Photonics technology, applications & business

October/November 2025

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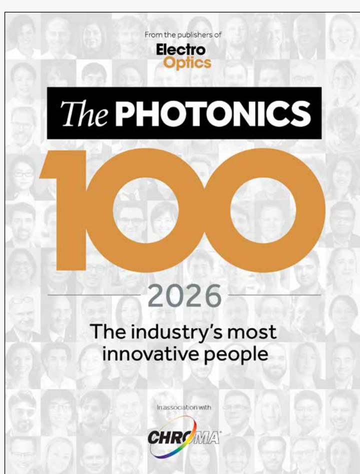

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Monitoring the environment with pre-existing fibre-optic networks

From earthquake detection to structural monitoring and even glacier science, fibre-optic sensing is redefining how we measure changes in our environment, writes James Wormald

Fibre-optic networks, originally laid to carry the world's internet traffic, are increasingly being dual-purposed as powerful distributed sensors. Researchers across Europe and the US are finding new ways to use underground and undersea cables to capture information on stresses, strains and vibrations, for applications such as earthquake and tsunami early-warning systems, monitoring the structural integrity of bridges and pipelines and even studying the effects of glacial calving and how the ice melts into the sea.

Away from fibre-optics, meanwhile, vision-based techniques are also getting in on the act, as high-speed cameras are also showing promise as non-contact vibration sensors, representing a shift in the way light-based technologies can be used to measure complex phenomena.

Why fibre is being used for sensing

The global communications backbone relies on fibre-optic cables buried underground or laid on the ocean floor. An estimated five billion kilometres of fibre is already in place, carrying terabits of data per second. Their ubiquity makes them an attractive candidate for dual use: continuing to deliver digital connectivity while doubling up as dense networks of sensors.

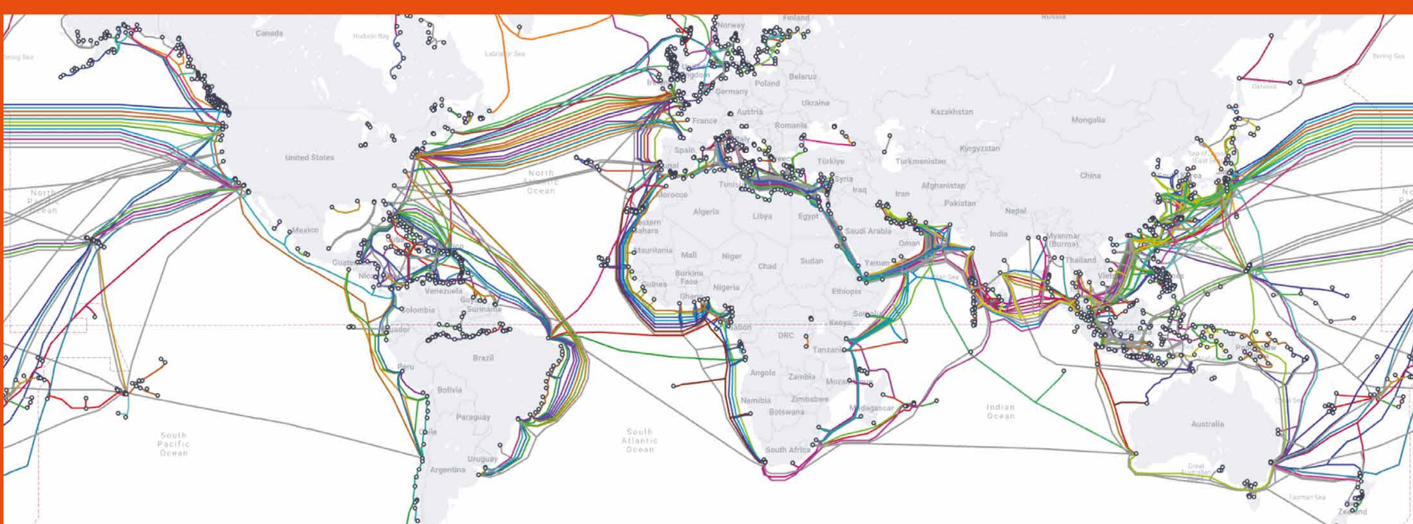
The principle behind this transformation is distributed acoustic sensing (DAS). A laser interrogator injects short pulses of light into a fibre and, by analysing the pattern of Rayleigh backscattering, can detect minute strains and vibrations. That means that what was once a passive channel for the transportation of data, can become the equivalent of thousands of microphones or accelerometers.

> **"Our aim is to create a global nervous system for critical infrastructure.We are hoping to turn existing fibre-optic cables into a 24/7 early-warning system"**

Cheaper and faster to deploy than networks of conventional sensors, which require physical installation; calibration and maintenance, recent fibre-optic sensing projects with published results reveal how the technology could work at scale. These include seismic research in California, structural monitoring in the UK and glacial wave detection in Greenland.

UK case study: a "nervous system" for critical infrastructure monitoring

The €5.1m EU-funded ECSTATIC (Enabling Continual Structural Testing and Integrity Checking) project being led by Aston University and Photonics21 is designed to explore the repurposing of existing fibre-optic networks to monitor the structural integrity of key



TeleGeography

The global underwater fibre-optic cable network

Lawrence Livermore National Laboratory

Gene Ichinose, a seismologist at Lawrence Livermore National Laboratory, looks over an interrogator, an instrument that allows buried fibre-optic cable to be turned into thousands of virtual seismometers

infrastructure such as bridges, tunnels, pipelines and railways.

"Our aim is to create a global nervous system for critical infrastructure," said David Webb, ECSTATIC Project Coordinator and Professor of Photonics at Aston. "We are hoping to turn existing fibre-optic cables into a 24/7 early-warning system, detecting the tiniest tremors or stress fractures before they become catastrophic."

The project's first live site is a Victorian-era railway viaduct, where buried optical fibres are being used to detect vibrations and strain as trains pass overhead. Instead of placing hundreds of individual sensors on the structure, the DAS system can read strain signatures directly from the fibres already running beneath it.

The key enabling technology is a dual-microcomb photonic chip, capable of probing multiple optical frequencies simultaneously. This allows precise detection of changes in the light travelling through the cable, which can then be interpreted by AI-based algorithms to identify stress, movement or early signs of fatigue.

The importance of such monitoring is underscored by disasters such as the 2018 Genoa Morandi Bridge collapse in Italy and the 2023 Carola bridge collapse in Dresden, Germany, which highlighted the devastating consequences of undetected structural degradation.

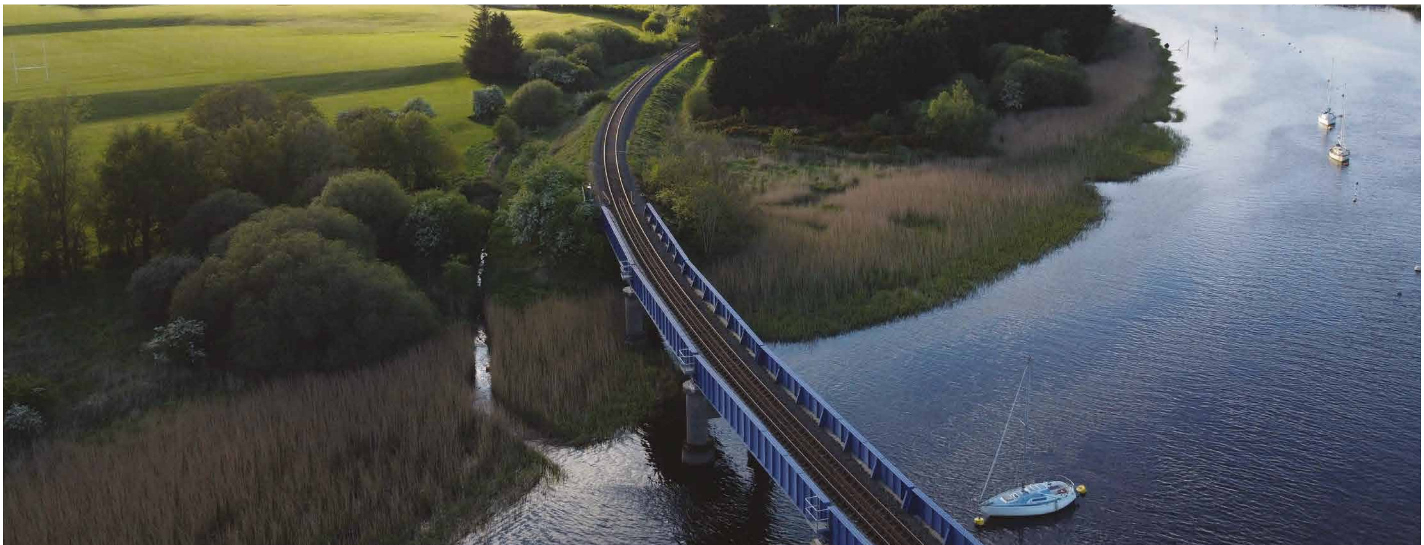
If successful, ECSTATIC could extend across Europe's transport and energy infrastructure. With partners including Network Rail, Telecom Italia Sparkle, OTE Group, Nokia and seismic experts at the National Observatory of Athens, the project represents a convergence of photonics, telecoms and infrastructure management.

US case study: listening to earthquakes through spare fibre

In California, a trial led by Lawrence Livermore National Laboratory (LLNL) has shown how unused fibre in the ground can be turned into dense seismic arrays. Seismologist Gene Ichinose and his team connected a DAS interrogator to 80km of dark fibre running from San Francisco's Moscone Center to Sunnyvale.

"The detail of the seismic wave field was unprecedented," said Ichinose. "With the distributed acoustic sensing technology, I'm seeing data from the equivalent of 8,000 seismometers. It's amazing because you can track the seismic wave propagating across the whole Bay area."

By measuring nano-strains in the fibre, the system recorded high-resolution data during a magnitude-3.9 earthquake near Dublin,



Unsplash / Geoffrey Moffett

Distributed acoustic sensing uses fibre-optic cables to monitor damage to key infrastructure such as bridges and railways

California. The interrogator itself, which is about the size of a microwave, transformed the fibre into 8,000 virtual seismometers, a density impossible to achieve with conventional instruments. "For $160,000, it's possible to purchase (around) eight-to-16 seismometers. But (for that price) you can buy an interrogator and have the use of 8,000 seismometers," said Ichinose.

The team believes DAS could provide a cost-effective backbone for earthquake early-warning systems. And with fibre already lacing the Bay area, the approach could generate real-time seismic data across a wide geography, without the need for extensive hardware deployments.

Greenland case study: tracking glacial calving and wave dynamics

Fibre-optic sensing is also finding a role in environmental science. In South Greenland, a University of Washington (UW)-led team deployed 10km of cable on the seafloor near the Eqalorutsit Kangilliit Sermiat glacier. Their aim was to capture the unseen effects of iceberg calving, a key driver of ice loss and sea-level rise.

"We took the fibre to a glacier, and we measured this crazy calving multiplier effect that we never could have seen with simpler technology," said co-author Brad Lipovsky, Assistant Professor in Earth and Space Sciences at UW.

Over three weeks, the fibre detected both seismic and acoustic signals from icebergs breaking off, some the size of stadiums and moving at up to 20mph. These events triggered not only surface tsunamis but also giant internal gravity waves within the fjord, some reaching the height of skyscrapers. Such mixing brings warm water into contact with submerged ice, and so accelerates the melt rate. "When icebergs break off, they excite all sorts of waves," said the paper's lead author, Dominik Gräff. "It's the kind of thing we've just never been able to quantify before."

The study, published in *Nature*, represents the first time DAS has been used on a submarine fibre to monitor glacier dynamics. It demonstrates a new tool for modelling melt rates, forecasting calving events and even contributing to tsunami warning systems. "There is a fibre-sensing revolution going on right now," said Lipovsky. "It's become much more accessible in the past decade, and we can (now) use this technology in these amazing settings."

Beyond fibre: using imaging as a vibration sensor

While fibre-based DAS is transforming how we sense motion across vast networks, researchers are also exploring new ways to measure vibration in localised, challenging settings. At Hiroshima University, a team demonstrated that high-speed industrial cameras can act as full-field, non-contact vibration sensors.

By capturing 1,000fps of vibrating objects, and processing the images to estimate displacement across frequencies up to 500Hz, two tests – one with a cymbal, another with a steel box – were used to track resonances and amplitude variations across entire surfaces.

Unlike accelerometers or piezoelectric sensors, which must be physically attached to the monitored structure, the camera-based method requires no contact, wiring or recalibration. It offers an intuitive, visual readout of vibration behaviour, potentially valuable for applications such as monitoring rotating machinery such as in engine diagnostics.

These global examples show how new modalities of measurement are being constantly innovated with the use of photonics. Underground and submarine fibre cables are being transformed into seismometers and structural monitors, while at close quarters, cameras are becoming sensitive vibration detectors to monitor complex mechanical systems.

The ultimate goal is nothing less than "a global nervous system," said Webb. **EO**

Manuela Köpfli / University of Washington

University of Washington's Dominik Gräff and two crew members load the fibre-optic cable onto the back of the research vessel *Adolf Jensen*

Event report

‘A bubble would burst... AI is here to stay’: CEOs chart photonics’ path forward

From ransomware recovery to AI adoption and nurturing talent, the heads of MKS, Thorlabs, Edmund Optics, IPG Photonics and Jenoptik share their hard-won lessons

At a time when photonics companies face challenges from AI disruption, talent shortages and supply chain volatility, the leaders steering some of the industry’s most influential firms gathered to share insights on how to prosper during volatile times.

At Optica’s recent Global Photonics Economic Forum 2025 in Malaga, John T.C. Lee of MKS, Marisa Edmund of Edmund Optics, Stefan Traeger of Jenoptik, Mark Gitin of IPG Photonics and Jennifer Cable of Thorlabs offered their advice.

Artificial intelligence and ‘the B-word’

One on-trend subject explored by the panelists was the growing role of AI in business operations. Traeger noted its impact on administrative processes and cutting bureaucracy. “Our company is way too bureaucratic,” he said. “In many ways, we have far too much red tape, and I have high hopes that AI can help us to cut back on it.”

At Edmund Optics, where “34,000 products need to be managed across nine distribution centres and all the different currencies,” said Edmund, “it’s incredibly hard to manage inventory at that level. So we’re just about to implement a new AI-based software to manage those types of global logistics challenges.”

Meanwhile, on the production side, “when you talk about adaptive factories and Industry 4.0,” said Gitin, “AI is certainly driving what’s happening there. All aspects of running factories are going to push us towards automation, and that automation will be driven by AI.”

It’s hard to have a conversation about AI at the moment, without mentioning the B-word, but the panel’s optimism for AI meant they were reluctant to categorise it as a bubble. “A bubble would burst at some point,” said Traeger, “I think AI is here to stay.”

“You and I both lived through the .com bubble,” said Lee, “that was a bubble from a valuation standpoint, but not in terms of ‘the world’s need for telecom bandwidth growth’.

“It’s now 25 years later and we have a lot more bandwidth. It doesn’t mean AI isn’t going to be useful, it’s just the next big thing in a series of big things all driven by Moore’s Law.”

Supply chain issues often top the list of things keeping a CEO awake at night, but do not always come from market disruptions or tariff threats.

“We’ve (previously) had a ransomware event where 40 out of 60 factories were down for four weeks,” said Lee. “We couldn’t trust the computers so the factories couldn’t run. That’s a pretty bad situation. We still had to make stuff, so we went back to using paper. (The most important thing was) we had to keep calm so we could think about how to solve the problem.”

This ability to remain calm and rely on structured processes to systematically solve problems is key, the panel agreed.

Edmund recalled: “When Covid temporarily closed the Malaysia-Singapore border, half our workforce couldn’t get (to our factory), so we contacted our friends at Schott, who had a facility in Penang, and asked if we could rent space (there). Within three weeks, we were back up and running.”

Although Thorlabs has a catalogue of more than 20,000 products, Cable said that same-day order processing and same-day delivery are core parts of the company’s business offering. But even though it’s one of Thorlabs’ “core commitments”, it’s important to have the agility to change that.

