
OXFORD INSTRUMENTS
OptistatDry

Some of the Invisible-Light Labs team in the lab.
Romana Maalouf Photography

Entrepreneurs to Watch

In this biennial feature, OPN throws the spotlight on a selection of creative scientists and engineers—and the enterprises they're building.

The companies represented by the 10 scientists and engineers profiled in the following pages range from laser fusion to AI-enabled drones, from portable spectrometers to UV disinfection, from inertial sensors to raw-milk testing. For expanded Q&As with the featured entrepreneurs, visit **optica-opn.org/link/entrepreneurs-2025**.

Courtesy of HB11 Energy

Warren McKenzie

Commercially viable laser fusion has been beyond the reach of the scientific community for decades, in part because the tritium fuel at the heart of most approaches is both scarce and radioactive. But Australian startup HB11 Energy believes it has a solution: boron. "It would have the same energy density as any other nuclear fuel, but with no radioactive waste," explains cofounder and managing director Warren McKenzie. "And boron is cheap and abundant; it's dollars per kilogram."

For a long time, most in the field didn't think hydrogen–boron fusion was possible—and some still don't. But in 2016, Heinrich Hora, a laser fusion pioneer and eventual cofounder of HB11, handed McKenzie a stack of papers to share with his research organization chairman. They showed hydrogen–boron fusion rates much higher than expected, and McKenzie became convinced it could work. "We took maybe the ultimate entrepreneurial leap of faith: the first laser fusion company when no one believed that laser fusion could work for energy production, a hydrogen–boron fusion company when no one believed hydrogen–boron fusion would work," he notes.

Boron is much harder to ignite than deuterium–tritium—McKenzie says it's like comparing "wood to gunpowder." But HB11 believes that its fast-ignition approach can overcome this difficulty with a two-pulse laser system. The first, nanosecond-length pulse compresses the fuel, while the second, picosecond-length pulse accelerates protons that provide a fusion-powered spark plug to initiate fusion within the compressed fuel pellet.

As it works toward commercial fusion, HB11 is commercializing specific components, including its pulsed-laser system and fuel targets. This dual-use business model allows the company to verify its technology while generating revenue that doesn't rely on investor or government funding.

"Thinking long term, laser fusion has to happen," says McKenzie. "Fossil fuels will run out, and we need another energy source. Fusion will unlock the largest source of clean energy on Earth."

COMPANY
HB11 Energy

FOCUS
Laser fusion for sustainable energy

hb11.energy

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Courtesy of MantiSpectra

Kaylee Hakkel

MantiSpectra COO Kaylee Hakkel was a student at Eindhoven University of Technology, Netherlands, when she joined a photonics group and started working with spectral sensors. Everyone in the group knew about large, lab-scale spectrometers, but their goal was to make the devices small and portable, so they would be easy and practical to use in the real world. "We wanted to make this beautiful technology available for everyone, not just people in a lab," explains Hakkel.

MantiSpectra was born out of this work. The company's ChipSense offering, a miniaturized, solid-state hyperspectral sensor chip, allows manufacturers to integrate real-time, contactless materials analysis directly into their products. The technology uses InP wafers over which InGaAs photodetectors are built with integrated film filters. The company says that this monolithic, wafer-level integration provides greater signal-to-noise ratio, high responsivity and resistance to vibrations, while enabling low-cost, high-volume manufacturing.

The company is now in a "scaling-up phase," according to Hakkel. "The supply chain is becoming crucial because we are scaling up the number of products we can deliver," she notes. "A lot of people can make one perfect thing, sometimes. But doing it again and again? That's the trick. Getting to that stage where your product is mass-producible is an important milestone." She says the company should be able to produce at these higher volumes by the end of this year.

MantiSpectra sees two major application areas for its chips: food production process control and smart consumer products. The former leverages the techology to provide materials data to industries like agriculture and textile production, either with a hand-held device or by integrating directly into equipment on the production line. For consumer electronics, the chips can be integrated into wearable devices to give insight into biometrics, or into home appliances to provide information on efficiency.

