals. Dr. Matoba is Fellow of SPIE and Optica, and a member of IEEE, the Optical Society of Japan (OSJ), and the Japan Society of Applied Physics(JSAP). He received the 2008 IEEE Donald G. Fink prized paper award.

Invited talk - Prof. Maciej Trusiak (17:20 – 17:50)

Speech Title: *Less is more: Advancing Large-Scale 2D and 3D Bioimaging with Lensless Digital Holographic Microscopy and Tomography*

Abstract: We present both numerical and experimental advances in high-throughput label-free lensless computational imaging for two- and three-dimensional biomedical applications. Our focus is on novel lensless holographic techniques enabling large-volume, high-content, stain-free imaging of both amplitude and quantitative phase of unimpaired bio-samples. These approaches are particularly well-suited for in-depth analysis of cells and tissues, offering scalable solutions for next-generation biomedical diagnostics. We demonstrate the capabilities of these methods through high-precision validation using static phantoms fabricated via two-photon polymerization and real-life challenging imaging of fixed biological tissue slices and cell cultures and time-lapse examination of dynamic live cells. Finally, we outline key challenges and opportunities ahead in pushing the frontiers of large-volume label-free 2D/3D quantitative phase imaging.

About the Speaker: Maciej Trusiak is an Associate Professor at the Institute of Micromechanics and Photonics, Faculty of Mechatronics, Warsaw University of Technology. He earned his B.Sc., M.Sc., and Ph.D. degrees in Photonics Engineering from the same university in 2011, 2012, and 2017, respectively. Following his doctoral studies, he completed a one-year postdoctoral fellowship in the Optoelectronic Image Processing Group led by Prof. Javier García and Prof. Vicente Micó at the University of Valencia, Spain. In 2022, he obtained his habilitation degree and launched the Quantitative Computational Imaging Lab (qcilab.mchtr.pw.edu.pl), focusing on computational imaging, lensless microscopy, optical metrology, interferometry and holography, quantitative phase imaging, and fringe pattern analysis. In 2023, he was awarded the ERC Starting Grant for research on lensless, label-free nanoscopy. Prof. Trusiak is an active member of the optical science community. He is a Senior Member of SPIE and Optica, and served on the SPIE Award Committee, acting as Chair of the Maria Goeppert-Mayer Award in Photonics Sub-Committee and Member of the Chandra Vikram Award in Optical Metrology Sub-Committee. He has held various organizational roles, including Co-Chair and Committee Member of the SPIE Interferometry and Structured Light Conference at SPIE Optics + Photonics 2022 and 2025, and Chair of the Warsaw Summer School for Advanced Optical Imaging 2024. He is also a Scientific Committee Member of Computational Optical Sensing and Imaging (COSI) at the Optica Imaging Congress 2024 and 2025. He currently serves as Associate Editor for Applied Optics (Optica Publishing Group) and Optics and Lasers in Engineering (Elsevier), Executive Editorial Board Member for Journal of Physics: Photonics (IOP), and Editorial Board Member for Advanced Devices & Instrumentation (AAAS Science Partner Journal). He also reviews for numerous high-impact journals in the optics & photonics field.

Contributed talk - Daniel Smith (17:50 – 18:05)

Speech Title: *Extending 4-Pol Imaging to Skylight and Ocean Wave Analysis*

Abstract: In this forward-looking study, we extend the application of 4-polarisation (4-pol) imaging's capability to map optical anisotropies, such as birefringence and dichroism to the polarisation patterns of skylight which results from atmospheric scattering processes. These skylight patterns have long been exploited for navigation and has been modelled for atmospheric sensing and planetary science applications. Simulating and measuring these patterns is essential for understanding the influence of factors such as weather conditions, aerosol content, and cloud cover. We present preliminary, 4-pol imaging data of skylight polarisation patterns under varying atmospheric conditions and compare these to established sky polarisation models. Furthermore, we demonstrate the application of 4-pol imaging to artificially induced water waves, revealing the method's capacity to resolve structural and orientational information in complex, dynamic surface patterns. These results form the basis for refining experimental setups and validating the potential of 4-pol imaging for environmental remote sensing and navigation applications.

About the Speaker: Optical Sciences Centre, SEAM, School of Science, Swinburne University of Technology, Australia

Contributed talk - Marius Navickas (18:05 – 18:20)

Speech Title: *Photo initiator-driven complex formation in SZ2080 photoresist*

Abstract: Laser lithography via two-photon photopolymerisation (TPP) has emerged as a rapidly developing technology, enabling the fabrication of sophisticated three-dimensional (3D) microstructures. Recent progress in this field primarily focuses on the creation of novel microstructures [1], developing new laser sources, and the synthesis of new photopolymerisation materials with desired properties. As a result, a hybrid organic-inorganic photoresist SZ2080 has been synthesised and tested for 3D fabrication [2]. We found that sensitization of SZ2080 with Irgacure 369 and BIS photoinitiators causes significant absorption changes, as shown in Fig. 1. The emission spectra of these photosensitizers were also affected by SZ2080. We attribute these changes to the coordination interactions caused by the Zr atom of SZ2080 resin, as we hypothesize that Zr, being an electron-withdrawing element, can coordinate with the photosensitizer. Here we present the results based on stimulated Raman scattering (SRS) spectroscopy, which was used to explore these non-trivial ground-state interactions.

About the Speaker: Laser Research Centre, Vilnius University, Lithuania

Session 8 (A111) - Incoherent Holography (II)

Chair: Prof. Joseph Rosen

Invited talk - Prof. Tomoyoshi Shimobaba (16:50 – 17:20)

Speech Title: ***Hologram generation via deep-learning***

Abstract: Holographic displays are ideal three-dimensional displays, and our current research focuses on leveraging deep learning for advanced hologram computation. In this presentation, we will introduce several unique approaches.Firstly, we will introduce a novel method for reconstructing 3D scenes from a collection of 2D images and subsequently computing the corresponding hologram. This technique utilizes state-of-the-art neural rendering methods such as NeRF or 3D Gaussian splatting. Furthermore, we will present a deep learning-based approach for generating holographic stereo pair specifically designed for holographic head-mounted displays. Finally, we will demonstrate an interactive holographic video game powered by a synergistic combination of deep learning and FPGA acceleration.

About the Speaker: Prof. Tomoyoshi Shimobaba received his B.E. and M.E. degrees from Gunma University, Japan in 1997 and 1999, respectively. He then received his D.E. degree from Chiba University, Japan in 2002. From 2002 to 2005, he served as a special postdoctoral researcher at RIKEN. He was an associate professor at the Graduate School of Science and Engineering, Yamagata University, Japan from 2005 to 2009, and subsequently an associate professor in the Graduate School of Engineering, Chiba University from 2009 to 2019. He is currently a professor in the Graduate School of Engineering, Chiba University. Additionally, he was a visiting researcher at Tampere University of Technology (Finland) in 2011 and a visiting professor at Warsaw University of Technology (Poland) in 2014. He currently serves as editors for Optics Letters, Scientific Reports, and IET Image Processing.

Invited talk - Prof. Yoshio Hayasaki (17:20 – 17:50)

Speech Title: *Holographic beam shaping for material fabric processing and volumetric display*

Abstract: Computer-generated hologram (CGH) allows an arbitrary spatial beam shaping. A spatial light modulator (SLM) displaying a dynamic CGH has been used to achieve dynamic optical excitation of material in laser processing, nonlinear microscope, and novel information apparatus. The holographic technique has some advantages: high throughput of laser irradiation, high-light use efficiency, reconfigurable three-dimensional beam shaping, instantaneous beam irradiation in the presence of the target movement and deformation, correction of the optical system, typically, spherical aberration correction, and an adaptive wavefront control of laser pulses for compensating unknown and unpredictable imperfections in an optical system. This talk will present the applications of material laser processing and volumetric display. In addition, a holographic optical engine (HolOE) that performs an optimization of the CGH in the optical system, called an in-system optimization, is presented. The HolOE performs high-quality beam shaping in the actual optical system, which is required in industrial implementation.

About the Speaker: Yoshio Hayasaki received PhD from University of Tsukuba, Japan, in March 1993. He was a researcher at RIKEN from April 1993 to March 1995. He was an associate professor at The University of Tokushima from April 1995 to March 2008. He is a distinguished professor at Utsunomiya University and vice-director of Center for Optical Research & Education (CORE). He is an optical system designer in information photonics, optical metrology, and laser material processing. He is a fellow member of SPIE, OPTICA, and Japanese Society of Applied Physics (JSAP), and a member of Optical Society of Japan (OSJ), Laser Society of Japan (LSJ), Japan Laser Processing Society (JLPS), and The Institute of Electrical Engineers of Japan (IEEJ).

Contributed talk - Indre Meskelaite (17:50 – 18:05)

Speech Title: *Parity-time symmetric waveguide structures for passive and active control of light propagation*

Abstract: In the face of an ever-increasing demand for computational power, optical computing emerges as a viable alternative to conventional electronic computing systems due to the associated higher speed and lower power consumption. Here, we propose a non-reciprocal optical device based on a planar periodic waveguide structure specially designed to adhere to the parity-time (PT) symmetry requirement of non-Hermitian photonics. Such a structure exhibits asymmetric reflectance for forward and backward light propagation and could, therefore, serve in controlling the propagation of light. In this work, we present the numerical investigation of the reflectance asymmetry in the proposed PT-symmetric waveguide structure, exploring both passive and active configurations. Additionally, initial tests at fabrication via femtosecond laser ablation are performed, and the encountered challenges are outlined. This work contributes to the development of key building blocks for optical computing platforms.

About the Speaker: Laser Research Centre, Vilnius University, Lithuania

Contributed talk - Manuel Montoya (18:05 – 18:20)

Speech Title: *Efficient simulations of partially coherent light using the Generalized Van Cittert-Zernike Schell Propagator*

Abstract: We present a novel, computationally efficient wave propagation algorithm that models the diffraction of partially spatially coherent light using a single forward propagation. The model uses the Van Cittert-Zernike theorem to find the complex coherence factor from a light source reaching the object plane, and it then uses the generalized Schell's theorem to compute the diffracion pattern produced at a given propagation distance, not limited to the far field. Our algorithm is orders of magnitude faster and highly accurate compared to conventional methods for computergenerated holography (CGH) and digital holography (DH). We demonstrate its potential experimentally for imaging and display systems with partially coherent light.

