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**review**

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Manchester, United Kingdom

30 - 31 October 2024

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## Welcome to Photonex 2024

**SPIE Photonex, the number one conference and exhibition in the UK photonics calendar, for the first time is taking place at the Manchester Central Convention Complex, between 30 - 31 October. Following is a preview some of the key conferences and hot topics.**

This year's SPIE Photonex offers a great opportunity to learn about the latest developments in research covering photonics, quantum technologies, and more; to see first hand the latest solutions, components, instruments, and systems; and to network with the movers and shakers from across the industry.

The conference and exhibition brings the whole supply chain together, including supplier companies, consultants, industrial users, researchers, science groups, and innovative start-ups. In the associated free exhibition there is the opportunity for delegates to see in one place the latest products and solutions from across the industry.

Attendees will be able to meet with representatives from leading companies, connect with colleagues, and learn the latest advances in photonics, biophotonics, quantum technologies, lasers, optical technologies, materials analysis, nanotechnology, thin film coatings, and more.

### Technical programme

Key pillars of SPIE Photonex are its Technical Programme, which this year offers tracks on silicon photonics and quantum

technologies (pages 12, 13, 16, and 17); and its Marketplace sessions (pages 18–21), in which attendees will learn about the latest research into these key branches of the subject, and where photonics applications and funding opportunities are making a significant difference to our futures – not just as industry players but as consumers and citizens in the wider world.

In Wednesday's first conference session, entitled Emerging Applications in Silicon Photonics I, attendees will learn about the application and commercialisation considerations for emerging applications in silicon photonics. The sessions include: Future Communications (chaired by Callum Littlejohns, Univ. of Southampton, UK), Heterogeneous Integration (Léopold Viro, CEA-LETI, Univ. Grenoble Alpes, France), and Artificial Intelligence (Lia Li, Zero Point Motion, UK).

Thursday's Silicon Photonics II session will consider the technology's application to lidar and sensing (chaired by Marc Sorel, Univ. of Glasgow, UK), photonic integrated circuit (PIC) manufacturing (Iain Crowe, Univ. of Manchester), and integrated photonics (Katherine Bryant, VTT, Finland, and Liam O'Faolain, Munster Technological Univ. and Tyndall National Institute, Ireland).

On the quantum photonics track, Wednesday's session, introduced by Denise Powell, of the UK's Compound Semiconductor Centre, will cover application drivers – quantum system integrators will share key considerations driving quantum photonic device requirements for quantum timing, navigation, sensing and computing.

As part of this session, there will also be the opportunity on Wednesday to tour the nearby Photon Science Institute, at the University of Manchester.

Thursday's quantum photonics sessions will continue with application drivers, followed by sessions on: Packaging and Integration: Highlights and challenges associated with improving quantum component/module performance whilst reducing size, weight, power and cost (also by Denise Powell); and Components: Novel developments in device design and architectures driving improvements in noise, stability and performance, chaired by Mohsin Haji, of the Univ. of Manchester.

Marketplace sessions on both days will cover a range of commercially focused sessions, including Wednesday's panel session on the UK Government's spending priorities, featuring SPIE Photonex regulars John Lincoln (of the UK's Photonics Leadership Group), Simon Andrews, of Fraunhofer UK, and Iwan Davies, of IQE.

Thursday's Marketplace session will also feature John Lincoln speaking on Modern Marketing Techniques to Reach Photonics Customers, alongside Mark Elliott, of Europa Science, and Rob Fisher, Sales Director of optics.org.

Besides all of the "tell", there will be plenty of "show", with an industry exhibition featuring almost 40 key companies and organizations. See more about this in our extended guide on pages 23–27. optics.org is one of the exhibitors, of course, so if you are attending the event, please come and meet us!

Author:  
Matthew Peach, Editor in Chief, optics.org



Credit: SPIE

SPIE Photonex 2024: Bringing the whole supply chain together.

## NCT/UCC Dresden receives \$2.2 million for tumor imaging

Support from Chan Zuckerberg Initiative will improve SWIR imaging in deeper tissue layers.

An international project group from the National Center for Tumor Diseases Dresden (NCT/UCC Dresden), UCLA and Imperial College London has received new funding for work on tumor imaging.

The \$2.2 million award from the Chan Zuckerberg Initiative continues its support for the researchers' work on the use of short-wave infra-red (SWIR) imaging in the diagnosis and treatment of cancers.

Several imaging techniques currently used in biological research cannot penetrate into deeper tissue layers, commented the Dresden team about the award, so in cancer treatment remnants of tumors or

individual cancer cells at tumor margins and in lymph nodes are not visible.

Doctors performing surgery are therefore repeatedly faced with the difficult question of whether all of the affected tissue has actually been removed.

SWIR has been recognized as a possible solution to this for some time. In 2023 a team at University College London used SWIR as an improved way to identify tumors, exploiting the diminished interference from autofluorescence of biological tissues at those wavelengths.

At the time UCL noted that a lack of clinically approved SWIR fluorophore

dyes was a barrier to clinical translation of SWIR techniques, but the decreased cost of InGaAs sensors used in the imaging of these wavelengths had stimulated development of devices suitable for deployment.

The Dresden project is investigating the lower scattering experienced by SWIR photons as they travel through tissues, allowing those photons to penetrate deeper and ultimately lead to improved visualization of tissue structures. In 2023 Oliver Bruns and Dresden colleagues used SWIR to fluorescence-image peripheral organs in awake and freely moving mice, intending it as a step towards functional neuroimaging of living animals.

### Improved radiation assessment through optical imaging

"In cancer research in particular, the unprecedented sensitivity of imaging using short-wave infrared light, fluorescent dyes and state-of-the-art cameras may enable us to make even just a few cancer cells clearly visible," commented Bruns from NCT/UCC Dresden's Department of Functional Imaging in Surgical Oncology about the new funding.

"Our goal is to precisely detect and remove even the smallest tumor remnants in the future."

The research team will use the new funding to carry out further fundamental studies and utilize novel physical effects in order to identify the optimal conditions for short-wave infrared imaging. To this end, they are working on the design of special Raman probes and a "visionary microscope that will overcome the limitations of previous microscopy techniques."

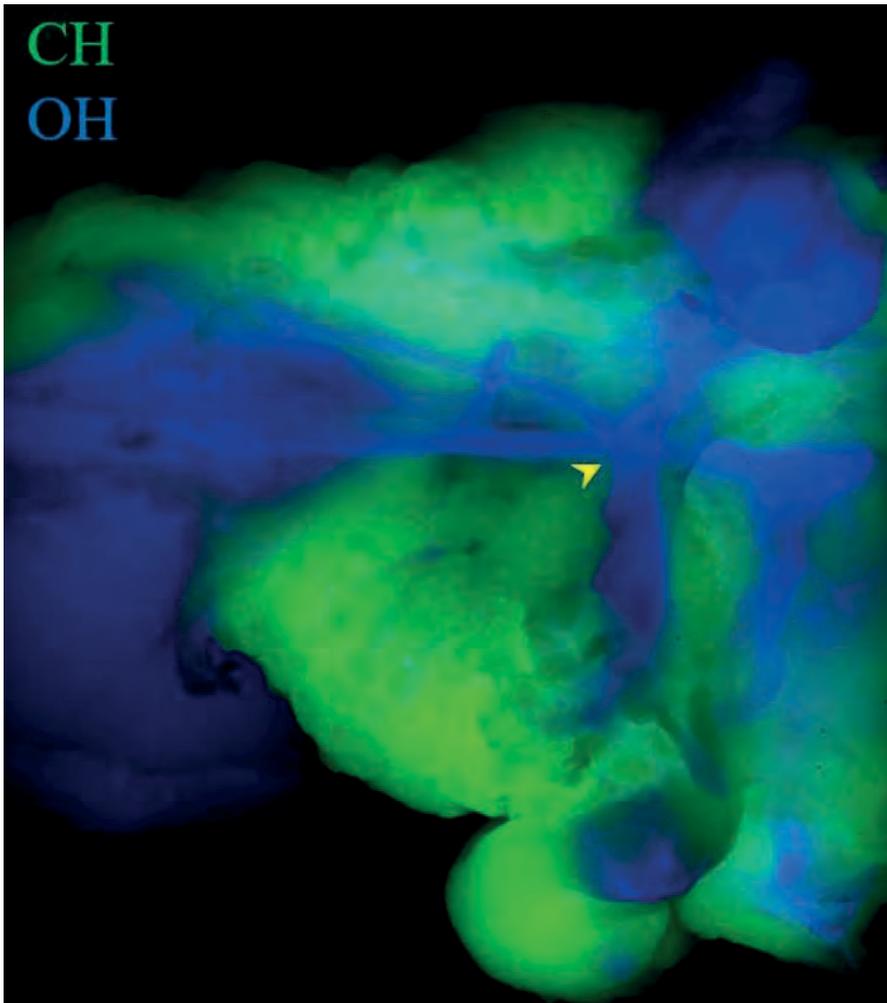
These innovative technologies could be used in various areas of biological research and medical diagnostics and, for the first time, enable the non-invasive microscopic examination of deeper tissue layers, according to the researchers.

This approach should bring other related advantages too, including the prospect of radiologists being able to better calculate the target volume of radiation during treatments and so lower the risk of incorrect dosage.

"To date the basis for this radiation assessment has been conventional imaging techniques such as MRI," commented the project. "We were not able to detect tumor spread in this way. This scientific approach is therefore an essential step towards improved therapy."

Author:

Tim Hayes, Contributing Editor, [optics.org](http://optics.org)



Credit: Bernardo Aclus/FBOO/NCT Dresden.

SWIR Raman imaging of the areas with OH and CH chemical bonds in a surgical model of a facial nerve embedded in adipose tissue.

## Emergent Photonics Research Centre opens at Loughborough University...

...and Southampton secures £4.6M EPSRC grant to develop X-ray microscope.

Loughborough University, in the UK, has launched a new research centre "dedicated to revolutionizing science and technology through photonics".

The Emergent Photonics Research Centre is a 600 m<sup>2</sup> facility, home to a team of researchers focused on advancing ultra-fast nonlinear optics and complexity, and creating technologies with applications ranging from quantum physics to biology.

The Center's research agenda includes developing photonic technologies, such as microcombs, to create accurate, portable devices for positioning, timing, and navigation. These devices will operate independently of GPS infrastructure.

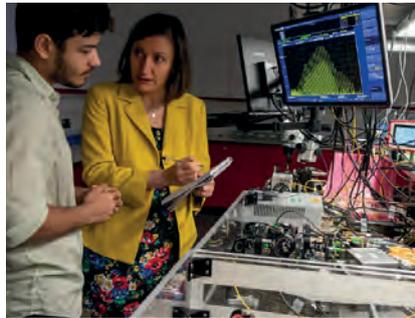
Another research priority is using terahertz waves to develop novel technologies. The Emergent Photonics Research team is already developing a terahertz wave camera capable of imaging microscopic items hidden inside 3D objects, with potential applications in medical diagnostics, security, and materials research.

Ongoing research projects are also exploring how artificial intelligence can be used to enhance control of photonic systems and how such systems can be used as fast and efficient deep-learning networks, a type of artificial intelligence modelled after the human brain's structure.

### 'Singular vision'

At an opening ceremony on Tuesday 11 June, academics and representatives from major UK funders, research councils, and research entities enjoyed a firsthand look at the center's facilities and a series of presentations.

Center Director, Professor Marco Peccianti, announced, "The Emergent Photonics Research Centre has a singular vision: to



*The Emergent Photonics Research Centre is home to a team of researchers focused on advancing ultra-fast nonlinear optics, complexity, and photonics knowledge. Pictured from right to left is Professor Alessia Pasquazi, Professor of Nonlinear Optics, and PhD student Debayan Das.*

harness the transformative power of Photonic Complexity to explore and manipulate natural phenomena, creating groundbreaking technologies in the process.

"We are inviting the global scientific community to join us at the frontier of discovery. We aim to become an incubator for innovation, where scholars, industry experts, and institutions from around the world can collaborate on pioneering research that bridges the gaps between disparate scientific domains."

