MINI MODES PHOTONICS SCHOOL

BOOK OF ABSTRACTS

Chęciny, Poland

6th – 8th September 2026

Invited Speakers

Sensing and microscopy: from bio to quantum

Tatevik Chalyan
Brussels Photonic Team (B-PHOT), Vrije Universiteit Brussel

Exploring the world around us and understanding how nature works since forever, we have used different sensors, first only the natural ones, such as eyes, ears, tongue, or hands. With the advancement of science and technology, nowadays a wide variety of hand-held sensors are commonly used in our daily lives. Benefiting from the fastest available tool – light, there is a continuous development of new instruments to implement optical sensing in medicine and drug delivery, field monitoring and environmental sensing, defence, and space exploration. Biosensing approaches such as refractometric sensing, fluorescence emission, or Raman scattering enable fast, precise, and targeted study of the sample of interest. Enhancing these techniques with the nonlinear and quantum nature of light allows us to study even smaller analytes or even farther events in the universe.

Dual-comb spectroscopy: good, fast, but not cheap?

Łukasz Sterczewski
Wrocław University of Science and Technology, Poland

Dual-comb spectroscopy (DCS) is an emerging technique for probing the complex optical properties of a sample in all states of matter. Compared to typical mechanically-scanned Fourier or grating spectrometers, it can provide broadband measurements in micro-to nanoseconds with high resolution. It plays an important role in optical metrology because all measured frequencies can be referenced to primary standards. However, one can ask whether it is possible to use this technique outside laboratories with portable light sources. The talk will discuss the principles and tricks to adapt DCS for portable, battery-operated instruments.

Different Minds, Better Teams. How Neurodiversity Becomes a Strength in Science and Corporate Work

Monika Wolff
Founder, Flow by Wolff

Neurodivergent people often bring exceptional strengths to scientific, creative, and technical environments. Yet these strengths do not automatically translate into team performance. They can be lost through unclear expectations, sensory overload, implicit communication, inefficient meetings, hidden knowledge gaps and decision processes that favour speed over shared understanding.

In this session, Monika Wolff shares her experience from science, consulting and neurodiversity-informed team development. The talk introduces neurodiversity through the lens of nervous system regulation and explores what changes when scientists move into corporate or interdisciplinary environments. Participants will learn how neurodiverse teams can work more successfully by making thinking visible, separating idea generation from evaluation and decision-making, and designing collaboration around different cognitive and regulatory needs.

The session includes a short interactive exercise that helps participants reflect on their own thinking patterns, strengths and collaboration needs without requiring personal disclosure or diagnosis. Participants will leave with a practical understanding of how different minds can become a source of better science, stronger teams and more sustainable innovation.

Ultrafast fiber lasers – a dual perspective from academia and industry

Mateusz Pielach
Institute of Physical Chemistry of the Polish Academy of Sciences / Fluence Technology

The most traditional career goal for people starting PhD studies is to become an academic researcher. What are the alternatives? How can a PhD degree be useful in industry, and how can you connect both worlds? This talk compares realities of research work from two different perspectives, academia and industry, using the development of all-fiber ultrafast laser systems as our roadmap. Apart from diving into the technicalities of building a femtosecond laser and using it for real-life applications such as high-precision micromachining, we will contrast the daily realities, timelines, and shifting goals of these two worlds. Finally, I will share practical survival tips to help you navigate your research successfully.

Poster Session

Quasi resonant excitation scheme for GaN visible single photon emitters.

Nilesh Dalla
University of Warsaw

In this work, we investigate defect-based single photon emitters in GaN layers grown on a sapphire substrate via MOCVD. Low-temperature (10 K) photoluminescence excitation spectroscopy was employed to probe their optical properties. We find that approximately 80% of the investigated emitters exhibit sharp spectral resonances in absorption. Excitation via these quasi-resonant states leads to an order-of-magnitude enhancement of the zero-phonon-line (ZPL) emission intensity. Furthermore, these resonances can be selectively addressed using linearly polarized light, indicating a well-defined dipole coupling. For selected emitters, we also observe significantly reduced spectral diffusion with ZPL linewidths as narrow as 138 µeV. This is substantially below the typical 1 meV linewidths reported for visible emitters in GaN. These results highlight the strong potential of GaN defect-based emitters for applications in quantum photonics.