About the Speaker: Vrije Universiteit Brussel

Session 9 (B103) - Microscopy and Tomography (I)

Chair: Dr. Ravi Kumar

Invited talk - Prof. Enrique Tajahuerce (16:50 – 17:20)

Speech Title: *Single-pixel microscopy: system design, enhancements, and applications*

Abstract: Single-pixel imaging techniques are based on sampling a scene with a set of widefield light patterns, while a simple bucket detector, such as a photodiode, records the light intensity transmitted, reflected, or diffused by the object. Images are then computed numerically from the photocurrent signal. The simplicity of the sensing device allows for efficient operation in conditions where light is scarce. Also, it simplifies the measurement of the spatial distribution of multiple optical properties of the sample, such as the spectral content. Moreover, single-pixel detectors allow for the use of a broader spectral range compared to conventional cameras. In this contribution, we provide a comprehensive review of our recent advances in computational microscopy techniques based on wide-field illumination and single-pixel detection. Specifically, we focus on the design and validation of a new platform for single-pixel microscopy (SPM) and applications of SPM in optical sectioning, super-resolution, autofocusing, and multispectral imaging.

About the Speaker: Enrique Tajahuerce is professor at the Department of Physics in Universitat Jaume I, Castelló, Spain. He belongs also to the Institute of New Imaging Technologies (INIT), in the same university, where he is the responsible of the Optics Section. He coordinates the Photonics Research Group (GROC·UJI). He is Fellow of OSA and Senior Member of SPIE. His research interests lie in the areas of diffractive optics, adaptive optics, optical security and encryption, digital holography, and computational imaging. Currently, he focuses its activity on computational imaging by means of structured light, integrated detection, and compressive sensing. These techniques have been applied to security and encryption, multispectral and polarimetric cameras, phase imaging, optical microscopy, and imaging through scattering media.

Invited talk - Prof. Martin Booth (17:20 – 17:50)

Speech Title: *Information-optimized adaptive optics for biomedical microscopy*

Abstract: Wavefront aberrations are a prominent issue in microscope imaging. Optical system imperfections and inhomogeneous sample structures introduce phase distortion (or aberration) that lead to compromised image quality. Adaptive optics (AO) are reconfigurable devices that modulate the phase of light to correct aberrations, restoring focusing quality and allowing deep penetration through inhomogeneous tissue samples to facilitate challenging in-vivo imaging for biomedical studies. Particularly useful are indirect – or "sensorless" – AO methods, which do not require a wavefront sensor. They infer wavefront correction from a small set of images, each acquired with a different bias aberration applied with the adaptive correction device. If not well optimized, these methods may require prolonged and repeated sample exposures. We developed a sensorless AO method using embedded machine-learning (ML) based control that considerably improved the efficiency of aberration measurement and estimation. We took steps to further advance information-guided ML-powered AO methods. In particular, we used Fisher information to guide AO method design, in particular the choice of bias aberrations. Further developments included multi-foci for wavefront sensing. We studied optimised wavefront representations to benefit deep multiphoton microscopy. This showed how alternative modal decompositions can assist the wavefront correction process.

About the Speaker: Prof Martin Booth is chair in Optical and Photonic Engineering at the University of Oxford. His research involves the development and application of adaptive optical methods in microscopy, laser-based materials processing and biomedical imaging. In particular, his group have developed numerous implementations of adaptive optics for aberration correction in high resolution microscopes and precision laser fabrication systems. He has held Royal Academy of Engineering and

EPSRC Research Fellowships and in 2016 received an Advanced Grant from the European Research Council. In 2014 he was awarded the International Commission for Optics Prize. He was appointed Professor of Engineering Science in 2014 and Chair in Optics and Photonics in 2023. He is a fellow of SPIE, Optica, and the Institute of Physics and serves on the board of Optica. He has over 180 publications in peer-reviewed journals, over thirty patents, and has co-founded two spin-off companies, Aurox Ltd and Opsydia Ltd.

Contributed talk - Mufeeduzaman Chavilkkadan (17:50 – 18:05)

Speech Title: *Topological shaping of light from structured materials*

Abstract: Recent advances in research have extended the concept of skyrmions—topologically stable vector textures originally introduced in particle physics—to various fields, including electromagnetism and optics [1]. In photonics, skyrmions have shown immense potential, particularly in driving innovation in advanced beam-shaping strategies. Liquid crystal spatial light modulators have emerged as promising platforms for the generation and manipulation of optical skyrmions due to their tunable optical properties. However, these devices are often bulky and expensive, prompting the exploration of alternative systems. In this study, we exploit the spin-orbit interaction of light and the tunable birefringence of liquid crystals under external fields to experimentally achieve the controlled generation of optical skyrmions using liquid crystal droplets which extends previous works restricted to the generation of optical vortices [2].

Here we exploit the unique ability of nematic liquid crystal droplets to modulate optical anisotropy through the self-organisation of the long-range orientational order of liquid crystals. Specifically, we have arranged the orientational boundary conditions in order to obtain spatial modulation of both the optical axis orientation and the birefringent phase retardation between ordinary and extraordinary waves passing that propagate through the droplet. This enables the transformation of a uniformly polarised input beam into skyrmionic polarization textures.

We experimentally demonstrate the production of first-order skyrmion structures at an arbitrary wavelength in the whole visible domain by varying the droplet radii over a couple of hundreds of micrometres. Moreover, we have developed a model that does not only provides an accurate description of the observation but also allows precise prediction of the generation of high-order skyrmions by appropriately selecting the droplet geometrical and optical characteristics.

This opens up avenues for tailoring skyrmion configurations on demand. Specifically, we take control of the properties of the generated skyrmions by applying external thermal and electrical fields to the liquid crystal system. In turn, the operating wavelength for a given skyrmion can be tuned on demand. Moreover, the nature of the skyrmion can be changed at a given wavelength. All the observations are supported by our modelling.

This work not only broadens the understanding of skyrmion behaviour in liquid crystal systems but also provides a versatile platform for applications in advanced optical technologies [3].

About the Speaker: CNRS, Laboratoire Ondes et Matière d’Aquitaine, Université de Bordeaux, 33400 Talence, France

Contributed talk - Uday Pratap Singh Kushwah (18:05 – 18:20)

Speech Title: *First principles studies of ternary hexafluorides as scintillators for medical imaging technologies*

Abstract: Scintillators are materials that convert ionizing radiation into detectable low-energy radiation and are crucial in applications such as medical imaging technologies like computed tomography (CT) and positron emission tomography (PET) [1]. In time-of-flight PET (TOF-PET), the signal-to-noise ratio and spatial resolution are directly related to the coincidence time resolution of scintillator detectors [2]. The discovery of new scintillators with higher yield and shorter response times would enable the development of more efficient and accurate detectors, potentially allowing for higher-resolution images

and reduced radiation doses to patients. However, experimental testing of scintillator materials is time-consuming and requires expensive specialized equipment, making computational identification of promising candidates highly desirable [3].

In this work, we investigate a family of inorganic ternary hexafluorides—K_2GeF_6, K_2SiF_6, $BaGeF_6$, and $NaGeF_6$—using first-principles methods. Initial Density Functional Theory (DFT) calculations were used to analyze their electronic structures, and results were compared to experimental measurements from optical absorption, luminescence, and photoemission spectroscopy.

Building on this, we recently employed many-body perturbation theory within the GW approximation using the BerkeleyGW code to compute quasiparticle energy levels and simulate photoelectron spectra for K_2SiF_6. Our GW-corrected band structures and calculated density of states show significantly improved agreement with experimental photoelectron spectra, providing a more accurate description of the material's electronic properties.

Future work will extend these advanced calculations to the other compounds in the series and incorporate excitonic effects via the Bethe-Salpeter Equation, along with the investigation of phonon-assisted processes in the optical response.

About the Speaker: Institute of Physics, University of Tartu, Estonia

Day 2: Sunday, September 21, 2025

Plenary talk1 - Prof. Aydogan Ozcan, ***University of California, Los Angeles, CA***

Speech Title: *Programming Light Diffraction for Information Processing and Computational Imaging*

Abstract: I will discuss the integration of programmable diffraction with digital neural networks. Diffractive optical networks are designed by deep learning to all-optically implement various complex functions as the input light diffracts through spatially engineered surfaces. These diffractive processors integrated with digital neural networks have various applications, e.g., image analysis, feature detection, object classification, computational imaging and seeing through diffusers, also enabling task-specific camera designs and new optical components for spatial, spectral and temporal beam shaping and spatially-controlled wavelength division multiplexing. These deep learning-designed diffractive systems can broadly impact (1) optical statistical inference engines, (2) computational camera and microscope designs and (3) inverse design of optical systems that are task-specific. In this talk, I will give examples of each group, enabling transformative capabilities for various applications of interest in e.g., autonomous systems, defense/security, telecommunications as well as biomedical imaging and sensing.

About the Speaker: Dr. Aydogan Ozcan is the Chancellor's Professor and the Volgenau Chair for Engineering Innovation at UCLA and an HHMI Professor with the Howard Hughes Medical Institute. He is also the Associate Director of the California NanoSystems Institute. Dr. Ozcan is elected a Member of the National Academy of Engineering (NAE) and a Fellow of the National Academy of Inventors (NAI) and holds >85 issued/granted patents in microscopy, holography, computational imaging, sensing, mobile diagnostics, nonlinear optics and fiber-optics, and is also the author of one book and the co-author of >1200 peer-reviewed publications in leading scientific journals/conferences. Dr. Ozcan received major awards, including the Presidential Early Career Award for Scientists and Engineers (PECASE), International Commission for Optics ICO Prize, Dennis Gabor Award (SPIE), Joseph Fraunhofer Award & Robert M. Burley Prize (Optica), Keith Terasaki Innovation Award, SPIE Biophotonics Technology Innovator Award, Rahmi Koc Science Medal, SPIE Early Career Achievement Award, Army Young Investigator Award, NSF CAREER Award, NIH Director's New Innovator Award, Navy Young Investigator Award, IEEE Photonics Society Young Investigator Award and Distinguished Lecturer Award, National Geographic Emerging Explorer Award, National Academy of Engineering The Grainger Foundation Frontiers of Engineering Award and MIT's TR35 Award for his seminal contributions to computational imaging, sensing and diagnostics. Dr. Ozcan is elected Fellow of Optica, AAAS, SPIE, IEEE, AIMBE, RSC, APS and the Guggenheim Foundation, and is a Lifetime Fellow Member of Optica, NAI, AAAS, SPIE and APS. Dr. Ozcan is also listed as a Highly Cited Researcher by Web of Science, Clarivate.

