WEDNESDAY
EDITION

SPIE. | optics.org | WEDNESDAY, JANUARY 29, 2025

PHOTONICS WEST SHOW DAILY

The sky's the limit
p. 15

$1M endowed fund announced by SPIE and National University of Singapore

The SPIE-CDE Fellowship in Optical Science and Engineering will support postgraduate students

At Monday morning's OPTO plenary, SPIE and the National University of Singapore (NUS) announced the establishment of the SPIE-CDE Fellowship in Optical Science and Engineering. The $500,000 gift from SPIE is matched by an equivalent $500,000 contribution from the College of Design and Engineering (CDE) at NUS to form a $1-million endowed fund.

Part of the SPIE Endowment Matching Program, this fund will support a PhD student working in the field of optics and photonics at NUS CDE. This is the 13th major SPIE gift to universities and institutes as part of the Society's ongoing program to support the international expansion of optics and photonics

continued on page 03

Check this out: 2025 SPIE President Peter de Groot (left) with National University of Singapore Associate Professor Aaron Danner (right). Credit: Joey Cobbs.

UBS Executive Vice Chairman Mike Ryan. Credit: Joey Cobbs.

Global Business Forum addresses latest trade and economic storms

Attendees at Monday's SPIE Global Business Forum gained an insight into the potential impact that the new US presidential administration will make on the photonics industry with a big-picture presentation from Mike Ryan, Executive Vice Chairman at the financial services giant UBS.

Opening the event, the University of Rochester-educated economist said that he is expecting some "game-changing" policy decisions from a highly disruptive new regime. Focusing on likely developments in the key areas of regulatory reform and trade policy, Ryan sees some positive impact in terms of economic growth, but a less benign outcome when it comes to tariffs, infrastructure, and immigration.

On what he called "regulatory relief," Ryan foresees a more business-friendly and, in his view, more balanced approach under the new president, as existing regulations are enforced in looser fashion, and far fewer new regulations are proposed. That will have a dis-inflationary effect, he predicted, telling a 250-strong crowd: "When regulations change — that is crippling for business."

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DON'T MISS THESE EVENTS.

PHOTONICS WEST EXHIBITION
10 AM – 5 PM Moscone North/South Exhibition Halls

QUANTUM WEST EXPO
10 AM - 5 PM Moscone South, Quantum Expo (Upper Mezzanine)

JOB FAIR
10 AM – 5 PM Moscone Center, Hall C (Exhibit Level)

AR | VR | MR EXHIBITION
10 AM – 5 PM Moscone North/South Exhibition Halls

ECONOMIC OPPORTUNITIES TO SCALE THE PHOTONICS SUPPLY CHAIN
10:30 AM – 12:00 PM Moscone South, Room 153 (Upper Mezzanine)

OPTICS AND AI: BOUNDLESS SYNERGIES FOR A LIMITLESS FUTURE
1:15 – 2:30 PM Moscone Center, Expo Stage, Hall DE (Exhibit Level)

THE PATH FROM STARTUPS TO END USERS IN COMMERCIALIZING QUANTUM SENSING TECHNOLOGY
3:15 – 5:00 PM Moscone South, Room 153 (Upper Mezzanine)

OPTO AND QUANTUM WEST POSTER SESSION
6:00 – 8:00 PM Moscone West, Room 2003 (Level 2)

For the full schedule and most up-to-date info, download the SPIE Conferences app. Some events require a paid technical registration.

IN THIS ISSUE.

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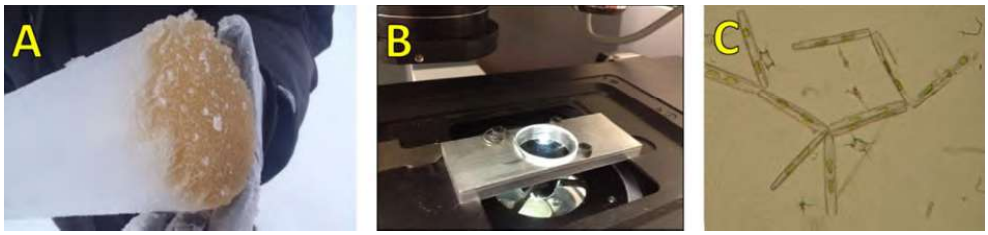
FL-PTIR imaging of sea-ice diatoms effectively tracks climate change

A Canadian research group's application of widefield fluorescence-detected photothermal infrared (FL-PTIR) imaging is analyzing seasonal changes in auto-fluorescent biocomponents of Arctic sea-ice diatoms.

Diatoms are single-celled organisms that play a vital role globally as primary producers in soils and bodies of water, providing around 40% of global carbon fixation, as well as significant oxygen production, through photosynthesis.



Climate clues: (A) Diatoms and other biomass concentrated at bottom-ice at the sea water interface; (B) Imaging set up for FTIR with FPA, diatoms mounted on 2 x 25 mm diameter BaF_2 salt window, on microscope stage; (C) *N. Frigida* and *Attheya spp.* diatoms viewed through a brightfield microscope at 40x. Credit: University of Manitoba.

Professor Kathleen Gough of the University of Manitoba described this approach and results of her group's decade-plus work in Arctic waters in her Saturday invited talk as part of the Advanced Chemical Microscopy for Life Science and Translational Medicine BiOS Conference.

Gough works in the Department of Chemistry, is an Adjunct Professor in the Department of Physiology and Pathophysiology, and is a Core Member of the Biomedical Engineering Graduate Program, at the University of Manitoba.

She explained, "The FL-PTIR method for high-speed, super-resolution IR spectroscopy and chemical imaging of auto-fluorescent biomaterials takes advantage of temperature-dependent autofluorescence emission modulations on the order of one percent per Kelvin."

A related preprint of a forthcoming SPIE paper, "Tracking climate change with FL-PTIR of Arctic sea-ice diatoms" — authored by Gough, her PhD student Rinuk 'Limurn, University of Manitoba, and Dr. Craig Prater of Photothermal Spectroscopy Corp., Santa Barbara, CA — states: "This new rapid analysis capability will enable us to quickly monitor seasonal changes in autofluorescent diatom biocomponents and to track the impacts of climate change on these critical organisms."

Gough told *Show Daily*, "One of the things that we're concerned about is that an earlier sea ice melt will lead to an earlier diatom bloom, which means mismatched trophic cascades [food-chain disruption], meaning the microscopic creatures in the water that rely on the diatoms for food may be trying to grow when the diatoms have already fallen away from the melted ice." Ultimately, such a disruption disturbs the vital role of diatoms in fixation of inorganic carbon, inorganic nitrogen, and inorganic phosphorus.

"We need to do longitudinal studies on how this process is changing. But right now within one season, we can already see what the changes are. We are also looking forward to see what would happen under other conditions."

MATTHEW PEACH

Intel makes quantum dot and tunable lasers on full-scale silicon

Invited presentations from groups at Intel and imec in Tuesday's conference sessions hinted that a new generation of lasers could soon be mass-produced on silicon. While Intel has been manufacturing lasers on silicon since 2016, Duanni Huang and Ranjeet Kumar from the US chip giant's integrated photonics solutions division reported advances in quantum-dot (QD) and tunable sources, respectively.

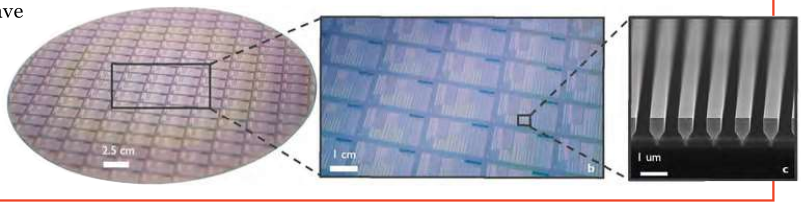
Huang detailed what is believed to be the first demonstration of QD lasers on 300-nm-diameter silicon wafers, with the Intel team producing both Fabry-Perot and distributed feedback (DFB) devices in work at the firm's "Fab11X" wafer fabrication facility in New Mexico. Based on gallium arsenide (GaAs) material grown separately and then die-bonded to the silicon wafer, the lasers emit at around 1300nm. The initial work attached 54 lasers to a single silicon wafer before removing the GaAs substrate, patterning the laser features, and then treating the material as if it was a regular silicon wafer for further processing and wafer-level testing. Huang said that the number of QD lasers fabricated on the wafer could be scaled up dramatically, and that the approach had "tremendous potential." For Intel, the adoption of QD lasers instead of standard devices should help reduce the complexity of its current photonic integrated circuit (PIC) designs, which still rely on numerous optical fiber connections.

Kumar followed up with details of the tunable laser effort, which could find use in a variety of applications aside from communications PICs, for example in optical coherence tomography, metrology, or automotive lidar.

This time the Intel lasers showed a tuning range of approximately 50nm, with one design emitting in the O-band (1300nm) and a second in the C-band (1550nm). Although such devices would inevitably have some disadvantages compared with benchtop tunable sources, including the limited breadth of their tuning range, Kumar said that in principle the Intel sources could be manufactured at a fraction of the cost.

In the same technical session Didit Yudistira from imec outlined the Belgium-based group's recent efforts on GaAs nano-ridge laser designs, where the lasing material is deposited directly onto a full-size silicon wafer and without the need for the kind of bonding step used by Intel. The initial work produced more than 100 lasers emitting at 1023nm, with Yudistira saying that the team was now looking to extend that wavelength to the O-band.

MIKE HATCHER



imec's GaAs nano-ridge lasers, grown directly onto a full-size silicon wafer. Credit: imec.

SPIE/Singapore continued from page 01

through increased educational capacity, funding of research, and the development of talent pipelines for industry.

Associate Professor Aaron Danner from the Department of Electrical and Computer Engineering, who played a key role in the development of the Fellowship within NUS CDE and who was present at the public announcement, expressed his hope that it would foster closer ties between NUS CDE and SPIE through the students supported by the program.

"Recipients of the SPIE-CDE Fellowship in Optical Science and Engineering will help build the future of optics and photonics," said SPIE CEO Kent Rochford. "Investing in optical engineering students pursuing their PhDs will have a critical impact on the field, and we are delighted to work with NUS to create exciting opportunities for these students."

"The mission of SPIE — partnering with researchers, educators, and industry to advance light-based research and technologies — is one that NUS CDE supports. The SPIE-CDE Fellowship formalizes our mutual commitment to developing young talent in this field," said Professor Kie-Leong Teo, Dean of NUS CDE.

The SPIE Endowment Matching Program was established in 2019 to increase international capacity in the teaching and research of optics and photonics. With this latest gift, SPIE has provided over $5 million in matching gifts, resulting in more than $13 million in dedicated funds. The SPIE Endowment Matching Program supports optics and photonics education and the future of the industry by contributing a match of up to $500,000 per award to college, institute, and university programs with optics and photonics degrees, or with other disciplines allied to the SPIE mission. Proposals for the next round of consideration are currently being accepted, and are due 30 April.

DANEET STEFFENS

Focused Energy moves to commercialize direct drive inertial fusion energy

Clément Paradis. Credit: Focused Energy.

Monday's Optical Technologies for Inertial Fusion Energy conference series featured an invited talk by Clément Paradis from Focused Energy (FE). The company, headquartered in Darmstadt, Germany, recently announced plans to open a $65 million facility near San Francisco, to attract world-class talent and to build on the fusion breakthroughs achieved at the nearby National Ignition Facility.