Mid-Infrared Optical Spectrometer Based on an Ultra-Low Noise Mode-Locked Fiber Laser

Arina Ismail
Aston University

The rapid advancement of mid-infrared (Mid-IR) photonics has made it a promising field in optical research. Mid-IR spectroscopy is highly effective for gas sensing due to strong molecular absorption in this region. However, developing highly sensitive and cost-effective spectrometers remains challenging because of laser noise and limitations in Mid-IR generation. This work investigates the development of a Mid-IR spectrometer based on low-noise mode-locked fiber lasers (MLFLs). A broadband spectrum is generated through supercontinuum generation from a near-IR laser and converted into the Mid-IR region via difference frequency generation (DFG) using an $AgGaS_2$ nonlinear crystal. The study focuses on MLFL noise characterization, spectral broadening, nonlinear frequency conversion, and gas-phase spectrometer implementation to achieve broadband, sensitive, and stable Mid-IR spectroscopic measurements.

Heralding Sub-50 ps Time-Bin Photonic States via Temporal Imaging

Antoni Skoczypiec
Faculty of Physics, University of Warsaw

Quantum information encoded in time bins is robust against decoherence, but clock rates are bottlenecked by the 20-50 ps timing jitter of Superconducting Nanowire Single-Photon Detectors (SNSPDs). This resolution limit hinders high-speed architectures and quantum key distribution (QKD) rates. We address this by applying temporal imaging to magnify the arrival time separation of photons, allowing us to herald subsequent single-photon pulses from a spontaneous parametric down-conversion (SPDC) source with sub-50 ps separation. Using a fiber-coupled electro-optic phase modulator (EOPM) as a time lens between two dispersive single-mode fibers, we magnified a 30 ps delay to approximately 1.0 ns, achieving a temporal magnification factor of 30. This technique successfully resolves time bins significantly smaller than native detector resolution, enabling ultrafast clock rates for high-dimensional quantum logic.

Experimental Investigation of Temperature Effects on All-Optical Nonlinear Activation Functions Based on a Fabry-Pérot Laser

Milica Dišić
University of Belgrade School of Electrical Engineering

Temperature control is routinely used for wavelength stabilization in semiconductor lasers, yet its impact on nonlinear activation behavior in photonic neural networks (PNNs) lacks systematic characterization. In this work, we experimentally investigate the role of temperature in reshaping all-optical nonlinear activation functions (NAFs) based on an injection-locked Fabry–Pérot laser diode. Unlike wavelength detuning, temperature simultaneously affects multiple lasing parameters, including gain spectrum, longitudinal mode competition, and resilience of the FP-LD to injected optical signals. Through controlled laboratory measurements, we analyze how these effects are intertwined to influence the key FP-LD NAF parameters. The results reveal a direct coupling between thermal tuning as an extremely efficient approach to NAF reconfiguration, further suggesting the importance of thermal sensitivity insights relevant for robust PNN design.

Measuring Population-Dependent Energy Shifts of Rydberg Atoms in Hot Vapor

Tomasz Prokop
University of Warsaw

We demonstrate a method to measure Rydberg level energy shifts induced by Rydberg atom interactions in thermal vapors. We believe this approach could provide a valuable tool for accurately modeling optical bistability.

HOPE for Photoacoustic Imaging of Lipids: Hybrid Optical Parametrically-oscillating Emitter at 1725 nm for Quantification of Intrahepatic Steatosis

Najia Sharmin
The University of Hong Kong

Photoacoustic microscopy (PAM) in the 1.7-μm absorption window is a promising technique for label-free imaging of lipids in various biological tissues. However, the performance of current nanosecond laser sources at this wavelength has constrained the capabilities of lipid-based PAM. In this study, we present a 1725-nm hybrid optical parametric oscillator emitter (HOPE) featuring a narrow bandwidth of 1.4 nm, an optical signal-to-noise ratio (OSNR) of approximately 34 dB, and a high spectral energy density reaching 480 nJ/nm. The enhanced laser performance substantially improves photoacoustic imaging sensitivity, enabling detailed visualization of intrahepatic lipid distributions with a maximal contrast ratio of 23.6:1. Furthermore, segmentation-based analysis of the PAM images enabled the quantification of steatosis levels consistent with clinical evaluations, highlighting the capability of the system for high-contrast, label-free lipid quantification.