COMPANY
MantiSpectra

FOCUS
Integrated spectral sensing

mantispectra.com

Courtesy of Labby

Julia Somerdin

In 2015, Labby cofounder and CEO Julia Somerdin was pursuing a master's degree in system design and management at the Massachusetts Institute of Technology (MIT), USA, when she met Anshuman Das, cofounder and CTO of Labby, who was a postdoc at MIT Media Lab. Drawn together by a shared interest in applied science and sustainability, they cofounded Labby in 2017 around a novel optical sensing technology. At the time, the technology was promising, but the right application wasn't yet clear.

That changed after Somerdin presented the technology at MIT's 2018 Nano Summit and attracted the attention of many industries. But the group that piqued her interest came from an unexpected realm—dairy farmers. They lacked the ability to quickly test their milk, which can allow problems with herd health and milk quality to go undetected.

After months of research, Somerdin and Das identified milk testing as an application where their technology could really make a difference. "I'm looking for innovation with impact, not just technology," Somerdin says. "We both love our planet, and we're looking for a way to improve it."

Labby leverages mobile spectroscopy and imaging sensing to provide on-site, real-time testing of raw milk, so that farmers can screen for quality and detect diseases and infections. Traditional testing often requires transporting samples long distances for expensive lab tests, so farmers are only able to receive this data about once a month and wait weeks for the results. In contrast, Labby's flagship product MilKey is integrated directly into the milking machinery on the farm, where it tests milk as it flows through the system. AI then interprets the data in seconds, reporting on the milk's quality, milk yield and cow health and generating actionable insights.

One bacterial infection, bovine mastitis, affects about 250 million cows globally and costs farmers an estimated US$32 billion a year. Labby hopes to decrease that cost by enabling early detection and intervention. "We're on a mission to transform the dairy industry, to help farmers make data-driven decisions," says Somerdin. "The real problem in the dairy industry is lack of real-time data at the origin of milk production."

COMPANY
Labby

FOCUS
Real-time raw-milk testing

labbyinc.com

WWF Denmark

Kenneth Richard Geipel

While formulating a thesis project for his bachelor's degree in robotics at Aalborg University, Denmark, in 2018, Kenneth Richard Geipel, Chief Commercial Officer and cofounder of Robotto, and three friends had the idea to combine neural networks, edge-processing and computer vision. They weren't sure what their autonomous, AI-enabled drones would be used for—a pizza-delivery drone came to mind. But when the students learned about the difficulty that firefighters have in getting real-time data about wildfires, they saw a more serious application for their technology.

The team's design leverages advanced perception robotics to detect fires and other objects, and the drones are equipped with small GPUs that receive all the telemetry data and camera feeds. Critically, this edge-level AI runs on small processors to allow real-time data processing and autonomous action. After a professor encouraged the students to publish their results, they were invited to attend conferences, where they were surprised to be approached by private investors. "When enough people say they're willing to back you financially, you start to believe in yourself," says Geipel. "So we launched Robotto."

