APRIL 2026 EDITION

INSIDE: POWERING THE FUTURE OF COMMUNICATION WITH QUANASTRA'S TECHNOLOGIES.

Quanastra

Quantum & Photonics Innovation

MAGAZINE

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The second edition of the magazine is here, and it is published on April 14th , celebrated worldwide as World Quantum Day. Inside, you'll find a snapshot of Quanastra's latest developments.

Editor's Note

We introduce the high-precision DC current source, specifically designed for accurate current delivery in advanced electronics projects undertaken by electronics team. Our new customisable high-vacuum fibre optic feedthroughs provide reliable optical connectivity in demanding quantum optics experiments. Our mechanics lab is advancing with improved SNSPDs for sensitive photon detection and robust cryogenic systems for ultra-low temperature environments. With the addition of a VMC machine, we can now fabricate custom prototypes to your specifications.

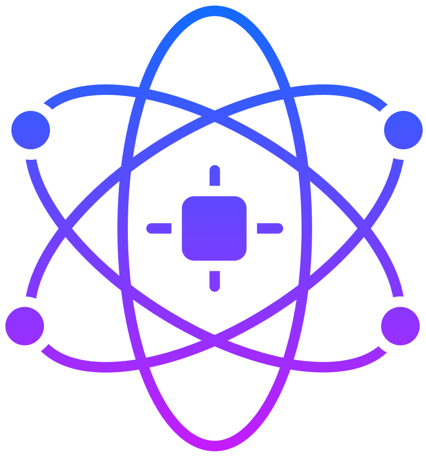
Two recent publications and two patents further highlight our ongoing R&D commitment. This edition also includes an accessible overview of free-space optical communication, a leading topic in the quantum community, and discusses how Quanastra can empower this area.

We aim for our audience to recognise Quanastra's progress and role within quantum technologies through this magazine. For added interest, explore our story section at the end, which weaves the quantum phenomenon of superposition into an engaging narrative and ends with thought-provoking questions.

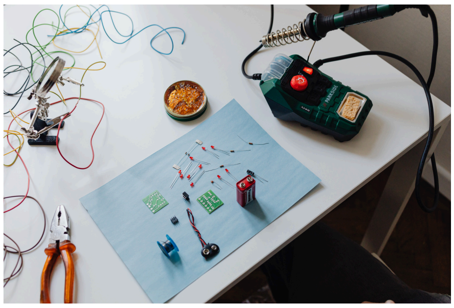
We hope this edition inspires your curiosity about quantum technologies and our role in the field.

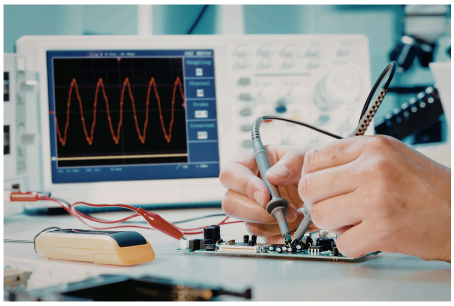
Thank you for reading.

Shreya satsangi
Editor-in-Chief



High Precision DC Current Source





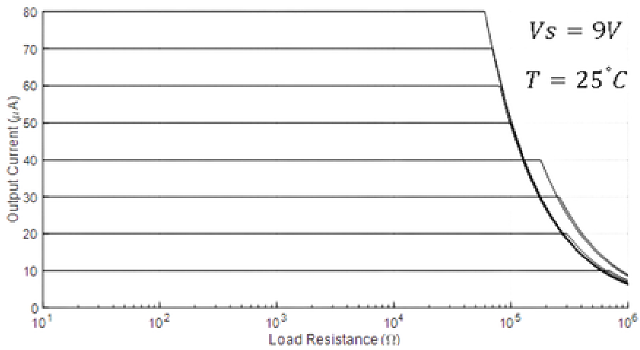
Feature Highlights

- Output current range: 5μA to 75μA
- Fine current resolution up to 0.5 μA.
- Load Independent Current Regulation within compliance range
- Stable operation over a wide load resistance range.
- Low-noise analog design suitable for precision measurements.