“Our large industrial customers don’t need same-day delivery,” she said, “they (just) need a predictable order delivery schedule. So, being agile enough to take that on without disrupting the core of the business, that’s been our challenge. And I think we’ve been successful.”

Approach to acquisitions

The CEOs also gave advice on obtaining corporate growth through acquisitions. “Most acquisitions that fail do so due to (bad) chemistry and (poor) relationships, yet it’s a trap that many have fallen into,” said Traeger. “My (advice) is to think post-merger. Every company is different, so, for me, it’s important to be mindful of that and make sure you do your due diligence into the culture of the company (you’re acquiring or is acquiring you).”

Other CEOs, meanwhile, outlined the importance of considering the risk/reward of proposed acquisitions. Lee suggested that, for companies that are big enough, such as MKS, “we can have the courage to hire 100 engineers for something that won’t pay off for

From left: Jennifer Cable, President of Thorlabs; Marisa Edmund, Chairman and CEO of Edmund Optics; Mark Gitin, CEO of IPG Photonics; John T.C. Lee, CEO of MKS; Stefan Traeger, CEO of Jenoptik; and moderator Michael Lebby

Optica

three years because if our general manager comes to me and says a proposed acquisition is a great idea, I can say, 'instead of paying $100m for that company, could you get there almost as fast if you did it with $10m?' The bar for acquisitions is much higher now."

Agreeing with this point, Edmund said that, from the point of view of privately-held family businesses such as hers, caution is key. "The first question is 'are they really leading the charge? Or could we do it better?' And another important consideration that many people don't think about is what are the consequences once you've purchased it? We can all read a P&L and see good cashflow, but we have to think about if it will still be profitable once we 'Edmundise' it... once we bring it up to an Edmund standard."

Workforce development and 'giving back'

Education, mentoring and outreach also emerged as key themes, as moderator Michael Lebby asked the panel how they give back to the industry. Traeger pointed towards Germany's apprentice programmes as a good way of attracting young talent, but more could be done by the industry itself to raise its profile. "Politicians don't get Brownie points for helping photonics," he said, "we're not the car industry. So, trying to explain why it matters, that's something we can do to give back."

Lee outlined initiatives including publishing free educational books on semiconductor manufacturing, photonics and packaging to train employees, but also [the need to] to educate the industry and support recruitment. He said: "We had a debate on it – 'should we make this free?' (we discussed). It was a lot of work and a lot of IP went into it, so should we keep it internal? But we thought 'no'. It's part of our obligation to the industry we're in."

Gitin also spoke about IPG's extensive internship programme, which introduces students "to some areas to understand them. Then they go back to school and potentially join us later," he said. "We also have mentoring programmes and an Emerging Leaders Programme, which is important to help people get to the next level."

Edmund detailed Edmund Optics' Outreach Division, which brings employees to schools, science camps and universities as volunteers during working hours, and Cable pointed towards Thorlabs' photonics education team, which runs Mobile Photonics Labs that "gives folks the experience of being in a laser lab. That's from the general public (level), all the way (up to) undergraduate and graduate students."

Leadership lessons

With five top-level CEOs together around the same table, Lebby asked if there were any key leadership lessons the panel could share.

"People are going to remember you for how you made them feel, not for what you did," said Lee, when discussing the legacy he wants to leave behind, and he trains his team to think the same way. Feelings of trust, empowerment and networked decision-making, meanwhile, were also mentioned by other speakers.

Decision-making, however, is not always easy. This idea of a leader being able to make hard decisions, and to be able to stay agile and pivot away from challenges was also highlighted by Edmund.

"One of our first board members said to me, 'I'm going to help you kill puppies'. It was a shocking statement and I didn't know how to take it. It was a horrible analogy, but (I liken it more to) ripping off a Band-Aid. If you're headed down a certain path and it's not working out, you have to pivot and do something else."

'I didn't know what a laser did – and I still don't'

"I'd describe myself as a recovering scientist. Meaning I failed," said John T.C. Lee, as the speakers began by reflecting on their personal journeys into photonics.

"I failed because when I started my career. I didn't know what a laser did – and I still don't. It was a dye laser and it took a PhD to run it, so I decided it was much too hard (for me) and I went over to the dark side – the business side."

Both Jennifer Cable of Thorlabs and Marisa Edmund of Edmund Optics ended up taking over family businesses, but neither took a linear path. Both initially pursued external careers before realising the larger business gave them the opportunity to impact communities and environments on a much bigger scale.

"I didn't study physics, I studied public health," said Cable. "I worked in Laos for two years and saw the global impact that could be made in public health. Then, after seeing how small- and medium-sized businesses could impact local communities, I realised I could have a far greater impact by leading the family business." **EO**

Laser-based sensor set to provide navigation for lunar landing

Advanced Navigation's Laser measurement Unit for Navigational Aid (LUNA) sensor

Australian navigation company Advanced Navigation has announced that its LUNA (Laser measurement Unit for Navigation Aid) sensor has successfully passed terrestrial trials and is moving into final space qualification ahead of deployment on Intuitive Machines' IM-4 lunar mission.

The IM-4 Nova-C class lander, scheduled for 2027 under NASA's Commercial Lunar Payload Services (CLPS) initiative, will carry the 2.8kg LUNA sensor to the lunar south pole. Permanently shadowed craters in this region receive no direct sunlight, creating extreme darkness that makes safe landing a significant challenge.

"Landing on the Moon has meant flying with only partial vision in the final kilometres," said Chris Shaw, CEO and Co-Founder of Advanced Navigation. "With no GPS to guide them, landers depend on a combination of sensors that can introduce drift or deliver incomplete data – turning every descent into a high stakes calculation where a single error could mean mission failure."

LUNA has been designed to mitigate those risks by using photonic measurement. The compact sensor emits laser beams to provide a continuous three-dimensional stream of velocity and altitude data relative to the lunar surface. This data is intended to act as a real-time correction, transforming what Shaw called a "partially blind" descent into a controlled manoeuvre.

Unlike conventional solutions, which often combine several independent instruments, LUNA consolidates multiple functions in a smaller form. According to Advanced Navigation, the sensor is approximately eight times smaller than alternatives and can replace several legacy sensors, reducing spacecraft mass, cost and complexity.

Testing in lunar-like environments

Subjected to extensive trials in environments designed to replicate lunar conditions, LUNA was tested to prove its mission capability. In Western Australia's Pinnacles Desert, chosen for its similarity to lunar regolith, the sensor was flown aboard a light aircraft to simulate the dynamics of a final descent. Over 100km of GPS-denied flight, the sensor recorded an error of just 28m. In further tests, the system was deployed 400m underground in Finland's deepest mine, a substitute for shadowed lunar craters. Across 6km of tunnels, LUNA achieved a best-case three-dimensional error of 0.55m (0.009%) and an average error of 2.83m (0.047%). By comparison, standard GPS accuracy in open-sky conditions is typically 2m to 10m.

Photonic design and integration

The optical heart of the sensor was developed by Australian Astronomical Optics (AAO). Its optical head assembly, known as ALOHA, consists of four space-qualified telescopes that generate and deliver the laser beams required for the measurements. "We've battle-hardened our ALOHA system to survive the intense journey to the Moon," said Lee Spitler, Head of Space Projects at AAO.

With ALOHA already space-qualified, the full LUNA unit will now undergo trials ahead of its delivery for spacecraft integration. These include vibration testing to simulate rocket launch conditions, electromagnetic compatibility checks to military standards and thermal vacuum trials to validate operation in the heat and cold extremes of space.

"Advanced Navigation's lightweight, high-performance sensor aligns with our strategy to reduce mass while increasing capability," said Dr Tim Crain, CTO at Intuitive Machines, "and it complements our precision landing technology by adding critical velocity and altitude data during descent."

Towards lunar autonomy

The ability to deliver high-accuracy velocity and position data without relying on GPS or existing infrastructure is seen as key to enabling autonomous lunar operations. Beyond supporting landings, LUNA is expected to provide navigation capability for future rovers, prospecting missions and long-range surface traverses.

"The LUNA sensor is a testament to the talent and innovation within the Australian space sector and paves the way for our nation to play an even greater role in the future of lunar exploration," said Enrico Palermo, Head of the Australian Space Agency. **EO**

Photonics Sprint campaign to shape the UK's photonics future


TechUK

TechUK has launched the Photonics sprint campaign, running from September 2025 to January 2026

Photonics Sprint is a five-month programme, running from September 2025 to January 2026, that will bring together experts, policymakers and industry leaders "to understand photonics applications, identify key challenges and opportunities, share best-practice case studies and set out the actions the UK must take to leverage its strengths and maintain (its) global leadership in photonics," according to Tech UK.

Dr Justyna Lisinska, Specialist Policy Officer at Cornerstone, spoke at the launch event. She said that, while government strategy recognises technologies such as AI and semiconductors, "there is still work to be done for photonics to gain greater recognition and credibility as a vital sector in its own right".

Dr Lisinska pointed to silicon photonics as one of the fastest-growing fields, with an expected annual growth rate of 20%-to-25%, citing applications in healthcare, quantum, telecoms, defence and semiconductors.

Also speaking at the launch, Daniel Burt, Innovation Consultant at Plexal, described the UK photonics ecosystem as rich in heritage, particularly in optical fibre technology which was mostly developed in Southampton. He highlighted strong regional capabilities such as Seagate's advanced photonics manufacturing in Northern Ireland, the CSA Catapult in Wales, specialising in compound semiconductors and Scotland's leadership in imaging, sensing and quantum.

Both speakers pointed to infrastructure and supply chain challenges. Dr Lisinska stressed the need for "pilot lines and facilities that enable businesses to test, scale and commercialise innovation," while Burt warned that the UK's future leadership depends on a "strong, diverse and resilient supply chain" and greater consistency in industrial support and funding. Talent was also raised as a pressing issue.

Looking ahead, TechUK says the campaign will continue through a series of workshops, roundtables and an insight series, culminating in a final report of recommendations for government and industry.

Scheduled events focusing on a number of specific photonics applications include:

- Telecoms and Space – 24 November
- Defence – 26 November
- Supply Chain resilience – December
- International collaboration – 19 January

OLEDs and metasurfaces could create holographic displays for smartphones

An optoelectronic device that integrates organic light-emitting diodes (OLEDs) with holographic metasurfaces (HMs) could be used to create compact hologram projections without the need for lasers, according to a study by St Andrews University.

Published in *Light: Science & Applications*, the paper claims the long-standing challenge of using OLEDs to generate holograms could be addressed by combining them with nanoscale metasurfaces. The approach would simplify holographic display architectures, potentially leading to lower costs and smaller device sizes.

OLEDs are already well established as flat, thin-film light sources in commercial mobile phones and television displays, where they function as arrays of coloured pixels. Their surface-emitting characteristics and broad spectral tunability have also positioned them as candidates for emerging photonics applications, including optical wireless communication, biophotonics and sensing. However, their low spatial coherence has, until now, limited their ability to produce holographic images.

By introducing a metasurface, the St Andrews team say they have demonstrated a way to control the far-field emission of an OLED to generate a holographic image. The metasurface consists of a planar layer of subwavelength features – meta-atoms – that locally shape incident light. Each meta-atom functions as an individual pixel of the holographic pattern, modifying phase and amplitude so that, through interference, a complete image emerges at the output.

"OLED displays normally need thousands of pixels to create a simple picture. This new approach allows a complete image to be projected from a single OLED pixel," said co-author Professor Graham Turnbull of the School of Physics and Astronomy at St Andrews.

The team also reported that the quality of the holographic image depends on both the emission spectrum and the spatial coherence length of the OLED. By analysing these factors, the researchers established a direct link between OLED optical properties and holographic image fidelity.

"We are excited to demonstrate this new direction for OLED," said Professor Ifor Samuel, also a co-author of the paper from the School of Physics and Astronomy. "By combining OLEDs with metasurfaces, we (are opening) a new way of generating holograms and shaping light."

Metasurfaces themselves are an active research area across photonics, with applications ranging from anti-counterfeiting to microscopy. Their flat, nanoscale structure offers an alternative to bulky optical components, enabling thin, lightweight systems for beam shaping and holography.

"Holographic metasurfaces are one of the most versatile material platforms to control light," said co-author Professor Andrea Di Falco, Professor of Nanophotonics at St Andrews. "With this work, we have removed one of the technological barriers that prevent the adoption of metamaterials in everyday applications. This breakthrough will enable a step change in the architecture of holographic displays for emerging applications, for example, in virtual and augmented reality."

Shutterstock / St Andrews University

University of St Andrews scientists have unveiled a breakthrough that could change holographic displays

Europe selects STARLight consortium to lead silicon photonics research

STARLight has been selected to spearhead silicon photonics research and manufacturing across Europe under the EU CHIPS Joint Undertaking initiative. The project, led by STMicroelectronics, will bring together 24 industrial and academic partners, from 11 EU countries, to develop a 300mm silicon photonics (SiPho) platform, and to establish a European silicon photonics value chain.

According to STMicroelectronics, STARLight will run until 2028 and focus on applications in data centres, AI clusters, telecommunications and automotive markets, and aim to deliver application-driven innovations while creating the infrastructure for high-volume manufacturing.

"Silicon Photonics technology is critical to put Europe at the crossroads to the AI factory of the future and the STARLight project represents a significant step for the entire value chain in Europe, driving innovation and collaboration among leading technology companies," said Remi El-Ouazzane, President, Microcontrollers, Digital ICs and RF products Group at STMicroelectronics.

STMicroelectronics

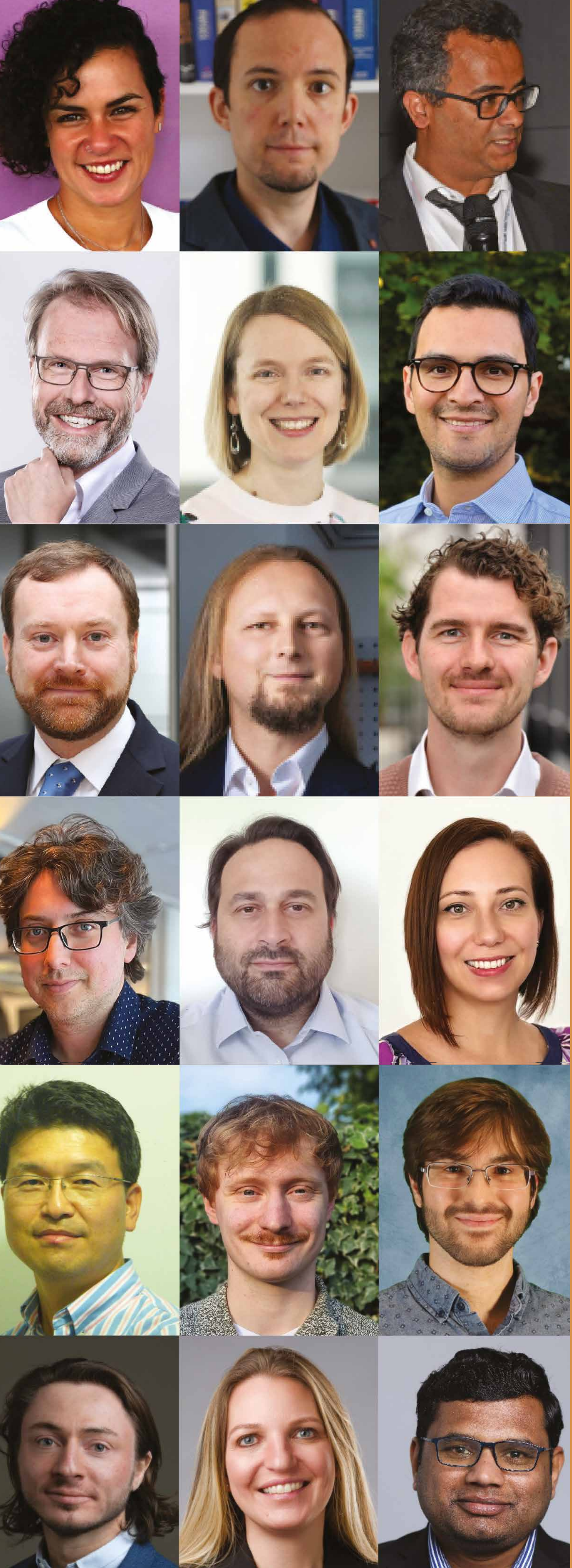
The STARLight project brings together a consortium of leading industrial and academic partners to position Europe as a technology leader in 300mm silicon photonics

Silicon photonics is increasingly seen as a preferred solution for data transfer in large-scale applications such as data centres, lidar, space systems and photonic processors for AI. A core objective of STARLight is the development of advanced photonic integrated circuits (PICs). Key challenges identified by the consortium include creating modulators capable of operating at more than 200Gbps per lane, integrating efficient on-chip lasers and incorporating new materials such as silicon-on-insulator (SOI), lithium niobate (LNOI) and barium titanate (BTO). Packaging and integration with electronic circuits will also be a focus, aimed at improving signal integrity and reducing power consumption.