Plenary talk2 - Prof. Saulius Juodkazis, Swinburne University of Technology, Melbourne, Australia

Speech Title: *Femtosecond Laser Direct Write: tool of nanomaterials synthesis, lithography, and in situ characterization*

Abstract: The most efficient energy deposition tool is ultra-short (sub-1 ps) laser pulse since it is faster than almost all energy relaxation mechanisms in electron-ion system in the solid state materials. This virtue makes high-intensity 2-20 TW/cm^2 femtosecond pulses suitable for creation of high-pressure/temperature phases of nanomaterials and to form them with high spatial precision and resolution determined by focusing. Recently, it was demonstrated that nano-scale localisation of fs-laser pulses at the interfaces and regions of the reduced permittivity (on the optical axis where absorption is driving an increase of electron density) facilitates further light localization, absorption, and energy deposition. This can be used for 2D and 3D nanolithography tasks with resolution and precision approaching 10 nm. It breaks the requirement that short wavelength and a very high numerical aperture optics to be used to reach resolution of tens-of-nanometers in nanolithography. The direct laser write of tens-of-nm structures with a micron-sized focal spot seemed impossible just few years ago.

About the Speaker: Saulius Juodkazis is a Professor and Deputy Director of the Optical Sciences Centre at Swinburne University of Technology, Melbourne, Australia. In 1998, he received his PhD (cotutelle) in experimental physics and material sciences jointly from Vilnius University, Lithuania, and Lyon-I University, France. His current interests are in the fields of light-matter interactions occurring in small space (nanoscale) and time (femtoseconds) domains. He planned, established, and directed a multi-user Nanotechnology facility at Swinburne open to the Australian National Fabrication Facility ANFF users from December 2011. His research is focused on applying principles of light-field enhancement and its spectral control for applications in micro-optics, solid-state lighting, and solar energy conversion.

Professor Juodkazis has contributed to the development of three-dimensional laser printing with nano-/micro-scale precision using femtosecond laser for applications in optofluidics, micro-optics, optical memory, and photonic crystals. He has shown experimentally the creation of high-pressure density phases of materials using tightly focused ultra-short laser pulses. He demonstrated that the nano-textured surface of Si (black-Si) has bactericidal/biocidal properties and acts as a “mechanical antibiotic”, which can be mass-produced. This work received the 2017 Eureka Prize for scientific research in Australia. He is a Fellow of the Optical Society of America (OSA) and the International Society for Optics and Photonics (SPIE).

Special talk - Dr. Ayesha Eduljee, *Editor of Discover Imaging, Nature Springer*

Session 10 (A102) – Industry

Chair: Prof. Shanti Bhattacharya

Invited talk - Prof. Heli Valtna (11:30 – 12:00)

Speech Title: *Science Commercialization Trajectories*

Abstract: Recent European policy reports underscore the urgent need to accelerate the commercialisation of scientific discoveries, aiming to narrow the innovation gap with the United States and China. Deep tech startups—those rooted in advanced scientific and engineering breakthroughs—are increasingly recognised as critical drivers of economic growth and societal progress. In response, proposals to double the European innovation budget are gaining momentum, with future funding mechanisms expected to prioritise applied research and commercialisation pathways. This presentation explores strategic trajectories for transforming scientific research into viable commercial ventures. It outlines practical approaches and models to support deep tech entrepreneurship and aims to spark a deeper discussion on the challenges and opportunities facing researchers, innovators, and policymakers in this evolving landscape.

About the Speaker: Dr. Heli Valtna is a junior researcher specialising in deep tech startups and innovation ecosystems. She holds a PhD in physics and has authored over 70 scientific publications in wave optics, along with four patent applications in computational imaging. Dr. Valtna is also the founder and former CEO of a deep tech startup. She researches deep tech startups at the University of Tartu, Faculty of Economics and Business Administration, and the Ministry of Economic Affairs and Telecommunications.

Invited talk - Mr. Erik Karlsen (Karl Storz) (12:00 – 12:30)

Speech Title: *Building the Future of Surgical Technology: How Karl Storz is Preparing for the Next Generation of Medical Device R&D*

Abstract: Karl Storz, a global leader in minimally invasive surgical technology, is advancing its commitment to innovation through a strategic expansion of its testing and development capabilities. This presentation outlines how these new investments are designed not only to enhance product performance and accelerate validation processes but also to create a strong foundation for future-oriented research and academic collaboration.

With an eye toward long-term impact, Karl Storz is preparing to host PhD interns and engage in structured research partnerships with academic institutions. By aligning state-of-the-art testing infrastructure with a culture of innovation, we aim to support the next generation of medical research and development. Attendees will gain insights into our evolving R&D strategy, how we envision collaboration with emerging researchers, and the role industry can play in shaping the future of surgical care through academic engagement and technological excellence.

About the Speaker: Erik Karlsen, Verification Engineer at Karl Storz Endoscopes. Karl Storz is an independent, family-owned MedTech company that ambitiously thinks in generations instead of quarters to improve patients' lives around the world. At KARL STORZ, we pride ourselves on harnessing leading technologies, precise workmanship, and dedicated customer support. Erik leads the verification department at Karl Storz's Tallinn facility. As a Verification Engineer, he has helped lead the verification department in expanding the DVT capabilities into the Estonian market. Prior to Karl Storz, Erik had worked in many industries, prior to his commitment to the Medical Devices industry. These industries include Shipping & Maritime, Oil & Gas, Defence & artillery, Food Co-packing, and Perforated Metals. Erik held various Engineering roles within these industries, including Senior Design

Engineer, Operations Engineer, Production & Service Engineer, CAD Engineer, Mechanical Engineer and currently Verification Engineer. He started out as a Mechanical Engineer Trainee for the U.S. Army and expanded to verification, supporting innovative products, and ensuring the endoscopes that Karl Storz produces are safe and adhere to the User Needs.

Invited talk - Mr. Vitalij Glazkov (Light Conversion, 12:30 – 12:45)

Speech Title: *Ultrafast laser systems for scientific applications*

Abstract: An overview of Light conversion commercially available products designated for robust performance, precision and output stability whether maintaining high repetition rates or energy per pulses. Products incorporate Yb based lasers together with OPA and user-friendly spectroscopy systems.

About the Speaker: A Scientific Laser Systems Engineer with a strong foundation in laser physics and hands-on expertise in ultrafast physics. I bring multi-faceted experience across laser system manufacturing, field service, and technical support. Over the years, I've worked closely with customers in both research and industrial settings – installing, servicing, and optimizing complex laser systems to meet application requirements.

Invited talk - Relika Alliksaar Williams, 12:45 – 13:15)

Speech Title: *Knowledge Transfer, Science & Innovation at the University of Tartu*

Abstract: Discover how the University of Tartu turns cutting-edge research into real-world innovation through effective knowledge transfer, patents, and industry collaboration.

About the Speaker: Knowledge Transfer Officer at the University of Tartu with a background in Material Sciences and extensive experience in intellectual property management. As an active member of ASTP and AUTM, I stay connected to the latest global practices in technology transfer. I specialize in managing inventions, guiding patent protection, and connecting research with real-world applications. Passionate about fostering collaboration, I work to maximize the societal and economic impact of research and believe in closer partnerships at every level to strengthen innovation ecosystems.

Session 11 (A111) - Structured Light (III)

Chair: Dr. Darius Gailevičius

Invited talk - Prof. Robert Brunner (11:30 – 12:00)

Speech Title: *Nature as Blueprint: Anti-reflective Moth-Eye Principle for Tailored Optical Functionality*

Abstract: Minimizing optical reflection across wide spectral ranges and incident angles remains a key challenge in advanced optical systems—particularly when environmental stability, material compatibility, and multifunctionality are required. In this contribution, we present several strategies for combining broadband, angle-insensitive, and system-specific anti-reflective (AR) surfaces with volumetric modifications, employing gradient-index architectures, and adapting to different material platforms.

We demonstrate moth-eye-inspired nanostructures fabricated by combining block copolymer micelle nanolithography (BCML) and reactive ion etching (RIE) on fused silica optics, and integrate these with micrometer-scale volume structuring via a sol-gel process. This enables both highly absorbing ("black") and strongly diffusing ("white") materials with reflectance below 0.1% across the 250–2500 nm spectral range. Transferred to hybrid polymers such as ORMOCER®, these structures achieve high transmission from 450 nm to 2 µm, excellent angular stability, and additional functionalities such as thermal robustness and hydrophobicity. Finally, we introduce a hybrid AR coating for high-index glasses that integrates a dense gradient-index (GRIN) layer with a nanostructured surface. This architecture provides a continuous refractive index transition from $n \approx 2.0$ to air, enabling transmittance gains exceeding 10% and outstanding AR performance from UV to IR wavelengths.

About the Speaker: Prof. Dr. Robert Brunner's research has always focused on the interaction of light with small structures. After completing his PhD in the field of near-field optical microscopy, he led the "Microstructured Optics" laboratory at the Research and Technology Center of Carl Zeiss for more than a decade. During this time, he gained extensive experience in direct-write laser lithography, interference lithography, and dry-etching techniques for the fabrication of refractive micro-optics, spectroscopic gratings, diffractive imaging elements, and nanostructured anti-reflective coatings. In 2010, he was appointed Professor of Applied Optics at the University of Applied Sciences Jena, Germany. His current research focuses on the development and investigation of new concepts in micro-optical systems, particularly for use in hybrid imaging (refractive-diffractive), spectral sensing, and multi- or hyperspectral imaging. He has deep expertise in the fabrication of micro- and nano-optical structures and is also actively involved in biomimetic optics research.