Potential Applications

- High Precision Current Biasing for laboratory experiments. (such as those required in optoelectronics, quantum, biomedical, nueroelectronics, etc.)
- RTD (such as PT100 / PT1000) temperature measurement
- Precision resistance measurement
- Sensor excitation (bio impedance, strain gauges, etc.)
- Calibration and reference current sources
- Low-noise analog and instrumentation systems

Model: QCS (Micron Series)



This product is a voltage-controlled, high precision current source optimized for micro ampere applications, delivering a stable and load-independent output across its operating range.

It offers fine current resolution and excellent long-term stability, making it well suited for PT100 excitation, precision calibration tasks, and low-noise instrumentation, where accurate and repeatable current biasing is critical.

It is a very compact, economically priced instrument that can be bought as a PCB attachment or as a small self sufficient box setup.

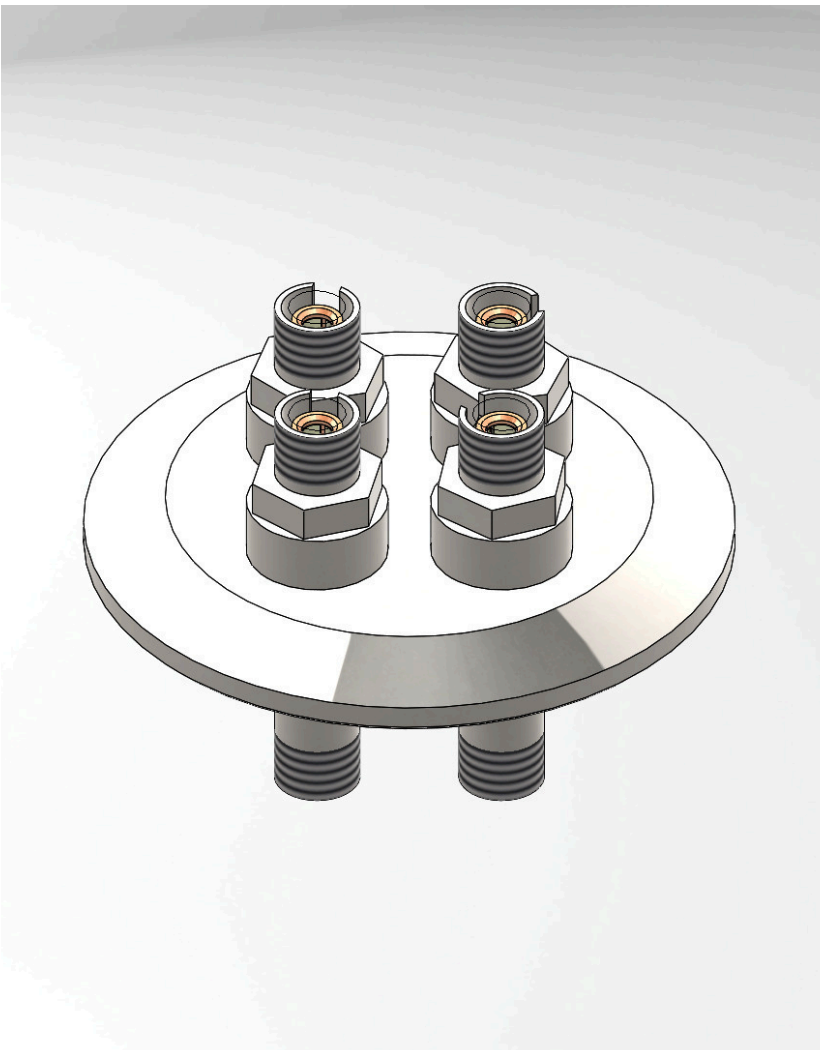
CUSTOM HIGH VACUUM FIBER FEEDTHROUH

FEATURES

•High vacuum compatible hermetic sealing
•Choose your own fiber as per requirement.
•Robust design for high-temperature bakeout up to 200 °C
•Compatible with demanding applications in quantum optics, photonics, and vacuum instrumentation

