# PREIN related presentations in Photonics West 2025

There are eight academic presentations by PREIN researchers. PREIN representatives are also invited as panelist in two panel discussion. In addition, there are a few presentations by Finnish start-ups like Vexlum and Ampliconyx arising from PREIN research and presentations of research with PREIN partners as collaborators.

Below presentations only by PREIN researchers are listed. You can Browse the program for SPIE Photonics West 2025

## January 27

- **Joint reconstruction of multiple initial pressures and the speed of sound in photoacoustic tomography**
  Miika Suhonen / University of Eastern Finland (Finland)
  **5:30 PM - 7:00** PM 27 January 2025

  In photoacoustic tomography (PAT), knowledge of the speed of sound (SOS) distribution of the target is needed for accurate image reconstruction. Joint reconstruction of initial pressure and SOS in PAT is found to be highly difficult to solve due to the instability of the problem. In this work, we propose a methodology where multiple initial pressure distributions formed in the target are utilized to generate the photoacoustic data. Different initial pressure distributions and spatially varying SOS are reconstructed simultaneously. The proposed approach is evaluated with numerical simulations. The results show that utilizing data from multiple pressure distributions improves the reconstructed SOS distribution.

## January 28

- **Real-time full-field spatial measurement of multimode fibers in the nonlinear regime (Invited Paper)**
  Goëry Genty/ Tampere University (Finland)
  **9:30 AM - 9:50** AM 28 January 2025

  We characterize in real-time the complex spatial amplitude of beams at the output of multimode fibers in the nonlinear regime. Our results provide insight into the recently observed self-cleaning dynamics in multimode fibers.

- **Collective excitations in nonlinear metasurfaces, challenges and possibilities (Invited Paper)**
  Mikko J. Huttunen/ Tampere University (Finland)
  **10:30 AM - 11:00 AM** 28 January 2025

  Nonlinear metasurfaces have recently emerged as promising candidates to enable nanoscale/flat nonlinear optics. Here, we discuss our latest work to develop more efficient nonlinear metamaterials by using high-Q-factor collective lattice excitations known as surface lattice resonances (SLRs). We also demonstrate how conversion efficiencies of metasurfaces can be further improved by embedding nonlinear metasurfaces into multipass cells. Superlinear dependence of second-harmonic generation (SHG) on the number of passes

through the metasurface has been measured confirming succesful phasematching during the proof-of-principle experiment.

- **Waveguide escalator on ultra-low-loss thick-SOI platform: towards monolithic integration of active devices**
  Arijit Bera / VTT Technical Research Ctr. of Finland Ltd. (Finland)
  **11:00 AM - 11:20** AM 28 January 2025

  Silicon photonics is arguably the most promising platform for the demonstration and commercialization of various next generation photonic technologies, thanks to its massive scalability and co-packaging with advanced CMOS electronics. To deliver its full promise, an ultra-low-loss waveguide platform with advanced 3D integration capabilities is crucial. VTT's 3 µm SOI platform offers record low propagation loss (2.7 dB/m) and insertion loss, with negligible polarization sensitivity. However, due to its bigger core, monolithic integration of active components by evanescent coupling is challenging. Here we solve the problem with a waveguide escalator technology that lifts the fundamental mode from the SOI core layer to the aSi:H upper layer where active devices such as, electro-optic modulator or superconducting nanowire singe photon detectors (SNSPD) will be integrated. Due to its thicker topology, some special design and fabrication techniques are adopted, which will be presented along with the experimental demonstration of the escalator.

- **Large-aperture silicon based FPI modules for hyperspectral imaging in the mid-infrared range**
  Oili Ylivaara / VTT Technical Research Ctr. of Finland Ltd. (Finland)
  **11:25 AM - 11:40 AM** 28 January 2025

  In this work we demonstrate the performance of the tunable large optical aperture silicon based Fabry-Perot interferometer (FPI) modules for mid-infrared (MIR) hyperspectral imaging. Large optical aperture and good signal-to-noise ratio of these FPIs brings added value for spectral imaging in the MIR range, thus improving material detection capabilities in areas like chemical imaging, industrial sorting and earth observation for example.