Paradis, Program Manager for FE and Pulsed Light Technologies, explained how the company is working to navigate the journey from cutting-edge research to practical and scalable solutions, "paving the way for the future of clean, commercial fusion energy." His ambitious roadmap will take FE's activities from today's labwork, to mass-production of fusion power plants by the mid-2030s.

"Our focus will include bridging the laser technology gap to fusion power plants through a strategic facility plan designed to mitigate critical target physics and technology risks for direct drive inertial fusion energy," he said.

The company stated, "Baseload power demand is projected to double between 2025 and 2050 as a result of factors including increasing standards of living, the electrification of transportation, and the adoption of AI powered by data centers. Commercial fusion is the only viable solution to the challenges of increasing baseload power to sustain economic growth while decarbonizing the economy."

Fusion road map: Focused Energy's Target Laboratory in Darmstadt, Germany. Credit: Focused Energy.

FE is developing low-cost, millimeter-scale deuterium/tritium fuel targets ("pearls") and modular laser arrays optimized for high repetition rate and efficiency. The company has already established a fuel targetry lab in Darmstadt. Paradis said, "The new Bay Area facility will help optimize the efficiency of the lasers and establish the global supply chain needed to support commercial fusion at scale."

Once in production, three soda cans worth of deuterium/tritium fusion fuel will be able to power a city the size of San Francisco for a day. Ultimately, FE will bring the fuels and lasers together, first in an integrated engineering facility to test and optimize target design and laser and target technology, and later in a pilot plant that will produce fusion power at commercial scale.

FE's laser technology roadmap maps the technology development "from flashlamp pumped to efficient diode-pumped fusion laser drivers" and includes "digital twin and an optical prediction tool kit to support and catalyse laser development."

MATTHEW PEACH

How to build a quantum workforce

A panel of experts discussed the challenges, opportunities, and best practices for building a quantum workforce on Monday. Moderated by Jess Wade, Imperial College London, the experts discussed nascent efforts in the US, UK, and Australia to build a pipeline of talent to serve exploding growth in the quantum industry.

Along with Wade, the panelists included Heather Lewandowski, University of Colorado, Boulder; Halina Rubinsztein-Dunlop; Thomas Searles, University of Illinois Chicago; Jake Douglas, Sandia National Laboratories; and Daisy Shearer of the UK's National Quantum Computing Centre.

"Quantum technologies have become a global priority," Wade said. "But to accelerate and increase our capacity to deliver quantum technologies, we need a talented, diverse, and adaptable quantum workforce."

For now, Lewandowski said studies show that industry is satisfied with the skills of workers at the PhD level, with the caveat that the quantum industry highly values hands-on and experimental skills. "So that's something we really need to focus on."

Douglas said that at Sandia, "we're really committed to supporting collaborations that grow the national US quantum ecosystem." He added that Sandia also operates the Elevate Quantum tech hub, which aims to move quantum forward in the US mountain west region.

Searles said, "now is the time when having a PhD in applied physics is probably one of the most important degrees that you can have," in terms of a career in quantum information science. As president-elect of the National Society of Black physicists, and his participation in the US National Quantum Initiative, he led an effort for IBM to invest in the quantum workforce at 27 historically Black colleges and universities.

In Australia, said Rubinsztein-Dunlop, the federal government is funding a quantum strategy for the country, as are state governments. It's all part of Australia, "recognizing that quantum education, quantum research, is important for the development of the country."

Shearer noted that the UK's National Quantum Technologies Program and National Quantum Computing Center have made a concerted effort to ensure that the country will have a quantum workforce, and has been investing in PhD funding, with specific centers for doctoral training on quantum topics. But they've also been looking to build a quantum workforce through public outreach and working with schools and teachers at the K-12 level. She said the country's mindset has been "how can we make sure we have the workforce and the talent that we need to deliver on our [quantum] technology aspirations?"

Let's get to work: Photonics West 2025 officially opens for business. Credit: Kevin Probasco.

WILLIAM G. SCHULZ

Global Business continued from page 01

He contends that, while the tax-cutting priorities of the new president will also help the US economy, it will likely leave significantly less cash for infrastructure spending and industrial policy interventions like the Biden-era's CHIPS and Science Act, which has spurred huge investment in semiconductor manufacturing. Ryan added that the private sector will be expected to step in to fill that gap. The expected hardline focus on immigration could mean as many as 10 million fewer workers in the economy, driving up labor costs and restricting economic growth. But it is what Ryan described as a "non-traditional" set of aggressive trade policies and likely tariffs that may have the most impact on the photonics industry.

"Trump sees tariffs differently," he said. "He views them as an essential tool of foreign policy." Ryan thinks that a major difference between the current and previous Trump regimes is that, this time, tariffs will actually be enacted rather than just threatened. "There is a much higher probability of tariff implementation," said Ryan, predicting that tariffs on Chinese imports would rise from 12% to 30%.

How exactly that plays out in the photonics supply chain remains to be seen, but with subsequent presentations from MKS Instrument's CEO John Lee, ASML's Louis van den Oetelaar, and Coherent Marketing Chief Sanjai Parthasarathi highlighting the globally interconnected nature of the business and the vast number of components that feature in systems like ASML's cutting-edge lithography tools, complications seem inevitable.

On a day when the apparent progress made by Chinese artificial intelligence (AI) developer DeepSeek sent technology stocks into a tailspin on Wall Street, all three of those speakers highlighted the ever-deepening connection between photonics and the rise of AI. Disruption won't just come from geopolitics, it seems.

MIKE HATCHER

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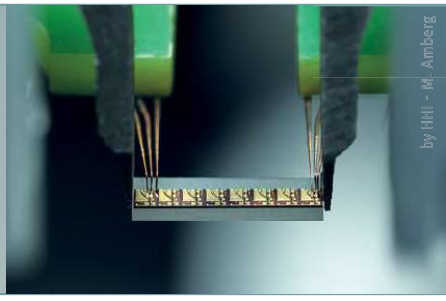

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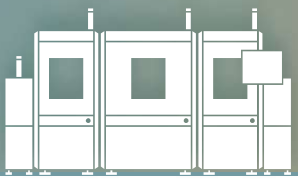

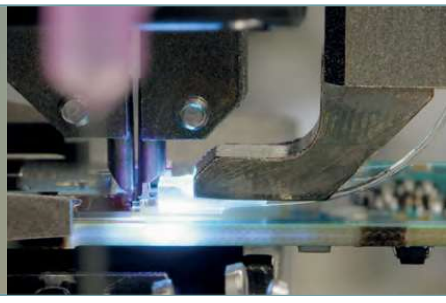

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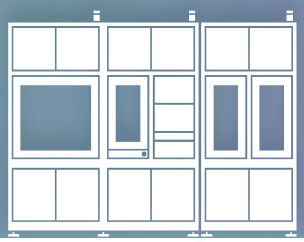

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PHOTONIS

AI push shapes photonics investment landscape

The return on an estimated trillion-dollar investment in AI-related infrastructure remains uncertain, but the photonics industry is benefitting in all sorts of ways.

Take a look at Gartner's June 2024 hype cycle for artificial intelligence (AI), and only one application has made it to the so-called plateau of productivity — computer vision. Most everything else, whether neuromorphic computing, cloud AI services, generative AI, or autonomous vehicles, remains somewhere between over-hyped expectation and the trough of disillusionment.

While the need for more efficient AI data centers has driven much of the recent investment in photonics, companies are also looking to harness the emergent technology. One example is Trumpf, which is working with Silicon Valley's SiM.ai on AI applications in laser materials processing. Credit: Trumpf Group.

Thus far, it's not much to show for what Goldman Sachs expects to be a trillion-dollar investment poured into generative AI alone, from data center upgrades to bleeding-edge chip design and language model development.

What the past year shows most evidently is that, once again, the "picks-and-shovels" nature of the photonics industry has made it a major beneficiary of this latest gold rush. Most obviously, that has translated to inflated sales of optical transceivers and fiber links for AI-related data center upgrades, investment in chip manufacturing capacity, and equity funding for a new generation of start-ups offering potential solutions to today's AI data-crunching and energy-consuming bottlenecks. According to one estimate the global electricity consumption of data centers is now on a par with that of Japan, equivalent to becoming the fifth-largest energy-consuming country in the world, and there is widespread acknowledgement that the turbo-charged computing demands of AI are pushing the sector down an unsustainable energy path.

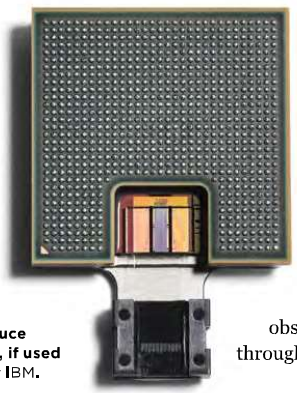
Graphics processing unit (GPU) specialist-turned-AI-pioneer Nvidia is at the heart of everything. Go back to February 2023 and you will not find a successful company, but one that had just posted a 50% drop in earnings as its annual sales flatlined at $27 billion. Just 18 months later, Nvidia announced a *net income* of nearly $20 billion on *quarterly* sales of $35 billion, and was suddenly worth more than $3 trillion.

Nvidia may not be a photonics company, but its influence on the industry in 2024 was enormous. AI computation requires cutting-edge chips produced using the latest semiconductor manufacturing equipment, and data centers where optical transceivers connect servers at the highest speeds currently possible. Beneficiaries include big-hitters Coherent and Lumentum, and perhaps most obviously the Thailand-headquartered contract manufacturer Fabrinet. 2024 saw Fabrinet continue its recent sequence of record-breaking financial quarters, with annual sales closing on $3 billion and revenues from data communications applications up 36% year-on-year. Nvidia accounted for $1 billion out of that annual sales total, three times the figure recorded in the prior year.

Indium phosphide (InP) components are arguably the most critical elements of those transceivers, and both Coherent and Lumentum have significant expansions to their wafer fabrication facilities under way. The former is poised to benefit from the outgoing US administration's CHIPS and Science Act by way of a preliminary agreement for $33 million earmarked for expanding its large InP wafer fabrication facility in Sherman, Texas.

Optical interconnects

More transceivers of course means more fiber, and last year also saw key supplier Corning sign a landmark agreement with North American service provider Lumen Technologies. Suggesting that the rapid advance of generative AI would require at least ten times more fiber connections within data centers, as well as a robust fiber network to transmit information between those data hubs, Lumen has reserved 10% of Corning's global fiber capacity for each of the next two years.



IBM believes that its new co-packaged optics process, based on polymer waveguides, could reduce data center power consumption by a factor of five, if used to replace electrical wiring. Credit: Ryan Lavine for IBM.

Shortly before that agreement Corning had hiked its quarterly revenue estimate by $200 million, specifically a result of generative AI demand, with CEO Wendell Weeks observing: "If you look at the world through glass eyes, like us, what you see

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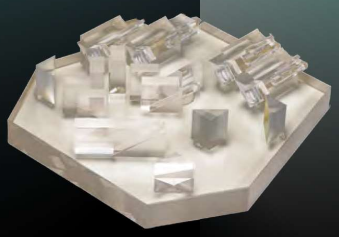
MINIATURIZING
OPTICAL SETUPS



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AI-related investment continued from page 07

is that you use a lot more fiber optics for any given amount of power to do generative AI; five to ten times as much."