TYPICAL APPLICATIONS

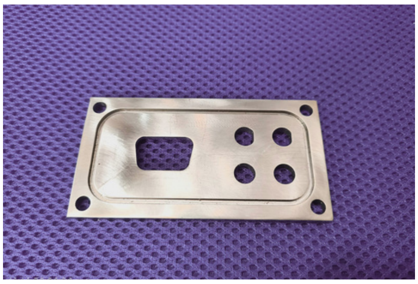
•Quantum optics experiments
•SNSPD and cryogenic detector systems
•UHV spectroscopy setups
•Laser delivery into vacuum chambers
•Photonic device testing in vacuum environments

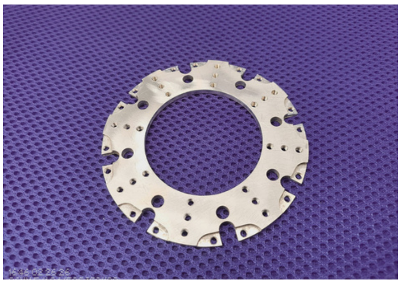


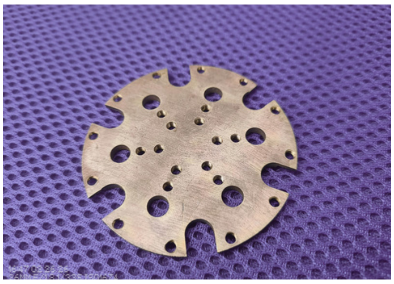
CUSTOM OPTIONS (AVAILABLE ON REQUEST)

•Different fiber core sizes (50 µm, 200 µm, etc.)
•Single-mode fiber configurations
•Custom flange compatibility (CF, KF, ISO)
•Extended wavelength ranges

TRANSFORMING METAL INTO MASTERPIECES: VMC IN ACTION







We Design, Develop & Deliver

Quanastra is now fully equipped with a Vertical Machining Center (VMC), enabling us to manufacture high-precision components in-house. With advanced milling capabilities and a strong focus on quality control, we are well-positioned to support custom manufacturing requirements across a wide range of industries.

Our VMC system allows us to carry out complete milling operations, making it ideal for operations like milling, drilling, tapping and contouring on a wide range of materials, ensuring accurate, consistent and reliable component production directly from our laboratory facility. We are capable of machining a variety of engineering materials, including PTFE (Teflon), stainless steel, copper, aluminium and mild steel, catering to diverse application needs.

The machine offers a working area of approximately 250 - 300 mm (X-axis), 150 –200 mm (Y-axis), and 60 - 80 mm (Z-axis), making it suitable for precision components within compact dimensions. With a tolerance capability of up to 50 microns, we ensure high levels of accuracy and repeatability in every part we produce.

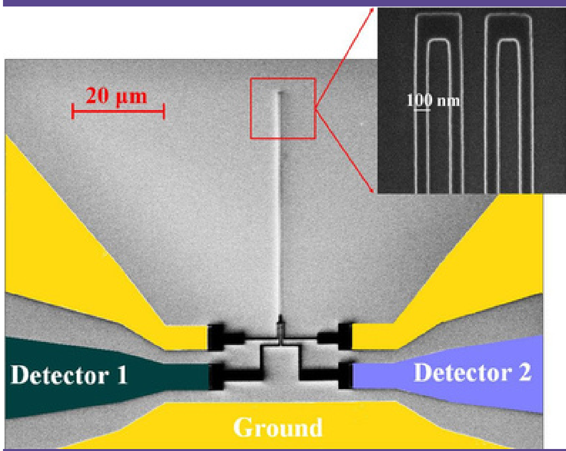
We welcome opportunities for custom manufacturing, prototype development and small-scale production. Our team remains committed to delivering precision-driven solutions with consistency, reliability and attention to detail.