With the consortium's early work targeting data centre demonstrators, STMicroelectronics, Sicoya and Thales will build systems based on PIC100 technology capable of handling up to 200Gb/s. The project will also develop free-space optical transmission prototypes and aims to progress towards a 400Gbps per lane optical demonstrator.

Beyond datacom, meanwhile, STARLight partners are also investigating photonic processors optimised for tensor operations – key to AI workloads such as matrix vector multiplications. By improving size, data processing speed and energy consumption, the STARLight team is hoping to develop more efficient neural network processing.

In telecommunications, Ericsson will work on optical switching and radio-over-fibre concepts to improve radio network capacity and efficiency, and Mbryonics will contribute technology to link free-space optical communication to fibre networks.



Is photonics an industry at the crossroads?

The latest Photonics100 cohort takes a look at some of the challenges and opportunities in the year ahead

The photonics industry stands at a critical juncture as it enters 2026, facing an unprecedented convergence of technical, economic and geopolitical pressures that threaten to reshape the sector's trajectory. From supply chain vulnerabilities and funding constraints to talent shortages and scaling bottlenecks, companies and researchers across the field are grappling with challenges that demand urgent attention – even as extraordinary opportunities emerge on the horizon.

Photonics faces another year of geopolitical turmoil
Perhaps no challenge looms larger over the photonics industry than the deepening fragmentation of global supply chains amid escalating East-West anxieties. Rimantas Budriūnas, an R&D Engineer at Light Conversion, warns that "the photonics industry faces notable geopolitical risks due to intensifying East-West tensions. Many key photonic components – including specialty optics, nonlinear crystals, optical fibres and photonic integrated circuits – are manufactured in China, with some key products having no readily available alternative suppliers. This dependency makes the industry vulnerable to sudden export restrictions, tariffs, or political escalations between China and Western markets."

Ryszard Piramidowicz, the Director of PIC development programme at VIGO Photonics and a professor at Warsaw University of Technology, puts the broader impact in context: "The photonics industry – and particularly the field of photonic integrated circuits – will face both significant challenges and extraordinary opportunities shaped by global disruptions. One of the most pressing challenges is the deepening geopolitical fragmentation, including the ongoing economic tensions between the West and China and the prolonged consequences of the Russian invasion of Ukraine.

"These factors have exposed vulnerabilities in the global supply chain for critical photonic components and materials, prompting an urgent need for diversification and regional resilience."

The uncertainty extends beyond component sourcing to affect business planning fundamentally.

Chennupati Jagadish, Distinguished Professor at the Australian National University, observes that "uncertainty of US tariffs on various countries has an impact on business planning its future. Cuts in R&D investments in the US and challenges faced by the university sector globally will have an impact on the photonics industry."

Amol Delmade, a Senior Photonics Engineer and Product Strategist at Pilot Photonics, provides a comprehensive view of interconnected challenges: "The three biggest challenges in the industry over the next year will likely revolve around scaling the production of photonics chips to meet rising global demand, reducing the power consumption of optical systems while achieving higher network capacity, and navigating the supply chain disruption due to the continuously changing geopolitical situation."

Yet within this challenge lies opportunity. Budriūnas notes that "this geopolitical uncertainty is also spurring increased public and private investment in strategic photonics manufacturing, presenting opportunities to bring back some critical component manufacturing closer to the Western markets, as well as providing the space for more defence-related photonics companies to emerge."

'A persistent lack of dedicated capital for photonics'

Access to capital remains one of the most pressing concerns for photonics companies, particularly the deep-tech start-ups navigating the notorious "valley of death" between proof-of-concept and commercialisation. Antony Murphy, the CEO of Causeway Sensors, provides a comprehensive analysis of the funding challenge facing the sector:

"The photonics industry faces three primary challenges in the next 12 months. The first – and most critical – is funding. There's a persistent lack of dedicated capital for photonics, compounded by a post-COVID shrinking of investment in the biotech end-application market. Deep tech, by its nature, demands significant, patient capital due to longer R&D cycles and higher initial investment in infrastructure, making it less attractive to generalist investors seeking rapid returns. This creates a 'valley of death' where promising innovations struggle to secure the necessary scale-up funding beyond initial grants."

Sumeet Mahajan, a Professor of Molecular Biophotonics & Imaging at University of Southampton, also highlights a structural funding problem: "The avenues to take promising early-stage research towards commercialisation and wide-scale biomedical and clinical use remain poor. Support for overcoming the so-called 'valley of death' continues to be sporadic and difficult. While risky, the opportunities can potentially be massive. There is a general risk aversion by public funders and industry."

Murphy identifies a second, equally fundamental problem that may reinforce that risk aversion: "The industry grapples with a significant branding and awareness deficit. Despite photonics underpinning an enormous array of modern technologies – from high-speed internet and medical diagnostics to autonomous vehicles and quantum computing – its pervasive influence is largely unrecognised by the wider public, policymakers and even some potential investors. This lack of clear identity hinders investment interest, public support and the ability to attract talent."

The funding landscape varies significantly by region and application. Pouya Rajaeipour, the CTO and co-founder of Phaseform, highlights concerning trends in Europe: "The EU is redirecting significant resources towards defence-related technologies, partly to strengthen strategic independence. While this is understandable, it risks sidelining critical investments in other high-impact photonics fields such as life sciences, imaging and sustainability, areas where European research has traditionally been strong and where photonics can have enormous societal benefits."

> "The lack of technicians in the pipeline threatens to limit the growth of the photonics sector … we need targeted investment into technician and apprentice training programmes"

Annika Möslein, the Head of Engineering at Quantum Dice, observes that "the gap for scaling up remains. Growth-funding in Europe lags behind the US and Asia, thus talent and IP often head overseas. Even if goals for supply-chain sovereignty are ambitious, bottlenecks in volume manufacturing, packaging, equipment and skills still mean that one faces long lead times and dependencies on external partners for manufacturing steps."

Madison Rilling, Executive Director of Optonique, connects the funding challenge directly to political recognition: "Although photonic technologies are crucial contributors and enablers to the most critical and fast-growing sectors, the photonics industry rarely benefits from political and public recognition and lacks comprehension as to its role in making possible life- and world-changing technologies. This translates into a lack of dedicated funding and support from government – for all stages of company growth."

Why photonics needs apprentice training programmes

Underpinning many of the industry's challenges is a severe and growing shortage of skilled professionals. Murphy articulates the workforce challenge clearly: "A considerable skills pipeline challenge persists. The specialised nature of photonics means that training pathways are often limited, with a heavy reliance on a relatively small pool of PhD-level graduates. There's a distinct lack of vocational and undergraduate routes to develop the technical expertise needed across the industry."

The issue is particularly acute in the UK. Calum Williams, a Lecturer at the University of Exeter, sounds an urgent alarm about recruitment and retention: "The UK (in particular) is facing an enormous challenge attracting talented students to pursue research (PhDs) or R&D (photonics or otherwise). There are now many other opportunities that offer more job stability and higher salaries. This will impact the sector enormously over the coming years, from academia to industry."

Hollie Wright, a Research Associate at Heriot-Watt University, identifies a critical gap at the technician level: "The lack of technicians in the pipeline threatens to limit the growth of the photonics sector. To overcome this, we need targeted investment into technician and apprentice training programmes."

Alison McLeod, the Director at Photonics Scotland, Technology Scotland, confirms these concerns from an industry perspective: "We know from the annual survey of our members that the biggest challenges they face are access to capital and access to skills. We anticipate this will be the same for the next 12 months."

The challenge extends beyond recruitment to the nature of required expertise. Goery Genty, a Professor at Tampere University, observes: "As technology evolves rapidly (e.g. AI, automation,

sustainability tech), finding and training talent with up-to-date skills could be very challenging."

Shahida Imani, the CEO and Co-Founder of ar Photonics, highlights the multidisciplinary requirements: "Many photonics/deep-tech ventures face long development timelines and capital intensity, which can be at odds with short-term investor expectations. Coupled with this is a growing talent bottleneck – particularly for roles that combine optics, semiconductor physics, embedded systems, and AI – making it difficult to build the multidisciplinary teams required for success."

Overcoming the technical barriers to scaling up

Even with adequate funding and talent, photonics companies face formidable technical challenges in transitioning from laboratory demonstrations to volume production.

Mariam Aamer Benelfaquih, the PDK/PCM Team Lead at Ligentec, identifies the core issue: "Over the next year, the photonics industry faces the significant challenge of scaling from prototyping to volume production. This is particularly true for integrated photonics, where we currently encounter bottlenecks in process stability, design-tool maturity and packaging."

The scaling challenge manifests differently across application domains. In optical communications, the demands are intensifying dramatically. Qian Hu, a Senior Scientist at Nokia Bell Labs, explains: "Training and operation of large language models is a revolutionary new driver for throughput requirements of data centre interconnects. As we are already reaching the limits of available electrical and optoelectronic bandwidth, keeping up with future demands will require a lot of innovation to be done to all parts of the optical system."

For quantum photonics, the obstacles are even more fundamental. Galan Moody, a Professor at University of California Santa Barbara, explains: "With quantum photonics, one of the biggest challenges is combining multiple materials into a functional platform with extremely low insertion and coupling losses. Losing photons means losing qubits and thus requires building in excessive redundancy. Ensuring low-loss photonic components are interfaced seamlessly with the quantum components, and then packaging these modules with low coupling losses, will be a major advance in quantum photonics in the next 12 months."

Michael Kues, a University Professor at Leibniz University Hannover, emphasises the need for standardisation: "The challenge in the next 12 months will be transitioning these innovations from lab prototypes to robust, real-world systems. This involves the standardisation of chip component fabrication and the development of interfaces to electronic chip systems."

Manufacturing infrastructure presents another significant bottleneck. Piramidowicz notes that "photonic integration still struggles with cost and scalability – especially in the mid-infrared (mid-IR) spectral range, which holds immense potential for sensing applications but remains hampered by limited access to foundries, immature process design kits and a lack of standardised platforms."

Jonathan Förste, the CTO and Co-Founder of Linque, articulates the integration dilemma: "One of the biggest challenges facing the photonics industry is achieving a high degree of maturity in the integration of complex PIC systems, especially through co-packaging and heterogeneous integration of different technologies such as III-V semiconductors on a silicon photonics platform. I believe that this lack of active components on a truly scalable technology platform such as silicon photonics is holding back the potential of integrated photonics as a whole."

Aleksandra Kaszubowska-Anandarajah, an Assistant Professor at Trinity College Dublin, reinforces this point: "I think photonic integration is still the biggest challenge and opportunity for our industry. Reliable and cost-effective fabrication, testing, calibration and packaging of PICs is necessary to deliver on all the promises of PICs, yet the progress in achieving these is quite slow."

Why photonics integration is imperative

A recurring theme across multiple domains is the challenge of moving from component-level performance to system-level integration. Peter Fendel, the CTO at Thorlabs, articulates this: "On the technology front, the biggest opportunity lies in advancing photonics integration and miniaturisation. While PICs are gaining traction in data and telecom sectors, the broader potential lies in enabling next-generation applications – ranging from precision agriculture and autonomous sensing to industrial-scale quantum computing. Here, micro-optic solutions and compact, scalable platforms will be key."

He emphasises the need for collaboration: "The technical demands of these new verticals – be it environmental ruggedness, low power consumption, or high-volume manufacturability – require R&D efforts that go beyond the capacity of any single company. Strategic partnerships, industry consortia and joint development initiatives will be critical to share both the financial risk and the technical expertise."

Dominic Sulway, the CTO at Light Trace Photonics, identifies the structural barriers: "The biggest challenge – and opportunity – for integrated photonics in the next 12 months is its transition from a niche technology to a foundational enabler of next-generation data communications and quantum technologies. While momentum is building, broad adoption is still held back by two key hurdles:

a fragmented value chain and the lack of accessible, reliable component designs.

"Companies seeking to integrate photonics chips into their products face a complex set of questions: Which material platform should they choose? Which foundry should they fabricate with? How can they ensure their designs are scalable and packageable? This lack of standardisation and clarity creates high barriers to entry and slows innovation."

The packaging challenge is particularly acute in emerging applications. Matthias Lauermann, the Head of R&D at Vanguard Automation, explains: "One of the biggest challenges facing the photonics industry in the next 12 months is the need to scale optical transceivers and interconnects to support ever-higher data rates. This requires more parallel optical lanes, tighter integration and minimal signal loss – demands that push conventional packaging technologies to their limits. In particular, co-packaged optics (CPO) – placing optics in close proximity to switching ASICs (application-specific integrated circuits) – poses major hurdles in terms of precise alignment, thermal constraints and reliable mass production."

"Despite photonics underpinning an enormous array of modern technologies… its pervasive influence is largely unrecognised by the wider public, policymakers, and even some of the potential investors"

Bridging regulatory and standardisation gaps

Beyond technical challenges, the industry struggles with regulatory readiness and lack of standardisation. Sanathana Konugolu Venkata Sekar, the Head of FAST Biophotonics at Tyndall National Institute and the CEO of BioPixS, identifies this as critical: "A key challenge for the photonics industry in the medium term is the lack of standardisation and regulatory readiness for emerging optical health technologies. At the same time, there is a major opportunity to develop benchmarking tools and validation protocols that are essential for clinical translation."

Sarah Bohndiek, a Professor of Biomedical Physics at University of Cambridge, identifies the translational barrier: "A major challenge is ensuring productive engagement with regulatory innovation to ensure smooth clinical translation of new technologies."

Jens Hofrichter, Vice-President Engineering at Lightium, expresses frustration with the current situation: "(The) biggest challenge is to get away from a boutique-style mixed bag of technologies to established standards and platforms."

Managing competition in maturing markets

The industry also faces challenges from market dynamics and competitive pressures. Pierre-Mary Paul, the Vice-President and Director of the Advanced Laser Solutions Business Unit at Amplitude, identifies several concerning trends, including low-cost competition: "Chinese manufacturers are rapidly scaling up production of ultrashort pulse lasers (>200W), creating pricing pressure and accelerating commoditisation in key segments."

He also notes market saturation in established areas: "Applications such as ophthalmology and display manufacturing are showing signs of saturation, with declining investment and reduced volumes."