Professor Nick Jennings, Vice-Chancellor and President of Loughborough University, commented, "The Emergent Photonics Research Centre represents a significant advancement in the innovative work being done in the field of photonics in the UK. The Centre's research will deepen our understanding of nature's complexities and drive the development of groundbreaking technologies with far-reaching impacts across multiple fields."

Professor Claudia Eberlein, Dean of the School

of Science, added: "Loughborough has made a major investment in establishing this large and highly sophisticated center in order to be at the forefront of photonics developments. Projects that have already started range from fundamental metrology to advances in communications technology and novel pathways of investigating living organisms."

### Southampton secures grant to build an X-Ray microscope

The University of Southampton has secured a £4.6 million (\$5.9 million) strategic equipment grant to pioneer the development of an innovative X-ray microscope from the UK's Engineering and Physical Sciences Research Council (EPSRC).

Led by Professor Jeremy Frey from the School of Chemistry and bolstered by the expertise of Dr. Bill Brocklesby from the Optoelectronics Research Centre (ORC), this project is also supported by the Rosalind Franklin Institute and the UK Central Laser Facility (CLF).

Over the next four years, this grant will fund the construction of an X-ray microscope, marking a significant departure from traditional light-based microscopy techniques. Once completed, the microscope will be housed in the Research Complex at Harwell.

Dr. Brocklesby commented, "This grant will allow us to apply the techniques that we've developed since this collaboration was started by the 'Basic Technologies' program, two decades ago."



*Strategic equipment grant for Southampton.*

Prof Frey added, "The grant is a good example of the collaboration between the University and the Harwell Campus. The Harwell site is ideal for the instrument development because of the synergies with the imaging technologies available at the RFI, Diamond, ISIS and the CLF alongside the extensive computational facilities."

Professor Angus Kirkland, Science Director for Correlated Imaging at the Rosalind Franklin Institute, said, "This project is exactly what the Rosalind was set up to enable – it will create the order of magnitude increase in both spatial resolution and data acquisition time, which will enable the imaging of hydrated samples with minimal sample damage. We are looking forward to working with colleagues at University of Southampton, the Central Laser Facility, and the Research Complex at Harwell to make this instrument a reality."

Author:

Matthew Peach, Editor in Chief, [optics.org](http://optics.org)



*Academics and esteemed guests celebrating the Emergent Photonics Research Centre at the opening event.*

## British Army announces first on-vehicle trial of high-powered laser weapon

**Dstl, DE&S and industry have worked to develop capability “to prepare UK armed forces for the future”.**

For the first time, scientists and engineers have successfully fired a high powered laser energy weapon from a British Army combat vehicle. The ground-breaking test, conducted at Dstl’s range in Porton Down, UK, saw the laser weapon neutralize targets at distances in excess of 1km.

The high-energy laser weapon mounted on to a British Army Wolfhound armoured vehicle, represents a major leap forward in the UK Ministry of Defence’s Land Laser Directed Energy Weapon (LDEW) Demonstrator program, “providing increased operational advantage on the battlefield,” according to the Dstl statement.

The lightweight portable high energy laser system is the first laser weapon integrated on a land vehicle to be fired in the UK. The demonstrator will allow the Ministry of Defence along with the British Army to gain an understanding of the utility of LDEW systems against evolving threats.

### Army tests

The next phase of testing will involve trials with Army personnel later in 2024, further evaluating the system’s capabilities and benefits in real-world scenarios. The “low-cost” system is fully portable and easy to operate. It can track multiple targets and rapidly engage.

Dstl CEO Dr Paul Hollinshead commented, “This is another significant milestone in accelerating the adoption of directed energy weapons. Working ever closer with DE&S and industry to develop critical new capabilities, we are preparing the armed forces for the future so they can detect, disable and destroy future and novel threats.”

Team Hersa, which pairs Dstl’s technical expertise with the best acquisition skills from DE&S, is managing delivery of the demonstrators and is responsible for preparing Defence for the introduction of innovative weapons systems, ensuring the



The laser weapon is mounted on a British Army Wolfhound armoured vehicle.

UK Armed Forces can successfully exploit this potentially game changing capability at pace.

Matt Cork, Dstl Programme Lead, said, “The joint working between Dstl, DE&S and industry has enabled rapid evolution of this laser demonstrator. The successful testing of this high-powered laser weapon marks a pivotal moment in our ongoing efforts to enhance the future operational capabilities of the British Army. This technology offers a precise, powerful and cost effective means to defeat aerial threats, ensuring greater protection for our forces.”

The laser system, developed in collaboration with a consortium of UK suppliers, showcases the potential of advanced technology in modern warfare. It operates with a command and control system and can be integrated with wider battle management radar and surveillance systems. The weapon can be mounted on various platforms to meet different operational needs. The British supply chain includes: Raytheon UK, Frazer-Nash, NP Aerospace, LumOptica, Blighter Surveillance Systems, and Cambridge Pixel.

James Gray, chief executive and managing director of Raytheon UK, said, “In successfully firing the first laser weapon integrated on a land vehicle in the UK, Dstl has proven that the Raytheon high energy laser weapon system can track, engage and defeat targets whilst mounted on a vehicle. We now look forward to the British Army experimenting with the weapon over the coming months and proving that the technology is battlefield ready.”

Dstl’s research and development efforts focus on preparing UK Defence for future challenges and improving operational advantage. By collaborating with DE&S, industry, academia, and international allies, Dstl continues to address some of the most complex issues facing UK Defence.

Author:

Matthew Peach, Editor in Chief, optics.org



The UK’s first test of a High-Energy Laser Weapon System (HELWS) was successfully completed by Raytheon UK and the Defence Science and Technology Laboratory (Dstl).

## UK invests £100 million to boost five quantum hubs

**Aims include breakthrough tech developments in healthcare, cybersecurity and transport.**

Three weeks after winning power in July, the new UK Government announced £100 million (\$128 million) in funding for five new quantum technology research hubs. Stated aims include “Faster medical scanners, secure communication networks, and next-generation navigation systems.”

Announced by the Science Secretary Peter Kyle, on Friday July 26th, the hubs are intended to bring researchers and businesses together to use their scientific expertise alongside the commercial know-how and resources to develop quantum technologies in areas like healthcare, security, and clean energy.

The Science Secretary made the announcement on a visit to the University of Glasgow, which will lead one of the hubs aiming to develop quantum technologies for resilient position, navigation and timing systems in national security and critical national infrastructure.

Dr. Kyle commented, “We want to see a future where cutting-edge science improves everyday lives. That is the vision behind our investment in these new quantum technology hubs, by supporting the deployment of technology that will mean faster diagnoses for diseases, critical infrastructure safe from hostile threats and cleaner energy for us all.”

The new hubs will be centers for advancements in areas like quantum-enhanced blood tests, faster MRI scanners, and new surgical interventions and treatments. They will also explore technologies crucial for national security. This could see aircraft operating with improved positioning systems that are resistant to GPS jamming, or submarines able to operate for extended periods without relying on satellites.

Additionally, says the Government statement, “research into a quantum internet could create secure and future-proof communication networks, safeguarding sensitive data and communications infrastructure – helping protect citizens and the economy.”

### Hubs and focuses

- Biomedical Sensing Research (University College London and University of Cambridge): Explores quantum sensors for

ultra-sensitive disease diagnosis, including rapid blood tests, and biomedical scanners to facilitate earlier diagnosis and treatment of diseases such as cancer and Alzheimer’s disease.

- Sensing, Imaging and Timing (University of Birmingham): Focuses on the development of quantum sensing for practical applications - brain scanners for dementia, cancer diagnostics, and advanced security and infrastructure monitoring.
- Integrated Quantum Networks (Heriot-Watt University): Aims to deliver the technologies for a future UK-wide ‘quantum internet’, enabling future-proof cybersecurity and powerful distributed quantum computing.
- Quantum Computing via Integrated and Interconnected Implementations (University of Oxford): Develops technologies for building quantum computers, advancing UK capabilities across hardware and software and targeting applications in a wide range of industry sectors.
- Quantum Enabled Position, Navigation and Timing (University of Glasgow): Creates quantum-based positioning and navigation systems for critical infrastructure,

autonomous vehicles, and improved indoor and underwater navigation.

The hubs will be delivered by the UKRI Engineering and Physical Sciences Research Council (EPSRC), with a £106 million investment from EPSRC, the UKRI Biotechnology and Biological Research Council, UKRI Medical Research Council, and the National Institute for Health and Care Research.

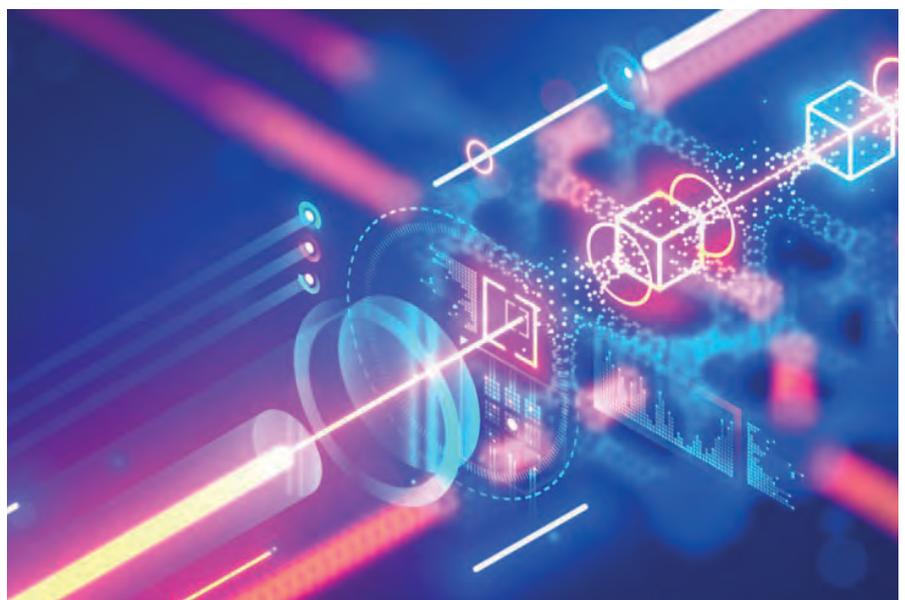
Professor Gerald Buller, Director of the IQN Hub, said, “The Integrated Quantum Networks Hub will provide the underpinning research required towards the establishment of a UK-wide quantum network. Establishing a widescale quantum internet could have impact across all sectors, predominantly allowing future-proof security for data communications, as well as linking up quantum computers and sensors.”

Professor Rachel McKendry, Co-Director of the Q-BIOMED Hub, said, “We are bringing together an outstanding team of researchers from academia, the NHS, charities, government, regulators and industry to help accelerate advances in quantum for human health and societal good. The ultimate beneficiaries of earlier diagnosis will be patients through faster access to life-saving treatment, and the NHS through more cost-effective models of care.”

Professor Douglas Paul, Project Lead for the QEPNT Hub, said, “This new hub will support the development of new and improved forms of atomic clocks, quantum gyroscopes and quantum accelerometers. Those technologies, integrated into portable and affordable future devices, will help reduce our reliance on satellites by providing new ways to locally measure position, navigation and timing.”

*Author:*

*Matthew Peach, Editor in Chief, optics.org*



*Quantum opportunities.*

## UCL laser printing creates sensors inside chicken embryos

**Two-photon process creates elastic spring structures responding to physical forces during growth.**

A project at University College London (UCL) and the University of Padua has created mechanical force sensors directly in the developing brains and spinal cords of chicken embryos.

Published in *Nature Materials*, the breakthrough could lead to better understanding and prevention of birth malformations such as spina bifida.

The mechanical forces exerted by the embryo during its development are crucial to the formation of organs and anatomical structures, such as the creation of the neural tube that ultimately gives rise to the central nervous system.

Monitoring these “morphogenetic” forces in living embryos has been challenging, and although methods to quantify mechanical or tensile stresses within individual large cells have been developed, a method to quantify dynamic tissue-level forces has been missing, said the project team.

“The force sensor technology must be compatible with embryo development to provide mechanical read-outs over developmentally relevant time frames of several hours, not seconds to minutes,” said the project in its paper. “Sensor size, spatial

position and orientation should be precisely controllable through in situ microfabrication at cell-level and tissue-level length scales during live imaging.”

