# FNIPday - NEUROIMAGING & PHOTONICS

Wednesday 18 March 2026 - Wednesday 18 March 2026

Archivio Antico - Palazzo Bo

# Book of Abstracts

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**T1 - Chair: G. Ruffato | International Speaker / 1**

## Liquid-crystal elements and spatial light modulators for light management

This talk will introduce optical elements displayed with liquid-crystal spatial light modulators (SLMs). These pixelated microdisplays are useful for encoding optical phase functions and controlling the polarization of light. Modern SLMs exhibit high spatial resolution and precise control of optical retardance, allowing them to display diffractive elements. They have become key components for the generation and control of structured light. Combined with geometric-phase elements or with metamaterials provide new schemes for imaging or optical processing. The talk will present the main SLM technologies, their advantages and limitations, as well as different examples of how light can be controlled with them.

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**Ignacio Moreno** is Full Professor of Optics at University Miguel Hernández (UMH), in Elche, Spain. He graduated in Physics (1992) and obtained the PhD (1996) at the Autonomous University of Barcelona. After two years at the University of Valencia, in 1998 he joined UMH, where he leads the TecnOPTO Lab. His research is centered in the use of liquid crystal spatial light modulators in diffractive and polarization optics, being coauthor of more than 180 articles in peer reviewed journals. He has been guest researcher at San Diego State University (USA), Institut FEMTO (France), Universidad de La Frontera (Chile) and the Military University of Technology (Poland). He is Fellow Member of SPIE and of OPTICA. He received the EOS2012 Prize from the European Optical Society (EOS). He has been Associate Editor of the journal Optical Engineering (2013-22), and President of the Spanish Society of Optics –SEDOPTICA (2017-2020). Since September 2024 he is the EOS President-Elect.
More info: Grupo de Tecnologías Ópticas y Optoelectrónicas » Ignacio Moreno
TecnOPTO-Lab UMH. https://tecnopto.umh.es/

**T1 - UNIPD Speakers / 4**

## Structuring light with metasurfaces

**T1 - UNIPD Speakers / 5**

## Light as a Molecular Force Sensor: How Optical Tweezers Reveal Biomolecular Binding

**Author:** Annamaria Zaltron[1]

[1] *DFA, UNIPD*

**T1 - UNIPD Speakers / 6**

## Distributed Optical Fiber Sensing: Imaging the World Through Light Scattering

Optical fibers can act as continuous sensors, turning guided light into a tool to measure temperature, strain, and vibration along their entire length. Originally developed for large-scale monitoring of structures and the environment, distributed fiber sensing has recently advanced to millimeter-scale spatial resolution, opening the door to high-resolution, minimally invasive measurements in new contexts and previously inaccessible scenarios. This talk outlines the physical principles behind distributed optical sensing and discusses how concepts common to imaging, such as scattering, resolution, and signal-to-noise, reappear in this different but complementary optical framework.

1 Wilfried Blanc; Luca Schenato; Carlo Molardi; Luca Palmieri; Andrea Galtarossa; Daniele Tosi. Distributed fiber optics strain sensors: from long to short distance. Comptes Rendus. Géoscience, Glass, an ubiquitous material, Volume 354 (2022), pp. 161-183. doi: https://doi.org/10.5802/crgeos.129
2 Palmieri, L.; Schenato, L.; Santagiustina, M.; Galtarossa, A. Rayleigh-Based Distributed Optical Fiber Sensing. Sensors 2022, 22, 6811. https://doi.org/10.3390/s22186811

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**Luca Schenato** graduated with honors from the University of Padua in 2003 as the best engineering candidate of the year (awarded with the Sarpi Gold Medal 2002/2003) and obtained his PhD in Electronic and Telecommunications Engineering in 2007 from the same institution. Over the years, he has held several positions in academia, including postdoctoral researcher at the Department of Information Engineering at the University of Padua and Researcher at the National Research Council. He is currently an associate professor of Electromagnetic Fields in the Department of Information Engineering at the University of Padua. Throughout his career, he has published over 170 papers in peer-reviewed international scientific journals, presented at international scientific congresses, authored 4 book chapters, and held 2 patents. Schenato's research interests are broad, but his main areas include the development and application of optical fiber sensors, also for industrial and civil applications.

**T2 - UNIPD Speakers / 7**

## Integrating imaging and quantitative analysis to study neuronal morphology and synaptic organization

The development and function of neuronal circuits depend on the precise organization of neuronal morphology and synaptic architecture. These processes are shaped by intercellular communication mechanisms, including astrocyte-derived signals influencing neuronal growth, branching and synapse formation1. Although advanced microscopy provides detailed structural information, extracting robust and reproducible quantitative descriptors of neuronal organization remains challenging2. This talk presents an integrated imaging and analysis framework to investigate how defined extracellular cues modulate neurite complexity and synaptic organization in primary neuronal cultures. This approach highlights the value of combining confocal imaging with machine learning-guided quantitative analysis to generate reproducible morphological and synaptic readouts that can be integrated with molecular datasets to link structural phenotypes to underlying cellular programs and intercellular communication.