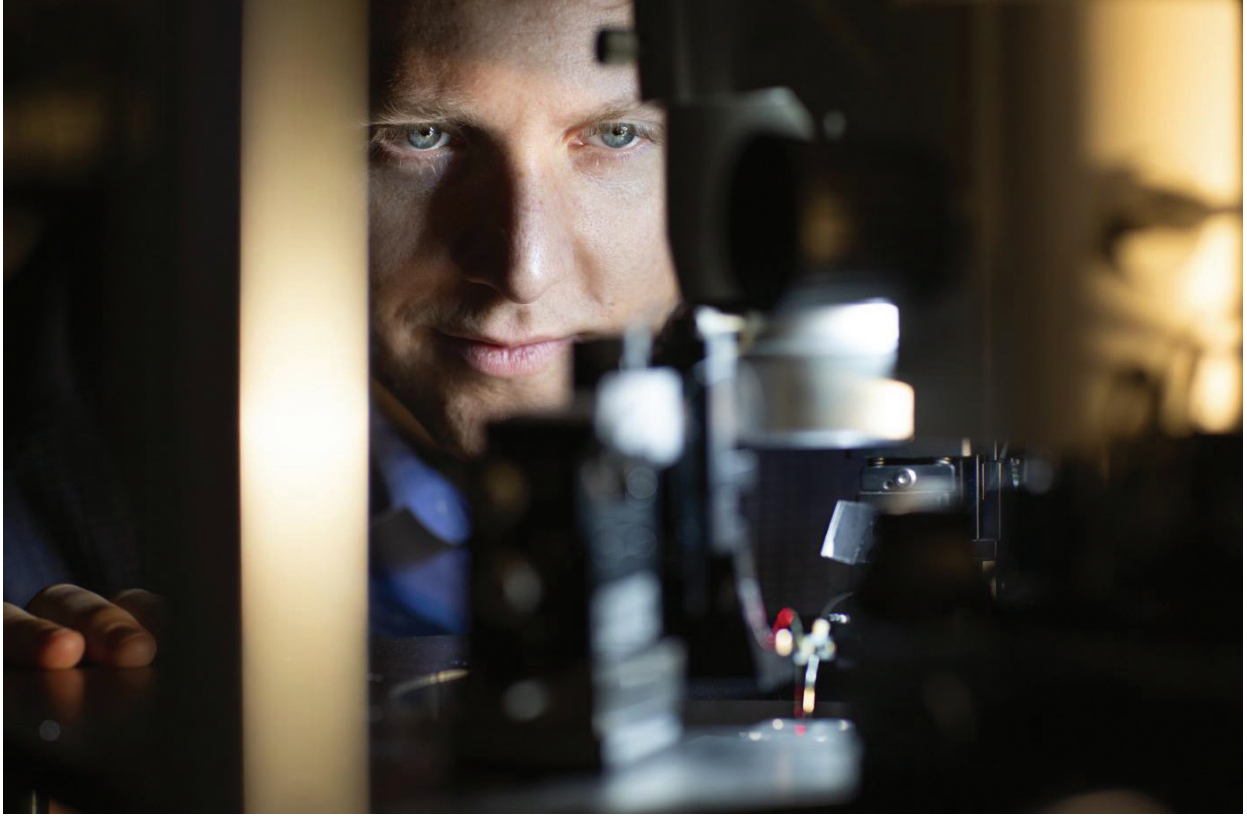
Now, Robotto has expanded to a diverse range of projects, offering bespoke AI-drone software solutions for industrial and security clients as well as for environmental efforts. In addition to its work on wildfires, the team is collaborating with the World Wildlife Fund in Thailand to monitor threatened ecosystems and aid conservation by tracking animal populations, and with the HERD project, which is exploring human–AI collaboration for controlling swarms of drones.

"Being in the middle of the jungle in Thailand, and then having these high-tech robotics working there, is super cool," Geipel says. "In Australia we work with some of the indigenous groups, and they share their ancient traditions with us, and then we're flying these drones with AI. It's surreal in some ways, but it's very fulfilling. We're just a couple of nerds from Denmark, and we have our product way out there."

COMPANY
Robotto

FOCUS
Wildfire and wildlife tracking

robotto.ai



Courtesy of Aarhus University

Nicolas Volet

When the COVID-19 pandemic began, Nicolas Volet, an associate professor at Aarhus University, Denmark, began rethinking how photonics could bolster public health. Around that time, studies showed that far-UVC light at 222 nm could inactivate airborne viruses while remaining safe for human exposure. Early field trials in Denmark, especially in agriculture, sparked new ideas.

In 2020, Volet teamed up with lighting veteran Peter Johansen and virologist Christian Holm to found UV Medico. Their goal was to bring filtered far-UVC light to everyday environments. "We focused on usability from the start," says Volet. "It had to be safe, efficient and easy to work with."

The company's systems use krypton-chloride excimer lamps with optical filters to emit narrowband 222-nm light. These are now used in hospitals, cleanrooms and public spaces in more than 30 countries.

More recently, Volet and his collaborators demonstrated a chip-based far-UVC laser. By combining blue diode pumping with nonlinear waveguides, they have taken a step toward truly compact ultraviolet sources for future use in diagnostics, sensing and communication. "Our vision is to make ultraviolet photonics more accessible," he says. "Smaller systems, better integration and tools that work across fields." Volet emphasizes collaboration. "We could never have done this alone," he says. "Progress came from combining perspectives across science, engineering, design, entrepreneurship and marketing."

