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Focus on technologies

Brillouin Microscopy Now Available through Open Access at IPHYS BIF



Biolmaging Core Facility at the Institute of Physiology of the Czech Academy of Sciences, Prague

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The Biolmaging Facility at the Institute of Physiology of the Czech Academy of Sciences (IPHYS) has recently expanded its technological portfolio with a new Brillouin microscopy system. The acquisition was made possible through the OP JAK project funded by the Ministry of Education, Youth and Sports of the Czech Republic (MEYS) and represents a strategic investment into progressive technologies that were previously not available in open access within Czech-Biolmaging or elsewhere in Czechia. As part of the national infrastructure Czech-Biolmaging and the Euro-Biolmaging Advanced Light and Electron Microscopy Prague Node, the facility now offers Brillouin microscopy in open access to the scientific community.

Šimon Vrana, Imaging Specialist at IPHYS Biolmaging Facility supports users in applying advanced biophysical imaging methods to their research questions.

"I am specialized in Atomic Force Microscopy, Brillouin and other biophysical methodologies. My role in the facility is to support our users with different imaging approaches to address scientific questions in this field of biomechanics."

What Brillouin Microscopy Can Reveal

Brillouin microscopy is an emerging optical modality that enables non-contact, label-free mapping of mechanical

properties in biological samples. The technique measures the interaction between laser light and thermally driven acoustic waves within a sample, providing information about its internal mechanical characteristics.

By extracting parameters such as the longitudinal elastic modulus and viscoelastic behavior, researchers can investigate how stiffness and mechanical heterogeneity influence biological systems. This is particularly relevant because changes in mechanical properties are often associated with development, differentiation, and disease.

From Cells to Plants: Broad Application Potential

Although Brillouin microscopy has been widely used in cell and tissue research, the first users of the new system at IPHYS are working in plant biology. Current projects include measurements on *Physcomitrella* moss provided by Imaging Facility Institute of Experimental Botany CAS, comparing genetically modified lines with wild-type counterparts.

The system is suitable for a broad spectrum of samples:

- Single cells
- Cell organoids
- Tissue sections
- Plant tissues

In general, any sample compatible with confocal microscopy can be investigated, provided it is sufficiently transparent and preferably adherent.

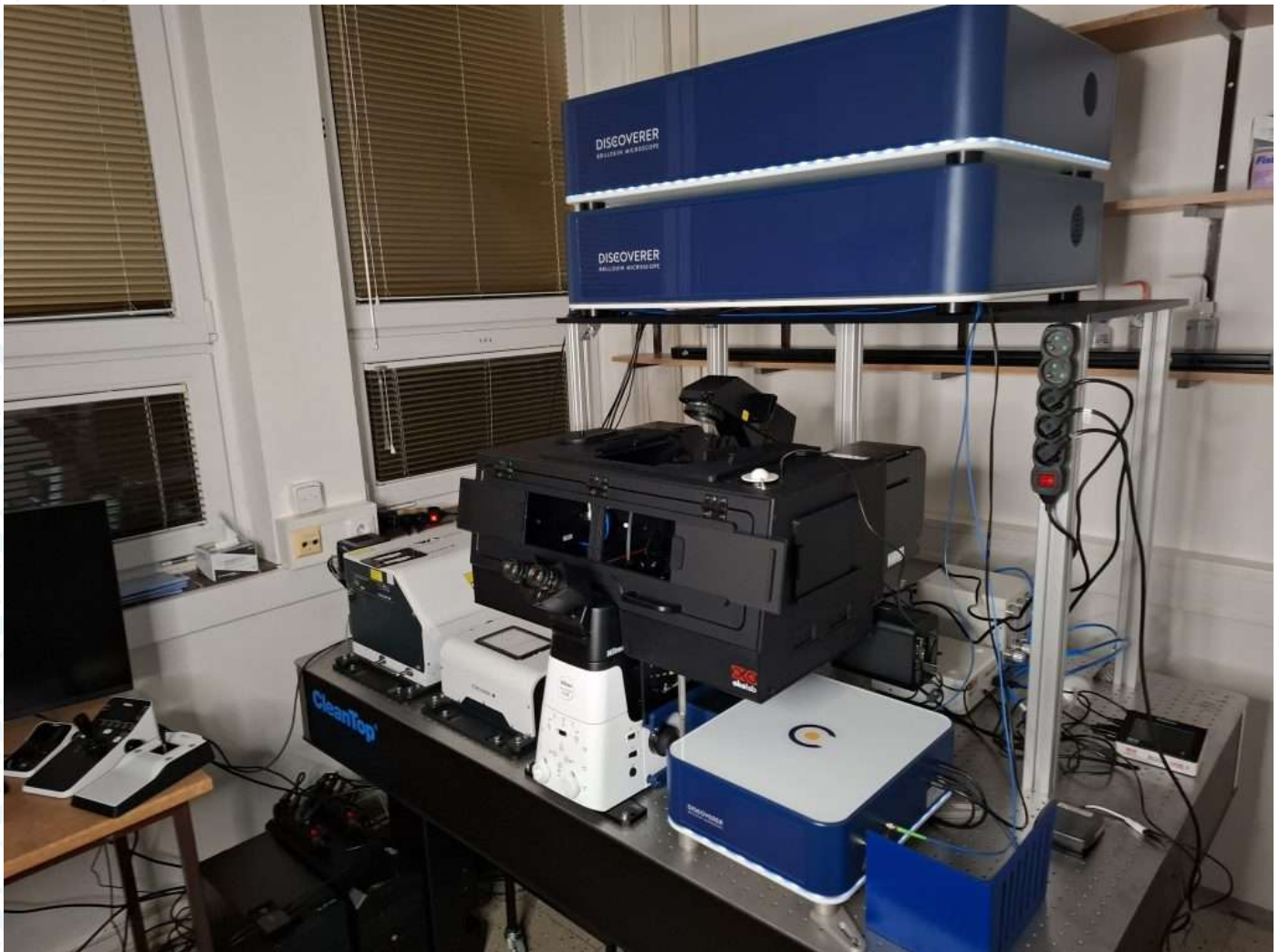
Why a Commercial System?