Energy-managed dissipative soliton fiber laser with a tunable spectral filter

Tymoteusz Kędzior
University of Warsaw, Institute of Physical Chemistry PAS

It has already been proven that diffraction gratings can be used as spectral filters in anomalous-dispersion fiber lasers operating at a 1550 nm central wavelength. In this work, the viability of this solution was tested for a normal-dispersion fiber system. A dissipative-soliton fiber laser operating at a 1064 nm central wavelength, based on passive double-clad fibers with normal dispersion and a 10 μm core, was constructed. The active medium consists of a double-clad Ytterbium-doped fiber, clad-pumped. By pumping into the cladding, it is possible to inject much higher optical power into the medium using a standard multimode laser diode, which in turn allows for generating higher average output power – up to 0.5–1 W, depending on the configuration. The laser uses a free-space optical system with a diffraction grating as a tunable spectral filter inside the cavity. This system presents a cheaper alternative to expensive tunable filters available in the 1060 nm range.

Accelerated Lifetime Testing of Optical Materials under High-Repetition UV Laser Irradiation

Martynas Keršys
Vilnius University, Faculty of Physics

This work presents accelerated lifetime testing of optical materials under high-repetition-rate ultraviolet laser irradiation. Optical component reliability is critical in modern high-power laser systems, where prolonged exposure to intense pulsed radiation can cause gradual degradation before catastrophic damage. BK7 glass, UV-grade fused silica, and a high-reflectivity coating were irradiated using 355 nm picosecond laser pulses at 399 kHz. Changes in functional optical parameters, such as transmission and reflection, were monitored in situ over time. Material lifetime was evaluated using t95 and t90 criteria, corresponding to defined decreases from the initial optical response. The results highlight the possibilities and limitations of using accelerated degradation measurements to predict optical material lifetime under less severe high-repetition UV irradiation conditions.

Electro-Optic Mach-Zehnder Modulator on Thin Film Lithium Niobate Using Oppositely Poled Waveguides

Stijn Vandepitte
Ghent University

Optical communication in the O-band experiences rising demands for single channel data rates. However, current high speed modulators on the silicon photonics platform are based on the plasma dispersion effect and are consequently bandwidth limited. High speed modulators based on lithium niobate are a commonly researched alternative. Modulation in thin film lithium niobate is achieved through the strong Pockels effect as opposed to the plasma dispersion effect. Here, a design on the X-cut thin film lithium niobate platform with a differential GSSG electrode configuration, where both arms are oppositely poled and defined in between the signal electrodes, is proposed. Simulations show effective $V_\pi L$ values down to 0.75 Vcm at a propagation loss of 0.08 dB/cm. Reliable and uniform poling of a single lithium niobate waveguide is also required. Initial steps in realizing uniform domain inversion of a ridge waveguide are also presented.

The Terajet Effect – Numerical Analysis and Potential Applications

Sebastian Dula
WAT Military University of Technology

The aim of this study is to numerically model and analyze the terajet effect. The potential and practical applications of this phenomenon are also discussed. The terajet effect involves the creation of a specific electromagnetic field distribution when a terahertz wave passes through a dielectric object whose dimensions are comparable to the wavelength. This phenomenon is characterized by a strong concentration of energy, and the resulting field amplifications depends on the geometric and material parameters of the considered system. The analysis of the phenomenon was performed for a plane wave incident on a dielectric structure with a simple geometric configuration. A cuboid with dimensions comparable to the wavelength, made of Teflon was considered as a model case. The terajet effect can be used in conjunction with a detector to increase its sensitivity. Furthermore, this effect forms the basis of Dielectric Cuboid Antenna, which is considered a promising solution for 6G technology.

Seeing Without Looking: Quantum Imaging with Undetected Light

Anastasija Jamrik
University of Belgrade School of Electrical Engineering

Can you see something without looking at it? If you are not an entangled particle, your answer will probably be no. On my poster, I will show you how it is possible to "see" an image of a specimen using entangled photons, ways to create them, show the benefits of using this type of imaging technique, and give a review of the latest work done on this topic. Specifically, my focus will be on the research paper published in 2025, which gives a first theoretical and experimental way of using Quantum Imaging with Undetected Light (QIUL) that doesn't rely on the spatial correlations of the photon-pair. To have a better grasp of this topic and the paper itself, I've collaborated with one of the researchers who worked on this paper, Marija Ćurčić. Besides helping me with the theoretical understanding of the topic, she has also let me do some experiments in the laboratory. Those results will be displayed on the poster.