The team’s answer was to apply laser bioprinting and create elastic shapes within the embryos through two-photon polymerization of a suitable material, expanding on previous research at the University of Padua into intravital 3D (i3D) bioprinting operations.

In 2020 a Padua project demonstrated that an i3D technique could successfully crosslink gelatin constructs to support and organize cell development, and create millimeter-scale structures under the epidermis of the skin in mice.

### Advanced microscopy and novel biomaterials

The new project has built on this work, redeveloping the technique to enable micrometer-scale photo-crosslinking of biocompatible photo-active polymers in a three-dimensional elastic hydrogel, to suit the demanding and fragile environment of a developing embryo and in particular the folds of the developing neural tube.

Two-photon bioprinting was identified as the route to crating the 3D shapes with high positional and structural accuracy directly in chick embryos, crosslinking a i3D polymer introduced into the area of interest. When exposed to a strong laser, the liquid transforms into a spring-like solid attached to the growing spinal cord of the embryos and deformed by the mechanical forces produced by the embryo’s cells, said the project.

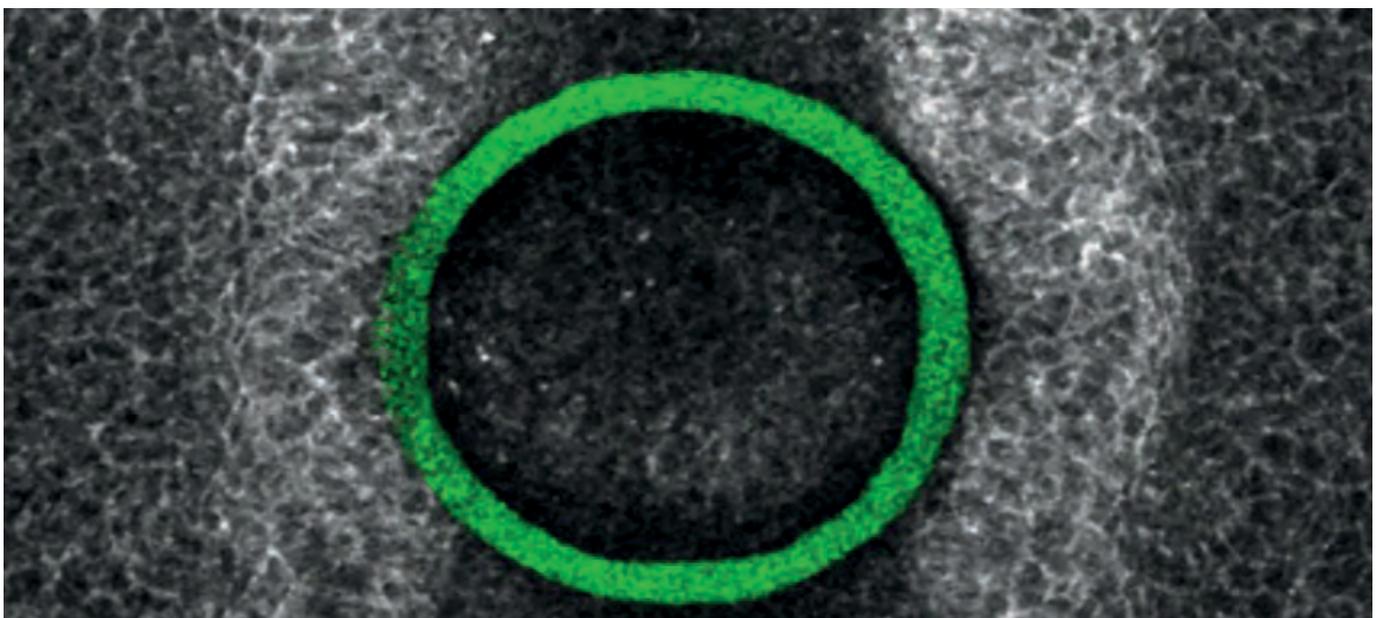
“We adapted i3D bioprinting to create elastic, compliant shapes anchored to the closing neural folds, such that their deformation serves as a read-out of forces generated by medial apposition of the neural folds. We refer to these structures as intravital mechano-sensory hydrogels (iMeSHs).”

A combination of live imaging and mechanical modelling was used to monitor the deformation of the new structure during embryo development. This let researchers observe the forces involved in normal growth of the neural tube, and also start to investigate whether pharmaceutical intervention might increase positive forces or decrease negative ones enough to help prevent malformations such as spina bifida.

“Thanks to the use of novel biomaterials and advanced microscopy, this study promises a step change in the field of embryonic mechanics and lays the foundation for a unified understanding of development,” commented lead author Eirini Maniou. “Our work paves the way for identifying new preventative and therapeutic strategies for central nervous system malformations.”

Author:

Tim Hayes, Contributing Editor, *optics.org*



*iMeSH shapes printed between chick embryo neural folds.*

## Artificial intelligence enhances super-resolution microscopy

**New Anglo-German generative model is more efficient than established approaches.**

Computational methods and algorithmic data processing are an important aspect of super-resolution microscopy, but a new approach to the task could offer a route to enhanced imaging.

A joint project between the Center for Advanced Systems Understanding (CASUS) at Germany's Helmholtz-Zentrum Dresden-Rossendorf, Imperial College London and University College London has used generative artificial intelligence (AI) to improve the quality of super-resolution images.

Generative AI is the principle behind current text- or image-creating applications such

as ChatGPT or Stable Diffusion, whereby a machine learning operation does not simply perceive and classify the data it receives, but expands upon it to create further data within controlled restraints.

The CASUS project's open-source generative AI algorithm, called a Conditional Variational Diffusion Model (CVDM), "improves the quality of images by reconstructing them from randomness" according to the researchers, and is computationally less expensive than established diffusion models.

"Diffusion models have long been known as computationally expensive to train;

some researchers were recently giving up on them exactly for that reason," commented Artur Yakimovich from CASUS. "But new developments like our CVDM allow minimizing of 'unproductive runs' which do not lead to the final model. By lowering the computational effort and hence power consumption, this approach may also make diffusion models more eco-friendly to train."

Super-resolution microscopy, in which imaging is possible below the notional diffraction limit, could be one valuable area of application for CVDM, since techniques such as structured illumination microscopy still face inherent hurdles relating to information loss and noise despite the strides made in performance.

### Immediate applicability to medical microscopy

CVDM is intended to minimize the unproductive runs during computation, and designed so that during the training phase the model is capable of finding the optimal training for noise reduction in a particular task on its own, without programmers needing to work through overall noise reduction "schedules" first via trial and error.

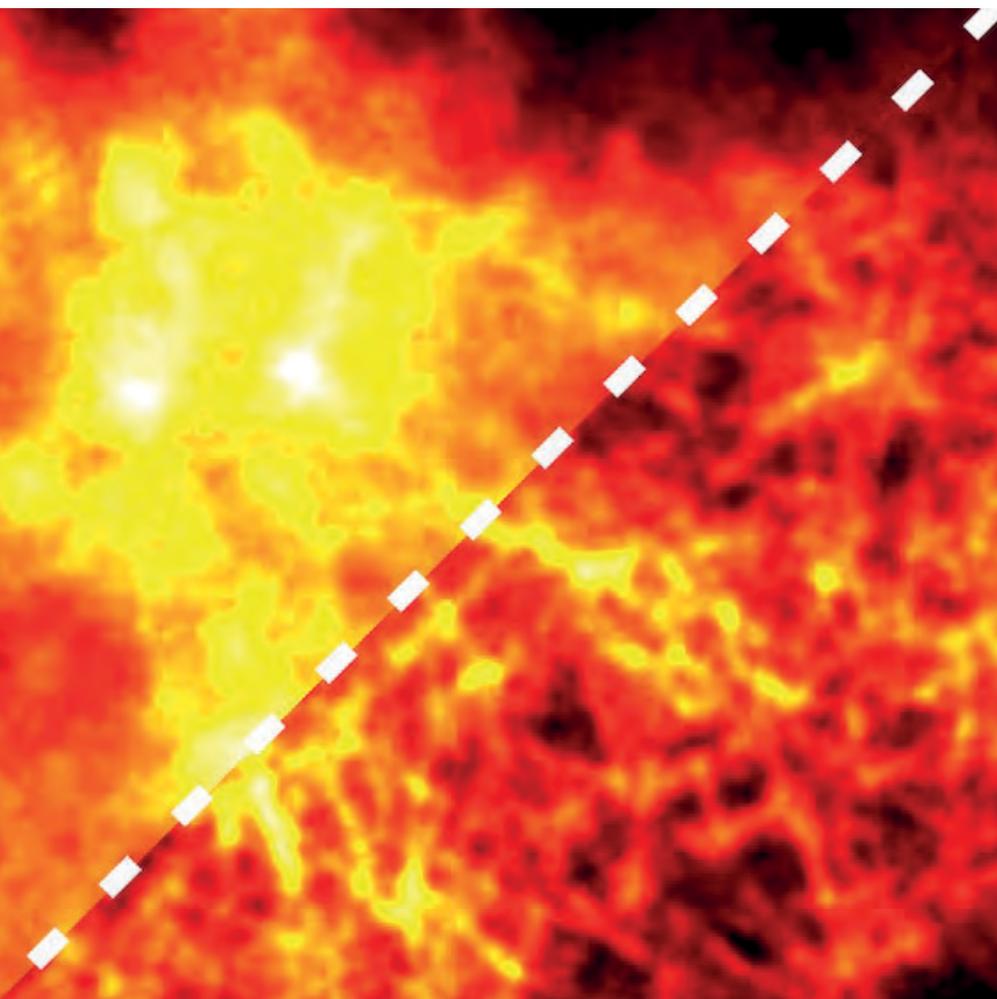
In tests applying CVDM to super-resolution images and structured illumination super-resolution microscopy, the project found that it could improve resolution by 4.42 percent when compared against existing diffusion probabilistic methods, and by 26.27 percent compared to a regression-based method.

Tests using clinical images of epithelial and urinary cells showed that a CVDM approach has "immediate applicability to medical microscopy," noted the project.

"We believe our approach has some new unique properties, namely high flexibility and speed at a comparable or even better quality compared to other diffusion model approaches," said Artur Yakimovich. "In addition our CVDM provides direct hints where it is not very sure about the reconstruction; a very helpful property that suggests the path to addressing these uncertainties in new experiments and simulations."

Author:

Tim Hayes, Contributing Editor, [optics.org](https://www.optics.org)



Credit: A. Yakimovich/CASUS.

A fluorescence micrograph taken from the open BioSR super-resolution microscopy dataset.

## Heriot-Watt team breaks ground on optical ground station

**£2.5M facility to demonstrate quantum-secured satellite links and explore laser clean-up of space debris. By Mike Hatcher, Business Editor, optics.org**

Work has begun on a new optical ground station in Scotland that is expected to demonstrate and test quantum-encrypted satellite communications using state-of-the-art optics technology.

The Edinburgh Quantum Communications Hub Optical Ground Station (HOGS), which is being built at Heriot-Watt University's Research Park, is scheduled to be fully operational later this year.

The university says that the facility will be used to explore sending ultra-secure transmissions to satellites with optical links, and to investigate new ways to search for space debris - and potentially use lasers to remove such debris from orbit.

Comprising a 4.5 meter robotic observatory dome and a 70 cm-wide observatory reflective telescope, HOGS will be able to track the paths of low-Earth orbit satellites and receive quantum signals - with adaptive optics used to further enhance its capability.

### Quantum network and space debris

"The facility will feature a plethora of cameras, sensors, and other photonic technologies enabling HOGS to expand how it can be used for both UK-based and international researchers and industry contacts," announced the institution, which is part of a consortium alongside Bristol, Strathclyde, and York universities.

Led by assistant professor and quantum communications expert Ross Donaldson, HOGS will also establish a direct connection to a new optical fiber network on the Heriot-Watt campus, allowing other researchers to demonstrate optical, quantum, and hybrid communication approaches.

"The new capabilities will support space environmentalism by finding debris, accurately tracking satellites, developing new techniques to find objects that haven't been seen before, and improving [object] identification," added Heriot-Watt.