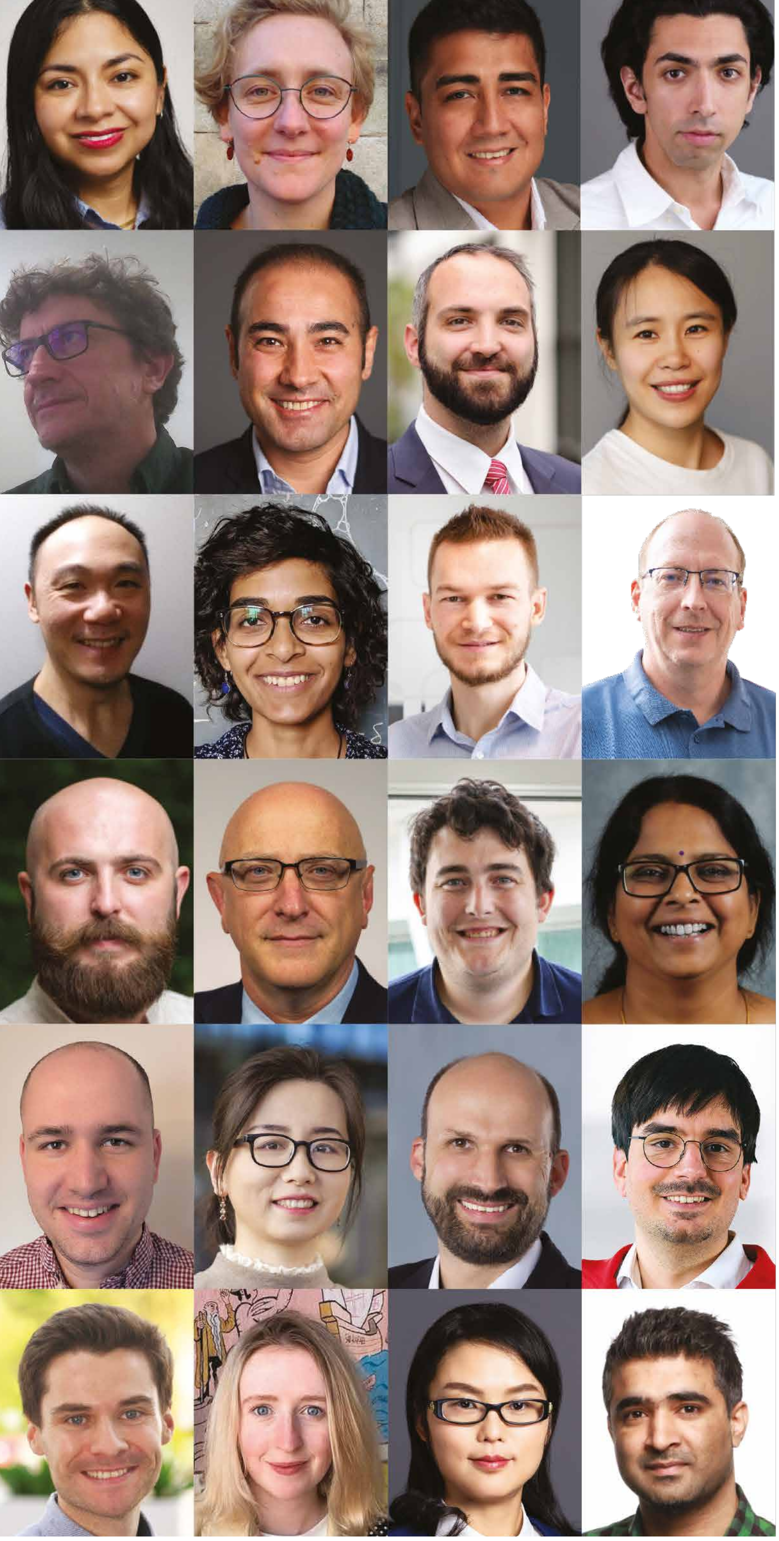
Supply-chain fragility compounds these competitive pressures. Paul says: "The industry continues to face disruptions due to geopolitical instability, tariffs and long lead times for components."

Jessica DeGroote Nelson, the Vice-President of Precision Optics and Technology Development at Edmund Optics, highlights the complexity: "The biggest challenge is meeting rising performance demands while keeping supply chains resilient – especially for specialised components such as diamond-turned mirrors and hard-coated filters."

Building better dialogue between lab and industry

Celia Millon, the CEO of RayVen Laser, says: "One of the biggest challenges facing the photonics industry is the growing disconnect between cutting-edge photonics innovations and their integration into real-world industrial applications. Many technologies – especially in ultrafast lasers, integrated photonics and quantum – are maturing rapidly, but adoption is slowed by complexity, lack of standardisation and insufficient application support."

Abdel Karim Ruvalcaba-Perez, a PhD student at Friedrich Schiller University Jena, emphasises the gap in supporting



infrastructure: "One of the most pressing challenges in the photonics industry over the next year lies in the translation of lab-scale innovations into robust, scalable, real-world solutions. While we continue to see remarkable advances in sensor miniaturisation, integrated photonics, and mid-infrared detection, the gap between demonstrator devices and industrial deployment remains significant, particularly in sectors such as agriculture, environmental monitoring and biophotonics."

The path forward for photonics

Despite these formidable challenges, industry leaders consistently identify pathways to overcome them. The solutions cluster around several key themes: enhanced collaboration, targeted investment, workforce development and strategic focus.

Benelfaquih outlines the collaborative approach needed: "To overcome these hurdles, we need closer collaboration among foundries, design tool providers and end-users. Continued investment in automation, component libraries and packaging solutions is also crucial."

She notes that "given the growing demand in sectors such as quantum, automotive lidar and bio-sensing, it's essential to have reliable, manufacturable and easily accessible photonic platforms".

On workforce development, Murphy provides specific recommendations: "Diversifying training pathways is paramount. This includes establishing more industry-led apprenticeships, integrated Master's programmes with industrial placements and upskilling initiatives that bridge academic research with commercial

Application-specific hurdles

Different sectors within photonics face distinct challenges that complicate the broader scaling effort. In biophotonics and medical applications, achieving reliable performance across diverse patient populations presents significant obstacles.

Francis Kalloor Joseph, an Assistant Professor at Erasmus Medical Center in The Netherlands, identifies critical limitations in photoacoustic imaging: "One of the biggest challenges in the next year is clinically validating photoacoustic imaging technologies in real-world healthcare settings. While research has shown promise, translating these systems into consistent, reproducible clinical tools remains a key hurdle."

He elaborates on two specific technical barriers: "First, achieving sufficient imaging depth across a broad patient population is essential. In many patients, especially those with higher BMI, the carotid arteries lie deeper than the imaging range of current photoacoustic systems.

"Second, skin tone remains a significant limitation. Patients with darker skin absorb more of the incoming light, reducing the energy that reaches deeper tissues. This can impact the clinical usability of photoacoustics in diverse populations."

For ultrafast laser systems, the challenges are multifaceted. Marwan Abdou Ahmed, the Head of Laser Development and Optics Department at Institut für Strahlwerkzeuge (IFSW), University of Stuttgart, provides a comprehensive overview: "Scaling both average and peak powers while preserving excellent beam quality and temporal stability remains a major difficulty, especially at kilowatt-levels and in demanding industrial environments such as battery manufacturing, semiconductor machining and aerospace. Furthermore, high peak powers pose serious laser safety concerns, including risks of eye and skin damage, ionising radiation and secondary emissions, all of which require robust shielding and safety protocols."

Maria Chernysheva, a Junior Research Group Leader at Leibniz Institute of Photonic Technology, identifies challenges specific to fibre lasers: "One of the key challenges facing the ultrafast fibre laser industry in the next 12 months is the push toward longer operational wavelengths – extending well beyond the telecom window.

"This shift demands a fundamental rethinking of available fibre-based components and fabrication techniques. In particular, managing dispersion and nonlinearity becomes increasingly complex, while scaling pulse energy and reducing pulse duration remain central goals."

She notes a critical supply chain gap: "Despite growing demand from applications in medical diagnostics, surgery, spectroscopy and gas sensing, the supporting infrastructure, particularly specialty fibres, compatible components and fibre processing equipment, is not keeping pace. Manufacturers are often reluctant to adjust product lines without a critical mass of R&D or clear market signals."

application. Critically, we must also highlight the societal impact and rewarding nature of careers in photonics to draw in new talent."

For funding challenges, Murphy suggests systemic solutions: "The funding gap necessitates the creation of more specialised investment vehicles and blended finance models that understand the unique risk-reward profile of deep-tech photonics. Government funding agencies must also increase their direct support and incentivise private investment specifically into this sector."

Hamed Sattari, the CEO of CCRAFT, emphasises the need for strategic focus: "Twelve months is a short window to overcome structural barriers, but it is a critical period to focus and align efforts. To build momentum, the industry should concentrate on one or two strategic application domains where photonics has a distinct edge and market pull."

Oliver Lischtschenko, the founder and CEO of Coher Sense, summarises the required approach: "Ultimately, success will come from being technically excellent, economically lean and geopolitically aware – and from building networks that are not only competitive, but also collaborative and resilient."

Möslein highlights the value of pan-European coordination: "The ecosystem itself is maturing but still scattered across countries and sectors, which demands cross-border partnerships and unified supply-chain advantages. The opportunity lies in stronger pan-European coordination, through initiatives such as PhotonHub, helping start-ups tap into the right facilities, partners and expertise across borders."

Jagadish emphasises the need for broader engagement: "The research sector needs to engage with the broader community to convince the community that investment in R&D is essential for productivity, jobs, economic growth, improved quality of life and national security."

Conclusion

The photonics industry in 2026 faces a complexity of challenges that would individually test any sector – geopolitical uncertainty, funding constraints, talent shortages, technical scaling barriers and regulatory gaps. Yet, as Imani observes, "with the right focus and agility, the industry is poised for a breakout phase that will shape multiple high-impact sectors".

The urgency is clear. Williams suggests that "the UK Government would need to begin offering incentives to undergraduates to pursue research careers and to make 'becoming a scientist/researcher' cool again with targeted advertising campaigns".

Success will require coordinated action across the ecosystem, according to this year's Photonics100. Governments must recognise photonics as strategic infrastructure and provide sustained, patient capital alongside policies that enable talent mobility and supply-chain resilience.

Industry must invest in collaboration platforms, standardisation efforts and workforce development. Academia must strengthen ties with industry, focusing research on deployment-ready solutions.

Joyce Poon, the Head of Photonics Architecture at Lightmatter and a Professor at the University of Toronto, captures the transformative potential: "I think the biggest challenge is the massive adoption of optical interconnects to enable the next generation of computing systems. If we can overcome these challenges, the photonics industry, as well as our society at large, would be radically transformed."

For an industry enabling so many transformative applications, 2026 represents not just a year of challenges, but a defining period that will shape the sector's trajectory for decades to come.

As Oleg Pronin, the Co-founder of n2-Photonics and a Professor at Helmut Schmidt University, reminds us: "Inertia and comfort are the biggest challenges. We should keep pushing and exploring; the future is bright." EO

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"The future of semiconductors is silicon photonics"

Photonics100 honouree and Deputy Director of Cornerstone, Callum Littlejohns, explains how the Cornerstone Photonics Innovation Centre is building a pipeline of silicon photonics-enabled companies to power AI, telecoms and quantum technologies

Electro Optics: Tell us the story of Cornerstone. How did it begin and what is its role within the technology sector?

Callum Littlejohns: Cornerstone is the premier hub for silicon photonics in the UK. It has recently been funded by the EPSRC (Engineering and Physical Sciences Research Council) to become the Cornerstone Photonics Innovation Centre, an innovation and knowledge centre, which enables us to serve as more than just a prototyping foundry.

Historically, Cornerstone has been a silicon photonics foundry focused on rapid prototyping for early-stage research and product development. But this programme is about more than that, it's about building an ecosystem that offers support, particularly to academics, to make the journey from researcher to company founder, while also supporting existing companies with R&D.

So, our mission within the centre is to build a pipeline of silicon photonics-enabled companies by 2030, which is when the funding ends. That's underpinned by the foundry, but we'll offer training, funding packages, support and networking opportunities that go with it, all of it centred around the fabrication facility.

It's a partnership between the University of Southampton, the University of Glasgow and the Science and Technology Facility Council (STFC), but it is led out of Southampton.

Those specific partners were chosen because they have the best academic cleanrooms in the UK, and Southampton leads it because we have eight-inch deep UV lithography capabilities, so all the work is compatible with industrial standard processes, and you can get way more on the chips because we work on the eight-inch wafer scale.

Glasgow has complementary expertise in nano-fabrication, centred around e-beam lithography, and a lot of research activity in silicon photonics and advanced packaging. STFC helps us with training, particularly around electronics training and training people new to the field in the relevant software packages.

We're also part of bigger research activities at those institutions. There's a large silicon photonics group at the University of Southampton that's now about 75 people, of which Cornerstone is about a third. We work closely with them to help enable others to access the latest research they develop.

EO: What's special about this area of photonics research? Why have you put your eggs in the silicon basket?

CL: We believe future semiconductor technologies will heavily utilise silicon photonics. That's almost universally accepted. To get to the data rates and the energy savings needed by AI, we need to move more and more from electronics to photonics. In a lot of cases, silicon photonics is the answer to that because it's manufacturable at scale, it's low-cost and it's compatible with existing infrastructure.

Of course, silicon photonics means lots of different things to different people. Twenty years ago it would have meant silicon itself. These days, it tends to mean photonics on silicon, where the substrate is silicon, but the actual optical and waveguide materials can be different. That's where the field is going, we have to integrate other materials on silicon for light sources and many people are integrating other materials again for modulators or detectors. If you look at the top 15 companies in the world by value, I think about two thirds of them are either using silicon photonics or investing in it.

Silicon electronics has been around since the 1950s, and that's why 90% of the globe's electronics is built in silicon, so we know how to make things in silicon at low cost and at huge volumes.

Even the field of silicon photonics has been around since the '80s, but it was very much a research field for 10 years or more. Bookham was the first silicon photonics company, set up in the late '90s, backed by our research group.

Intel got involved later on, and it's progressed quite quickly in the past decade, from an interesting research domain to a technology that solves real problems in the real world. Intel and others have been making commercial products for more than a decade, and now there are a host of new start-ups in the area and all the big guns are investing in it, in one form or another.

EO: Talking about the progression of silicon photonics over the past decade, how has Cornerstone changed since it started in 2014? Are you still inspired and fuelled by the same goals, or how has your focus shifted?

CL: The aim at the beginning was to serve UK academia. We set out to support UK researchers who didn't have the same cleanrooms that we had and to make what they wanted on their behalf. To facilitate that, we needed to buy a scanner to do the eight-inch lithography at scale. That's what Cornerstone's first funding paid for.

We took a view very early on that

The Cornerstone cleanroom at the University of Southampton

> "13% of all innovation over the past 35 years relies on photonics. Within that, the UK sits third behind the US and China"

we should be open source, so that the platform was as accessible as possible. We didn't want to put up any unnecessary barriers. Being based at a university, we're not in it to make money like a company would be. Those values – being open source and being flexible and adaptable to what people need – very quickly resonated with industry, and we found, almost by accident, that companies were curious and we had a lot of interest internationally.

I think our first international client was in about 2018, and then pretty quickly it started to be dominated by companies.

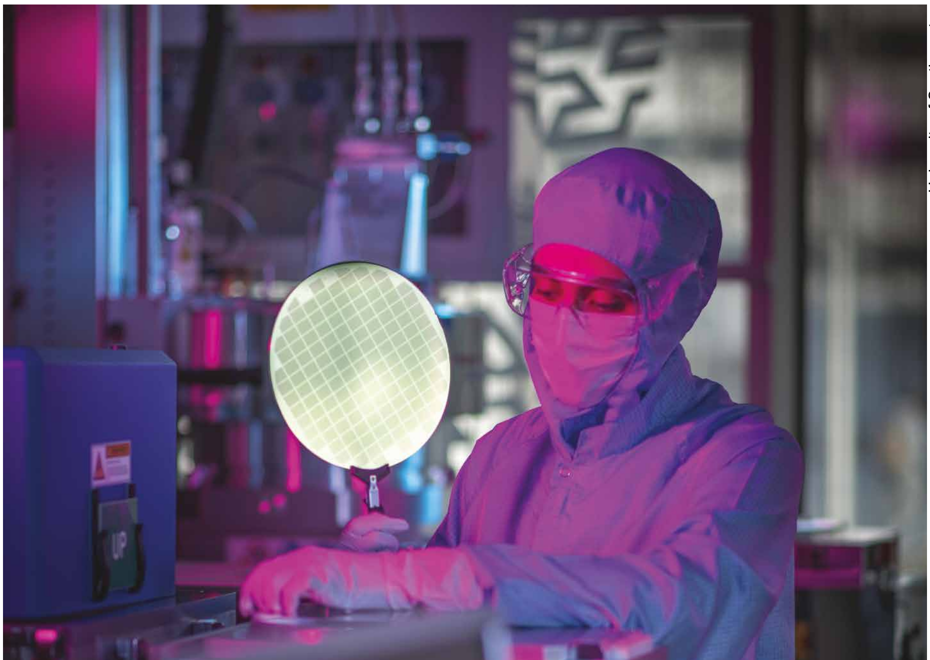
For the past couple of years we've been working more with small-to-medium enterprises (SMEs), and in some cases bigger companies, than we have with academic researchers. That's because the ability to adapt processes, at scale, to what they need is very appealing to SMEs. We got kind of lucky with the timing. Just as we were getting off the ground being able to make things for people, the whole field started to really take off.