Corning is also working on the next level of optical connectivity, developing glass substrates it calls "Fusion" that can be embedded with optical waveguides for co-packaged optics (CPO) to link chips directly. Another blue-chip tech company working on CPO is IBM, which in December said its polymer optical waveguide technology, developed in-house, could dramatically reduce power consumption for scaling generative AI data centers, while enabling developers to train a large language model up to five times faster.

IBM believes that its solution could help future-proof data centers, and usher in a new era of more sustainable communications that can handle future AI workloads.

CPO is one of a number of technological developments promising to reduce energy consumption to sustainable levels. That fundamental requirement has opened another set of opportunities for startups developing highly integrated photonics solutions, and a surge of venture investments over the past 12 months. Nvidia is highly influential here as well, and is directly backing the Silicon Valley startups Xscape Photonics and Ayar Labs.

Combining silicon photonics expertise from Columbia University and Broadcom, Xscape revealed details of a $44 million series A equity round in October, with CEO Vivek Raghunathan explaining that the firm's "ChromX" platform would be able to handle hundreds of wavelengths on a single optical fiber, a huge upgrade on current technology that is typically restricted to only four wavelengths.

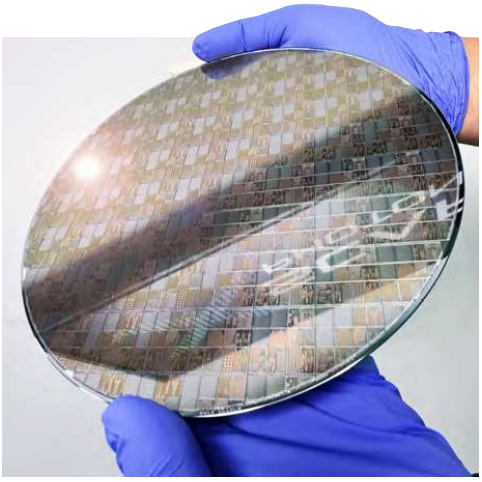
"Historically, performance and scalability challenges have been addressed by building bigger data centers to train large language models," said Raghunathan at the time. "This approach is not sustainable and unlocks a myriad of additional issues around energy consumption and cost."

Ayar's silicon photonics interconnects are rooted in a research collaboration involving the Massachusetts Institute of Technology (MIT), UC Berkeley, and University of Colorado in Boulder — plus financial support from the US Defense Advanced Research Projects Agency (DARPA).

The idea is to eliminate bottlenecks created by traditional copper interconnects and pluggable optics, and the company has attracted support from across the AI data center ecosystem. Its $155 million series D round, closed in December, brought total investment in the San Jose firm to $370 million. Analysts at Yole Intelligence have identified Ayar as a major player in optical interconnects over the past few years, as the firm established strong development partnerships with not only Nvidia but the likes of Intel, GlobalFoundries, and Hewlett Packard Enterprise.

Other deals have included $11.5 million in seed funding for Quintessent, a spin-out from John Bowers' photonics research group at the University of California, Santa Barbara working on interconnects based around multi-wavelength comb lasers exploiting the advantages of quantum dot structures.

Manny Stockman from venture outfit Osage University Partners (OUP), which led Quintessent's seed round, commented that novel chip-scale laser architectures had rarely been the focus of attention in AI datacoms, because the industry had tended to focus on engineered solutions. "But at OUP, as we observed various AI and computing hardware companies push the limits of bandwidth and packaging with optical systems, we found they were all challenged by the scaling and cost of their optical laser source," pointed out the investor at the time of the funding round.



The "ChromX" technology platform developed by startup Xscape Photonics is said to handle hundreds of wavelengths on a single fiber, promising flexibility and efficiency for AI workloads as the energy demands of conventional data center architectures rise unsustainably. In October 2024 the Santa Clara firm raised $44 million from a consortium including Nvidia. Credit: Xscape Photonics/Business Wire.

Apparently closer to commercial reality is Celestial AI, yet another Silicon Valley company working on optical interconnects. Co-founded by former Khosla Ventures partner David Lazovsky and MACOM executive Preet Virk, Celestial followed up its $100 million series B round of 2023 with an additional $175 million effort in early 2024, saying that its "Photonic Fabric" was poised to disrupt the market for optical connectivity solutions in accelerated computing. The approach is claimed to offer the only solution that would enable the disaggregation of compute and memory functions, thus allowing each element to be leveraged and scaled most effectively.

Celestial touts a 25-times increase in bandwidth and memory capacity while reducing latency and power consumption by up to ten times, when compared with existing optical interconnect alternatives and copper.

Trumping all of those equity funding announcements, however, was Boston's Lightmatter. Aiming to go a significant step beyond optical interconnects, Lightmatter is working on what it describes as a "photonic supercomputer," something that sounds like a more fundamental advance on conventional architectures and something of a "black swan" in terms of market disruption if it succeeds. The firm's "Passage" technology is based around programmable Mach-Zehnder interferometers, in the form of 3D-stacked photonic chips.

Since raising $400 million in its October 2024 series D round — and bringing total funding so far to $850 million — Lightmatter has agreed to major partnerships with the chip manufacturer GlobalFoundries, and the semiconductor packaging and testing services giants ASE and Amkor Technology.

Not everybody is focused on InP and silicon photonics, and it may come as a surprise to hear that lithium niobate — the photonics equivalent of an old warhorse — is still making waves in venture circles. September 2024 saw Zurich-based Lightium and the Cambridge, Massachusetts, firm HyperLight raise $7 million and $37 million respectively for their developments in thin-film (TFLN) versions of the otherwise mature material.

Lightium, which had been aiming to launch its production-grade photonic foundry operation by the start

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SPIE Catalyst Award finalists. Credit: (L-R) SCHOTT AG, Thorlabs, and Vacuum Innovations

SPIE Catalyst finalists offer education, skill building, and sustainability programs

The trio of finalists are pursuing climate-friendly glass production, global photonics workforce growth, and technical-skill development.

Now in its second year, the SPIE Catalyst Award honors for-profit companies making significant social or environmental impact in their community or society at large. Finalists for the Catalyst Award in 2025 are SCHOTT AG, Thorlabs, and Vacuum Innovations for consideration in one of three categories: Environmental Sustainability; Community Engagement, Outreach, Education, and Training; and Equity, Diversity, Inclusion, and Accessibility.

SCHOTT AG:

The company's use of 100% hydrogen as a fuel for optical-glass production marks a milestone in its journey towards decarbonization.

In a bid to move toward climate-friendly glass production, SCHOTT scientists, for the first time, have produced special optical glass on an industrial scale using only hydrogen as production fuel. This milestone is a key step towards SCHOTT's goal of climate-neutral glass production by 2030, and offers a promising indication of future options for customers, energy suppliers, and the wider industry.

The primary goal of SCHOTT's project is to decarbonize its optical-glass production by replacing natural gas fully with hydrogen, significantly reducing CO emissions. By replacing natural gas with hydrogen in its high-temperature melting processes, SCHOTT has demonstrated that glass can be produced without compromising quality or safety, while also reducing CO emissions. Initial tests showed no negative impact on glass properties, showing hydrogen's potential as a clean fuel alternative for the future; SCHOTT's efforts have proven that the high energy demands of melting glass — requiring temperatures of up to1,700°C — can be met using hydrogen without compromising the quality of the glass. This advancement sets a standard for the glass industry and other high-energy industries aiming to decarbonize their production processes. The project also paves the way for further long-term tests and makes it clear that the expansion of a hydrogen infrastructure for specialty glass production can be worthwhile.

The ongoing project aims to scale up hydrogen use from initial laboratory tests to continuous production. This has involved adapting furnace infrastructure and burner systems to support hydrogen as a future fuel source, and ensuring that glass quality remains consistent. Over the past six years, SCHOTT has conducted extensive research, starting with small-scale hydrogen integration in 2020, and culminating in full-scale production trials starting with 35% hydrogen admixture over four weeks. As a second step, new trails were performed using 100% hydrogen. During the latter testing, a smooth transition from natural gas to hydrogen was achieved within five minutes. After a three-day continuous run, the glass properties produced with hydrogen were comparable to those made with natural gas. The results confirm that hydrogen can achieve the same melting temperatures with no adverse effects.

"We are honored to be named a finalist for the SPIE Catalyst Award alongside other innovators driving environmental sustainability," said SCHOTT Head of Sustainability Communications Jonas Spitra. "This acknowledgment underscores our commitment to leading climate-friendly glass production, specifically through our use of 100% hydrogen as a fuel source. This recognition reaffirms our belief that decarbonizing glass production is not only possible but critical to a sustainable future. At SCHOTT, we will continue to push the boundaries of what's achievable as we get closer to our goal of becoming a climate-neutral company by 2030."

Thorlabs:

Thorlabs Photonics Learning

Thorlabs Photonics Learning is a multi-faceted, global initiative that takes a holistic approach to photonics workforce and community development. The program aims to raise awareness about photonics, provide access to key equipment and leaders within the field, and spark interest in joining and excelling

continued on page 13

Catalyst Award finalists continued from page 11

within the photonics community in a bid to foster a more diverse, inclusive, and educated generation of innovators. The program emphasizes in-person, hands-on experiences that generate awareness, access, and knowledge; through its multiple touchpoints and initiatives, people from all cultures, backgrounds, and identities can discover the basics of the photonics field while envisioning an attainable path to establishing their own photonics-focused career.

The program is built on a solid foundation: 4,000 Thorlabs educational kits are already being used in academic programs across 77 countries, including four that live in permanent museum displays. Thorlabs' Shanghai lab has created experiences for 300 summer-school students and 3,000 industry members, and related educational videos have exceeded 1,000,000 views. In the meantime, collaborative approaches enrich hands-on experiences: Thorlabs' Mobile Photonics Labs have engaged 7,000 visitors worldwide, with 21% of US-based events focused on women-centered and minority-serving institutions and programs.

The Thorlabs Photonics Learning program is based on a highly collaborative, interactive approach which includes:

- Integrating educational initiatives by weaving together educational kits, digital content generation, mobile app development, and training curriculum to enrich educational experiences.
- Deepening partnerships with educators through engagement with local professors to establish academic programs that educate both students and professors about photonics approaches. For example, creating and providing space for lab activities in order to enhance college courses.
- Illuminating viable career paths by showcasing the practical connections that create a photonics career. For example, high school students are invited to mobile lab events at colleges to explore photonics applications and industry roles, and then tour the college facilities with photonics faculty to learn about fulfilling academic requirements.
- Relating to underserved and underrepresented communities to help all students realize that a career in photonics is achievable. For example, during a high-school mobile lab event in Gallop, New Mexico, held in collaboration with K-12 outreach program SPARCQS (Sparking Curiosity in Quantum Science), a local tribal member shared their story about becoming a Los Alamos National Laboratory researcher and professor after graduating from that school.