Time-Resolved Spectral Measurements of Superfluorescent Upconversion Emission in Lanthanide Ion-Doped Nanoparticles

Maksymilian Ogorzałek
University of Warsaw

This poster presents experimental work investigating room-temperature superfluorescence (SF) in neodymium-doped upconversion nanoparticles. SF is a collective emission phenomenon distinct from conventional spontaneous emission: it arises from a coherently coupled ensemble of emitters, rather than individually excited ions decaying independently. This coupling causes the ensemble to produce an intense, short burst of light, rather than the slow exponential decay governed by the excited-state lifetime. In lanthanide-doped nanoparticles, SF boosts the decay rate and peak intensity by up to three or four orders of magnitude. The work required high-energy femtosecond infrared laser and a time-gated spectroscopic measurement system and combines experimental detection methods with a simplified theoretical account.

Development and Characterization of Waveguide Refractive-Index Sensors Based on Lossy Mode Resonance

Filip Mazurek
Łukasiewicz Research Network - Institute of Microelectronics and Photonics; Faculty of Physics, University of Warsaw

Planar waveguide refractive-index sensors based on lossy mode resonance (LMR) were fabricated and experimentally characterized. The LMR effect occurs when a thin, optically absorbing dielectric film on a waveguide supports lossy guided modes, producing an attenuation band whose spectral position is highly sensitive to the surrounding refractive index. Several sensors with different dielectric coatings were investigated.

Transmission spectra were measured for analytes with different refractive indices, and resonance-wavelength shifts were analyzed to evaluate the performance of each structure. Particular attention was paid to the influence of dielectric-layer parameters on the resonance position, shape, and sensitivity.

The comparison of sensor configurations enabled identification of design parameters that influence sensitivity and spectral operating range. Transfer Matrix Method (TMM) modeling was employed to predict and interpret the observed spectral response.

Development of an SPDC photon-pair source for Hong–Ou–Mandel interferometry

Jacek Winiarczyk
University of Warsaw

This work presents the development of a photon-pair source based on type-I spontaneous parametric down-conversion (SPDC) in a BBO crystal pumped at 370 nm, generating non-collinear signal and idler photons at approximately 750 nm. Photon detection is performed using avalanche photodiodes, with arrival times recorded by a HydraHarp 400 event timer (1 ps resolution). Strong temporal correlations are observed in coincidence measurements. Current work focuses on spectral characterization of the biphoton state and the implementation of a Hong–Ou–Mandel (HOM) interferometer using a 50:50 beam splitter. The completed setup will be used to measure the HOM interference dip as a probe of spatio-temporal indistinguishability. This system will be employed to investigate modifications of the HOM interference pattern induced by temporal delays and distinguishability changes, enabling studies of macroscopic material properties.

Towards Integrated Photonic Neural Hardware: Realization of an experimental testbed for an on-chip Fabry-Pérot Laser Nonlinear Element

Miloš Romčević
University of Belgrade, School of Electrical engineering

Scaling table-top photonic neurons to fully integrated photonic neural network (PNN) chips requires nonlinear elements that operate reliably in chip-scale form. In this work, conducted within the Centre for Neuromorphic photonics, led by prof. Jasna Crnjanski, we realize an experimental testbed for an on-chip, Fabry-Pérot laser diode (FP-LD) based, nonlinear element. The setup is built from scratch, and includes electrical driving, thermistor-based temperature control loop, and fiber-collimator edge coupling, providing the basis for stable optical injection (OI) and response readout. Using the setup, static and dynamic OI measurements are performed to map the bistability boundaries, yielding quantitative transfer function characterization across a variety of operating regimes of the on-chip FP-LD. The system produces stable and repeatable nonlinear responses, confirming robust chip-scale nonlinear operation, paving the way to future multineuron PNN chip experiments.