"The telescope may also open



(l-r): Graham McPhail, Professor Gillian Murray, Dr Ross Donaldson, and Professor Gerald Buller from Heriot-Watt University at a ground breaking ceremony for the forthcoming optical ground station.

opportunities for teams to explore new de-orbiting techniques for small space-debris using lasers."

HOGS is part of the wider Quantum Communications Hub project, one of four thematic efforts on emerging quantum technology that received significant funding in the UK over the past decade.

Aside from the involvement of four universities, it benefits from space engineering expertise provided by the UK Science and Technology Facilities Council's RAL Space Facility.

Other UK researchers with relevant interests in experimental satellite quantum communications will be invited to work onsite using the HOGS telescope to track satellite paths with high precision, says

Heriot-Watt, adding that undergraduate and postgraduate students will benefit from the new capability.

Local school children will also be hosted on the site to promote the wider knowledge and understanding of satellite communications and astronomy.

### Global connectivity

In a release from Heriot-Watt, Donaldson

said: "We want to show that UK scientists have the capabilities to deliver satellite quantum-based communications and have the expertise to do all the required operations.

"Creating secure global connectivity is the goal and we look forward to demonstrating our abilities once the Optical Ground Station is up and running.

"Our high latitude location offers us the chance to track space junk and debris in polar orbits for long periods of time, which may allow us to identify smaller objects."

University of York professor Tim Spiller, who is also the director of the Quantum Communications Hub, added: "Satellites

*continued page 11*

continued from page 10

## Heriot-Watt team breaks ground on optical ground station

will form an essential part of future worldwide quantum communications, and in-orbit demonstrator missions are essential in proving the UK's capabilities as a leader in secure quantum communications.

"The ground-based receiver is clearly a key element of any mission, and we look forward to HOGS becoming operational at Heriot-Watt University."

### UK's new quantum hubs

News of the HOGS ground-breaking comes a month after Heriot-Watt said it would also head up a new quantum research effort known as the Integrated Quantum Networks (IQN) Hub, under the leadership of Professor Gerald Buller.

It is one of five new quantum technology hubs announced by the UK government as



The Heriot-Watt team, pictured with optics and photonics equipment that will be installed in the new HOGS facility to enable quantum-secured satellite links.

Photo: Heriot-Watt University.

part of the latest £160 million investment (including £54 million of in-kind support from industry) to ensure the UK remains at the forefront of the potentially revolutionary technologies following the initial decade-long effort.

Aside from IQN, the new hubs are focused on biomedical diagnostics (Q-BIOMED); sensors, imaging, and timing (QuSIT);

quantum computing (QCI3); and quantum-enabled position, navigation, and timing applications (QEPNT).

The IQN hub is set to undertake research towards the ultimate goal of a 'quantum internet', with globally interlinked quantum networks connecting multiple quantum computers to produce enormous computational power.



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# Technical Topic: Emerging Applications in Silicon Photonics

Learn about the application and commercialisation considerations for emerging applications in silicon photonics! Today's sessions include future communications, heterogeneous integration, and artificial intelligence.

Wednesday 30 October 2024 • 09:00 - 16:00 GMT | Manchester Central, Central Hall, Room 5 Central

## Session 1: Future Communications

Session Chair: Callum Littlejohns, Univ. of Southampton (*United Kingdom*)

9:00 - 9:45

### Keynote Presentation: THz fast, nanometer small: plasmonic photonic integrated circuits on silicon

Wolfgang Heni, co-CTO, Polariton Technologies AG (*Switzerland*)

Plasmonic photonic integrated circuits (plasmonic PICs) are at the forefront of silicon-photonics innovation, paving the way for the next generation of high-speed integrated photonics. We reveal the latest insights into their performance, reliability, and loss metrics, showcasing how plasmonic modulators are set to power future optical interconnects at staggering speeds of 1.6T, 3.2T, and beyond.

9:45 - 10:15

### High-speed and high-efficiency silicon optical modulators

David Thomson, Optoelectronics Research Ctr., Univ. of Southampton (*United Kingdom*)

Our recent results on high performance silicon optical modulators will be presented including world leading integrated devices in terms of speed and power consumption.

10:15 - 10:45

### Fourier transform accelerators using integrated photonics

Imon Kundu, Optalysys (*United Kingdom*)

At Optalysys, we have developed a scalable photonic computing architecture by accelerating Fourier transforms using silicon photonics. The photonic integrated circuits along with electronic feedback logic and reconstruction algorithms allow us to compute Fourier transforms of any size and precision. The quad photonic Fourier transform cores form the basis of our QSFP/OSFP pluggable products, as well as chiplets with densely packed photonic cores for extreme Fourier transform acceleration. The scalable nature of the photonic architecture has enabled us to design hardware accelerators for next generation data privacy technologies, such as Fully Homomorphic Encryption.

10:45 - 11:25

Coffee break in Exhibition, Central Hall

## Session 2: Heterogeneous Integration

11:25 - 11:55

To be confirmed

11:55 - 12:25

### III-V laser integration on silicon by direct bonding and regrowth for high-speed optical telecommunications

Claire Besançon, III-V Lab, a joint lab, Nokia Bell Labs, Thales and CEA-LETI (*France*)

We will report III-V laser integration on silicon by InP-seed bonding and regrowth for high-speed optical telecommunications. The key steps of this emerging III-V/Si integration scheme and associated challenges, such as hydrogen desorption and thermal strain induced on the III-V stacks at growth temperature, will be presented. Finally, results obtained from laser fabricated from III-V  $\mu\text{m}$ -regrowth on a planar InP-seed layer bonded on a SOI wafer will be discussed according to the state of the art.

12:25 - 12:55

### III-V quantum dot laser grown on Si for Si photonics

Huiyun Liu, University College London (*United Kingdom*)

Si is one of the most important semiconductor materials. Although it has been the mainstay for modern electronics, it is not widely used for light emitting sources because bulk Si is an inefficient emitter. Direct epitaxial growth of III-V compound nanostructures on Si substrates is one of the most promising candidates for realizing photonic devices on a silicon platform. High performance III-V quantum dot (QD) lasers grown on Si and Ge substrates have been developed since 2011. In this presentation, the development milestones of InAs/GaAs QD lasers monolithically grown on a Si platform will be summarised, and the potential trend in next few years will also be predicted.

12:55 - 14:15

Lunch concessions available for purchase in Exhibition, Central Hall

## Session 3: Artificial Intelligence

14:15 - 14:45

### How lossless and high bandwidth optical circuit switches can enable a new generation of efficient and highly scalable AI data centres

Chris Porthouse, CPO, Saliency Labs (*United Kingdom*)

As AI compute clusters scale ever larger and the demand for network bandwidth to feed data to these clusters increases, the cost, power, and thermal demands of providing a network fabric using electrical switches and copper are becoming increasingly untenable.

Optical circuit switches (OCS) are being deployed as an alternative to electrical switches, significantly lowering cost and power, while enabling higher throughput. However, designing a reliable optical switch that is capable of volume deployment and meeting the advanced requirements of multiple data centre AI customers presents unique challenges.

We will discuss these demands and how Saliency Labs' ground-up OCS design addresses them, in addition to the use cases our lossless, high bandwidth, broadband switch enables.

14:45 - 15:15

### Variational optical processors

Charles Roques-Carmes, Stanford Univ. (*United States*)

Programmable arrays of Mach-Zehnder interferometers (MZIs) represent a cutting-edge platform in integrated photonics, facilitating a wide range of applications in both classical and quantum photonics. These applications span from boson sampling to neural network inference and automatic learning of communication channels. Notably, self-configuring MZI arrays enhance functionality by enabling deterministic learning of communication channels through a finite sequence of measurements and adjustments. In this talk, I will introduce an approach coined "variational optical processing," which consists in mapping modal representations of an incident light field onto a variational optimization of the network's output. This method enables the system to autonomously identify and optimize various "modes" of light, thereby facilitating the decomposition of partially coherent light fields into mutually incoherent components, the separation of entangled photons into Schmidt modes, and the efficient learning of communication channels. The versatility, efficacy, and robustness of variational optical processing promise substantial advancements in the analysis of both classical and quantum optical light fields across diverse physical settings.

15:30 - 16:00

Presentation in Central Hall, Stage 1

Support for UK businesses at Photonics West and Laser World of Photonics

# Technical Topic: Emerging Applications in Silicon Photonics

Learn about the application and commercialisation considerations for emerging applications in silicon photonics! Today's sessions include LiDAR & Sensing, PIC Manufacturing, and Integrated photonics.

Thursday 31 October 2024 • 09:00 - 14:55 GMT | Manchester Central, Central Hall, Room 5 Central

## Session 1: LiDAR and Sensing

Session Chair: Marc Sorel, Univ. of Glasgow (United Kingdom)

9:00 - 9:45

### Keynote Presentation: Silicizing the fiber optical gyro

Avi Feshali, Anello Photonics, Inc. (United States)

Anello Photonics is a Silicon Valley-based startup developing next generation navigation technologies. The heart of the Anello's products is the silicon photonics optical gyro, the SiPhOG™ which is a 10X reduction in SWAP-C compared to current products. Over the past years ANELLO partnered with a high volume fab in the US to build state of the art silicon nitride process technology to enable ANELLO's products. In this presentation I will give an overview of optical gyro technology and discuss various design choices for optical gyroscope architectures and their impact on performance. Finally, we will highlight the performance SiPhOG—with an angular random walk of 0.05 °/hr and a bias instability of 0.5 °/hr—and demonstrate its ability to measure earth rate. Additionally I will present an overview of adjacent technologies that are enabled through our silicon nitride process technology and go over the capabilities.

9:45 - 10:15

### Hybrid InP/SiN photonic circuits for RF and optical sensing

Frédéric van Dijk, III-V Lab (France)

We will present the developments carried out at III-V lab in collaboration with CEA-Leti on the hybrid integration of III-V chips with ultra-low-loss silicon nitride circuits for optical detection and RF systems. Different types of hybrid circuits will be presented: 1- a narrow linewidth laser based on the combination of an InP R-SOA and a long Bragg grating on SiN, 2- a Kerr frequency comb based on a high-power InP DFB laser butt-coupled to a high-Q SiN micro-ring, 3- a long cavity mode-locked laser based on an R-SOA and a SiN circuit with a delay line and a Bragg grating. We will also present recent progress in hybrid integration using flip-chip assembly of the III-V chip on SiN circuits.

10:15 - 10:45

### Recent advances in silicon photonic devices harnessing nonlinearities and AI

Carlos Alonso Ramos, C2N, CNRS (France)

We will present our most recent advances in the use of nonlinearities for the development of advanced photonic devices. We will also discuss the use of AI for the design and optimization of devices and circuits.

10:45 - 11:15

### Coffee break and networking in Exhibition, Central Hall

## Session 2: PIC Manufacturing

Session Chair: Matthew Halsall, Univ. of Manchester (United Kingdom)

11:15 - 11:45

### Introducing the CORNERSTONE Photonics Innovation Centre (C-PIC)

Graham Reed, Univ. of Southampton (United Kingdom)

The CORNERSTONE Photonics Innovation Centre (C-PIC) is a new EPSRC Innovation & Knowledge Centre (IKC) that strives to take silicon photonics research to everyday life. Hosted by the Universities of Southampton & Glasgow, along with STFC, C-PIC will build on the CORNERSTONE open-source foundry service to provide a wide range of support for researchers and entrepreneurs including advanced design training, support for commercialisation, test services, and lots more. This talk will outline opportunities for you to engage with the programme.

### 11:45 - 12:15 Micro-transfer printing for heterogeneous silicon photonic integrated circuits

Gunther Roelkens, Ghent Univ., imec (Belgium)

Hear about our progress in using micro-transfer printing for the heterogeneous integration of III-V semiconductors and LiNbO<sub>3</sub> on silicon photonic integrated circuits.

Programme current at time of print.

12:15 - 12:45

### Integrated photonic packaging: from prototype to production scale up

Jeroen Duis, PHIX Photonics Assembly (Netherlands)

Photonics packaging starts with development of early prototypes, for this initial cost and lead times are critical for companies and in order to get first working demonstrators in hands of customers. Limiting Non Recurrent Engineering cost and adhering to delivery is times are critical. Therefore PHIX has been working on design guidelines and rules, these are allowing for configurable packages and short lead times making the development cycle more predictable. When devices are ready and development iterations are performed one can go further with the development of the full device involving all engineering groups for the thermals, mechanical design, Electrical (RF), optical and last but not least all manufacturing processes. Putting all disciplines together in the design cycle and being well aware of the market requirements will make sure the optimal solution is selected.