"We are incredibly proud of the global impact Thorlabs Photonics Learning has achieved in raising awareness about photonics, providing access to people and state-of-the-art equipment, and illuminating advancement pathways for individuals to join and excel within the photonics community," said Thorlabs Director of Photonics Education Bill Warger. "Being named an SPIE Catalyst Award finalist is a tremendous honor and reinforces our commitment to empower a diverse, inclusive, and well-educated workforce poised to drive innovation across the entire photonics industry."

Vacuum Innovations:

Optical Coating Design & Technology Education

Optical coating is not offered as a major in any US-based college, leading to a lack of development of new engineers in the industry. While inroads have been made for optical technicians at various community-college programs, domestic optical-coating engineers generally require on-the-job training, something which can be limited by both the level of expertise and available training time by the employer.

Vacuum Innovations' (VI) goal is to develop an improved understanding of optical coating designs and properties for customers, employees, and vendors. To accomplish this, VI offers in-person lectures and demonstrations worldwide, as well as by educating the optics workforce about the benefits, and demand, for optical experts and technicians. VI President James Oliver, a longtime SPIE Member, has developed and taught optical coating multiple-day workshops, courses at conferences, employee-focused courses for internal training, and specialty workshops. Currently, VI-led classes educate over 100 industry professionals annually at in-person events, enhancing the level of optical coating knowledge as well as accelerating the growth of engineers and scientists that are new to the field. VI has held workshops in the USA, Europe, the United Kingdom, and at various society conferences for over 20 years.

In addition, VI hosts their technical in-person series as an outreach to current and prospective customers, with an opportunity to help develop and grow the optical-coating community. They target different geographic areas to make the courses more accessible. The goal for the program is to continue hosting workshops every three years abroad, whether that be Europe or Asia, to ensure they are not only expanding our reach, but also remaining current on developments outside the US. US-based workshops continue at a pace of two per year, with ongoing in-house training for VI's local workforce.

VI purposely located their manufacturing facility in an economically disadvantaged area, and their local work-force development is targeted to an underserved population. By holding regular in-house lunches, they educate local employees about optical-coating technology on a weekly basis. The company's ongoing goal is to train and educate individuals about the value and applications of optics, optical design, and optical coatings, plus awareness of multiple paths for potential employment, especially with the rising demand for optical technicians.

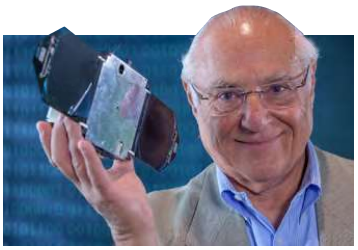
"Vacuum Innovations is honored to be selected as a finalist for the 2025 SPIE Catalyst Award," notes VI's Sales and Marketing Manager Marcella Oliver. "Although this program is relatively new, we have been fortunate to connect with numerous industry professionals and respected companies, advancing the education of optical coating. Hosting these workshops has been particularly rewarding, as it allows us to contribute directly to the growth of the optical coating community. Through these face-to-face workshops, we facilitate valuable discussions on optical coating design, analysis, and testing, applying the insights gained to real-world challenges. Congratulations to all the other finalists, and we wish you the best of luck!"

From providing a path toward environmentally friendly sustainability in the optics industry, to growing the options for technician skill enhancement and educating shared communities about optics and photonics and related career options, these three SPIE Catalyst Award finalists have created impactful programs that enhance and serve their photonics-focused communities. The winner of the SPIE Catalyst Award will be announced during the SPIE Prism Awards tonight.

DANEET STEFFENS

Building beyond Earth: What's in it for photonics?

As in-space servicing and manufacturing gathers momentum, Photonics West Plenary Hot Topic speaker and nanosatellite pioneer, Henry Helvajian, looks at the growing role of photonics out in orbit.



Nanosatellite pioneer, Henry Helvajian, presented the LASE Plenary Hot Topic, "The changing landscape of outer space," on Monday afternoon. Credit: Helvajian/The Aerospace Corp.

When Sputnik launched on 4 October, 1957, it was the first human-made object to orbit Earth. The Russian satellite reached space atop a R-7 Intercontinental Ballistic Missile, prompted the establishment of NASA, and triggered the Space Race. Yet, despite the admiration — and fear — that Sputnik sparked around the world at the time, few could have fathomed the sheer numbers of spacecraft that followed.

Thanks to the development of small satellites and modern rockets, the cost of making and launching spacecraft has plummeted, and satellites in space have proliferated. Today, around 12,000 satellites orbit Earth and come 2030, the US Government Accountability Office estimates numbers will soar to more than 60,000. Nanosatellite and 3D laser micromachining pioneer, Henry Helvajian, is a Principal Scientist at The Aerospace Corporation, a non-profit, and federally-funded research and development center committed exclusively to the US space enterprise. He reckons this figure could be closer to 100,000, once spacecraft launched by nations outside of the West are added to the count.

A SpaceX Falcon Heavy rocket carrying NASA's Europa Clipper spacecraft launches from NASA's Kennedy Space Center in Florida on 14 October, 2024. SpaceX has been instrumental in slashing craft and launch costs — all necessary for future in-space manufacturing. Credit: SpaceX.

In his Plenary Hot Topic, "The changing landscape of outer space," on Monday 27 January, he described what this means for space and photonics technologies. "Today we only service spacecraft when absolutely necessary but by the 2030s, in-space services, with refuelling, repair, relocation, assembly and manufacturing, hopefully will be routine — some finance groups forecast the market to be as large a multiple trillion dollars in 15 years," he says.

Microgravity manufacturing

Myriad organizations already manufacture products in low earth orbit for use on Earth, pursuing the enhanced properties that microgravity can bring. Helvajian points to the 'Factories in Space' database, founded by physicist and satellite engineer, Erik Kulu, which lists some 185 firms, including photonics firms, working on products in space for use on Earth. Amongst these, Flawless Photonics, Luxembourg, is pioneering the manufacture of optical fibers while Apsidal, US, is developing novel photonics.

Meanwhile, a recent white paper — *Semiconductor Manufacturing in Low-Earth Orbit for Terrestrial Use* — from NASA and Stanford University scientists, and colleagues, stated: "Earth's gravitational forces pose substantial barriers to quick, high-yield semiconductor production… Transitioning this industry into space is the only path forward if the US is to keep pace with the technological arms race unfolding across the globe."

As Helvajian asserts: "The fact is, in-space servicing, assembly and manufacturing is real and it's happening now. Globally, we do not realize how much our lives are tied to information that comes from space; weather, banking (funds transfer timing), location, communications."

"It was always expensive to launch spacecraft but this has changed, and is about to change even more," he adds. "Look at SpaceX's Starship — this will eventually carry hundreds of tons into space weekly."

Crowded space

A more crowded space, and thriving in-space servicing, assembly, and manufacture (ISAM) sector, could have a profound impact on photonics. According to Helvajian, these extraterrestrial activities will demand space-based fuel delivery systems and could well include large infrastructures with kilometers-long scaffold, where organizations can set up payloads. "Companies are already lining up to manufacture structural materials such as carbon fiber composites as a work around to the limitations of the rocket payload volume — photonics and lasers will play a key role in assembly and verification."

Helvajian points out how laser-based 3D printing will be fundamental to the additive manufacturing of high quality components in space — the European Space Agency 3D printed the first metal part in space in September 2024. He also points to photonics in optical tracking, diagnostics, and communications applications. "Operations in space are typically done while traveling around seven kilometers per second — quick assessments and decision making will be important," he says. "Optical laser communications can transmit key data, at line-of-sight, between spacecraft — Space X's Starlink satellites already use this and others will follow."

But as the number of satellites has risen, so has the level of accompanying junk — or space debris — and likely will for some time yet. Figures from the European Space Agency reveal some 40,000 plus space debris objects — greater than 10 cm in size — are in orbit. Meanwhile more than one million 1cm to 10 cm sized fragments, and 130 million pieces ranging from 1mm to 1cm in size, are also circling Earth.

"Developing a sustainable space environment is already an issue and if not resolved it's going to be the Wild Wild West out there because of debris crashes," says Helvajian. "A 1mm piece of debris travelling at orbital velocity is equivalent to a baseball flying at around 80 miles an hour."

Clearly space debris collisions pose clear risks to ISAM operations, but again, photonics can be applied to the problem. The Aerospace Corporation scientist points out how satellite imagery can capture collisions while lidar can characterize space debris and track its orbit. "We can also use this approach to provide a potential 'safe haven' for new satellites as they are launched and placed in orbit," he says.

Space standards

Growing industry interest in ISAM, and the growing problem of space debris, hasn't been lost on US government and related organizations, now racing to work out how best to manage activities. Back in 2017, the US Defense Advanced Research Projects Agency (DARPA) set up the Consortium for Execution of Rendezvous and Servicing Operations (CONFERS) to "empower a robust space economy" — CONFERS is now a global trade association for the satellite servicing industry with members including Northrup Grumman, Astroscale, and The Aerospace Corporation. "It's producing standards and rules for good behavior in space," highlights Helvajian.

NASA also recently launched a national coalition, the Consortium for Space Mobility and ISAM capabilities (COSMIC), in response to US government strategy to develop its domestic in-space servicing, assembly, and manufacturing capability — Helvajian and The AeroSpace Corp are involved. And like-minded endeavors exist across Europe, Canada, Japan, and other nations.

Artist's concept of SpaceX's Starship Human Landing System (HLS) on the Moon — at 165 feet, it is the same height as a fifteen-storey building. NASA is working with SpaceX to develop Starship HLS to carry astronauts from lunar orbit to the Moon and back. Credit: SpaceX.

As collaborations gather momentum, Helvajian is very hopeful that come the 2030s, ISAM activities will be well underway. "Northrup Grumman has already been carrying out commercial space servicing and the US, and our allies, are putting a sustainable set of rules for good behavior," he says. "The transition [to space] is here and there are huge opportunities for photonics."

REBECCA POOL

PHOTONICS WEST SHOW DAILY

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PRODUCT FOCUS

Welcome to the optics.org Product Focus which we have published specifically for Photonics West 2025 in partnership with SPIE and the Photonics West Show Daily.

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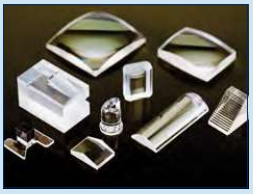

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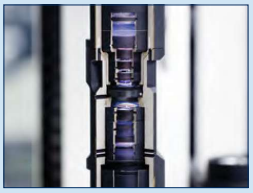

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Photonics for sustainability

Presentations at SPIE Photonics West showcase photonics technologies for a brighter, more sustainable future.

Photonics technologies are making significant contributions to sustainability by improving energy efficiency, reducing environmental impact, and enabling the development of clean energy sources. From enhancing renewable energy generation to optimizing resource management and manufacturing processes, photonics offers a range of tools that can help build a more sustainable future around the world.

A few examples of how harnessing the power of light can create cleaner, more efficient technologies to reduce environmental impact include:

- LEDs: Energy-efficient LEDs consume less energy and have longer lifespans compared to traditional incandescent and fluorescent lights, reducing energy consumption and waste.
- Solar photovoltaics: Advances in materials science and photonics have improved the efficiency and cost-effectiveness of solar panels, making solar energy a more viable and sustainable energy source.
- Optical fiber communication: Fiber-optic networks consume significantly less power than traditional copper-based electrical networks, contributing to a greener and more sustainable information infrastructure.
- Environmental monitoring: Lasers and optical sensors are used to detect and measure greenhouse gases and monitor air and water quality, providing data for use in environmental conservation.
- Cleaner manufacturing: High-precision lasers used in manufacturing processes such as cutting, engraving, and welding, reduces waste and energy consumption, and minimizes the use of harmful chemicals and processes.

