24th CZECH-POLISH-SLOVAK OPTICAL CONFERENCE

ON WAVE AND QUANTUM ASPECTS OF CONTEMPORARY OPTICS

BOOK OF ABSTRACTS

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Tuesday, 15 September 2026 · 08:30–10:00 · Main Hall — Plenary Session 1 · Quantum and ultrafast photonics

PL-01 · PLENARY

Quantum Non-Gaussian Optics

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Presentation	Plenary talk
Programme	Tuesday, 15 September 2026 · 08:30–09:15 · Plenary Session 1 · Quantum and ultrafast photonics · Main Hall
Presenter	R. Filip

The talk will introduce this advanced topic, its motivation and historical development, and focus on basic quantum optics experiments with quantum non-Gaussian single-photon states of light, as well as on their detection, evaluation, and manipulation. It will then move to a broader class of advanced experiments and new ideas involving multi-photon quantum non-Gaussian states from nonlinear optics and cavity QED with atoms and solid-state emitters, and on their application to highly nonlinear quantum operations and quantum optomechanics, including hierarchical evaluation of the quantum non-Gaussianity of photons and phonons. It will conclude with current challenges and recent research topics.

Keywords: quantum optics, nonlinear optics, cavity QED, non-Gaussian quantum states

PL-02 · PLENARY

Ultrafast valleytronics in bulk semiconductors

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Presentation	Plenary talk
Programme	Tuesday, 15 September 2026 · 09:15–10:00 · Plenary Session 1 · Quantum and ultrafast photonics · Main Hall
Presenter	M. Kozák

Electrons in semiconductors with multiple minima (valleys) of the conduction band carry information about which group of equivalent valleys they occupy. Valley quantum number, which corresponds to the electron's wave vector, is a promising candidate for new generation information processing and storage devices and quantum computing. Valleytronics has been widely studied in 2D materials with broken time-reversal symmetry, in which the individual valleys can be addressed directly by coupling to specific helicity of circularly polarized light due to the existence of optical selection rules [1]. However, such selection rules do not exist in technologically important bulk semiconductors, including silicon and diamond.

Here we report on the development of an ultrafast optical technique allowing to generate and read valley polarized populations of electrons in bulk semiconductors on sub-picosecond time scales. The method utilizes unidirectional intervalley scattering of electrons accelerated by oscillating electric field of linearly polarized infrared femtosecond pulses. The valley polarization induced in silicon and diamond is characterized via polarization anisotropy of transient absorption of a delayed infrared probe pulse allowing us to determine the intervalley scattering time of electrons as a function of sample temperature, excited electron density [2] or the density of dopants.

Keywords: Valleytronics, semiconductors, ultrafast laser spectroscopy

Acknowledgements

We acknowledge the support given by Charles University (Grant Nos. UNCE/SCI/010, SVV2020-260590, PRIMUS/19/SCI/05 and GA UK 124324), the Czech Science Foundation (Grant No. 26-21965S) and the European Union (ERC, eWaveShaper, Grant No. 101039339). This work was supported by TERAFIT (Project No. CZ.02.01.01/00/22_008/0004594), which was funded by OP JAK, call Excellent Research.

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Tuesday, 15 September 2026 · 10:30–12:20 · Main Hall — Terahertz spectroscopy, ultrafast currents and spin dynamics

IN-01 · INVITED

Ultrafast dynamics of terahertz plasmons in epitaxial graphene nanostructures

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Presentation	Invited talk
Programme	Tuesday, 15 September 2026 · 10:30–10:55 · Terahertz spectroscopy, ultrafast currents and spin dynamics · Main Hall
Presenter	P. Kužel

We demonstrate ultrafast control of THz plasmons by femtosecond optical pulses in lithographically prepared nanoribbons and nanodots of epitaxial graphene using combined time-resolved near-field and far-field THz spectroscopies (0.1–20 THz). Epitaxial graphene was grown on Si and C side of 6H-SiC substrate. Graphene grown on Si-face (additionally submitted to a hydrogen intercalation process) forms p-doped quasi-free-standing single layer graphene (QFSLG). The C-face of SiC with faster graphene growth hosts multilayer epitaxial graphene (MEG), where each layer exhibits electronic properties similar to isolated monolayer graphene: the layers close to the substrate are usually significantly n-doped while outer layers are quasi-neutral. We show that ultrafast dynamics of plasmons are entirely controlled by the chemical potential of laser-excited hot carriers through their temperature. The laser pulse heats the carriers up to about 5000 K and the carrier cooling to the lattice temperature occurs within a few picoseconds. In (doped) QFSLG the carrier mobility is ~1700 $cm^2V^{-1}s^{-1}$ and the photoexcitation is accompanied by a weak plasmon redshift. Interestingly, in MEG the ultrafast dynamics is controlled by quasi-neutral layers with the carrier mobility of 7.5×10^5 $cm^2V^{-1}s^{-1}$ and it is characterized by a significant blueshift and broadening of the plasmon resonance.

Keywords: epitaxial graphene, 2D nanostructures, plasmons, terahertz, ultrafast

IN-02 · INVITED

Ultra-broadband THz time-domain spectroscopy using organic nonlinear crystals

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Presentation	Invited talk
Programme	Tuesday, 15 September 2026 · 10:55–11:20 · Terahertz spectroscopy, ultrafast currents and spin dynamics · Main Hall
Presenter	Ł. Sterczewski

Historically, access to the far-infrared (THz) range between 1–10 THz has been technologically difficult due to the low photon energy at such low optical frequencies [1]. Incoherent THz Fourier spectrometers have typically required cryogenically cooled detectors, while coherent time-domain systems utilizing near-infrared femtosecond lasers and second-order nonlinear materials have suffered from spectral coverage limitations (<5 THz) due to phonon resonances in inorganic or semiconductor media. In the past two decades, a surge of activity in organic nonlinear media has resulted in new families of $\chi^{(2)}$ materials for THz spectroscopy with broadband phase matching and compatibility with convenient Er:fiber lasers [2]. In the talk, we will discuss progress on exceeding the bandwidth of THz time-domain spectroscopy past 30 THz (10 μm) pumped by all-fiber lasers operating at telecommunication wavelengths. This involves research on new organic nonlinear media [3], optimization of pump laser parameters, and advanced schemes to filter out residual pump photons. We will also discuss the limitations of existing materials considering linear absorption, phase-group index mismatch, and diffraction losses.

Keywords: Organic nonlinear crystal, far-infrared, THz, Fourier transform spectroscopy, time-domain spectroscopy

Acknowledgements

The author acknowledges funding from the European Union (ERC Starting Grant, TeraERC, 101117433). Views and opinions expressed are, however, those of the authors only and do not necessarily reflect those the European Union or the European Research Council Executive Agency. Neither the European Union nor the granting authority can be held responsible for them. This work is supported by the use of National Laboratory for Photonics and Quantum Technologies (NLPQT) infrastructure, which is financed by the European Funds under the Smart Growth Operational Programme.

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OT-01 · ORAL

Terahertz Electronic and Spin Currents in Wafer-Scale Van der Waals Bi_2Se_3/WSe_2 Heterostructures and Polymorphs

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 11:20–11:35 · Terahertz spectroscopy, ultrafast currents and spin dynamics · Main Hall
Presenter	M. Mičica

Terahertz emission spectroscopy (THz-TES) is a powerful probe of ultrafast carrier and spin dynamics in complex two-dimensional (2D) materials. Here, we apply THz-TES to wafer-scale van der Waals heterostructures based on Bi_2Se_3/WSe_2, integrating topological insulators, transition metal dichalcogenides, and ferromagnets. We demonstrate the generation of coherent terahertz electronic and spin currents by optical excitation and show that the terahertz phase enables the separation of distinct underlying mechanisms. A central result is the strong dependence of the terahertz response on the WSe_2 polymorph: changing a single atomic monolayer in the stack, corresponding to 1T′, 2H, or 3R stacking, markedly modifies both the electrical and magnetic terahertz signals. We further reveal the role of crystal symmetry in proximity-induced magnetic properties, including a magnetic nonlinearity associated with the 1T′ phase. These results establish scalable 2D heterostructures as a versatile platform for tailoring coupled photonic, electronic, and spintronic functionalities at terahertz frequencies [1].

Keywords: 2D materials, transition metal dichalcogenides, THz emission spectroscopy, spintronics, polymorphs

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OT-02 · ORAL

Terahertz Time Domain Spectroscopic Ellipsometric Determination of Dopant Concentration in 4H-SiC

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 11:35–11:50 · Terahertz spectroscopy, ultrafast currents and spin dynamics · Main Hall
Presenter	J. Liu

Silicon carbide (SiC) is an important wide-bandgap semiconductor for high-power, high-frequency, and high-temperature applications [1]. Its device performance is strongly influenced by free-carrier dynamics and, in hexagonal polytypes such as 4H-SiC, by anisotropy [2]. Although SiC has previously been basically characterized using terahertz time-domain spectroscopy (THz-TDS) [3], the in-depth characterization of SiC such as polarization information due to its anisotropy has not been determined. THz complete Time Domain Spectroscopic Ellipsometry (THz-cTDSE) [4] provides a nondestructive and contactless method for measuring the complex, polarization-dependent response of SiC and extracting its uniaxial permittivities. In this work, we develop a THz-cTDSE system (Fig. 1) for reconstructing the complete Jones and Mueller matrices of the anisotropic 4H-SiC substrate and the doped SiC epitaxial layer. The system employs photoconductive antennas as the THz emitter and detector from Menlo system GmbH [5]. In this configuration, the THz-cTDSE employs a femtosecond ELMO Laser (from Menlo system GmbH) to generate a infrared beam with 100 MHz repetition rate and <1 W average power. The laser pulses are shorter than 90 fs with the central wavelength of 1560 nm to illuminate the THz emitter and the detector. Due to polarization selected source and detector, four polarization-resolved signals are acquired in both transmission and reflection geometries without mechanical rotation of the polarization components over the frequency range from 0.1 to 4.4 THz. The experimental results are processed into complete Jones and Mueller matrices and analyzed using optical models incorporating a Drude contribution to describe the free-carrier response and determine parameters including carrier concentration, mobility, effective mass of carriers and thickness of doped layers. Measurements reveal pronounced polarization-dependent reflection, diattenuation, and retardance from the SiC wafer and doped SiC epitaxial layers. These results demonstrate the potential of THz-cTDSE as a contactless technique for characterizing the electronic and polarization-dependent optical properties of semiconductor wafers and epitaxial structures.

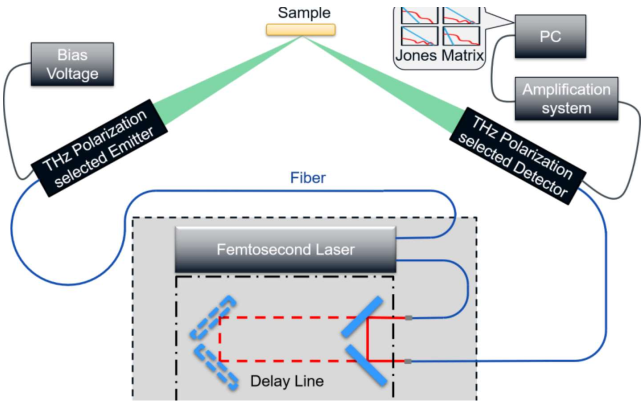

Figure 1. THz-cTDSE setup

Acknowledgements

Appreciation of the SGS financial support in my contribution: Ministry of Education, Youth and Sports of the Czech Republic (SP2026/083)

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OT-03 · ORAL

Modeling of ultrafast spin dynamics for enhancement of spintronic terahertz emission

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 11:50–12:05 · Terahertz spectroscopy, ultrafast currents and spin dynamics · Main Hall
Presenter	J. Toběrný

Spintronic terahertz emitters (STEs) are novel sources typically consisting of a ferromagnetic/nonmagnetic metallic thin-film stack, offering ultra-broadband emission (0.1–15 THz), polarization switching by changing the magnetization of their ferromagnetic film, and low cost [1]. These properties make STEs attractive candidates for THz sources in material characterization tools such as terahertz complete time-domain spectroscopic ellipsometry (THz-cTDSE) [2]. However, their optical-to-THz efficiency is relatively low compared to photoconductive antennas or rectification crystals, which limits their practical applications in THz-cTDSE. Several methods to enhance the terahertz output power from STE have already been shown [3–5]. These approaches can be divided into three main strategies: maximizing near-infrared absorption, improving terahertz outcoupling, and enhancing spin-current generation together with efficient spin-to-charge conversion. We investigate the generation of a THz pulse in STEs by modeling spin dynamics using a time-dependent diffusion approach, which can be used to optimize the multilayer metallic stack and enhance THz emission. The metallic stack geometry and near-infrared excitation absorption profile have a combined effect on the resulting THz pulse, which is captured by a qualitative agreement of the model with reported experimental data for varying numbers and thicknesses of the metallic layers.

Keywords: spintronic terahertz emitter, spin dynamics, time domain, diffusion approach, spin-to-charge, modelling, terahertz spectroscopic ellipsometry

Acknowledgements

This work was supported by the Ministry of Education, Youth and Sports of the Czech Republic through the e-INFRA CZ (ID:90254). We acknowledge the project "Materials and Technologies for Sustainable Development" (CZ02.01.01/00/22 008/0004631) funded by the European Union and the state budget of the Czech Republic within the framework of the Jan Amos Komenský Operational Program, project "Advanced Materials for Energy and Environmental Technologies" (CZ.02.01.01/00/23 021/0008592) and project "RE-FRESH" (CZ.10.03.01/00/22 003/0000048). Further support was provided by GACR (25-15775S); Ministry of Education, Youth and Sports of the Czech Republic (SP2026/083).

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OT-04 · ORAL

Controlling quantum dot charge and spin states with sound

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 12:05–12:20 · Terahertz spectroscopy, ultrafast currents and spin dynamics · Main Hall
Presenter	P. Machnikowski

Semiconductor quantum dots (QDs) combine optically addressable charge excitations with long-lived spin qubits, and offer a controllable interface between them [1]. Recent QDs also provide uniform ensembles of nuclear spins coupled to the QD spin [2], serving as a quantum memory [3]. However, QDs lack phonon-mediated charge and spin transitions despite strong energy modulation by elastic waves [4]. This limitation hinders their integration into hybrid quantum systems based on phononic interconnects, which are promising for coherently linking systems with complementary functionalities. We propose acousto-optical schemes that overcome this limitation and enable control of charge and spin states in QDs. For charge states, we develop acousto-optical parametric control of the "swing-up" type [5], including higher-harmonic driving that separates the control field frequency from much larger state splitting [6]. For spin states, we use a detuned optical coupling to a trion state to break spin conservation, enabling acoustic spin control [7]. To overcome gate infidelity due to relatively long operation time under quasistatic noise in QDs, we find an error-mitigating control sequence. As the same interaction structures arise for quantized acoustic modes in the coherent-state limit, these methods can enable generating QD-phonon entanglement, nonclassical phonon states, and facilitate state transfer.

Keywords: coherent control, quantum dots, spin qubits, acoustic waves, phonons, optical transitions

Acknowledgements

National Science Centre (Poland) Grants No. 2023/49/N/ST3/03931 and No. 2023/50/A/ST3/00511; MEEDGARD project - QuantERA II Program (EU Horizon 2020 GA No. 101017733 and the National Centre for Research and Development, Poland project No. QUANTERAII/2/56/MEEDGARD/2024).

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Tuesday, 15 September 2026 · 10:30–12:25 · Modular Hall — Nonclassical states, quantum correlations and measurements

IN-03 · INVITED

Engineering Nonclassical Light for Quantum Technology from Gaussian States

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Presentation	Invited talk
Programme	Tuesday, 15 September 2026 · 10:30–10:55 · Nonclassical states, quantum correlations and measurements · Modular Hall
Presenter	K. Thapliyal

Quadratic Hamiltonians generate and preserve Gaussian states, whose dynamics is completely determined by the first and second moments of the canonical bosonic operators. There are numerous applications of the Gaussian states. However, the Gaussian states offer limited capabilities in quantum technologies: Achieving stronger nonclassical properties and quantum supremacy requires truly non-Gaussian operations, such as photon addition, subtraction, and catalysis. We therefore investigate controlled photon addition and subtraction in single-mode and entangled optical beams, identifying optimal regimes for generating strongly nonclassical states beyond the Gaussian limit. Experimental implementations demonstrating photon addition and subtraction of up to twenty photons confirm the feasibility of this approach across all considered states [1–3]. Specifically, we illustrate that the photon-number fluctuations in twin beams as well as the corresponding signal and idler beams can be reduced by photon addition and subtraction [1,2]. We also propose compound optical beams constructed from simple experimental building blocks that generate well-defined quantum-correlated structures [3]. These engineered states provide a versatile and experimentally accessible platform for the direct comparison of different quantum operations aimed at producing highly nonclassical and entangled states. The presented framework provides practical guidelines for engineering nonclassical and non-Gaussian states in platforms relevant to quantum communication, sensing, and information processing.

Keywords: Quantum state engineering, non-Gaussian state, sub-shot noise, sub-Poissonian twin beam, photon addition, photon subtraction

Acknowledgements

K.T. acknowledges funding from the European Union's Horizon Europe research and innovation program under the Marie Sklodowska-Curie grant agreement No. 101126636. K.T. and J.P. acknowledge support by the project No. 25-15775S of GAČR.

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OT-05 · ORAL

Characterization of quantum states of light with multiplexed binary click detectors – stellar rank, nonclassicality, and photon statistics

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 10:55–11:10 · Nonclassical states, quantum correlations and measurements · Modular Hall
Presenter	J. Fiurášek

Characterization of nonclassical states of light has a very long history yet it is still an important and active research topic today. Here, we report recent results on characterization of nonclassical states of light by measurements with binary click detectors that can only distinguish the presence and absence of photons. We first consider certification of the stellar rank of quantum state that quantifies the amount of non-Gaussian resources required for its generation. We show that two click detectors arranged in Hanbury Brown–Twiss setup can certify even stellar ranks higher than one, although this scheme provides only very coarse-grained information about the photon number statistics. We also present tight nonclassicality criteria for the unbalanced Hanbury Brown–Twiss measurement scheme with two binary click detectors. Finally, we provide fundamental bounds on the ability to determine photon number distribution from tomographically incomplete measurements with an array of M click detectors. We show that the lower and upper bounds on photon number probabilities can be determined by solving a linear program. We present and discuss numerical results for various input states. Our results can offer quantitative guidance on the number of detection channels required to determine the photon number distribution with a given precision.

Keywords: nonclassical states of light, stellar rank, photon statistics, nonclassicality criteria

Acknowledgements

The author acknowledges support by the project OP JAC CZ.02.01.01/00/23_021/0008790 of the Ministry of Education, Youth and Sports of the Czech Republic and EU.

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OT-06 · ORAL

Quantum Correlations in Three-Beam Symmetric Gaussian States Accessed via Photon-Number-Resolving Detection and Quantum Universal Invariants

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 11:10–11:25 · Nonclassical states, quantum correlations and measurements · Modular Hall
Presenter	J. Peřina, Jr.

Quantum correlations of symmetric 3-beam Gaussian states are analyzed using their quantum universal invariants. These invariants, 1-, 2-, and 3-beam purities, are expressed in terms of the beams' intensity moments up to sixth order. The 3-beam symmetric Gaussian states with varying amounts of the noise are experimentally generated using entangled photon pairs from down-conversion by the technique of compound beams [1,2], their invariants are determined [3], and their quantum correlations are quantified [4]. The coexistence of bi- and tripartite entanglement and genuine tripartite entanglement is experimentally confirmed in these states that resemble the noisy GHZ/W states.

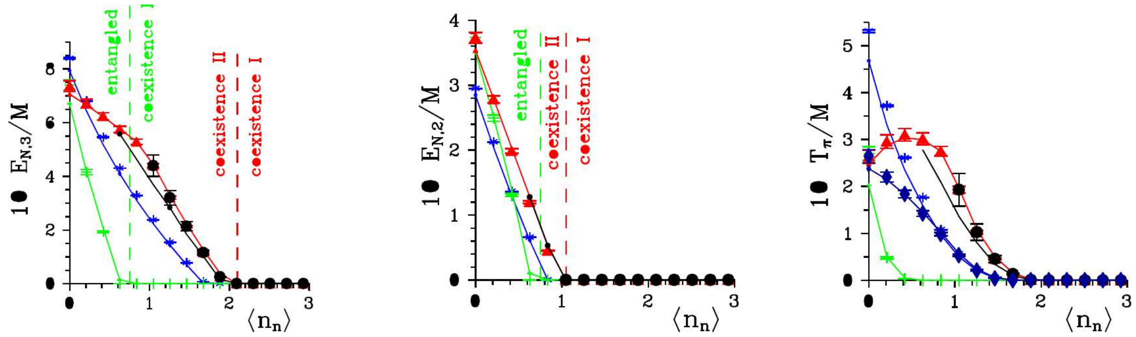

*Figure: Tripartite (bipartite) negativity per mode $E_{N,3}/M$ ($E_{N,2}/M$) and cotangle per mode $T\pi/M$ as they depend on the mean noise photon number $<n_n>$ per beam. Black curves and circles: exact values - sixth-order moments; green [red] curves and + [triangles}]: lower [upper] bounds - fourth-order moments; blue curves and *: second-order moments; navy blue curve and diamonds: noisy GHZ/W states.*

Keywords: 3-beam Gaussian states, genuine tripartite entanglement, coexistence of bi- and tripartite entanglement, quantum universal invariants, compound beams, photon counting

Acknowledgements

J.P. and A.Č. acknowledge support by the project ITI CZ.02.01.01/00/23_021/0008790 of MŠMT. J.P. acknowledges support by project No. 25-15775S of GAČR.

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OT-07 · ORAL

Experimental investigations of non-classical properties of a structured twin-beam

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 11:25–11:40 · Nonclassical states, quantum correlations and measurements · Modular Hall
Presenter	P. Pavlíček

We split the idler beam of a twin-beam into several components and perform the detection of individual photons on the signal beam. The single-photon detection is used for post-selection by a fixed number of photons [1]. The individual components of the multiple twin-beam exhibit non-classical properties and strong mutual anticorrelations in photon numbers [2]. The idler beam as a whole also exhibits non-classical properties. Non-classical properties of the individual components of the twin-beam are evidenced by determining the Fano factor. Non-classical properties of combinations of several parts or the entire idler beam are characterized by nonclassicality witnesses and the associated nonclassicality depths [3,4]. Nonclassicality depths of the fields differing in their size and dimension are mutually compared. Comparing the experimental results with model predictions we present the analysis of an idler beam split into three parts with mutual quantum correlations introduced by post-selection. The beams' parameters are plotted as they depend on the number of detections in the signal beam. Additionally, the full reconstruction of the twin beam is performed allowing us to visualize the beams' characteristics as they would be measured by an ideal detector [5].

Keywords: single-photon detection, multiple twin-beam, photon number anticorrelations, nonclassicality witnesses, nonclassicality depth, full reconstruction

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OT-08 · ORAL

Resource-efficient entanglement detection in high-dimensional states via two-qubit witnesses

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 11:40–11:55 · Nonclassical states, quantum correlations and measurements · Modular Hall
Presenter	J. Kadlec

This work presents an efficient method for detecting entanglement in high-dimensional two-qudit states by mapping the Hilbert space onto the space of two qubits. This transformation enables the use of well-established two-qubit entanglement witnesses. The proposed approach is not restricted to any specific class of states, successfully identifies a vast majority of pure entangled states, and requires a number of measurements that does not increase with the dimensionality of the qudits. The method demonstrates solid sensitivity when applied to two notable classes of states—incomplete-permutation-symmetric states and random pure states mixed with white noise—and is shown to be feasible with current experimental techniques.