Efficient Hyperfluorescent OLEDs Using Newly Synthesized Blue MR-TADF Emitters

Kristupas Bagdonas
Vilnius University

Organic light-emitting diodes (OLEDs) are among the dominant display technologies, but efficient, stable, spectrally pure blue pixels remain an unsolved problem. Multi-resonant thermally activated delayed fluorescence (MR-TADF) emitters are promising as they combine narrowband emission and triplet exciton harvesting, enabling high colour purity and quantum efficiency. This work investigates new compounds synthesized by modifying actively studied multiresonant cores to improve photophysical and device-relevant properties. The compounds showed narrow blue emission below 20 nm, while a small 80 meV singlet–triplet energy gap enabled delayed fluorescence, confirming MR-TADF behaviour. Hyperfluorescent OLEDs were fabricated by vacuum thermal evaporation. DB1TNF-based devices showed deep-blue emission at 461 nm and reached 23% quantum efficiency. In contrast, tDB2TNF-based devices reached 21% EQE and showed better stability, with LT50 = 43 h at 1000 cd m^{-2}.

Extended Hong-Ou-Mandel effect

Natalia Bednarek
University of Warsaw

The Hong–Ou–Mandel (HOM) effect is a fundamental multi-photon quantum interference phenomenon arising from the indistinguishability of two photons incident on a beam splitter. While traditionally studied with single-photon states, HOM-like interference has also been observed using weak coherent states. We investigate the extension of the HOM effect to interferences between single photons and coherent or pseudo-thermal states of light and compare the resulting coincidence statistics for different classes of quantum states. Particular attention is given to regimes involving large photon numbers. We show that characteristic HOM signatures persist even in the presence of imperfect detector efficiency and for potentially macroscopic photon numbers. This opens the possibility of observing HOM-like effects using classical photodetectors rather than single-photon-counting devices. Furthermore, we discuss the connection between the extended HOM effect and homodyne detection.

Architecture and Initial Tests of a simultaneous, Two-Meridian OCT for Corneal Air-Puf Studies

Mateusz Nowak
Faculty of Physics University of Warsaw | International Center of Eye Research (ICTER)

Air-puf OCT tonometry benefits from simultaneous imaging of air-induced corneal deformation along two arbitrary meridians. We present a polarization-multiplexed method applicable to standard OCT: illumination is split into orthogonal polarizations and a path delay shifts one channel in depth, enabling two co-registered images. Separate, synchronized scanners drive each polarization, with 10 kHz resonant scanners per orientation yielding a 20 000 B-scan rate—providing, to our knowledge, the best temporal resolution for such studies of air-induced corneal surface dynamics. Adjustable meridian position/orientation and limitations are discussed.

Formation of GaN Ridge Waveguides for Optical Second Harmonic Generation

Ignas Dailidėnas
Vilnius University

To achieve efficient second harmonic generation (SHG), traditional approaches often rely on periodically poled structures, which are technologically complex and difficult to fabricate. An alternative approach is modal phase matching (MPM), where the effective refractive indices of the interacting guided modes are matched by waveguide geometry. In this work, the optimization of GaN ridge waveguides fabrication for SHG at a pump wavelength of 1064 nm is demonstrated. Fabrication used UV laser photolithography and ICP-RIE. Four pattern-transfer routes were studied. The main challenge was to reach full etch depth while maintaining vertical sidewalls and low roughness. SHG near 532 nm was measured and compared with a planar GaN reference.

Interferometry in quantum imaging

Ewa Pajurek
University of Warsaw

Standard cameras rely on regular light waves to create images. However, this traditional approach has major limitations such as inability to perform under environmental noise. To fix this, in Quantum Imaging Laboratory (QIL), instead of just looking at the overall brightness of the light, pairs of light particles, photons, are tracked to see how they arrive at a detector together. By analyzing these photon pairs, we can reconstruct sharp images through messy environments. As a first-year researcher, my hands-on work focused on building a custom Michelson interferometer. By studying the interferometry patterns, not only was I able to learn about the foundational properties of light, but also experience the challenges and rewards of bringing theory to an experimental setup. Essentially, this poster shows that by updating a classic tool like the classic interferometer, we can obtain clear images where non-quantum photography doesn't stand a chance.

Towards structured illumination ghost imaging - beyond the correlation resolution limit

Maja Rynkiewicz
University of Warsaw

Quantum Ghost imaging relies on the spatial correlations of photon pairs generated by SPDC, which determines the achievable image resolution. The correlation width is inversely proportional to the crystal length, creating a trade-off between the brightness and resolution. In this work, we investigate the use of a structured pump beam shaped with a SLM to in turn shape the correlations of the generated photon pairs. By imprinting a SIM-fringe pattern onto the pump beam, this resolution limit imposed by the correlation width may be surpassed. Measurements are performed using a 32x32 Piccolo SPAD array, allowing spatially resolved detection of photon correlations.