Invited talk - Dr. Gabrielius Kontenis (12:00 – 12:30)

Speech Title: *Generation of helical intensity beams and pulses for micromachining*

Abstract: Laser micromachining is a versatile technique for material modification, but its efficiency is often limited by photon fluence, which is constrained by factors like pulse energy, wavelength, beam diameter, and pulse duration. Beam shaping, which processes materials over extended surfaces or volumes rather than point-by-point, has emerged as a promising solution. A way to produce pulses with a temporal intensity distribution of a helical nature is shown. This approach employs geometric phase elements inscribed into fused silica volume as volumetric nano gratings. The ingenious optical setup combines higher-order Gaussian or Bessel beams of chirped and delayed pulses. By adjusting pulse chirp and delay, we control the helicity speed up to the THz range, with the helical number and rotation direction tunable via the order difference of the higher-order beams. Micromachining of silicon indicates that tunable helical pulses can be harnessed for advanced micromachining applications.

About the Speaker: Gabrielius Kontenis is a senior researcher at Vilnius University Laser Research Center, specialising in ultrafast laser technology and its applications in material processing and beam engineering. His research focuses on enhancing laser beam quality and tailoring spatial and temporal properties for advanced laser microfabrication. He earned his PhD in material engineering in 2024 from Vilnius University on the Spatially structured beam formation for laser radiation control.

Invited talk - Prof. Ahmed H. Dorrah (12:30 – 13:00)

Speech Title: *Volumetric Holography with Structured Light: From Light Sheets to Optimal Communication Modes*

Abstract: Controlling light in three dimensions with precision is a cornerstone of modern holography, with profound implications for immersive displays, optical manipulation, and imaging. In this talk, I present two complementary approaches to volumetric wavefront shaping that expand the capabilities of digital holography. The first leverages light sheets—non-diffracting, pencil-like beams—to reconstruct 3D scenes by stacking structured 2D planes along the optical axis. This method enables continuous-depth holography with high fidelity and low cross-talk, providing a scalable solution for wide-angle volumetric displays and wearable optics. The second approach employs communication mode optics, where the optimal orthogonal eigenmodes between a source and a receiver volume are computed via singular value decomposition. These modes form a physically optimal basis for synthesizing arbitrary 3D light distributions with continuous depth, high contrast, and minimal interference. Both techniques use phase-only spatial light modulators and together offer versatile tools for generating high-resolution 3D holograms across a range of platforms, from wearable displays to advanced microscopy and light–matter interaction studies.

About the Speaker: Dr. Dorrah is an Assistant Professor in the Department of Applied Physics and Science Education at Eindhoven University of Technology. He was previously a Research Associate at Harvard SEAS, working on Structured Light and Flat Optics. He earned his MASc (2015) and PhD (2019) in Electrical and Computer Engineering from the University of Toronto, with visiting research appointments at Lawrence Berkeley National Lab and the University of the Witwatersrand. His research focuses on light–matter interaction, structured light, and meta-optics for applications in sensing, imaging, micromanipulation, and optical communications.

Session 12 (B103) - Microscopy and Tomography (II)

Chair: Prof. Rakesh Kumar Singh

Invited talk - Prof. Piotr Zdańkowski

Speech Title: *Common-path grating-based digital holographic microscopy and optical diffraction tomography for biomedical imaging*

Abstract: Digital holographic microscopy (DHM) has become essential for labelfree quantitative phase imaging, enabling non-invasive characterization of transparent biological samples. However, conventional DHM setups utilizing separate reference beams are highly sensitive to environmental disturbances such as vibrations and require highly coherent illumination, introducing speckle noise and limits their practical biomedical applications.

To overcome these issues, we developed common-path grating-based digital holographic microscopy (CPDHM), employing diffraction gratings as integrated interferometric elements. This approach inherently provides robustness against environmental perturbations by using self-referenced interference, allowing low-coherence, quasi-achromatic illumination sources. The CPDHM setup significantly simplifies the optical design, enhances system stability compared to the traditional reference-beam DHM with substantially reduced coherence requirements. Moreover, CPDHM can be easily integrated into standard microscopes by simply inserting a diffraction grating between the tube lens and camera.

Our system is also compatible with optical diffraction tomography (ODT), achieved through oblique illumination and multi-angle projection collection, enabling precise three-dimensional refractive index mapping. We recently demonstrated this capability in the lipid droplet content assay. While common-path systems typically risk overlapping phase and conjugate-phase images in dense samples due to self-interference, we mitigate this by adjusting the shear between interfering beams. Acquiring multiple frames with variable shear, we numerically separate phase information from its conjugate, overcoming the problem of overlapping objects and also effectively extending the field of view of the system.

About the Speaker: Piotr Zdańkowski is a research assistant professor at the Institute of Micromechanics and Photonics, Faculty of Mechatronics, Warsaw University of Technology. He specializes in advanced optical imaging techniques, with a primary focus on super-resolution microscopy, adaptive optics, quantitative phase imaging (QPI), and optical diffraction tomography (ODT). Piotr earned his PhD from the University of Dundee in 2018, where he was developing a system integrating adaptive optics into stimulated emission depletion (STED) microscopy, for 3D imaging of biological samples. Currently, Piotr co-leads the Quantitative Computational Imaging Lab (QCI Lab), developing cutting-edge imaging methodologies including common-path QPI and ODT, Fourier Ptychographic Microscopy (FPM), lensless microscopy and super-resolution fluorescence microscopy.

Invited talk - Dr. Gyanendra Sheoran

Speech Title: *Depth-Resolved Telecentric Microscopy Using Electrically Tunable Lens and Variable NA Controller*

Abstract: Axial microscopic imaging of optically thick samples using an electrically tunable lens offers a fast and efficient approach, but is significantly challenged by the lack of telecentricity at the image plane. We propose a telecentric wide-field microscopic imaging system integrating a variable numerical aperture controlled microscope objective (VNAMO) and an electrically tunable lens (ETL) for enhanced depth-resolved imaging of optically thick samples. The telecentric configuration ensures uniform magnification and minimizes parallax errors across the field of view. The VNAMO dynamically adjusts resolution and depth of field, while the ETL enables rapid, non-mechanical axial scanning without

sample disturbance. Together, these elements provide flexible control over imaging parameters, allowing high-contrast, high-resolution, and telecentric image across varying depths. This system is ideal for biomedical and industrial applications requiring precise, volumetric analysis with minimal optical distortion.

About the Speaker: Dr. Gyanendra Sheoran is an Associate Professor in the Department of Applied Sciences(Physics). He did his Ph.D. from IIT Delhi, India and served as a postdoctoral fellow in the School of Chemical and Bio-Medical Engineering, Nanyang Technological University, Singapore. His research areas include Optical imaging and instrumentation, Digital holography, Spectral Imaging, Biomedical optics and Microwave Holography. He has published more than 115 publications in peer-reviewed journals and International conferences and 2 Indian National Patents. He is also an Assessor of the National Accreditation Board for Testing and Calibration Laboratories (A Board of Quality Council of India) as per ISO17025:2017 for assessing the Optical calibration laboratories in India.

Invited talk - Dr. Lars Loetgering

Speech Title: *Ptychography and the principle of reciprocity*

Abstract: Ptychography is a label-free phase imaging technique that revolutionized microscopy in spectral domains where high-quality lenses are challenging to come by, including x-rays, extreme ultraviolet, terahertz radiation and electrons. In recent years, related techniques have emerged that utilize ptychography for visible light microscopes diffraction tomography and high throughput whole slide imaging. In my talk, I will give an overview of the several flavors of ptychography. Moreover, I compare ptychography to related techniques, including structured illumination microscopy (SIM) and image scanning microscopy (ISM) using the principle of reciprocity. Several experimental and theoretical challenges remain to be addressed.

About the Speaker: Dr. Lars Loetgering is a research scientist at Carl Zeiss Microscopy in Germany, Jena. He earned his PhD in Physics at Technical University Berlin, where he developed novel algorithms for computational microscopy using x-rays. Subsequently he pursued postdoctoral positions working on EUV lensless imaging at the Advanced Research Center for Nanolithography, Amsterdam, and at the University of Jena. His current research spans from fluorescence microscopy to numerical wave propagation, inverse design, and machine learning.

Session 13 (A102) - Microscopy and Tomography (III)

Chair: Prof. Maciej Trusiak

Invited talk - Dr. Mikolaj Rogalski (14:00 – 14:30)

Speech Title: *Hybrid Fourier ptychography and transport of intensity equation phase microscopy*

Abstract: This work presents a hybrid computational imaging approach that combines Fourier Ptychographic Microscopy (FPM) with the Transport of Intensity Equation (TIE) to achieve accurate and robust phase reconstruction across the full spatial frequency spectrum. While FPM offers high-resolution, wide-field imaging, it struggles to recover low spatial phase frequencies, especially in optically thick samples. The presented method addresses this limitation by supplementing standard FPM data with a single, defocused brightfield image used in TIE-based recovery. This enables enhanced phase reconstruction and improves contrast for subtle features.

About the Speaker: Mikołaj Rogalski is a postdoctoral researcher in the QCI lab at Warsaw University of Technology, working in the field of computational imaging and optical microscopy. His research focuses on 2D and 3D quantitative phase imaging, digital holography, Fourier ptychographic microscopy and lensless holographic methods for biological imaging.