WAVEGUIDE INTEGRATED SNSPD FOR INTEGRATED PHOTONICS

ABSTRACT

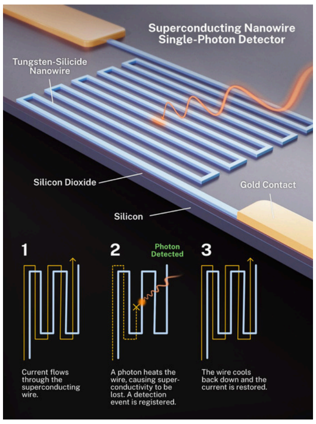
Integrated photonics is expected to play a key role in the scalability of quantum systems for applications such as quantum computing, quantum communications, quantum internet, and quantum metrology. One of the primary components of quantum integrated photonics is a single photon detector, which reads out the quantum information encoded in photons.

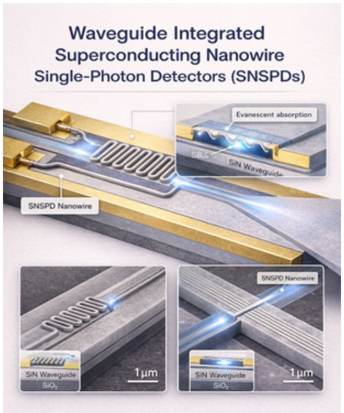
Amongst available single-photon detection schemes, superconducting nanowire single photon detectors (SNSPDs) remain the most promising technology for effective on-chip coupling, because they can be seamlessly integrated with a wide range of waveguide materials and substrates and have shown unparalleled performance from visible to the mid-infrared regime.

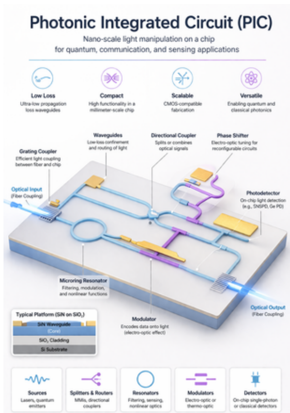


READ MORE

Dr. Vidur Raj from Quanastra published a review on different aspects of SNSPDs and schemes for their on-chip integration for different integrated photonics applications. Although mostly concentrated on quantum applications, we also cover some of the important wider photonics applications including imaging, AI and machine learning, and single-photon spectroscopy, and conclude the review with a future outlook discussing emerging research areas.

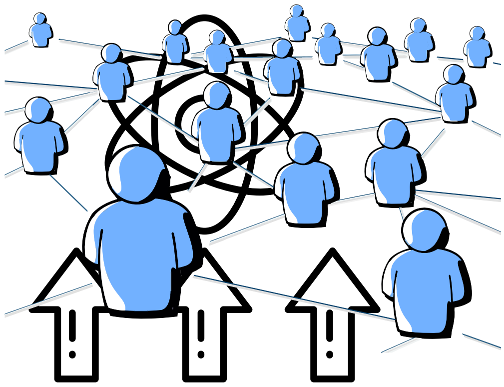






FEATURED ARTICLE

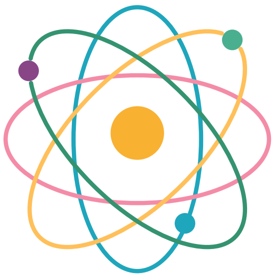
Powering the future of Communication using Quanastra's Technologies.



The global communications system is almost completely saturated, with every sector—telecom, defence, finance, and even space—wanting more bandwidth, faster transmission, and stronger security. But the infrastructure we rely on today, largely built around radio frequency (RF), is beginning to show its limits. The spectrum is crowded, expensive, and heavily regulated. Scaling it further is not impossible, but it is increasingly inefficient.

RF has taken us a long way. But it was never designed very high bandwidth dense communication network. Many believe it has already reached its limits. This is where free-space optical (FSO) communication starts to become relevant—not as a replacement, but as the next step.