The facility invested in a commercial Brillouin microscope (Discoverer, CellSense) to ensure reliability, robustness, and accessibility for users. Unlike many

need for extensive in-house development and maintenance.

Multimodal Imaging: Correlating Mechanics and Fluorescence

A key advantage of the IPHYS setup is its integration of Brillouin microscopy with spinning disk fluorescence microscopy, including the Olympus SoRa super-resolution system. This multimodal



custom-built systems, the commercial platform enables streamlined operation and faster onboarding.

“We want to offer Brillouin Microscopy as a service, and the CellSense system is very reliable and user-friendly. After a short training and some troubleshooting, users should be able to measure samples themselves.”

This strategic choice allows Czech-Biolmaging to provide sustainable open access to technology without the

configuration enables researchers to correlate mechanical mapping with high-resolution fluorescence imaging. In practice, this means that users can:

- Visualize fluorescently labeled proteins or structures
- Identify regions of interest
- Switch to Brillouin mode to quantify local viscoelastic properties
- Correlate structural, molecular, and mechanical information

“Users can examine a cell sample stained

with fluorescent dyes, identify a protein of interest, and then shift to Brillouin microscopy to measure local viscoelastic properties without dyes or mechanical probes.”

Beyond Brillouin imaging, the facility provides access to confocal and multiphoton microscopy, FLIM, PLIM, light-sheet imaging, and mechanical testing approaches such as AFM and compression, biaxial tensile testing—allowing comprehensive multimodal experimental design.

Scientific Questions Addressed

The facility primarily supports projects where biomechanics plays a central role in the biological question. Researchers can investigate:

- Mechanical changes during development and differentiation
- Stiffness gradients in organoids and tissues
- Biomechanical alterations in fibrosis, cancer, or neurodegeneration
- Effects of genetic modification on plant cell wall mechanics
- Mechanical testing in tissue engineering

By integrating Brillouin microscopy into broader imaging workflows, scientists can better understand how physical properties shape biological function.

Full-Service Support: From Experiment

Design to Custom Data Analysis

As part of Czech-Biolmaging, the IPHYS Biolmaging Facility operates under a 100% open-access policy and provides comprehensive user support.

Services include:

- Consultation to select the optimal imaging approach
- Hands-on instrument training
- Experimental design assistance
- Advanced data analysis support

While commercial software provides basic Brillouin data processing, the facility also supports advanced workflows using third-party tools such as Fiji and develops customized solutions in C++, C#, or Python when required.