Invited talk - Prof. Rakesh Kumar Singh (14:30 – 15:00)

Speech Title: *Polarization-Resolved Wide-Field Microscopy for Live Cell Imaging*

Abstract: Quantitative phase imaging (QPI) enables high-resolution visualization of intracellular morphology in transparent biological specimens, making it ideal for live cell imaging. We have developed a novel single-shot polarization digital holographic microscope (PDHM) to enhance QPI sensitivity to intracellular organization and structural anisotropy. The single-shot PDHM captures the full 2×2 Jones matrix with high spatial resolution, we then applied Jones matrix decomposition to extract birefringence, diattenuation, and inhomogeneity, revealing quantitative differences in anisotropy across cell types. Also, a specially oriented cube beam splitter enables double field-of-view acquisition by folding two sample regions onto the same sensor, allowing real-time polarization-contrast imaging. The system was validated on standard optical elements and applied to live MCF-7 breast cancer cells, MCF-10A cells, and U-87 MG glioblastoma cells. We further applied deep learning to monitor blood coagulation dynamics, enabling rapid evaluation of anticoagulant efficacy. This framework supports dynamic, wide-field, polarization-resolved QPI for biomedical research and diagnostics.

About the Speaker: Rakesh Kumar Singh is an Associate Professor at the Department of Physics, IIT (BHU), India. He obtained his master's degree from the BHU and his Ph.D degree from the IIT Delhi. After completing his Ph.D. thesis, he worked as a post-doctoral researcher at the University of Oulu, Finland, and later moved to the University of Electro-Communications (UEC), Tokyo, Japan, as a fellow of the Japanese Society of Promotion of Science (JSPS). Dr. Singh has been a visiting researcher at the National University of Ireland, Denmark Technical University, Tel Aviv University, Bar Ilan University, Israel, and Huaqiao University, China. His research work is in the area of Optics and Photonics, such as computational imaging, Optical Metrology, coherence optics, digital holography, laser speckle, etc. He is a senior member of the SPIE, Optica, and a life member of the Optical Society of India.

Invited talk - Dr. Vinoth Balasubramani (15:00 – 15:30)

Speech Title: *Adaptive Optics from Microscopy to Tomography: Illuminating the Brain*

Abstract: Adaptive optics (AO), originally developed for astronomy to overcome the blurring effects of Earth's atmosphere, is now transforming neuroscience by enabling sharper, deeper views of the brain. In microscopy, AO corrects optical aberrations caused by scattering tissue, allowing researchers to capture cellular and subcellular details with unprecedented clarity. When extended to techniques such as Holographic tomography, AO enhances imaging depth and resolution, making it possible to probe neural circuits and brain function in ways that were once out of reach. In this talk, I will trace the journey of AO from its astronomical beginnings to its applications in advanced microscopy and tomography for neuroscience. Drawing on developments in wavefront sensing, computational correction, and multimodal imaging, I will highlight how AO is helping neuroscientists see deeper, measure more precisely, and move closer to unlocking the complexities of the brain.

About the Speaker: Dr. Vinoth Balasubramani is a Senior Research Fellow and Optical Team Lead at King Abdullah University of Science and Technology (KAUST), Saudi Arabia. He is a multidisciplinary optical physicist and engineer specializing in advanced microscopy, holographic tomography, adaptive optics, and biomedical imaging for neuroscience and life sciences. His research has been recognized with multiple international honors, including the *Emerging Research Scientist Award*, the *Outstanding Graduate Award (Taiwan)*, the *CTCI Research Scholar Award*, and several best presentation awards at international conferences. He has delivered invited talks at leading institutions worldwide, including OSA-DH, MIT, Cambridge, and UCLA, and continues to advance next-generation optical imaging technologies.

Contributory talk - Paulius Zakarauskas (15:30 – 15:45)

Speech Title: *Micro processing of sapphire using femtosecond deep UV fabric pulses*

Abstract: We present a high-resolution microfabrication approach for sapphire using femtosecond deep ultraviolet (DUV) laser pulses, aiming to fabricate diffractive optical elements. Sapphire's exceptional optical and mechanical properties make it an ideal material for optical applications [1], but its hardness and transparency pose significant challenges for conventional processing. In contrast to lithography, which requires complex, multi-step procedures, our method uses direct laser ablation with 257 nm femtosecond pulses, followed by wet etching and annealing, to enable precise and flexible patterning. This technique offers a compelling alternative to traditional lithographic methods, combining high resolution with reduced fabrication complexity for the production of diffractive optics and micro-optical components [2].

Ablated and wet-etched regions were characterized according to ISO standards using a profilometer with a vertical resolution of 12 nm. The results were analyzed based on two variables: ablation depth and average surface roughness of the modified areas, as shown in Fig. 1. After etching with 5% HF acid, we achieved an average surface roughness (Sa) of less than 100 nm. These findings demonstrate that femtosecond DUV laser processing, when combined with wet etching and/or annealing, enables high-resolution and high-quality structuring of hard, transparent materials like sapphire.

About the Speaker: Laser Research Center, Vilnius University, Lithuania

Contributory talk - Marta Berholts (15:45 – 16:00)

Speech Title: *Quantum watch: tracking time without ticks*

Abstract: This talk presents the concept of a quantum watch, developed during my postdoctoral research at Uppsala University in the HELIOS laser laboratory [1]. The system is based on a helium atom excited into a coherent superposition of Rydberg states using an ultrashort, broadband laser

pulse. These highly excited states, with long lifetimes and large spatial extent, form a Rydberg wave packet that evolves in time.

The interference between multiple Rydberg states produces quantum beats in the photoelectron yield, encoding precise timing information (see Fig. 1). We observed a rich beat structure near the helium ionization threshold and found excellent agreement between experimental results and simulations.

Unlike traditional clocks that count discrete ticks, this quantum watch measures time through evolving quantum fingerprints, enabling femtosecond-scale resolution without a counter. This approach opens new possibilities for ultrafast time-resolved spectroscopy and quantum control.

About the Speaker: Institute of Physics, University of Tartu, Estonia

Session 14 (A111) - Advanced Manufacturing

Chair: Dr. Gabrielius Kontenis

Invited talk - Dr. Darius Gailevičius (14:00 – 14:30)

Speech Title: *Photonic crystals in Laue regime*

Abstract: Typically, photonic crystals (PhCs) are associated with a periodic distribution of refractive index with lattice constants on a subwavelength scale. Smart engineering enables non-traditional light manipulation, including the use of omnidirectional reflectors, switching devices, and advanced sensors. In terms of optical modes of operation, associated with the visible or sometimes the near-infrared range the lattice constants are achievable either by planar lithography (single or multi-layer), laser additive manufacturing, self-assembly, deposition-based methods, which in their way provide superb resolutions, but either limit the dimensionality of the structure, the lattice geometry or are high resolution along limited dimensions (e.g. planar). However, with a shift in paradigm moving from the Bragg-like conditions (sub) to the Laue diffraction (sup-wavelength), one can achieve both transmittance and dispersion control with lower constraints in resolution and added benefit of moving in the realm of bulk processing and optical grade materials. This is important for high-intensity laser applications, where optically induced damage can be an issue, and the technological steps to have resilient photonics are more complicated. This Laue PhC concept is presented here.

About the Speaker: Darius Gailevičius is working at Vilnius University, currently in the Laser Micromachining Group, focusing on various approaches to centering and direct laser writing to produce volume and other types of optical elements. Refractive index distribution and spatial periodic arrangements are particular topics of interest, especially their applications in laser cavities.

Invited talk - Prof. Domas Paipulas (14:30 – 15:00)

Speech Title: *Direct fabric writing with UV femtosecond pulses: Advancing Diffraction-Based Photonics in Transparent Dielectrics*

Abstract: Direct laser writing (DLW) with ultrafast lasers has become a staple technology for advanced material processing. However, one highly sought yet underdeveloped application is the direct recording of diffractive optical elements (DOEs) in dielectric materials. The challenge to precisely control the spatial phase distribution is successfully demonstrated only in bulk recording, where laser-induced tiny changes in optical properties can be accumulated with multilayer processing. While effective, this method is time-consuming and significantly limits design flexibility. Using ultraviolet wavelengths in femtosecond microprocessing offers several advantages over longer IR pulses. Most notably, UV processing achieves better focusability with low numerical aperture optics, enabling the creation of smaller feature sizes (<10 μm) with conventional high-speed laser scanning setups. Additionally, operating in the linear absorption regime—or by minimizing the multi-photon absorption order in high-bandgap materials—allows for precise control over the geometry of ablated craters in optically transparent dielectrics. Our research on UV ablation in traditional optical glasses, such as fused silica and soda-lime glass, demonstrates that crater depth can be controlled with a precision of 50 nm by fine-tuning pulse energy (Fig. 1a). Moreover, the depth growth exhibits linear tendencies during multi-pulse processing. The resulting crater bottom regions display exceptionally low roughness, comparable to untreated material surfaces. These findings open new possibilities for fabricating superficial phase patterns through direct laser ablation alone: using an iterative Fourier transformation algorithm (IFTA) for DOE design and optimizing the crater geometries, good efficiency (>30 %) holograms at binary or multi-level complexity can be rapidly produced, which could be applicable in a wide variety of photonic applications Fig. 1b,c). Shorter wavelength provides other advantages in the integration of spatially structured volumetric phase elements in hard materials such as sapphire. The universality, flexibility,

and reasonable cost of this technology open new opportunities in rapid prototyping and iterative testing of DOE devices for many photonics applications

About the Speaker: Prof. Domas Paipulas is a scientist with extensive experience in femtosecond micromachining and serves as the group leader of the Femtosecond Micromachining Laboratory at Vilnius University’s Laser Research Center (LRC) in Lithuania. He has been working in this field since 2007 and has played a key role in establishing the femtosecond machining laboratory at LRC. His primary research focus is on "Femtomachining for Photonics Applications," which includes employing ultrafast lasers for laser micromachining, studying light-matter interactions, developing integrated photonics, designing optical systems, and more. He has published over 60 papers and is the co-author of two European patents.