COMPANY
UV Medico

FOCUS
Far-UVC disinfection and chip-scale UV photonics

uvmedico.com

Today, he balances academic work with his role as CTO. Many team members are former students or collaborators from Aarhus University, where Volet leads research and teaches. "It's been a great environment for connecting research with broader impact," he adds. "We've also had the chance to work on projects supported by Innovation Fund Denmark."

His advice to early-career researchers and entrepreneurs: "You don't need to have all the answers. Focus on asking the right questions, and partner with people who care where the answers might lead."

Romana Maalouf Photography

Josiane P. Lafleur

"I see myself as a scientist who wants to share an amazing technology," says analytical chemist Josiane Lafleur. The initial spark came from a scientific comment on a paper by cofounder Silvan Schmid, which posed a bold question: Could nanomechanical systems lead to "a rebirth for infrared spectroscopy"? The team launched Invisible-Light Labs shortly thereafter, in 2019.

The spinoff's first product, EMILIE, combines nanoelectromechanical systems (NEMS) with traditional Fourier transform infrared (FTIR) spectroscopy to enable highly sensitive photothermal detection. "We designed EMILIE as a plug-and-play accessory for FTIR spectrometers, bringing ultra-sensitive IR detection to labs everywhere, without the cost of cryogenic cooling or expensive lasers," Lafleur explains.

Progress was not without challenges. "We were out of money," Lafleur recalls. A turning point came in 2022, when a grant from the European Innovation Council allowed the spinoff to expand its team and accelerate development. True validation followed shortly after, with the first user requests. "That's when we felt we'd created a product that scientists genuinely needed." Today, EMILIE is being installed in labs across Europe and topped *The Analytical Scientist's* 2024 Innovation Awards. A strong partnership with Bruker Optics is now helping bring the technology to users worldwide.

While the initial focus was on research, Lafleur envisions a far broader impact. "The absence of regulations around ultrafine aerosols and nanoplastics, for example, is largely due to a technological gap in nanoparticle characterization," she notes.

Lafleur hopes that by closing this gap, EMILIE will not only help pave the way for the development of new environmental standards and regulations but also accelerate the development of new drugs and materials.

Looking ahead, Lafleur, who completed an MBA mid-journey, urges fellow scientists to balance curiosity with pragmatism: "I often have to say, 'We need to be able to sell this.' Because our tools need to be used to achieve their true impact."