A Unique Opportunity within the Infrastructure

With the introduction of Brillouin microscopy, Czech-Biolmaging strengthens its position within Euro-Biolmaging ERIC.

The combination of:

- Open access
- Commercial, user-friendly Brillouin technology
- Integrated multimodal imaging
- Comprehensive expert support

makes the IPHYS Biolmaging Facility a unique access point for researchers interested in biomechanics-driven biological questions in Czechia and Europe.

Get in touch with the Core Facility



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<https://bioimaging.fgu.cas.cz/>

Introducing a unique platform for targeted heat shock in live cells



Bioimaging Core Facility at IMTM, Palacký University Olomouc

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Palacký University
Olomouc

When it comes to advanced technologies at the interface of microscopy and nanotechnology, IMTM's Bioimaging core facility has developed a genuinely unique experimental platform. We developed an original approach to induce spatially and temporally controlled heat shock directly within single living cells by combining a plasmonic surface and confocal laser scanning microscopy (CLSM).

This methodology builds on more than two decades of experience with DNA laser

micro-irradiation, a technique that uses focused UV laser light to induce localized DNA damage within the cell nucleus, typically in stripe-like patterns that enable robust, quantitative analysis. Coupled with fluorescently tagged DNA damage response factors, this approach has been instrumental in visualizing repair processes in real time and has substantially contributed to paradigm shifts in the field of DNA damage and repair, including the identification of novel pharmacological targets relevant to cancer therapy.

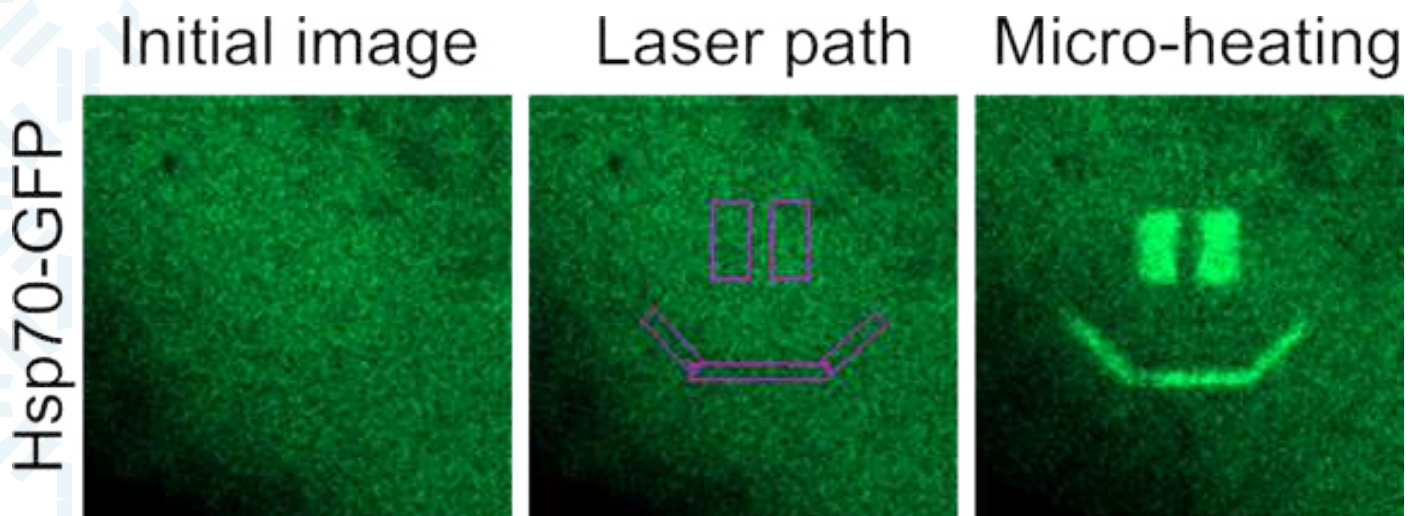


Figure: Recruitment of heat shock protein 70 fused to green fluorescent protein (Hsp70-GFP) to sites of thermally induced protein damage following micro-heating. Laser-irradiated regions of interest within the cell (shown here in the shape of a smiley) become selectively highlighted due to the local accumulation of Hsp70-GFP at sites of protein damage.