1 Allen NJ, Eroglu C. (2017). Cell Biology of Astrocyte-Synapse Interactions. Neuron, 96(3), 697-708. doi: 10.1016/j.neuron.2017.09.056
2 Bagheri N, Carpenter AE, Lundberg E, Plant AL, Horwitz R. (2022). The new era of quantitative cell imaging-challenges and opportunities. Molecular Cell, 82(2), 241-247. doi: 10.1016/j.molcel.2021.12.024

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**Giulia Favetta** is a postdoctoral researcher at the Department of Biology, University of Padova (Italy). She obtained her PhD in Biosciences (Cell Biology and Physiology) in 2025, investigating D1 receptor signaling in striatal astrocytes and how astrocyte-derived cues shape neuronal maturation and synaptic organization. Her work integrates primary neuron/astrocyte cultures and astrocyte-conditioned media (ACM) paradigms with quantitative confocal microscopy, proteomics and transcriptomics, supported by robust image-analysis pipelines for reproducible quantification across batches and large datasets, linking cellular phenotypes to underlying molecular programs. She received the University of Padova Graduate Alumni Award (2022), has co-supervised BSc/MSc students, and served as a teaching assistant in BSc and MSc courses. She authored a Progress in

Neurobiology review (2025) and co-authored several peer-reviewed publications in international journals.

**T2 - UNIPD Speakers / 8**

## How to use near-infrared spectroscopy to study the developing brain?

The brain undergoes radical changes during the first years of life, which lay the foundations for many essential perceptual and cognitive abilities, such as language use or face perception. Imaging these neural changes is thus highly relevant, but not easy, as infants are challenging research participants. Near-infrared spectroscopy (NIRS) is a relatively new brain imaging technique, which is quickly becoming the method of choice for many developmental applications due to its infant-friendly use, low cost, motion tolerance and wearability. This talk will describe how NIRS can be used to investigate newborns and young infants'speech perception and language development abilities, illustrating technological, methodological and practical challenges and breakthroughs. I will show how NIRS can be used with typically and atypically developing infants in the lab, at the bedside and in home settings.

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**Judit Gervain** is a Full Professor of Developmental Psychology, University of Padua, Italy and a Senior Research Scientist, CNRS, France. Her research focuses early speech perception and language acquisition in typically and atypically developing infants. Her work is published in leading journals, such as Science Advances, Nature Communications, PNAS, Current Biology. She is an associate editor at Developmental Science, Annual Reviews of Developmental Psychology and Neurophotonics. Her work has been funded by the ERC, the Human Frontiers Science Program, as well as French and Italian national funding agencies. Since 2024, she has been serving as the President elect of the International Society for Near-Infrared Spectroscopy.

**T3 - UNIPD Speakers / 9**

## Brain diseases: a network story?

Neurological diseases such as neurodegeneration, stroke, and brain tumors are often studied as separate conditions, yet they share common neuroimaging features and biological mechanisms. This talk introduces the human brain connectome as a unifying framework to explain how molecular pathology, focal lesions, and structural damage spread across large-scale brain networks. Alterations in brain connectivity provide a direct link between underlying pathology and clinical symptoms across neurological disorders, including Alzheimer's and Huntington's disease, stroke, and glioblastoma. Evidence shows that network vulnerability, disconnection patterns, and both increased and decreased connectivity represent shared, transdiagnostic features of neurological diseases. These insights support a shift from region-based to network-based models and may inform the development of new tools for patient stratification, prognosis, outcome prediction, and clinical decision-making.

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**Lorenzo Pini** is an Assistant Professor (RTD-A) at the Department of Neuroscience, University of Padova, focusing on clinical and computational neuroscience. His work investigates brain connectivity in neurological disorders using multimodal neuroimaging and non-invasive brain stimulation. He completed his PhD in Biomedical and Translational Sciences at the University of Brescia (2019) and conducted postdoctoral research on structural and functional connectivity in neurological and neurodegenerative patients. He has collaborated with the Vrije Universiteit Amsterdam, CHUV Lausanne, and maintains partnerships with the University of Verona, University of Brescia, and Karolinska Institutet. Author of 70 peer-reviewed publications, he is also co-inventor of a diffusion-based method for predicting survival in brain tumor patients.