Photon Trapping and Dispersion Engineering in Modified Optical Microcavities

Zsófia Bedyńska
University of Warsaw

We studied the behaviour of photons in an optical microcavity modified by adding a set of Gaussian defects onto the surface of one of the planar confining mirrors. We characterised the optical properties of these structures by analysing their transmission spectra. We also performed AFM measurements of the modified DBR surface to map its geometry and determine the precise profiles of the wells.

Measurements on cavities with wells of different shapes and sizes allowed us to observe how their dispersion relation changes compared to a simple planar cavity. We aim to correlate the photonic bound states—which appear in addition to the standard dispersion parabola—with the depth and width of the photon-trapping wells.

Understanding the resulting optical properties of various single trapping wells will allow us to combine them into more complex systems (such as 1D and 2D lattices in a tuneable LC cavity) to explore further phenomena in our setup.

A Compact, Room-temperature CMOS-based Terahertz Gas Spectroscopy System

Patricija Ivanauskaitė
Vilnius University & Center for Physical Sciences and Technology (FTMC)

Poster presents a compact, room-temperature terahertz (0.1-10 THz) spectroscopy system designed to transition gas “fingerprint” sensing from lab environments to field applications. Setup pairs CMOS-based TeraFET (field-effect-transistor) emitter and detector with a custom circular multipass gas cell (21.5 cm diameter). Custom f=42 mm HDPE aspheric lenses optimize beam coupling, and frequency-modulated continuous wave method verified 1.93 m optical path length (just 1% away from theoretical). Broadband detector characterisation (0.1-1.2 THz) using Toptica photomixer system showed that log-spiral antenna is best at lower frequencies, noting system bandwidth is limited by emitter rather than the detector. Validation using 0.1-1 mbar methanol across 255-260 GHz resolved absorption lines matching JPL database. This work demonstrates a cost-effective, CMOS-driven infrastructure for real-time trace gas monitoring with uses industrial safety, environmental tracking, and medical diagnostics.

Shifted Wave Interference Fourier Transform Spectroscopy (SWIFTS) at the single photon level

Beata Siorek
University of Warsaw

The goal of my MSc thesis is to experimentally develop a shifted wave Fourier transform spectroscopy (SWIFTS) method at the single photon level. An optical frequency comb is a signal with a spectrum consisting of evenly spaced lines. The SWIFTS method provides information on the phase differences between adjacent spectral lines of a comb. By measuring both the spectrum and the spectral phase of a frequency comb, it is possible to reconstruct its temporal profile, which cannot be observed directly because it changes at timescales too fast to be resolved by photodetectors. Traditional methods for measuring the spectral phase usually require non-linear elements and are hard to perform at the single-photon level, therefore SWIFTS may be a good alternative in the case of attenuated frequency comb signals.

Deep learning-based image reconstruction in Fresnel Incoherent Correlation Holography (FINCH)

Zofia Iwaniuk
University of Warsaw

This work investigates the use of deep neural networks for image reconstruction in Fresnel Incoherent Correlation Holography (FINCH). The proposed architecture learns the mapping between recorded holograms and high-fidelity image reconstructions, enabling effective suppression of noise and reconstruction artifacts arising from iterative deconvolution procedures. Furthermore, the network reduces the computational burden associated with conventional Lucy-Richardson-Rosen reconstruction by decreasing the number of iterations required to achieve comparable image quality.

Mouse brain tissue imaging with temporally focused two-photon excitation and SPAD array detection

Oliwia Zawistowska
University of Warsaw

Two-photon excitation (2PE) microscopy is an imaging technique widely used in biological research thanks to its penetration depth. Combined with the temporal focusing it enables us to achieve high axial contrast by limiting the excitation of the fluorescent molecules out of the focal plane. On the poster, we demonstrate the results of imaging mouse brain tissue samples stained with different fluorophores (mCherry, Alexa 546, Alexa 647) and propose the staining method for which we measured the highest fluorescence emission while using a 1030 nm excitation beam. We present fluorescent lifetime (FLIM) measurements of the samples obtained with the SwissSPAD2 array.