(Images courtesy of the Laboratory of Genome Integrity, Institute of Molecular and Translational Medicine)

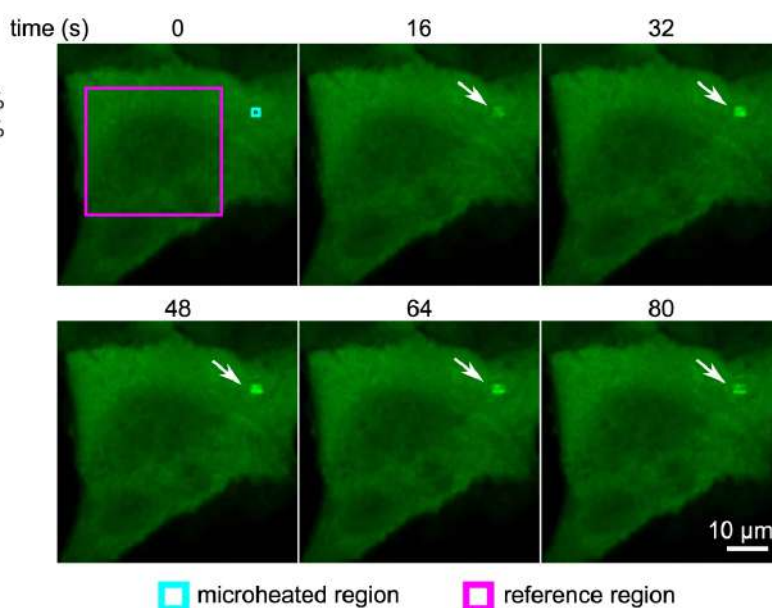
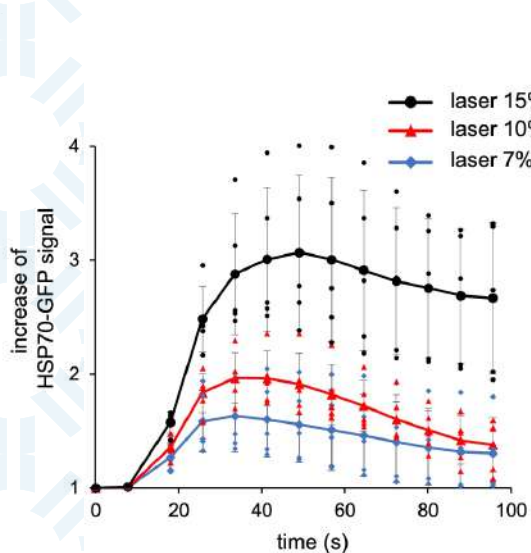
By integrating this well-established laser micro-irradiation concept with plasmonic nanoparticles, we introduced a completely new way to interrogate cellular responses to heat and, in particular, to proteotoxic stress. Plasmonic nanoparticles exhibit a remarkable ability to convert incident laser light into localized heat through localized

surface plasmon resonance (LSPR). Using state-of-the-art CLSM systems, we can exploit this effect to selectively heat subcellular regions with unprecedented spatiotemporal precision, using laser lines that are standard components of modern laser-scanning and wide-field microscopes. This “micro-heating” methodology provides

a powerful new tool for studying the immediate heat shock response in live cells—an enduring technical challenge in cell biology. In our published work, we demonstrated the induction of protein aggregation within micrometer-scale regions of interest (typically $3 \times 3 \mu\text{m}$) with temporal resolution of seconds. This capability enables direct observation of molecular dynamics that were previously inaccessible using conventional thermal-stress approaches. In addition, we can quantitatively monitor local increases in green fluorescent protein (GFP) signal intensity, which we interpret as the recruitment and accumulation of proteins at sites of thermally induced damage.

We are currently extending this proof-of-concept system by automating both thermal damage induction and downstream image analysis, with the aim of developing a high-throughput platform. In parallel, we are exploring applications beyond conventional light-microscopy-based cell imaging, leveraging the broader potential of advanced CLSM technologies across multiple areas of biomedical research. We anticipate that micro-heating approaches may ultimately achieve an impact comparable to that of DNA laser micro-irradiation, particularly in studies of cellular stress responses and proteostasis.