EO: Moving on to making things for people, then, what more can you tell me about the different applications your work is being used for?

CL: We have a number of different platforms, the idea being that we can support a broad wavelength range. We have a silicon nitride platform that will support visible wavelengths, for example. That's interesting for things like bio sensing and quantum – ion trapping technologies for quantum computing, for example, need very specific wavelengths that tend to be less than a thousand nanometres. Then we also have silicon-on-insulator platforms that target telecom applications at traditional telecom wavelengths. Historically, that's been the de-facto standard platform, but that's definitely changing.

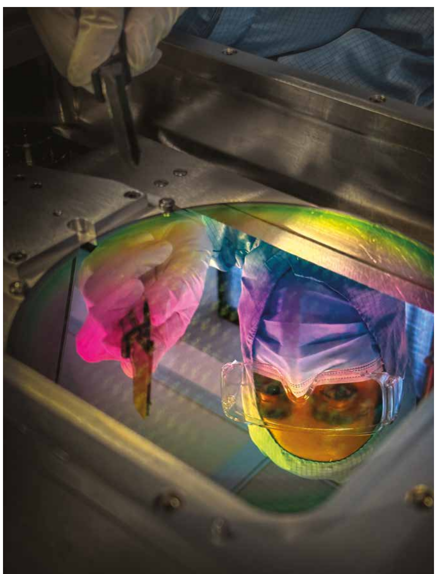
Then we have other platforms such as germanium on silicon. That supports longer wavelengths and it's interesting for sensing technologies such as bio sensing, environmental sensing, and – you can imagine – the defence applications as well. We make sure we're flexible, and ensure we have multiple platforms to suit lots of different applications. We're lucky we're tied to the research groups at Southampton and Glasgow because that's where these technologies were developed in the first place.

We work very closely with the research group, so sometimes, for example, we'll be approached by a company to deliver a research programme. It could be led by the research group, but the Cornerstone team will do the fabrication on the project. We can have these really nice collaborations between the research group,



University of Southampton

'We set out to support UK researchers who didn't have the cleanrooms we had'



University of Southampton

Dr Thalia Dominguez Bucio, pictured in the cleanroom

"Photonics is the fifth largest industry in the UK, but a huge proportion of the population has never heard of the word"

the Cornerstone team and companies, to adapt what we can fabricate to support the goals of the company. We can cover all the stated applications in silicon photonics.

I haven't mentioned lidar – that's an emerging field – and some of the research group are co-founders of a lidar company called pointcloud. That company makes coherent focal plane arrays that you can image things with static chips and no moving parts, so you don't have to have a spinning thing on the roof like the Waymo autonomous vehicles in San Francisco.

EO: Right. So, in terms of aiding the commercialisation of silicon photonics technology, what are some of the barriers, such as scaling up, that make that a challenge for companies?

CL: Scaling up is somewhat of a challenge, but I think less so these days simply because most of the major foundries have invested in a silicon photonics platform that you can access.

Whether you can get in or not is another story. That's the challenge, really, as it can be quite expensive for companies in the early days, but that's where we can help.

We fill that gap by helping companies get ready for volume manufacturing. In fact, one of the key activities we're working on right now is to form partnerships with volume manufacturers so we can provide that route to market, and make sure it's all tested and validated.

But, it's not just about getting stuff made, of course, it's the entire process of designing things in a different foundry. We're working with Wave Photonics, for example, who are a UK start-up that specialises in custom process design kits.

Other challenges are that the software for photonics is still not at the same level as electronics because it's still developing. But it has massively improved over the past 10 years. There needs to be more interaction between foundries and software designers in terms of sharing data.

In photonics, minor changes in parameters like widths and heights of waveguides can have a huge effect on performance, and that's an unavoidable fabrication effect. Not all foundries are open to sharing that information, but if the data is made open and available to designers, it would help them make far more robust designs.

That's why we're building an open-source platform where not just the designs are open source, but all the data attached to them as well – the simulation models, as well as the fabrication data and actual optical measurement data of the outputs.

Then, by combining all that information with machine-learning algorithms, we can shorten the time to market for new applications, because designers are more confident it will work as they've considered real fabrication tolerances. Historically, it may take three or four design iterations to get a fully functioning chip.

Funding can also be difficult for those companies working on hardware innovations as the timescales to become a profitable company are longer than software, so it can be difficult to get that longer term funding commitment.

Then there can be simple challenges that are specific to emerging applications, such as the lasers or photodetectors not being available or not mature enough at the wavelengths required, and that slows things down.

It's only really at telecom wavelengths where the whole ecosystem is mature, including the light source, the modulator, the detectors and the packaging to go around it. But this is all changing, there's a lot of research being done in these areas.

Companies are popping up every day that support these new emerging fields to fill in these gaps. It's an exciting time to be in silicon photonics.

EO: You say it's getting quicker and easier, but presumably the market is expanding at an even greater pace. With a limited team, how do you decide which projects to take on?

CL: In terms of platform development, that tends to be driven by the user and who's asking for what. We try to be adaptable to what the market's asking for. That means we see the trends in what people are requesting, and then that knowledge helps guide our technology development. We'll often get asked to do the same thing by different people, then, obviously, we

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VOLTA


University of Southampton

'Each member of the research team drives their own individual areas of expertise'

know that's important and we should work on developing that function or platform or whatever it is.

It tends to be market driven; we listen to what our users are asking for and we're routinely asking for their views as well.

There's also a bit of a push from the research community on the other side, so we like to keep track of what's being developed there. Companies often don't know what they can have, so it can be a marriage between the pull from industry and the push from the emerging research coming through.

Each member of the research group drives their own individual areas of expertise, then Cornerstone sits in the middle and takes that on board, listens to what the industry is asking for, and comes up with the most appealing technology developments.

We look at market surveys and things like that, of course, to see where everybody else thinks the world's going. We know we're never going to compete with any of the big players such as (Taiwan's) TSMC doing co-packaged optics, but that's not the intention.

We tend to focus more on what's emerging, rather than trying to compete directly with the big foundries.

Having said that, the research group does currently hold the world record for the fastest silicon modulator – of a particular design, which beats what TSMC and others have published, but we're not going to try to manufacture it at scale because that's not the purpose of Cornerstone.

EO: Where do you think silicon photonics fits in the UK's broader tech strategy, and how important is it for the country to shout about its achievements?

CL: I think it's very important. The UK is really strong in photonics. There was a recent study by the Photonics Leadership Group that looked for photonic keywords in 135 million research publications over the past 35 years. It concluded that 13% of all innovation over that time relied on photonics, and within that, the UK was third behind only China and the US. So, we are very strong in photonics, and we should be shouting about it more.

If you look at the industrial strategy and the "frontier technologies" they've defined, silicon photonics plays a huge role with energy savings in AI hardware; in future telecoms in data centres, 6G and space communications; and then quantum technology as a whole – the vast majority of quantum technologies need photonics somewhere, and a lot of that can be silicon photonics.

There are lots of wins for the UK with start-ups, but we tend to struggle with growing the companies and making them huge, something the industrial strategy itself identifies.

EO: One of the ways to improve that is by increasing the level of private funding in a country, but, in order to do that, there has to be the infrastructure and the talent and skills to invest in. What's the state of the UK talent pipeline in silicon photonics and how does Cornerstone help to improve it?

CL: It's a challenge, because, in my opinion, photonics is still not well known. It's actually the fifth largest industry in the UK, but a huge proportion of the population has never heard of the word. We're trying to improve that in the Cornerstone Photonics Innovation Centre with activities that support public engagement and policy engagement, to try to spread the word.

Everyone relies on photonics, but they don't necessarily realise that photonic devices are everywhere: displays, lighting, the internet relies on it; but as an industry, we're not very good at getting the message across to the public, particularly young people when it comes to engaging with them and nurturing future talent.

There's a lot of work to be done, but there is hope because you can retrain people. There are loads of people who know how to lay out PCBs for electronics, for example, and it's not entirely different to design a photonic chip. So, re-skilling people from other areas is definitely something we could be better at.

Many of the skills needed are transferable from other fields, as well. Cornerstone's team of technicians is hired from some very diverse backgrounds. Some trained as neuroscientists, some are people who worked in COVID testing labs or Airbus apprentices, and some of them have PhDs in MEMS and photonics.

I think it's possible to re-skill people, we just need to make people aware of it as a career path. **EO**

Photonic applications boost environmental monitoring

A recent online panel discussion explored the latest innovations bolstering data accuracy across green projects

From remote greenhouse gas sensing to air and water quality monitoring, photonic innovations continue to evolve, allowing researchers to find more efficient ways to analyse the quality of the environment. Such applications are lending themselves well towards the improvement of data accuracy. However, challenges remain when it comes to balancing the meeting of specific needs with limited resources, all while minimising environmental impacts.

A recent *Electro Optics* panel discussion explored notable trends occurring across photonic environmental monitoring application areas, and how prominent obstacles can be overcome to succeed long-term. Experts from Aerodyne Research, Headwall Group and the Passepartout project at Munster Technological University discussed best practices when it comes to implementing photonic tools for environmental monitoring, the differences in applications when monitoring various elements, including water and gases, and what is to come in the future.

Common challenges in environmental monitoring

The panel explored the most common challenges being faced daily when it comes to accurately and efficiently monitoring environmental states at a granular level. Liam O'Faolain coordinates the Passepartout project at Munster Technological University, an EU-funded scheme focused on the development of photonic gas analysers to monitor air quality. He said: "The good news is that photonic systems have the advantage of being highly specific, bringing low interference with other components, and can operate with low calibration. The bad news is they're generally quite expensive, and there's a number of pollutants now that have a high spatial and temporal variability. I see quite a big need for higher-density sensor networks, higher numbers of sensors per square kilometre. The cost needs to come down for this to happen. So, some of the big challenges are in how these laser gas analysers are put together, very often needing a skilled engineer to align each mirror, each lens, each component. So, I think we need to move on from that and find newer ways of putting together our photonic-based gas analysers to drive down costs significantly."

According to Dave Nelson, President of Aerodyne Research: "A general challenge of field measurements is that you're typically not in a laboratory environment, and so a lot of optical instruments have thermal dependencies on their calibration. Temperature stabilisation can be a serious challenge for many instruments." He noted that power requirements present additional constraints. He said: "A lot of our instruments, for example, are extractive gas sampling ones, where you need to establish a gas flow, usually with a vacuum pump. So that can require significant electrical power, which is also a constraint in field measurements."

Mobile measurements introduce further challenges including vibration, G-forces and the need for precise location data.

When it comes to hyperspectral imaging for environmental monitoring, Headwall Group's Chief Product Officer, David Blair, said: "Hyperspectral certainly has some common challenges with other technologies, as well as some unique ones. As we think about the way the environment that you're monitoring changes from the lab, out into this more robust remote sensing world, your background is diverse, and your ability to control that background is limited. Solar angles, cloud, humidity, all of these basic parameters of our environment actually influence our ability to measure, and to get consistent results."

Blair emphasised that data management represents a critical challenge: "There's been a natural tendency to save all of the data, and to work with it over time, but these are very large data sets as you're now interrogating the entire scene. So the ability

From left: Liam O'Faolain, Project Coordinator for the Passepartout project at Munster Technological University; Dave Nelson, President of Aerodyne Research; David Blair, Chief Product Officer, Headwall Group

to reduce the data, reduce the dimensionality of the data you choose to keep, and to store answers rather than raw data is critical."

Differences in applications

With environmental applications varying widely, the panel discussed how the monitoring of air quality differs from water or ground monitoring.

"For most optical techniques, air is the friendliest environment," said Nelson. "That's where electromagnetic waves freely propagate. And for some applications, air and water are equally attractive. Soil is generally difficult." He explained that his team has developed methods to extract molecules from liquids and soils for measurement in air at reduced pressure.

For O'Faolain, "we are looking at pollutants in urban areas, including black carbon, NOx, ozone and carbon monoxide. The gas phase is a relatively benign environment to make measurements in. The absorption cross-section is low, so you need long paths or various tricks. At Passepartout, a lot of the techniques were based on photothermal and photoacoustic spectroscopy, which allow miniaturisation of the sensor."

Blair commented: "For hyperspectral, the surface reflectance spectroscopy technique really finds that soil, and typically solid measurements are the most effective areas for environmental monitoring. We find that, while they may be heterogeneous, they are relatively static, unlike aerosol-based samples, which are dynamic, where noise can often dominate over signal."

Monitoring methane emissions

The discussion then turned towards specific research. O'Faolain explained how the Passepartout project had been driving value by detecting fugitive methane emissions.

He said: "Some of the popular techniques for us are cavity ring-down spectroscopy, and using infrared camera-based systems. We've been working on quartz-enhanced photoacoustic spectroscopy systems and, as previously mentioned, the challenge is the low-absorption cross-section.

"So, with traditional techniques, you need a long path, hence the use of cavity ring-down. Quartz-enhanced photoacoustic spectroscopy uses a quartz tuning fork as the transducer, which allows you to pick up a weak signal quite effectively, and it's relatively immune to background noise, which allows you to detect the presence of methane while even using quite a small cell, or a small photonic unit.

"The future of the big methane detection market is huge demand for a large number of units, which is why I'm always thinking about cost reduction. Techniques such as QPAS have very strong potential for scalability. Tens of thousands of units can well be imagined, or more even."

Overcoming the 'isobar problem'

Nelson discussed Aerodyne's work using isotopes as environmental tracers and key learnings from laser-based methods.

"Isotope-ratio mass spectrometry (IRMS) has been the standard for making isotopic measurements in the environment and in geochemistry for decades. But laser measurements have distinct advantages for some isotopic measurements. The potential advantages of optical methods include lower capital costs. Laser systems are often much less expensive than mass spectrometric systems. There are also lower operating costs; we were just talking about the need for a skilled operator. In general, IRMS mass spec methods require a very skilled operator, and that's less the case for optical methods. They can be automated."

He added: "Another advantage is a complete elimination of the isobar problem. Isotope ratio spec, in general, suffers from this isobar problem, where when you're measuring carbon-13 CO_2, you're also measuring oxygen-17 CO_2, and there's no way to separate those two. You have to do a correction factor, and if you want to measure O-17, it's virtually impossible with mass spec because it's dwarfed by the C-13 signal. An optical method doesn't have that problem; it's based on a vibrational spectrum, and all of the individual isotopologues can be completely resolved."

> "I'd urge you to keep this one sentence in your head: 'Before you get to work something at 50,000 feet, go try to work it at 10 feet, or in the lab'. Make sure you start simple"

David Blair, Headwall Group

"We need to find newer ways of putting together our photonic-based gas analysers to drive down costs"

Liam O'Faolain, Munster Technological University

> Nelson acknowledged challenges including matrix effects and concentration dependence, but noted: "I think, in general, optical techniques, for some measurements, are almost completely supplanting IRMS. So, for example, water isotope measurements, are all pretty much done optically now with cavity ring-down spectroscopy. For carbon dioxide isotopes, it's strongly going in that direction, especially for exotic isotopes of carbon dioxide. The optical methods have tremendous advantages."

Hyperspectral imaging applications

Blair discussed customer demands for hyperspectral imaging, emphasising expectations for precision, interoperability and accurate geo-positioning.

"These customers, when we look at where they are spending their time with the instruments, they're focused on agricultural measurement. It's the number one series of application centre questions that we get. How can I measure soil conditions more accurately than basic vegetative indices and DVI (difference vegetation index), and similar? How can I understand advanced methods of plant health and vitality? Can I estimate yield at some point earlier in my growing season?

"In water quality, the algal bloom situation continues to amplify as we see waters warming as a result of global warming. The need to be able to quickly identify materials so they can be mitigated with a minimum amount of the chemicals and processes required, or to allow human intervention to mitigate that earlier, is critical here."