**T3 - UNIPD Speakers / 10**

## How recurrent connectivity and short-term adaptation sculpt the perturbome of neuronal cultures in vitro

**T2 - UNIPD Speakers / 11**

## Investigation of organelle coupling dynamics by a new set of chemogenetic reporters

The coordination of cellular activities relies on the close positioning of intracellular organelles at membrane contact sites (MCSs), which has been found altered in several diseases. However, MCS study has been hampered by the lack of tools allowing to track membrane proximity with high spatial and temporal resolution. To address this limitation, we developed reversible fluorescent probes that can detect MCSs between various intracellular organelles. These new reporters are based on splitFAST, a chemogenetic system originally designed to visualize dynamic protein-protein interactions in the green, red, or far-red spectrum. We found that the probe targeting ER-mitochondria (ER-mit) contact sites promptly detects transient interactions between these organelles with high resolution, permitting us to monitor how MCSs change in response to different cellular treatments. Interestingly, we observed that some ER-mit contacts are highly dynamic and undergo fusion and fission events. Additionally, by expressing the ER-mit reporter, we confirmed an increase in ER-mit MCSs in astrocytes, neurons, and fibroblasts derived from Alzheimer's disease mouse models and human patients. Finally, by endowing these probes with calcium-sensing domains, we created a new set of reporters named PRINCESS (PRobe for INterorganelle Ca2+-Exchange Sites based on SplitFAST), allowing to simultaneously visualize MCSs and measure local Ca2+ dynamics. These probes will be helpful to better highlight the role of MCS dynamics in health and disease.

[Michela Rossini, Paloma García Casas, Linnea Påvénius, Mezida Saeed, Hjalmar Brismar, Maria Ankarcrona, Arnaud Gautier, Paola Pizzo, Riccardo Filadi]

**T2 - UNIPD Speakers / 12**

## Optical probing of biomolecular alterations towards label-free detection of early stage brain disease

**T2 - UNIPD Speakers / 13**

## From light to circuits: using Danio rerio to dissect neural circuits

Neural circuits underpin behavior, yet dissecting their function at single-cell resolution remains challenging due to complexity and inaccessibility in vivo. In this talk, I will show how larval zebrafish (Danio rerio) enables optical approaches that connect brain-wide activity to circuit organization and behavior. Leveraging volumetric calcium imaging, I will present experiments probing experience-dependent plasticity through manipulations of sensory input and neuromodulatory state, combining recordings of spontaneous and visually evoked activity to reveal circuit reorganization during development. I will then discuss ongoing work on disease models created using CRISPR, using imaging-based measurements of visual responses and retinotopy to characterize how genetic perturbations impact circuit development. Finally, I will outline future directions toward more complex behaviors, including social interactions in juvenile fish.

**T3 - Chair: F. Lorenzi | International Speaker / 14**

## Dissecting the mechanisms regulating astrocyte function at the nanoscale with computational approaches

Astrocytes are cells in the central nervous system involved in numerous functions, from the regulation of neurotransmission to the maintenance of ionic and metabolic homeostasis, as well as memory and learning1. However, how astrocytes contribute to these diverse processes is still only partially understood. Here, I will illustrate how computational approaches are providing novel insights into this topic. Our results suggest that the nanoscale morphology of astrocytes leads to the compartmentalization and amplification of signals at synapses2 and that the spatial properties of calcium stores finely tune local microdomain signals[3]. Our in silico experiments suggest that the altered morphology of astrocytes observed in Alzheimer's disease creates diffusional traps at the blood interface. Together, our results reveal mechanisms that regulate astrocyte communication with neurons and mural cells and contribute to the global effort to elucidate the roles of astrocytes in health and disease.

1 Verkhratsky, A. & Nedergaard, M. Physiology of Astroglia. Physiol. Rev. 98, 239–389 (2018).
2 Denizot, A., Arizono, M., Nägerl, U. V., Berry, H. & De Schutter, E. Control of Ca2+ signals by astrocyte nanoscale morphology at tripartite synapses. Glia 70, 2378–2391 (2022).
[3] Denizot, A., Castillo, M. F. V., Puchenkov, P., Calì, C. & De Schutter, E. The Ultrastructural Properties of the Endoplasmic Reticulum Govern Microdomain Signaling in Perisynaptic Astrocytic Processes. Glia 74, e70091 (2026).

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**Audrey Denizot** is a tenured research scientist in the AIstroSight team at Inria Lyon in France. After her training as a biologist at Ecole Normale Supérieure de Lyon, she obtained her PhD in computational neuroscience at INSA Lyon, France, followed by a postdoc at the Okinawa Institute of Science and Technology, Japan. The main goal of her research is to better understand how astrocytes contribute to brain function in various (patho-)physiological conditions. She does so by developing computational models of astrocytes, in close collaboration with experimentalists. Her work has provided key insights into how the complex nano-anatomy of astrocytes dictates local signaling. Concomitantly, her lab develops open-access tools and codes to foster the application of the FAIR principles within the growing computational glioscience community.

**T2 - Chair: M. Bruzzone | International Speaker / 15**

## Transcranial optical localization techniques for cortex-wide imaging of microcirculation and neurovascular coupling