The Sustainability track at Photonics West will cover how photonics technologies are addressing environmental and sustainability challenges with more than 300 enlightening presentations ranging from renewable energy generation and agricultural science to biomedical and industrial applications.

Exploring the impacts of climate change

On 25 January, Kathleen M. Gough of the University of Manitoba discussed wide-field fluorescence-detected photothermal infrared (FL-PTIR) imaging in her presentation "Tracking climate change with FL-PTIR of Arctic Sea ice diatoms."

"We have been using conventional FTIR imaging with a focal plane array detector to examine sea-ice diatoms from the Canadian Arctic for several years," says Gough. "With IR, we can see the spatially resolved cellular biomass composition in individual diatoms and compare species. The rich information in IR spectra lets us study how diatoms (autotrophs) allocate inorganic carbon to fats and protein — first to fat in the early spring and later to protein as the algal bloom starts. Since the diatom spring bloom is the first pulse of photochemically-fixed inorganic nutrients, they are the bottom of the Arctic food chain. Climate change induced alterations in their growth cycles and their carbon allocation can have a huge impact on Arctic Sea life and on the atmosphere throughout the entire year. Diatoms are also responsible for about 20% of atmospheric oxygen, they are the rainforest of the ocean. We need to understand them better!"

Gough notes that spatially resolved FL-PTIR spectra allowed researchers to discover that the chemical structure of silica frustule changes with the frustule function. "This was totally unexpected, never seen before," says Gough. "It opens up an entirely new direction of study — the relation between chemical form and structural function in these exquisitely designed, naturally evolved organisms."

Photonics in agriculture

Photonics play a big part in the world of agriculture including the use of machine vision, RGB cameras, 3D cameras, and thermal cameras for crop monitoring and plant phenotyping; spectroscopy and spectral imaging for measuring crop health; laser speckle imaging for measuring plant sap flow; and sensor-driven autonomous growing. These technologies and others offer innovative solutions for optimizing agricultural practices, enhancing crop productivity, and reducing environmental impacts. Photonics sensors can provide precise and real-time data, leading to better decision-making in plant health management, resource usage, and food production efficiency.

Today, the conference "Photonics Technologies in Plant and Agriculture Science II" features several presentations on how photonics can improve efficiency, sustainability, and productivity in agriculture.

"Our conference aims to provide a platform where the latest developments in phyto- and agriphotonics can be presented and discussed," says conference co-chair Dag Heinemann of Hannover Centre for Optical Technology HOT. "We want the attendees to learn about the newest technical developments, but also innovative implementation of photonics technologies in the agricultural sector. Due to the active participation of industry, there is an efficient interface between the development of new sensor technologies and the implementation of photonic processes. Through this combination, we want to promote the initiation of new collaborations and thus harness the innovative power of photonics for the agricultural sector."

Conference co-chair Gerritt Polder of Wageningen University and Research notes that photonics technologies are playing a growing role when it comes to more efficient, advanced, and sustainable agriculture.

"The future of photonic technologies in the agricultural sciences lies in strong interdisciplinary cooperation," says Polder. "Collaboration between researchers and industry from the field of photonics with scientists from the field of plant and agricultural sciences is essential to fully develop the potential of modern photonic technologies in this sector. In addition, agricultural machinery manufacturers and farmers must also be involved as end users in order to ensure

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Kathleen Gough. Credit: University of Manitoba

Gerrit Polder in the field. Credit: Gerrit Polder

Dag Heinemann. Credit: Leibniz University Hannover

Karin Hinzer. Credit: University of Ottawa

SUSTAINABILITY TRACK BEST PAPER AWARD WINNERS

Injection laser system architecture, upgrades, and future at the National Ignition Facility
Paper 13358-21
John E. Heebner, Lawrence Livermore National Lab. (United States)

Bridging the energy gap: converting radiative heat to power with passive cooling
Paper 13361-25
Jeremy N. Munday, University of California, Davis (United States)

Sustainability continued from page 18

a transfer into practice. If this bridge can be successfully built, photonic processes can provide an important building block for the establishment of precision agriculture and deliver significant added value through the provision of advanced sensor data."

Photovoltaics systems

"We are very excited to be working on predicting energy yield for new vertical photovoltaic systems where energy is generated from when the sun rises to when it sets with high efficiencies," says Karin Hinzer of the University of Ottawa. "Accurate energy yield modelling of photovoltaic systems is essential for the design, financial analysis, and monitoring of solar photovoltaic plants."

On 30 January, Hinzer will present "Vertical bifacial photovoltaic system field data performance and model validation for various orientations and latitudes," which includes a comparison of five different types of software and how well they can predict energy generated as a function of time of day and time of year, and comparing with experimental data from calibrated outdoor test beds in Colorado and Alaska. Hinzer notes that new east-west geometries are good to generate electricity in the morning and evening when they are most needed and can easily complement traditional photovoltaic systems that are usually south-facing.

"I am always interested in developing photonic chips that generate power in a sustainable way as well as developing chips that are highly efficient and have a low carbon footprint during fabrication and use," says Hinzer. "In the last two years, photovoltaic deployment doubled globally and we now have two TW of installed photovoltaic systems worldwide. With the present growth curve, we should have eight TW deployed by 2030. We need to get to around 100 TW which would cover more than half of the electricity needs."

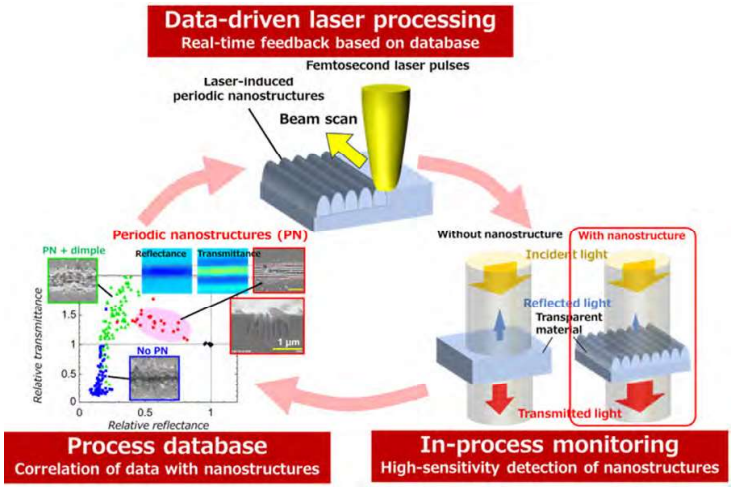
As photonics technologies continue to evolve, they will play an increasingly critical role across multiple domains, helping us achieve global sustainability goals and mitigate the impacts of climate change.

KAREN THOMAS

Pioneering precision: Data science and laser processing for manufacturing control

Discover how data-driven laser processing is set to change manufacturing at Aiko Narazaki's Plenary Hot Topic, "What does the fusion of laser processing and data science bring?"

In 2024, Aiko Narazaki and her research team from the Innovative Laser Processing Group at National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan, set out to show exactly what their data-driven laser processing system could do. Collaborating with Professor Godai Miyaji and colleagues from Tokyo University of Agriculture and Technology, they used in-process monitoring and machine learning to control a high power, ultrashort femtosecond pulsed laser in real-time, carving periodic nanostructures onto glass with remarkable precision and control.



Data-driven laser processing combines in-process monitoring and shape data to create nanostructures in glass with remarkable precision and control. Credit: Aiko Narazaki.

According to Narazaki, the defects generated whilst creating these laser-induced periodic surface structures (LIPSS) were reduced by more than 95%. "Glass is a hard and brittle material, prone to cracking — so precise microfabrication is often difficult and requires special care," she explains. "So we linked our in-process monitoring database to shape data we'd observed using high-resolution SEM after processing, and could determine the process window and perform feedback control processing in real-time.

"Our defect rates were about 1/30 of conventional systems without feedback, processing at the same speed," she adds. "Our results are still at the demonstration stage — to apply this to production lines, the key will be faster data processing technology."

Narazaki is also Principal Research Manager of the Research Institute for Advanced Electronics and Photonics at AIST. In her Laser Plenary Hot Topic, "Data-driven LASE Processing: What does the fusion of laser processing and data science bring?," on Monday afternoon, she presented how combining data science with laser processing can raise the throughput and quality of laser-based manufacturing and materials fabrication. Set to transform industries from aerospace and automotive to medical electronics — think battery manufacturing, medical device fabrication and microelectronics — she is certain the technology will, as she puts it: "contribute to sustainable manufacturing and society in the future."

Data and pulses

So what can data science offer ultrashort lasers? During ultrashort laser processing, intense laser light interacts with material matter for a very short time, exciting electrons before they thermally diffuse. As such, the process can deliver relatively damage-free, material-independent, precise processing. But on the downside, the electrons' non-linear excitation is very sensitive to laser parameters, such as pulse width, energy and frequency, as well as beam profile and scanning speed, making process optimization very slow and laborious.

"In my group, we're developing and integrating three core technologies: high-speed in-process monitoring, data processing such as machine learning, and fast laser modulation," says Narazaki. "AI can optimize simple phenomena as can be obtained by human intuition, but it can also [help] when a wide variety of physical phenomena are complexly correlated — laser processing is a typical example," she adds. "We can apply [data science] to ultrashort laser processing to raise productivity and quality."

As well as applying their data-driven laser set-up to LIPSS formation on glass, Narazaki's team has used the system to drill micro-holes into silica glass, modulating the laser pulse intensity to improve the laser ablation rate. But while rapidly modulating the intensity of the laser pulses optimizes laser-drilling, it also vastly raises the number of parameters that need to be controlled during the process.

Team effort

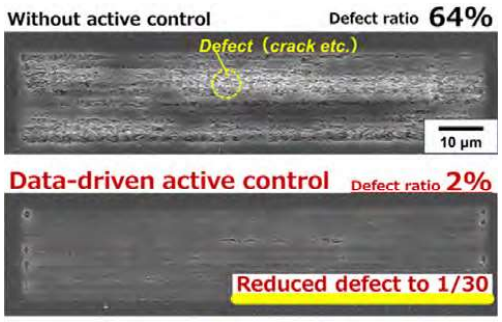
"To deal with this, we created a database of around 1000 shapes of metals and glasses machined with pulse intensity modulation," says Narazaki. "We then constructed an AI simulator that could predict machine shapes and increase the degrees of freedom of our laser processing... there were around one million predictable patterns."

Her project collaborators, Professor Yohei Kobayashi and his team of the University of Tokyo and Mitsubishi Electric Co., have also integrated Bayesian optimization — a probabilistic method that can help tune parameters — to a deep-UV picosecond laser processing system to accelerate the machining of shapes via laser micro-drilling. As part of this approach, they captured images of the drilled holes and used the data to alter the intensity and number of laser pulses, and streamline processing. "In the case of a single parameter, the obtained shape could approach the desired [shape] after only ten trials," says Narazaki.