For an in-depth look at our published setup and findings, please see: **Mistrík, M., Skrott, Z., Müller, P. et al. Microthermal-induced subcellular-targeted protein damage in cells on plasmonic nanosilver-modified surfaces evokes a two-phase HSP-p97/VCP response. Nat Commun 12, 713 (2021). <https://doi.org/10.1038/s41467-021-20989-9>**



Get in touch with the Core Facility



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imtm.cz/core-facilities/bioimaging-core-facility

When word order matters: Alterations in the language pathway were linked to processing of syntactically complex sentences in patients with Lewy bodies

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Language processing and the ability to comprehend syntactically complex sentence structures are defining features of human communication. In contrast to English, Czech relies on a relatively flexible word order, with grammatical relationships primarily indicated by morphological case markings on nouns (e.g., nominative vs. accusative forms). This linguistic property provides a unique framework for investigating the neural mechanisms underlying syntactic processing.

In our previous work, we demonstrated that Slovak patients with Parkinson's disease exhibit impairments in sentence reading comprehension, accompanied by task-dependent alterations in functional connectivity. Building on these findings and with the help of MAFIL we were able to continue our research and aim to characterize neural alterations associated with the comprehension of syntactically complex sentences in patients with Lewy body diseases and mild cognitive impairment (MCI-LB), with a specific focus on language-related, domain-specific brain networks.

The language network comprises two principal pathways: a dorsal pathway,

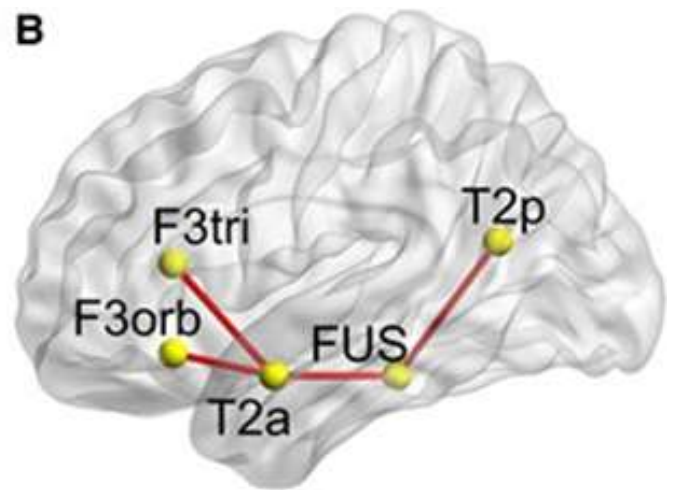
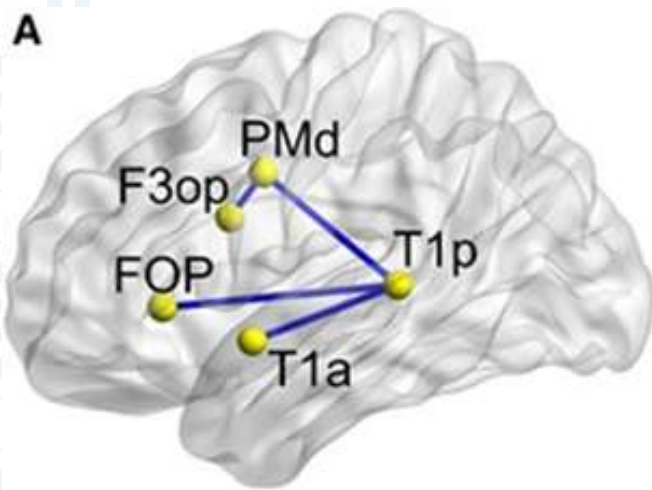
primarily involved in auditory-motor integration, speech production and repetition, and phonological processing; and a ventral pathway, which predominantly supports speech comprehension and semantic processing, see Figure below.

Behavioural results of this study revealed impaired sentence comprehension in MCI-LB patients compared to healthy controls. These deficits were associated with altered task-dependent functional connectivity within specific subcortical-cortical circuits and, notably, within the dorsal language network. Importantly, our findings link the dorsal language pathway to the processing of syntactically complex sentences in MCI-LB. Altered frontotemporal connectivity observed in this patient group may therefore represent a sensitive neural marker of language-related cognitive impairment in α -synucleinopathies.

Publication:

Novakova L, Gajdoš M, Carbol D, Rektorova I. Sentence comprehension in Lewy body diseases: a functional magnetic resonance imaging study. *Brain Commun.* 2025 Oct 30;7(6):fcaf423.

doi: [10.1093/braincomms/fcaf423](https://doi.org/10.1093/braincomms/fcaf423).