12:45 - 13:55

### Lunch concessions available for purchase in Exhibition, Central Hall

## Session 3: Integrated Photonics

Session Chair: Claire Besançon, III-V Lab, a joint lab, Nokia Bell Labs, Thales and CEA-LETI (France)

13:55 - 14:25

### Demonstration of zero birefringence in 3 μm-thick SOI for datacomm applications

Katherine Bryant, VTT (Finland)

Polarization-independent PIC operation is critical for a range of applications, such as quantum networks and in data centers that utilize polarization division multiplexing. Measurements in 3 μm-thick SOI for both effective and group index birefringence and their dispersion at 1550 nm are presented. Strip waveguide dimensions to achieve a value of zero for each of those four parameters is shown. The dependence on strip waveguide width of zero effective index birefringence wavelength is elucidated.

14:25 - 14:55

### Photonic integrated circuit-assisted photothermal spectroscopy of gas and liquids

Liam O'Faolain, Munster Technological Univ. and Tyndall National Institute (Ireland)

Liam O'Faolain (William Whelan-Curtin) leads the Nanophotonics Group in MTU's Centre for Advanced Photonics and Process Analysis. His research group focuses on developing efficient lasers and innovative sensors based on nanophotonics and integrated photonics. He spent 15 years at the University of St Andrews. In 2012, he joined the group of Prof. David A. B. Miller at Stanford University as an SU2P entrepreneurial fellow before returning to take up a lecturing position at St Andrews at the start of 2013. In August 2016 he re-located his research group to Munster Technological University. He is the author/co-author of more than 120 journal papers. His "h"-factor is 50. He co-ordinates the Horizon Europe Innovation action EVOQUE.

# Technical Topic: Application and Commercialisation Considerations for Quantum Photonic Components

Wednesday 30 October 2024 • 13:00 - 18:30 GMT | Manchester Central, Central Hall, Stage 2

**Session 1: Application Drivers: Quantum system integrators will share key considerations driving quantum photonic device requirements for quantum timing, navigation, sensing and computing.**

**Session Chair: Denise Powell**, Compound Semiconductor Centre (United Kingdom)

13:00 - 13:20

**Welcome and introductions**

**Denise Powell**, Compound Semiconductor Centre (United Kingdom)

13:20 - 13:40

**Holdover atomic clocks for PNT applications**

**Mohsin Haji**, National Physical Lab. (United Kingdom)

Holdover atomic clocks are an essential part of a robust and resilient timing network. They are atom- or ion-based local timing references that can provide resilient precision timing to critical national infrastructure (CNI) in place of Global Navigation Satellite Systems (GNSS) timing signals when disruptions occur. Holdover clocks can be used to mitigate against disruption to GNSS timing signals for Position, Navigation and Timing (PNT) applications, and can provide resilient timing where GNSS signals cannot be accessed. This presentation will provide an overview of the latest developments in holdover clock technologies, and expand on key photonics-related component requirements.

13:40 - 14:00

**Tiqker, from lab to fab; a system engineering journey**

**Marco Palumbo**, Infleqtion (United Kingdom)

Tiqker is Infleqtion's optical atomic clock to be launched as a product early 2025. In this talk I will focus on the effort conducted by the team at Infleqtion UK, Oxford, from lab to fab to create an UK made version of the Tiqker Prime. The road to productization pass via system engineering, a practise largely lost in the UK and that is often misunderstood or under appreciated. Here I will stress the importance to regain the manufacturing "spurs" that were once the pride of Great Britain, and how time is really one of the critical infrastructures we should really care about.

14:00 - 14:20

**Miniaturization using Advanced Packaging**

**Tracy Wotherspoon**, Microchip Technology Caldicot Ltd. (United Kingdom)

A brief introduction into Microchip's Advanced Electronic Packaging site in South Wales, with a case study into how packaging can miniaturize a quantum gyroscope.

14:20 - 14:40

**Coffee break and networking**

**Session 2: Components: Novel developments in device design and architectures driving improvements in noise, stability and performance.**

**Session Chair: Mohsin Haji**, National Photonics Lab. (United Kingdom)

14:40 - 15:00

**Challenges and Opportunities in Vertical Cavity Surface emitting lasers (VCSEL) manufacturing for Quantum and High-speed applications**

**Mo Missous**, Integrated Compound Semiconductors Ltd (United Kingdom)

Vertical Cavity Surface emitting lasers (VCSEL) have become dominant components in a range of applications spanning high-speed data communication, laser printers, mobile communications, 3D sensing (face recognition), LIDAR and industrial manufacturing to name a few. Compared with their edge emitting counterparts, they are relatively easy to manufacture, and above all, can be tested on-wafers for wavelength, modes and power greatly helping in reducing costs. Their success derives largely from the fact that a small shift in wavelengths (few nm) due to wafer non-uniformities does not hinder the intended applications and as consequence higher device yields are readily attainable. Modern Quantum applications in sensing, timing or magnetometry all use VCSELS as convenient low power components drivers for excitation of certain gases (Cs and Rubidium). However, the requirements for single mode frequency, linear polarization and precise output wavelength (to within 0.1nm) at operating temperatures (which can vary from ambient to 90 C) places stringent requirements on VCSEL device design and fabrication/testing yields. In this talk I will illustrate how full 4" wafer mapping of > 100,000 devices is needed to sort out and bin VCSEL devices according to spectral wavelength, Mode, power and beam shape. The precise requirements of an exact wavelength, power and mode stability lead to significant drops in VCSEL device yields in common MOCVD grown VCSEL wafers. Implications of these results for telecom and sensing will also be discussed.

15:00 - 15:20

**INEX Microtechnology: UK sovereign wafer-scale manufacturing of vapour cells, MEMS devices, and compound semiconductors.**

**Ben Steele**, INEX Microtechnology Ltd. (United Kingdom)

INEX has successfully demonstrated production of vapour cells on a wafer-scale for use in laser references, quantum sensing, and quantum PNT applications in our UK facility. We develop and manufacture advanced compound semiconductor and MEMS devices used in a range of applications. We have three business pillars: GaN (RF and Power), Vapour Cells, and Contract Manufacturing (Photonics and MEMS). This talk will focus on INEX's activities on wafer-fabricated vapour cells for optical and quantum technologies and our mission to provide components to the UK's growth in these sectors.

15:20 - 15:40

**PCSELS production and applications**

**Richard Taylor**, Vector Photonics (United Kingdom)

16:30-18:30

**Tour: Photon Science Institute, Univ. of Manchester**

Space is limited. Check at the registration desk for availability.

# Technical Topic: Application and Commercialisation Considerations for Quantum Photonic Components

Thursday 31 October 2024 • 13:00 - 18:30 GMT | Manchester Central, Central Hall, Stage 2

**Session 1: Application Drivers: Quantum system integrators will share key considerations driving quantum photonic device requirements for quantum timing, navigation, sensing and computing.**

**Session Chair: Mohsin Haji, National Physics Lab. (United Kingdom)**

10:00 - 10:20

**Quantum PNT: The road to manufacture**

**Richard Patrick, CPI TMD Technologies Ltd. (United Kingdom)**

CPI TMD present the latest developments in their range of quantum-enabled PNT solutions, where the company is applying lessons learnt from its 75 year history deploying complex systems in the harshest environments. Products discussed will include HARLEQUIN, an inertial navigation system demonstrator for maritime applications, and CIFS, a compact optical clock.

10:20 - 10:40

**Integrated Quantum Photonics for Gas Sensing Applications**

**Benjamin Smith, QLM Technology (United Kingdom)**

Imaging and quantifying greenhouse gas emissions will be a key component in meeting the worlds Net Zero target by 2050. This talk discusses integrating single photon (quantum) detectors into a Lidar with tuneable diode laser spectroscopy to enable a technology capable of producing three-dimensional images of objects and gas plumes. This innovative imaging technology can continuously detect, visualize, locate and quantify plumes of gas molecules from a distance of 200m using automated or remote manual control modes. The scale up of such a technology is also considered, given its reliance on key quantum photonic devices along with skilled personnel.

10:40 - 11:00

**Prioritising the mission and practicality over performance**

**Alexander Jantzen, Aquark Technologies (United Kingdom)**

Unlocking disruptive and promising capabilities, contemporary quantum technology is harnessing quantum behaviours for commercial benefit, but to achieve this requires feats of engineering, highly specialised personnel and often tightly controlled environments. Performance comes at a cost and as technology matures, the focus has to shift onto its potential and future value to society. This talk will explore Aquark's view on how to validate and prioritise in a rapidly evolving technology landscape.

11:00 - 11:30

**Coffee break and networking**

**Session 2: Packaging and Integration: Highlights and challenges associated with improving quantum component/module performance whilst reducing size, weight, power and cost.**

**Session Chair: Denise Powell, Univ. of Manchester (United Kingdom)**

11:30 - 11:50

**Photonics Packaging Challenges for Quantum Devices**

**Liam Moroney, ALTER Technology (United Kingdom)**

The general challenges and trends in photonic devices from the perspective of Alter Technology UK as a product design, assembly and test house will be discussed. We highlight the added difficulties involved with the commercialisation and manufacture of quantum photonic components, such as uncommon wavelengths, low loss interfaces, cryogenic temperatures, bulky components, supply chains and establishing future-proof component specifications for an emerging market. We explore examples related to photonic integrated circuits, frequency stabilised lasers (Flame), tapered amplifiers and chip-scale atomic clocks.

11:50 - 12:10

**Manufacturing Quantum Enabling Semiconductor Photonic Components**

**Andrew Robertson, Bay Photonics (United Kingdom)**

The development of a new generation of semiconductor photonic components are enabling quantum technology. The assembly and packaging of semiconductor-based photonic components for quantum-enabling technologies present significant challenges that stem from the stringent performance, scalability, and reliability requirements of quantum systems. These components, such as emitters, detectors, and photonic integrated circuits (PICs), often require precise alignment at the nanometre scale to ensure optimal coupling between light sources, waveguides, and detectors. For scale up, this precision demands highly controlled and automated assembly processes. Moreover, the packaging

of these components often requires additional complexities to ensure stable operation, such as strident environmental and thermal control. In summary, the challenges in the assembly and packaging of semiconductor-based photonic components for quantum applications stem from the need for extreme precision, environmental robustness, thermal management, and scalability. Solving these issues will be critical to the advancement of quantum-enabling technologies.

12:10 - 12:30

**Photonic Integration for Quantum Technology at Fraunhofer Centre for Applied Photonics**

**Henry Bookey, Fraunhofer Centre for Applied Photonics, Glasgow (United Kingdom)**

The translation of quantum technology from our laboratories to practical use can require the ruggedisation and miniaturisation of different optical subsystems – including stabilised laser sources, filters, modulators, receivers, beam steering and routing. This talk will cover some of the approaches we take to deliver quantum systems to the field and look at emerging photonic integration techniques that will be enabling the next generation of quantum sensing, communication and computing. Hybrid photonics exploiting direct laser microfabrication will be introduced.

12:30 - 1:00

**Lunch concessions available for purchase in Exhibition Hall**

**Session 3: Components: Novel developments in device design and architectures driving improvements in noise, stability and performance.**

**Session Chair: Mohsin Haji, National Physics Lab. (United Kingdom)**

13:00 - 13:20

**Scaling up VCSEL Production: Quick-Fab for Rapid Device-Level Feedback**

**Sam Shutts, Cardiff Univ. (United Kingdom)**

The ramp in demand for vertical-cavity surface-emitting lasers (VCSELs) used in technologies such as smartphones and communication networks shows no signs of slowing. Pressure on manufacturers to ship more chips, combined with the stringent specification tolerances required for emerging quantum sensor applications, has led to an ever-increasing need for rapid device-level feedback within production cycles. In this presentation, we will introduce a 'quick-fab' VCSEL process developed at the Institute for Compound Semiconductors and describe the on-wafer testing carried out at Cardiff University's Translation Research Hub. This process provides assessment of wafer uniformity and performance validation. We will also present examples of VCSELs grown on GaAs and Ge substrates up to 200 mm in diameter.