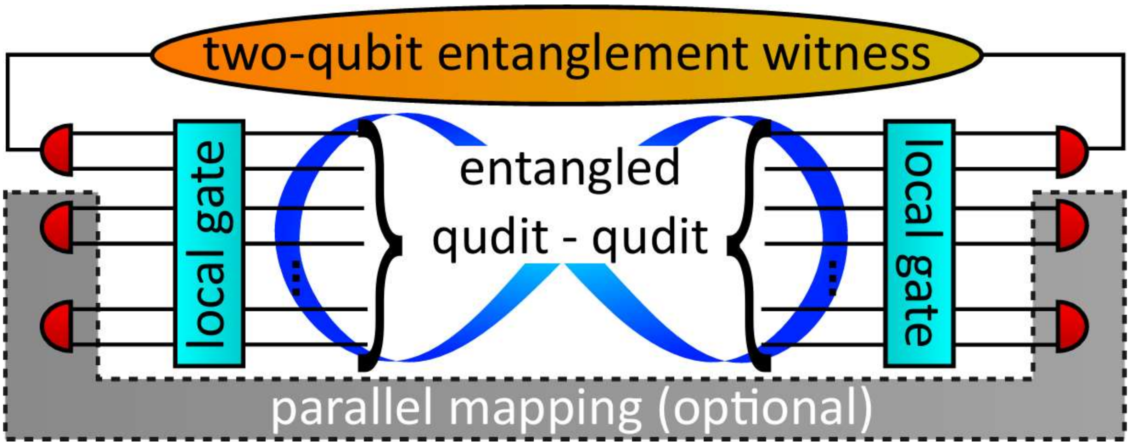

Fig 1: Conceptual scheme

Keywords: Quantum entanglement, entanglement witness, qudit, qubit, efficient detection, higher-dimensional states

Acknowledgements

The authors acknowledge support by the project of the Czech Science Foundation (25-17253S).

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OT-09 · ORAL

Entanglement of photons produced by positronium annihilation

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 11:55–12:10 · Nonclassical states, quantum correlations and measurements · Modular Hall
Presenter	T. Sowiński

Positronium, a bound state of an electron and an antielectron, first theoretically predicted [1,2] and later experimentally discovered [3,4], is the lightest hydrogen-like atom. Due to its unique properties, it is the subject of intensive research aimed at the most precise tests of quantum electrodynamics. According to the QED description, a positronium atom initially prepared in the ground state annihilates into two high-energy gamma photons having equal energies and mutually orthogonal, quantum-mechanically entangled polarizations [5,6]. Unfortunately, experimental confirmation that photons are produced exactly in this correlated state is not straightforward, as the direct detection of polarization for high-energy photons is not technologically possible. The recent beautiful experiment [7] investigating the angular correlations of Compton-scattered photons originating from positronium annihilation has brought us much closer to experimental confirmation that the emitted photons are likely entangled. During the talk, based on quantum metrology methods, we will quantify the conclusions drawn from this experiment and discuss possible directions for its further improvements. The talk will also be an opportunity for a broader look at metrological problems regarding high-energy photons, which have so far eluded experimental control.

Keywords: positronium decay, entanglement of gamma photons, QED tests

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OT-10 · ORAL

Quantum and classical nanoparticle's levitodynamics

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 12:10–12:25 · Nonclassical states, quantum correlations and measurements · Modular Hall
Presenter	P. Zemánek

The recent experimental progress in controlling the mechanical motion of a single levitated particle opens new avenues for investigating more complex configurations in higher dimensions or with more levitated, interacting objects down to the quantum level. Optical cooling and levitation offer relatively easy tunability of key system parameters (oscillating frequency, optical coupling strength between particles or axes, damping, effective temperature, etc.) over several orders of magnitude. Additionally, the forces acting on the particles can be tuned between conservative (Hermitian) and non-conservative (non-Hermitian) systems, and, importantly, their parameters can be switched in a fraction of the oscillation period. This paves the way for realizations of challenging experiments at the quantum-classical boundary using "macroscopic" nanoobjects that go far beyond the typical quantum objects (e.g. photons, atoms, molecules) by several orders of magnitude.

We will present optical cooling of two mechanical degrees of freedom of an optically levitated nanoparticle to mean occupation numbers below 1 using the geometry of an optically trapped nanoparticle inside a high-finesse optical cavity. Further, we will present experimental examples of non-Hermitian dynamics in non-reciprocally coupled oscillators, where we exploit the inter-axial and inter-particle tunability of optical interactions.

Keywords: quantum cavity optomechanics, nanoparticles levitation, optical trapping, non-Hermitian system

Acknowledgements

We acknowledge support by the Czech Science Foundation (GA23-06224S), the Ministry of Education, Youth and Sports of the Czech Republic and the European Commission (project CZ.02.01.01/00/22_008/0004649), and the Czech Academy of Sciences (Praemium Academiae).

Tuesday, 15 September 2026 · 14:00–15:30 · Main Hall — Plenary Session 2 · Holographic and computational bioimaging

PL-03 · PLENARY

Holographic Endoscopy for Neuroscience Advancements

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Presentation	Plenary talk
Programme	Tuesday, 15 September 2026 · 14:00–14:45 · Plenary Session 2 · Holographic and computational bioimaging · Main Hall
Presenter	T. Čižmár

Light-based in-vivo brain imaging relies on the transportation of light through highly scattering tissues over long distances. As scattering gradually reduces imaging contrast and resolution, it becomes challenging to visualize structures at greater depths, even when using multiphoton techniques. To overcome this limitation, minimally invasive endo-microscopy techniques have been developed that typically use graded-index rod lenses. However, a recently proposed alternative involves the exploitation of holographic control of light transport through multimode optical fibres [1], which promises superior imaging performance with less traumatic application [2]. Following the review of the fundamental and technological bases, the talk will introduce a 110 μm thin laser-scanning endo-microscope, which enables volumetric imaging of the entire depth of the mouse brain in vivo [3]. The system is equipped with multi-wavelength detection and three-dimensional random-access options, and it has a lateral resolution of less than 1 μm. Various modes of its application will be presented including the observations of fluorescently labelled neurons, their processes, and blood vessels. Finally, the use of the instrument for monitoring calcium signalling and measurements of blood flow in individual vessels at high speeds will be discussed.

Keywords: multimode optical fibres; wavefront shaping; holographic imaging; laser-scanning microscopy; fluorescence microscopy

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PL-04 · PLENARY

Lensless holographic microscopy and tomography from deep UV to near IR for enhanced bioimaging on a standard sensor.

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Presentation	Plenary talk
Programme	Tuesday, 15 September 2026 · 14:45–15:30 · Plenary Session 2 · Holographic and computational bioimaging · Main Hall
Presenter	M. Rogalski

Lensless holographic microscopy offers a compact and scalable route to label-free, high-throughput two- and three-dimensional bioimaging over large fields of view. Its broader application, however, is often constrained by insufficient intrinsic contrast and strong multiple scattering in optically dense specimens. In this lecture, I will present a unified broadband computational lensless imaging framework built around a standard CMOS sensor and operating under low-photon-budget conditions from the deep ultraviolet, at approximately 240 nm, to the silicon detection limit near 1100 nm.

This exceptionally broad spectral range unlocks complementary imaging capabilities within a single cost-effective on-chip platform. In the deep ultraviolet, wavelength-dependent absorption provides intrinsic chemical contrast, enabling mesoscale mapping of nucleic acids, lipids and proteins in cells and tissue sections without staining. In the near infrared, complex-field holographic imaging reduces the detrimental effects of scattering and improves the visualization of optically dense, highly heterogeneous specimens. To further mitigate scattering, I will introduce a glycerin-tartrazine optical-clearing solution that is rapid, reversible, inexpensive and non-destructive, facilitating high-throughput phase imaging of thick biological samples, including murine liver and kidney tissues. Finally, physics-aware multiple-scattering reconstruction enables large-volume quantitative phase tomography at the gigavoxel scale.

Together, these advances demonstrate how broadband illumination, simple sensor-level hardware, tailored sample preparation and computational reconstruction can transform lensless holography into a versatile platform for label-free, high-content and information-rich bioimaging across complementary spectral regimes.

Tuesday, 15 September 2026 · 16:00–17:25 · Main Hall — Advanced optical fibres, modal control and distributed sensing

IN-04 · INVITED

Analysis of the Optical Properties of Free-Form Nanostructured-Core Fibers for Data Transmission Systems

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Presentation	Invited talk
Programme	Tuesday, 15 September 2026 · 16:00–16:25 · Advanced optical fibres, modal control and distributed sensing · Main Hall
Presenter	R. Buczynski

The application of nanotechnology in the development of optical fibers enables the shaping of their optical properties. Dispersion, modal and polarization properties of the nanostructured fibers are determined with an internal discrete nanostructure of the core composed of multiple types of glasses. We discuss the current state of the art of this early-stage concept for silica and soft glass fibers, and their possible applications. Experimental verification and technological aspects of developing proof-of-concept nanostructured fibers are demonstrated.

Based on the previously demonstrated concept of nanostructured-core silica fibers, we evaluate the present fiber as an advanced functional fiber platform for data transfer and communication systems. The proof-of-concept fiber exhibits chromatic dispersion of approximately 8–12 ps nm^{-1} km^{-1} across the C+L band, low polarization-mode dispersion with weak temperature sensitivity over −40 to +80 °C, and low splice losses to standard single-mode fibers. Telecom system level tests confirm compatibility with coherent transmission and dense wavelength division multiplexed operation, including representative 100 Gbit s^{-1} and 88 × 10 Gbit s^{-1} configurations.

Keywords: free-form optical fibers; graded index fibers; silica fibers; dispersion engineering; optical transmission.

Acknowledgements

This work was financially supported by the National Science Centre, Poland, grant no. UMO-2022/46/A/ST7/00238 (MAESTRO 14).

OT-11 · ORAL

Efficient perturbation-based optimization of individual spatial modes in nanostructured optical fibers

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 16:25–16:40 · Advanced optical fibres, modal control and distributed sensing · Main Hall
Presenter	M. Napiórkowski

Nanostructured optical fibers, composed of thousands of subwavelength glass rods, allow for nearly arbitrary effective material refractive index distributions and offer unprecedented control over properties of individual spatial modes at the cost of increased design complexity.

This work presents a fast optimization algorithm based on perturbation theory, which allows for efficient shaping of the effective refractive indices of multiple individual spatial modes. In the first steps, the method applies continuous corrections to the material refractive index of the individual glass rods based on analytically derived gradients. Afterwards, optimized free-form design is translated into fabrication-ready binary nanostructure, which can be further tuned using analytical gradients due to subwavelength size of the individual elements.

The effectiveness of the presented algorithm is demonstrated in optimization of nanostructured weakly coupled few-mode fibers, in which the separation between effective refractive indices of spatial modes is a critical parameter allowing for energy-efficient increase of data capacity. Compared to deep learning-based approaches, the proposed method achieves improved mode separation with significantly fewer simulations.

The method is not limited to few-mode fibers and provides a physics-driven alternative for the rapid design of nanostructured fibers, where control over individual mode properties is essential.

Keywords: Nanostructured optical fibers, numerical optimization, perturbation theory, few-mode fibers

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OT-12 · ORAL

Design and experimental characterization of conventional and microstructured D-type optical fibers

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 16:40–16:55 · Advanced optical fibres, modal control and distributed sensing · Main Hall
Presenter	T. Martynkien

We designed, fabricated, and experimentally characterized conventional and microstructured D-type optical fibers. In conventional optical fibers, the germanium oxide (GeO2) dopant concentration in the core is approximately 20 mol%, and the distance between the core edge and the cladding/air interface is about 1-3 μm. In the case of microstructured D-type optical fibers, the distance between the core edge and the air cladding interface is approximately 6-8 μm. In this case, however, the enhancement of the evanescent field is achieved by a photonic cladding that separates the core from the solid cladding. The proximity of air holes in microstructured D-type fiber and of the air-cladding interface in conventional fiber to the core, shifts the zero-dispersion wavelength toward shorter wavelengths. We performed numerical simulations of the basic propagation properties of the fabricated fibers using the finite element method (COMSOL Multiphysics). We demonstrated very good agreement with the measured characteristics, including effective refractive index, chromatic dispersion, and modal birefringence, over a broad spectral range. Finally, we discussed the applications of manufactured D-type optical fibers.

Keywords: D-type optical fiber, chromatic dispersion, modal birefringence, evanescent field

OT-13 · ORAL

Single optical fiber line setup using K-type side-hole fiber for simultaneous Rayleigh-based distributed measurements of hydrostatic pressure and temperature

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 16:55–17:10 · Advanced optical fibres, modal control and distributed sensing · Main Hall
Presenter	A. Bednarek

This work presents the optimization of a polarization-resolved distributed sensing method for measuring the response of a K-type side-hole fiber to temperature, pressure, or both parameters simultaneously. The primary measuring technique used is the optical frequency-domain reflectometry (OFDR) based on Rayleigh backscattering. The originally developed interrogation approach relied on an optical switch, which sequentially excited the two orthogonal polarization modes of the fiber from opposite fiber ends. In the optimized scheme, the switch-based configuration is replaced by a Faraday mirror placed at the further fiber end, enabling both polarization-resolved Rayleigh responses to be acquired within a single measurement. This eliminates temporal mismatch between the channels and allows one-end interrogation, which is advantageous in confined or inaccessible sensing environments. The developed side-hole fiber structure exhibits record-high, opposite-sign pressure sensitivities in distributed Rayleigh-based measurements, reaching −1.9 GHz/MPa and +0.7 GHz/MPa [1] for the two orthogonal polarization modes, while maintaining nearly identical temperature sensitivities. These properties provide a strong basis for high-resolution decoupling of pressure and temperature changes. Further enhancement of the fiber structure was deemed necessary as the polarization-maintaining performance turned out to be insufficient in some cases and led to partial coupling between polarization modes. Fiber optimization focuses on increasing the phase birefringence and polarization extinction ratio by enhancing the core ellipticity, thereby improving polarization stability during distributed multiparameter measurements.

Keywords: distributed sensing, K-type side-hole optical fiber, hydrostatic pressure sensing, temperature sensing, multiparameter measurements

Acknowledgements

Research funds provided by:

Fundation for Polish Science (FENG.02.07-IP.05-0139/23) and National Science Centre (Grant Opus 18, DEC-2019/35/B/ST7/04135). The work was supported by the project "Minigrants" for doctoral students of the Wrocław University of Science and Technology (50SD/0031/26).

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OT-14 · ORAL

Antiresonant Hollow-Core Fibers: Overcoming Practical Challenges in Gas Sensing

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 17:10–17:25 · Advanced optical fibres, modal control and distributed sensing · Main Hall
Presenter	P. Perehiniec

Antiresonant hollow-core fibers (AR-HCFs) are a class of optical fibers that guide light within an air-filled core using antiresonant reflection from surrounding microstructured elements. Because of this propagation mechanism, some of their properties are advantageous over solid-core fibers. While these advantages make AR-HCFs highly versatile in fiber optics, they are particularly well suited for gas sensing, especially in laser absorption spectroscopy [1]. Their hollow core can be filled with gasses, enabling direct interaction between gas and the guided light within the guiding structure. Compared to conventionally used gas cells, AR-HCFs require smaller sample volumes and offer faster response times. Additionally, their broadband guidance allows for multi-species detection using tunable laser sources [2]. In order to use them to their maximum potential in gas sensing applications, further studies are being conducted. In this presentation we would like to show a few practical aspects of those studies with their results. Those studies include AR-HCFs splicing, their coiling ability and other nuances that are related to usage of those fibers for gas sensing.

Keywords: gas sensing, laser absorption spectroscopy, antiresonant hollow-core fibers, fiber splicing

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Tuesday, 15 September 2026 · 16:00–17:25 · Modular Hall — Computational holography, lensless imaging and microfabrication

IN-05 · INVITED

Microoptics in every pocket - most frequent use of optics in our lives

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Presentation	Invited talk
Programme	Tuesday, 15 September 2026 · 16:00–16:25 · Computational holography, lensless imaging and microfabrication · Modular Hall
Presenter	L. Kotačka

Applied optics, diffraction, and holography have served as the most valuable measures in anti-counterfeit devices for more than four decades. It doubtlessly reached the very fundamental limits of diffraction phenomena and actually helped to develop various diffractive features in a way beyond classical understanding of it ill. The talk will briefly summarize the historical as well as the most recent advances in the field following us in everyday life, protecting banknotes, ID documents and other valuable documents.

Keywords: Diffraction, micro-optics, holography, anti-counterfeit measures

OT-15 · ORAL

New achievements in holographic gray-scale structures fabrication using direct laser writing lithography

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 16:25–16:40 · Computational holography, lensless imaging and microfabrication · Modular Hall
Presenter	T. Kohut

The paper deals with modern approaches in microstructure device production above possibilities of the e-beam origination. Three-dimensional (3D) holographic structures such as microlenses with variable height, blazed gratings, computer generated holograms are indispensable in advanced optical variable devices (OVD). Their performance could be significantly reduced by nonideal exposure of photoresist during optical direct laser writing. In this presentation, we demonstrate correction and significant improvement of gray-scale lithography exposure by understanding of Gaussian beam propagation and attenuation in absorbing photoresist. We demonstrate flawless fabrication of advanced holographic security elements, for example, microlenses and Fresnel lenses with variable height, blazed gratings and computer generated holograms with selected diffraction efficiency.

Keywords: lithography, holography, optical variable devices, security features

OT-16 · ORAL

Optimizing Diffraction in Digital Micromirror Devices for Single-Pixel Imaging and Incoherent Holography

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 16:40–16:55 · Computational holography, lensless imaging and microfabrication · Modular Hall
Presenter	R. Kotyński

Digital micromirror devices (DMDs) are widely used MEMS-based spatial light modulators comprising a pixelated array of micromirrors that switch between two discrete states. Although primarily employed for reflective beam shaping, DMDs can also function under coherent illumination as two-dimensional blazed diffraction gratings or diffractive optical elements (DOEs). In this regime, multiple diffraction orders are generated, with the highest diffraction efficiencies occurring near the direction of specular reflection. At specific wavelengths, the specular reflection may coincide with a diffraction order. For the DLP7000, this occurs for orders 6–10 in the visible spectral range and for lower orders in the near-infrared (NIR). Such overlap is generally undesirable, and the use of germanium thin-film filters to suppress it in the NIR has previously been proposed [1]. The approach was subsequently validated in a NIR single-pixel imaging (SPI) system. Beyond SPI, where DMDs are predominantly employed as binary spatial modulators under incoherent illumination, their application to Fresnel incoherent correlation holography (FINCH) as beam-splitting elements generating self-interfering reflected wavefronts is investigated. The first demonstration of DMD-based FINCH was recently reported [2]. Recent results on binary mask optimization for this configuration, obtained using a gradient-based stochastic optimization framework incorporating Rayleigh–Sommerfeld diffraction between nonparallel planes, will be presented [3].

Keywords: digital micromirror device, incoherent holography, single-pixel imaging, Rayleigh-Sommerfeld diffraction, stochastic optimization

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OT-17 · ORAL

Extending the Field of View in Lensless Holotomography via Limited Projection Reconstruction

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 16:55–17:10 · Computational holography, lensless imaging and microfabrication · Modular Hall
Presenter	J. Dudek

Lensless digital in-line holographic microscopy (LDIHM) enables label-free amplitude and phase imaging over a wide field of view, easily reaching approximately 100 mm² with lateral resolution of 1–2 µm [1]. Its extension to three-dimensional tomographic imaging through oblique-illumination scanning enables acquisition of angular information from multiple directions, analogous to optical diffraction tomography. In our recent work, we developed a lensless holotomography (LHT) framework that achieved a field of view exceeding 0.6 cm² and pixel-level resolution of approximately 2.4 µm, validated on complex 3D phantoms and optically cleared biological tissue [2]. Building on this platform, we investigate extending LHT toward a larger effective field of view. We exploit lateral hologram displacements induced by larger illumination angles. In this regime, each recorded hologram remains limited by the camera sensor, while the corresponding specimen region is laterally shifted. As a result, different regions are sampled by different subsets of illumination angles. Rather than restricting reconstruction to the central region visible across the full angular scan, we examine whether peripheral regions captured with fewer projections can still support reliable tomographic recovery. This limited-projection strategy provides an effective XY scanning mechanism without mechanical translation and offers a pathway toward extended-field-of-view, label-free holotomographic bioimaging.

Keywords: lensless holotomography, label-free bioimaging, computational microscopy, quantitative phase imaging, three-dimensional imaging, limited projection reconstruction, extended field of view.

Acknowledgements

Funded by the European Union (ERC, NaNoLens, Project 101117392). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Council Executive Agency (ERCEA). Neither the European Union nor the granting authority can be held responsible for them.

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OT-18 · ORAL

Gigapixel-Scale Lensless Holography with Robust Spatially Varying Numerical Refocusing

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Presentation	Oral talk
Programme	Tuesday, 15 September 2026 · 17:10–17:25 · Computational holography, lensless imaging and microfabrication · Modular Hall
Presenter	K. Glinka

Lensless digital in-line holographic microscopy (LDIHM) is a compact quantitative phase imaging modality capable of capturing large fields of view while preserving fine spatial detail [1]. These characteristics are described by the space-bandwidth product (SBP), representing the total number of independently resolvable pixels. In this work, we present a hardware-computational framework for achieving gigapixel-scale SBP in LDIHM, with particular emphasis on robust numerical refocusing across ultra-large reconstructed fields. We investigate and compare refocusing strategies based on spatially varying propagation, adaptive patch-wise reconstruction, and dynamic focus estimation to maintain reconstruction fidelity and quantitative accuracy across non-planar and extended specimens. Particular attention is given to numerical stability, propagation precision, and computational scalability for large holographic datasets. To maximise SBP, we combine a large-area sensor with multi-height pixel super-resolution [2] acquisition, as well as hologram tiling and stitching. RGB illumination is added to provide complementary contrast information and improve feature discrimination in wavelength-dependent samples. We achieve an integrated SBP approaching 10 gigapixels after incorporating numerical refocusing into the reconstruction pipeline. System performance is validated using resolution test targets, tissue sections, and cellular specimens. The presented framework establishes a scalable route toward high-throughput lensless imaging with gigapixel-scale information throughput and precise large-area numerical refocusing.

Keywords: lensless digital holographic microscopy, space-bandwidth product (SBP), computational imaging, high throughput imaging, numerical refocusing, quantitative phase imaging

Acknowledgements

Funded by the European Union (ERC, NaNoLens, Project 101117392). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Council Executive Agency (ERCEA). Neither the European Union nor the granting authority can be held responsible for them.

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Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session — Poster Session 1

P-01 · POSTER

Stabilized Two-photon-level Interference: A Classical Mach–Zehnder Platform and Its Application in Quantum Communication

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Presentation	Poster
Poster number	P-01
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	O. Galkina

Mach–Zehnder, Sagnac, and Michelson interferometers are the standard building blocks of single-photon interference in fiber-based quantum-communication systems. These same interferometer types can equally be extended to the two-photon regime, with time-bin encoding for quantum key distribution as a key resulting advantage [3–5]. Here we focus on two-photon interference realized on a fiber Mach–Zehnder platform [1,2]. Based on the theoretical noise budget, an interference visibility of about 33.3% was predicted — arising from the statistical splitting on the two beam splitters; the stabilized interferometer in classical regime confirmed an expected visibility, in good agreement with the prediction and sufficient for future two-photon-level operation once connected to a quantum source [1,2]. We also attempted a fully quantum measurement, but encountered a practical limit arising from the source: the limited coincidences count combined with the DWDM filtering loss reduced the statistical significance of the coincidence measurement. Reaching the phase stability required for two-photon-level quantum interference remains a key experimental challenge on the way from classical to quantum interferometry.

Keywords: two-photon interference, fiber optics, Mach–Zehnder interferometer, coincidence detection, time-bin quantum key distribution

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P-02 · POSTER

Microwave Field Detection Using a Rydberg-Atom Quantum Receiver

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Presentation	Poster
Poster number	P-02
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	M. Krupová

Rydberg-atom based quantum receivers (Q-receivers) represent a promising platform for microwave sensing and metrology. Rydberg atoms are atoms excited to states with principal quantum number n in the tens to hundreds, exhibiting extraordinary sensitivity to electromagnetic fields due to their large electric dipole moments. In rubidium, a multi-level ladder excitation scheme (5S → 5P → nD/nS) enables coupling to microwave transitions between adjacent Rydberg states. The microwave signal is detected through modifications of the electromagnetically induced transparency (EIT) spectrum, enabling a direct, all-optical, atom-based and calibration-free electric-field measurement.

