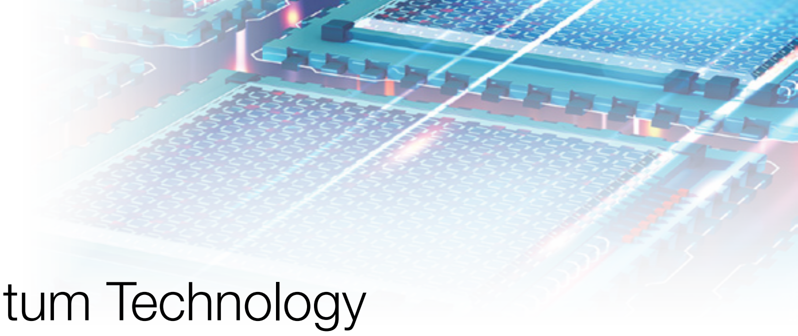


HAMAMATSU
PHOTON IS OUR BUSINESS

The Silent Architect of Quantum Technology

How Photonics Shapes the Applications of Tomorrow in Advanced Process Monitoring

Quantum technologies are rapidly shifting from foundational physics to realworld impact. The manipulation of quantum phenomena such as superposition, entanglement, and tunneling unlocks new modes of measurement, communication, and computation. Across this landscape, photonics stands out as a core enabling technology, as it is essential for interacting with quantum systems at the single-particle level.

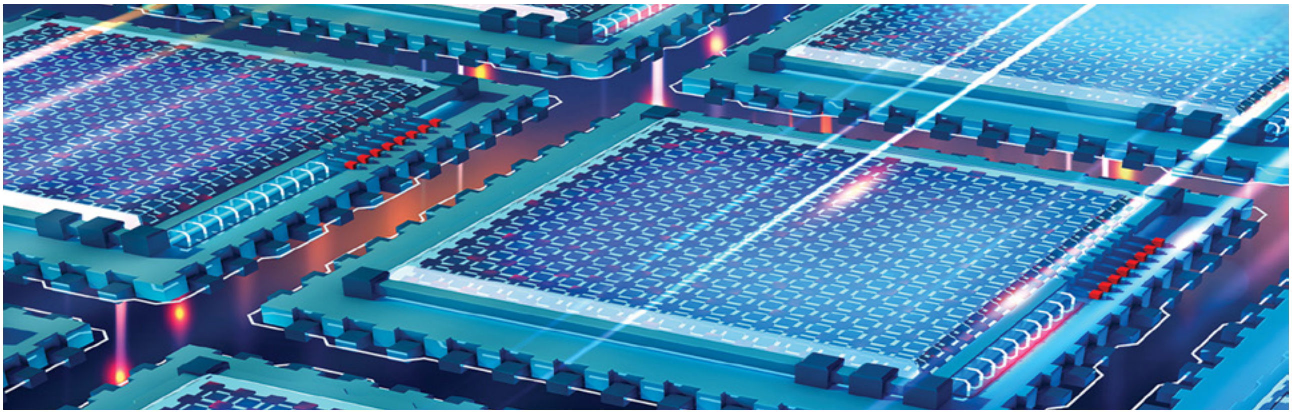
Two promising applications, magnetoencephalography (MEG) and neutral atom quantum computing, demonstrate how light-based systems are transforming both our understanding of the human brain and our computational capabilities.

Optically Pumped Magnetometers – Imaging the Brain with Light and Atoms

For decades, magnetoencephalography (MEG) has been one of the most powerful tools in neuroscience. It allows researchers to track brain activity with millisecond precision by measuring the faint magnetic fields generated by neurons. But traditional MEG systems are bulky, expensive, and rely on sensors that must be cooled to near absolute zero. That setup makes them difficult to use, especially with children, patients who can't stay perfectly still, or anyone outside a tightly controlled lab.

Now, a new kind of sensor is changing that. Optically pumped magnetometers (OPMs) are compact, lightweight devices that use light and atomic vapors to measure magnetic fields. Because they work at room temperature and can be placed directly on the scalp, they allow for wearable MEG systems that move with the user. These sensors are sensitive enough to detect brain signals in everyday environments, and flexible enough to be integrated into custom-fitted headgear made with 3D printing. That is opening the door to a wide range of new applications, from early epilepsy diagnosis in children to mapping language and motor function while people move, speak, or interact naturally.

One example of this next generation of brain imaging comes from a collaboration between Cerca Magnetics, a University of Nottingham spin-off, and Hamamatsu Photonics. Together, they've developed an OPM-based MEG system using vapor cells smaller than a golf ball—just 8.5 cm^3—with magnetic sensitivity down to 20 $fT/\sqrt{Hz}$. The headset was first presented at SPIE Photonics West 2025 and was also featured at Laser World of Photonics 2025.