Plenary speaker Dr. Aiko Narazaki. Her research group at AIST is working on the project "ICT-Data Driven Active Laser Processing," supported by Japan's New Energy and Industrial Technology Development Organization. Credit: AIST.

So far, Narazaki and colleagues have used data-driven ultrashort laser processing for on surface nanofabrication and micro-drilling on glass. However, they are now applying their technology to new materials and different applications, such as direct writing in transparent materials such as optical chips and co-packaged devices. Narazaki is also drawn to perovskite solar cells, saying "these are attracting attention as the next generation solar cell." The researchers are also looking at fine 3D printing of biomaterials, including pure proteins, for biomedical and biochip applications.

"In the future, we will build a bigger database and provide smarter optimization AI models based on that database for data-driven processing," asserts Narazaki. "This will generate process recipes for desired products, without using a lot of labor and taking too much time."



Creating nanostructures with and without data-driven control. Credit: Aiko Narazaki.

"Data-driven processing is going to enable us to explore a far wider parameter space," she says, "This could pave the way to processing methods that have been difficult to approach in the past — we are looking forward to the possibilities that human curiosity will bring."

REBECCA POOL

AI-related investment continued from page 09

of this year, reckons that it will become the first company to design and manufacture TFLN-based photonic chips on an industrial scale.

AI vision

On the other side of the AI coin, 2024 saw the emergence of a handful of applications illustrating how optics and photonics companies are beginning to exploit the new possibilities of AI. And as the Gartner hype cycle indicated, much of the initial focus revolves around artificial vision. Examples from Cognex include a system that combines AI with two- and three-dimensional vision technologies to solve a range of inspection and measurement challenges, and an AI-powered tool for optical character recognition that — unlike previous iterations — now requires virtually no setup.

Speaking to investors in November, Cognex CEO Robert Willett observed: "As AI enables machine vision to solve more human-like tasks, we have conviction that a larger portion of future market growth will be driven by a more diversified set of small- and medium-sized businesses, who need products that are easy to implement and which deliver powerful results."

Meanwhile Teledyne's thermal imaging subsidiary FLIR has launched an AI-powered, closed-circuit multispectral camera designed to enhance urban roadway safety, for example by spotting fires in road tunnels. The camera utilizes three of FLIR's own AI models, developed and trained from millions of images collected from around the world, simultaneously. The company explains that one model can identify and classify fallen objects, while the other two classify vehicles on thermal and visible-range streams, including unusual objects like e-scooters, and vulnerable road users such as pedestrians and cyclists.

Trained on millions of images, Teledyne FLIR's AI-powered, closed-circuit multispectral camera is designed to enhance urban roadway safety. Credit: Teledyne FLIR.

Other, earlier-stage developments in the laboratory promise AI-related enhancements to super-resolution microscopy by an Anglo-German research collaboration said to offer "immediate applicability" to medical microscopy. And at CEA-Leti in France, researchers are looking to embed edge AI in CMOS sensors directly — thus promising to enable a new generation of devices capable of exploiting image data to perceive a scene, understand a situation, and potentially even intervene in some way.

Trumpf invests in AI

And in what has been an otherwise tough year for industrial laser vendors — largely resulting from a steep drop in demand from Western automotive manufacturers struggling with the seismic shift to electric vehicles (EVs) while facing fierce price competition from rivals in China — some AI possibilities have begun to emerge. One example is Trumpf's collaboration with San Jose-based SiM.ai, where the goal is to equip Trumpf laser systems with AI technology for applications in welding, cutting, marking, and 3D metal printing. The German laser giant said in July that it already has close to 100 employees working on AI-related product development, and the collaboration intends to solve complex materials processing challenges with direct AI integration.

For example AI-optimized sensors could be used to monitor the quality of a laser welding process in real time, at a rate of more than 3000 images per second. For EV manufacture that could dramatically reduce inspection times during laser welding steps, including production of the all-important battery element that accounts for such a huge proportion of total EV cost.

So what's next? As Goldman Sachs analysts have pointed out, the path of any technology development cycle is rarely linear, and with something as fundamentally disruptive as AI it seems more likely to be characterized by unprecedented waves of hype, investment, and digestion. With the trillions of dollars being spent, any worthwhile return will need to be a lot more significant than some coding advances and marginally more sophisticated chatbots. Photonics may end up providing a few relatively niche industrial AI applications, but it looks indispensable to the data centers of the future if energy demands are to be kept on a sustainable path.

MIKE HATCHER

Q and A with Jenoptik North America

Show Daily interviews Jay Kumler, President of Jenoptik Optical Systems, and President of Jenoptik North America, Inc.

Jay Kumler, President of Jenoptik Optical Systems, and President of Jenoptik North America, Inc. Credit: Jenoptik.

Jenoptik is a global photonics group comprising two divisions: Advanced Photonic Solutions and Smart Mobility Solutions. The company's non-photonic activities, particularly for the automotive market, are operated as independent brands within the Non-Photonic Portfolio Companies. Key markets include the semiconductor and electronics industries, life science and medical technology sectors, as well as the emerging "smart mobility" field.

Around 4,600 people worldwide work for Jenoptik Group, headquartered in the city of Jena, Germany (which gave the 1991-founded company its name). For most of the 20th century, Jena was a world center of the optics industries, in which companies such as Carl Zeiss and Schott laid the foundations for today's photonics industry. Jenoptik AG is listed on the German Stock Exchange in Frankfurt and traded on the MDax and TecDax markets. In fiscal year 2023, the firm generated revenue of 1,066 million euros.

In recent years, its North American operations have been expanded significantly. With the purpose of investigating the growing significance of these markets to the company, *Show Daily* has interviewed Jay Kumler, who is not only President of Jenoptik Optical Systems, and of Jenoptik North America, Inc., but also an SPIE Fellow and Photonics West regular.

Show Daily: ***What are some of the notable developments at the company in North America, considering growth in sites, new products, and market activities?***

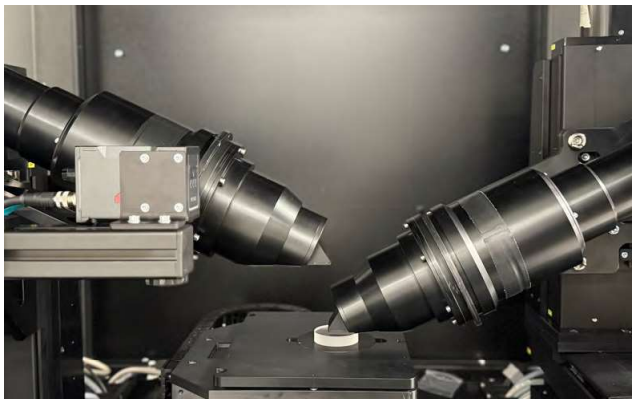
Jay Kumler: Jenoptik North America has been expanding our capabilities and our capacities to support our customers. Our headquarters in Jupiter, Florida, has expanded its clean room capacity. Our Huntsville, Alabama, plant has also expanded clean room space and added new capabilities. We are working closely with our customers to make sure we can meet their needs now and in the future.

What is the relationship between the company's North American and German operations?

Jenoptik is operating in four strategic business units (Semiconductor and Advanced Manufacturing, Biophotonics, Metrology & Production Solutions, and Smart Mobility Solutions). All four SBUs have a footprint in North America. Each of our four strategic business units operate globally, therefore most functions are highly integrated between USA, Europe, and Asia. Our R&D teams collaborate on joint projects, our business development teams work closely, and our global operations team makes sure we optimize what we make where, and why.

Outline some of the company's achievements since 2020 — and development plans?

The past four years have been marked by significant growth. Jenoptik has succeeded in developing new light sources for semiconductor and biophotonics customers, and we have expanded our laser rangefinder and free-space optical communications products.



On show at the Moscone: Jenoptik's new metrology instrument, the "ImageMaster® Pro AR Reflection," which is used to measure the MTF and various image quality parameters of AR waveguides. Credit: Jenoptik.

Following are just a few accomplishments from Jenoptik North America:

- We designed and built the engineering camera lenses on NASA's MARS 2020 Perseverance Rover. The spectacular photographs from the navigational cameras were enabled by Jenoptik innovation.
- Our free-space optical communications terminals were recognized by *TIME* magazine on 30 October, 2024 as one of the best inventions of 2024.
- Our Smart Mobility Solutions business unit introduced the first AI enabled Port Security camera system which meets the requirements from Homeland Security Office of Science and Technology.

Recent acquisitions, and does the company have an agenda for future acquisitions?

We were busy in M&A in the past few years. We acquired Trioptics in 2020, and then SwissOptic and BerlinerGlas in late 2021. Our strategic plan for the next few years is to focus on organic growth, operational excellence, innovation, and customer-centricity.

What is the 2025 message from the company for Photonics West; and which are the key new products to look out for?

We are your strongest partner for instrument design and development. Our focus on delivering complex systems (light source, custom optics, filters, stages, cameras) helps our customers get to market quicker with their new products. All of our business units will be represented at Photonics West, and each of them have new products on display. Trioptics will be introducing an important new metrology instrument called the "ImageMaster® Pro AR Reflection" which is used to measure the MTF and various image quality parameters of AR waveguides. The instrument is the first commercial instrument of its kind with diffraction limited optics to ensure accurate and precise wide FOV measurements.

What has been your experience of exhibiting and participating at Photonics West?

Photonics West is the Super Bowl of the photonics industry. It is the event and marketplace which launches our teams into the new year. It is hard to imagine our industry without Photonics West! Our customers are there, and many representatives of our supply chain are also in San Francisco at Photonics West. Our supply chain is extremely strategic, and it is important to have a platform to meet with suppliers at this event.

What is the company's involvement with industry associations, such as SPIE?

As a corporation, we engage and participate in many industry associations, including SPIE. We encourage our employees to volunteer and serve on SPIE committees, and when possible, we publish our work in the technical conferences. We benefit greatly from both the technical conferences and the exhibitions.

In the company's view, what is the current state of the market and the likely developments and technology trends for the year? Furthermore does Jenoptik see enhanced market opportunities arising from the US Chips Act, 2022?

We are a strong player in semiconductor equipment, and we should benefit from the US investments in the Chips and Science Act. We focus on high growth markets. As such, each one of our strategic business units will experience growth and changes in 2025. In Biophotonics, we are working on advanced imaging systems for spatial genomics & multiomics. In our Smart Mobility Solutions business unit, we are introducing new products for road safety, including distracted driving and noise pollution detection.

What is the likely impact on business of changing economic conditions, geopolitics, and competitive landscape through 2025?

Being a global company helps Jenoptik navigate challenges like economic conditions because we operate globally. Regional issues and geopolitics can be managed with more dexterity. The biggest challenges in North America are the export controls on advanced computing semiconductors and semiconductor manufacturing equipment as well as items that support supercomputing applications. Even with the challenges, we believe that megatrends support the long-term demand for our products in all business units and we will enjoy solid growth through 2025.

What are the opportunities for the company in the emerging markets of quantum, augmented and virtual reality, fusion and green-tech?