In this contribution, we present our implementation of a rubidium-based Rydberg Q-receiver. The experimental setup employs a room-temperature rubidium vapour cell with ladder excitation. A probe beam monitors EIT transmission as a function of coupling laser frequency, while the microwave signals near the relevant Rydberg transition frequency are detected through the resulting Autler-Townes splitting. We present pilot results acquired with this system and characterize its performance in terms of sensitivity and noise limits.

Looking ahead, we aim to extend the system towards quadrature detection by implementing a local-oscillator microwave reference that enables phase-sensitive reception and simultaneous measurement of microwave field amplitude and phase.

Keywords: Rydberg atoms, quantum sensing, microwave detection, electromagnetically induced transparency (EIT), rubidium vapour, atom-based metrology

P-03 · POSTER

Experimental verification of complementary relations of tri- and bi-partite correlation measures in three-qubit states

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Presentation	Poster
Poster number	P-03
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	M. Zeman

We report on experimental verification of complementary relations between genuine tripartite quantum state negativity and the corresponding reduced correlation measures of bipartite states: the first order coherence, maximum steering inequality violation and Bell-nonlocality. We show that the theory proposed by Dong et al. [1] holds for the discussed generalized gGHZ state as well as for maximum-sliced MS states, which belong to a family of single-parameter states that are widely used to derive various complementary relations. Using the constructed experimental setup, we generate a series of gGHZ and MS states, which are subsequently reconstructed using full quantum state tomography. Our experimental results confirm the proposed theory and provide strong evidence for fundamental connections between tripartite negativity and bipartite correlations for pure and generally mixed states.

Keywords: Correlation, negativity, coherence, steering, Bell-nonlocality, complementary relations, experiment, three-qubit state

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P-04 · POSTER

Evaluating the Impact of Optical Element Imperfections on Entanglement Quality and Brightness of a Sagnac-based type-II SPDC Entangled Photon Source Using Jones Formalism

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Presentation	Poster
Poster number	P-04
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	S. Rudnicki

This work presents a numerical simulation framework for a Sagnac-based type-II Spontaneous Parametric Down-Conversion (SPDC) source for generating frequency-degenerate, polarization-entangled photon pairs. Utilizing Jones formalism, the simulation evaluates how imperfect optical components impact source brightness and entanglement quality. A significant challenge in SPDC source design is the requirement for optical elements to function across two widely separated wavelengths (the pump and signal/idler). Such elements are, more often than not, very expensive. This study analyzes the feasibility of using non-ideal components by specifically modeling the effects of unequal retardance in half-wave plates and polarization leaks in polarizing beam splitters and their influence on the quality of such a source. The simulation also serves as a practical guide for adjusting input polarization to reach target entangled states and optimization of a laboratory setup.

Keywords: Type-II SPDC, Sagnac Interferometer, Jones Formalism, Polarization Entanglement, Numerical Simulation, Optical Imperfections

P-05 · POSTER

Motion-compensated 3D refractive index reconstruction in limited-angle tomography with sample rotation using holographic optical tweezers

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Presentation	Poster
Poster number	P-05
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	F. Dłużewski

This work presents TomoTweezers, a new approach to performing holographic tomography with optical tweezers. The presented system delivers anisotropic tomographic reconstruction through sample rotation along the optical axis of the system – instead of an axis perpendicular to the viewing direction. The rotation is realized using three axially rotated optical traps created via holographic wavefront shaping with a phase-only spatial light modulator. To address sample movement during manipulation, we introduce an iterative reconstruction algorithm that utilizes a differentiable forward model based on Ewald sphere mapping. The algorithm estimates the 6-degree-of-freedom sample trajectory during rotation to assist in reducing motion-induced artifacts. The performance of the tomographic reconstruction is demonstrated with biological and technical objects.

Keywords: Optical tweezers, holographic tomography, refractive index, micromanipulation, iterative reconstruction

Acknowledgements

The authors acknowledge the statutory funds of Warsaw University of Technology. The authors would also like to thank Paulina Laskowska, Institute of Hematology and Transfusion Medicine for providing samples of leukemia cells.

P-06 · POSTER

Hybrid Spectral-Spatial Domain Registration for Nanometric Tracking in Digital In-Line Holographic Microscopy

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Presentation	Poster
Poster number	P-06
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	K. Kalinowski

Digital in-line holographic microscopy (DIHM) enables label-free, three-dimensional tracking of micro- and nano-scale objects in biophysics, fluid dynamics, and pathogen detection[1,2], making nanometric localization accuracy fundamental to extracting quantitative dynamics from these systems. The current standard for image registration in DIHM relies on Discrete Fourier Transform (DFT) phase correlation[3,4], valued for its global robustness, but DFT suffers from a quantization-imposed precision floor in the sub-pixel regime. Spatial-domain Lucas-Kanade (LK) optical flow[5,6] surpasses DFT in sub-pixel accuracy, as confirmed by our numerical and experimental evaluation, yet its narrow convergence basin causes divergence under large displacements typical in particle tracking. We propose the Hybrid Spectral-Spatial Domain (HSSD) algorithm, resolving this trade-off by cascading a DFT-based coarse estimator with LK refinement of the residual motion. The DFT stage provides robust integer-pixel initialization within LK's convergence basin, while LK eliminates the quantization artifacts that limit standalone DFT precision. Validated numerically under six noise types and experimentally with a piezo-actuated DIHM system (532 nm, 0.95 NA, 18.5 nm/px calibration), HSSD achieves RMSE of 22.4 nm, outperforming standalone DFT (26.6 nm) and LK (35.0 nm). Moreover combined with DarkFocus axial estimation[7], HSSD enables full XYZ nanometric particle tracking.

Acknowledgements

Funded by the European Union (ERC, NaNoLens, Project 101117392) and Warsaw University of Technology within the Excellence Initiative: Research University (IDUB) programme.

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P-07 · POSTER

Comparison of Non-Blind and Blind Deconvolution Methods Applied to Coded Aperture Imaging

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Presentation	Poster
Poster number	P-07
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	A. Güneş

Coded aperture imaging (CAI) is an effective indirect imaging technique, particularly for systems employing spatially incoherent illumination. Image reconstruction requires accurate deconvolution because the recorded object intensity distribution is formed by convolution with the optical system's point-spread function (PSF). Reconstructed images may therefore exhibit blur, background noise, diffraction artifacts, correlation-induced distortions, and sensor noise. We propose and experimentally demonstrate optimization-based deconvolution methods using the Adam optimizer with a total-variation maximum-a-posteriori (TV-MAP) objective function. Their performance is compared with that of established methods, including Wiener filtering, Richardson–Lucy and Richardson–Lucy–Rosen algorithms, Landweber iteration, and the Kaczmarz method. Blind Richardson–Lucy deconvolution and blind Adam-based optimization are also evaluated. Optical measurements were performed using a spatially incoherent light-emitting diode operating at 625 nm. Coded phase masks were generated and applied to the object wave using a liquid-crystal spatial light modulator. The proposed methods were assessed under blind and non-blind deconvolution conditions using both experimental and simulated datasets. The results indicate that blind and non-blind approaches offer complementary advantages under different imaging conditions. Both Adam-based methods exhibit improved robustness to experimental imperfections and provide reconstructions with reduced artifacts and enhanced image quality compared with conventional deconvolution techniques.

Keywords: Coded Aperture Imaging, Deconvolution, Wiener filter, Richardson–Lucy, TV-MAP, Point Spread Function

Acknowledgements

This work was conducted while Amine Güneş was undertaking an Erasmus+ traineeship at the Faculty of Physics, University of Warsaw.

P-08 · POSTER

A Hybrid Digital Holography and Fourier Ptychographic Microscopy Approach for Quantitative Phase Imaging

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Presentation	Poster
Poster number	P-08
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	W. Wróblewski

Quantitative phase imaging has emerged as a powerful label-free method for inspecting biological samples. However, each of them comes with their own limitations. Classical interferometric techniques, such as digital holographic microscopy (DHM), are inherently limited by the coherent diffraction limit and are highly susceptible to speckle noise. Conversely, non-interferometric techniques like Fourier ptychographic microscopy (FPM) offer high-resolution synthetic aperture imaging but cannot reconstruct low-frequency phase information accurately due to stringent matched-illumination condition [1]. To overcome these limitations, we implement a hybrid off-axis Mach-Zehnder DHM and FPM configuration within a unified optomechanical platform. We initially capture a single off-axis hologram to retrieve a reliable, low-frequency phase anchor that populates the central aperture of the Fourier space. Subsequently, a sequence of intensity-only images is captured under angle-varied illumination provided by a programmable LED ring. An adaptive FPM algorithm synthesizes an extended frequency bandwidth to broaden the imaging resolution. The system's performance was evaluated using bio-inspired 2D phase phantoms replicated in resin via two-photon polymerization [2]. The experimental results validate that our hybrid method successfully suppresses coherent artifacts and retrieves robust, high accuracy phase profiles. This configuration serves as a foundational benchmark for expanding towards high-throughput 3D optical diffraction tomography.

Keywords: Quantitative phase imaging, digital holography, fourier ptychography, synthetic aperture, phase phantoms

Acknowledgements

The authors gratefully acknowledge the financial support from the National Science Centre, Poland (NCN) through grant no. 2023/48/Q/ST7/00172.

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P-09 · POSTER

Design and fabrication of integral imaging security features for polymer banknotes

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Presentation	Poster
Poster number	P-09
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	M. Machalová

Integral imaging based on microlens arrays represents one of the most advanced optical security technologies used on modern polymer banknotes.

In this work, we present the design, fabrication, and optical characterisation of a custom integral imaging security feature. A dedicated image array was designed for a hexagonal microlens array and fabricated by direct laser lithography. After silver metallization and nickel electroforming, a nickel shim was produced and used for UV-sensitive ink printing on biaxially oriented polypropylene (BOPP) foil.

The study focuses on the visual performance of the security element. First, the influence of the period mismatch between the microlens array and the underlying image array is investigated, demonstrating how small variations modify the reconstructed image and optical effects. Second, the effect of the printed ink amount on the appearance and image quality is evaluated, providing insight into the relationship between printing parameters and the perceived optical performance.

The presented results contribute to the optimization of integral imaging security features and provide practical guidelines for the design and manufacture of next-generation optical security elements for polymer banknotes.

Keywords: micro lenses, integral imaging, polymer foil, security features

P-10 · POSTER

Complete polarization characterization of anisotropic samples using terahertz time-domain spectroscopic ellipsometry

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Presentation	Poster
Poster number	P-10
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	P. Kostka

The use of terahertz (THz) radiation for non-destructive material characterization has grown rapidly in recent years. Among emerging polarization-sensitive techniques, terahertz time-domain spectroscopic ellipsometry (THz-TDSE) provides comprehensive information about the optical properties of anisotropic materials, semiconductors, and thin films. The presented work focuses on the development, calibration, and experimental validation of a THz-TDSE system. The experimental setup employs a femtosecond laser and a spintronic terahertz emitter as the THz radiation source. Detection of the THz electric field is performed using electro-optic sampling in a ZnTe nonlinear crystal. By coherently measuring two orthogonal transmitted electric-field components for two independent linearly polarized incident states, we obtain the four polarization measurements of amplitude and phase required to reconstruct the complete frequency-dependent Jones matrix of each sample. The measured Jones matrices are subsequently transformed into Pauli exponential coefficients, which provide a direct description of diattenuation and retardance in the individual Stokes bases. This representation enables a straightforward analysis of the polarization properties of the measured samples. The functionality of the system was verified by measurements of a quartz crystal, demonstrating reliable reconstruction of the complete Jones matrices and the corresponding polarization properties.

Keywords: terahertz radiation, ellipsometry, time-domain, optical anisotropy, Pauli coefficients

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P-11 · POSTER

The Comparative Study of Quadrant Photodiodes and 2D Lateral Effect Detectors in Optical Tweezers Application

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Presentation	Poster
Poster number	P-11
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	S. Drobczyński

This study evaluates Quadrant Photodiode (QPD) and a 2D Lateral Effect Detector (LEPD) technologies, with a specific focus on their sensitivity to beam profile irregularities and the resulting impact on measurement precision. We performed a head-to-head comparison by analyzing the Brownian motion of trapped microspheres. The position signals were recorded using both a silicon-based QPD and a 2D LEPD. We specifically investigated how beam asymmetries, often introduced by imperfect alignment, optical aberrations, or non-spherical trapped objects affect the calibration of trap stiffness. We demonstrate that position measurement with a QPD is highly sensitive to the symmetry and intensity profile of the laser beam. Because the QPD calculates displacement based on the power balance between discrete segments, any inherent beam asymmetry or non-uniformity is misinterpreted as a spatial shift. This necessitates rigorous centering of the beam and a perfectly Gaussian profile to avoid systematic errors. In contrast, we show that the 2D Lateral Effect Detector operates on a principle analogous to video camera. It provides a position output based on the center of mass (centroid) of the light distribution. This resistive-layer mechanism is intrinsically robust against beam inhomogeneities and spot-shape distortions. Much like camera-based tracking, the LEPD ensures that the measured coordinate remains the true geometric center of the beam, regardless of the intensity profile's internal structure.

Keywords: Optical tweezers, quadrant photodiode, lateral effect photodiode

P-12 · POSTER

A Hierarchical Differentiable-Optics Model for Automated Calibration of an LC-SLM-Camera Diffraction System and Hologram Optimization

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Presentation	Poster
Poster number	P-12
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	A. Güneş and Z. Iwaniuk

Accurate calibration of an LC-SLM–camera diffraction system is essential for reliable hologram optimization. We introduce an automated, measurement-driven calibration method based on a hierarchical differentiable forward model.

Unlike most approaches, which assume a prescribed propagation model and independently calibrated system parameters, our method jointly infers the complex SLM modulation response, illumination amplitude and phase, propagation geometry, and camera placement, including possible tilt, shift, and rotation, from a predefined set of displayed patterns and corresponding intensity measurements. Model complexity is increased hierarchically, beginning with a low-dimensional Fresnel description and subsequently refined to include learned shift-invariant and spatially varying corrections, while regularization limits unnecessary flexibility.

After calibration, the model is frozen and used as a differentiable surrogate for gradient-based hologram optimization. As a result, the optimized SLM signal is expressed in terms of experimentally accessible drive values rather than the desired phase of the SLM's complex reflection coefficient distribution.

Accurate learning of the forward model is possible using a training set of 500–2000 SLM–camera image pairs acquired either in an optical simulation or in the experimental setup. Numerical validation using an independent optical simulator demonstrates accurate recovery of the prescribed SLM response, illumination, and system geometry, together with successful hologram optimization despite substantial initial model mismatch.

Keywords: Fresnel diffraction, holography, differentiable optics, hierarchical differentiable model

Acknowledgements

This work was conducted while Amine Güneş has was undertaking an Erasmus+ traineeship at the Faculty of Physics, University of Warsaw

P-13 · POSTER

One-way generation of vector beams using the spatial light modulator

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Presentation	Poster
Poster number	P-13
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	A. Popiołek-Masajada

In the most general case, the optical field at a given point is described by its amplitude, phase, and state of polarization. Modern optics makes it possible to generate so-called structured beams, which have a designed spatial distribution of these parameters within the beam. Modulating the amplitude and phase of a light wave within a beam is relatively straightforward. These are the so-called scalar beams, examples of which include vortex beams with phase singularities. The ability to shape a light beam in terms of a specific polarization distribution—that is, to create vector beams—is a more challenging task. The generation of such beams requires the coherent superposition of two orthogonally polarized components with a precisely controlled phase shift. Traditionally, interferometric methods are used for this purpose, but they require very precise alignment and are sensitive to mechanical vibrations. To overcome these limitations, we propose the use of a linearly birefringent spatial light modulator. Such a modulator decomposes the optical field into two orthogonally polarized components and enables precise control of their relative phase. We present a compact one-way optical schemes that converts a linearly polarized input beam into a vector beam with spatially modulated azimuth or ellipticity. The proposed configuration (see Figure), in which laser beam passes through quarter waveplate, spatial light modulator and again quarter waveplate, can be considered as a circularly birefringent (optical rotation) system. Polarization transformations are characterized using Stokes parameters and analyzed via the Mueller matrix formalism. Theoretical predictions were verified experimentally.

a) b)

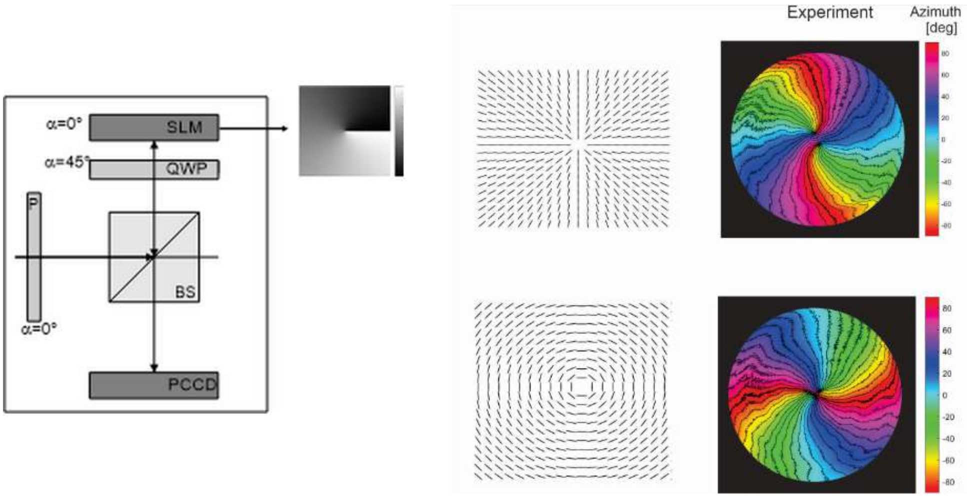

Figure 1 a) Experimental setup, b) exemplary experimental results of azimuth distribution.

Keywords: structured beam, polarization, spatial light modulator

P-14 · POSTER

Optical characterization of chiral polymer plasmonic structures

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Presentation	Poster
Poster number	P-14
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	I. Lettrichova

Chiral plasmonics has emerged as a new direction of plasmonics research. The principle lies in the fact that chiral molecules interact differently with circularly polarized light, absorbing left- and right-handed circular polarization to different extents. This interaction can be enhanced by coupling chiral molecules with plasmonic nanostructures (1-3).

We present preparation of 3D chiral polymer plasmonic structures prepared by single-step process based on direct laser polymerization in a volume of liquid polymer. A commercial Nanoscribe Photonic Professional GT laser lithographic system was used for polymer structure fabrication. We prepared 4 different designs of chiral structures: “cross”, “C”, “L” and “G”-shaped in both left- and right-handed enantiomorph, as well as one achiral reference structure. Structures were arranged in a field of 150×150 μm^2 with a period of 1-4 µm. In the next step, the polymer structures were metal coated with 40 nm Au layer. Morphology of prepared structures was shown using atomic force microscope. The radiation characteristics were simulated using FDTD method and measured by circular dichroism (CD) spectroscopy. CD spectra reveal the chiral character of prepared structures in near-infrared region.

Keywords: chiral structures, polymer structures, plasmonic structures, two-photon polymerization

Acknowledgements

This work was funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I05-03-V02-00054, and by the Slovak Research and Development Agency under project No. APVV 20-0264.

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P-15 · POSTER

Bioinspired 3D Nanoprinting of Photonic Structures Mimicking Peacock Spider Structural Color

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Presentation	Poster
Poster number	P-15
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	M. Zdurienčík

In this work, we present the design of bioinspired nanostructured antireflection coatings inspired by the photonic “super-black” structures found on the body of the peacock spider (Maratus volans). The proposed structure is designed to suppress reflection across the visible spectral range while maintaining reduced angular dependence. As shown in

Figure 1, the coating consists of a periodic rectangular array of IP-Dip polymer ellipsoids with a pitch of 500 nm, forming a structured photonic surface that modifies light propagation and reduces optical reflectance. Such antireflection structures are of interest for improving light absorption in optical and optoelectronic devices, including crystalline silicon solar cells

[1]. The proposed design demonstrates how bioinspired 3D nanoprinting can be used to realize functional photonic surfaces with enhanced light-management properties.

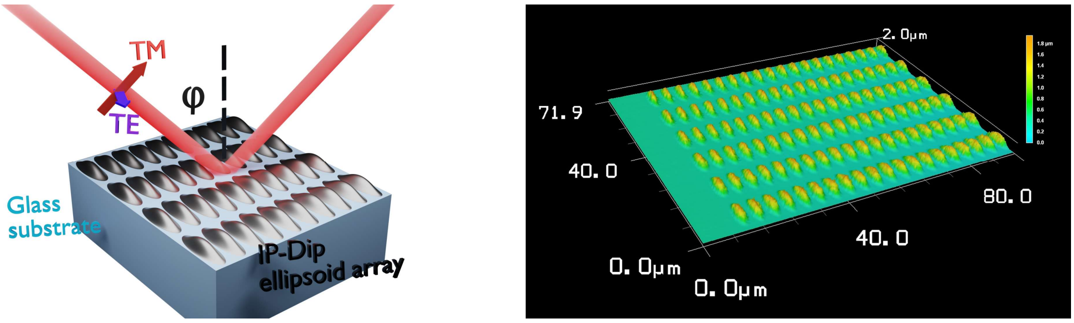

Figure 1. Periodic rectangular structure of IP-Dip ellipsoids with spacing of 500 nm, left: design, right : confocal microscopy image

Keywords: nanoprinting, photonic structure, reflectance suppression, peacock spider

Acknowledgements

This work was supported by the Slovak National Grant Agency under the project no. VEGA 1/0223/23 and the project “Grating Structures for LED, Laser and Photonic Component Applications” under the Plan for Recovery and Resilience of the Slovak Republic, funded by the European Union – NextGenerationEU (Grant No. 09I05-03-V02-00054).

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P-16 · POSTER

Simulations of Polarized Supercontinuum Generation in an All-Normal Dispersion Birefringent Honeycomb PCF

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Presentation	Poster
Poster number	P-16
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	R. Cichowski

We present a silica-based birefringent photonic crystal fiber (PCF) with a squeezed honeycomb lattice and germanium-doped core designed for polarization-maintaining all-normal dispersion supercontinuum generation. The proposed structure combines structural anisotropy with refractive-index engineering to achieve simultaneous control of chromatic dispersion, birefringence, and modal confinement. Numerical simulations performed using the finite-element method and coupled nonlinear Schrödinger equations demonstrate all-normal dispersion up to 2.3 µm for both polarization modes, phase birefringence approaching 5×10^{-4} at 1.55 µm, and effective mode area below 30 µm² over a broad wavelength range. Nonlinear propagation simulations with 30 fs pulses at 1.55 µm confirm stable and coherent supercontinuum generation for both slow- and fast-axis excitation, with bandwidths exceeding 1 µm. The optimized geometry provides a balanced compromise between broad bandwidth, spectral smoothness, and polarization extinction ratio, while remaining compatible with practical fabrication.

Keywords: photonic crystal fiber, supercontinuum generation, all-normal dispersion, birefringence, polarization-maintaining fiber, nonlinear optics, honeycomb lattice, silica fiber

P-17 · POSTER

Numerical and Experimental Evaluation of Fe:ZnSe Lasers at 4.1 µm

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Presentation	Poster
Poster number	P-17
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	R. Švejkar

In recent years, increasing effort has been directed towards the generation of high-power coherent radiation in the mid-infrared spectral range of 4-5 µm, driven by applications involving free-space propagation and the characteristic absorption bands of many important molecular species [1,2]. This study reports the realisation of multi-watt quasi-continuous-wave operation of an Fe:ZnSe laser under cryogenic conditions, supported by numerical modelling. The Fe:ZnSe polycrystalline gain medium was longitudinally pumped by a compact, high-power diode-pumped solid-state Er:YAG laser emitting at 2.94 µm. The laser system delivered a maximum output power exceeding 16 W at 4.1 µm, with a slope efficiency of 45 % relative to the incident pump power. A numerical model describing the laser performance was developed and extended to incorporate thermal effects relevant to low-temperature operation, including the temperature-dependent upper-state lifetime, varying from approximately 100 µs at 77 K to 100 ns at 300 K [2], as well as temperature-dependent emission and absorption cross-sections [1,3]. The inclusion of these thermal effects resulted in improved agreement between simulated and experimental results. The combined theoretical and experimental findings demonstrate the strong potential of Fe:ZnSe lasers for high-power mid-infrared applications where compactness, and high efficiency are advantageous.