Quantum Computing with Neutral Atoms – From Fundamental Physics to Practical Use

Whenever classical computers hit a wall, whether it's simulating the behavior of complex molecules in pharmaceutical development, finding the best route for a hundred delivery trucks, or solving puzzles in machine learning, quantum computers promise to step in. Among the many approaches to building these machines, neutral atom quantum computers stand out for their simplicity in design and their potential to scale.

The concept sounds futuristic but is surprisingly elegant. Instead of using silicon chips, these systems trap individual atoms using tightly focused laser beams, called optical tweezers, and arrange them into programmable grids. Each atom acts as a quantum bit (qubit), and by precisely controlling laser light, researchers can perform computations by switching atomic states and linking them together through quantum interactions.

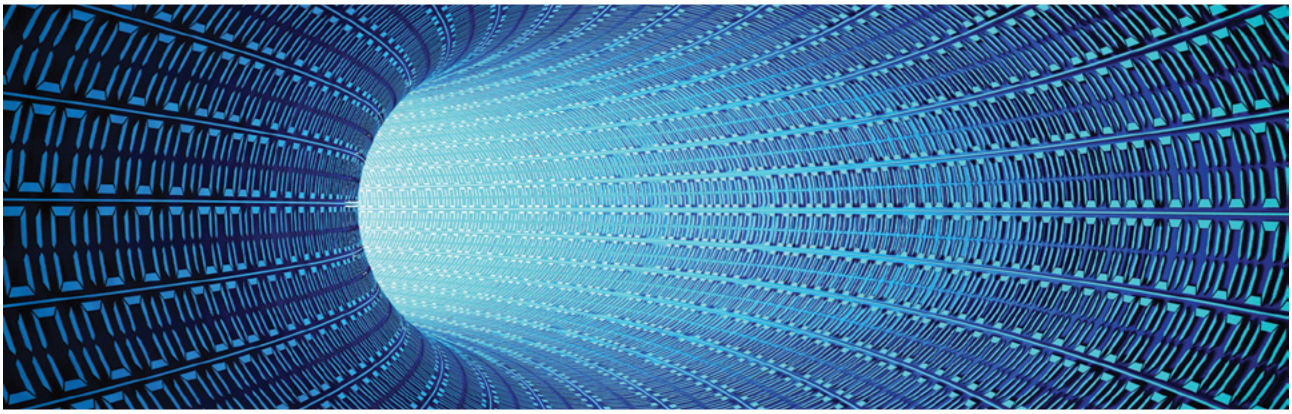
What makes neutral atom platforms special is their flexibility. Unlike more rigid architectures, the positions of the atoms can be rearranged on demand, allowing the system to adapt to different types of calculations. This makes them particularly good for problems that benefit from reconfigurable connectivity.

Neutral atom quantum computers are already showing promising results. Arrays of more than 100 atoms have been demonstrated, and researchers are regularly hitting key milestones in gate fidelity, control speed, and measurement accuracy. This progress is enabled by advanced photonic components such as liquid crystal on silicon spatial light modulators (LCOS-SLMs) to dynamically configure trap geometries, single-frequency lasers for precise quantum state manipulation, and high-speed, low-noise cameras for reliable qubit readout. Because they work with light from start to finish—trapping atoms, driving logic operations, and reading out results—neutral atom quantum computers are inherently photonic machines.

Photonics is Driving the Quantum Frontier

In both MEG and neutral atom quantum computing, photonics is not merely supportive. It is central. The ability to generate, manipulate, and detect light with high precision is what makes practical quantum applications possible. As such, the pace of quantum innovation is closely tied to advances in photonics engineering.

Across the field, a growing ecosystem of collaboration between established photonics leaders and agile quantum startups is accelerating progress. Companies like Hamamatsu Photonics exemplify this development. Working with younger ventures such as Cerca Magnetics helps translate foundational photonics knowledge into real-world quantum systems, whether in clinical brain imaging or scalable quantum processors.



Hamamatsu also serves as a case study in how a long-standing commitment to pushing the boundaries of light-based technologies can unlock entirely new application fields. By refining the core tools of photonics—lasers, detectors, modulators, and optical materials— such companies continuously extend the reach of what's technologically possible in the quantum domain.

Ultimately, as quantum systems become more robust and widely deployed, photonics will remain the enabling backbone. The future of applied quantum technology is a photonic one, and its continued advancement depends on the precision, creativity, and persistence of those who shape light itself.

For more information, please visit www.hamamatsu.com
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