Dorsal and ventral language pathways. Dorsal (A) and ventral (B) pathways for language with region of interests (ROIs) that were used for analysis; T1a/p: anterior/posterior superior temporal gyrus; T2a/p: anterior/posterior middle temporal gyrus; FUS: fusiform gyrus; F3orb/tri/op: pars orbitalis/triangularis and opercularis of the inferior frontal gyrus; FOP: deep frontal operculum; PMd, dorsal premotor cortex.



Image Courtesy of MAFIL, CEITEC, MUNI. Image not related to the study discussed above.

Get in touch with the Core Facility



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Annual Scientific Conference

Imaging Principles of Life 2026

REGISTRATION
OPEN

30 September – 1 October 2026

Institute of Molecular Genetics of the Czech Academy of Sciences,
Prague, Czech Republic

REGISTRATION DEADLINE: 15 July 2026

Registration is now open for the annual Czech-Bioluminescence scientific conference Imaging Principles of Life 2026.

Join us for two days of inspiring scientific lectures, engaging discussions, and networking with the Czech and international imaging community.

Program Highlights

- Invited talks by international experts in biomedical imaging and data analysis
- User presentations
- Industry presentations and exhibition
- Poster session

This year's program will introduce a new hybrid lecture format bringing together users and core facility staff to present selected research projects from two

complementary perspectives:

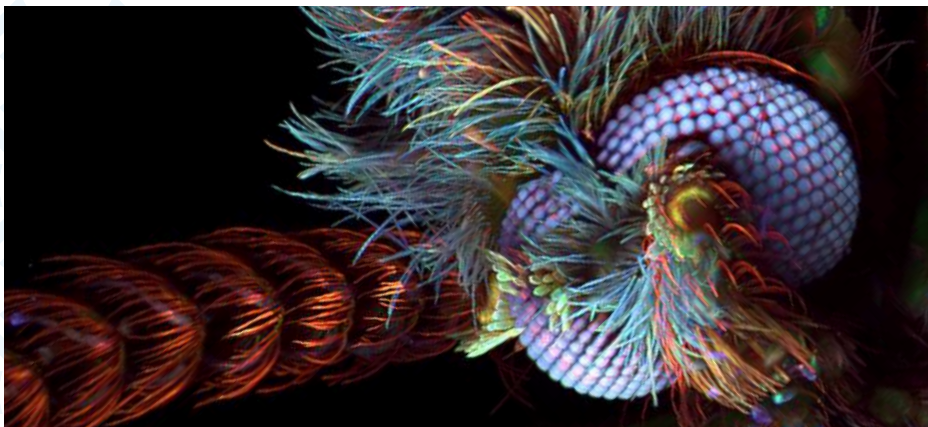
- the scientific achievements and research impact, and
- the services, technologies, and methodologies provided by the core facilities.

Confirmed International Speakers

- **Prof. Jean-Yves Tinevez**, Head of the Image Analysis Hub, Institut Pasteur, Paris, France
- **Jun.Prof. Dr. Christian Franke**, Head of the Digitized Experimental Microscopy Facility, Friedrich Schiller University Jena, Germany

Additional speakers will be announced soon on the conference website.

CONFERENCE WEBSITE



Global Collaboration

Imaging4All at IMG EM: Advancing Mitochondrial Research through VolumeEM



Czech-Biolmaging is part of the global imaging community through its membership in Euro-Biolmaging ERIC, a founding member of Global Biolmaging. Through this international network, Czech-Biolmaging connects researchers worldwide with advanced imaging technologies, expertise, and training opportunities. One such initiative is the Imaging4All programme, which supports researchers from low- and middle-income countries by providing funded access to advanced imaging infrastructures and hands-on training at leading facilities.

In 2025, the Electron Microscopy Core Facility at the Institute of Molecular Genetics (IMG), welcomed **Anil Can (Acıbadem University, Türkiye)** through this programme funded by Global Biolmaging and Wellcome Trust. During his two-week visit to Prague, Dr. Can applied advanced volume electron microscopy (volumeEM) approaches, including Focused Ion Beam Scanning Electron Microscopy (FIB-SEM) and Transmission Electron Microscopy (TEM) tomography, to explore mitochondrial damage in mouse testicular tissue.

His project investigates the effects of monosodium glutamate (MSG) on mitochondrial ultrastructure and evaluates the potential protective role of ferulic acid. By combining high-resolution volumetric acquisition with advanced image processing and analysis, volumeEM allows detailed visualization of mitochondrial architecture and subtle structural alterations that are difficult to detect using conventional 2D methods.