COMPANY
Invisible-Light Labs

FOCUS
NEMS-based IR spectroscopy for nanomaterials characterization

invisible-light-labs.com

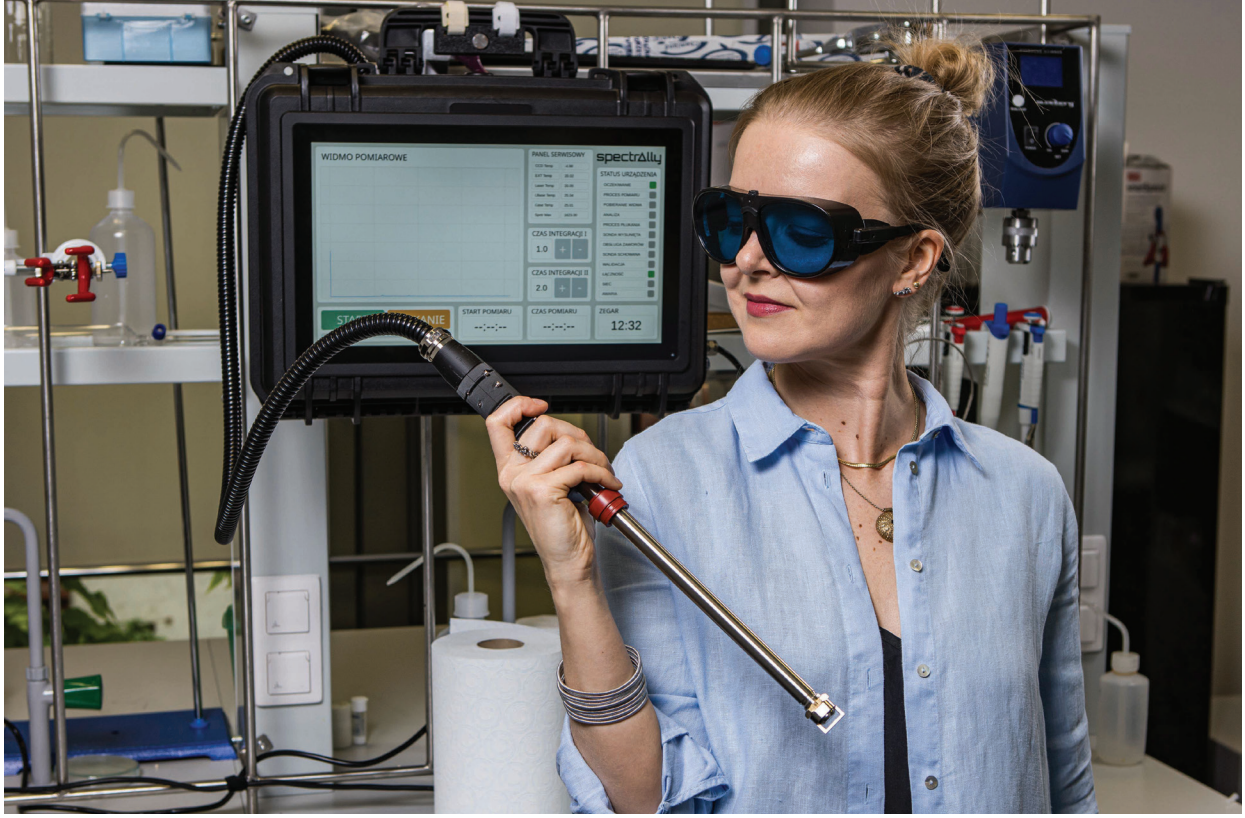


Photo by S. Przerwa

Karolina Orłowska

Karolina Orłowska never set out to build a company—she simply chased "very interesting projects." A Ph.D. in optical force metrology was followed by post-doctoral work in Raman spectroscopy. Then, in 2019, she and three colleagues founded Gekko Photonics to miniaturize Raman for industry. "Step by step, prism by prism, lens by lens we built our own device," she says, "and wrote algorithms so the user sees one number, not a sophisticated plot."

The startup's probe slips directly into a reactor, streams spectra to the cloud and, using proprietary AI, reports concentration, reaction rate or mixing homogeneity in seconds. That saves hours off traditional workflows, turning quality control into a live dashboard. Gekko's platform is customizable, a trait the team calls "tailor-made spectroscopic solutions."

Survival was far from guaranteed. Early biomedical projects burned cash, and by 2022 funds were nearly exhausted. The pivot came when an investor heard their plans to target chemical manufacturing instead. "She said, 'This is brilliant!' That was the moment I knew it would work," Orłowska recalls. Pilot orders followed, and the team—now roughly 15 people—serves resin, polymer and specialty-chemical plants across Europe.

COMPANY
Gekko Photonics

FOCUS
Raman spectroscopy and AI for real-time process control

gekkophotonics.com

What differentiates Gekko is relentless translation. Inside the company, physicists, electronics engineers, software developers and chemists learn enough of each other's language to collaborate. Outside, her group converts academic optics into plant-floor operations. "People are the most important thing," she stresses.

Next up for the Polish firm is a surface-enhanced Raman head for detecting microplastics and trace biomarkers, plus a return to the paused biomedical diagnostics once chemical-industry cashflow is steady. And establishing partnerships with "brilliant people anywhere—my role is to translate university language into market language," explains Orłowska.

Her advice for would-be founders? "Be brave, keep learning and surround yourself with people who can do what you can't. In the lab you can stay up all night for results; in a company you must wait, listen—and try again."

Courtesy of Nicslab

Andri Mahendra

As a Ph.D. student at the University of Sydney, Australia, Andri Mahendra discovered that "controlling light on a chip is not a trivial process." The commercial gear was bulky, expensive and scarce, so he designed his own circuit, soldering the first prototype in his kitchen and hand-delivering it to a lab mate 24 hours later. "He transferred US$2,500 up front; that was the moment I realized there was a business here," Mahendra recalls.

That kitchen project became Nicslab, launched in 2017 and run full-time since late 2018. The firm's platform integrates dozens of precision voltage and current sources, photodiode read-back and laser/TEC control in a shoebox package. The result is a dedicated, scalable driver that replaces racks of laboratory instruments at a fraction of the price and footprint.