13:20 - 13:40

**Reconfigurable universal platform for spectroscopy applications**

**Vojtech Olle, RedWave Labs (United Kingdom)**

Redwave Labs will present their work on a reconfigurable universal platform and will discuss the importance of control electronics in the most demanding spectroscopy applications such as multigas sensing a well the future role of universal platform in the next generation of clocks.

13:40 - 14:00

**Koheras ACOUSTIK: the ideal laser engine for scaling up quantum technologies**

**Marc Smillie, NKT Photonics (United Kingdom)**

We will present why the Koheras ACOUSTIK is the ideal laser engine to scale up cold atoms based quantum technologies. The rack mountable ACOUSTIK system is designed to house modular line cards which integrates multiple functions, including modulation, in a robust all-in-fibre package. It all starts with the Koheras BASIK single frequency fiber laser, delivering low noise and long-term stability, making it an ideal choice for quantum applications. The laser is inherently single mode and will never experience mode hopping, the intrinsic linewidth is ultra-narrow and supports frequency stabilization to the sub-Hertz level. In combination with our compact frequency conversion line cards, the system supports a wide range of wavelengths covering atomic systems including (but not limited to) Rb, Sr, Yb and Ba. Combined with our new modulation line cards, we can satisfy most phase, frequency, and amplitude modulation requirements; moving experiments off the optical table and into the Koheras ACOUSTIK rack-system. NKT Photonics has an R&D and production facility in Southampton ready to support a UK Sovereign supply chain for the quantum industry.

*Programme current at time of print.*

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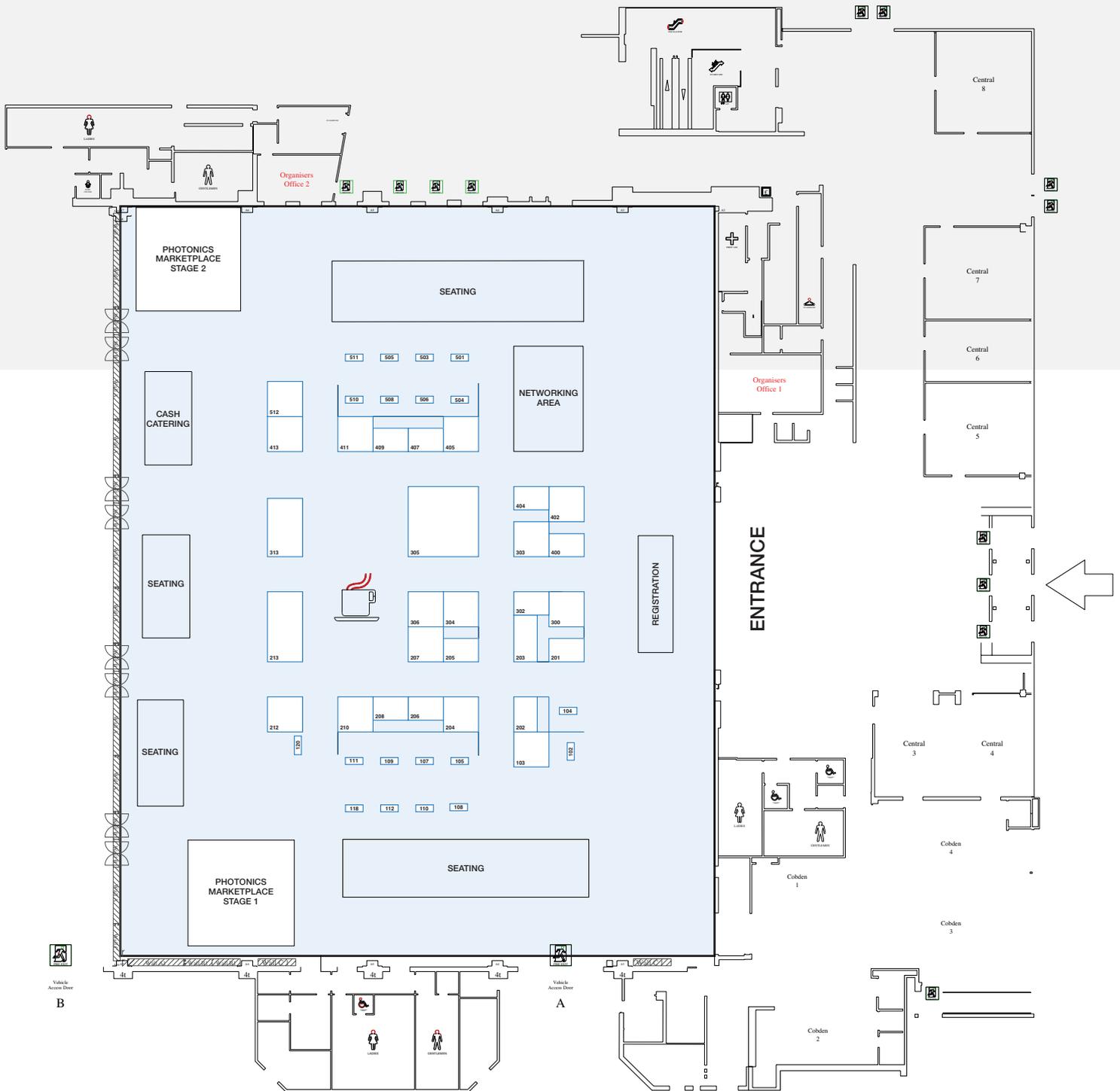
## Manchester Central Central Hall 2

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## Photonics Marketplace Session 1

30 October 2024 • 10:30 - 12:00 GMT | Manchester Central, Central Hall, Stage 1

### Morning Schedule

**10:00 - 10:30**

Company Presentation

**A different approach to Hyperspectral**

**Samuel Hornett**, Alrad Imaging, (United Kingdom)

**10:45 - 11:00**

**Innovate funding opportunities in photonics**

**Iain Mauchline, Matthew Wasley**, Innovate UK (United Kingdom)

The talk will cover the current innovation funding landscape broadly, and in the application sectors relevant to photonics, particularly for UK businesses but also relevant to researchers and overseas partners.



**11:00 - 11:15**

**Funding opportunities in Horizon Europe**

**Craig Sharp**, Innovate UK (United Kingdom)

Horizon Europe is the EU's research and innovation programme and under associated status, the UK can lead and partner in projects across the programme. The 2025 calls are currently in development, and I will give an early indication on the themes that will be covered as well as actions for your organisation to prepare for these collaborative opportunities.



**11:30 - 11:45**

**Photonics and Philanthropy: Pioneering new access routes for tomorrow's thought leaders**

**Patrick Parkinson & Olympia Kennard**, University of Manchester (United Kingdom)

Since 1824, the University of Manchester has pioneered world-changing firsts. And our story started with the fundamental belief in education without barriers. We recognise the strength in diversity of thought, experience, and background. In this session, we will discuss how - in partnership with local, national, and international partners - we are training the workforce of tomorrow in photonics and optics, and how philanthropic partners like SPIE are helping to create new routes to careers in photonics for historically underrepresented groups.



**11:45 - 12:00**

**National materials innovation strategy**

**David Knowles**, Henry Royce Institute (United Kingdom)

This talk will cover the method(s) applied in the development of the national materials innovation strategy which is being supported by the Henry Royce Institute under the direction of the Materials Innovation Leadership Group. This is a top down approach, largely led by alignment to industrial and national priorities.



*Programme current at time of print.*

# Photonics Marketplace Session 1

30 October 2024 • 12:00 - 16:00 GMT | Manchester Central, Central Hall, Stage 1

## Afternoon Schedule

**12:00 - 12:15**

Panel Discussion

**Update on UK government spending priorities**

**Moderator: John Lincoln**, Photonics Leadership Group (*United Kingdom*)

Panelists:

**Simon Andrews**, Fraunhofer UK (*United Kingdom*)

Simon leads Fraunhofer UK Research Ltd and supports Fraunhofer Centre for Applied Photonics, based at the University of Strathclyde, in Glasgow. This first UK Fraunhofer Centre follows the proven German model of providing professional R&D services to industry, whilst staying connected to excellent research in the university sector.

**Iwan Davies**, IQE (*United Kingdom*)

Iwan is currently IQE plc Group Technology Director, representing the company on numerous European associations, including Photonics 21, UK PLG, EPIC, Aeneas, and others. He leads IQE plc in UK National and European Research Projects, principally through Innovate UK, Horizon and ECSEL/KDT/Chips JU programmes.



**12:30 - 13:00**

Company Presentation

**Award-winning femtosecond lasers open new horizons**

**Oleksandr Derevianchenko**, ESKPLA, (*Lithuania*)

**13:00 - 13:30**

Company Presentation

**Nanoscribe's Quantum X align for PIC,**

**Alexander Legant**, Nanoscribe GmbH, (*Germany*)

**13:30 - 14:00**

Company Presentation

**PowerPhotonic Variable Beam Shaper**

**Steve Kidd**, PowerPhotonic, (*United Kingdom*)

**14:00 - 14:30**

Company Presentation

**I-Photonics - Thin-film technologies & Vacuum coating systems**

**Eugene Pinchukov**, I-Photonics, (*Lithuania*)

**15:15 - 15:30**

**DBT support for photonics, semiconductors, and quantum technologies**

**Phillip White**, Science & Technology Directorate, DBT (*United Kingdom*)

The presentation will include Feedback from SEMICON Taiwan, plans for SEMICON Japan, National Quantum Technology Showcase and Photonics West. Other forward plans, inward mission, outward missions, international CR&D calls.



**15:30 - 16:00**

**Support for UK businesses at Photonics West and Laser World of Photonics**

**John Lincoln**, Photonics Leadership Group (*United Kingdom*)

**Alison McLeod**, Photonics Scotland (*United Kingdom*)



Programme current at time of print.

# Photonics Marketplace Session 2

31 October 2024 • 10:00 - 12:00 GMT | Manchester Central, Central Hall, Stage 1

## Morning Schedule

**10:15 - 10:45**

Panel Discussion

### Modern Marketing Techniques to Reach Photonics Customers

**Moderator: John Lincoln**, Photonics Leadership Group (*United Kingdom*)

Panelists:

**Mark Elliott**, Europa Science (*United Kingdom*)

Mark is the Chief Operating Officer at Europa Science, publisher of Electro Optics and Imaging & Machine Vision Europe, responsible for content and commercial delivery of projects and products. A trained newspaper journalist, he has since been Managing Editor of ELLE UK, Publisher of Empire, and Managing Director of Time Out, in a career spanning more than three decades in many roles across a range of consumer and business-to-business brands.

**Rob Fisher**, optics.org (*United Kingdom*)

Rob Fisher is the Head of Sales & Marketing for the SPIE online resource optics.org, Photonics West show daily and vertical industry titles including VISION Focus, ARVRMR Focus and the recently launched Quantum Focus magazine. With over 25 years of expertise in media marketing, Rob has a proven track record of delivering strategic, consultative marketing solutions across digital, print, and event platforms. He has dedicated his career to advancing photonics-based technologies, collaborating with companies to design and execute targeted, marketing campaigns that align with their objectives and amplify their brand presence within specialized markets.



**10:45 - 11:00**

### Intellectual property and patents

**Mike Street**, Marks & Clerks LLP (*United Kingdom*)

The presentation will address the following questions:

What is intellectual property (IP) and why do I want it?

What is a patent?

How do I get a patent?

What to protect, when to protect and where to protect?

Patent ownership.

Infringement vs validity.

Practical advice for managing patents.



**11:00 - 11:30**

Company Presentation

### Arbitrary Waveform Generators to control AOM, EOM and NV Center

**Stefano Parma, Michele Ramponi**, Active Technologies (*Italy*)

Active Technologies is a manufacturer of Arbitrary Waveform Generators and Fast Pulse Pattern Generators. In 20+ years of activity the company always aims to develop high performance instrumentation.

Programme current at time of print.