Why Light Changes the Equation



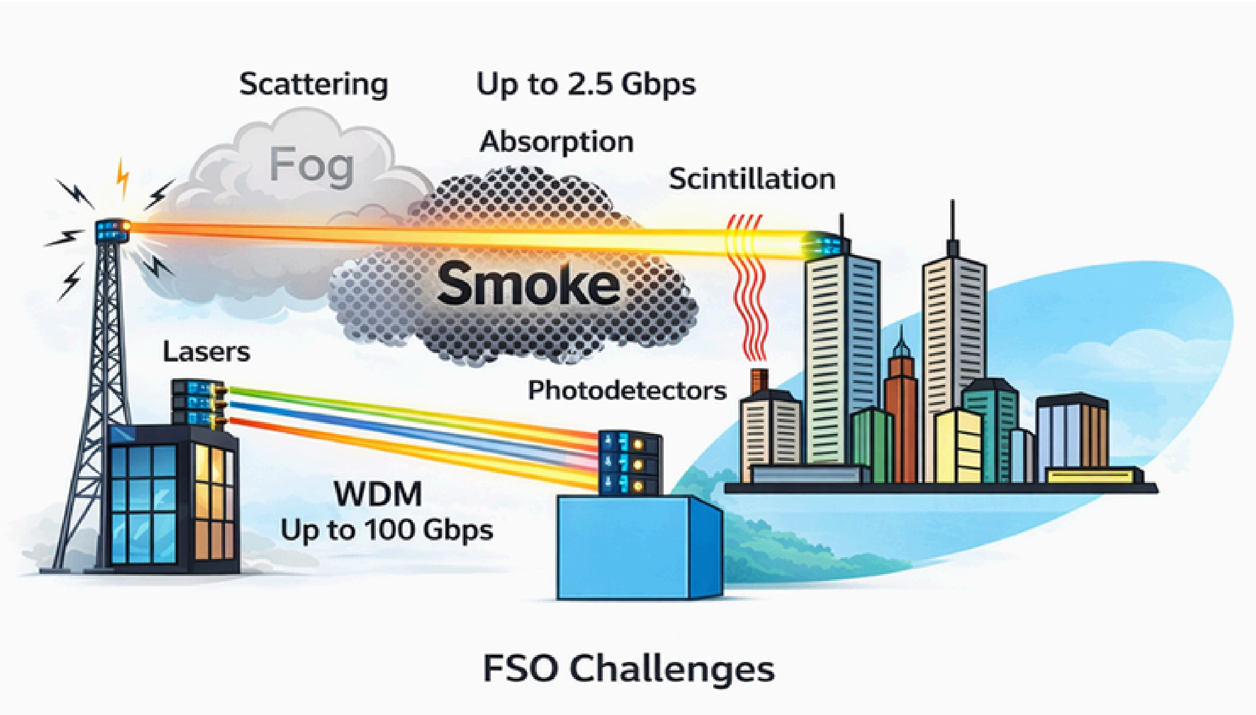
At its core, FSO is simple. Instead of sending signals through cables or radio waves, it uses light, transmitted directly through air or space.

That single change opens up an entirely different operating regime with unparalleled applications.

The optical spectrum is effectively unconstrained compared to RF. This allows data rates to scale from megabits per second to potentially terabits per second, without running into spectrum allocation issues. At the same time, the beam itself is highly directional, which makes it highly secure and extremely difficult to intercept.

There are other practical advantages: the optical spectrum is license-free. No auctions, no regulatory delays. From a system perspective, this is a clean and scalable solution.

And the market is already moving in this direction—driven by 5G/6G backhaul, satellite communication, and the need for secure links.



Since the light is no longer confined, FSO systems can be deployed without the need for physical infrastructure such as cables or trenches. This makes them significantly faster to deploy, especially in environments where laying fiber is difficult, expensive, or impractical.

But there are reasons why FSO is not as widely used as it should be. FSO are a difficult engineering challenge because of the issues mentioned below:

1.The Channel Is the Problem

Unlike fiber, where the environment is controlled, FSO operates in an open channel—the atmosphere. And that channel is unpredictable causing problems with the communication.

2.Distance Defines the Problem

At very short distances—chip-to-chip or lab-scale links—the limitations are mostly engineering problems. Alignment, packaging, and integration dominate.

Move to a few kilometers, and the atmosphere starts to matter. Fog, turbulence, and beam instability begin to limit performance.

Push further—to satellite links and beyond—and the problem changes again. Now, the system is no longer limited by scattering or turbulence, but by the number of photons that actually reach the receiver.

3. FOG: THE SIMPLEST AND MOST SEVERE FAILURE MODE

Among all atmospheric effects, fog is the most unforgiving.