Customers quickly validated the need. Today Nicslab ships to more than 20 countries, counting NVIDIA, Fujitsu, the US Army and several space-science groups among its users. Revenue is fueled by advance payments: "If they'll wire money and wait three months, you know you're solving a painful problem," Mahendra says.

The startup's momentum caught the eye of the Luminate NY accelerator in Rochester, where Nicslab beat over 600 applicants to take Company of the Year 2024 and a US$1 million investment.

Mahendra attributes the company's edge to relentless customer feedback loops and a talent pool of "geeks who love rapid prototyping." Eight inventions (one US patent has already been granted and another is expected later this year) protect ingenious mixed-signal architectures that squeeze multichannel precision into handheld boards.

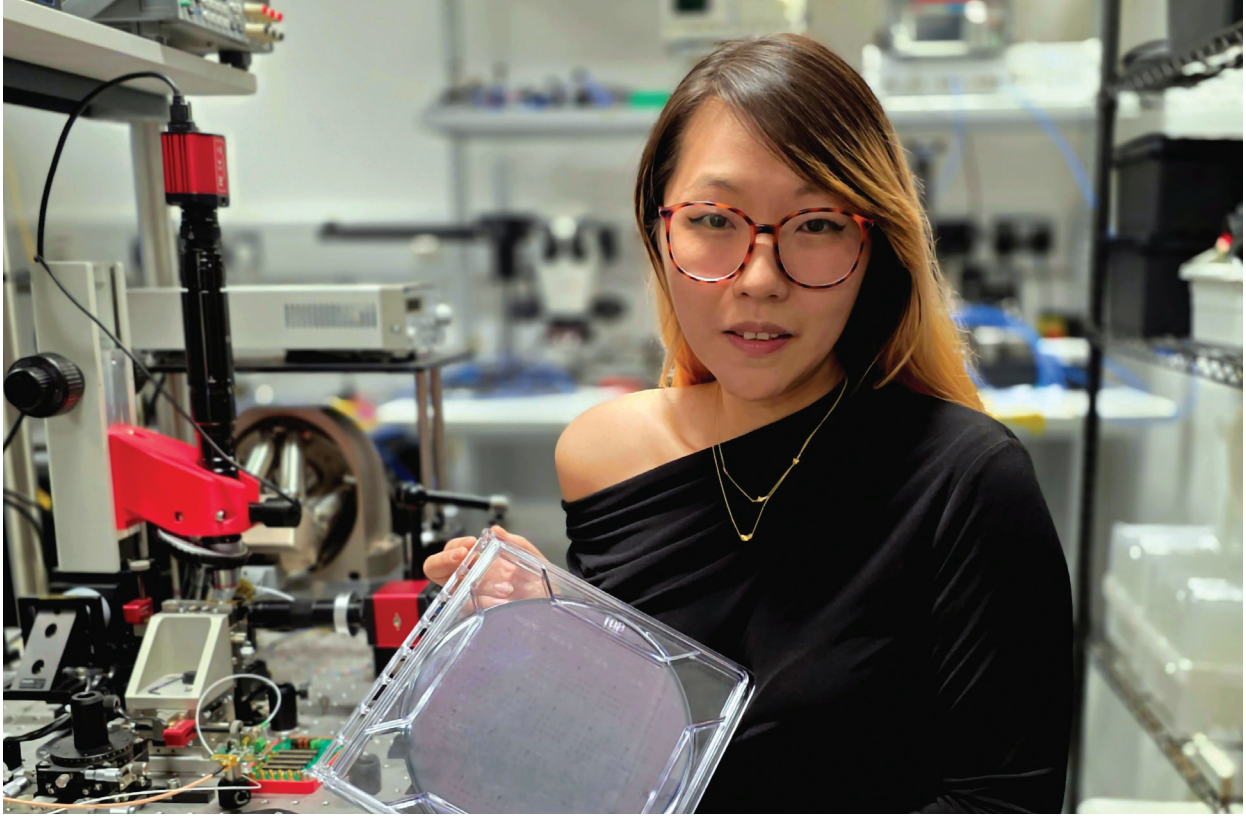
Looking ahead, Nicslab is steering toward adapting its electronics for high-volume semiconductor fabs and co-packaged optics, while iterating a NASA-requested variant for exoplanet instruments.