# Photonics Marketplace Session 2

31 October 2024 • 12:00 - 16:00 GMT | Manchester Central, Central Hall, Stage 1

## Afternoon Schedule

11:30 - 14:00

### Session 1:

#### New Photonics Developments for Applications in Bio and Life Sciences

Session Chair: Antonio Castelo, EPIC-European Photonics Industry Consortium (France)



11:30 - 12:00

Keynote Presentation

#### Into the light of a dark black night: mid-infrared fiber-optics and applications

Angela Seddon, Univ. of Nottingham (United Kingdom)

The MIR (mid-infrared) spectral region is 3-50 mm wavelength. Many molecular fundamental vibrational absorptions lie within 3-15 mm wavelength, coinciding with the low-loss window of chalcogenide glass fiber-optics, for a new 'window of opportunity' for sensing.



12:00 - 12:20:

#### Advanced Miniaturization Techniques: The Role of Selective Laser Etching of Glass

Arnas Žemaitis, Femtika UAB (Lithuania)

The presentation explores advanced miniaturization techniques enabled by selective laser etching of glass, allowing material manipulation with micron-level precision. It emphasizes high-precision microfabrication applications, enhancing scalability and integration for biomedicine, optics, and microelectronics industries.



12:20 - 12:40:

#### 3D bioprinters

Alexander Legant, Nanoscribe (Germany)

The achievements of the two-photon polymerization based world's highest resolution 3D micro-printer will be presented. The device offers a defined control on the feature sizes and resolutions ranging from nanometer to micrometer scale and accessible print area of ~ cm<sup>2</sup>. This versatility has opened new frontiers in the field of microfluidics, photonics, biomedical engineering, plasmonics, micro-optics, mechanical metamaterials, biomimetics, life sciences, and micro-robotics.



12:40 - 13:00:

#### Highly Durable Coatings for Infrared Applications

Mike Ivanovski, O-Photonics (Lithuania)

In this presentation, we will explore the development and performance of highly durable coatings designed for infrared (IR) applications, specifically tailored for chalcogenide glass, silicon (Si), germanium (Ge), and zinc sulfide (ZnS) substrates. These coatings have been engineered to withstand harsh environmental conditions while maintaining superior optical performance in demanding IR environments.



13:00 - 13:20:

#### Microscopy: FLIM-FRET

Joshua Seagrave, Laser2000 (United Kingdom)

The Luminosa microscope from Picoquant introduces cutting-edge photonic technology for bio and life sciences. With high-sensitivity fluorescence detection and modular design, Luminosa supports applications like single-molecule detection and live-cell imaging. This presentation highlights how its innovative features enhance research in biological systems.



13:20 - 13:40:

#### Spectrometer solutions for bio-life science

Alexis Feugier, Ocean Optics (The Netherlands)

Ocean Optics has been developing for more than 30 years miniature spectrometers for many different market segments including solutions for Bio and Life Science.

We will present a few applications using different kind of spectroscopy techniques which have been used successfully by our customers.



Programme current at time of print.

## Photonics Marketplace Session 2 *(continued)*

31 October 2024 • 12:00 - 16:00 GMT | Manchester Central, Central Hall, Stage 1

### Afternoon Schedule

13:40 - 14:00

#### Compact, all-in-one multicolor laser sources for photomanipulation experiments

**Elaine Blackwood**, Photonic Solutions *(United Kingdom)*

High-resolution, high-speed fluorescence imaging techniques rely on the high-brightness and wavelength precision of lasers for illumination. I will highlight the functionality of a multicolour laser source that allows for optimal spectral, spatial and temporal control of the output for photomanipulation experiments.



14:30 - 14:45

Company Presentation

#### HÜBNER Photonics - High-performance lasers for science and industry

**Kirn Akram**, HÜBNER Photonics *(Sweden)*

## Photonics Marketplace Session 3

31 October 2024 • 14:00 - 15:30 GMT | Manchester Central, Central Hall, Stage 2

### Afternoon Schedule

14:00 - 15:30:

#### Hands-On Training

#### From Bench to Stage: a Communication Skills Makeover for Technologists

**Instructor: Sara Diegoli**, Quantum Programmes Director, Anchored In Ltd. *(United Kingdom)*

One of the most difficult skills for technologists to master is communicating their ideas to different audiences in a compelling, engaging, and accessible way. From networking in professional settings, to public engagement, collaboration, pitching and even grant writing, the key skills to effective communication remain the same: how to tailor your message to grab your audience's attention and maintain their engagement. With lots of hands-on practice, this workshop will improve participants skills and confidence in communicating their research and networking in a range of different settings.



*Programme current at time of print.*



## Experts in Photonics and Imaging technology for over 50 years

ALRAD Photonics and ALRAD Imaging are excited to be exhibiting again at SPIE Photonex 2024!

The **ALRAD Photonics** extensive product range includes industry-leading electronic display measurement systems and eye-safe lasers for challenging industrial applications. We also provide structured light lasers for machine vision, laser diode modules for scientific/biomedical/industrial applications, precision optics and more. We'll be joined on booth 508 this year by our partner ELDIM and an interactive demo of CubeX-500 - their latest multi-spectral angular mapping instrument for analysing the output from electronic displays.



### CubeX-500

Fast, detailed analysis of LED, OLED and uLED devices under test, providing valuable insights into product quality and performance. With a measurement time of less than 5 seconds, CubeX-500 is suited to both R&D and mass production environments in the automotive, avionics, display, defence and mobile communications industries.



### ZQ1-MagicLine

Specially developed for applications that require high visibility and reliable eye safety - from precise alignment in metalworking to exact positioning in logistics. Featuring an impressive optical power of 600 mW in laser class 2M and wavelength of 520 nm, maximising visibility for the human eye.

**ALRAD Imaging's** portfolio covers the spectrum from UV through Visible to IR, SWIR and Thermal. We supply the latest scientific camera technology and components including optics, acquisition and illumination products, for machine vision, scientific, medical, agriculture, UAV/drone and security applications. Meet us at Photonex on booth 510 where we'll be demonstrating groundbreaking new Hyperspectral technology from our partner Living Optics!

Break the boundaries  
of machine vision with  
Hyperspectral Imaging



### High-Speed Hyperspectral Imaging System

Groundbreaking new High-Speed Hyperspectral Imaging system, operating at video rates of 30~60 fps and higher. A first in Hyperspectral imaging, opening up new application areas and significantly improving precision in computer vision applications such as detection, identification, segmentation and object tracking.



### LumiSun-50

Innovative, compact benchtop LED solar simulator that meets IEC 60904-9, 60904-3 Class A+A+A+ for spectral match, nonuniformity of irradiance, and temporal stability. LumiSun-50 is ideal for measuring the efficiency and spectral response of PV cells, as well as photobiology, solar degradation, and other sunlight research studies.

## Product Focus



Vortex are looking forward to Photonex this year, MD Ian Reilly commented, 'Our business, is definitely growing, particularly for IR filters.'

More people are realising their value to identify/detect numerous substances and

chemicals due to their strong infra-red fingerprints.

The advent of quantum dot technology means IR Camera prices are falling, thus making so many more applications affordable.

**We look forward to meeting you on Stand 507 to discuss your detection needs and help make them a reality!**



#### Vortex Optical Coatings

Unit 10 Jacknell Road  
Dodwells Bridge Industrial Estate  
Hinckley, Leicestershire LE10 3BS  
United Kingdom

Email: [enquiries@vortexoc.com](mailto:enquiries@vortexoc.com)

Phone: +44 (0) 1455 613029



Laser 2000 (UK) Ltd is a leading supplier of photonics and optoelectronics solutions in the UK and Ireland.

With over 30 years of experience, we offer a broad range of cutting-edge products, including lasers, optics, fibre optics, and imaging systems. Laser 2000 provides solutions for customers including research institutions, biomedical, defence and telecommunications.

Our expertise lies in providing tailored photonics solutions, technical support, and advanced technology that enhances precision, efficiency, and innovation in various applications.

[www.laser2000.co.uk](http://www.laser2000.co.uk)

#### Laser 2000 (UK) Limited

Unit 9, Avro Court,  
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Huntingdon, Cambridgeshire, PE29 6XS

Email: [sales@laser2000.co.uk](mailto:sales@laser2000.co.uk)

Phone: +44 (0) 1933 461 666



#### StingRay:

The highest-performing top-hat-profile laser on the market, available in a variety of fan angles to create the line you need for measurement and profiling applications.

The StingRay allows the user to optimise the focus location for the best measurement resolution.

With optional RS-232 control the laser power is adjustable and includes onboard diagnostics for operating hours, diode current, output power, temperature and more. Selected StingRay models also include the  $\mu$ Focus and Fibre-Ready (FR) versions.

#### BeamCam Laser Beam Profiler:

Get a full picture of your system's optical performance with the World Star Tech BeamCam.

The BeamCam laser beam profiler allows you to see the exact shape and features of your laser beams at a microscopic scale.

Designed for repeatable and reliable data acquisition, it is ideal for CW and Pulse Laser Beam Profiling / Precision Beam Pointing Stability Measurement applications in manufacturing, servicing and assembly environments.

#### Alrad Instruments Ltd

Alder House  
Turnpike Road Industrial Estate  
Newbury, Berkshire RG14 2NS  
United Kingdom

Phone: 01635 30345

*Sales: Option 1*

*Customer Services: Option 2*

*Accounts: Option 3*

*Technical Support: Option 4*

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[www.alrad.co.uk](http://www.alrad.co.uk)

## Novanta moves into new \$12M facility in Stockport, UK

**Firm that started locally as Laser Quantum manufactures lasers and sub-systems for medical and industrial applications.**

Novanta, a pioneer in manufacturing advanced lasers and optical sub-systems for medical and industrial applications, has relocated from its founding premises in Stockport, UK, to a state-of-the-art 70,000 square foot facility at the nearby Orion Business Park, quadrupling its capacity to house its expanding team and serve clients.

Originally founded as Laser Quantum Ltd, the organization was established in 2002, prior to being acquired by US-based Novanta Corporation in 2017.

CEO Matthijs Glastra commented, "This transformative move marks a significant new chapter in our journey, symbolizing the unification of our UK team and ongoing commitment to growth and innovation across Novanta.

"Our investment in this state-of-the-art laser sub-system facility reinforces our position as a trusted technology partner to our global OEM customers. It also demonstrates our commitment to providing our team with the best possible work environment to innovate and excel. We're excited about the opportunities this move presents and look forward to



Photo: Matthew Peach, optics.org

*Laser sub-system assembly: two-thirds of the new facility is enclosed in a clean room environment.*

continuing to deliver exceptional value to our clients from our new facility."

### Highlights of the new facility

- **World-class laser sub-system assembly:** Two-thirds of the new facility is enclosed in a clean room environment and sets the standard for quality, lean manufacturing, standard work practices and procedures, ensuring excellence in every aspect of optoelectronic module assembly.

MA., USA, provides a range of technology solutions for medical and advanced industrial original equipment manufacturers. The company combines deep proprietary technology expertise and competencies in photonics, vision and precision motion with a capability to solve complex technical challenges. Its common shares are quoted on Nasdaq under the ticker symbol NOVT.

*Author:  
Matthew Peach, Editor in Chief, optics.org*



Photo: Matthew Peach, optics.org

*At the opening of the new UK site in Stockport, CEO Matthijs Glastra commented, "This transformative move marks a significant new chapter in our journey, symbolizing the unification of our UK team and ongoing commitment to growth and innovation across Novanta.*

# Exhibitor Directory



## ACAL BFI Booth No. 207

Acal BFI is a leader in advanced solutions for tomorrow's technologies, providing engineering, design, manufacturing and tailored services and delivering a broad range of specialist products and solutions across Europe, with a focus on a consultative, design-led approach that aims to develop, designs and custom solutions that meet a project's specific requirements in collaboration with customers and their expert field engineers and Technology Centre capabilities.

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Telephone: +44 (0)118 978 8878  
E-Mail: sales-uk@acalbfi.co.uk  
www.acalbfi.com



## Active Technologies SRL Booth No. 110

Active Technologies is a manufacturer of Test & Measurement equipment in particular Arbitrary Waveform Generators and Fast Pulse Pattern Generators. The company was founded in 2003 as start-up of the University of Ferrara, in Italy. In 20+ years of activity the company always aims to develop high performance instrumentation to research & industrial customers. As a Small Medium Enterprise (SME), Active Technologies can be involved in EU research projects to customize a specific test solution.