Keywords: Fe:ZnSe laser, high-power laser, numerical simulation, mid-IR laser, Fe:ZnSe

Acknowledgements

The research has been supported by the Czech Science Foundation project No. 25-16282S – Fe-Doped Solids: The Key to Efficient Generation of High-Power Laser Radiation in the Mid-Infrared Region.

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P-18 · POSTER

Structured-core thulium-doped fiber for high-power fiber lasers

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Presentation	Poster
Poster number	P-18
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	B. Švejkarová

Thulium fiber lasers (TDFLs) are important radiation sources around 2 µm, enabling numerous applications in medicine, materials processing, sensing, and defense [1]. Their high efficiency originates from the so-called two-for-one cross-relaxation process in active fibers, which can theoretically double the overall quantum efficiency when pumped at ~790 nm. However, in high-power operation, thermally induced effects in the fiber represent a major limitation to further power scaling. To reduce the thermal load, several approaches were therefore investigated, for example, through longitudinal concentration structuring [2] or by reducing the effective doped area of the core [3,4]. These approaches aim to achieve high local thulium ion concentration for an efficient two-for-one process while maintaining the average concentration low enough to suppress heat generation. In this work, we report on an enhanced 7-rod-core thulium-doped fiber recently introduced in [5]. The manufacturing method has been improved allowing production of low-loss structured fibers with favorable ion environment. Laser experiments at 30-W output power level demonstrate slope efficiencies exceeding 64% at both 1940 nm and 1907 nm wavelengths, confirming the fiber design's effectiveness and indicating a promising path toward further efficiency improvements and power scaling of TDFLs.

Keywords: Tm-doped fibers, fiber lasers, pedestal-free fiber, heat load.

Acknowledgements

This work was supported by the Czech Science Foundation (26-21543S) and co-funded by the European Union and the state budget of the Czech Republic under the project LasApp CZ.02.01.01/00/22_008/0004573.

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P-39 · POSTER

Optical Mueller matrix ellipsometry of silicon carbide

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Presentation	Poster
Poster number	P-39
Programme	Tuesday, 15 September 2026 · 17:25–19:00 · Poster Session 1 · Poster Session
Presenter	Z. Gelnarova

Spectroscopic ellipsometry is a well-established, non-contact, and non-destructive technique widely used for industrial characterization of semiconductor materials, particularly silicon. However, extending its application to silicon carbide (SiC) introduces challenges due to the material's complex optical properties [1,2]. These include transparency across the visible spectral range, incoherent reflections from the wafer's back surface, and intrinsic anisotropy with a tilted optical axis.

In this study, 4H polytype SiC wafers were characterized across a broad near-infrared to ultraviolet range (0.49 eV – 6.42 eV) using a Woollam RC2-DXNIR Mueller matrix ellipsometer. The core contribution of this work lies in the development of a comprehensive optical model designed to interpret the resulting data. This model successfully accounts for the intrinsic anisotropy and back-side incoherent reflections, providing a robust framework for extracting precise optical constants.

Our model provides a promising framework for analysis and quality control of subsequent thin films, epitaxial layers, and ohmic contacts deposited on SiC substrates. Furthermore, this NIR-Vis-UV approach complements our broader characterization framework, which includes highly specialized terahertz complete time-domain spectroscopic ellipsometry (THz-cTDSE) for low-doped semiconductor layer analysis [3], directly supporting the development of advanced SiC-based semiconductor devices [4].

Keywords: Silicon carbide, Mueller matrix ellipsometry, optical constants, anisotropy, optical modeling.

Acknowledgements

We acknowledge financial support from GACR (25-15775S); Ministry of Education, Youth and Sports of the Czech Republic (SP2026/083); project "Materials and Technologies for Sustainable Development" (CZ.02.01.01/00/22_008/0004631); project REFRESH (CZ.10.03.01/00/22_003/0000048); project OPTAK (CZ.01.01.01/01/22_002/0001113); and OP JAC, reg.NO. CZ.02.01.01/00/23_021/0008592 Advanced Materials for Energy and Environmental Technologies.

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Wednesday, 16 September 2026 · 15:00–16:35 · Main Hall — Plenary session 3 - Quantum, Photonic & Glass Technologies

PL-05 · PLENARY

Enabling Quantum Technologies with Wide-Bandgap Semiconductors: Progress and Challenges

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Presentation	Plenary talk
Programme	Wednesday, 16 September 2026 · 15:00–15:45 · Plenary session 3 - Quantum, Photonic & Glass Technologies · Main Hall
Presenter	J. Chochol

Wide-bandgap semiconductors are commonly associated with power conversion, but their impact extends to photonics, sensing and emerging quantum technologies. This talk reviews their evolution from laboratory materials to a multibillion-dollar industry shipping hundreds of millions of devices.

The focus is silicon carbide, an anisotropic semiconductor sufficiently compatible with established silicon manufacturing concepts to enable high-volume production for electric vehicles, data centers and energy infrastructure. Key distinctions between SiC and silicon will be highlighted across bulk-crystal and epitaxial growth, wafer processing and metrology, together with the challenges of defect control, yield and scalability. SiC applications extend beyond power electronics to radiation-tolerant devices, radiation detectors and solar-blind ultraviolet photodetectors. Its distinctive combination of wide bandgap, optical transparency, nonlinear optical response, high refractive index and optically addressable defects also supports integrated photonic circuits, single-photon emitters, spin–photon interfaces, quantum sensing and frequency conversion.

GaN and diamond provide complementary reference points, illustrating alternative technological pathways and trade-offs between material performance, manufacturability and ecosystem maturity. The talk concludes by considering how advances in materials control, manufacturing infrastructure, metrology and device integration could support the translation of quantum technologies from laboratory demonstrations towards scalable applications.

Keywords: Wide-bandgap semiconductors; silicon carbide; semiconductor manufacturing; integrated photonics; colour centres; single-photon sources; quantum sensing; spin–photon interfaces.

IN-06 · INVITED

Photonics Research at the Department of Laser Physics and Photonics FNSPE CTU in Prague

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Presentation	Invited talk
Programme	Wednesday, 16 September 2026 · 15:45–16:10 · Plenary session 3 - Quantum, Photonic & Glass Technologies · Main Hall
Presenter	I. Richter

The Nanophotonics and Quantum Technologies Group (Department of Laser Physics and Photonics, FNSPE CTU in Prague) has been systematically focused on the study of photonic nanostructures, their design, analysis of their interaction with electromagnetic fields, as well as methods for their preparation, characterization, and selected applications. In the area of analysis and design, it focuses, particularly from a theoretical perspective, on a wide range of nanophotonic structures, such as photonic crystals, metamaterials, plasmonic structures, and special substrates and waveguides, nanoparticle systems, and, more recently, non-Hermitian, non-reciprocal, and topological photonic structures (photonic bound states in the continuum - BICs). The group also engages in advanced numerical modeling of the interaction of electromagnetic radiation with the environment, based on a rich portfolio of complementary methods (developed in-house, freely or commercially available). As for the experimental activities, the group has long been engaged in a range of techniques for the preparation and characterization of photonic nanostructures. For the fabrication of nanoparticles and nanostructures, it primarily utilizes methods of nanochemistry and self-assembly, in combination with other techniques. In connection with this, we also employ a range of characterization methods, from optical (including confocal) to electron microscopy and atomic force microscopy, in correlation with spectroscopic methods. In collaboration with other research institutions, the group also focuses on selected applications of nanophotonics, such as plasmonic sensors, advanced SERS substrates, the use nanoparticles in theranostics, the preparation of special targets for inertial fusion research, research into new quantum generators, etc. Recently, the group has also focused on selected quantum technologies, particularly within the context of optical, photonic, and plasmonic platforms (generation, detection, and applications of quantum-entangled photons). Finally, several examples of our recent research activities will be given (BICs in waveguiding structures, nonlocal plasmonics, Fourier modal method, and others).

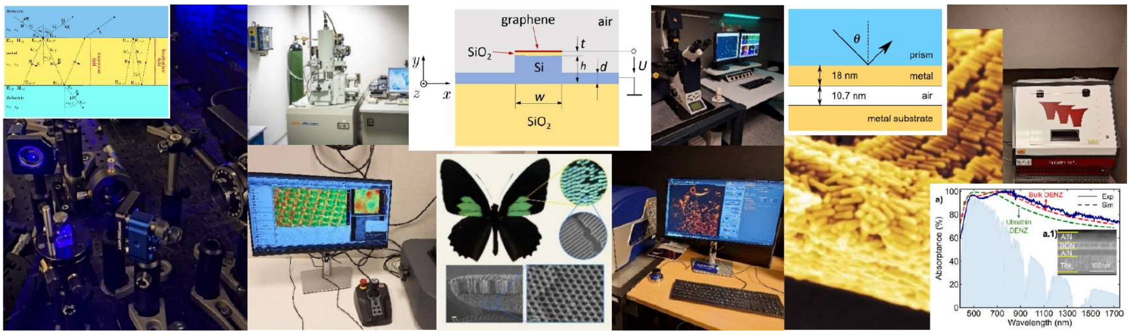

Figure 1. Examples of research activities at the Group of nanophotonics and quantum technologies.

Keywords: integrated photonics, photonic crystals, surface plasmons, quantum optics, subwavelength grating waveguides, spin-lasers, nanostructures, bound states in the continuum

Acknowledgements

Funding by the CSF projects (25-15775S and 26-21651S) are gratefully acknowledged.

IN-07 · INVITED

Glass moulded optics – design and challenges.

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Presentation	Invited talk
Programme	Wednesday, 16 September 2026 · 16:10–16:35 · Plenary session 3 - Quantum, Photonic & Glass Technologies · Main Hall
Presenter	J. Kočárek

Presentation introduces methods of glass molding and explains the ones convenient for optically functional components for lighting applications. Brief history of optical glass molding is mentioned together with relation to the former Czechoslovakia. The molding process specifics are explained and recommendations for optical design are highlighted. Molding tool basics and process limits are explained together with the tool lifetime. Shape precision, surface modulation and functional specifics are presented and discussed on case studies. Surface modulation is presented in detail, measurement vs. simulation is compared. Limited use of glass molding for imaging optic is shown. Properties of glass and advantages for complicated applications are highlighted. The application of thin sol-gel optical layers is noted as the key advantage against the plastic optic.

Keywords: glass, molding, modulation, precision, lighting, thin layer, design

Thursday, 17 September 2026 · 08:30–10:30 · Main Hall — Czech–Polish Photonics 2026 Workshop

WT-01 · WORKSHOP

AI-Powered Precise Positioning Workstation

T. Kołcon

Łukasiewicz - Industrial Institute for Automation and Measurements

Presentation	Workshop talk
Programme	Thursday, 17 September 2026 · 08:30–08:45 · Czech–Polish Photonics 2026 Workshop · Main Hall
Presenter	T. Kołcon

Precise positioning and visual inspection are important stages of photonics manufacturing, where small inaccuracies can affect product quality, production efficiency and material consumption. This presentation introduces an AI-supported workstation developed by Łukasiewicz Research Network – PIAP and implemented by one of the Polish photonics manufacturers.

The solution combines microscopic vision, automated positioning and artificial intelligence in an iterative, operator-supervised process. AI algorithms support component localization, position correction and defect detection, while a user-friendly interface allows the operator to monitor the process and handle exceptional cases.

The system has been tested in an industrial environment and has delivered measurable improvements. The positioning cycle time was reduced from 5 to 2 minutes, the reject ratio decreased from 10% to 3%, and operator efficiency increased approximately twofold. Only one day of training was required for independent operation.

The presented case demonstrates how human-centered AI can improve the repeatability, usability and sustainability of photonics manufacturing while reducing the burden of repetitive, precision-demanding tasks.

Keywords: artificial intelligence, photonics manufacturing, precise positioning, machine vision, defect detection, human-centered automation

WT-02 · WORKSHOP

Innovative Laser and Scintillation Materials for Modern Applications

K. Nejezchleb

Crytur spol. s r.o., Project LASCIMAT

Presentation	Workshop talk
Programme	Thursday, 17 September 2026 · 08:45–09:00 · Czech–Polish Photonics 2026 Workshop · Main Hall
Presenter	K. Nejezchleb

The structure and results reached by the project “Innovative Laser and Scintillation Materials for Modern Applications” will be presented. The project is funded under the OP-JAK programme of the Ministry of Education, Youth and Sport of the Czech Republic. The members of the project consortium are the Institute of Physics of the Czech Academy of Sciences, the Faculty of Nuclear Sciences and Physical Engineering at the Czech Technical University in Prague, and the companies Nuvia and Crytur.

The project comprises of five research activities focusing on bulk single-crystal scintillators based on oxygen-containing, halide and sulphide compounds; on ultra-fast scintillating nanostructures; on organic and nanocomposite scintillating materials; on bulk single-crystal materials for active media in lasers for the VIS and IR regions; and on characterisation methods and procedures for optimising industrial technologies for the preparation of scintillation and laser materials.

WT-03 · WORKSHOP

Advanced Fizeau Interferometry for Complex Optics: Wavelength Tuning, Absolute Metrology and Subaperture Stitching

P. Psota

OPMET Labs

Presentation	Workshop talk
Programme	Thursday, 17 September 2026 · 09:00–09:15 · Czech–Polish Photonics 2026 Workshop · Main Hall
Presenter	P. Psota

This contribution presents an advanced Fizeau interferometry approach combining wavelength tuning, absolute interferometry, retrace error correction, and subaperture stitching. The method enables measurements of multi-surface, large-aperture, and high-NA optical components. Its capabilities are illustrated through practical case studies, including a stitched measurement of a diamond-turned polymer dome.

WT-04 · WORKSHOP

Laser switching of phase change materials for active photonic devices - a custom solution

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Presentation	Workshop talk
Programme	Thursday, 17 September 2026 · 09:15–09:30 · Czech–Polish Photonics 2026 Workshop · Main Hall
Presenter	O. Pavelka

Chalcogenide thin films are highly promising materials for next-generation high-capacity data storage and active integrated photonic devices. These technologies rely on reversible, optically induced phase transitions between the material's amorphous and crystalline states. While current phase-change research primarily utilizes red or infrared lasers, shifting this optical manipulation to the blue spectral region offers a massive increase in data capacity and spatial resolution. However, observing these specific high-frequency phase dynamics requires specialized diagnostic tools unavailable on the commercial market. To address this scientific gap, we designed and constructed a custom pump-probe phase microscope from scratch for a scientific customer at the University of Pardubice, using only a basic conceptual schematic from a related study as our starting point. The bespoke system employs a 405 nm fiber-coupled pump laser to induce the localized phase change and a 450 nm probe laser to simultaneously monitor the resulting sub-microsecond dynamics in optical transmittance and reflectance. Featuring custom electronics, sub-micron XYZ positioning, and high-speed nanosecond detection, this tailored solution directly empowers researchers to investigate blue-wavelength optical memory and advance the boundaries of nanophotonics.

Keywords: phase change materials, optical data storage, pump-probe microscopy, custom-made system

WT-05 · WORKSHOP

LIBA 2000+: The only glass with optic parameters produced in the Czech Republic

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Presentation	Workshop talk
Programme	Thursday, 17 September 2026 · 09:30–09:45 · Czech–Polish Photonics 2026 Workshop · Main Hall
Presenter	V. Kulas

This paper discloses details about LIBA 2000+ glass produced by Preciosa Ornela. It is a lead-free crystal glass (barium crystal) with optical properties which was developed from glass originating from beads production, that are used in various industries.

The glass is made using high-purity raw materials without the need for physical decolorization, thanks to that it exhibits excellent internal transmittance in the range of 380–980 nm.

To ensure that LIBA 2000+ glass meets the high requirements of internal homogenity in technical applications (e.g., according to ISO 12123:2018), an all-platinum homogenization system is used during its production. This ensures that the required homogenity parameters are achieved.

The properties of LIBA 2000+ glass are listed in the ZEMAX database.

The combination of high optical purity, homogeneity, and low solarization makes LIBA 2000+ glass ideal for demanding optical applications, such as optical elements in concentrated solar power plants or components in LED lights.

Because LIBA 2000+ glass was developed from glass originating from beads production, that are used in various industries, where there is great importance placed upon good machinability. It exhibits very good grindability and polishability compared to standard optical glasses.

LIBA 2000+ glass is melted in a continuous furnace, which enables Preciosa Ornela to offer competitive prices, while consistently supplying large production volumes.

The most important parameters of LIBA 2000+ glass

Specific gravity	ρ	2 580 + 20 kg/m^3
Coefficient of expansion	α	9.4 ± 0.4 . 10^{-6} K^{-1}
Index of refraction	n_D	1.5200 + 0.0010
Abbe number :	**vd**	**58,70**
Softening point (10$^{7.65}$ dPa s)	t_L	686 ± 10 °C
Transformation point (10$^{13.3}$ dPa s)	t_g	504 ± 10 °C
Deformation point (10^{11} dPa s)	t_d	568 ± 10 °C

WT-06 · WORKSHOP

The idealized digital optical microscope and other hyperspectral camera applications

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Presentation	Workshop talk
Programme	Thursday, 17 September 2026 · 09:45–10:00 · Czech–Polish Photonics 2026 Workshop · Main Hall
Presenter	D. Štys

Every optical system has color aberration. Thus, to classify chemical composition of the sample based on color, we first need to perform the color correction. And since the optics projects each wavelength differently, in space and in sharpness, we need to completely analyze the spectrum of the light at each position of the image. No matter how difficult the task is and how underdetermined the problem is. On the other hand, from purely statistical point of view, the signal of the digital RGB camera in 8 bits (i.e. 256 levels in three channels) allows to distinguish approximately 16.8 million color tones, i.e. spectra. We will never be able to prepare, e.g., 16.8 million compositions of distinct steel alloys or determine from space 16.8 million surface areas. The traditional information delivered by the camera electronics converts the original signal into a deeply modified dataset which does not enable objective analysis of the signal. Thus, the information in standard digital camera image is irreparably lost.

In the talk I will show a method by which we determine the spectra in each point of the image. During the method development we acquired an in-depth view of the information content of the image, namely we determined the positions of centroids of spectrally distinct objects. We found out that the number of distinguishable objects is twice that of the number of sensor elements and we can increase the image resolution 4×. We can construct the ideal light microscopy image, where signals from all objects at all wavelengths are in focus and the chemical composition may be determined. For general digital camera observations, we provide exact information about the chemical composition of observed objects.

Technically as well, our approach is highly reducing the computational load at the camera and the data flux while eventually the final analyzed dataset contains up to 14 000 times more information than that of the RGB camera, i.e., hyperspectral cube in the range 350 nm to 1050 nm.

In space or drone applications, the data flux is minimized for the grayscale raw data and analysis is done at the ground station which minimizes the energy costs. In case of usage of large sensors (i.e. 250 Mpix Canon sensor), the data storage space is minimized, and the image is transformed or visualized at wish for given application. In the mobile phone, the standard 50 Mpix camera provides 200 Mpix image, moreover with standard RGB coding. Thus, only one camera is needed instead of standard two for top mobile phone models. Etc.

We are looking for users of our technology who would co-develop individual applications with us.

WT-07 · WORKSHOP

Maskless micro-deposition for photonics: from reticles to high-frequency interconnects

P. Kowalczewski

XTPL S.A.

Presentation	Workshop talk
Programme	Thursday, 17 September 2026 · 10:00–10:15 · Czech–Polish Photonics 2026 Workshop · Main Hall
Presenter	P. Kowalczewski

This talk addresses two challenges: patterning micrometre-scale features on non-flat optics without a mask, and interconnecting photonic chips without the parasitic inductance of wire bonds. We present a technique that places metals, opaque resins, and functional inks in features from 1 µm upward on glass, curved surfaces and across height steps. The talk covers results from light-blocking coatings on camera-lens prisms and transparent conductive meshes, then turns to photonic packaging, where printed lines replace wire bonds at millimetre-wave frequencies.

Thursday, 17 September 2026 · 11:00–12:25 · Main Hall — Chiral sensing, optical metrology and computational diagnostics

IN-08 · INVITED

ROAspect: A Raman Optical Activity platform for chirality determination in research and pharmaceutical analysis

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Presentation	Invited talk
Programme	Thursday, 17 September 2026 · 11:00–11:25 · Chiral sensing, optical metrology and computational diagnostics · Main Hall
Presenter	D. Vala

Raman Optical Activity (ROA) probes molecular chirality through small intensity differences in Raman scattering between right and left-circularly polarized light – a signal several orders of magnitude weaker than the parent Raman spectrum. Because two mirror-image forms of chiral molecules can differ in metabolic activity, efficacy, and safety, stereochemical analysis is not just a formality: in pharmaceutical science, it is a key driver of decisions. Single-enantiomer strategies and chiral switches turn those precise analytical results into a competitive advantage.

ROAspect, developed by ZEBR and Palacký University Olomouc, is an integrated ROA platform designed to recover weak chiroptical signals with high spectral quality and artefact control. The instrument combines polarization modulation, top-tier optics, custom optomechanics, spectral response management, and automated calibration in a single system. Multiple chiroptical modulation schemes implemented on one platform support cross-validation and discrimination of tiny signals from measurement artefacts. ROAspect enables enantiomeric excess quantification, absolute configuration assignment when supported by first-principles simulations, and conformational analysis, without crystallization or derivatization. It is designed for real world samples, realistic concentrations, and native environments, bridging fundamental chiroptical spectroscopy with applied stereochemical analysis.

ROAspect addresses the needs of academic laboratories, pharmaceutical development, and emerging process analytical technology (PAT) workflows. It supports real-time and at-line stereochemical verification and tightens control of critical quality attributes.

Keywords: Raman Optical Activity; chiroptical spectroscopy; enantiomeric excess; absolute configuration; pharmaceutical analysis; process analytical technology

OT-19 · ORAL

Lensless Holographic Detection of Circular Dichroism for High-throughput High-resolution Chiral Sensing

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 11:25–11:40 · Chiral sensing, optical metrology and computational diagnostics · Main Hall
Presenter	B. Górski

Circular dichroism (CD), the differential absorption between left- and right-circularly polarized light, is a key chiroptical signature used to distinguish enantiomers and to characterize nanostructured chiral materials. Conventional CD microscopy relies on point-scanning, which is slow and prone to artifacts from prolonged acquisition, while recent wide-field holographic schemes require complex interferometric instrumentation and extensive polarization averaging. Here, we demonstrate a wide-field, high-resolution CD imaging platform based on lensless digital in-line holography. By interposing a circular polarizer between a fiber-coupled 405 nm laser and the sample, the system records holograms under left- and right-circularly polarized illumination directly on a CMOS sensor. A multi-height Gerchberg–Saxton phase retrieval reconstructs the complex optical field at each polarization, from which a spatially resolved CD map is computed. We apply this approach to nitro-doped NOBOW liquid-crystalline structures, which exhibit pronounced CD near 400 nm, and observe a clear sign inversion of enantiomeric domains upon switching the incident polarization. The compact, lens-free architecture combines a large field of view with short acquisition times, providing a robust platform for high-throughput chiroptical characterization and potential anti-counterfeiting applications based on macroscopically invisible chiral patterns.

Keywords: Circular dichroism, lensless holography, digital in-line holography, chiral imaging, phase retrieval, wide-field microscopy, chiroptical sensing, liquid crystals

Acknowledgements

This work was funded by the National Centre for Research and Development (NCBR), Poland, as part of the 3rd competition for joint research projects under the Polish–Chinese cooperation programme (grant no. WPC3/2022/47/INTENCITY/2024).

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OT-20 · ORAL

Algorithm for minimizing the replica overlap problem in common-path shearing microscope

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 11:40–11:55 · Chiral sensing, optical metrology and computational diagnostics · Main Hall
Presenter	M. Rogalski

Common-path shearing interferometry [1,2] is a robust technique for quantitative phase imaging (QPI) [3], in which – contrary to typical reference-arm based interferometric systems [4] – both interfering beams travel through the same optical path. This configuration offer significant advantage in terms of robustness to the environmental disturbances, however – since both beams pass through the measured sample – the measured object phase is spoiled (overlapped) by its own, transversely shifted replica [5]. In this work, we present the Multi-shear Replica Removal (MRR) algorithm [6], a dedicated computational approach designed to mitigate these overlap effects basing on multiple (at least two) interferograms with variable shears. The MRR algorithm employs an iterative procedure to effectively decouple overlapping replica information, allowing for the high-fidelity reconstruction of phase distributions. We demonstrate the effectiveness of the algorithm through numerical simulations and experimental results obtained using a grating-based shearing microscope. Our findings show that the MRR algorithm robustly decouples overlapped object and replica information, effectively doubling the imaged field-of-view. This advancement enhances the capabilities of shearing-based QPI systems, making them more suitable for high-resolution imaging of biological and technical micro-objects.