- **Widely tunable external cavity lasers based on the 3 µm-thick silicon-on-insulator platform for operation in the C and L bands in the DYNAMOS EU project**
  Katherine Bryant / VTT Technical Research Ctr. of Finland Ltd. (Finland)
  **2:30 PM - 2:50 PM** 28 January 2025

  Broadband, high wall-plug-efficiency, and narrow-linewidth tunable lasers with a small footprint remain a critical unmet need in a range of applications. In particular, ever-increasing demands on speed and throughput in data center networks can be addressed with the novel fast-tunable-laser based network system proposed in the DYNAMOS EU project. The 3 µm-thick silicon-on-insulator (SOI) platform offers the benefits of ultra-low propagation loss, broadband operation, polarization insensitivity, and mature fabrication techniques scalable to high volumes. We demonstrate a wide tuning range of over 60 nm in the C and L bands for external cavity lasers (ECLs) fabricated on 3 µm SOI. The devices are based on tunable reflectors with three ring resonators using the Vernier effect, three Mach-Zehner interferometers (MZIs), or a combination of these components.

## January 29

No PREIN related presentations.

## January 30

- **Applications of machine learning to fiber laser optimization (Invited Paper)**
  Regina V. Gumenyuk / Tampere University (Finland)
  **9:00 AM - 9:25** AM 30 January 2025

  We demonstrate the application of a neural network to predict the output laser performance with high accuracy and within only a few milliseconds of time frames both in spectral and temporal domains. We explore complex scenarios where intracavity parameters trigger the mutually dependent pulse evolution changes and investigate the accuracy prediction in different neural network architectures. Our work paves the way to intelligent laser design with ultimate autonomy and resolving inverse design problems.

- **AI for nonlinear control in fiber-optics (Invited Paper)** Goëry Genty / Tampere University (Finland)
  **2:10 PM - 2:35** PM 30 January 2025
  Abstract to be published.

## PANEL DISCCUSSIONS

### Emergent Quantum and Photonics Technologies in Bio-Applications Beyond National Borders: New Opportunities for International Collaborative Research

**25 January 2025** • 1:00 PM - 2:30 PM

Moscone North/South, Moscone Center, Expo Stage, Hall DE (Exhibit Level)

International collaboration often results in significant scientific breakthroughs. The formation of government-to-government partnerships leveraging national funding and expertise can be a key enabler to further research and impact well beyond national borders. This panel will discuss the opportunities and challenges presented by bilateral partnerships. The discussion will center around the example of the Research Council of Finland (RCF)-National Institutes of Health (NIH) Partnership Program, which includes opportunities to advance emerging technologies, among others. The RCF-NIH Partnership Program encourages investigator-initiated collaborative research between U.S. and Finnish teams. Of particular interest to the panel are opportunities available under the program in areas such as quantum applications, advanced photonics, innovative biomedical imaging, and AI technologies.
The panel will also highlight research interests, opportunities, and resources within the field of Quantum Science and Advanced Photonics with a goal to generate awareness of existing and emerging research funding opportunities and to facilitate connections between U.S. and Finnish investigators.

**Moderator**
Sergey Polyakov**,** Physicist NIST (United States)

**Panelists:**

**Afrouz Anderson**
Program Director for the Division of Applied Science and Technology
National Institutes of Health (NIH), National Institute of Biomedical Imaging and Bioengineering (NIBIB) (United States)

**Juha Purmonen**
Executive Director of Photonics Finland, Development Manager Business Joensuu, Impact Manager PREIN Flagship (Finland)

**Jyrki Saarinen**
Professor of Photonics Applications and Commercialization
University of Eastern Finland, Vice director PREIN Flagship (Finland)

**Petri Koikkalainen**
Counselor of Science and Higher Education
Finnish Embassy (Finland)

**Sarah Scharf**
Regional Program Director for the Division of International Relations
National Institutes of Health (NIH), Fogarty International Center (FIC) (United States)

**Geetha Senthil**
Deputy Director of the Office of Special Initiatives
national Center for Advancing Translational Sciences (NCATS) (United States)

See the programme

## Nordic Academic Meetup: What will Photonics do for us next?

**30 January 2025** at 5:30 PM – 8:00 PM at the Nordic Innovation House in Palo Alto, California

Join us for a Nordic Academic Meetup – Photonics **enables our everyday devices**, but also holds immense **promise for the future**. How might photonics change our lives, what are new usage areas, **which other fields** of science are in key to photonics breakthroughs? Please join this event to learn and discuss, regardless of your background!

M**oderator**
Dr. Tea Vellamo, Administrative coordinator of the Finnish Flagship for Photonics Research and Innovation (PREIN)

P**anelists**:
Dr. Timo Aalto, Research Team Leader at VTT Technical Research Center of Finland
Dr. Ausra Baradoke, CEO of Deep Scientific, Lithuania
Dr. Hugo Laurell, Postdoctoral Researcher at University of California, Berkeley (Swedish)
M.Sc. Remigijus Šliupas, Co-Founder and CEO of OPTOMAN, Lithuania

More information and registration