For aspiring researchers–founders, his advice is direct: "Get out of the lab. Real validation begins outside the lab—when someone pays for your solution."

COMPANY
Nicslab

FOCUS
Compact electronics for integrated photonics and semiconductors

nicslab.com



Courtesy of Zero Point Motion

Lia Li

For Lia Li, cofounder and CEO of inertial sensing startup Zero Point Motion, the lab has always felt like home. As a child, she often tagged along with her parents—both mechanical engineers—to their labs at the University of Bristol, UK. "I always knew I wanted to do science," Li recalls.

A fortuitous combination of experiences inspired Li to found Zero Point Motion. While doing her degree in physics, her love of tabletop experiments led her to focus on lasers. She was introduced to inertial sensors while working at BAE Systems, before getting her Ph.D. in quantum physics. Finally, everything came together when she learned about photonic integrated circuits through the CORNERSTONE facility of the University of Southampton, UK. "It's optomechanics with a semiconductor twist," Li explains. "All these things I'd done in my career came together."

Zero Point Motion's sensing approach fuses silicon photonics with MEMS for ultra-low-noise, miniaturized accelerometers and gyroscopes that perform even if GPS is weakened or unavailable. "We're combining the fundamental building blocks of light and motion through high-volume, low-cost semiconductor fabrication methods," Li says. "By bringing together photons and phonons, our sensors can be orders of magnitude more precise and stable than what's on the market today."

The company's Eclipse offering is a bottlecap-sized, 6 degree-of-freedom inertial measurement unit that leverages a patented photonic signal in areas like autonomous robotic platforms, construction and manufacturing. The Horizon sensor, Li says, is "the big play." Horizon will integrate every part of the sensor, including photodetectors, lasers and ASIC, on the wafer level, to shrink both size and cost for applications in smartphones, cars, robotics and many others.

And Zero Point Motion isn't stopping there. The company, which just closed a pre-series A funding round worth £4 million, also plans to integrate quantum features. In the long term, Li has an even bigger vision. "My passion project would be to redefine all sensors with light, from microphones to ultrasound sensors and beyond," she says. "With light as the enabler, suddenly you don't have to play by the same rules as before."

COMPANY
Zero Point Motion

FOCUS
Inertial motion sensors

zeropointmotion.com

Courtesy of CQT

Robert Bedington

Satellite physicist Robert Bedington did not set out to be an entrepreneur. After stints miniaturizing space-weather instrumentation in the UK and Japan, he joined Singapore's Centre for Quantum Technologies (CQT) to help shrink a quantum-optics experiment. The result—SpooQy 1, a shoebox-sized CubeSat that created and measured entangled photon pairs—launched in 2019 and stayed healthy until reentry two years later. "People kept walking into the lab asking, 'Can we buy one of those QKD [quantum key distribution] satellites?'" Bedington recalls. "After many such requests, we thought, maybe we should."

That demand from would-be customers became the business case for SpeQtral, which spun out of the university in 2019. As CTO, Bedington now leads a team of more than 20, combining optics, electronics and aerospace specialists to build "pocket-sized infrastructure for quantum-safe encryption." The company's first spacecraft is slated to launch later in 2025, and it carries a spontaneous-parametric-down-conversion source: one photon of each entangled pair is detected on-board, and the twin is beamed to a ground station, creating encryption keys resistant to the power of future quantum computers.

The company is already integrating a second-generation platform, due around 18 months after the first launch. That mission adds laser downlinks and a weak-coherent-pulse source, giving customers a menu of options that balance security and cost. "Not everyone needs protection against hypersonic drone attacks," Bedington notes. "Matching threat model to price point is how we make quantum security commercially viable."

SpeQtral sees its progress as a stepping-stone toward the quantum internet, distributing entanglement not just for keys but for linking quantum computers and sensors worldwide. The journey, Bedington admits, has been "brutal, jumping straight to satellites was going from zero to a hundred." His lesson would be to ship something small sooner, then scale. Still, he's convinced the payoff is worth it. "Think in constellations, not single missions," he says. "We're laying the foundation for an internet where entanglement is the bandwidth."

COMPANY
SpeQtral

FOCUS
Entanglement-based QKD from space

speqtralquantum.com