Keywords: Common-path shearing interferometry, quantitative phase imaging, digital holographic microscopy, replica overlap removal, phase retrieval, grating interferometry, optical microscopy

Acknowledgements

This work was funded by the Project No. WPC3/2022/47/INTENCITY/2024 funded by the National Centre for Research and Development (NCBR) under the 3rd Polish-Chinese/Chinese-Polish Joint Research Call (2022).

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OT-21 · ORAL

Optimizing measurement tradeoffs in multiparameter spatial superresolution

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 11:55–12:10 · Chiral sensing, optical metrology and computational diagnostics · Main Hall
Presenter	J. Řeháček

The joint estimation of the centroid and separation between two incoherent point sources represents a fundamental multiparameter estimation problem in quantum optics and imaging science. Traditionally, reaching fundamental resolution limits has been hindered because the optimal measurements for each individual parameter are maximally incompatible in the limit of small separation. This incompatibility effectively prevents the saturation of the multi-parameter quantum Cramér-Rao bound. In this paper, we introduce measurement strategies specifically designed for the critical regime where sources are in close proximity. By constructing optimal modal projections derived from the first three elements of an orthonormalized point spread function basis, we formally demonstrate a tradeoff relation that dictates how information is distributed between variables. Our scheme offers highly adjustable performance, allowing for the extraction of maximum total information while precisely balancing sensitivity between centroid and separation estimates. For the practically relevant case of a Gaussian point spread function, the proposed measurement utilizes Hermite-Gauss modes and maintains high efficiency across a wide range of separations. These results successfully bypass the Rayleigh curse and provide a robust framework for practical superresolution. Furthermore, these optimal measurement schemes can be implemented using multi-plane light conversion involving a small number of phase-only masks.

Keywords: optical metrology, superresolution, multi-parameter estimation

Acknowledgements

Financial support from the project “Center of advanced electron and photon optics,” project number: TN02000020, funded by the Technology Agency of the Czech Republic, is gratefully acknowledged.

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OT-22 · ORAL

Attention-Enhanced Deep Learning Approach for Optical Vortex Localization

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 12:10–12:25 · Chiral sensing, optical metrology and computational diagnostics · Main Hall
Presenter	W. Forjasz

Optical vortices, also known as phase singularities, are localized points in an optical field exhibiting zero intensity and an undefined phase [1]. These singularities arise naturally in structured optical fields, where destructive interference creates amplitude nulls and a winding phase topology [2,3]. In practice, vortices can be generated using beam-shaping techniques using spatial light modulators, enabling controlled phase dislocations. They are highly sensitive to wavefront distortions, even weak aberrations shift their positions and alter propagation trajectories [4]. Consequently, tracking distinct vortex dynamics serves as an effective method for characterizing optical aberrations. While intensity minima may indicate the presence of phase singularities, the lack of phase information in a single measurement makes their unambiguous identification and characterization an ill-posed problem. To overcome this, we propose a deep learning approach [5,6] to extract phase-related features directly from intensity data. We propose a convolutional neural network (CNN) architecture with attention mechanisms integrated into convolutional layers, enabling the capture of long-range dependencies and improving sensitivity to subtle intensity variations associated with phase singularities. Furthermore, the network employs residual connections for optimized training and parallel pathways for multi-scale feature extraction. Ultimately, the network estimates exact coordinates of phase singularities directly from the input intensity distribution.

Keywords: Convolutional Neural Network, Artificial Intelligence in Metrology, Optical Vortices, Phase Singularities, Attention Mechanisms, Determination of Aberration.

Acknowledgements

This work has been funded by the National Science Center Poland (OPUS 2024/55/B/ST7/02085) and The National Centre for Research and Development Poland (0230/L-13/2022).

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Thursday, 17 September 2026 · 11:00–12:25 · Modular Hall — Nonlinear photonics, plexcitonic materials and photoinduced dynamics

IN-09 · INVITED

Recent advanced in development and fundamental studies of spatiotemporal multimode fiber lasers

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Presentation	Invited talk
Programme	Thursday, 17 September 2026 · 11:00–11:25 · Nonlinear photonics, plexcitonic materials and photoinduced dynamics · Modular Hall
Presenter	K. Krupa

Multimode fiber lasers have recently emerged as a powerful platform for exploring novel spatiotemporal nonlinear dynamics while offering new opportunities for energy scaling beyond the limitations of conventional single-mode architectures. Owing to the interplay between spatial and temporal degrees of freedom, these systems support a rich variety of dissipative states and nonlinear phenomena that remain largely unexplored.

This talk will present recent advances in the development and fundamental understanding of spatiotemporal multimode lasers based on graded-index multimode fibers. In particular, we will discuss how intracavity spectral filtering can be used to control and access a wide range of operating regimes, including single-mode, multimode, and chaotic noise-like pulse states. In all cases, Kerr-induced beam self-cleaning enables the generation of high-quality output beams. We will further show how the balance between chromatic and modal dispersion governs pulse formation and compressibility, enabling the compression of picosecond pulses to femtosecond durations.

Beyond all-fiber architectures, the presentation will also introduce a novel fully multimode laser concept combining multimode fiber sections with a bulk Yb:YAG amplifier. This approach extends multimode operation beyond the state of the art and opens new perspectives for high-power ultrafast sources and the investigation of complex spatiotemporal laser dynamics.

Keywords: fiber laser, multimode fiber, spatiotemporal dynamics

Acknowledgements

K.K. acknowledges financial support from Narodowe Centrum Nauki NCN (OPUS25 2023/49/B/ST7/01482) and Narodowa Agencja Wymiany Akademickiej NAWA (Canaletto BPN/BIT/2024/1/00035). K.K. and A.T. acknowledge financial support from NATO (SPS G6137). S.W. acknowledges financial support from the Italian Ministry of Foreign Affairs and International Cooperation (MAECI) Grant no M00357

OT-23 · ORAL

Nanogap plexcitonic structures for tailoring strong light-matter coupling

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 11:25–11:40 · Nonlinear photonics, plexcitonic materials and photoinduced dynamics · Modular Hall
Presenter	P. Wróbel

Plexcitonic nanostructures, combining plasmonic resonances with excitonic transitions, have recently attracted significant attention as a platform for controlling strong light–matter coupling at the nanoscale. Their ability to confine electromagnetic fields well below the diffraction limit leads to enhanced interaction strength and the emergence of hybrid states with distinct optical properties, relevant for quantum photonics, sensing, and low-threshold light sources. Despite this potential, fabrication of large-area nanogap architectures that provide both reproducibility and tunable strong coupling remains challenging.

In this study, we present hybrid nanogap plexcitonic structures fabricated using nanosphere lithography, enabling production of large-area plasmonic nanocavities. The structures are formed by self-assembled dielectric nanospheres followed by metal deposition, resulting in disordered arrays of nanogap antennas subsequently integrated with thin films of quasi-two-dimensional halide perovskites. This approach allows precise control over the nanogap geometry and excitonic environment, providing a versatile platform for engineering light–matter interaction.

In the experiment, using spectroscopic ellipsometry we demonstrate the formation of strongly coupled plexcitonic states, and investigate the influence of structural parameters on the coupling strength and spectral response. The presented system offers a robust and scalable route toward tunable strong coupling, opening new opportunities for advanced nanophotonic and quantum optical devices.

Keywords: Nanogap plasmonics, plexcitonic systems, 2D halide perovskites, strong light-matter coupling

Acknowledgements

This work was supported by the National Science Centre, Poland, under the SONATA BIS project No. 2024/54/E/ST3/00409.

OT-24 · ORAL

Temperature-Dependent Optical Properties of Two-Dimensional Hybrid Perovskites for Plexcitonic Systems

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 11:40–11:55 · Nonlinear photonics, plexcitonic materials and photoinduced dynamics · Modular Hall
Presenter	M. Brzoska

Two-dimensional Ruddlesden–Popper hybrid perovskites have attracted increasing attention due to their pronounced excitonic response and the possibility of tuning exciton energy through compositional and structural engineering. This tunability, arising from their quantum well–like structure, is essential for tailoring optical properties in optoelectronic and photonic applications. In this work, we investigate the temperature dependence of optical properties of two-dimensional metal halide perovskites with the general formula $(RNH_3)_2BX_4$ (R – long-chain organic group, B – metal cation, X – halide anion). The study focuses on mixed-halide lead-based systems with phenethylammonium as the organic cation, namely $(PEA)_2Pb(I_xBr_{1-x})_4$. Spectroscopic ellipsometry performed over a temperature range from −55 °C to 145 °C is used to monitor changes in the optical response, including the complex dielectric function, excitonic resonances, and bandgap position. The extracted optical parameters are used to determine the exciton oscillator strength and its evolution with temperature and composition, with particular attention to correlations with structural phase transitions. The experimentally derived oscillator strength is further applied in numerical analysis of plexcitonic metal–perovskite systems to evaluate its impact on the strong coupling regime, providing insight into the design of tunable nanophotonic devices.

Keywords: 2D perovskites, temperature dependence, optical properties

Acknowledgements

This work was supported by the National Science Centre, Poland, under the SONATA BIS project No. 2024/54/E/ST3/00409.

OT-25 · ORAL

Optical sensing with hyperbolic nanodisks

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 11:55–12:10 · Nonlinear photonics, plexcitonic materials and photoinduced dynamics · Modular Hall
Presenter	O. Kochanowska

Hyperbolic metamaterials (HMMs) extend light-matter interactions beyond the capabilities of conventional isotropic materials. Owing to their extreme anisotropy, where one component of the diagonal permittivity tensor has the opposite sign to the other two, HMMs exhibit a unique optical modal response. Their extinction spectra are dominated by two modes: a strongly radiative electric dipole (ED) resonance and an absorptive magnetic dipole (MD) coupled with an electric quadrupole (EQ) resonance. Here, we investigate hyperbolic nanodisks composed of silver-silica multilayers for dual-peak optical sensing. By tuning their composition and geometry, we numerically design an easy-to-fabricate HMM sensor with an optimized optical response, featuring well spectrally separated ED and MD–EQ modes and high sensitivity of both resonances. The sensors are based on amorphous (random) arrays of hyperbolic nanodisks, where particle density significantly affects resonance intensity, spectral position, and sensitivity. To validate the numerical predictions, we fabricated amorphous arrays of Ge:Ag:SiO2 multilayer nanodisks on a glass substrate and measured their response in water solutions of glucose. The fabricated sensors exhibit sensitivities of 180-250 nm/RIU in the visible/near-infrared spectral range, comparable to those of plasmonic sensors, demonstrating strong potential for dual-band refractometric sensing in environmental monitoring.

Keywords: optical sensors, hyperbolic metasurfaces, nanodisks, amorphous array

Acknowledgements

We thank the Polish National Science Center for support via the project 2019/35/B/ST5/02477.449

OT-37 · ORAL

Dielectric mirrors for on-chip applications inspired by blue morpho

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 12:10–12:25 · Nonlinear photonics, plexcitonic materials and photoinduced dynamics · Modular Hall
Presenter	D. Pudiš

This work focuses on the design, fabrication, and analysis of vertical dielectric mirrors for on-chip photonic applications inspired by the wing nanostructure of morpho butterflies. Their characteristic coloration originates from structural color caused by light interference within a hierarchical, tree-like structure. The design is based on the thin-film theory of multilayer systems and precise numerical simulations using COMSOL Multiphysics. Due to technological constraints, the structures were designed to operate in higher-order Bragg reflections. The final mirrors were fabricated via 3D laser lithography based on two-photon polymerization. Optical properties were characterized through spectral and angular reflectance measurements. The results show good agreement with simulations and exhibit similar behaviour to natural morpho butterflies. This paper presents a novel approach to developing morpho-like dielectric mirrors for visible light reflections using 3D laser lithography. The proposed methodology could be broadly applied to various on-chip applications.

Keywords: dielectric mirror, multiple layer, polymer, Morpho

Acknowledgements

We acknowledge the financial support from Slovak Research and Development Agency (APVV-20-0264) and the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I05-03-V02-00054.

Thursday, 17 September 2026 · 14:00–15:30 · Main Hall — Plenary Session 4 · Biomedical spectroscopy and plasmonic biosensing

PL-06 · PLENARY

Electric-field-resolved infrared spectroscopy for biology and medicine

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Presentation	Plenary talk
Programme	Thursday, 17 September 2026 · 14:00–14:45 · Plenary Session 4 · Biomedical spectroscopy and plasmonic biosensing · Main Hall
Presenter	I. Pupeza

Optical electric fields are now experimentally accessible on the level of their individual oscillations in the THz-to-PHz frequency range. Their measurement delivers the most comprehensive information content attainable by optical spectroscopy – if performed with high sensitivity and linearity. The talk will report on recent developments toward simultaneously increasing the detection sensitivity, linear dynamic range and bandwidth in field-resolved spectroscopy (FRS) in the mid-infrared molecular fingerprint region [1]. This is achieved by implementing electro-optic sampling [2] with powerful 2-µm gate pulses generated by Tm-fiber lasers, resulting in the ability to linearly measure optical electric fields with strengths ranging from a few mV/cm to the MV/cm level, that is, over more than 15 orders of magnitude in intensity [3]. Along with the outstanding control over broadband infrared waves obtained via intrapulse difference-frequency generation [4], these results constitute crucial steps toward infrared (non-)linear spectroscopy of solids, liquids, and gases at the ultimate limits set by the nature of light. The talk will conclude with an outlook on biomedical applications of these spectroscopic techniques which are currently being prepared in our group, including high-throughput infrared flow cytometry and breath analysis by infrared FRS.

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PL-07 · PLENARY

Advances in plasmonic biosensors and their biomedical applications

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Presentation	Plenary talk
Programme	Thursday, 17 September 2026 · 14:45–15:30 · Plenary Session 4 · Biomedical spectroscopy and plasmonic biosensing · Main Hall
Presenter	J. Homola

Biosensors hold great promise for use in many important sectors, such as molecular biology, medical diagnostics, environmental monitoring, food safety, and security. Affinity biosensors based on optically excited surface plasmons (often referred to as plasmonic biosensors) represent the most advanced optical label-free biosensor technology. Over the past two decades, plasmonic affinity biosensors have become a principal tool for investigating biomolecular interactions in real time and have also been extensively studied for detecting and quantifying chemical and biological species [1].

In this lecture, we introduce plasmonic affinity biosensors, discuss the main challenges associated with their development for biomedical applications, and present selected advances in plasmonic biosensor research aimed at addressing some of these challenges. In particular, we cover advances in plasmonic nanostructures, sensor instrumentation, the transport of target molecules in microfluidic systems, and assays for detecting analytes in complex biological media. Examples of medical applications of advanced plasmonic biosensors are also presented, with particular emphasis on their use in investigating the molecular aspects of myelodysplastic syndromes (MDS is a group of hematological malignancies that may progress to acute myeloid leukemia) and in detecting MDS biomarkers [2].

Keywords: plasmonic biosensors, optical biosensors, surface plasmons, biodetection, biomedicine

Acknowledgements

This work has been supported by a grant from the Program Johannes Amos Comenius under the Ministry of Education, Youth and Sports of the Czech Republic CZ.02.01.01/00/22_008/0004558 Advanced MUltiscaLe materials for key Enabling Technologies, Co-funded by the European Union.

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Thursday, 17 September 2026 · 16:00–17:25 · Main Hall — Biomedical optical modelling, microscopy and phase imaging

IN-10 · INVITED

Full-Wave Modeling of the Electric-Field-Resolved Mid-Infrared Response of Biological Cells

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Presentation	Invited talk
Programme	Thursday, 17 September 2026 · 16:00–16:25 · Biomedical optical modelling, microscopy and phase imaging · Main Hall
Presenter	P. Koleják

The mid-infrared response of a cell depends on molecular composition, geometrical shape, and intracellular structure. In field-resolved spectroscopy [1–6], the transmitted electric-field waveform is measured with amplitude and phase, so that absorption, dispersion, and scattering all contribute to the detected response. This is particularly relevant for cells, whose internal organization is structured in compartments on sub-wavelength length scales, and whose overall shape is on the order of the wavelength of mid-infrared radiation. Here, we use the Lightwave Explorer open-source software [7,8] to perform full-wave finite-difference time-domain simulations of artificial and biologically motivated cell models and determine how subcellular geometry, refractive-index contrast, and mid-infrared resonances are encoded in measurable field-resolved signals. By systematically varying these parameters, we identify which structural and spectroscopic features leave distinguishable signatures in the transmitted waveform and on which length scales this information becomes mixed by sub-wavelength heterogeneity and scattering. These simulations provide a forward-model basis for interpreting field-resolved measurements of intact cells and for assessing their sensitivity to intracellular organization in a label-free setting. In the longer term, this could support label-free analysis of intact cells, drug screening, and diagnostic workflows, while reducing sample preparation and preserving native cellular states, e.g., via near-field field-resolved microscopy [9].

Keywords: Field-resolved spectroscopy, Imaging, Mid-infrared, Cell, Sub-wavelength, FDTD, Lightwave Explorer

Acknowledgements

Funding by the State Research Center OPTIMAS and the European Research Council (101088303) is gratefully acknowledged.

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OT-27 · ORAL

Overcoming ensemble limitations in upconverting nanoparticles using single-particle fluorescence microscopy

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 16:25–16:40 · Biomedical optical modelling, microscopy and phase imaging · Main Hall
Presenter	B. Krajnik

Single-molecule spectroscopy provides access to information that remains inaccessible in conventional ensemble measurements. By eliminating population averaging, it enables the observation of rare features and phenomena otherwise obscured in ensemble measurements. Here, we apply single-molecule spectroscopy and microscopy to investigate upconverting nanoparticles (UCNPs), a class of materials that poses significant challenges for quantitative characterization due to difficulties in determining nanoparticle concentration and quantum efficiency. UCNPs are typically composed of a host lattice doped with lanthanide ions, which enable absorption of low-energy photons and emission at higher energies via upconversion processes. In this work, we focus on $NaYF_4$ nanoparticles doped with Yb^{3+} and Er^{3+} ions, one of the most efficient and widely studied UCNP systems. We demonstrate that experiments performed at the level of individual UCNPs [1] overcome these limitations, enabling direct evaluation of nanoparticle performance. This approach allows reliable assessment of their luminescent efficiency for applications as luminescent probes, as well as characterization of the homogeneity of synthesized nanoparticles. Furthermore, single-particle measurements provide unique insight into energy transfer mechanisms within these systems [2]. Finally, we highlight the potential of individual UCNPs for luminescent nanothermometry, demonstrating their applicability as nanoscale temperature sensors [3].

Keywords: single-molecules, fluorescence microscopy, upconversion, UCNPs

Acknowledgements

This study was supported by the Polish National Science Center (SONATA 16, grant no. 2020/39/D/ST5/03359).

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OT-28 · ORAL

The mixture of glycerin and tartrazine: a solution to reversibly increase tissue transparency for in vitro quantitative phase imaging

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 16:40–16:55 · Biomedical optical modelling, microscopy and phase imaging · Main Hall
Presenter	M. Krysa

Thick biological specimens present significant challenges for Quantitative Phase Imaging (QPI) due to scattering-driven signal degradation. We present a simple, room-temperature, reversible optical-clearing strategy using a Glycerol-Tartrazine Solution (GTS) comprising 60% glycerol and 10% tartrazine to enhance phase-map fidelity.

The effectiveness of GTS was validated using 50–80 μm murine liver and kidney sections, which are highly heterogeneous and typically difficult to image using QPI. Utilizing Fourier ptychographic microscopy and lensless digital holographic microscopy, we demonstrate that GTS significantly reduces phase artifacts and improves structural continuity compared to phosphate-buffered saline (PBS). These improvements were quantitatively confirmed via one-pixel-lag autocorrelation of phase-gradient values.

GTS is stable for months, and its effects are fully reversible within ~15 minutes of PBS washing, facilitating subsequent staining or multimodal analysis. This low-cost, scalable approach advances label-free quantitative histology by enabling high-throughput computational imaging of strongly scattering thick specimens.

Keywords: Optical Clearing Agent (OCA), Tissue sections, Fourier Ptychographic Microscopy (FPM), Lensless Digital Holographic Microscopy (LDHM)

Acknowledgements

The authors would like to acknowledge funding institutions: National Science Centre, Poland (SONATA 2020/39/D/ST7/03236); The National Centre for Research and Development, Poland (LIDER14/0329/2023; INTENCITY WPC3/2022/47/INTENCITY/2024). The research was conducted on devices co-founded by the Warsaw University of Technology within the Excellence Initiative: Research University (IDUB) programme.

OT-29 · ORAL

Dynamic Loss Weighting for Improved High-Frequency Reconstruction in Single-Frame Phase Retrieval

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 16:55–17:10 · Biomedical optical modelling, microscopy and phase imaging · Main Hall
Presenter	W. Ogonowski

Light is widely used in measurement techniques based on the analysis of its intensity and phase changes introduced by the optical properties of the investigated object. In the case of transparent or weakly absorbing samples (e.g., biological cells), intensity variations are minimal. Therefore, essential structural information is encoded in the phase of the light wave [1]. One common phase retrieval approach for lensless microscopy relies on in-line holograms recorded at various defocus distances [2], followed by phase reconstruction using the Gerchberg–Saxton algorithm [3]. However, this method requires multiple frames, reducing acquisition speed and increasing system complexity. The application of a convolutional neural network (CNN), specifically a multi-scale residual network [4], enables phase retrieval from a single frame by generating images at different focal planes. The main objective of this study was to investigate CNN training strategies to improve reconstruction of high order fringes. We analyzed hybrid loss functions [5] combining classical metrics such as Minimal Square Error (MSE), Gradient Magnitude Similarity Deviation (GMSD), and Structural Similarity Index Measure (SSIM), together with dynamic weighting during training. The best performance was achieved when the contribution of structural components (GMSD/SSIM) increased in early training stages and decreased in the final phase.

Keywords: deep learning, residual neural network, training strategy, hybrid loss function, dynamic loss weighting, phase retrieval, interferometric imaging, lensless microscopy

Acknowledgements

This work has been funded by the National Science Center Poland (OPUS 2024/55/B/ST7/02085).

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OT-30 · ORAL

Physics-Unrolled Deep Learning Framework for Accurate Quantitative Phase Imaging

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 17:10–17:25 · Biomedical optical modelling, microscopy and phase imaging · Main Hall
Presenter	L. Lu

We introduce PDL-TIQPI, a compact physics-informed deep learning framework for high-fidelity transport-of-intensity phase imaging. By unrolling the ADMM algorithm into a lightweight four-layer neural network, it seamlessly integrates wave-optics modeling with deep learning. The framework features dual-level physics constraints, embedding linear transfer function priors within the architecture and enforcing nonlinear forward-model consistency in the loss function. Demonstrating exceptional data efficiency, PDL-TIQPI achieves diffraction-limited reconstruction using fewer than 100 training samples. Compared to traditional iterative methods, it delivers a three-order-of-magnitude speedup while maintaining superior robustness against non-weak phase objects and non-periodic boundary conditions.