The visit highlights Czech-Biolmaging's commitment to open access, international collaboration, and capacity building through global initiatives such as Imaging4All, with continued remote support from the IMG EM team beyond the on-site training.

Read more at:

www.eurobioimaging.eu/news/exploring-mitochondrial-damage-through-volumeem-a-facility-perspective-from-prague/



Dominik Pinkas, Anil Can, Marketa Dalecka, and Vlada Filimonenko in front of the Electron Microscope.

Global Collaboration

Expanding Bioimage Analysis Partnerships through Global Bioluminescence: VMCF at CUNI

International collaboration within the Global Bioluminescence (GBI) framework also connects the **Viničná Microscopy Core Facility (VMCF)** at the Faculty of Science, Charles University, Prague, with partners across Europe and beyond.

This collaboration originated in 2023, when **Martin Schätz**, Head of Image Analysis Unit at VMCF undertook a Staff ERASMUS job shadowing visit at the Advanced Light Microscopy Facility at i3S – University of Porto, led by **Dr. Paula Sampaio**. Focused on advanced image analysis, the visit laid the foundation for professional connections that have since developed into sustained international cooperation. During his visit, he also contributed to the construction of the LEMOLISH microscope and delivered teaching within a ZEISS seminar dedicated to tissue clearing data.

Throughout 2025, these connections translated into concrete joint activities. Following their initial meeting through Global Bioluminescence, **Dr. Vad Pérez** from Mexico City successfully applied for Czech-Bioluminescence User Project Support call to conduct bioimage analysis at the VMCF facility in Prague. The collaboration expanded to include exchange of expertise in data management, advanced analysis workflows, and software training, strengthening capacity on both sides.

With support from VMCF and the **Global Bioluminescence Analysts' Society (GloBIAS)**, Martin was awarded a Global Bioluminescence Job Shadowing grant, enabling further knowledge exchange. His visit included targeted training activities at the National Laboratory for Advanced

Microscopy-Instituto Mexicano del Seguro Social and an invited lecture at the IMSS XXXIV Health Research Forum in Mexico titled: "Image analysis in the health sector: current state and trends, opportunities for collaboration, actors, and tools".

In 2026, VMCF continues to build on this momentum. A bioimage analyst from ISTA, Austria, Vienna is expected to visit Prague through a GBI job shadowing program, further reinforcing regional collaboration in analysis methodologies and sustainable data management.



Dr. Vad Pérez with Martin Schätz during his Job Shadowing visit in Mexico.

Upcoming courses

Learning opportunities for the months ahead

In the first half of the year, we offer a broad range of educational activities, combining hands-on and theory-based courses in biomedical imaging and image analysis, tailored to both beginners and advanced users.

Design Experiment with Examples from Microscopy and Omics

Date: 16 – 17 March 2026

Location: IPHYS BIF, Prague

Processing and Analysis of Microscopic Images

Date: 13–17 April 2026

Location: IMG, Prague

[CZ] Course for acquiring qualification and professional competence in the field of experimental animal use

Date: 20–24 April 2026

Location: CUNI, Prague

Basics of Light Microscopy Imaging in Plant Research

Date: 26–27 May 2026

Location: IEB, Prague

Advanced 3D Image Visualization and Quantification

Expected in: May/June 2026

Location: IEM, Prague

Fundamentals of Light Microscopy

Expected in: June 2026

Location: CELLIM CEITEC, Brno

[EN] Course for acquiring qualification and professional competence in the field of experimental animal use

Date: 9–13 March 2026

Location: CUNI, Prague

EM-SPS Sample Preparation Series

Date: 13–16 April 2026

Location: BIOCEV, Vestec

AI-based Segmentation and Tracking

Date: 19–20 May 2026

Location: IMG, Prague

FRET by All Means

Expected in: May/June 2026

Location: BIOCEV, Vestec

Super-resolution in Light Microscopy

Date: 8–10 June 2026

Location: IMG, Prague

Fundamentals of BioImage Analysis

Date: 29 June – 3 July 2026

Location: VMCF, Prague

Opportunities for users

Prague Node: Participate in the Picture of the Month/Year competition

We warmly invite you to participate in the new season of the competition!

The current competition period runs from June 2025 to May 2026, so be sure to submit your best images during this time.