Mining and geological survey applications represent another growing area that the panel see for environmental monitoring.

Ensuring accurate data management

The conversation moved to important aspects of accurately monitoring environmental effects and managing data effectively.

"Making sure that the instruments are properly calibrated, obviously, is a key point, otherwise there will be big question marks over your data," said O'Faolain. He emphasised the importance of metadata and open repositories.

Blair outlined one of the distinctions that can emerge with how data is used in both the research and commercial settings: "These are technologies that grew up in the research community, fundamental research to applied research, into early adopter use cases. There is an expectation that a user of the technology can push a limited number of buttons, to run a predictable, expected workflow and to generate a consistent data output. Again, a demand that we see routinely is no longer wanting raw data to play with – they want an answer, and they want it the same way every time."

"A key principle for us – whether this is an advantage or disadvantage is unclear – is we have a lower dimensionality of data than the hyperspectral approach" said Nelson.

"With a point sensor, we're making measurements at one location, and doing exquisitely sensitive measurements there, trying to measure multiple species, potentially. So, we like to save all of the spectra. This is sort of the opposite of what David (Blair) was saying.

"We don't like to rely just on the process data, because then you can never get back to the fundamental measurement."

He also emphasised the importance of geolocating measurements: "Of course, we take great care to know exactly where we're making the measurement, so everything is geolocated, and we use GPS time servers so we know when we're making the measurement, to within tens of milliseconds."

According to Blair: "There are a few things that certainly we've considered in our equipment, and I've seen pretty broadly understood in industry.

"Some of them are as fundamental as built-in tests and validations in the electronics themselves. As you move from research-oriented basic technology into more commercial-grade technology, there's an expectation that, at start-up, all of the routines and sequences are evaluated, and that you have all of the calibration necessary embedded in the instruments so that you're not relying on human error."

The best practices in optical environmental monitoring

The panel provided best practice tips regarding optimal implementation and maintenance of optical environmental monitoring applications. Blair said: "I'd urge you to keep this one sentence in your head: 'Before you get to work something at 50,000 feet, go try to work it at 10 feet, or in the lab'. Make sure that you start simple, because if it does not work in that environment, it really will be a challenge when you add the atmosphere, the environment, human interference and influence."

O'Faolain warned: "The outside world is difficult; the temperature and pressure changes. Whatever measurement you make in the lab, it's going to get worse when you take it out to the field."

He emphasised talking to end users and system integrators early in the process.

According to Nelson: "In general, when you're making environmental measurements, at least ones that involve field deployments, not installed monitors that are there all the time, things are just much more difficult. You've got time pressure, varying temperatures, and often you've got people that are working 10- or 12-hour days, and maybe are not at their best with using troubleshooting skills at their fingertips. You should expect everything to be harder."

What are the future trends in photonic environmental monitoring?

Finally, the experts outlined the future trends they see occurring in the sector.

Nelson said: "Smaller and cheaper is always attractive, and there's always going to be pressure to do that. On the other hand, we want accurate measurements, and there are physical limitations to how accurate you can be if you squeeze and totally optimise cost and size. So there's a really fundamental trade-off there. Do you want a network of 10,000 instruments measuring noise, or do you want a network of 500 measurements that actually have signals? That's one area that I think is currently being debated and worked out in the area of environmental sensors."

According to Blair: "What we see being exciting in the coming years is, in general, this integrated multimodal data collection and processing – this idea that we don't have federated sensors. But what we have is a network of multiple sensors that all talk to one another, that give the right answer – not the answer of any one individual technology or vendor."

He highlighted beyond-visual-line-of-sight drone regulations as a significant development, along with AI-driven detection capabilities.

O'Faolain concluded: "The idea that one kind of technology or one sensor family is going to dominate is fading, and we're moving increasingly to this multimodal, multi-level network, where you have the best in class for each particular task, all being combined.

"It also appears in terms of pollutants, I think we can see unexpected consequences of some of the new green initiatives, with new pollutants emerging as new fuels, and so on, are being used." EO

Microelectronics UK's Microbrewery was a social hub at the centre of the event

Microelectronics UK

Microelectronics UK 2025: innovation, investment and future of the photonics ecosystem

That's a wrap on the inaugural Microelectronics UK show, which showcased innovation, collaboration and a bold £10m Government boost for the UK semiconductor industry. **James Wormald** reports from London's Excel

The first-ever Microelectronics UK event brought the semiconductor, photonics and embedded systems communities together under one roof, and the results were electric. Over two days at London's Excel, more than 3,000 attendees from industry, government and academia converged to build partnerships, share ideas and showcase cutting-edge technologies shaping the UK's high-tech future.

From standing-room-only conference sessions to the buzzing energy of the Start-up Launchpad, the show's debut proved the UK's microelectronics ecosystem is not just alive, but accelerating. Networking spilled over from exhibition stands to the Microbrewery social hub, where engineers and executives could swap insights over craft beers. Plus, there were highlights such as an F1 simulator and Hartley's new optical computer, which drew queues of tech enthusiasts.

£10m Government investment kickstarts the show

The event opened with a headline announcement that would set the tone for the days ahead. In his opening address, Tech Minister Kanishka Narayan MP revealed a new £10 million Innovate UK fund aimed at supporting up to 40 British semiconductor businesses.

"This funding will help early-stage companies innovate and bring new products to market," he said. "Semiconductors are a key strategic priority for us. They underpin every aspect of our modern economy, from AI and quantum computing to clean energy, telecommunications and defence. They are the invisible infrastructure of the digital age and a clear engine of growth."

The announcement builds on a semiconductor skills package unveiled earlier this year, furthering Government ambitions to make the UK a leading force in chip design, research and innovation.

"We're supporting learners at every stage, from school leavers to PhD researchers," said Narayan, emphasising that the goal is not just funding technology, but cultivating talent.

He added: "These interventions are already strengthening our ecosystem and ensuring the UK is ready to lead in the technologies of tomorrow."

The applause that followed captured the optimism in the room. For many, this was the signal that the UK is finally matching words with action.

Launches, partnerships and new players

The show floor was a hive of activity, with a stream of product unveilings, demonstrations and partnership announcements. Hartley Ultrafast, a Bristol start-up recently emerged from stealth, for example, was a huge hit showcasing its photonic neural network prototype, with round-the-booth queues to get a glimpse of the optical computer.

The UK Electronics Skills Foundation (UKESF), meanwhile, recognised 33 companies for signing its Skills Charter, a commitment to nurturing engineering

The Photonics UK theatre conference agenda was opened on the second day by Mark Elliott, Chief Operating Officer of *Electro Optics'* publisher Europa Science

L-R: Alison McLeod (Photonics Scotland); Shaun Viola (MBDA); Nikki Antoniou (Airbus); and Dawn Wood (BAE Systems) on Using Optic Technology in Modern National Security

> "It's not out of place to talk about replacing copper with photonics and optical interconnects in the fullness of time, but costs have to come down first"

talent. Recipients included tech giants such as Apple and Arm, mentioned alongside smaller innovators with less familiar names such as EDA Solutions. Big or small, the message was clear – skills are the foundation of growth.

International collaboration was also a recurring theme at the event.

SMD Semiconductor, for example, made headlines by announcing two memoranda of understanding (MoUs) signed with strategic global partners, serving to highlight Malaysia's ambitions to become a global semiconductor manufacturing superpower – and how it can do so by aligning with the UK for its recognised R&D strength.

"The UK is highly innovative in terms of R&D and product IP," said Shariman Jamil, CEO of SMD Semiconductor. "The only problem is... if you want to build larger volumes of product. This is where Malaysia comes in."

The collaboration makes strategic sense, as the UK leads in advanced research and intellectual property, while Malaysia dominates in large-scale chip packaging and manufacturing, as Hai Liang (Duncan) Lee from the Malaysia Semiconductor Industry Association noted that semiconductors make up 40% of Malaysia's exports, representing 7% of all global trade.

Bringing the two ecosystems closer could prove transformational.

As Iain Mauchline, Head of Semiconductors at Innovate UK, put it during a roundtable on photonic supply chains: "Strategic international partnerships (need to) became a priority. Taiwan has been the main (example); we've built strong links with government and research agencies… and that's already led to joint projects."

Such partnerships could extend beyond Asia. As Caroline O'Brien, incoming CSA Catapult CEO, reminded the audience during the same discussion: "The UK cannot do everything in semiconductors or photonics, so partnerships are essential. We have real strengths here, but not the full set of capabilities. Tapping into international expertise is the only way to move forward."

The skills drive

Across the conference's many stages, one topic was omnipresent in debates: the skills pipeline. Multiple speakers, from government officials to industry veterans, stated that without a deeper and well-served talent pool, growth will stall. Narayan's £10m investment announcement directly tied into that theme, following the Government's semiconductor skills programme launched earlier in the year. And proved that "supporting learners at every stage of their learning" was not just rhetoric. It reflects a wider strategy that includes apprenticeships, postgraduate research and mid-career retraining.

Iain Thomas, Head of Electrical and Electronics at Rolls-Royce, was another of the event's speakers to reinforce the industry's commitment to nurturing talent. Deeply embedded in university research networks, Rolls-Royce offers sponsored PhDs and partners with the Aerospace Technology Institute (ATI) on engagement programmes, he said.

Thomas also revealed Rolls-Royce's expanding interest in photonics for sensing and high-speed communications, particularly within small modular reactors and aerospace systems.

"We very strongly want to develop technology and products that we can read across multiple sectors," he said.

Europa Science CEO Warren Clark opening the first day on the Photonics UK stage

L-R: Mark Arthur (Honeywell); Nikolaos Lyras (ESA); Henny Sands (UK Space Agency); Mike Curtis-Rouse (Satellite Applications Catapult) and Martin Agnew (Airbus) on 'Photonics and Beyond: The Use of Light Technology in Space'

John Lincoln, of the Photonics Leadership Group, showcased its research

Turning strategy into united action

On the Semiconductors UK stage, Sue Daley, TechUK's Director, provided a grounded, but urgent, perspective, referencing the company's Plan for Chips report, which outlines three key missions:

- Turning current strengths into leadership.
- Improving access to finance for UK chip firms.
- Building global partnerships to strengthen supply chains.

"If the global chip market is heading for $1 trillion by 2030," she said, "the UK needs to turn strategy into serious action. The National Semiconductor Strategy has made positive strides… but now we must focus on delivery."

Although the UK has momentum, success depends on execution, collaboration and sustained investment.

This sentiment that was echoed on the other side of the hall, as O'Brien remarked on the importance of collaboration during a Photonics UK roundtable on PIC supply-chain dynamics.

"This will be an industry challenge where the supply chain needs to leverage all of its capabilities to meet demand," she said.

During the same discussion, however, Taimur Mirza, Leonardo's Principal Photonics Engineer, said that while collaboration is important, companies must tread carefully. "(Collaboration) isn't straightforward," he said, "especially in areas such as defence where sovereignty matters. We must ensure the UK retains critical capability, even while partnering internationally."

If the semiconductor sector can position itself as the backbone of the modern digital economy, photonics can claim to be its brain.

Mapping out the future of the sector, Mark Rushworth, CEO of Finchetto, said: "The current approach is co-packaged optics, then a step beyond that is optical interposers, getting even closer to the chip, and the next step beyond that – maybe 10 years out – is fully optical compute.

"The key point is: light is the fastest medium we have for data transfer, so that's the endgame."

Rather than solely concentrating on the benefits to come, however, the Photonics UK panels also detailed the various bottlenecks blocking the path, as well as reasons to be hopeful for finding the right solutions.

"It's not out of place to talk about replacing copper with photonics and optical interconnects in the fullness of time, but costs have to come down first," said O'Brien. "The next stage is 3D integration – putting compound semiconductors on top of these substrates – (and) we already have a


Microelectronics UK

The opening address – many of the conferences were standing-room only


Microelectronics UK

Exhibition stands surround the popular Microbrewery


Microelectronics UK

The event included a Q&A with *Top Gear* stunt driver Paul Swift, and tips on precision driving at an F1 simulator

world leader in compound semiconductor manufacturing, IQE in South Wales, and that gives us leverage."

Discussing other areas where the UK already has world-class expertise to use as a stable foothold, Mauchline said: "It comes down to which materials chemistry set we want to focus on. There has been a lot of intervention, such as pilot lines and a packaging line in Glasgow, where scaling up would depend on choosing the right materials and concentrating on the UK's capabilities."

Voices from the floor

Overall, there was a consensus that the atmosphere at Microelectronics UK was an overwhelmingly positive one, not just from speakers focusing on the positives and exhibitors pleased with the footfall, but attendees, too, hailing the event as a landmark success for the UK market, "the most rewarding show in decades" and a "fantastic platform for learning and networking" were among the responses.

For up-to-date news on the UK photonics scene, or to view a digital edition of our UK Photonics Uncovered special supplement, please go to: www.electrooptics.com/uk-photonics

UK Photonics Uncovered

Launched at the event to accompany and educate attendees, *UK Photonics Uncovered*, a new publication by the publishers of *Electro Optics*, offered the most comprehensive look yet at Britain's fast-growing photonics sector, which the title revealed is projected to be worth £50 billion by 2035. The title dives into government policy, market dynamics and cutting-edge applications across healthcare, defence and telecommunications. It features contributions from government, industry experts and academics, providing both context and foresight into how light-based technologies are reshaping UK innovation.

By the time the lights dimmed and the last conversations wrapped up at The Microbrewery, one thing was certain: if the UK's future in microelectronics and photonics depends on collaboration, vision and drive, then Microelectronics UK 2025 provided the blueprint. The show has already said it is returning to Excel next year, on September 29 and 30. EO

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Ppq barrier broken: carbon monoxide sensing at 920 parts per quadrillion

Breakthrough CO detection system combines intelligent optimisation with precision laser control

Researchers from the Harbin Institute of Technology in China have shattered a trace gas sensing record, developing an ultra-sensitive carbon monoxide detection system enabled by intelligent algorithm optimisation and advanced laser control that pushes the boundary to an unprecedented 920.7 parts per quadrillion (ppq) sensitivity.

"Detecting carbon monoxide at the parts-per-quadrillion level pushes the abilities and applications of trace gas sensing," explains Jeremiah Hashley, a technical writer with Wavelength Electronics.

"Achieving that sensitivity opens up detection of impurities or background gases that were previously impossible to observe with traditional CO sensors. In practical terms, it means you can monitor ultra-clean processes, detect extremely low leak rates and diagnose trace contamination in otherwise 'pure' environments."

A new approach to gas sensing

At the heart of this breakthrough is light-induced thermoelastic spectroscopy (LITES), which detects thermoelectric signals from a quartz tuning fork (QTF) that change dependent on laser light stimulation and gas absorption.

"CO-LITES uses a non-contact technique," says Hashley. "Unlike quartz-enhanced photoacoustic spectroscopy, the QTF doesn't need to be immersed directly in the gas, so corrosion or electrode degradation is avoided."

By pairing this design with an optimised multi-pass cell and a low-frequency, PDMS-coated QTF, the researchers achieved high sensitivity in a compact footprint.

Intelligent optimisation

Two key innovations enabled the system to achieve its record-breaking sensitivity. The first was the use of an artificial fish swarm algorithm (AFSA) to optimise the design of a three-mirror multi-pass cell with a double helix structure. This computational approach solved a complex engineering challenge: maximising the optical path length while minimising volume and maintaining uniform spot distribution.

"Designing a multi-pass cell to maximise optical path length, minimise volume, and achieve uniform spot distribution is a complex optimisation problem in a high-dimensional space," Hashley explains. "The AFSA enabled a systematic exploration of the parameter space to generate a 'double helix' spot distribution through three mirrors, resulting in a long optical path (25.8m) within a compact volume (165.8ml), while maintaining a small and efficient system."

The algorithm achieved this by iteratively adjusting the parameters of mirror placement, angles and spacing to create a highly dense pattern of spot distribution within a compact design. The result is an optical path length-to-volume ratio that significantly increases gas-light interaction time without expanding the physical size of the system.