Invited talk - Prof. Jyrki Saarinen (15:00 – 15:30)

Speech Title: *Rapid prototyping for imaging and beyond – 3D printed centimeter-scale optics*

Abstract: Rapid prototyping is essential for saving both time and money, as well as for enabling concrete testing and comparison of various alternative options and ideas. 3D printing, also known as additive manufacturing, significantly reduces the manufacturing time of lenses from days or weeks to mere hours. Additionally, 3D printing facilitates the creation of freeform optics, which feature arbitrary surface profiles without translational or rotational symmetry. However, most 3D printing methods struggle to meet the stringent requirements for imaging quality, such as micrometre-level surface accuracy and nanometer-level surface roughness, without laborious and sometimes impractical post-treatments. We present state-of-the-art results for illumination and imaging-level 3D printed optics based on our inkjet-printing-based method. We also explore the novel possibilities introduced by multimaterial 3D printing.

About the Speaker: Professor Jyrki Saarinen is currently heading the Centre for Photonics Sciences at the University of Eastern Finland. He received D.Sc. (Eng.) from Helsinki University of Technology (nowadays Aalto University) in 1995, where he is still Adjunct Professor on Micro-Optics. Recently, his research topic has been 3D printing in photonics and, in general, photonics applications and commercialization. He is an Optica Fellow.

Contributory talk - Edvinas Aleksandravičius (15:30 – 15:45)

Speech Title: *Fabrication of optical phase elements in bulk sapphire by ultrashort UV pulses*

Abstract: Sapphire possesses many desirable properties for use in photonics, such as a broad transmission spectrum, a high damage threshold, and chemical inertness. Because of these properties, sapphire is commonly used as a substrate for deposition and subsequent direct laser writing of other materials. However, there are few examples of photonic crystals in bulk sapphire itself, as there are many challenges when it comes to fabricating optical phase elements in it. We show that the use of ultrashort pulses <100 fs as well as UV femtosecond pulses can alleviate many of these issues, particularly the formation of cracks in larger structures. We provide examples of functional photonic crystal spatial filters up to 3 mm in diameter, 500 µm below the surface, surpassing previous records by over an order. The maximum refractive index contrast achieved by this method is 3-4 10-3.

About the Speaker: Laser Research Center, Vilnius University, Lithuania

Contributory talk - Aditya Savio Paul (15:45 – 16:00)

Speech Title: *Chaos-Driven Event Characterization*

Abstract: Ideal methods in generating computationally holistic representations of dynamic events/targets are enunciated by making observations from varied spatial locations. This research considers capturing (applicable over different sensor suites) transient events, characterised by constantly changing states. In the framework of sampling optimally spatial points, a chaotic sampler is developed, based on deterministic nonlinear solutions. These samples are used to train a neural radiance field model to produce volumetric dense representations. The chaotic sampling pattern improves scene coverage and reduces redundancy, enabling efficient data acquisition without compromising reconstruction fidelity. The resulting field model is robust towards illumination effects, supporting photorealistic rendering from novel viewpoints. This representation is further transformed into temporal holographic states, enabling near-realistic 3D visualization, optimizing the depth cues. Our results discuss reconstruction fidelity and holographic realism compared to conventional grid-based sampling approaches. Besides capturing events modelled over long-term predictions like orbits of asteroids and comets, this approach finds applicability towards computational imaging and temporal investigations.

About the Speaker: Institute of Physics, University of Tartu, Estonia

Session 15 (B103) - Holography and Microscopy

Chair: Dr. Tatsuki Tahara

Invited talk - Prof. Mariana Potcoava

Speech Title: *Incoherent Holographic Lattice Light-Sheet Microscopy*

Abstract: This talk provides a comprehensive review of IHLLS microscopy from the perspective of optics. Emphasis is placed on the advantages that IHLLS detection arm configurations present, given the degree of freedom gained by uncoupling the excitation arm of the LLS microscope and the IHLLS detection arm but keeping the z-galvo scanning for both detection systems. The new imaging properties are first highlighted in terms of optical parameters and how these have enabled biomedical applications. Then, based on the multiple possibilities for generating the LS/LLS in the microscope (using Gaussian and Bessel beams), a systematic comparison of their optical performance is presented. Finally, the novel optical implementations in the IHLLS detection arm, enabled by advances in optics and photonics, are highlighted. These advancements allow for new ways of creating and using light sheets in microscopy, particularly in areas like biomedical imaging.

About the Speaker: Mariana Potcoava is a dedicated research scientist with 25 years of hands-on R&D experience in academia and in industry. Her experience involves programming, theoretical and practical work in optics, spectroscopy, lasers, image processing, and complex optical instrumentation development for biomedical research areas. Throughout her work, she has pursued research to design and build optical instrumentation, requiring the integration of various electro-optics subsystems for imaging characterization, with micrometer and nanometer resolution. As a graduate student in applied physics at the University of South Florida (2009), she built a digital holographic microscope for human eye retinal scanning with micrometer resolution. During her employment at the 3i company (2015-2016), she worked with dedicated professionals to build multiple lattice light-sheet microscopes (LLSM) at 3i's office and in the field, which gave her better skills in building commercial microscopes. Returning to academia at the University of Illinois at Chicago (UIC), she built a custom version of LLSM to provide a previously unavailable live cell imaging resource for the UIC research community. Her current research at UIC is to develop technologies to improve the resolution of the LLSM and other 3D-resolved fluorescent microscopes to help researchers and medical professionals better understand diseases at a molecular level, which could lead to improved diagnostics and therapeutic strategies.

Invited talk - Dr. Egidijus Auksorius

Speech Title: *High-Resolution Dynamic Full-Field Optical Coherence Microscopy: Illuminating Intracellular Activity in Deep Tissue*

Abstract: Dynamic full-field optical coherence microscopy (d-FF-OCM) is a label-free interferometric imaging method that maps intrinsic subcellular motions in cells and tissue to produce fluorescence-like contrast. Existing systems struggle to maintain high resolution deep inside highly scattering tissues. We introduce a high-resolution d-FF-OCM that overcomes this limit, achieving nanometer-scale resolution up to ~100 μm depth. The setup combines 100× oil-immersion objectives (NA = 1.25) with a laser-pumped incoherent white-light source, plus real-time reference-arm adjustment to preserve signal and contrast while focusing deeper. Applied to fresh ex vivo mouse liver and small intestine, it revealed structures invisible to conventional OCT—including sinusoidal microvasculature and organized hepatic cell layers, as well as enteric neural plexuses and intestinal crypts—entirely label-free. By uniting deep penetration with high spatial resolution in scattering tissue, this advance offers a powerful tool for biological microscopy, spanning fundamental research to rapid intraoperative pathology.

About the Speaker: Egidijus Auksorius is the team leader of the Optical Coherence Microscopy Group at the Center for Physical Sciences and Technology in Vilnius, Lithuania. He received his Ph.D. in physics from Imperial College London for work on super-resolution STED microscopy and fluorescence-lifetime imaging. He subsequently worked as a research fellow at Harvard Medical School and at Institut Langevin in Paris on full-field optical coherence tomography (FF-OCT). He later served as a senior researcher at the Polish Academy of Sciences, applying Fourier-domain FF-OCT to eye imaging. His current research interests include the development and application of high-resolution FF-OCT for biomedical imaging.

Contributory talk - Dmytro Danilian (15:30 – 15:45) Online talk

Speech Title: *Reusable magnetic mixture of CuFe2O4–Fe2O3 and TiO2 for photocatalytic degradation of pesticides in water*

Abstract: Photocatalysis is a promising treatment method to remove pollutants from water. TiO2-P25 is a commercially available model photocatalyst, which very efficiently degrades organic pollutants under UVA light exposure. However, the collection and the recovery of TiO2-P25 from cleaned water poses significant difficulties, severely limiting its usability. To address this challenge, we have prepared a sintered mixture of TiO2-P25 nanomaterials and magnetic CuFe2O4–Fe2O3 nanocomposites. The mixture material was shown to contain spinel ferrite, hematite and maghemite structures, copper predominantly in Cu2+ and iron predominantly in Fe3+ state. The CuFe2O4–Fe2O3 and TiO2-P25 mixture demonstrated magnetic collectability from processed water and photocatalytic activity, which was evidenced through the successful photodegradation of the herbicide 2,4-D. Our findings suggest that the sintered mixture of CuFe2O4–Fe2O3 and TiO2-P25 holds a promise for improving photocatalytic water treatment, with the potential to overcome the current photocatalyst recovery issue.

About the Speaker: Institute of Physics, University of Tartu, Estonia

Contributory talk - Jawahar Desai (15:15 – 15:30) Online talk

Speech Title: *Three-dimensional one-shot imaging for single or multiple in-focus planes*

Abstract: Incoherent digital holography (IDH) has made 3D imaging possible under fluorescent and other thermal light sources. We herein introduce a technique for 3D imaging that enables the reconstruction of only a specific transverse plane or multiple planes at a time from the same single-shot recorded pattern according to the user's wishes and by postprocessing this pattern. The multiple features of this single-shot technique make it cost-effective and time-efficient since different situations of the observed scene can be reconstructed from the same IDH without the need to record another IDH.

About the Speaker: School of Electrical and Computer Engineering, Ben-Gurion University of the Negev, Israel

Contributory talk - Yunhui Gao (15:00 – 15:15) Online talk

Speech Title: *Ultra-High-Resolution Computational Wavefront Sensing for Complex Optical Fields*

Abstract: Quantitative characterization of optical wavefronts is fundamental to applications spanning both scientific research and industrial technologies. However, existing wavefront sensors often compromise between spatial or temporal resolution, compactness, or versatility. Here, we present a single-shot, reference-free computational wavefront sensing method capable of characterizing ultra-complex optical fields. By exploiting the intrinsic physical properties of wavefronts, we developed SAFARI (Spatial and Fourier-domain Adaptive Regularized Inversion), a generalized computational

framework that robustly reconstructs wavefronts from a single exposure. When integrated with a diffuser-based wavefront sensor, SAFARI enables accurate characterization of highly aberrated or turbulent wavefronts, structured light with ultra-high topological charges, and dense speckle fields. The resulting sensor system combines compactness, high versatility, and ultra-high spatial resolution, matching or surpassing the performance of conventional task-specific solutions.