Optimization of a Wide-Field Fluorescence Microscope for Single-Emitter Imaging on Hexagonal Boron Nitride

Valeria Zúñiga Pérez
Friedrich-Alexander-Universität Erlangen-Nürnberg / Fraunhofer Institute for Applied Optics and Precision Engineering

Setup and optimization of a wide-field fluorescence microscope designed for imaging single emitters on hexagonal boron nitride (hBN). The system was developed to detect individual perylene molecules deposited by thermal evaporation onto exfoliated hBN flakes. A 405 nm excitation laser, high-NA objective (NA = 0.95), and sCMOS camera were integrated to achieve sensitive wide-field imaging. Key challenges, including mechanical vibrations and strong background fluorescence, were addressed through the implementation of motorized translation stages and the replacement of borosilicate coverslips with low-fluorescence fused silica coverslip. After optimization, diffraction-limited blinking emitters were observed. However, spectroscopic analysis revealed that the emission did not originate from the deposited perylene molecules. These results highlight the importance of background suppression and spectral verification in single-emitter studies and establish a platform for future investigations.

Polarization-Controlled All-Optical Nonlinear Activation Functions Using an Injection-Locked Fabry-Pérot Laser

Natalija Ivanović
School of Electrical Engineering, University of Belgrade

Photonic neural networks require compact and energy-efficient nonlinear activation units capable of reconfiguration and operation entirely in the optical domain. In this work, we experimentally investigate how the polarization state of an injected optical signal influences nonlinear activation functions (NAFs) realized using an injection-locked Fabry-Pérot laser diode (FP-LD). Since FP-LDs exhibit polarization-dependent injection efficiency, the alignment between input polarization and the dominant laser axis strongly affects injection-locking dynamics and nonlinear response. Through systematic polarization variation, we analyse the polarization-induced changes in key FP-LD NAF parameters. Results show that polarization is instrumental in tuning the obtained NAFs without modifying the device structure.

Overcoming light scattering with high optical nonlinearity

Andrzej Kozłowski
FUW

Light scattering fundamentally limits deep optical imaging in complex media. To overcome this, I introduce Nonlinear Imaging with Speckle Excitation (NISE), a technique that exploits scattering to achieve super-resolution imaging through opaque layers. When laser light traverses a scattering medium, it forms a random speckle pattern. By utilizing luminescent labels with extreme optical nonlinearity, such as avalanching microcrystals, the effective excitation becomes highly sparse. Due to speckle intensity statistics, only the single brightest, sub-diffraction-sized speckle grain contributes to the signal. Scanning the incident beam within the optical memory effect range shifts this localized spot across the sample. My experiments demonstrate that NISE successfully reconstructs super-resolved images of targets hidden behind opaque barriers, effectively imaging the sample as if the scatterer were absent from the beam path.

Amplifying Saturable Absorber for All-Fiber Oscillators

Bartosz Fabjanowicz
IChF PAN

In this work we propose a new type of saturable absorber based on amplification and nonlinear polarization evolution in active fibers. Amplifying saturable absorber was constructed. Measurements of saturable absorption were performed for different input pump powers and pulse energies.

Fisher flux density in dark polariton propagation

Paweł Ptaszek
UW

In a recent work "Hüpfl, J., Russo, F., Rachbauer, L.M. et al." a new wave description of propagation of fisher information was described. We propose a generalized continuity equation for electromagnetic propagation in atomic media and show where information is being generated and dissipated.

Quantum shot noise limited multiband radiometer enabled by Rydberg atoms

Wiktor Krokosz
Centre of New Technologies, University of Warsaw

In this work, we demonstrate a multiband radiometer utilizing room-temperature Rydberg atoms to directly detect fixed frequency photons from thermal black-body radiation. A six-wave mixing process in a rubidium-87 vapor cell was employed to convert terahertz thermal radiation into easily detectable optical photons. We show that conversion efficiency is significantly enhanced by housing the vapor cell within a tunable resonant metallic waveguide featuring selective temperature control. This optimized architecture enables high-sensitivity radiometric measurements across multiple frequency bands, specifically 74 GHz, 126 GHz, and 613 GHz, utilizing a single device. Furthermore, the system achieves an antenna-target cooperativity exceeding 0.8 and demonstrates quantum shot-noise limited performance for integration times under 100 milliseconds. Long-term stability assessments reveal a minimum Allan variance of 0.37 K. These results establish Rydberg-atom radiometers as highly tunable alternatives to classical radiometry for advanced microwave, millimeter-wave, and terahertz sensing applications.