The second major innovation focused on the quartz tuning fork itself. The researchers customised a QTF by increasing its length from 3.9mm to 9.1mm, decreasing the width from 0.36mm to 0.25mm, adding round heads to enhance stress during vibration, and using gold electrodes to improve oxidation and corrosion resistance. They then coated it with polydimethylsiloxane (PDMS), a polymer material with low thermal conductivity and high thermal expansion coefficient.

"Researchers wanted to reduce the resonant frequency of the QTF to increase the energy accumulation time, thus improving the detection sensitivity," says Hashley. "The PDMS coating reduced heat diffusion and increased mechanical stress during vibration, which boosted thermoelastic signal amplitude. Combined, these changes yielded a ~10.59× improvement in signal-to-noise ratio over a commercial QTF."

The resonant frequency was reduced by 70%, from approximately 32.8kHz to 9.5kHz. "Lowering the resonant frequency stretches the oscillation cycle, allowing more energy accumulation per cycle and stronger coupling of the thermoelastic effect," Hashley explains. "This makes weak absorption changes easier to detect."

Precision control at the foundation

Achieving ppq-level sensitivity required more than innovative optical and mechanical design – it demanded extraordinary stability in the laser system itself. The researchers selected Wavelength Electronics' QCL1500 LAB quantum cascade laser driver and TC10 LAB temperature controller to provide the necessary precision and stability.

"For a system targeting ppq-level detection, any current noise or instability in driving the quantum cascade laser directly degrades precision," says Hashley. "The QCL1500 LAB driver must provide ultra-low noise, high modulation bandwidth, high precision, and stability over long integration times in order not to mask the weak signals. Signal-to-noise ratio is very important in these types of applications."

Temperature control proved equally critical. The TC10 LAB maintained the laser temperature at 35°C with stability as low as 0.0009°C.

"The QCL output wavelengths shift with temperature," Hashley explains. "At ppq sensitivity, even microkelvin-level drift can shift the baseline or misalign the laser absorption, corrupting the measurement. Maintaining thermal stability at 0.0009°C minimises these drifts, preserving the integrity of long integration measurements."

The relationship between driver performance and detection limits is direct. "In ultra-sensitive spectroscopy, driver noise translates directly into baseline fluctuations – jitter – in laser output," says Hashley. "If too high, that noise is indistinguishable from weak gas absorption signals. The QCL1500 LAB's ultra-low current noise floor ensures that the limit of detection is determined by physical noise – fundamental limits – and not the electronics."

Real-world applications and industry impact

The CO-LITES sensor has been tested in real-world scenarios, including measuring CO concentrations on campus and in exhaled human breath, demonstrating responsiveness to traffic cycles and metabolic signals.

The implications extend across multiple industries. In semiconductor manufacturing, even trace impurities can negatively impact yield. For hydrogen fuel cells, tiny amounts of CO poison the catalyst, degrading performance. In planetary exploration, detecting gases at extremely low concentrations can indicate biological or geological processes.

"Clean energy and fuel cells stand to benefit from ultra-low CO contamination monitoring," says Hashley. "Semiconductor and microelectronics fabrication need this for purity control, environmental monitoring and climate science can use it for trace gases, and biomedical diagnostics can apply it to breath analysis and early disease markers."

Looking beyond these immediate applications, Hashley sees potential in unexpected areas. "Perhaps exoplanet atmospheres or astrobiology with embedded ultra-sensitive sensors onboard space probes to detect tracers in thin atmospheres," he suggests. "Or quantum technology labs, where trace gases degrade vacuum or cryogenic systems."

The future of ultra-sensitive detection

The achievement signals a broader trend in gas sensing technology. "Researchers are moving towards molecular fingerprinting at all-time low concentrations, integrating machine learning, algorithmic noise reduction, integrated photonics and compact spectrometers to push towards single-molecule-level detection," says Hashley.

Wavelength Electronics is positioning itself to support this evolution with ultra-low-noise, high-bandwidth, precision current and temperature control products optimised for advanced spectroscopy systems.

Looking ahead, he anticipates significant developments in control technology. "Future laser and temperature control technology will focus on ultra-low noise, higher bandwidth, and smarter stability management. Next-generation drivers might deliver sub-nanoamp current noise and multi-MHz modulation capability, while temperature controllers maintain microkelvin precision over long measurements. These advances will make ultra-sensitive spectroscopy more reliable, compact and practical for both research and industrial environments."

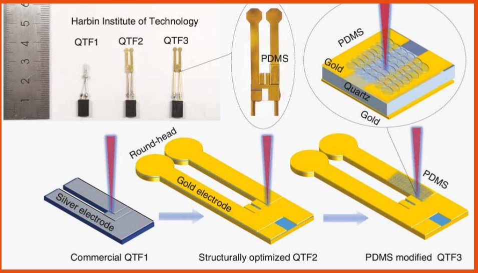
For researchers pushing the boundaries of gas detection sensitivity, Hashley says: "Researchers aiming to push the limits of gas detection sensitivity should focus on eliminating every possible noise source: electrical, thermal and mechanical. System stability is key. Precision drivers and temperature controllers must maintain consistent operation over long integration times."

He emphasises the importance of comprehensive system design. "Optical design should balance path length enhancement with compactness and low loss, while materials and coatings should be optimised to maximise signal strength. Careful noise characterisation early in development helps identify the true limiting factors before optimisation begins."

Ultimately, the practical value of breakthrough sensitivity depends on reliability. "Record-breaking sensitivity is only valuable if it can be achieved repeatedly and in real-world conditions," Hashley concludes.

With ppq-level detection now demonstrated in CO-LITES sensors, the stage is set for a new generation of ultra-sensitive gas sensing applications that can monitor processes and detect phenomena previously hidden in the noise floor of conventional instruments.**EO**

Find out more by reading the latest White Paper from Wavelength Electronics: Ultra-sensitive CO-LITES detection at the parts per quadrillion level.



Schematic of QTF optimisation. Insert: real picture of different QTFs

Hollow-core fibre is 'the most significant advance in more than 50 years'

Relativity Networks CEO Jason Eichenholz tells **James Wormald** how replacing conventional optical fibre with HCF can cut latency, boost capacity and meet the surging demands of AI and telecommunications

Electro Optics: Tell us about your development of hollow-core fibre… what optical communication problems does it solve and why is now the right time to do it?

Jason Eichenholz: Hollow-core fibre (HCF) represents the most significant advancement in optical communications in more than 50 years.

Unlike traditional fibre, where light travels through glass, our technology guides light through the air using precision-engineered glass structures that create mirror-like boundaries.

The fundamental optical communication problems we solve centre on latency and signal quality. HCF reduces latency by 33% compared with traditional glass fibre, enabling light to travel nearly 50% faster. HCF also delivers signals with approximately 1,000x lower nonlinearities and chromatic dispersion compared with conventional glass fibre. This dramatically reduces signal distortion and enables faster, farther data transmission while maintaining signal integrity, which is critical for telecommunications networks that can't afford errors or delays.

Traditional glass fibre has reached its fundamental limits after 40 years without major changes to its physical capacity constraints. Our hollow-core technology breaks through these limitations by eliminating the glass medium that causes these constraints. The timing is critical because telecommunications infrastructure is being pushed to its absolute limits. Networks need to support terabit-scale communications and beyond, while maintaining the ultra-low latency that modern applications demand.

The market urgency is particularly evident in the transition to 800G and beyond. Existing campus intensity modulated fibre transceiver technologies have limitations as the data rate increases. 1.6Tb/s and 3.2Tb/s transceivers are limited in their reach with standard glass single-mode fibre. One can transition to higher power/more expensive coherent transceiver technology or simply improve the transmission quality by replacing the optical fibre with HCF. The improved transmission quality allows for higher launch power for long-haul networks, increases fibre data capacity, lowers power consumption and eliminates the need for inline optical amplifiers.

EO: Which applications and markets are you prioritising it for and why?

JE: We support the high-speed and high-bandwidth communications pathways that AI and other cloud-based computing-intensive applications now require. Relativity Networks serves multiple high-performance sectors, including cloud-computing hyperscalers seeking to expand their AI and data centre footprints, telecommunications providers preparing for next-generation networks, healthcare and pharma organisations that need access to faster data and 5G infrastructure companies aiming to build future-ready networks.

Our HCF technology allows data to move nearly 50% faster and travel 1.5x further without impacting network performance. This enables hyperscalers to build facilities where power is available, opening up a 2.25x geographic area for data centre selection.

We are laser-focused on telecoms for data centres and expanding the metro edge because that's where the immediate, massive demand exists. Hyperscalers are planning more than $1 trillion in infrastructure spending through 2030 to support AI growth, and they need solutions now. We are paving the path to support players in quantum communications and high-power lasers for directed energy spaces as well.

EO: Tell us about any specific cases where hollow-core opens up paths that are inaccessible by solid-core.

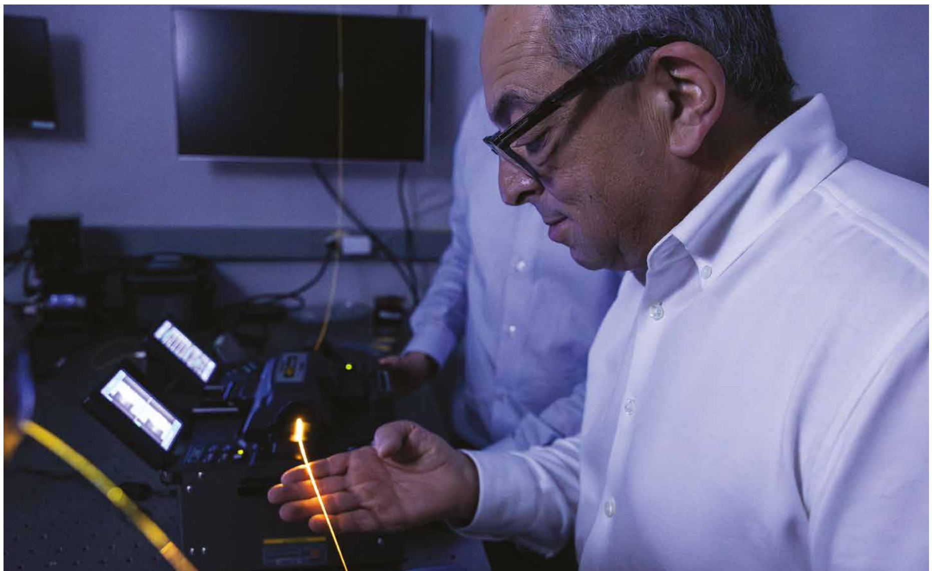
JE: Traditional solid-core fibre forces data centres to be located within 60km of each other due to latency constraints. This creates power bottlenecks in urban areas where land is not available and power sources are limited.

Our HCF technology breaks this constraint by extending the geographic reach to 90km, opening up access to power-abundant areas and regions with opportunities for co-located renewable energy sources. Hyperscalers can now build near wind farms, solar installations or underutilised grid capacity while maintaining the ultra-low latency that AI and cloud computing applications demand. In these areas, power availability has become the primary bottleneck to scaling AI infrastructure.

We're also seeing applications in high-frequency trading where nanoseconds matter, and in quantum computing where our fibre minimises decoherence that typically occurs through light-material interactions, helping preserve delicate quantum states.

EO: What will your additional $6m funding ($11m total) mean to the project in the short term? What's the next stage this will get you to?

JE: Our oversubscribed $6.1m seed round validates our vision and accelerates our ability to meet surging market demand for HCF. The funding primarily supports the scaling of production capabilities through



Relativity Networks

Jason Eichenholz, CEO and founder of Relativity Networks, with hollow-core fibre

our partnership with Prysmian, a trusted installation partner and global leader in cable systems.

In the short term, this launches high-volume manufacturing at Prysmian's dedicated facility in Eindhoven, Netherlands. We're moving beyond our successful field installations and multimillion-dollar contracts to industrial-scale production that can support the entire AI infrastructure buildout.

We're also expanding our complete ecosystem approach – not just manufacturing fibre, but developing new optical transceivers and high-power amplifiers that operate at wavelengths impossible with traditional glass fibre. This integrated approach maximises HCF's transformative potential. Having Prysmian as both a manufacturing partner and investor through this round positions us perfectly to deliver at the scale and speed this market transformation demands.

EO: Do you think the optical comms ecosystem is ready to integrate HCF at scale? If not, what needs to be done?

JE: The ecosystem is rapidly adapting, and we're making the integration as transparent as possible for our customers. We can leverage existing communications infrastructure, and Relativity takes care of the technical complexities for them. Our approach is designed to be seamless, allowing customers to avoid completely overhauling their systems. (This is because) we can teach installers of existing infrastructure to work with our HCF, extending the reach of both legacy and new systems without requiring massive infrastructure replacement.

EO: Do you think HCF will ultimately replace standard fibre, or can the two operate together in a two-tier technology system?

JE: There are specific, compelling reasons to move away from a 50-year-old technology that's reached its fundamental limits. HCF offers dramatically lower latency and approximately 1,000x lower nonlinearities. These aren't incremental improvements, they're transformational capabilities. That being said, it is unlikely that HCF will be deployed anytime soon in applications such as Fibre to the Home (FTTH), where latency isn't a critical problem or where nonlinearities and dispersion severely impact performance.

However, customers are already deploying our HCF fibre within the same cable systems as traditional fibre, so there is definitely a way in which the two can operate together in a hybrid approach. Organisations can deploy HCF where ultra-low latency and superior performance are critical, while maintaining standard fibre for less demanding applications.

This creates a natural two-tier system where HCF handles the most demanding telecommunications requirements – AI workloads, high-frequency trading and quantum applications – while standard fibre, sometimes in the same cable, continues serving traditional networking needs. The key is having the flexibility to choose the right technology for each application and performance requirement.

EO: How easy is it to upgrade existing systems with HCF? Or do they need to be completely replaced?

JE: We can leverage the existing communications infrastructure and Relativity Network to offload the technical complexities for customers. Our HCF integrates seamlessly with existing infrastructure, unlocking immediate

> "HCF offers dramatically lower latency and approximately 1,000x lower nonlinearities. These aren't incremental improvements, they're transformational capabilities"


Relativity Networks

Jason Eichenholz (left), CEO and founder of Relativity Networks, with co-founder, Rodrigo Amezcua Correa, in the lab

expansion opportunities, and we can extend the reach of legacy or new systems without requiring complete replacement.

However, to fully realise HCF's transformative potential, we're also building new optical transceivers and high-power optical amplifiers designed specifically for our fibre.

These operate at wavelengths and power levels that weren't possible with traditional glass fibre, opening up entirely new operating bands and capabilities.

Think of it as having many blank canvases – you're no longer restricted to the wavelengths and power limits associated with conventional single-mode fibre.

This flexibility allows for both drop-in upgrades to existing systems and greenfield deployments that take full advantage of HCF's superior performance characteristics.

Organisations can start with integration into existing systems and then expand into our advanced ecosystem components as they scale their operations. The beauty lies in this graduated approach, offering immediate benefits with existing infrastructure, but also transformational capabilities when they're ready to fully embrace next-generation networking.

EO: Are you currently working with – or are you seeing interest from – many telecoms and hyperscale data infrastructure companies?

JE: Absolutely. We have secured multimillion-dollar contracts and deployed our fibre in several US field installations for telecoms and hyperscaler customers, proving real-world performance and demand.

The hyperscalers are eager to adopt our technology at scale because they understand it directly addresses their biggest constraints – power availability and latency requirements.

The interest spans from major cloud providers expanding their cloud and AI infrastructure to telecoms companies preparing next-generation networks. What's particularly encouraging is that these aren't just pilot programmes. We're seeing substantial commercial commitments that demonstrate confidence in our technology's ability to solve critical infrastructure challenges. Our partnership with Prysmian also brings with it their extensive customer relationships and global reach, connecting us with hyperscalers and telecoms providers worldwide who need our solutions.

EO: Will you need or be looking out for more funding or partners and collaborators? Which are of more value at this stage?

JE: As we scale, we will continuously evaluate other funding and partnership opportunities. Our focus now is to meet what we're seeing as truly insatiable market demand.