About the Speaker: Department of Precision Instrument, Tsingua University, Beijing, China

Contributory talk - Sai Deepika Sure (15:45 – 16:00) Online talk

Speech Title: *Engineering the field of view dynamically with coded aperture imaging*

Abstract: This study presents a novel incoherent imaging technique designed to engineer the field of view without sacrificing magnification and resolution1. In this technique, we introduced a coded phase mask (CPM) into the imaging system to capture multiple regions of an object, some outside the camera's field of view. We synthesized CPM for N different scattering phases2 to obtain distinct sparse points of each scattering phase on the camera to enlarge the field of view. By integrating the CPM into the system, the field of view is expanded3, and the objects that are lost due to a limited field of view start to appear on the camera. The images for each object taken over time are captured with respect to the corresponding CPM and deconvolved computationally via Wiener deconvolution4. Subsequently, the objects that are individually reconstructed are multiplexed to acquire the final image of an object with a relatively high signal-to-noise ratio (SNR).

About the Speaker: School of Electrical and Computer Engineering, Ben-Gurion University of the Negev, Israel

Poster Session (16:00 – 17:00)

Poster1: Samuel I. Zapata-Valencia

Poster title: *Multispectral detection imaging validation for single-pixel microscope*

Abstract: A single-pixel microscopy system for multispectral imaging was validated. The setup integrates a white light source with a camera-based spectrometer to acquire 16 spectral images of a USAF test target, with a spectral step of 10 nm. The combination of single-pixel imaging techniques and spectrometry enables data acquisition under low signal-to-noise ratio conditions. System performance was assessed through reflectance and fluorescence imaging of both biological and non-biological samples, including spatial resolution characterization using the USAF resolution test.

About the Presenter: Universitat Jaume I, Castelló, Spain

Poster2: Manivel Rajan

Poster title: *Luminescence properties and electronic excitations of Cs2HfF6 studied by excitation using 10 keV electrons and VUV photons*

Abstract: Scintillator materials have a wide range of applications, from a simple ionizing radiation detection to advanced medical and scientific solutions that require superior time resolution [1]. The ternary wide-gap fluorides are promising candidates that enable the combination of cross-luminescence (CL) and Cherenkov radiation to achieve sub-nanosecond time resolution [2]. Cross-luminescence alone, as seen in binary wide-gap fluorides like BaF2, KF, RbF [3] and CsF [4], has demonstrated sub-nanosecond time resolution. Additionally, for high-density bright scintillators, the combining of Cs with Hf has resulted in a noticeable photon conversion efficiency in cesium hafnium hexachloride, Cs2HfCl6 [5]. In this context, we prepared both powder and single crystal samples of cesium hafnium hexafluoride, Cs2HfF6, using the co-precipitation method [6] and the slow evaporation solution growth method, respectively. The hexagonal crystal structure and lattice parameters of the synthesized compound were determined by means of XRD analysis for the powder sample. The cathodoluminescence of Cs2HfF6 and its temperature-dependent decay kinetics were studied using a pulsed 10 keV electron beam in Tartu. Time-integrated luminescence spectroscopy of the Cs2HfF6 powder under excitation by VUV photons at the FinEstBeAMS beamline of MAX IV laboratory [7] unveiled a single emission band with the maximum at 4.2 eV at 7 K. This broad emission band is attributed to self-trapped excitons (STE), as the excitation spectrum for this emission shows the most intense peak at 9.8 eV near the intrinsic absorption edge. This peak is due to the direct formation of excitons, but the 4.2 eV emission can also be excited at higher photon energies in the fundamental absorption region. The band gap value □11.4 eV was estimated from the excitation spectra. This value is in good agreement with the features observed in the reflection spectrum of the Cs2HfF6 single crystal measured at 7 K. The reflection and excitation spectra will be compared with the published results of electronic band structure calculations [8] and the data from the public AFLOW database. The peculiarities of relaxation processes leading to the appearance of either intrinsic (CL, STE) or extrinsic emissions will be discussed.

About the Presenter: Institute of Physics, University of Tartu, Estonia

Poster3: Karolis Adomavičius

Poster title: *High-throughput spatio-temporal optical coherence tomography*

Abstract: Spatio-Temporal Optical Coherence Tomography (STOC-T) enables high-speed retinal imaging but suffers from limited sensitivity. We present a high-throughput (HT) optical design that

improves STOC-T sensitivity by up to 3.5× (5.5 dB). This is achieved by replacing the standard 50/50 beamsplitter with a 90/10 one and using a pupil-plane pick-off mirror to maximize light delivery and signal detection. We validate the design on reflective and scattering phantoms, as well as *in vivo* human retina, demonstrating significant SNR gains without increasing source power. This simple, light-efficient approach makes STOC-T more suitable for realtime, low-signal imaging applications.

About the Presenter: Center for Physical Sciences and Technology (FTMC), Vilnius, Lithuania

Poster4: Heberley Tobon

Poster title: *Simultaneous reflection and transmission infrared single-pixel microscopy using adaptive optics and compressive sensing techniques*

Abstract: A cost-effective, multimodal single-pixel microscope (SPM) is presented. Advanced image reconstruction, in terms of resolution is achieved through the optimized SPM optical system design. Wavefront distortions are corrected using adaptive optics, while compressive sensing allows for reduced data acquisition without sacrificing resolution. Through this combination of technologies, efficient image reconstruction is facilitated, positioning the proposed SPM as a valuable tool for high-quality imaging in biomedical and material science applications.

About the Presenter: Universitat Jaume I, Castelló, Spain

Poster5: Amit Yadav

Poster title: *Depth imaging through dynamic scattering media by synthetic wavelength*

Abstract: Optical imaging plays a crucial role in diverse applications. Despite its significance, the performance of optical imaging systems is often compromised by aberrations and distortions. For instance, imaging through scattering media remains a significant challenge for contemporary optical imaging systems. This difficulty is further amplified in dynamic scattering environments, where the scattering medium itself exhibits temporal fluctuations, as seen in scenarios involving fog, flowing fluid. Several techniques have been demonstrated to be effective in overcoming the obstacles of scattering. However, estimating the depth behind the scattering media remains a challenging task due to the incoherent nature of the scatterer. In this work, we present a common-path synthetic wavelength imaging (SWI) technique for depth imaging behind the scattering media.

About the Presenter: Indian Institute of Technology - BHU, Varanasi, India

Poster6: Amaljith Chandroth Kalliyadan

Poster title: *Tunable Si-based nano grating for sensing and light modulation applications*

Abstract: Periodic metamaterials (MTMs) exhibit various resonance characteristics that depend on the period and composition of the layers used in their design. One notable phenomenon is guided mode resonance in grating structures. Recently, we reported such a device based on a 700nm deep silicon nano grating filled with nematic liquid crystals (NLC) in the nano gaps of 560nm, enabling fast modulation and tuning of TE-polarised light on the device1. In this work, we concentrated on studying the effect of phase modulation with the NLC for the TM polarised light. Simulations have achieved a phase modulation of ~120°, and initial experimental studies showed a tuning of ~20nm, while the simulation predicts 113nm tuning, suggesting the potential for a complex liquid crystal behaviour within the nano cavities. Resonance mode calculations in these nano cavities will be presented in an attempt to explain the different findings. The phase modulation capability is important for next generation fast spatial light modulators.

About the Presenter: Ben Gurion University of the Negev, Israel

Poster7: Francis Gracy Arockiaraj

Poster title: *Quantitative Phase Imaging for Imaging through Scattering Media*

Abstract: We have developed a method of quantitative phase imaging (QPI) for imaging through scattering media. As a first step, we explored phase imaging in invasive mode. In this preliminary study, we proposed a quantitative phase imaging approach through a scatterer using the self-reference on-axis coherent interferometer method, wherein four phase-shifted holograms with relative phase shifts are recorded between the reference and object beams. These holograms are then superposed to form a complex hologram for both the point spread hologram and the object hologram. This superposition, followed by the deconvolution process, enables the retrieval of the phase information of the object when it is occluded by a scattering medium. The phase map of the object recovered under a strong scatterer is explored in this study. This phase recovery process finds a wide range of applicability in medical imaging.

About the Presenter: Institute of Physics, University of Tartu, Estonia

Poster8: Elizaveta Dmitrijeva

Poster title: *Characterisation of Fabry–Pérot resonators fabricated via grayscale UV lithography and their application to the investigation of strongly coupled systems*

Abstract: The research of strongly coupled systems is of great importance due to their high potential for practical applications, which are expected to lead to new technological advancements in optics and photophysics, photochemistry, quantum mechanics, polaritonic chemistry, hydrogen technologies, as well as in the study and utilisation of room-temperature Bose–Einstein condensation1–6.

The main objective of this work was to investigate polaritonic states arising in strongly coupled systems using a back focal plane spectrometer based on the Olympus BX51 microscope7. The optical properties of resonators fabricated via grayscale UV lithography were analysed in parallel8,9. The transfer matrix method (TMM) was employed to determine structural parameters such as layer thicknesses and refractive indices, which are crucial for shaping the optical response of the cavities.

An important advantage of grayscale lithography is that it produces multiple resonators with different thicknesses within a single fabrication cycle. This significantly increases efficiency and flexibility compared to traditional fabrication methods.

Based on these results, a deeper understanding of Fabry–Pérot resonators designed to study strongly coupled systems can be achieved. This research demonstrates that grayscale UV lithography is highly suitable for fabricating high-quality optical cavities and contributes more broadly to exploring light–matter interactions, paving the way for novel photonic structures and applications.

About the Presenter: University of Tartu, Institute of Physics

Poster9: Austėja Trečiokaitė

Poster title: *Full-field optical coherence tomography with a digital defocus correction*

Abstract: Full-field optical coherence tomography (FF-OCT) is an interferometric imaging technique that employs a spatially and temporally incoherent light source to capture high-resolution images deep within biological tissue. Despite its advantages, image quality can be severely degraded by optical aberrations, particularly sample defocus, which restricts the effective imaging depth. In this work, we demonstrate that sample-induced defocus in strongly scattering media can be digitally corrected over a broad range, provided that the optical path lengths of the sample and reference arms are precisely

matched. We validate this digital defocus correction on both reflective and scattering samples, achieving robust compensation for defocus offsets of up to 1 mm. This approach significantly enhances image fidelity without requiring additional hardware modifications, highlighting the potential of digital correction strategies to extend the performance and applicability of FF-OCT in biomedical imaging.