Active Technologies SRL  
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44124 Ferrara, Italy  
Telephone: +39 0532 1772145  
E-Mail: info@activetechnologies.it  
www.activetechnologies.it



## AeroDIODE Booth No. 212

**SPIE CORPORATE MEMBER**  
AeroDIODE is an e-commerce player based in USA and FRANCE. AeroDIODE makes high-precision opto-electronics solutions based on photonics components such as laser diodes, SOAs (Semiconductor Optical Amplifiers), AOMs (Acousto-Optic Modulators) or other fiber coupled devices. Contact us!

AeroDIODE  
11 Rue Ferdinand Buisson  
33130 Bègles, France  
Telephone: +33 627 69 41 52  
E-Mail: contact.aerodiode@aerodiode.com  
www.aerodiode.com



## Alrad Imaging Booth No. 510 Ground-breaking new high-speed, video-rate hyperspectral camera technology from Living Optics

ALRAD Imaging's portfolio covers the spectrum from UV through Visible to IR, SWIR, Thermal and Hyperspectral. We supply the latest scientific camera technology and components including optics, acquisition and illumination products, for machine vision, scientific, medical, agriculture, UAV/drone and security applications. Working with world-class suppliers and integration partners for over 50 years to source the best solution for any project, including bespoke software and complete solutions.

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Telephone: +44 (0)1635 937000  
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www.alrad.com



## Alrad Photonics Booth No. 508 MagicLine: the world's brightest eye-safe laser in its class for industrial/alignment applications!

ALRAD Photonics' extensive product range includes industry-leading electronic display measurement systems, eye-safe lasers for challenging industrial applications and the world's most compact laser marking system. We also provide structured light lasers for machine vision, laser diode modules for scientific/biomedical/industrial applications, precision optics and more. We have over 50 years' of photonics expertise and pride ourselves on sourcing the best solution for any project.

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## AP Technologies Limited Booth No. 210

**SPIE CORPORATE MEMBER**  
**Phekda High Performance Spectrometer for LIBS, <0.1nm FWHM Resolution**

We offer a wide range of optoelectronic solutions. Light sources include 235nm to NIR LEDs; visible-NIR single/multimode laser diodes & thermal IR emitters. Detector technologies are silicon photodiodes (including XUV, direct electron & x-ray sensitive); Silicon Photomultipliers (SiPMs) and Lead Salt (PbS for 1-3µm, PbSe for 1-5µm). We have compact and high-resolution spectrometers from 180-2500nm and also supply Time-of-Flight sensors, fiberoptic components & liquid crystal optics.

AP Technologies Limited  
21A Charles Street  
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United Kingdom  
Telephone: +44 1225 780400  
E-Mail: mjs@aptechnologies.co.uk  
www.aptechnologies.co.uk

## Brinell Vision

*Prototyping and Enhancing Systems*  
**Brinell Vision Ltd.**  
**Booth No. 202**

**SPIE CORPORATE MEMBER**  
**BV-NVIS A1000K Precision Night Vision filter**

Brinell Vision is a UK manufacturer of precision optical & laser filters with optical production in Perthshire & Manchester. Brinell Vision products protect & enhance the performance of some of the World's most demanding optical systems & are qualified to operate in harsh environments on the ground, air and space. Applications for SWIR or MWIR imaging & sensors, medical laser optics, geostationary weather monitoring, astronomy, night-vision (NVIS) & daylight readable display for aircraft.

Brinell Vision Ltd.  
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Telephone: +44 161 408 0040  
E-Mail: info@brinellvision.com  
www.brinellvision.com



## Casix Inc. Booth No. 105

Casix Inc., founded in 1992, are recognised as a leading manufacturer of precision optics for applications in biomedical, industrial laser, instrumentation, telecom and automotive. Our core competences include: Lenses (spherical, cylindrical & aspheric (precision molding, CNC or traditional polishing)), windows, mirrors, filters, beam splitters, prisms, waveplates, polarisers etc, opto-mechanical sub-assembly, flow cells & capillaries, fiber pigtailed & collimator assemblies.

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E-Mail: sales@casix.com  
www.casix.com

# Exhibitor Directory



**codixx AG**

**Booth No. 111**

**Glass polarisers, patterned polarizers**

CODIXX is a manufacturer of linear and structured polarizers for the infrared, visible and ultraviolet spectral ranges. These polarisers serve a wide spectrum of applications, in industrial vision and measurement technology, medical, security, optical communications and Photonics. The polarisation is based on a unique technology for manufacturing and processing nanoparticles in glass. Since its establishment in 1998, the company has consistently advanced, currently holding a prominent position.

codixx AG

Betrieb Barleben  
Steinfeldstraße 3

39179 Barleben, Germany  
Telephone: +49 39203 9630  
E-Mail: colorpol@codixx.de

www.codixx.de



**CPI Electron Device Business**

**Booth No. 102**

CPI TMD Technologies is a West London-based manufacturer of complex systems for military, commercial and scientific applications, with a 75-year history deploying its products in challenging environments. The company offers a turnkey cold atom platform as well as quantum-enabled sensing technologies for precision navigation and timing.

CPI Electron Device Business

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E-Mail: ElectronDevices@cpii-int.com  
www.cpii.com



**Crystran Ltd.**

**Booth No. 300**

**SPIE CORPORATE MEMBER**

With 30 years of experience in manufacturing and supplying high-quality optical components. We manufacture windows, lenses, prisms and specialist optics as both standard products and to the designs of our customers. We work with a range of IR, UV and Visible materials.

Crystran Ltd.

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Poole, Dorset BH12 4PA  
United Kingdom

Telephone: +44 1202 307650  
E-Mail: sales@crystran.co.uk  
www.crystran.co.uk



**Diverse Optics Inc.**

**Booth No. 306**

**SPIE CORPORATE MEMBER**

We know your optics are as unique as you are. Reduce cost, trim weight, simplify design, and improve the performance of your optics using polymers. For 30 years, we've manufactured the most challenging polymer optic components and assemblies for leading defense, medical, and commercial applications with advanced technology and an experienced team of professionals. With our knowledge of injection molding and diamond turning, we'll show you how polymer optics are perfected.

Diverse Optics Inc.

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United States

Telephone: +1 909 593 9330  
E-Mail: info@diverseoptics.com  
www.diverseoptics.com



**Edmund Optics**

**Booth No. 208**

**SPIE CORPORATE MEMBER**

**Laser, Imaging, Precision and Filter Optics**

Edmund Optics® is a leading, global provider of optical technology solutions. The company employs 1,250+ employees across 18 global locations and continues to expand. The company services its customers through three distinct offerings: Marketplace - Edmund Optics' One-stop shop; Optical Manufacturing - Custom and volume manufacturing of high-quality optical and imaging components and systems; as well as Engineering Services - Optical consulting, design, and prototyping services.

Edmund Optics

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**EKSPLA**

**Booth No. 405**

**Tunable wavelength lasers featuring tuning range from 193 nm to 18 000 nm**

Innovative manufacturer of solid state and fiber lasers, systems and components from unique custom system for basic research to small OEM series. In-house R&D team and 30 years' experience enable to tailor products for specific applications and/or according to specific requirements. Main products are: femtosecond, picosecond and nanosecond lasers, tunable wavelength systems, ultrafast fiber lasers, spectroscopy systems and laser electronics.

EKSPLA

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Telephone: +370 5 264 9629  
E-Mail: sales@ekspla.com  
www.ekspla.com



**Everix, Inc.**

**Booth No. 120**

**SPIE CORPORATE MEMBER**

At Everix, we employ a novel and cost-effective manufacturing process to produce a wide range of optical filters for AR/VR, consumer electronics, biomedical and industrial applications. We do not rely on traditional deposition coating techniques to make our filters, thus we can design and produce the worlds' thinnest optical filters with near zero angular shift optical performance. Our filters are available in flexible or rigid designs and can be cut to the customers' desired form factor.

Everix Inc.

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www.everixopticalfilters.com



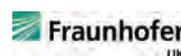
**Femtika**

**Booth No. 407**

FEMTIKA, founded in 2013, is a leading provider of advanced laser microfabrication solutions in multiphoton polymerization and selective laser etching. The cutting-edge technology allows precise and efficient processing in a wide range of industries, including microelectronics, medical devices, and aerospace engineering. Our state-of-the-art facility is equipped with the latest equipment and technology, allowing us to provide our clients with the highest level of service and support.

Femtika

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E-Mail: info@femtika.lt  
www.femtika.com



**Fraunhofer UK Research Ltd.**

**Booth No. 203**

**SPIE CORPORATE MEMBER**

Fraunhofer UK Research Ltd is a not-for-profit Research and Technology Organisation providing professional applied R&D services to benefit UK industry. Through the Fraunhofer Centre for Applied Photonics it provides applied research and prototyping services for a wide variety of novel laser sources and their applications across a wide range of markets.

Fraunhofer UK Research Ltd.

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www.cap.fraunhofer.co.uk

# Exhibitor Directory



## Hamamatsu Photonics UK Ltd. Booth No. 112

**SPIE** CORPORATE MEMBER

Hamamatsu Photonics is a world-leading manufacturer of optoelectronic components and systems. The Company's corporate philosophy stresses the advancement of photonics through extensive research and yields products that are regarded as state-of-the-art. All products are designed to cover the entire optical spectrum and provide solutions for a wide variety of applications including analytical, consumer, industrial and medical instrumentation.

Hamamatsu Photonics UK Ltd.  
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www.hamamatsu.co.uk



## HÜBNER Photonics Booth No. 104

**C-WAVE - Widely tunable, single frequency CW laser for Quantum, Raman and Nanophotonics applications**

HÜBNER Photonics offers the full range of high performance Cobolt lasers, C-WAVE cw tunable lasers, VALO femtosecond lasers along with a full selection of C-FLEX laser combiners. HÜBNER Photonics Inc. has become a preferred supplier of lasers to major instrument manufacturers and leading research labs for cutting-edge applications in the areas of fluorescence microscopy, multiphoton microscopy, flow cytometry, Raman spectroscopy, metrology, holography, nanophotonic and quantum research.

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## PROMOTIONAL PARTNER



## Imaging & Machine Vision Europe Booth No. 511

Imaging & Machine Vision Europe  
4 Signet Court  
Cambridge CB5 8LA  
United Kingdom  
www.imveurope.com



## I-Photonics Booth No. 409

**SPIE** CORPORATE MEMBER

**Vacuum coating systems, optical components & job coating service**

I-Photonics designs and manufactures turn key vacuum coating solutions in the precision optics market. Having grown from the scientific lab, today we represent a great team of professionals in surface coating solutions with proprietary market proven optical monitoring and ion beam sources. Our coater portfolio spans from PIAD, IBS, optical DLC coatings to Plasma assisted long throw sputtering for exceptional optical filter productions including DWDM filters.

I-Photonics  
Parko g. 3, Avižieniai  
14198 Vilniaus r. sav., Lithuania  
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E-Mail: info@i-photonics.lt  
www.i-photonics.lt



## Island Optics Ltd. Booth No. 302

**SPIE** CORPORATE MEMBER

**Precision Wedges**

Island Optics Ltd. is a leading manufacturer of high-quality precision optics, known for delivering superior products at competitive prices with quick delivery. We also produce extremely parallel optics and wedged optics. Certified to ISO 9001:2015 standards, we serve diverse sectors including research, medical, aerospace, defence, semiconductors and display technologies.

Island Optics Ltd.  
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Isle of Man  
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E-Mail: sales@island-optics.com  
www.island-optics.com



## Laser 2000 UK Booth No. 305

**Deep 3D / Live Cell Imaging, Laser Safety, Multi-instrument Test & Measurement Platforms**

Laser 2000 (UK) Ltd is a value added reseller, providing products and solutions for photonics and networks applications since the 1990s. We maintain very close relationships with our manufacturers, and systematically check to make sure that they meet our exacting standards. Although many of the manufacturers we deal with are based outside of the UK, we know them personally so that when their support is needed, we and your project are not just a number for them.

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www.laser2000.co.uk



## Laser SOS Ltd. Booth No. 402

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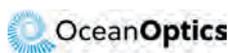
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