Keywords: Physics-informed deep learning, quantitative phase imaging, deep unrolling network, transport-of-intensity phase imaging

Thursday, 17 September 2026 · 16:00–17:25 · Modular Hall — Integrated Photonics for Sensing and Spectroscopy

IN-11 · INVITED

Nanophotonic Membrane Waveguides for Mid-Infrared Gas Sensing: From Device Physics to Integrated System

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Presentation	Invited talk
Programme	Thursday, 17 September 2026 · 16:00–16:25 · Integrated Photonics for Sensing and Spectroscopy · Modular Hall
Presenter	M. Feiler

Mid-infrared (MIR) absorption spectroscopy identifies and quantifies gases through their characteristic fingerprint-like ro-vibrational transitions, but conventional multi-pass cell instruments remain bulky and demand large sample volumes. Integrated photonic waveguides promise both compactness and microliter volumes, yet standard dielectric designs suffer from high propagation losses and reflection-induced spectral noise that cap sensitivity in the ppm range. Here we report a suspended nanophotonic membrane waveguide platform that removes these limitations utilizing air-like guided modes that maximise evanescent overlap with the surrounding gas, while a microstructured cladding suppresses propagation loss and reflection noise below detectable levels. This yields 20 ppb CO_2 detection and $\delta^{13}C$ precision of 0.2‰, matching high-end benchtop instruments. The devices are integrated into a compact analyzer in which an interband cascade laser is butt-coupled directly into the waveguide and the output is coupled to a HgCdTe detector, without free-space optics, on a common thermally controlled base. A laser-engraved microfluidic glass gas cell, cold-welded with indium, forms a quasi-hermetic 2 µl interaction volume fed by piezoelectric micropumps. Spectral tuning and sensitivity are retained in this compact form, enabling portable precision sensing for environmental, space, and biotechnology applications, with microbial culture monitoring as the immediate target.

Keywords: mid-infrared spectroscopy, membrane waveguide, gas sensing, integrated photonics, lab-on-chip, microbial monitoring

Acknowledgements

This work was supported by the Tromsø Research Foundation (UiTrace, 17_SG_JJ), the European Research Council (sCENT2, 101158155), the Research Council of Norway (sCENTsor, 349907), and the European Union's Marie Skłodowska-Curie Actions (101067268).

OT-31 · ORAL

GaAs-based Integrated Photonics: From Near-IR Waveguide Validation to Mid-IR Gas Sensing

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 16:25–16:40 · Integrated Photonics for Sensing and Spectroscopy · Modular Hall
Presenter	J. Olszewski

GaAs-on-AlGaAs is an attractive platform for integrated photonics as it provides broad infrared transparency, refractive-index engineering capabilities, and compatibility with III-V light sources. In this work, we develop and validate a GaAs waveguide platform comprising a GaAs guiding layer on an AlGaAs lower cladding grown epitaxially on a GaAs substrate. The platform targets near-infrared (for technological processes validation) and subsequent mid-infrared (for development of sensing structures) spectral range. Eigenmode simulations were performed to determine the effective and group indices, modal confinement, polarization dependence, and the evolution of guided modes with geometry and wavelength. Ridge waveguides with varied cross-sections were fabricated using optical lithography and dry etching. Initial characterization at 1.55 µm employed edge coupling scheme to measure the insertion loss of fabricated test waveguides, confirming optical transmission while retaining the combined contributions of input/output coupling, facet quality, and propagation loss. Building on the established GaAs/AlGaAs mid-infrared evanescent-wave sensing concept, we numerically investigate suspended GaAs membrane waveguides to be realized by selective removal of the AlGaAs underlayer. Simulations show that suspension can substantially increase interaction between the guided mode and the surrounding gas, making this architecture promising for on-chip absorption spectroscopy, provided that propagation and coupling losses remain adequately controlled. The results provide a coherent development pathway connecting epitaxial platform design, fabrication, validation, and mid-IR sensor-oriented modeling, demonstrating the potential of the GaAs/AlGaAs platform for compact integrated spectroscopic systems.

Keywords: mid-infrared, photonic integrated circuits, GaAs/AlGaAs, gas sensing

Acknowledgements

This work received support from the National Center for Research and Development through project HyperPIC (FENG.02.10-IP.01-0005/23, IPCEI ME/CT) and from the PIXEurope Pilot Line (PIXEurope is co-funded by the Chips Joint Undertaking and national funding authorities of the Participating States: Austria, Belgium, Finland, France, Ireland, Italy, The Netherlands, Poland, Portugal, Spain, United Kingdom).

OT-32 · ORAL

Laser-based gas sensing – simplifying and speeding data analysis using neural networks

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 16:40–16:55 · Integrated Photonics for Sensing and Spectroscopy · Modular Hall
Presenter	P. Chmielowski

Optical spectroscopy is a powerful tool in gas sensing applications. Laser-based spectroscopy offers high sensitivity and selectivity. Additional advantages include fast response time, compact design, and no need for sample preparation. In principle, optical gas sensing is relatively straightforward: a tunable laser source and a detector are used to record an optical spectrum. Molecular concentration information can then be extracted by analyzing the resulting absorption lines. In practice analysis is often complicated by the presence of additional signal components, including fluctuating and nonlinear baselines and interference fringes that are superimposed on the absorption features. Advanced algorithms employing full-spectrum fitting are typically required to accurately retrieve molecular concentrations. However, these methods can take several seconds, or even tens of seconds, to process a single measurement. Such delays are impractical in scenarios requiring high-speed data acquisition. In our work, we investigate whether neural network (NN)-based algorithms can be used for rapid spectral analysis. Our initial experiments are focused on using NN with data from tunable diode laser absorption spectroscopy (TDLAS). Preliminary results show that NNs are significantly faster than traditional fitting methods. During the conference we will highlight critical aspects of NN training that significantly affect the final performance of this approach.

Keywords: Artificial intelligence, neural networks, gas sensing, laser-based spectroscopy, data analysis

OT-33 · ORAL

A metal-dielectric photonic crystal-based gas sensor with phase response of exceptionally high in both sensitivity and FOM

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 16:55–17:10 · Integrated Photonics for Sensing and Spectroscopy · Modular Hall
Presenter	M. Gryga

Metal-dielectric photonic crystals (MDPhCs) supporting Bloch-like surface waves (BLSWs) at the interface of an MDPhC and the analyte have emerged as a very promising alternative for sensing gaseous analytes [1]. The BLSWs exhibit narrow spectral resonances that are advantageous compared to the broader responses typical for surface plasmon resonance. While previous studies have predominantly focused on reflectance dip shift responses, this work investigates the sensing potential of phase responses exceptionally high in both sensitivity to refractive index (RI) variations and figure of merit (FOM). We present a sensing concept based on the phase interrogation applied to gaseous analytes employing an MDPhC in the Kretschmann configuration. The MDPhC composed of TiO_2/Au bilayers and a TiO_2 termination layer enables excitation of BLSWs for both TE and TM polarizations. Phase response is analysed for RIs in the range of 1–1.0015, and the sensitivity to RI and FOM can reach 40,000 nm/RI unit (U) and 100,000 RIU^{-1}, respectively. The results demonstrate that phase-based response provides sensitivity compared to conventional reflectance dip shifts, but significant enhancement in the FOM. These findings highlight the strong potential of phase-sensitive detection in BLSW-based sensors employing MDPhCs for accurate and efficient gas sensing applications.

Keywords: Metal-dielectric photonic crystals, Bloch-like surface waves, Phase response, Gas sensing, Sensitivity, Figure of merit

Acknowledgements

This work was supported by the European Regional Development Fund under the project Research Platform for Digital Transformation and Society 5.0 within the Jan Amos Komensky Operational Program (project number CZ.02.01.01/00/23_021/0012599), and by the student grant system through project SP2026/022.

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OT-34 · ORAL

Binary organic mixture detection using PDMS swelling

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Presentation	Oral talk
Programme	Thursday, 17 September 2026 · 17:10–17:25 · Integrated Photonics for Sensing and Spectroscopy · Modular Hall
Presenter	N. Tarjányi

Polydimethylsiloxane (PDMS) swells when in contact with some organic solvents [1]. The swelling rate depends mainly on the type of solvent, the size, and shape of the sample. The swelling process can be investigated, e.g., by measuring the sample's dimensions/weight [2], or using various optical methods [3–7]. A PDMS sample with dimensions of 10×10×3 mm^3 polymerized in a quartz cuvette was exposed to a mixture of ethanol and diethyl ether mixed in different ratios. The stress exerted by the cuvette's walls on the PDMS during its swelling induced optical birefringence of PDMS, the time evolution of which was monitored using white light and 2 linear polarizers. From transmission spectra measured for different mixing ratios of ethanol and diethyl ether in the mixture applied to PDMS, we extracted information about the time dependence of the intensity of light passed through PDMS for three selected wavelengths. From the time dependences of the light intensity, we identified the time t_m of acquiring the maximum intensity value (at a specific wavelength) as the parameter suitable for determining the mutual ratio of the components in the mixture. The achieved result can be used in the construction of an optical chemical sensor for binary mixtures.

Keywords: PDMS, swelling, birefringence, binary mixture, optical chemical sensor

Acknowledgements

This work was supported by the Slovak National Grant Agency [grant number VEGA 1/0223/23] and partly funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia [project number 09I05-03-V02-00009].

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Thursday, 17 September 2026 · 17:25–18:55 · Poster Session — Poster Session 2

P-19 · POSTER

Photoluminescence Imaging and Spectroscopy of 2D Perovskites

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Presentation	Poster
Poster number	P-19
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	A. Bohdan

Two-dimensional (2D) Ruddlesden-Popper perovskites have emerged as promising materials for optoelectronic applications due to their enhanced environmental stability and tunable optical properties compared to their three-dimensional counterparts. In this work, we investigate the photoluminescence (PL) characteristics of layered perovskite thin films, focusing on the relationship between synthesis parameters, structural heterogeneity and emission behaviour. Steady-state photoluminescence spectroscopy was used to analyse emission spectra, revealing distinct excitonic features associated with quantum well confinement in the 2D structure. To further investigate spatial variations, we implemented a photoluminescence mapping approach in which the emitted PL signal was divided: one portion directed to a spectrometer for spectral analysis, and the other to a camera for real-time imaging. This configuration enabled simultaneous acquisition of spectral and spatial information, providing insight into local inhomogeneities, defect distribution, and phase segregation. The combined PL spectroscopy and mapping results highlight the strong correlation between micro-structural domains and optical response, emphasising the importance of film uniformity for device performance. These findings contribute to a deeper understanding of emission mechanisms in 2D perovskites and demonstrate an effective methodology for comprehensive optical characterisation.

Keywords: 2D halide perovskites, photoluminescence, photoluminescence imaging

Acknowledgements

This work was supported by the National Science Center, Poland, under the Sonata BIS Project No. 2024/54/E/ST3/00409.

P-20 · POSTER

Plasma-Deposited DLC and SiO_x Thin Films for Optical Fiber Sensing Structures

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Presentation	Poster
Poster number	P-20
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	M. Šetina

Diamond-like carbon (DLC) is a promising material for optical sensing applications due to the possibility of tailoring its structure, optical absorption, refractive index, and mechanical properties through plasma deposition parameters. This work focuses on the systematic optimization of DLC thin films deposited by radio-frequency plasma-enhanced chemical vapor deposition (RF-PECVD), with the aim of subsequently depositing them onto geometrically modified optical fibers and using them as optically active sensing layers.

The deposition process is controlled by an automated script, enabling the reproducible execution of individual process steps together with continuous logging of process parameters. The experimental methodology is based on varying a single deposition parameter while keeping the remaining conditions constant. Particular attention is paid to working pressure and negative self-bias voltage, which affect ion bombardment energy, sp^2/sp^3 carbon bonding, deposition rate, and the resulting mechanical and optical properties of the films. Preliminary experiments show that, at a constant self-bias voltage of −375 V, increasing the working pressure from 8 to 12 Pa increased the average film thickness from approximately 813 to 1079 nm, while the indentation hardness increased from 11.26 to 12.57 GPa.

To improve adhesion and provide an optically suitable transition between the substrate and the DLC film, an intermediate layer prepared from hexamethyldisiloxane (HMDSO) is employed. Plasma decomposition of the precursor produces layers with compositions ranging from organosilicate to SiO_x-like, whose composition and optical properties can also be controlled through the deposition conditions. This approach enables the combination of a highly transparent intermediate layer with a higher-refractive-index DLC layer, providing a basis for multilayer optical structures with a tunable spectral response.

Future work will investigate DLC-based resonant structures and the incorporation of metallic nanoparticles deposited by magnetron sputtering. The combination of a tunable DLC refractive index with localized surface plasmon resonance (LSPR) may provide a promising platform for optical fiber sensors targeting species relevant to the dissolved gas analysis (DGA) of electrical insulating oils.

Keywords: diamond-like carbon, DLC, RF-PECVD, HMDSO, SiO_x, optical fiber sensor, LSPR, dissolved gas analysis

P-21 · POSTER

Implementation of Simplified Optoelectronic Architectures for Rapid Point-of-Care Hemoglobin Diagnostics in Small Ruminants.

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Presentation	Poster
Poster number	P-21
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	A. Stach

Anemia represents a clinically significant syndrome in small ruminants, primarily driven by pervasive gastrointestinal parasitism, which requires immediate and accurate detection to prevent fatal outcomes [1]. Conventional diagnostic workflows are frequently challenged by logistical delays and sample stability issues during transport, emphasizing the need for robust, field-deployable point-of-care technologies.

Optical monitoring of hemoglobin concentration within the Soret band offers exceptional sensitivity [2]. However, it remains challenging due to the significant influence of sample geometry on the measurement outcome. The objective of this study was to analyze the correlation between broadband spectral responses acquired via a laboratory-grade spectrometer and the readouts from a prototype sensor employing discrete light-emitting diode (LED) sources.

Initially, the absorbance characteristics of blood samples at varying concentrations were determined, facilitating the selection of optimal spectral bands for implementation in a simplified solid-state optoelectronic system. The results demonstrate high linearity of the measurement model in the low-to-medium concentration range, alongside the emergence of signal anomalies at higher concentration levels.

The conducted analysis validates the application potential of low-cost LED emitters for point-of-care diagnostics, while simultaneously highlighting the necessity for further optimization of sample layer control methods to achieve full measurement reproducibility.

Keywords: Optical spectroscopy, optoelectronics, absorbance, LED sensor, hemoglobin concentration, point-of-care diagnostics

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P-22 · POSTER

Resonant interaction of acoustic waves with light in optical fibers

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Presentation	Poster
Poster number	P-22
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	A. Borodkin

Fiber-optic distributed acoustic sensing is widely used for underwater applications, but its sensitivity in the air is severely limited. The acoustic sensitivity of the conventional optical fibers is low at the normal sound pressure. Most of fiber-optic in air acoustic sensors based on the special optical fibers with thick polymer layer, Rayleigh-enhanced optical fibers and long fibers wrapped on the cylinders in order to increase their sensitivity. In this work we propose a new method to significantly increase the sensitivity of fiber-optic microphone using fundamental breathing modes of coiled optical fiber. Acoustic response of the standard single-mode optical fiber (G.652.D) coiled with different diameters was measured by heterodyne Mach–Zehnder interferometer in the 2–8 kHz range under controlled acoustic conditions (Fig. 1). Acoustic responses exhibit resonance peaks at the frequencies of the breathing modes of the coiled fibers. The resonance amplitude is up to 30 dB higher than the base level of the signal. We explain the resonance behavior, which agrees well with the experiment data, and demonstrate how to control it. Further investigation could provide a new type of high-sensitive frequency-selective fiber-optic microphone working in air.

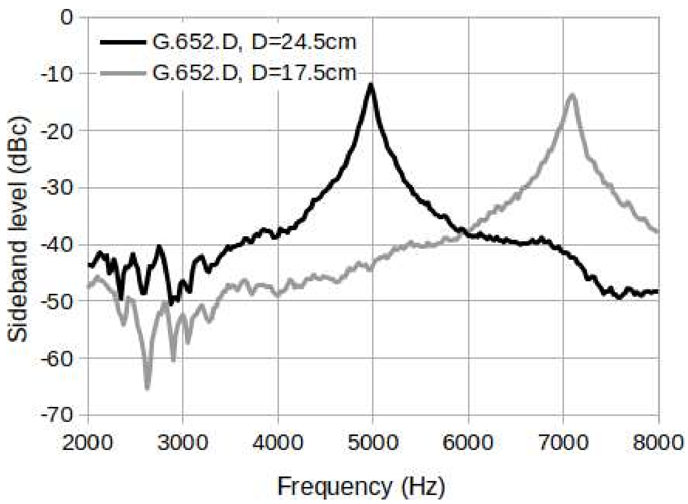

Fig.1. Comparison of acoustic responses for 10 m of G.652.D fibers with coil diameters of 24.5 cm and 17.5 cm.

Keywords: acoustic sensing, Mach-Zehnder interferometer, optical fiber sensing, fiber ring breathing mode, resonant fiber-optic microphone

Acknowledgements

We gratefully acknowledge funding of this work by the Ministry of the Interior of the Czech Republic under the Grant No. VK01030114 within the program OPSEC. The European Union and the state budget of the Czech Republic co-funded the development of the research infrastructure under project LasApp (CZ.02.01.01/00/22_008/0004573), as well as research into the influence of acoustic noise on the delivery of precise frequency signals over optical fibers via project Queentec (CZ.02.01.01/00/22_008/0004649).

P-23 · POSTER

Low-Coherence Interferometric Monitoring of Interface Stability and Dynamic Surface Changes in PDMS-Coated Fiber Sensors

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Presentation	Poster
Poster number	P-23
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	D. Kacik

Due to its hydrophobic nature, polydimethylsiloxane (PDMS) is generally considered non-reactive when immersed in water. In this paper, we utilize low-coherence interferometry to monitor the influence of immersion time on the reflection intensity at the PDMS–water interface. The experimental sensor was fabricated by depositing a PDMS layer onto the end-face of an optical fiber, which serves as the sensing arm of a Michelson interferometer. This sensing path is compensated by a tunable air-delay line acting as the reference arm.

A key advantage of low-coherence interferometry is the ability to isolate interference signals within a narrow spatial range, governed by the source's coherence length. Our observations reveal that while the spatial position of the interference envelope maximum remains stable during water interaction, the reflection amplitude undergoes significant variations. These findings suggest that the interaction induces changes in surface morphology rather than bulk degradation, highlighting the sensitivity of this method for real-time monitoring of polymer coatings.

Keywords: Fiber-optic sensor, PDMS, Low-coherence interferometry, Michelson interferometer

Acknowledgements

This work was partly funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia [project number 09I05-03-V02-00009], and the Slovak National Grant Agency under the projects No. VEGA 1/0223/23.

P-24 · POSTER

Dual-core side-hole polarization-maintaining fibers for distributed and point multiparameter sensing

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Presentation	Poster
Poster number	P-24
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	E. Wątła

Temperature cross-sensitivity remains one of the key challenges in optical fiber sensing, particularly when simultaneous measurement of more than one environmental parameter is required. This work presents the development and characterization of dual-core polarization-maintaining side-hole optical fibers designed for multiparameter sensing based on spectral interrogation techniques. In the proposed fiber structure, each core forms an individual polarization-maintaining side-hole sensing element. The differentiation of temperature sensitivity between the two cores is achieved by using different germanium doping levels, namely 5 mol% and 20 mol% GeO_2. In turn, the pressure sensitivity is tailored by introducing air holes in the vicinity of the cores, which induce a polarization-dependent response to hydrostatic pressure. As a result, the investigated fibers exhibit distinct spectral responses of the two cores and their orthogonal polarization modes to temperature and pressure. The applicability of this fiber design is demonstrated in two sensing configurations: Rayleigh-scattering-based distributed measurements and point measurements using fiber Bragg gratings inscribed in each core. The presented results show that the dual-core side-hole fiber architecture provides a versatile platform for multiparameter optical fiber sensing, enabling simultaneous temperature and pressure discrimination in distributed measurements, while also allowing localized sensing based on Bragg gratings written directly in the same specialty fiber structure.

Keywords: side-hole optical fiber, dual-core fiber, distributed sensing, Rayleigh scattering, fiber Bragg grating, hydrostatic pressure sensing, temperature sensing, multiparameter measurements

Acknowledgements

Research funds provided by:

National Science Centre (Grant Opus 18, DEC-2019/35/B/ST7/04135).

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P-25 · POSTER

Polymer-Based 4-Channel AWG: Prototype Fabrication and Optimization

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Presentation	Poster
Poster number	P-25
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	P. Gaso

The Arrayed Waveguide Grating (AWG) structure is one of the most important building blocks of integrated photonics and modern optical communication systems. In recent decades, the dynamic development of optical networks has required a significant increase in transmission capacity, information transfer speed, and data processing efficiency. For this reason, there is a growing need to develop compact, reliable, and economically accessible photonic devices capable of ensuring efficient multiplexing and demultiplexing of optical signals in telecommunication systems. In this work, we present an initial prototype of a 4-channel AWG-based optical demultiplexer fabricated on a polymer platform, with a central wavelength of 1550 nm and a channel spacing of 400 GHz. The device design was developed with consideration of the technological limitations of Direct Laser Writing (DLW) lithography, as well as the optical performance requirements of the system. The designed device consists of a single-mode rib waveguide structure made of the polymer material IP-Dip, with air serving as the cladding layer. Such a configuration provides a suitable refractive index contrast necessary for efficient light guidance while simultaneously simplifying the fabrication process. The obtained results demonstrate a promising pathway toward the development of low-cost, highly integrated, and flexible photonic components suitable for future optical communication and sensing applications.

Keywords: 3D laser micro-printing, polymer, arrayed waveguide grating

Acknowledgements

This work was supported by the project “Grating Structures for LED, Laser and Photonic Component Applications” under the Plan for Recovery and Resilience of the Slovak Republic, funded by the European Union – NextGenerationEU (Grant No. 09I05-03-V02-00054) and by the Slovak National Grant Agency under the project No. VEGA 1/0223/23 and the Slovak Research and Development Agency under the project No. APVV-20-0264.

P-26 · POSTER

Fabrication Technology of Broad-Spectrum Antibacterial Surfaces

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Presentation	Poster
Poster number	P-26
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	M. Goraus

The global rise of antimicrobial resistance has increased the need to develop alternative strategies capable of inhibiting bacterial colonization. One of the promising approaches is the preparation of topographically modified nanostructured antibacterial surfaces. Such surfaces have already been fabricated, mostly inspired by natural antibacterial surfaces. However, these surfaces are very often sensitive to only a single microbial species. The aim of this paper is to present a method for preparing a surface with broad-spectrum efficacy. Our surfaces were prepared using interference lithography combined with a soft lithography replication process. Through this technological process, two periodic and two quasi-periodic surfaces with periods of 500 nm and 800 nm were fabricated and subsequently subjected to antibacterial analysis using the imprint method. The tested bacterium was E. coli. The achieved results confirmed the potential of these configurations as passive antibacterial strategies with possible applications in healthcare environments.

Keywords: Nanostructured surfaces, antibacterial activity, bactericidal effect, laser interference lithography, periodic structures, quasi-periodic structures, replication, soft lithography

Acknowledgements

The project is co-funding by European Regional Development Fund. This work was supported by the Slovak National Grant Agency under the project No. VEGA 1/0223/23.

P-27 · POSTER

Substrate preheating and the powder composition influence on the clad bead properties

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Presentation	Poster
Poster number	P-27
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	H. Chmelíčková

Laser cladding by metal powder injection to the melted substrate surface is one of high power diode laser applications. Besides optimal laser parameters and powder injection conditions, also substrate initial temperature can have influence on final clad bead properties. This paper compares cladding of three different powders (Metco 42C, Ledurit 60, Ledurit 68), deposited on C45 (1.0503) steel substrates with three different temperatures of preheating (ambient, 150 °C, 300 °C) using high power diode laser LDM in company MATEX PM Plzeň. Dimensions, pores and cracks occurrence were found out by means of laser scanning confocal microscope Olympus LEXT OLS3100 on the samples cross sections. Beads surfaces were observed by means of the digital microscope Keyence VHX-7000. The highest bead with minimal defects was achieved with Metco 42C with ambient temperature. Vickers hardness test in beads vertical axis revealed maximal value for Ledurit 68 with 300 °C. Material durability, explored via scratch test with diamond indenter in horizontal line 2 mm below the bead top, shows increasing tendency with increasing temperature.

Keywords: Laser cladding, substrate preheating, defects, hardness, scratch test

Acknowledgements

The authors gratefully acknowledge the support by project The Cherenkov Telescope Array – participation of the Czech Republic (The Ministry of Education, Youth and Sports no. LM2023047).