About the Presenter: Center for Physical Sciences and Technology (FTMC), Vilnius, Lithuania

Poster10: Eulalia Puig I Vilardell

Poster title: *Modeling 5D Information Encoding in I-COACH Using Spiral Phase Masks*

Abstract: Interferenceless Coded Aperture Correlation Holography (I-COACH) enables the capture of high-dimensional object information using single-shot intensity measurements on a monochrome sensor. In this study, we present a simulation-based analysis of an I-COACH system designed to encode five-dimensional information: three-dimensional spatial structure, wavelength, and orbital angular momentum (OAM). Object information is modulated using a spiral phase mask, introducing vortex beams as carrier beams, which allows to encode the object information across distinct OAM channels. By systematically simulating the system's response to different spatial depths, wavelengths, and spiral phase profiles, we construct a five-dimensional point spread function (PSF) library spanning 3D space, spectral content, and orbital angular momentum (OAM). Object reconstruction is performed via deconvolution against this PSF library, allowing separation and retrieval of depth, wavelength, and OAM. The simulations provide insights into the system's optical encoding and resolving capabilities.

About the Presenter: Institute of Physics, University of Tartu, Estonia

Poster11: Narmada Joshi

Poster title: *Coded Aperture Imaging with Polarization-Dependent Encoding*

Abstract: Polarization-based phase modulation provides a new pathway for extending coded aperture imaging (CAI) beyond conventional spatial and spectral dimensions. Here, we demonstrate a polarization-resolved 3D imaging method. Polarization-based phase modulation provides a new pathway for extending coded aperture imaging (CAI) beyond conventional spatial and spectral dimensions. Here, we demonstrate a polarization-resolved 3D imaging method that employs a single birefringent optical modulator together with a standard image sensor, avoiding the need for polarization-sensitive detectors. The technique introduces a polarization-dependent blur that enables a unique one-to-one mapping between intensity and polarization. We present the theoretical model and experimental proof of concept, showing that polarization information can be efficiently encoded and computationally reconstructed in a single camera shot. This polarization-enabled CAI framework offers promising opportunities for material characterization, multimodal, and birefringent imaging.

About the Presenter: Institute of Physics, University of Tartu, Estonia

Poster12: Kaisa Katre Lepmets

Poster title: *Fabrication of strongly coupled cavity arrays using grayscale UV litography*

Abstract: Strong light–matter coupling underpins emerging technologies in polaritonics, enabling hybrid states that combine photonic and excitonic properties, that are central to emerging technologies such as low-threshold polariton lasers, quantum simulators, and ultrafast optical switches – yet scalable fabrication methods remain limited. [1], [2], [3], [4], [5]

In this study, we demonstrate the fabrication of large-scale arrays of dye-doped, strongly coupled Fabry–Pérot (FP) cavities using grayscale UV lithography. By blending the photoresist AR-P3510T with

varying concentrations of Rhodamine 6G dye, we systematically investigated the impact of dye concentration on lithographic performance, including defect formation and cavity uniformity. To our knowledge, this represents the first successful use of grayscale UV lithography for the scalable production of strongly coupled FP cavity arrays, offering significant advantages over conventional fabrication techniques in terms of throughput and tunability. [6]

Our approach enabled the creation of hundreds to thousands of strongly coupled FP cavities, with the potential to accelerate fundamental research in strong light–matter coupling. Beyond basic studies, this method also provides a promising route for on-chip fabrication of polaritonic cavities, paving the way toward compact laser-like light sources and novel integrated polaritonic devices.

About the Presenter: Institute of Physics, University of Tartu, Estonia

Poster13: Tauno Kahro

Poster title: *Preparation and characterization of diffractive optical lenses by grayscale maskless photolithography*

Abstract: Miniaturization of optical systems is necessary to achieve high resolution, speed and portability [1,2]. Typically, multiple photolithography steps are required to create complex 3D microstructures. Grayscale lithography allows one to simplify the manufacturing process of 3D microfeatures, because a single lithography step can be used [1-3]. Maskless lithography can thereby be utilized, which means that design file is exposed directly onto the resist-coated wafer via a spatial light modulator [4].

In the present study, the preparation of optical lenses was carried out in an ISO5 cleanroom by using the Tabletop Maskless Aligner (µMLA, Heidelberg Instruments) with a dose control of the light source at 390 nm. Positive photoresist (AR-P 3510T, Allresist) was spin coated with a thickness of ~2.3 µm (4000 rpm, 60 s) onto cleaned glass substrates and soft-baked on a hot plate at 100°C for 60 s. To improve the adhesion of the photoresist to the glass substrates the promoter AR 300-80 new (Allresist) was applied, whereas AR 300-44 (Allresist) was used for developing the UV irradiated structures.

About the Presenter: Institute of Physics, University of Tartu, Estonia

Poster14: Erikas Tarvydas

Poster title: *Dynamic full-field optical coherence microscopy for live tissue imaging*

Abstract: Noninvasive tools that resolve fine cellular architecture deep in tissue are critical for biology and medicine. Dynamic full-field optical coherence microscopy (d-FF-OCM) provides label-free contrast by mapping subcellular dynamics. We developed an advanced d-FF-OCM platform that maintains nanometer-scale resolution nearly 100 µm beneath the surface. The approach combines high-NA oil-immersion objectives with a laser-driven broadband source and employs active reference-path adjustment to preserve image quality at depth. In freshly excised mouse liver and small intestine, the system visualized features such as sinusoidal networks, hepatocyte layers, enteric plexuses, and crypt structures that elude standard OCT. By coupling deep penetration with ultrastructural detail, this method establishes d-FF-OCM as a versatile tool for studying tissue organization and for rapid, label-free assessment in surgical pathology.

About the Presenter: Center for Physical Sciences and Technology (FTMC), Vilnius, Lithuania

Poster15: Aadil Shafi Bhat

Poster title: *Synthesis of Cu2+@SiO2 nanocomposites for antimicrobial applications*

Abstract: Mesoporous silica is widely studied for its high surface area, tunable pore size, and biocompatibility, making it attractive for antimicrobial applications. In this work, we present a modified Stöber approach for the incorporation of Cu^{2+} ions in the form of salt solutions directly into the silica mesopores during their formation, avoiding post-synthesis loading and enabling uniform distribution of copper species in the whole volume of the mesoporous silica particle. This confinement allows controlled, sustained ion release, overcoming limitations of free copper salts such as burst dosing and reduced efficacy after exposure to a wet/humid environment. The composition and morphology of synthesized nanocomposites were characterized by SEM, HRTEM, XRD, XPS, and TXRF, confirming successful incorporation and homogeneous distribution of Cu^{2+}. Preliminary results show that $Cu^{2+}@SiO_2$ demonstrates antimicrobial activity against Gram-negative bacteria Escherichia coli and Pseudomonas aeruginosa, and Gram-positive Staphylococcus aureus. This simple and scalable strategy establishes mesoporous silica as a versatile platform for durable antimicrobial coatings, medical device surfaces, and environmental hygiene technologies.

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About the Presenter: Institute of Physics, University of Tartu, Estonia

Poster16: Alessandra Imbrogno

Poster title: *Green energy storage: development of sustainable supercapacitors by direct laser writing of natural materials (SUPER-GREEN)*

Abstract: The rapid increase in demand for powered connected devices poses environmental concerns both in terms of high energy production requirements and end-of-life disposal. Implementation of eco-friendly energy storage systems and self-powered solutions is crucial to ensure future sustainability of such devices. Accordingly, SUPER-GREEN proposes the development of novel self-powered and eco-friendly supercapacitors whereby electrode materials will be fabricated by direct laser writing of biopolymers and eco-friendly materials will be used as electrolytes. The capabilities of developed structures will be assessed through demonstration of supercapacitive behaviour, towards realisation of next generation all natural green supercapacitor devices.

About the Presenter: Tyndall National Institute in Cork, Ireland

Poster17: Gregory Oxley

Poster title: *From Isolated Tools to Organized Discovery: An AI Framework for Classifying Exoplanets by Evolutionary Stage*

Abstract: Research into exoplanet analysis tools reveals that current spectral analysis tools operate in isolation, creating inefficiencies and missed opportunities for enhanced scientific discovery. The tools—ExoMAST, Eureka!, PLATON, petitRADTRANS, and SPECIES—demonstrate varying levels of community adoption but lack communication between each other, leading to repeated analyses and potential bias introduction. Recent JWST observations of WASP-39b and K2-18b illustrate this challenge perfectly: while WASP-39b achieved remarkable molecular detections (7σ to 33σ) across multiple pipelines, K2-18b's initial biosignature claims required 60+ different data reduction approaches and 250+ atmospheric retrievals to resolve disputed results. This poster proposes an AI-enhanced integration framework that connects these established community tools through machine learning interfaces to automate validation, reduce systematic biases, and prevent over-interpretation. Assessment of community usage patterns reveals that petitRADTRANS and PLATON represent the

highest-priority targets for AI integration due to their exceptional community adoption (80-95% and 70-85% respectively). The proposed approach builds upon existing infrastructure rather than requiring new telescopes or instruments, focusing on software integration that preserves the scientific rigor characterizing current methodologies while making comprehensive cross-validation routine rather than exceptional. The framework also incorporates Solar System evolutionary analogs to provide scientific context—for example, distinguishing WASP-39b's photochemically-produced SO_2 from volcanic SO_2 outgassing like on Io, enabling automated classification of planetary evolutionary stages rather than just molecular detection. Using these examples, this work demonstrates how AI could enhance automated molecular identification, confidence scoring, and evolutionary pattern recognition while maintaining the collaborative nature of astronomical research that drives discovery. By automating what currently requires months of manual analysis, this framework could accelerate the pace of exoplanet discovery and bring us closer to answering whether we are alone in the universe.

About the Presenter: Open University, UK