Our partnership with Prysmian exemplifies the power of strategic collaboration. They bring decades of fibre manufacturing expertise, global production capabilities and established customer relationships that would take us years to develop independently.

The AI economy won't wait, and the infrastructure demands are massive. Our focus is on assembling the partnerships that can deliver solutions at the pace and scale this transformation requires. When solving problems fundamental to an industrial revolution-scale transformation of the world economy, there is plenty of funding available.

Still, the right partnerships can be worth more than any amount of capital. EO

> "You're no longer restricted to the wavelengths and power limits of conventional single-mode fibre. Think of it as having many blank canvases"

In association with EPIC

'Datacom and AI will continue to drive the photonics industry'

Ron Keating, CEO at Excelitas, a US-based manufacturer of advanced optics, illumination, detection and sensor technologies, talks to **Jérémy Picot-Clémente,** EPIC's Photonics Technologies Programme Manager

Jérémy Picot-Clémente: What's the background to your appointment as CEO at Excelitas?

Ron Keating: In 1992, after completing a BSc in Engineering/Industrial Management at Texas A&M University, I started as an Application Engineer and later became General Manager with Ingersoll-Rand, a services, equipment and systems manufacturer for fluids and gases. In 2000, I joined Kennametal, a company specialising in cutting tools and tooling systems for metalworking, as Vice-President. In 2007, I transitioned into private equity as CEO of Contech Engineered Solutions, a company specialising in civil infrastructure, especially engineered site solutions. Then, in 2014, I was recruited as CEO by Evoqua, a water treatment company. We took Evoqua public in 2017 and successfully sold it in 2023. Following that, I joined Excelitas as CEO.

JPC: How has Excelitas developed?

RK: Excelitas was established in 2010 as a spin-off from PerkinElmer's Illumination & Detection Solutions, with a focus on core photonic technologies, including illumination, detection, emitters and sensors.

Initially backed by the private-equity firm Veritas Capital, Excelitas expanded through numerous acquisitions into more advanced and diversified product segments, including arc lamp power supplies, high-voltage power systems, UV curing, LED/lamp systems, MEMS optical engines, spectroscopy, high-performance scientific CMOS/CCD/high-speed cameras, and specialty light sources and components from UV to infrared, to enhance coverage in analytical instrumentation and industrial processes.

These acquisitions allowed the company to serve a broader range of markets including biomedical, scientific instrumentation, defence, aerospace, industrial, and semiconductor.

In 2017, AEA Investors acquired Excelitas and further strengthened our R&D capabilities, enabling faster product development and operational excellence.

In 2024, we divested our aerospace and defence electronics businesses to sharpen our focus on our core competencies and end markets, namely: life sciences, medtech, semiconductors and advanced industrial applications.

Today, Excelitas employs approximately 7,000 people with 11 manufacturing operations in Europe, eight in North America and eight in Asia.

JPC: What are the main factors of your success?

RK: Our success stems from a deep commitment to solving our customers' most complex challenges and making sure that we are developing and delivering strong success in their capabilities. We invest heavily in R&D, with more than 700 engineers who are highly focused on our core mission: enriching life and being innovation-driven. We work with both system integrators and large OEMs, delivering critical components that enable their technologies – making sure we provide the products at the pace they require. We have the capability to serve customers globally through a broad manufacturing footprint, and we quickly adjust and modify products as customer requirements evolve.

Together, these strengths position us as the partner of choice for advanced industrial technologies.

JPC: What were the core values you brought from your previous experience to Excelitas?

RK: From the very beginning, I've always been market-focused – starting with the customer and understanding their needs. Once you do that, you can then optimise and streamline internal processes to ensure you're delivering the highest quality product, within the lead time the customer expects, and at the best possible value you can provide for them.

At the employee level, I've consistently worked to enable and empower my teams to succeed, and to create a high-performance culture, that is, one that's highly enabled, highly empowered and highly accountable.

JPC: Having a global presence, how have the recent changes in tariffs affected you?

RK: Tariffs are changing daily and are a challenge. However, because our global manufacturing network allows us to service from facilities and plants in close proximity to our customers, tariffs have not been a major issue. Our geographic flexibility enables us to make long-term decisions around the strategy, staying close to our core competencies to ensure that we're developing and delivering those in a very stable manner.

JPC: How do you see the European market developing?

RK: We see the European market as continuing to be strong. We're well aligned within this region and benefit from great technologies and tremendous engineering talent across our European facilities. What we're seeing now is that many of the new products developed in Europe are being deployed more broadly

Excelitas' pco.edge 10 bi LT CMOS camera. Keating believes advanced industrial applications will be a growth area for the company

across global markets. Accordingly, we have leveraged our global manufacturing footprint to ensure that we are providing these products in a competitive manner in alignment with where our customers want our products to be manufactured and to be delivered. Our European manufacturing operations are robust and are enabled by an incredible R&D and technology team that drives innovation and enables global deployment.

JPC: How do you see the future of the photonics market?

RK: Life sciences and medtech will continue to grow, as will the semiconductor industry, which is expected to gain tremendous momentum over the next five years. Fortunately, we are aligned with Tier 1 suppliers in the semiconductor industry, which will drive data centre growth. Datacom and AI will continue to drive the photonics industry, presenting a significant opportunity for us as we invest in this area. Another growth area will be advanced industrial applications, including machine vision learning, shop floor enablement and the capabilities around detection and sensing.

JPC: What will be your biggest challenge in the next few years?

RK: Our biggest challenge will be staying aligned with our customers and supporting their organic growth opportunities. This means delivering products at the right time and, ultimately, at the cost position they expect.

To this end, we've made some important changes at Excelitas. Over the past two years, we've integrated the company from a collection of smaller independently-operated acquisitions into one unified company. This allows us to better leverage our global footprint and align with customer expectations regarding product delivery and location.

JPC: What's your advice for the next generation of entrepreneurs?

RK: My advice is the same as when I started in the industrial tech space: make sure you understand what the market is looking for and how you can align with what the customer defines as value. One thing we always remember in business as a whole, is that we don't engineer, design, or produce products simply because we want to, we do it because a customer has paid us to deliver a solution that meets their needs.

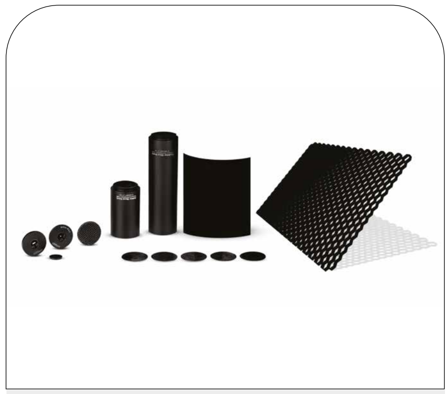
To succeed, you need to be nimble, reactive, highly responsive and disciplined. Ultimately, you must establish the right management operating system to consistently deliver on the value proposition you've committed to in the marketplace. EO

"In 2024, we divested our aerospace and defence electronics businesses to sharpen our focus on our core competencies"

Ten of the best

The most eye-catching components, devices and applications to appear in our inbox over recent weeks

Contact us at: editor.electro@europascience.com



Edmund Optics
Acktar Ultra-Black coatings

A range of ultra-black coatings and components has been released by Edmund Optics. Designed for stray light suppression in optical systems, the coatings, which include Metal Velvet and Spectral Black, achieve total hemispherical reflectance as low as ~1% across VIS, SWIR and LWIR. The dry, non-particulate coatings are vacuum compatible and suitable for the clean-room. Available as foils, films, panels, beam traps, pinholes, air slits and with C-Mount tubes, they support applications in imaging, infrared sensing and laser systems.

Lumencor
Volta Scanner

The Volta scanner is a high-speed optical system from Lumencor, made to monitor transient cellular processes in 96 and 384 microwell plates. A dual-laser design (462nm and 660nm) enables simultaneous optical stimulation and detection. Sub-millisecond (0.1ms) temporal resolution is achieved via voltage-sensitive fluorescent dyes. The system uses a photodiode array to collect kinetic data across wells, and supports assays of transgenically expressed ion-channels such as drug-induced QT prolongation in cardiomyocytes.

Spectrum Instrumentation
Multichannel GHz Digitiser

DN6.33x series multichannel digitisers offer 12-bit resolution and sampling rates up to 10GS/s with bandwidths up to 3GHz. Available with as many as 12 synchronised input channels, the instruments enable simultaneous, time-correlated measurements across multiple signals, with each channel providing programmable input ranges between ±200mV to ±2.5V alongside offset control and onboard calibration. They are designed for applications requiring precise signal capture, such as photonics research; radar; communications and semiconductor testing.

ams Osram
Vegalas high-power laser diode

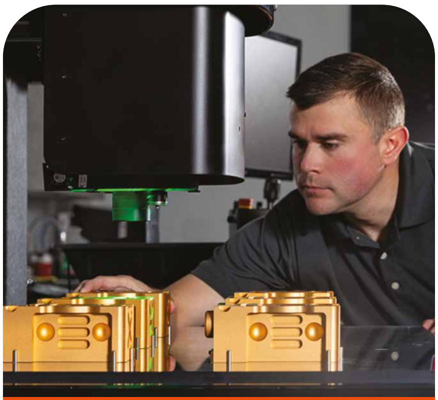
The Vegalas Power laser diode is ams Osram's first in the series. The blue GaN-based laser module integrates multiple emitters to deliver 42W optical output in short pulse operation with around 45% wall-plug efficiency. Designed for projection and illumination systems, it enables compact, high-brightness light engines for applications such as consumer and professional projectors, automotive head-up displays and industrial machine vision, as well as agricultural and stage lighting. It complements existing LEDs and sensors for next-generation optical systems.

Omron Industrial Automation
Time-of-Flight laser sensor

Omron Industrial Automation's E3AS-HF Time-of-Flight (ToF) laser sensor series is made for long-range optical detection up to 6m. Equipped with a patent-pending high-sensitivity photodiode and advanced sensing algorithm, Omron says it detects low-reflectivity, shiny or curved surfaces, even at harsh angles. Suitable for continuous level detection in automation systems, the IP67/IP69K-rated sensors feature IO-Link connectivity and offer spot or diffuse beam options for reliable sensing in industrial and machine vision applications.

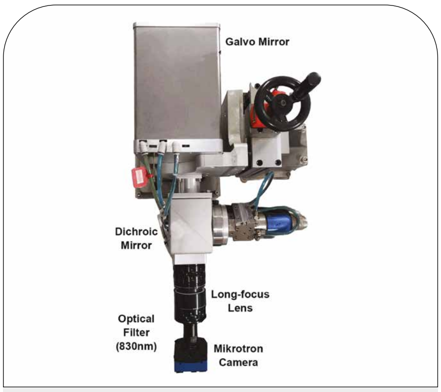
Keysight
WirelessPro 3GPP AI Simulation Platform

The WirelessPro 3GPP AI Simulation Platform is a software environment made for modelling, prototyping and validating advanced wireless systems. It integrates AI and ML capabilities at the physical layer and supports link- and system-level simulations using standard channel models. Key features include neural receiver embedding, beam management and channel state prediction. Aligned with 3GPP specifications, the platform enables realistic simulation of mobility, handover and control scenarios.



OGP
SmartScope M130

The SmartScope M130 is a large-format 3D multisensor metrology system, designed for makers of large, heavy parts. It features the IntelligCentric-M optical system with fixed telecentric optics; Virtual Zoom technology for rapid, distortion-free imaging and a 20MP camera. Combined with advanced sensors, illumination and Zone3 software, the SmartScope enables high-throughput, precise optical measurements and supports XYZ travel up to 790 x 815 x 200mm, an optional extended Z-axis and a 75kg payload.



Mikroton
EoSens high-speed camera

Recently deployed in an experimental LPBF monitoring system at Nanjing University of Science and Technology, Mikrotron's EoSens MC1362 high-speed camera is capable of capturing 160 x 160px melt pool images at 10,000fps with 9.85µm/pixel resolution. Synchronised with a galvanometer scanner and AI analysis, the camera, which isolates melt pool emission using a dichroic mirror, blocking reflected 1070nm laser light, maps optical signals to build coordinates in real time, enabling the detection of keyhole pores in thin-walled LPBF parts.

Edmund Optics
Handheld infrared viewer

Edmund Optics has expanded its line of handheld infrared (IR) viewers for detecting and visualising infrared laser emissions used in photonics system set-up and alignment. The new models offer a range of magnifications; wavelength sensitivities and detection capabilities suited to varied optical and laser applications. Compatible with C-mount lenses; IR filters and camera adapters, the viewers support flexible integration into laboratory and production environments, and are designed for use in semiconductor manufacturing; optical communications; biomedical research and industrial laser systems.

Aerotech
AGV-CPO scan heads

The AGV-CPO series from Aerotech includes two-axis galvo scan heads with 22-bit resolution, dual 64µm encoders, optional water or air cooling for stability and minimal thermal drift, and can be used for applications such as micro-machining, laser texturing, high-speed drilling, cutting and ultrafast laser processing that requires precise, dynamic beam control. The scan heads are available with either 10, 14 or 22mm apertures, and share a common control architecture with higher-performance models via the Automation1 platform, meaning they can be part of scalable operations.

Suppliers

Find the suppliers you need quickly and easily. Also available online at www.electrooptics.com/suppliers

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Scaling up European photonics for global competitiveness

By Carlos Lee, Director General, EPIC

Europe's photonics industry is globally respected for its world-leading innovations. With more than a hundred acquisitions occurring worldwide every year in photonics, many involving non-European companies acquiring European firms, the continent is standing at a crossroads.

This growing trend risks transferring valuable technological assets abroad. However, it also underlines the urgency for European companies to take the lead in consolidation and strengthen their position by even actively acquiring companies in the US and Asia.

On 9 October, EPIC brought together industry leaders to discuss whether it is time for Europe to consolidate itself and ensure it remains a global powerhouse rather than a fragmented collection of small, brilliant companies.

Currently, 86% of European photonics companies are small businesses employing fewer than 50 people. While this vibrant entrepreneurial spirit has fuelled innovation, it also presents a challenge: many small companies struggle to scale and fully access the major markets dominated by larger global players.

A primary advantage of consolidation is access to larger companies. Large industrial customers frequently require suppliers to demonstrate substantial scale and operational capacity, qualities small start-ups often cannot provide.

Becoming part of a larger group may significantly expand business opportunities with large customers.

Being part of a larger group also offers broader access to established sales networks. Building international distribution channels independently is costly and time-consuming. Consolidation enables smaller companies to leverage extensive group networks, accelerating market reach and enhancing brand recognition.

Consolidation is also crucial for keeping value chains within Europe. Retaining control over suppliers, manufacturers, and integrators strengthens European resilience against geopolitical and supply chain disruptions. This approach safeguards regional jobs and technical expertise, ensuring innovation and production remain anchored here in Europe and not relocated abroad.

On 9 October, EPIC brought together industry leaders to discuss the value of small European firms seeking consolidation

While some entrepreneurs prefer managing small lifestyle companies, considering the long-term sustainability of their business is paramount, especially after the founder's retirement. Planning a timely transition of ownership through consolidation or strategic partnerships can secure the company's future, preserve jobs and maintain its indispensable role within Europe's photonics landscape.

EPIC can attract more investors beyond traditional venture capital, attract those who value long-term industrial leadership, knowledge retention and job preservation. Foundations and family offices with patient capital can provide essential support for strategic consolidation, empowering companies to strengthen the European industry without pressure for rapid exit strategies.

Small companies in photonics can certainly thrive, primarily by focusing on niche markets that benefit from specialised, highly innovative solutions; markets where agility and deep expertise offer competitive advantage. However, competing broadly in key sectors without scale may become increasingly difficult. Many small companies face limitations accessing large contracts or international customers due to scale-related barriers. Therefore, consolidation may offer a pathway for small companies to grow beyond niche roles and compete at the global level.

For more than 20 years, EPIC has worked to build a strong and interconnected European photonics industry. Consolidation, when guided strategically, is not a threat but an opportunity to secure Europe's leadership, retain our knowledge and jobs, and ensure that the next generation of photonics innovation continues to advance from Europe to the world. EO


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