Jenoptik North America is designing and building key sub-assemblies for quantum computers for a number of leading quantum companies. It is an area of focus for

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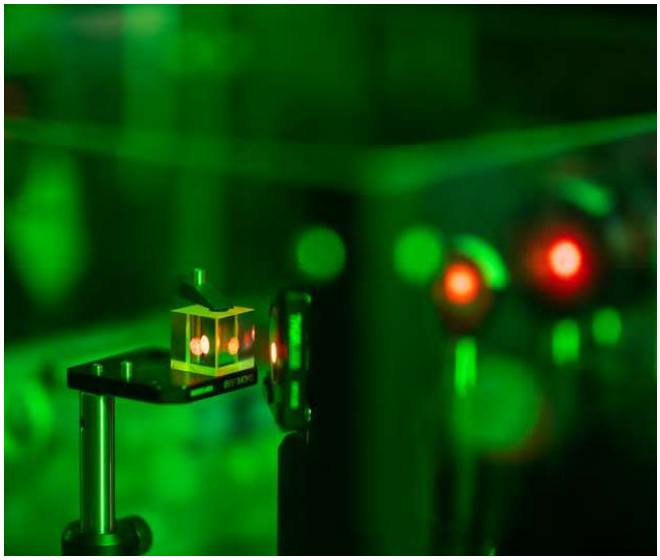
Disentangling the science behind quantum entanglements and structured light

Andrew Forbes, who gave a plenary presentation at Quantum West, discusses the latest explorations taking place in his Structured Light Laboratory.

Andrew Forbes in his laser lab. Credit: U of Witwatersrand

SPIE Fellow and Distinguished Professor at the University of Witwatersrand Andrew Forbes has already enjoyed a varied career — if primarily laser-focused — working in industry, on government projects, and in academic and applied research. These days, his Structured Light Lab, which has just spun off a new start-up, explores structured light and its applications, carried out at both the classical and quantum levels.

In a plenary entitled "Quantum Structured Light Takes Shape" during Quantum West earlier this week, Forbes shared his team's progress on quantum entanglement of photons in their spatial degree of freedom. He demonstrated how light patterns can be abstracted, mixing degrees of freedom to produce quantum topologies in light, thereby introducing new paradigms for quantum-state observables and classification. He also outlined the advantages and disadvantages of using such single-photon and entangled states in real-world applications, offering a perspective on the present challenges as well as the plethora of exciting opportunities in the field. The talk covered his recently published research in the SPIE journal *Advanced Photonics* on distortion-free transfer of structured light; in addition, Forbes explained — on a scientific level, of course — how doughnuts and coffee mugs share the same topology.



Key for teleportation, a beam splitter in Forbes' lab stands ready. Credit: Andrew Forbes

"When you think of quantum mechanics or quantum physics, it seems like a very difficult topic — very abstract and lots of mathematics," Forbes said in a pre-plenary interview with SPIE. "I don't believe that needs to be the case. That's why, in my talk, I have no equations whatsoever." What he does offer, are lots of cool pictures: "Structured light is a fancy way of saying 'patterns of lights,' so what I'm doing in my work is 'quantum mechanics with pictures,', and I want to show how these pictures can be used to have enormous power in the quantum world."

Key characteristics of structured light include its flexibility, the fact that it's manipulatable and leverageable depending on what one is trying to achieve. This is because structured light has what Forbes calls "an infinitely large alphabet," setting it distinctly apart from the ones and zeros — and that most infamous binary, Schrodinger's cat, being dead *and* alive — of the traditional quantum world. "We call this a two-level alphabet," says Forbes. "In the traditional quantum world, we've always played with two-letter alphabets: polarization, for example, which is very popular in optical world. What we're doing with *patterns* of light is saying, 'Why stay with a two-letter alphabet? Why not have *all* the letters of the alphabet?'" With pictures, you gain infinite numbers: "Ask any child — they can draw you an endless number of pictures! So combining quantum with structured light gives us access to a very, very large playground — our Hilbert space — in which to execute quantum mechanics. That's the enormous potential that structured light brings to the table."

That potential can be harnessed for numerous applications, including two that Forbes' team focuses on. One is quantum communication: "We can pack a lot of information into the light by using this very big alphabet, and this we do with quantum entangled states in our lab every day." The other application is quantum imaging.

Quantum imaging allows you to do "weird and wonderful things that you couldn't do classically," says Forbes. "Think of it as taking photographs in the dark. That's what quantum light does. There's no light around, just this one single photon. We have counter-intuitive ways of thinking about how to take a photograph and how to move that information around, ways that would be impossible in the classical world."

Currently, quantum communication is based on the aforementioned two-letter alphabet, but Forbes and his team have demonstrated that you can achieve better outcomes in a larger dimension. For instance, says Forbes, "we can pack up to about 10 times the information that you presently can do into one photon. The practical implication is that I'm going to send one photon from me to you, and I want this photon to have as much information as possible, so that I don't have to send too many of them, right? That's what we're trying to do. We're trying to show that you can pack a lot of information into one photon instead of sending many photons with very little information."

That's where the success of the distortion-free transfer comes in. One of the main challenges to quantum communication is all-pervasive noise: when photons are being transferred, if they go through a noisy channel or turbulent atmosphere, they get distorted. That's limiting communication distance, and limiting how much information can be sent without corruption. What Forbes and his team discovered and published earlier this year, is that there's another way to solve the problem. "What everybody's been asking up to now is, 'How can we make this entanglement very robust, so that these photons stay entangled?' and what we've found is that there's another way to do it: You can let the entanglement be fragile. No problem. Instead let's make the *information* robust, shift your focus away from the entanglement and onto the information. We've shown that using topology we can make this information very robust, even in very noisy systems." This, he notes, has huge implications, not only for communication but also for quantum computers. "As we try to make the computers bigger and bigger with more elements, they become noisier and noisier. So this is a major technological challenge that has to be solved. And

The Structured Light Lab Team. Credit: U of Witwatersrand

we think our work offers an alternative roadmap to addressing that challenge. If you build the entanglement based on this new principle of ours, it can still be very noisy, but the information will not see the noise."

Which brings us back to that doughnut and coffee cup. "In my talk, I show you that you can take a doughnut, and you can stretch and squish it into a coffee cup," says Forbes. Mathematicians will say, 'These two things are equivalent because topologically, they have the same structure.' And if you abstract that idea, what it means is the doughnut can get heavily distorted because of all the noise, so distorted that it looks like a coffee mug, but *topologically* it hasn't changed so you can still *read* it — you can read its original signal, despite the fact that it looks completely different. In the context of communication and computing, that means, even though the noise has made the signal look really weird, don't worry: Don't look for donuts or coffee mugs — look for the underlying topology."

The other major issue in quantum communication is achieving longer transferring distances. "We need to get the reach," says Forbes. "So we're trying to solve both: Can we put a lot of information into the photon, as much information as possible? Can we get it to go as far as possible while still retaining that information? And if, during its processing, either the distance or on the chip, it experiences unfavorable conditions, can we make it immune to that? If we can solve those problems, then we can have high-information capacity, high resilience, long reach, then we can do anything. That's the dream. We're still very far from that, but that's what we're working towards."

While Forbes is excited about the ongoing work in his lab, he points out that there is much more to be done. By sharing his research, he hopes that others will develop quantum structured light in new areas. "If you're a handyman or a handywoman, you need a toolbox full of tools. The quantum-structured-light toolbox, it's still pretty empty which, of course, means it's full of potential. If we develop the tools, we'll find we can apply them to many, many applications. I really enjoy presenting this opportunity: 'Look how empty the toolbox is. Why don't you be part of the solution? There are amazing things that can be done, and we want you to contribute to this exciting field.'"

DANEET STEFFENS

Jenoptik

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Jenoptik. Trioptics in California is working closely with XR companies to deliver best-in-class measurement equipment for qualifying all parts of the AR/VR/MR systems, including image projectors, waveguides, displays and cameras.

We leverage AI in all of our Smart Mobility Solutions products. AI allows us to recognize license plates and vehicles and deliver the products needed for smart communities of the future. Machine vision is also used in our Laser Processing robots which are used to process materials for the automotive industry in Rochester Hills, Michigan.

At product level, Jenoptik acts as an "enabler" and, as a sustainability partner to our customers, plays a decisive role in the transformation towards CO neutrality. With our expertise and product offerings, we are able to enable our customers to act more efficiently and sustainably and contribute to greater resource conservation and climate protection. For example, our green VECTOR camera helps with air quality and emission controls.

How about the importance of research and academic inputs into the company?

Innovation is at the core of the Jenoptik culture. As Steve Jobs said, "Innovation distinguishes between a leader and a follower." Jenoptik is a leader. Therefore, we need to continue to invest significant capital in research and development, and we need to partner with external partners when appropriate. We engage universities and research centers and make sure we are staying in touch with thought leaders.

How does the company provide encouragement for students, potential new employees, and deliver training to staff?

We have had great success with our internship program in Florida, and we have a strong onboarding process to acclimate new employees to the company. We also promote opportunities for employees to work in other facilities located in other parts of the world. The investment in the employee exchange program pays dividends as it facilities better cooperation and integration in one Jenoptik. Training happens throughout the year, both technical training and leadership training. All of these are important to make sure our Jenoptik culture stays strong and consistent.

MATTHEW PEACH

PRISM AWARDS 25

Congratulations Prism Awards 2025

Finalists

BIOMEDICAL

Delta Life Science

Enspectra Health

Norlase

CAMERAS AND IMAGING SYSTEMS

Eoptic

NIL Technology

Thorlabs, Inc.

LASERS

n2-Photonics GmbH

Scantinel Photonics GmbH

Thorlabs, Inc.

QUANTUM TECH

Ki3 Photonics Technologies, Inc.

Leonardo DRS (Daylight Solutions)

Qunnect

OPTICAL MATERIALS AND COMPONENTS

LightPath Technologies

Omega Optical

xolo GmbH

SENSORS

EXALOS

FluIDect GmbH

Interherence GmbH

SOFTWARE

BRELYON

HyperSpectral Corp.

PlanOpSim

TEST AND MEASUREMENT

Innovations in Optics, Inc.

Quartus Engineering Inc.

TRIOPTICS GmbH

CATALYST AWARD 25

SCHOTT AG

Thorlabs, Inc.

Vacuum Innovations

SPIE.

prismawards.org

Patrick Flanigan receives IBM-SPIE HBCU Faculty Accelerator Award

The annual $100,000 award supports research and education in quantum optics and photonics at historically Black colleges and universities.

Patrick Flanigan (left) is honored at the Quantum West plenary by Halina Rubinsztein-Dunlop (right). Credit: Joey Cobbs.

Patrick Flanigan, a principal investigator at North Carolina Central University (NCCU) is the recipient of the 2024 IBM-SPIE HBCU Faculty Accelerator Award in Quantum Optics and Photonics. The $100,000 annual award, presented jointly by SPIE and the IBM-HBCU Quantum Center since 2021, supports research and education in quantum optics and photonics within IBM-HBCU Quantum Center member institutions. The Center currently includes 27 historically Black colleges and universities (HBCUs). The first three faculty-award recipients were: Renu Tripathi, a professor of physics and engineering at Delaware State University; Wesley Sims, an assistant professor of physics at Morehouse College; and a group project at Tuskegee University.