The size of water droplets in fog is comparable to optical wavelengths, which leads to strong scattering. The beam does not simply weaken—it gets diffused in all directions.

The result is often a complete loss of signal.

In dense fog, attenuation can reach levels where even short-range links fail. This is one of the primary reasons why FSO systems struggle with consistent uptime in certain environments.

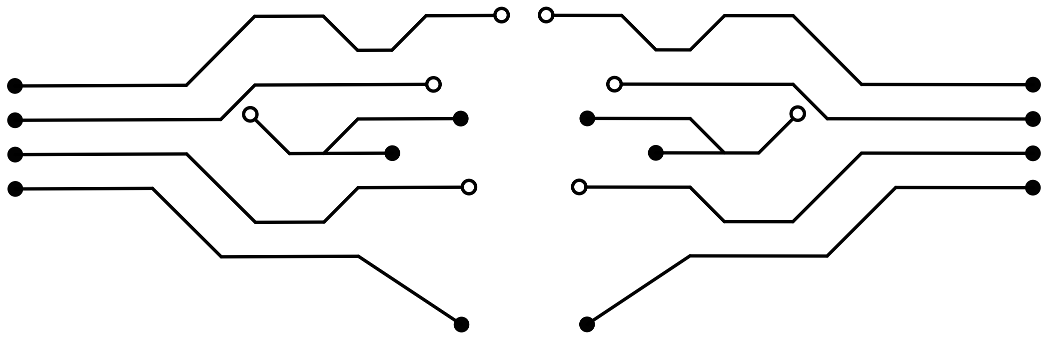
4.TURBULENCE: THE PROBLEM YOU CANNOT SEE

Even in clear conditions, the atmosphere is not stable.

Small variations in temperature and pressure create fluctuations in refractive index. As light propagates through these variations, the beam experiences distortion.

This shows up as scintillation—random fluctuations in intensity at the receiver.

From a system perspective, this means the signal is never steady. Even if the average power is sufficient, momentary drops can introduce errors. Designing around this requires higher margins, which reduces overall efficiency.



5.When the Beam Refuses to Stay Still

There is another effect that becomes important over distance—beam wander.

Instead of hitting the same spot on the detector, the beam shifts randomly due to large-scale turbulence. In simple terms, it moves around.

Since receiver apertures are typically small, even slight movement leads to partial signal loss. Over longer distances, this becomes a significant contributor to link instability.

6.Even Small Misalignment is not allowed

FSO systems require precise alignment.

The beam divergence is small, which helps maintain power density, but it also means that even minor misalignments matter. Mechanical vibrations, thermal expansion, or environmental disturbances can all degrade performance.

This is manageable in static systems, but becomes much harder in:

- UAV communication
- Satellite links
- Long-distance outdoor deployments

In these cases, alignment becomes an active control problem.

7.Finally, the Eye Safety constraints

There is a hard limit on how much optical power can be transmitted safely.

High-power beams can damage the human eye, which imposes regulatory constraints on system design. This creates a fundamental trade-off between power and safety.

Operating around 1550 nm helps, since it is relatively safer for the eye, but the limitation remains.

8.Noise Is Always There

Unlike fiber systems, FSO receivers are exposed to the environment.

Sunlight, sky radiation, and artificial lighting all contribute to background noise. This reduces signal-to-noise ratio, particularly during daytime operation, and places additional demands on detection systems.

9.At Long Distances, Everything Becomes About Photons

As distance increases further, especially in space, a different regime emerges.

The system becomes photon-limited.

At this point, the issue is no longer turbulence or alignment—it is whether enough photons reach the detector to begin with. Every photon carries information, and losing even a fraction of them matters.

This is where conventional detection approaches begin to struggle.

