A LOOK AHEAD

Optics in 2026 & Beyond

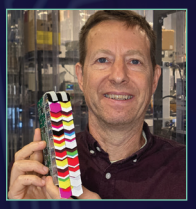
Each December, OPN looks at interesting research results of the past year. But what about the year ahead? We asked several contributors to our "Optics in 2025" feature for thoughts on areas that might advance in 2026.

LABEL-FREE OPTICAL MAPPING

The next frontier in optics lies in fusing photonics with biology, creating systems that can see and hear at the molecular level. Optical resonators, frequency combs and quantum light, combined with advances in AI and machine learning, are converging to make real-time, label-free diagnostics and environmental monitoring a reality. The future of this field lies in its potential to advance knowledge through discovery and to reveal phenomena that were once beyond our reach.

Judith Su, *University of Arizona, USA*

PHOTONIC ORIGAMI



Optics will open new frontiers rather than just improve electronics. Accordingly, adding a third dimension to planar photonic circuits through levitation and photonic origami will break the current complexity barrier across a range of processes. Incorporating plasma at population inversion and quantum emitters such as ions into 3D architectures will broaden their functionality, enabling reconfigurable, multidimensional photonics that perform tasks beyond the reach of flat designs.

Tal Carmon, *Tel Aviv University, Israel*

NOVEL OPTICAL PULSES

The last few years have seen the first nonlinear optics experiments that involve light propagation that is governed by a fractional derivative, or more precisely, a fractional Laplacian. With results like these now becoming almost routine, I expect a wider variety of such experiments in different optical contexts, and with this the development of applications, for example in the generation of novel optical pulses.

Martijn de Sterke, *University of Sydney, Australia and California Institute of Technology, USA*

NANOPHOTONICS FOR BIOSENSING

Nanophotonic advances for medical and environmental applications will accelerate with the development of intelligent, miniaturized on-chip biosensors and advanced multimodal platforms. By integrating nanophotonic sensing with surface enhanced vibrational, hyperspectral and fluorescence imaging modalities, these systems will enable the extraction of comprehensive and multi-parametric data. Future efforts are expected to move toward capturing conformational, chiral and kinetic information, and to establish high-throughput screening capabilities.

Hatice Altug, *École Polytechnique Fédérale de Lausanne (EPFL), Switzerland*

ADVANCES IN CAMERA CMOS TECHNOLOGY

Progress in camera CMOS technology—the heart of optical imaging—continues to accelerate, with sensors featuring increasingly larger pixel counts, now exceeding 100 MP. This is complemented by the adoption of faster camera communication standards enabling data rates of 100 Gb/s. Furthermore, the growing prevalence of back-illuminated pixel architecture has led to higher quantum efficiency of cameras. For imaging, these advancements will facilitate a further increase in the field of view without sacrificing resolution, while also offering higher sensitivity.

Viacheslav Mazlin, *Institut Langevin, Université PSL, France*

TOPOLOGICAL VORTEX WAVEGUIDES

Topological photonics has ushered in a new era of light manipulation and robust wave transport. Recent advances in topological vortex waveguides supported by chiral-symmetric disclinations enable selective OAM-mode control and stable vortex transport. The underlying physical principles may not only drive disruptive innovations in photonic devices such as vortex fibers and lasers, but also hold profound implications for fundamental research and interdisciplinary technological development across emerging optical sciences.

Zhichan Hu, *Nankai University, Tianjin, China*

HARNESSING NONLINEAR COMPLEXITY

Recent advances, from programmable integrated photonics to ultrafast thin-film modulators, offer unprecedented control and flexibility to manipulate high-dimensional nonlinear dynamics. In parallel, AI has demonstrated strong potential to mitigate experimental instabilities and exploit complex nonlinear effects. From 2026 on, photonics will likely see a surge of cross-disciplinary breakthroughs, exploiting AI-driven strategies to harness broader degrees of freedom in applications spanning imaging, spectroscopy, metrology, signal processing and computing.

Benjamin Wetzel, *XLIM Institute, CNRS - Université de Limoges, France*

Photos: Courtesy of the researchers
Infographic: Groot Gregory and Alessia H. Kirkland