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P-28 · POSTER

Visible Wavelengths Optical Fiber Infrastructure for Laser Interferometry and Spectroscopy Applications

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Presentation	Poster
Poster number	P-28
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	J. Hrabina

This contribution presents a pilot concept for an optical fiber network to disseminate visible-wavelength ultra-stable narrow-linewidth lasers across multiple optical setups and facilities. The main aim is to replace the traditional approach of numerous individual He-Ne laser sources with a single, modern, high-power fiber laser, while maintaining the technical requirements for frequency stability, optical polarisation maintaining and metrological traceability needed in laser interferometry, spectroscopy and optical inspection industry applications. We demonstrate the system key concepts, including laser frequency and linewidth control, polarisation control, and the infrastructure's Doppler-induced phase-noise-free distribution approach.

Keywords: optical fiber network, length metrology, laser interferometry, time and frequency metrology

P-29 · POSTER

Long-term measurement of the sensing properties of the PDMS Fabry-Perot cavity

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Presentation	Poster
Poster number	P-29
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	I. Martinček

Polydimethylsiloxane Fabry-Perot cavity is an optical structure, which is often used for the detection of various physical and chemical parameters in combination with optical fiber [1–3]. In this paper, we characterize the sensing properties of proposed optical fiber sensor based on a polydimethylsiloxane optical cavity defined by two aluminium layers in liquid ethanol. Sensor is located at the tip of optical fiber. Sensing properties are characterized by measuring the spectral shift of interference signal. This spectral shift is caused by extension of the Fabry-Perot cavity caused by swelling of polydimethylsiloxane. Measurements are conducted and evaluated in long-term repeated measurements, carried out under identical conditions over the period of two months. Obtained results can be used to assess the possibility of using polydimethylsiloxane as a sensing material for optical fiber interferometric sensor.

Keywords: optical fiber tip sensor, PDMS Fabry-Perot cavity

Acknowledgements

This work was supported by the Slovak National Grant Agency under the project No. VEGA 1/0223/23.

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P-30 · POSTER

Preparation of polymer Mach–Zehnder interferometer using 3D laser micro-printing

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Presentation	Poster
Poster number	P-30
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	D. Jandura

Interferometric photonic sensors have become an important area of research due to their high sensitivity and compact dimensions. Among them, Mach–Zehnder interferometer (MZI) structures are widely used for the detection of environmental changes, including temperature variations. At the same time, recent progress in high-resolution 3D laser lithography has enabled the fabrication of complex micro-optical structures with high precision and design flexibility.

This paper presents the development of a temperature sensor based on a Mach–Zehnder interferometer fabricated using a commercial Nanoscribe 3D laser lithography system. The structure was produced by two-photon polymerization, which allows the fabrication of compact photonic devices with customizable geometries. The sensing mechanism is based on phase changes in the interferometer arms caused by temperature-dependent variations of the refractive index and thermal expansion of the material. The proposed approach demonstrates the potential of 3D laser lithography for the realization of compact interferometric sensors suitable for applications in environmental monitoring, industrial sensing, and biomedical technologies.

Keywords: 3D laser micro-printing, polymer, Mach–Zehnder interferometer

Acknowledgements

This work was supported by the project “Grating Structures for LED, Laser and Photonic Component Applications” under the Plan for Recovery and Resilience of the Slovak Republic, funded by the European Union – NextGenerationEU (Grant No. 09I05-03-V02-00054) and by the Slovak National Grant Agency under the project No. VEGA 1/0223/23 and the Slovak Research and Development Agency under the project No. APVV-20-0264.

P-31 · POSTER

Tunable Aluminum-Based Metal-Insulator-Metal Nanocavities for UV-Vis SERS Applications

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Presentation	Poster
Poster number	P-31
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	J. Zaporowska

Surface-Enhanced Raman Spectroscopy (SERS) requires cost-effective and spectrally tunable substrates. In this work, we investigate aluminum-based Metal-Insulator-Metal (MIM) nanocavities as a sustainable alternative to traditional noble metals, extending plasmonic capabilities into the UV-Vis spectral range. Using Finite-Difference Time-Domain (FDTD) simulations, we demonstrate that tuning geometric parameters (nanodisk radius and dielectric thickness) induces strong coupling between high-energy and low-energy plasmonic modes. This hybridization manifests as an anti-crossing in the extinction spectra. Crucially, optimizing this strong coupling enhances the local electromagnetic field at the accessible nanodisk edges by over an order of magnitude. Consequently, these Al-based structures achieve theoretical enhancement factors comparable to gold and silver, successfully overcoming aluminum's inherent optical losses. To validate our models, we experimentally fabricated large-area MIM nanocavities using scalable Nanosphere Lithography (NSL) and Physical Vapor Deposition (PVD). Morphological and optical characterizations confirm the viability of strongly coupled aluminum nanostructures as highly efficient, low-cost platforms for next-generation molecular sensing.

Keywords: SERS, MIM nanocavities, Strong coupling, LSPR, Nanosphere lithography

P-32 · POSTER

Peering into ECM-based memristive structures: uncovering factors governing their opto-electrical response

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Presentation	Poster
Poster number	P-32
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	K. Kliczewska

Memristors are a fascinating class of electronic components that complement the basic circuit elements and are distinguished by their ability to retain an electrical resistance state determined by the history of applied voltage and current [1]. This property allows them to emulate analog switching and learning processes known from biological synapses, making them promising candidates for neuromorphic computing. In this context, electro-optical memristors are an emerging class of devices that combine non-volatile electrical memory with optical readout and modulation [2,3].

Here, we investigate ECM-based Ag/SiO_2/Ag electro-optical memristive structures which, despite their apparently simple three-layer architecture, reveal highly complex and detail-sensitive operation. The devices were fabricated by PVD and characterized using combined electrical measurements and spectroscopic. The structures exhibit filament formation, resistive switching, memory effects, and analog modulation of the optical response. However, their operation strongly depends on subtle factors, including local pixel properties, current compliance, electrode morphology, electrode asymmetry, and the position of the optical probe. These factors determine whether the device operates, how stable its response is, and which ionic transport pathway dominates. The results highlight the need to look beyond the nominal layer stack to understand the origin of opto-electrical response.

Keywords: Optical memristor, optical switch, memristive system, electrochemical metallization, filament

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P-33 · POSTER

Grating waveguide on polymer base

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Presentation	Poster
Poster number	P-33
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	Ľ. Šušlik

Photonics has become recently intensively evolving area, where the possibilities of photonic structures or crystals (PhC) for integrated optoelectronics and sensing application were found. The use of three dimensional (3D) laser technology with combination of stable polymer resin enable printing of micro-optical and nano-optical components or other type diffractive structures for optoelectronics applications. In this work we demonstrate possibilities of 3D laser technology based on two photon polymerization for application in waveguide and sensors technology. We prepared three-dimensional polymeric waveguide channel with grating surface. The basic idea is a waveguide with a square profile with a diameter of 4 microns and the grating was formed by thin lamellae with a period of 1.6 microns. The photonic structure is prepared in IP-DIP polymer material. In this work, we focus on optimizing the preparation and design of the structure. In the experimental work of our research, spectral measurements are performed where dips in the near infrared region of the spectrum caused by the diffraction structure are evident. We expect that the given structure may be promising especially for sensor and filter applications.

Keywords: Direct laser writing, Photonic structure, Grating

Acknowledgements

This work was supported by the project “Grating Structures for LED, Laser and Photonic Component Applications” under the Plan for Recovery and Resilience of the Slovak Republic, funded by the European Union – NextGenerationEU (Grant No. 09I05-03-V02-00054)

P-34 · POSTER

Wrinkled PDMS platforms for tunable photonics

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Presentation	Poster
Poster number	P-34
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	U. Malecka

Wrinkled polydimethylsiloxane (PDMS) platforms offer a versatile route toward mechanically tunable photonic structures operating across the visible and infrared spectral ranges. PDMS combines high elasticity, visible transparency, infrared-active vibrational bands, chemical stability, and compatibility with scalable processing, making it an attractive base material for adaptive optical and thermal-management devices [1,2]. Here, we present PDMS-based platforms in which strain-induced oxygen plasma treatment produces self-organized sinusoidal wrinkles with controllable geometry. The mismatch between the stiff oxidized surface layer and the elastic PDMS bulk enables periodic surface structuring, while mechanical deformation provides a direct mechanism for tuning the optical response.

The investigated systems include bare wrinkled PDMS films acting as gradient-index interfaces and resonant metal–oxide–metal coatings deposited on wrinkled substrates to enhance spectral selectivity and mechano-optical modulation. These architectures allow the effective refractive index, scattering, reflectance, transmittance, and emissivity to be modified through processing conditions and applied strain. In particular, wrinkled surfaces reduce infrared reflectance in atmospheric window, supporting their use in tunable passive radiative cooling, while coated structures exhibit angular- and strain-dependent spectral features [3]. The results demonstrate that elasticity-driven surface morphology can serve as a practical design strategy for reconfigurable photonics, adaptive filters, broadband coatings, and smart thermal-emission surfaces.

Keywords: PDMS, nano- and microstructures, strain-tunable photonics, radiative cooling

Acknowledgements

This study was financially supported by the Polish National Science Center (Grant No. 2022/46/E/ST5/00381).

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P-35 · POSTER

Precise optics manufacturing and measurement in JLO

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Presentation	Poster
Poster number	P-35
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	S. Michal

This poster presents the capabilities for precision optical components manufacturing and quality control at the Joint Laboratory of Optics (JLO) of Palacký University and the Institute of Physics of the Czech Academy of Sciences.

The JLO has been involved in particle and astroparticle research within major international scientific collaborations, for long time. This participation includes, among other things, the design and manufacture of optical components or optomechanical assemblies and their subsequent inspection, assembly, and maintenance. The optical components consist primarily of large-area yet relatively thin glass or composite reflective elements, as well as medium-sized optical components with highly complex shapes. Large-area optics most often consist of polished and coated flat and spherical mirrors with radii of curvature in the scale of meters and transverse dimensions in the of hundreds of millimeters. The quality and durability of the applied coating and the substrate geometric shape are the main evaluated parameters of these mirrors. By medium-sized parts, we mean products with dimensions ranging from tens to hundreds of millimeters, which contain many individual optical and mechanical surfaces.

The precision optical components production involves a relatively complex manufacturing process. At JLO, both conventional technologies and CNC machines or a combination of the two, are utilized to produce optical components. State-of-the-art contact and non-contact measuring equipment with digital evaluation is used to inspect its optical and mechanical properties.

Keywords: Precise optics manufacturing, CNC, measurement, shape, roughness, CMM, interferometer.

Acknowledgements

The work is supported by OP JAC financed by ESIF and the MEYS (Project No. SENDISO - CZ.02.01.01/00/22_008/0004596) and Cherenkov Telescope Array - participation of the Czech Republic project (Project No. LM2023047).

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P-36 · POSTER

Studying reflection of light at the interface of two dielectric media using Ansys Speos simulation – support for laboratory exercise

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Presentation	Poster
Poster number	P-36
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	N. Tarjányi

One of the laboratory exercises that final-year students of a bachelor's degree in the field of Electro-Optics at FEEIT UNIZA solve as part of the Optoelectronics subject deals with observing the interaction of polarized light with the interface between two dielectric media. By measuring the intensities of s- and p-polarized beams (at 635 nm) reflected from a dielectric material, students determine the Brewster angle and refractive index of the material. The extension of the laboratory exercise by a simulation part using the Ansys Speos tool allows overcoming the time and physical limitations of the exercise (a source with one fixed wavelength, the time required to assemble the apparatus, and the measurement itself) and increasing its variability. Students can change the material's type, the light source's wavelength, and the angle of incidence of the light beam on the material. Using the simulation, they can prepare for the experimental part by verifying the expected behavior of the signal, or they can later compare the simulation result with the experimental one. In this paper, we describe the procedure for creating a simulated task in the Ansys Speos and discuss possible alternatives for its use in the teaching process.

Keywords: Laboratory exercise, Fresnel equations, refractive index, optical simulation, Ansys Speos

Acknowledgements

This work was supported by the Slovak National Grant Agency [grant number VEGA 1/0223/23] and the Slovak Grant Agency KEGA through project No. 006ŽU-4/2024.

P-37 · POSTER

Multiphysical insights into strain-tunable photonics in PDMS-based micro- and nanostructures

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Presentation	Poster
Poster number	P-37
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	T. Stefaniuk

Adaptive photonic systems require precise control of optical properties under varying environmental and operating conditions, particularly in applications related to radiative thermal management [1]. In elastomer-based platforms such as polydimethylsiloxane (PDMS), mechanical deformation provides an additional degree of freedom, enabling dynamic tuning of optical response through modifications of surface morphology and effective material parameters [2,3]. However, the coupled interplay between optical, thermal, and mechanical effects in such systems remains complex and requires a comprehensive multiphysical description.

In this work, we present multiphysical numerical investigations of PDMS-based micro- and nanostructures, focusing on strain-induced modifications of their optical and radiative properties. The analysis incorporates angular-dependent emissivity, and heat exchange mechanisms, including solar irradiation and atmospheric radiation. Various structural configurations are evaluated to identify geometries that exhibit optimal performance and adaptability under mechanical deformation.

The simulations, supported by experimentally derived material parameters, reveal the key mechanisms governing strain-dependent spectral behavior, including variations in optical path length, resonance conditions, and effective emissivity. The results demonstrate that mechanical tuning enables dynamic control of radiative properties across a broad spectral range, highlighting the potential of PDMS-based structures for scalable, adaptive thermal management systems.

Keywords: PDMS, nano- and microstructures, strain-tunable photonics, radiative cooling

Acknowledgements

This study was financially supported by the Polish National Science Center (Grant No. 2022/46/E/ST5/00381).

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P-38 · POSTER

Demonstration of β-Ga_2O_3 optical strip waveguides for UV-NIR applications

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Presentation	Poster
Poster number	P-38
Programme	Thursday, 17 September 2026 · 17:25–18:55 · Poster Session 2 · Poster Session
Presenter	M. Zdurienčík

Unique properties of ultra-wide bandgap materials, such as gallium oxide (Ga_2O_3), have enabled the development of new photonic platforms. Owing to its wide bandgap (~4.8 eV) and refractive index of approximately 1.95, efficient light propagation has been demonstrated in simple strip waveguides and nanowires across a broad spectral range (UV-NIR). In addition, low nonlinear losses and high critical electric field strength make Ga_2O_3 a promising candidate for high-power photonic applications. This potential has already been demonstrated through the use of Ga_2O_3 coatings to enhance the laser damage threshold of photonic devices. A detailed characterization of Ga_2O_3 strip waveguides is essential for further advancement of Ga_2O_3-based photonic components. Recent studies have reported propagation losses as low as 3.7 dB/cm, confirming Ga_2O_3 as a suitable material for integrated photonics. However, comprehensive analysis of mode propagation and loss mechanisms remains limited. In this work, we present the fabrication and characterization of Ga_2O_3 strip waveguides. Thin films of β-Ga_2O_3 were grown on c-plane sapphire substrates using liquid-injection metal-organic chemical vapor deposition. The structures were defined by direct-write laser lithography and subsequently etched using argon plasma. The waveguide facets were polished to enable cut-back measurements of optical losses. The analysis of this fundamental building block is crucial for the continued development of Ga_2O_3 photonic devices.

Keywords: Gallium oxide, ultra-wide bandgap, waveguide

Acknowledgements

We acknowledge the financial support from Slovak Research and Development Agency (APVV-24-0325), Slovak Grant Agency VEGA (2/0156/25), Slovak Academy of Sciences (SAS-TUBITAK/JRP/2024/1107.C/COPS) and the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I05-03-V02-00030.

VSB TECHNICAL UNIVERSITY OF OSTRAVA | FACULTY OF MATERIALS SCIENCE AND TECHNOLOGY

CZECH OPTICAL CLUSTER

PPTF Polish Technological Platform on Photonics

OptiXs

Friday, 18 September 2026 · 08:30–10:20 · Main Hall — Integrated Photonics and Semiconductor Lasers

IN-12 · INVITED

System-Level Photonic Integration of WERS Circuits on Silicon Nitride

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Presentation	Invited talk
Programme	Friday, 18 September 2026 · 08:30–08:55 · Integrated Photonics and Semiconductor Lasers · Main Hall
Presenter	M. Ziman

Waveguide-enhanced Raman scattering (WERS) exploits the extended evanescent interaction between a guided mode and an analyte to amplify the intrinsically weak Raman signal, enabling chip-scale spectroscopy on the silicon nitride (Si_3N_4) platform. This work presents the system-level photonic integration of a WERS spectrometer, progressing from individual building blocks to a fully integrated circuit. We report a mask set comprising several test circuits that benchmark the constituent components — slot-waveguide sensing spirals, MMI-based channel-to-slot mode converters, and grating couplers — alongside full WERS spectrometer variants. The slot-waveguide sensing region, which concentrates optical power to maximise analyte interaction, was designed using finite-element (FEM) field simulations. Because the narrow-band response of a grating coupler limits broadband Raman collection, the designs employ several distinct grating geometries, including a compact lensed coupler topology, optimised to outcouple different portions of the Raman spectrum of isopropyl alcohol (IPA) under λ_{pump} = 633 nm and 785 nm excitation; IPA was chosen for its non-toxicity and strong Raman activity below 1000 nm. Grating parameters were optimised through 2D and 3D FDTD modelling, and the test structures provide systematic verification of coupling efficiency, bandwidth, and conversion loss, providing a design and characterisation methodology for the on-chip WERS spectrometer.

Keywords: waveguide-enhanced Raman scattering (WERS), silicon nitride photonics, grating coupler, slot waveguide, lab-on-chip, FDTD simulation

Acknowledgements

This work was supported by the Slovak Research and Development Agency (APVV-24-0536, APVV-24-0466).

IN-13 · INVITED

Multiphysics Modelling of Photonic Structures with Photonic Laser Simulation Kit (PLaSK)

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Presentation	Invited talk
Programme	Friday, 18 September 2026 · 08:55–09:20 · Integrated Photonics and Semiconductor Lasers · Main Hall
Presenter	M. Dems

Nowadays, theoretical modeling of newly developed photonic devices almost invariably precedes the experimental stage, as it enables the investigation of various concepts and designs without the need for costly prototype fabrication. Such analyses are performed by solving equations that describe the relevant physical phenomena and, depending on the validity and applicability of these models, can predict the behaviour of real devices with varying degrees of accuracy. In many practical cases, the equations governing the physical properties of photonic devices, with vertical-cavity surface-emitting lasers (VCSELs) being a notable example, are too complex to be solved analytically and therefore require computational methods. As a result, these calculations often resemble experiments more than purely theoretical studies; hence, terms such as simulations or computer experiments are commonly used.

To facilitate such simulations, we have developed a comprehensive software package for investigating a wide range of physical phenomena occurring in photonic devices, including, but not limited to, semiconductor lasers. This software, named PLaSK (Photonic Laser Simulation Kit), enables efficient coupling and interaction between different physical models and can be used both for rapid evaluation of a specific property by solving a single equation and for rigorous, self-consistent multiphysics analyses. The implemented numerical models range from simplified scalar approaches, which allow efficient approximate analysis of basic devices, to highly accurate methods capable of accounting for physical effects neglected by simpler models, thereby enabling rigorous investigation of complex structures.

In this work, we present the general architecture of the software and its fundamental design principles. We then demonstrate the broad range of its applications. First, we outline the principles of self-consistent VCSEL modelling and present an example that is progressively extended by incorporating additional physical effects and increasing the structural complexity of the device. We also demonstrate optimization procedures for a one-dimensional array of edge-emitting GaN lasers and illustrate the software's capability for rigorous analysis of subwavelength high-contrast gratings.

Keywords: numerical methods, computer simulations, digital twin, VCSELs, laser arrays, subwavelength gratings

OT-35 · ORAL

A Comprehensive Technology Platform for VCSEL Development at Łukasiewicz–IMiF

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 09:20–09:35 · Integrated Photonics and Semiconductor Lasers · Main Hall
Presenter	A. Trajnerowicz

Vertical-Cavity Surface-Emitting Lasers (VCSELs) have become key enabling components for optical communications, 3D sensing, LiDAR, spectroscopy, biometric identification, and emerging photonic integrated systems. Their low power consumption, circular output beam, wafer-level testability, and compatibility with large-scale two-dimensional arrays make them one of the most important semiconductor laser technologies for next-generation photonic applications. Łukasiewicz Research Network – Institute of Microelectronics and Photonics (Łukasiewicz–IMiF) has developed advanced technological capabilities for the fabrication of GaAs-based VCSELs and novel surface-emitting laser architectures. The technology platform is supported by a 700 m² ISO 5–ISO 7 cleanroom equipped with a complete III–V semiconductor processing infrastructure, including photolithography, electron-beam lithography, laser direct writing, ICP-RIE etching, metal and dielectric deposition, rapid thermal processing, proton implantation, wafer bonding, and selective wet oxidation. Recent developments focus on reproducible oxide-aperture formation, symmetry-broken and non-circular aperture technologies, trench-assisted oxidation, high-quality mesa processing, and fabrication of monolithic high-contrast grating (MHCG) mirrors. Ł-IMiF has also established process flows for VCSELs incorporating subwavelength grating reflectors, including nanometer-scale patterning, Au–Au wafer bonding, substrate removal, and advanced current-confinement schemes. These capabilities form a flexible end-to-end technology platform for the realization of next-generation VCSELs with engineered optical confinement, novel cavity concepts, and application-tailored performance. The VCSEL technology at Ł-IMiF is developed in close collaboration with epitaxy providers, architecture designers, and characterization laboratories like Lodz University of Technology, Wrocław University of Science and Technology, VIGO Photonics, or JENOPTIK.

Keywords: VCSEL, lasers, semiconductor technology, processing, optoelectronics

OT-36 · ORAL

Quantum Cascade Surface Emitting Laser

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 09:35–09:50 · Integrated Photonics and Semiconductor Lasers · Main Hall
Presenter	O. Hejtman

Quantum Cascade Lasers (QCLs) offer high-power potential through intersubband transitions in quantum well superlattices. However, scaling conventional edge-emitters is restricted by catastrophic optical mirror damage (COMD) at the facets. Surface emission offers a promising alternative but is fundamentally incompatible since the intersubband transitions within the quantum cascade require transverse-magnetic (TM) polarization, which is natively incompatible with vertical emission [1]. We incorporate a second-order periodic grating to outcouple the TM-polarized light vertically via scattering [2]. The full structure is considered as a leaky periodic waveguide using our semi-analytical Plane Wave Admittance Method (PWAM), which is used to simulate photonic dispersion relation within the reduced Brillouin Zone. Introduction of the grating opens a stopband at the Γ-point, creating a high-quality (Q) factor mode well-suited for lasing, accompanied by a slow-light regime that enhances the density of states (DOS) [3]. We demonstrate that this high-Q resonance is a Bound State in the Continuum (BIC) protected by symmetry, and we characterize its topological phase transitions [4]. Threshold gain for lasing of the mode is also calculated to evaluate practical implications for real-world devices.

Keywords: Quantum cascade lasers, surface emission, second order Bragg grating, photonic dispersion bands, bound states in the continuum, topological phase transition

Acknowledgements

Student Grant Agency GAČR (25-15775S), Ministry of Education, Youth and Sports of the Czech Republic (SP2025/090), Materials and Technologies for Sustainable Development MATUR (CZ.02.01.01/00/22_003/0000048), Advanced Materials for Energy and Environmental Technologies (CZ.02.01.01/00/23_021/0008592).

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OT-38 · ORAL

Concept of a monolithic photonic integrated circuit for precision frequency comb control

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 09:50–10:05 · Integrated Photonics and Semiconductor Lasers · Main Hall
Presenter	L. Hvozdara

We present the design and operating concept of an InP/InGaAs/InAlAs monolithic photonic integrated circuit (PIC) developed for precision control of a frequency comb in gas spectroscopy applications targeting air pollution monitoring. The PIC integrates two quantum cascade lasers operating near 1240 cm^{-1}.

The emission wavelength of the first (fixed) laser is actively stabilized at a chosen N_2O absorption line. Stabilization is achieved by an active current control loop that uses the laser's output beam passing through an off-chip compact gas cell to monitor the transmitted signal using the type II superlattice (T2SL) antimonide detector. This provides an absolute frequency reference. The second (tunable) laser is current-controlled to scan its emission wavelength in the vicinity of this reference frequency. Its output beam is subsequently used to interrogate and control an external frequency comb.