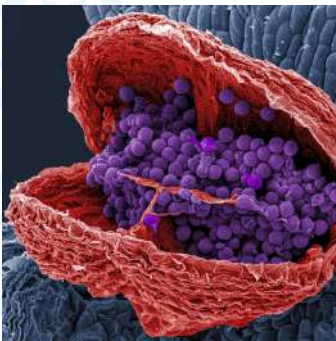
Don't miss your chance to compete for the Picture of the Year award, with a main prize of 10,000 CZK, kindly sponsored by leading microscopy companies. The winner will be announced in June 2026 during the annual

barbecue Photons, Electrons and Sausages.

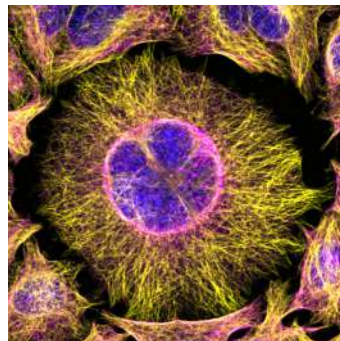
Selected contributions will also be featured in Czech-BioImaging promotional materials, offering valuable visibility and recognition within the scientific community.

We look forward to your submissions!

imcf.natur.cuni.cz/IMCF/picture-of-the-month



June 2025
Tomáš Figura
The maw of the sciaphilla



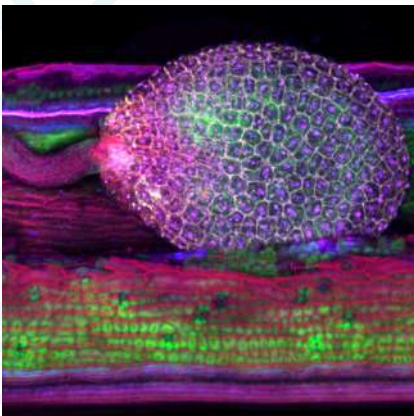
July 2025
Spoorthi Suresh Hiremath
Cellfie: A triple stained portrait of HeLa's senescence



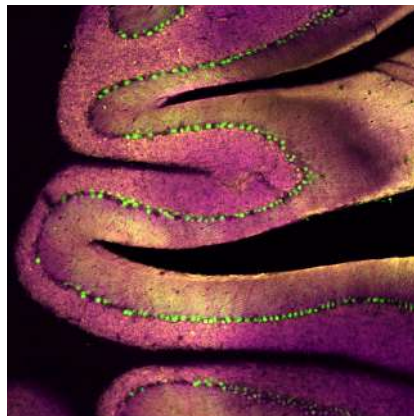
August 2025
Štěpánka Martišková
Fragile flowers



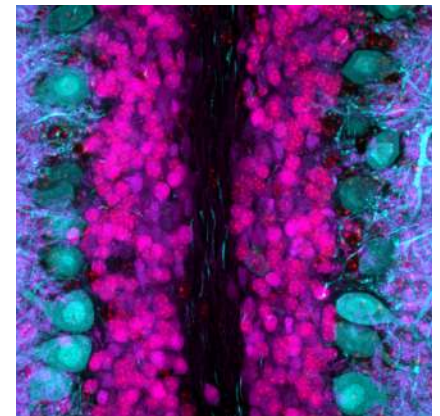
September 2025
Tomáš Figura
Plague Doctor



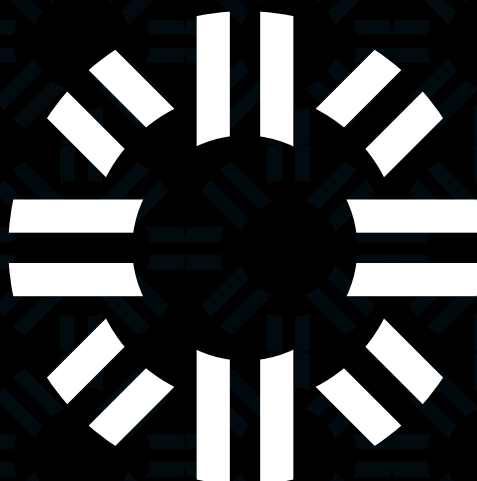
October 2025
Lukáš Synek
Umbilical cord



November 2025
Lenka Gmíterková
Road in the fields



December 2025
Lenka Gmíterková
Gates of imagination



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