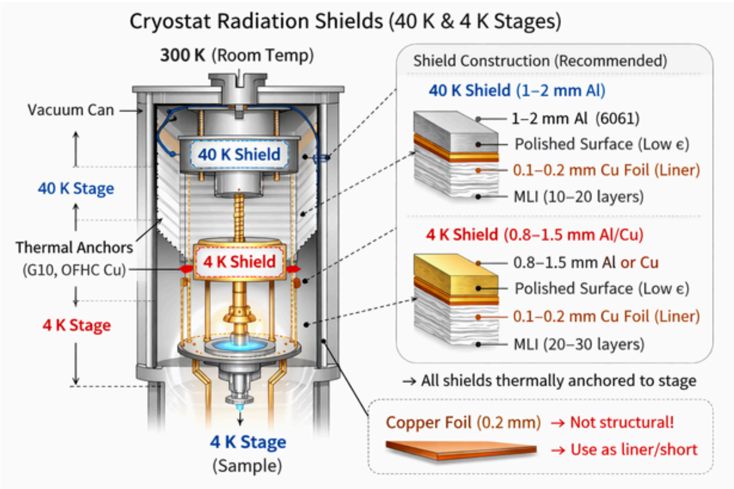
10.Where Detection Starts to Matter More Than Transmission

Most discussions around FSO focus on transmission—beam shaping, wavelength, optics.

But as systems move toward longer distances and lower signal levels, detection becomes the limiting factor making way for single photon detectors.

Role of Quanastra and its Technology in Free Space Communications:

Quanastra's technology is expected to play a big role in making free space communications a reality, particularly in challenging environments where conventional RF links fall short. One way to overcome the current limitation of FSO is to operate it in mid-IR regime. However, this spectral region remains underdeveloped globally due to the complexity of materials, fabrication, optics and detectors in this region. Quanastra is actively bridging this gap by developing thin-film coatings and optical stacks specifically engineered for mid-IR transmission and durability.

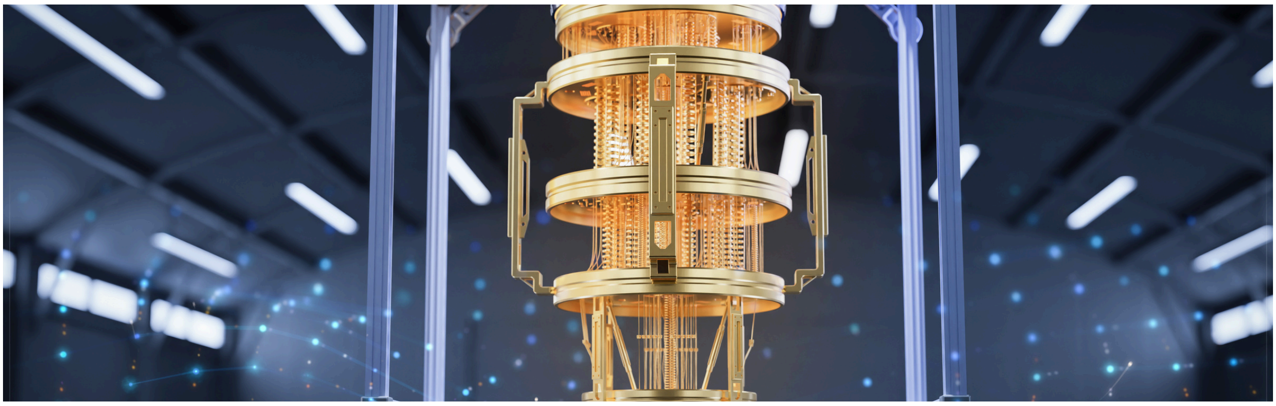


By building core capabilities across optics and photonic detection, the company is addressing several of the fundamental limitations that currently restrict the widespread deployment of FSO links.

Quanastra is one of the pioneering startups providing single photon detection in mid-IR regime. These are critical for ultra-sensitive communication links, especially in long-distance, low-signal, or quantum-secured communication scenarios. High-efficiency, low-noise single-photon detectors enable operation at extremely low power levels while maintaining high data integrity and security. This becomes particularly important for next-generation communication paradigms, including quantum key distribution (QKD) and deep-space optical links

Another key area of development at Quanastra is mid-infrared (mid-IR) optical components, including high-performance mirrors and spectrally selective optical filters. Operating in the mid-IR regime offering intrinsic advantages for free-space propagation, such as reduced scattering under certain atmospheric conditions and improved performance in fog, dust, and turbulence compared to shorter wavelengths such as 1550 nm at which currently the optical communication happens.

hrough these developments, Quanastra is not only contributing to incremental improvements but is enabling a technological shift toward **high-speed, secure, and resilient free-space communication networks,** with applications ranging from terrestrial links to satellite communications and beyond.