Flanigan's project, "Triple-resonance micro-ring resonators for on-chip entangled photon generation via spontaneous six-wave mixing (SSWM)," will explore how to significantly reduce the footprint of future photon-based quantum-computing and quantum-information systems, as well as enabling the exploration of new physics that may emerge in the chip-scale system. The project has a core quantum optics-and-photonics focus: The SSWM technique is used to produce a trio of quantum entangled photons by simultaneously exciting three energy transitions in a rubidium atom. The goal of the project is to design nanophotonic components to miniaturize the platform for SSWM, which so far has been only achieved in free space on an optical table.

Flanigan will be working with multiple colleagues: at NCCU, Professor Branislav Vlahovic will contribute his expertise on quantum computing and Professor Yongan Tang will share his expertise on electromagnetic simulations. The fabrication and experimentation of the triple-resonance micro-rings will be done by Professor Qing Gu of North Carolina State University. The foundational theory of entangled photon generation by SSWM was developed by Professor Jianming Wen of State University of New York at Binghamton.

Flanigan, whose background lies in photonics engineering focusing on design-optimization of photonic devices, joined NCCU in February 2024. His research topics at NCCU so far have encompassed quantum computing, photonics, and optical metamaterials. He has already shown his commitment to teaching — including taking on the popular undergraduate "Introduction to Astronomy" course — and by assisting in the mentorship of three graduate students.

Now, he'll have a graduate student of his own to mentor. "Winning this award is a great honor, and I am very thankful to all my collaborators in and outside of NCCU for their help," said Flanigan. "The physical mechanism underlying this project was experimentally demonstrated only a few months ago, so it is very exciting to be on the cutting-edge of quantum computing and quantum communications research. Winning this award will allow us to continue our work and expand by obtaining new equipment and taking on new students."

Appropriately enough, Flanigan's work is being undertaken during 2025, the United Nations-declared International Year of Quantum Science and Technology. "SPIE is particularly proud of our partnership with the IBM-HBCU Quantum Center and our shared support of quantum research programs at HBCUs," said SPIE CEO Kent Rochford. "The impact of quantum science continues to grow, and we are very excited – especially as the project resulting from this award coincides with the International Year of Quantum Science and Technology in 2025 – to support Patrick Flanigan in his and his colleagues' efforts to further enhance the range and application of quantum-related research."

And in terms integral to the award itself, Flanigan is viewed as a serendipitous match: "The IBM-SPIE HBCU Faculty Accelerator Award plays an important role in the IBM-HBCU Quantum Center's overall effort to build an ecosystem for traditionally underrepresented students and professionals to be a part of the quantum industry," said Dr. Kayla Lee, Global Lead, Ecosystem Growth at IBM Quantum. "Dr. Flanigan's project is a perfect example of the cross-institution collaboration that makes the award and center a success — and pushes the industry forward."

Prior to his engineering work at Etaphase, Flanigan pursued doctoral studies at Brown University, where he integrated concepts from plasmonics to enhance the performance of devices such as solar cells, photodetectors, and bio-sensors; assisted in developing lab experiments in advanced nanodevice fabrication and characterization techniques for an undergraduate class; and mentored graduate and undergraduate students. His postdoctoral research — modeling heat-assisted magnetic recording (HAMR) — was conducted at Trinity College in Dublin, where he also mentored a graduate student.

DANEET STEFFENS

Coherent's Tim Gerke. Credit: Joey Cobbs.

Coherent's new femtosecond source advances nonlinear microscopy

During the BiOS exhibition, Coherent Field Engineer Tim Gerke told *Show Daily* about the newly launched Chameleon Discovery LX, the latest addition to the established Chameleon Discovery range of advanced femtosecond lasers.

Specified for researchers in nonlinear microscopy and ultrafast spectroscopy, this source provides ultrashort 100 fs pulses and features a tunable wavelength range from 680 to 1080 nm with output powers up to 3.2 W at the peak of the tuning curve.

Gerke commented, "It features built-in wide dispersion precompensation and fast power modulation, so it enables deep, high-speed imaging that is optimized for key fluorophores in multiphoton microscopy."

He added, "The Discovery LX is a new milestone in Coherent's more than two decades of expertise in tunable femtosecond laser development. Its design and performance reaffirm our commitment to advancing nonlinear microscopy applications."

Coherent states that the nonlinear microscopy market continues to thrive, with applications spanning neuroscience, immunology, and disease research, along with growing interest in using this technique in clinical settings.

"As microscopy techniques advance, the need for laser sources with superior reliability and more advanced parameters grows. The Discovery LX meets these demands with an optimized design tailored for all key nonlinear microscopy applications," Gerke said.

Also making its Photonics West debut is Coherent's Cell X multi-wavelength laser engine, enabling "custom wavelengths for OEMs." This engine offers up to four addressable output laser wavelengths (from 405 nm, 488 nm, 561 nm, and 637 nm) with independent user-adjustable position and focus.

Cell X incorporates up to four of Coherent's established OBIS lasers. So in that footprint, Cell X can reduce space and complexity by eliminating electronic redundancy of this engine. It is suited for applications in flow cytometry.

MATTHEW PEACH

Professional development education series returns to SPIE Photonics West

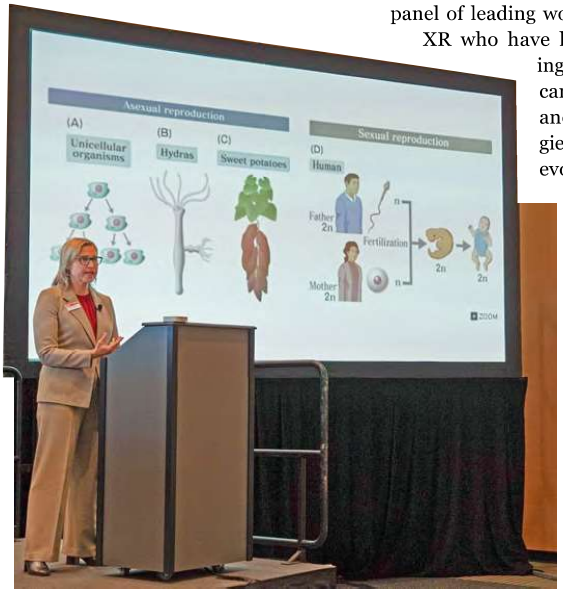
Participants learn methods for making optics and photonics more equitable and inclusive.

The Lunchtime Professional Development Education series — part of SPIE's Professional Development program sponsored by various industry organizations — combines career development, networking, and socializing opportunities, along with a catered lunch. These sessions give attendees a chance to engage with peers and colleagues and learn about diversity, inclusion, and other timely topics.

Led and facilitated by SPIE Equity, Diversity, and Inclusion (EDI) Committee Chair Jess Wade and SPIE Diversity and Inclusion Lead and Meetings Manager Josh Henry, the one-hour sessions have also been designed to fit into a packed SPIE conference schedule.

The four sessions run daily, from noon to 1 PM, on the Community Stage on Level Two of Moscone West:

During Monday's session, 2025 SPIE Immediate Past President Jennifer Barton of the University of Arizona discussed how the forces of evolution and technology have shaped women's roles and opportunities. Throughout human history, women's customary roles have been shaped by the fact that women bear the disproportionate energetic cost of propagating our species. In the last 12,000 years, technology has emerged as a force that has both hindered and helped equality of the sexes. Barton examined how these two forces brought us to the current state of women's opportunities, and what the future might bring.



Jennifer Kehlet Barton, BIO5 Director and 2025 SPIE Immediate Past President. Credit: Cappy Jarvi.

Tuesday's session topic was neuro-inclusion in physics. Daisy Shearer, an Outreach and Engagement Officer at the UK's National Quantum Computing Centre, discussed how we can create working environments that are inclusive for neurodivergent physicists. Recent research indicates that much of the neurodivergent population is drawn to STEM fields, meaning that a larger proportion of the STEM workforce falls under this umbrella. Despite this, many neurodivergent individuals encounter challenges that cause them to leave academic and research roles despite their potential to greatly contribute to research and innovation. Participants in this session reflected on their physical workspaces and working practices in the context of neuro-inclusion and learned about practical steps that can be taken to embrace a diverse range of neurotypes. Attendees left with a greater understanding of neurodiversity in physics and tools to develop a personal action plan for creating change at their workplace.

Wednesday's session features a panel of leading women in the field of XR who have leveraged networking to navigate diverse career paths in optics and related technologies. In today's rapidly evolving technological landscape, building a strong network is essential for career growth and innovation. XR experts Kelsey Wooley, Chunhua Wang, Heini Haartti-Mäkinen, and Lihua Zhao, will begin with short, impactful presentations on how networking influenced their career journeys, followed by an interactive panel discussion. Participants will then engage with the panelists in a Q&A session designed to foster meaningful dialogue and share practical advice.

Workshop attendees learning while enjoying a lunch. Credit: Cappy Jarvi.

"This one started last year as a self-organized type of round table for the AR | VR | MR audience — organized by a few of the chairs," notes Henry. "It was kind of small, but there was a lot of energy behind it. So rather than keep it in a small space, we're opening it up to a wider audience, making it part of the Photonics West conference as well as AR | VR | MR."

Thursday's session has Tara Fortier of NIST covering communication for self-advocacy and conflict resolution. Effective communication is essential for sharing our perspectives, needs, and ideas. Strong communication is crucial not only for advocacy and leadership but also for effective management and all interpersonal relationships. However, being truly heard — particularly in moments of conflict — can be a significant challenge. One common obstacle is that our communication can unintentionally trigger defensiveness in others, whether we are asking for a raise, advocating on behalf of others, or presenting new ideas. Fortier will offer strategies to minimize defensiveness, helping attendees clarify their position and navigate difficult conversations with greater ease.

In this together

In addition to the EDI-focused lunchtime education sessions, SPIE Photonics West includes multiple other opportunities to network and mingle during professional development, networking, and social events such as the Women in Optics Meet-up, the Executive Women's Meetup, the LGBTQ+ Social, and the Black Scientist's Social.

SPIE has a history of supporting diversity in science. In recent years, as issues and discussions around diversity in STEM have grown, so has the Society's commitment to address these concerns and contribute to a diverse and inclusive science community.

But SPIE doesn't do this work alone — SPIE constituents are at the heart of this process. As the organization continues to build their equity, diversity, and inclusion programs, it's always open to the optics and photonics community for ideas and suggestions.

"Participants who would like to contribute topics or feel passionately about programs such as these are encouraged to step forward and volunteer their time or just their expertise — to give opinions, thoughts, and ideas," says Henry. "It takes the whole community working together to build these types of programs."

Not just preaching to the choir

As Henry points out, the point of these meetings is not to target certain communities with this education, but to bring the message to everyone. "Oftentimes, these presentations feel like we're preaching to the choir — talking to people who have been in their same situation," says Henry. "But as we make topics broader and more universally relatable, I think we can get a wider variety of people to have the conversations that they need to have."

The idea behind the lunchtime education sessions is to give attendees a sense of empowerment — to come away from a discussion feeling like they've learned something they can take back to their organizations and be more successful. "The entire point of a conference is having a community of people who can support you, meeting the people that speak on these panels or the people you sit at the table with, all of those people have a vested interest in what's being presented and making contact," says Henry. "I know when I attend conferences, the thing that I feel most excited about going away from it is feeling like what I do is understood and supported and recognized, and that what I'm doing is important. I think if we can make people realize the importance of what they do and empower them to work beyond just attending conferences, we've done our job."

KAREN THOMAS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