The rear-emitted on-chip beams from both lasers are combined using a low-back-reflection evanescent coupler, generating a heterodyne difference-frequency signal. This signal is detected either by a fast external detector or an on-chip quantum cascade detector and analyzed in real time. The resulting feedback enables precise stabilization and control of the tunable laser emission, ensuring accurate and reliable frequency-comb operation for sensitive trace-gas detection.

The proposed architecture provides a compact and scalable solution for integrated mid-infrared spectroscopy systems.

Keywords: Photonic integrated circuits, mid-infrared, quantum cascade lasers, monolithic integration

Acknowledgements

This work received support from the National Center for Research and Development through project HyperPIC (FENG.02.10-IP.01-0005/23, IPCEI ME/CT).

Friday, 18 September 2026 · 08:30–10:20 · Modular Hall — Magneto-optics and quantum light–matter interactions

IN-14 · INVITED

Quadratic and cubic magneto-optical Kerr effect

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Presentation	Invited talk
Programme	Friday, 18 September 2026 · 08:30–08:55 · Magneto-optics and quantum light–matter interactions · Modular Hall
Presenter	J. Hamrle

Magneto-optical Kerr effect (MOKE) provides a contactless probe of spin ordering through the symmetry of the optical permittivity tensor. While most Kerr magnetometry relies on the linear-in-magnetization term, many technologically relevant films and single crystals exhibit sizable quadratic and even cubic contributions that can mask or mimic magnetization response. In this contribution we present a symmetry-guided framework that links linear (K), quadratic (G_s, G_{44}) and cubic (H) tensor elements to crystal class and sample orientation [1,2]. We then demonstrate an experimental procedure for disentangling the individual MOKE components using the 8-directional method, based on Kerr measurements at multiple in-plane field directions and different sample orientations. Surprisingly, those higher-order terms are sensitive to the structural order such as $L2_1$/B2 ordering and twinning, demonstrated on Co_2MnSi [3], Ni(111) [4,5] and Co(111) [6]. Also, Ni(111) at 635 nm exhibits quadratic and cubic signals comparable to the linear response, underscoring the need for systematic separation [5]. Finally, we show ab-initio calculated linear, quadratic and cubic permittivity spectra.

Keywords: Magneto-optical Kerr effect, quadratic and cubic magneto-optical Kerr effect, permittivity tensor, MOKE spectroscopy

Acknowledgements

Financial support by the EU and the Ministry of Education of the Czech Republic within the Ferroic Multifunctionalities Project (Ferrmion) (CZ.02.01.01/00/22 008/0004591) is acknowledged.

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IN-15 · INVITED

Magneto-optic sol-gel nanocomposites for the functionalization of micropatterned structures for integrated photonics

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Presentation	Invited talk
Programme	Friday, 18 September 2026 · 08:55–09:20 · Magneto-optics and quantum light–matter interactions · Modular Hall
Presenter	Y. Dadoenkova

Magneto-optical (MO) materials are used in the design of integrated optical isolators and modulators, as well as in magnetic field and environmental sensors. However, the integration and patterning of MO materials on photonic platforms remain a significant technological challenge [1]. Conventional thin-film deposition techniques—such as sputtering and pulsed laser deposition—require high-temperature treatments (at least 650 °C) and suffer from severe lattice mismatch with standard substrates, while adhesive bonding lacks long-term thermal and mechanical stability. An alternative approach, liquid-phase sol-gel deposition, enables low-temperature processing (90 °C) with efficient direct infiltration into any type of microscale structure (glass, Si_3N_4, photoresist, gold, …) [2]. The incorporation of MO nanoparticles (for instance, cobalt ferrite [3] or yttrium-iron garnet [4] particles of 10-20 nm diameter) into a sol-gel solution containing silica precursors thus provides a functionalization of a micropatterned structure. Thin films (with a thickness of around a few hundred nanometers) of such a MO nanocomposite can be obtained using simple techniques: spin coating or dip coating. This approach allows a high volume fraction of MO nanoparticles, which provides giant values of the off-diagonal dielectric permittivity tensor, comparable to those of the corresponding bulk MO material.

Keywords: magneto-optics, sol-gel approach, nanocomposite materials, magneto-optic nanoparticles, Faraday effect

Acknowledgements

This work was supported by the European Union's Horizon Europe research and innovation program under grant agreement No. 101129645 (CIRCULIGHT Horizon-EIC-2023-PathFinderOpen-01-01 project), and by the ÉLAN Recherche 2024 program of the Jean Monnet University of Saint-Étienne (project ÉLANYD).

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OT-39 · ORAL

Magnetically tunable cutoff of the odd LRSPP mode in a double-slab magneto-plasmonic waveguide at 1.55 μm

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 09:20–09:35 · Magneto-optics and quantum light–matter interactions · Modular Hall
Presenter	D. Javůrek

We computationally investigate the magneto-optically (MO) induced shift of the odd long-range surface plasmon polariton (LRSPP) mode cutoff in a double-slab (IMIMI) plasmonic waveguide at $\lambda = 1.55$ μm. The structure consists of two metallic slabs of thickness a separated by a dielectric gap of width d, embedded in an MO medium with $n = 1.688$ and having off-diagonal gyration $g = 0.05$ in TMOKE configuration. Mode analysis is performed using the 2×2 transfer-matrix method for gyrotropic media with TMOKE effect, validated against finite-element eigenmode simulations (COMSOL). In the isotropic limit, the IMIMI waveguide supports four guided SPP modes — even and odd hybridizations of both LRSPP and SRSPP from the constituent coupled IMI waveguides — above a critical gap width d_c; below d_c the odd LRSPP reaches cutoff and only three modes propagate. Activation of transverse magnetization shifts this cutoff toward larger gap widths. We study four configurations defined by the sign distribution of g in the outer / central / outer dielectric regions: uniform (+,+,+), central-only (0,+,0), outer-only (+,0,+), and antiparallel (+,−,+). For the uniform case, the cutoff shifts from $d_c \approx 1.995$ μm to 2.030 μm. The central-only configuration produces a nearly identical shift, showing that the cutoff is governed by the gyrotropy of the inter-slab layer. Adding MO activity only in the outer regions (+,0,+) leaves the cutoff virtually unchanged. The antiparallel alignment (+,−,+) yields the largest shift, extending the cutoff to $d_c \approx 2.045$ μm. In all cases, the shift magnitude grows with decreasing slab thickness a due to enhanced inter-slab coupling. The magnetically tunable mode cutoff represents a qualitative change in the waveguide mode structure — a transition from a four-mode to a three-mode regime — with implications for design of magnetically switchable plasmonic mode filters at telecom wavelengths.

Acknowledgements

This project has received funding from the European Union's Horizon Europe research and innovation program under grant agreement No101129645 (project CIRCULIGHT, www.circulight.eu). Views and opinions xpressed are, however, those of the author(s) only and do not necessarily reflect those of the European Union or EISMEA. Neither the European Union nor the granting authority can be held responsible for them. We acknowledge as well the following projects for support: Project Advanced Materials for Energy and Environmental Technologies (MEET), reg.~no.~CZ.02.01.01/00/23_021/0008592 and the project Materials and Technologies for Sustainable Development (MATUR), reg.~no.~CZ.02.01.01/00/22_008/0004631; e-INFRA CZ project with ID:90254 supported by Ministry of Education, Youth and Sports of the Czech Republic; REFRESH - Research Excellence For REgion Sustainability and High-tech Industries funded by the European Union, project no. CZ.10.03.01/00/22_003/0000048. Data are available at doi: 10.5281/zenodo.19607022.

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OT-40 · ORAL

NON-CLASSICAL OPTICAL DYNAMICS OF PERIODIC DIELECTRIC LAYERS EMBEDDED WITH MULTI-LEVEL ATOMS

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 09:35–09:50 · Magneto-optics and quantum light–matter interactions · Modular Hall
Presenter	N. Ghangas

We present a comprehensive investigation of entanglement dynamics in multi-level V-type atomic systems embedded within photonic crystals (PCs). We mainly focus on the synergistic roles of photonic band gap (PBG), resonant dipole-dipole interactions (RDDIs) and quantum interference through analytical modeling and numerical simulations using the Schrödinger equation. Key findings reveal that resonant interaction dominates when the interatomic distance is comparable with the localization length of photon-atom bound states lying in the band gap region. For atoms with antiparallel dipole orientations, both initially entangled and separable states exhibit robust entanglement preservation due to strong collective interactions. Conversely, when dipoles are oriented orthogonally, initially entangled states exhibit unique oscillatory patterns in their entanglement dynamics. This effect arises from the formation of dark states due to destructive interference within the structured photonic environment, with RDDIs sustaining non-Markovian dynamics. We further demonstrate that positioning the atomic excited states deeper within PBG accelerates the decay of entanglement oscillations due to the exponential suppression of resonant energy exchange mediated by evanescent modes. Our analysis establishes RDDIs and quantum interference as potential tools for tailoring entanglement dynamics, paving the way for controlled quantum coherence in PC platforms. Further, we will explore these investigations for Hyperbolic Metamaterials.

Keywords: Periodic dielectric platforms, Multi-level atoms, Light-matter interactions, Photonic band gap, Non-classical dynamics, Coherence time.

Acknowledgements

We thank the Polish National Science Center for support via the project 2024/06/Y/ST7/00093.

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OT-41 · ORAL

Generation and transfer of entanglement in a hexagonal spin system

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 09:50–10:05 · Magneto-optics and quantum light–matter interactions · Modular Hall
Presenter	W. Leoński

The quantum Ising spin model, especially the transverse-field Ising model, is a powerful abstraction that naturally arises in several quantum optics platforms where effective two-level systems (“spins”) interact via light-mediated couplings. Here, we concentrate on the dynamics of quantum entanglement in a finite hexagonal loop spin system described by an Ising-type Hamiltonian [1]. We consider both the evolution of an initially entangled state and the generation of entanglement from an initially separable state. Our analysis shows that the strength of spin–spin coupling plays a key role in controlling the transfer of entanglement between different pairs of spins.

For unentangled initial states (product states), we demonstrate that appropriately tuned interaction parameters enable the efficient creation of the bipartite entanglement in the system. The entanglement is quantified using negativity [2,3]. Additionally, we investigate the relationships between entanglement and mixedness (characterized by the linear entropy), appearing in the system.

The presented results provide insight into how internal interactions in spin systems can be used to control the generation and distribution of the entanglement.

Keywords: loop spin system, entanglement, mixed states, negativity; linear entropy, Ising model

Acknowledgements

J.K.K. and W.L. acknowledge the support provided by a program of the Polish Ministry of Science entitled ‘Regional Excellence Initiative’, project no. RID/SP/0050/2024/1.

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OT-42 · ORAL

Fano profile in the resonance fluorescence spectrum of a quantum dot coupled to phonons

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 10:05–10:20 · Magneto-optics and quantum light–matter interactions · Modular Hall
Presenter	P. Machnikowski

We present a theory of resonance fluorescence (RF) of a quantum dot (QD) in the regime of weak optical excitation [1]. The QD is coupled to the phonon modes of the surrounding bulk semiconductor, described by a super-Ohmic spectral density. We show that the RF spectrum of this system consists of a central elastic line, a broad phonon sideband known from other linear and non-linear spectra of such systems, as well as a narrow inelastic contribution, which stems from noise-induced transient dynamics [2,3]. At moderate phonon couplings, the interplay between the broad sideband and the inelastic feature leads to a Fano-like profile near the resonant energy with the Fano parameter determined by laser detuning. In the weak-coupling limit resonant light scattering is entirely suppressed. The amplitude of the Fano feature grows linearly with temperature, while its width depends solely on the spontaneous emission rate of the emitter. We relate the quantum character of the reservoir to the non-commutativity of noise observables and show that the Fano resonance persists in the classical (commutative) limit. We also discuss how the redistribution of optical coupling efficiency between the central line and the sidebands affects the total scattering rate under various excitation conditions. We include also the effects of inhomogeneous line broadening due to background charge noise and show that the effect partly persists even in the presence of such fluctuations.

Keywords: quantum optics, resonance fluorescence, quantum noise, quantum open system, quantum dot

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Friday, 18 September 2026 · 10:50–11:50 · Main Hall — Machine learning and collective measurements in quantum optics

OT-43 · ORAL

Machine learning as a tool in quantum optics: nonclassicality quantification and detection-efficiency estimation

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 10:50–11:05 · Machine learning and collective measurements in quantum optics · Main Hall
Presenter	R. Machulka

Identification of nonclassical nature of multiphoton quantum states is of utmost importance for the development of quantum photonic technologies. Under realistic experimental conditions, a photonic quantum state is affected by interactions with its environment. As a result of such noisy interaction, the nonclassical features of the original quantum state are significantly reduced or may even be completely absent in the detected state.

This reduction of nonclassicality in the detected field can, however, be exploited to determine the quantum efficiency of the measuring device. This approach is referred to as the method of absolute detector calibration. Both tasks — characterizing the nonclassicality of the detected field and estimating the efficiency of the detector used to measure it — typically require large amounts of experimental data and complex numerical reconstruction.

In this work, we demonstrate that the self-learning capabilities of artificial neural networks can be leveraged to assess and fully characterize the nonclassicality of multiphoton quantum states generated via photon-number-resolved post-selection from twin beams, as well as to determine the quantum efficiency of a single-photon detector. This approach significantly reduces both experimental and computational complexity by bypassing the reconstruction of the twin-beam photon-number distribution.

Keywords: machine learning, nonclassicality, detection efficiency

OT-44 · ORAL

Non-classical State Preparation in Driven Hybrid Optomechanical Systems: From Blockade to Squeezing

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 11:05–11:20 · Machine learning and collective measurements in quantum optics · Main Hall
Presenter	A. Kowalewska-Kudłaszyk

We theoretically investigate the generation of non-classical correlations and quantum noise reduction in a hybrid quantum system consisting of a superconducting microwave resonator (SMR) and a nanomechanical quantum drum (QD). The system's nonlinearity is induced by a superconducting qubit embedded within the SMR, which creates a Kerr-type anharmonicity essential for preparing non-classical states. By applying a balanced linear coupling transformation to the photonic and phononic fields, we define hybrid photon-phonon modes (supermodes).

The primary focus of this study is the quantification of steady-state inter-mode entanglement between the microwave and mechanical degrees of freedom. We demonstrate that the interplay between the qubit-induced nonlinearity and the coherent hopping between resonators allows for the generation of robust quantum correlations between single photons and single phonons. Furthermore, we analyze the emergence of squeezing and principal squeezing within these hybrid supermodes, identifying parameter regimes where quantum noise is suppressed below the vacuum level.

Our results indicate that even in regimes where individual modes might not exhibit strong non-classicality, the hybrid nature of the excitations - described as atom-cavity-mechanics polaritons - enables the creation of significant inter-mode entanglement.

These findings provide a framework for engineering hybrid quantum interfaces and have potential applications in quantum metrology and high-precision sensing.

Keywords: squeezing, photon blockade, entanglement, hybrid systems

Acknowledgements

A.K.K. acknowledges the financial support by the Polish National Science Centre (NCN) under the Maestro Grant No. DEC-2019/34/A/ST2/00081.

J.K.K. acknowledges the support provided by the program of the Polish Ministry of Science entitled `Regional Excellence Initiative', project no. RID/SP/0050/2024/1.

OT-45 · ORAL

Adaptive Negativity Estimation via Collective Measurements

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 11:20–11:35 · Machine learning and collective measurements in quantum optics · Main Hall
Presenter	K. Lemr

We explore an efficient method for entanglement quantification in two-qubit and qubit-qutrit quantum systems based upon the framework of collective measurements in conjunction with machine learning. We introduce an adaptive measurement procedure in which measurement settings are dynamically adjusted based on prior measurement outcomes aiming to optimize the inference precision given a limited number of these measurement settings. The procedure makes use of the Long Short-Term Memory networks to recurrently process collective measurements on two copies of the investigated states. Obtained results demonstrate the tangible benefits of the adaptive measurements in comparison to previously described non-adaptive strategies.

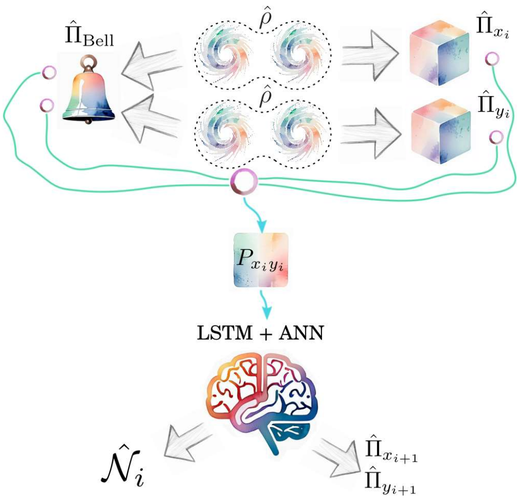

Fig. 1: Conceptual scheme of the adaptive entanglement quantification using collective measurements processed by machine learning.

Keywords: collective measurements, adaptive measurement, machine learning, entanglement quantification

Acknowledgements

The authors acknowledge support by the project of the Czech Science Foundation (25-17253S).

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OT-46 · ORAL

Deep-learned classification of quantum correlations from collective measurements

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 11:35–11:50 · Machine learning and collective measurements in quantum optics · Main Hall
Presenter	J. Soubusta

The paper suggests employing deep artificial neural networks (ANNs) for resource-efficient classification of quantum correlations based on collective measurements conducted in the geometry of entanglement swapping.

ANNs are trained to categorize two-qubit quantum states into five mutually exclusive classes depending on the strength of quantum correlations exhibited by these states. The precision and recall of the ANN models are analyzed as functions of the quantum resources consumed, i.e. the number of collective measurements or shots performed. The results indicate that the ANN models outperform analytical solutions, as they are capable of distinguishing between classes intractable by analytical witnesses. ANNs can also operate under a reduced number of measurement configurations, and significantly better cope with detection noise.

Keywords: machine learning, neural networks, two-qubit states, quantum correlations, collective measurements

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Friday, 18 September 2026 · 10:50–11:50 · Modular Hall — Adaptive and reconfigurable photonic materials and systems

OT-47 · ORAL

Adaptive optical systems enabled by ionic and electronic transport

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 10:50–11:05 · Adaptive and reconfigurable photonic materials and systems · Modular Hall
Presenter	T. Stefaniuk

Dynamic control of light is a central requirement for modern photonics, from compact modulators to neuromorphic and in-memory computing platforms [1]. Ion and electron migration provide a versatile route toward optical systems that are not only functionally reconfigurable through reversible refractive-index modulation, but also physically reconfigurable through voltage-driven material redistribution and changes in the effective dimensions of nanoscale structures. This work focuses on two complementary mechanisms: carrier accumulation/depletion at semiconductor–oxide interfaces and electrochemical metallization based on silver-ion migration and filament formation. Carrier accumulation enables fast, volatile, and electronically driven optical modulation, whereas ECM introduces slower but persistent changes associated with metallic cluster motion, filament growth, dissolution, and electrode reshaping [2]. Using spectroscopic ellipsometry combined with electrical measurements in resonant Ag/ITO/SiO_2/Ag and Ag/SiO_2/Ag structures, these processes can be distinguished and deliberately coupled. The results show that electric bias can tune both optical constants and the physical state of the active layers, enabling volatile modulation, multilevel nonvolatile optical storage, dynamic light modulation, and polarization control within simple thin-film architectures. This interplay between electronic and ionic reconfiguration offers a route toward adaptive photonic devices combining high-speed operation, lasting memory, and multifunctional optical response [3].

Keywords: Optical memristor, optical switch, memristive system, electrochemical metallization, filament

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OT-48 · ORAL

Light-driven control of subwavelength metallic filament dynamics in ECM-based memristive structures

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 11:05–11:20 · Adaptive and reconfigurable photonic materials and systems · Modular Hall
Presenter	K. Brańko

Memristors are history-dependent resistive devices capable of storing and processing information within the same physical element [1], but their purely electrical operation is limited by Joule heating, crosstalk, and stochastic switching. Integrating light into memristive systems can help overcome these constraints by enabling contact-free addressing, high-bandwidth readout, and parallel operation through wavelength, phase, and polarization degrees of freedom [2,3].

Here, we investigate optical control of metallic filament dynamics in ECM-based memristive structures. The study focuses on how optical excitation influences filament formation, reinforcement, and rupture, rather than merely monitoring resistive switching. Using electro-optical characterization and a custom-built optical setup, we analyze how light interacts with nanoscale filaments and metallic clusters embedded in metal–dielectric–metal architectures. Our results indicate that optical stimulation can modify both electrical and optical device states, suggesting that light may selectively promote volatile or non-volatile switching pathways depending on excitation conditions and filament configuration. These findings point toward ECM-based optical memristors in which light acts as an active control parameter.

Keywords: Optical memristor, optical switch, memristive system, electrochemical metallization, filament

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OT-49 · ORAL

PDMS-based nano- and microstructures for strain-tunable photonics

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 11:20–11:35 · Adaptive and reconfigurable photonic materials and systems · Modular Hall
Presenter	P. Wytrych

Polydimethylsiloxane (PDMS) is a versatile elastomer combining chemical stability, low surface energy, high elasticity, and broad optical transparency in the visible range with characteristic vibrational absorption bands in the infrared [1,2]. These properties make it an attractive platform for nano- and microstructured optical materials whose response can be tailored by geometry, composition, and mechanical deformation. Here, we investigate PDMS-based architectures designed to control optical properties across the hyperspectral VIS–IR range. The study compares several structural concepts, including surface-engineered systems, PVD-coated multilayers, wrinkled nanoribbon structures, volumetric composites containing fillers such as PDMS, polyethylene, TiO_2, or SiO_2, and porous media with controlled voids or gradient porosity. By linking fabrication routes with the resulting morphology and optical response, we identify how refractive index contrast, scattering, infrared absorption, and surface structuring jointly determine reflectance, transmittance, and emissivity. Particular attention is given to mechano-optical modulation under tensile strain, where the elasticity of PDMS enables reversible tuning of the optical response through deformation-induced changes in structure geometry. The results provide design guidelines for strain-tunable PDMS photonics and broadband coatings. They also indicate promising directions for passive radiative cooling, where optimized infrared emissivity, low solar absorption, and mechanical durability are essential for efficient thermal management [3].

Keywords: PDMS, nano- and microstructures, strain-tunable photonics, radiative cooling

Acknowledgements

This study was financially supported by the Polish National Science Center (Grant No. 2022/46/E/ST5/00381).

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OT-50 · ORAL

High-Fidelity 3D Microfabrication Using Adaptive Wavefront Shaping

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Presentation	Oral talk
Programme	Friday, 18 September 2026 · 11:35–11:50 · Adaptive and reconfigurable photonic materials and systems · Modular Hall
Presenter	P. Jákl

Two-photon lithography (TPL) is a technique widely used for the fabrication of complex 3D microstructures with detailed topology. However, achieving consistent sub-diffraction resolution remains challenging due to depth-dependent aberrations and limited throughput. This study proposes an advanced TPL framework incorporating a Spatial Light Modulator (SLM) to actively compensate for optical aberrations, thereby preserving focal spot integrity throughout the fabrication volume. By implementing dynamic wavefront shaping, we demonstrate enhancements in spatial resolution and structural fidelity, particularly for high-aspect-ratio features. Furthermore, the integration of multi-focal arrays allows for high-throughput parallel processing without sacrificing the precision of the additive process. We demonstrate the versatility of this approach through the fabrication of functional micro-optical elements and specialized probes for optical trapping. Our results suggest that SLM-based aberration control is essential for the reliable production of high-performance micro-scale devices, bridging the gap between fundamental resolution limits and scalable manufacturing for optomechanical applications.

Keywords: optical stereolithography, holography, two-photon photopolymerization

Acknowledgements

The authors acknowledge support from Technology Agency of the Czech Republic (project FW12010359), the Ministry of Education, Youth and Sports of the Czech Republic (project CZ.02.01.01/00/22_008/0004649), the Czech Academy of Sciences (Praemium Academiae) and institutional support RVO: 68081731.

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Computational imaging, holography and microscopy

Lasers, nonlinear and ultrafast optics

Fibre optics and optical communications

Spectroscopy, sensing and biophotonics

Nanophotonics, plasmonics and optical materials

Integrated photonics and optoelectronics

Optical metrology, components and instrumentation

Terahertz, magneto-optics and spin photonics

Industrial photonics, manufacturing and education