Why April 14? The Quantum Constant That Became a Celebration

The second publication of Quanastra's magazine falls on April 14 — and that is no coincidence. Across the world, this date is celebrated as World Quantum Day.

Why 4.14? Look no further than the Planck constant, a fundamental pillar of quantum mechanics. Its value is approximately 4.14×10^{-15} eV·s – a beautiful nod to the 14th of April.

By publishing this magazine on April 14, Quanastra is proud to be part of that global effort. Whether you are a student, a researcher, or simply quantum-curious, this day invites you to ask big questions and discover just how deeply quantum science already touches your daily life.

World Quantum Day isn't merely a symbolic choice. Its goal is to bring quantum science out of textbooks and research labs and into everyday conversation. The initiative invites scientists, artists, engineers, science communicators, and curious minds everywhere to share how quantum technologies are reshaping our understanding of nature, from the subatomic level to life-changing applications in computing, sensing, and communication.

The idea was launched by the initiative 'Quantum Across the Globe' on 14 April 2021, and the first official World Quantum Day was celebrated on 14 April 2022. Since then, it has grown into a worldwide phenomenon.

On World Quantum Day 2025 alone, more than 530 events were organised across 83+ countries and 318+ cities — featuring conferences, public talks, podcasts, exhibitions, interviews, and hands-on demonstrations.

Photo *Gallery*

THE MAGIC QUANTUM SOUP

Three friends, Loveleena, Ritika, and Nived, walked into a restaurant. This might sound like the opening of a lame joke, but let me promise you, this is not. The three friends looked at the menu and saw that today's special is the 'magic quantum soup'. They all got curious and decided to order the magic quantum soup.

Soon they were all served a bowl of soup from one single big bowl, all identical to each other's. It looked normal and they expected all the bowls to taste the same. They were told that the soup is in a superposition of being sweet like honey, spicy like chili, and sour like lemon. But once you taste it, it collapses into one flavor with equal probability.

Loveleena, Ritika, and Nived, each grab a spoon from their bowl to taste.

Loveleena dips in first. Zap! Her spoon picks the sweet flavour. To her, the soup is purely honey-sweet now. Ritika tastes next. Zap! She gets the spicy kick, and the soup is chili all the way for her.

Nived goes last. Zap! Sour lemon zings his tongue.

The friends chat excitedly. "It's sweet!" says Loveleena. "No, spicy!" argues Ritika. "Definitely sour!" insists Nived. They're all right on their own. And it is also true that before anyone tasted, the soup wasn't just one flavour. It was all three at once, in superposition, like a colourful dance of possibilities.

In a typical restaurant, if three people wanted three different flavours, the chef would be sweating over the stove. She would have to prepare one pot of honey-sweet broth, a second pot of spicy chili base, and a third pot of sour lemon zest. It would take three times the ingredients, three burners, and three times the effort.

But here, with a flick of her wrist, she prepared just one batch of soup. Through the "magic" of quantum mechanics, she placed the soup into a superposition state where the flavours of sweet, spicy, and sour all existed simultaneously in the same liquid. By making only one pot to satisfy three distinct cravings, she saved immense time and resources, letting the laws of quantum physics do the heavy lifting.

This is exactly how a quantum computer functions. While a classical computer must process each 'flavour' of a problem one at a time, a quantum computer processes all possibilities simultaneously in a single 'pot' of data, finding solutions with far less time and energy.

Now that you are an expert of superposition, we have questions for you:

- Before anyone tasted the soup, what flavours was it in?
- Why did Alice, Bob, and Charlie each experience a different flavour, even though their bowls looked identical?
- What happens to the superposition when someone takes a taste?
- If they tasted again right after, would the soup still be in superposition, or is it stuck with one flavour now?
- How does the story show that superposition involves equal chances?

Let’s build the future together

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