ISSUE 12
16/01/26

Q-Newsletter

HIGHLIGHT

Not a Unified Theory of Everything... But

Bridging quantum computing and astrophysics might not give us a theory of everything, but it could give us something almost as exciting: a new way to see distant worlds. Johannes Borregaard and collaborators from Harvard University argue that quantum computing could make direct exoplanet imaging much more efficient by squeezing more information out of extremely faint planet light.

For a super-faint exoplanet, only a small number of photons reach our instruments, and each photon carries valuable information not only in its arrival time and position, but also in its optical phase, which encodes where it came from on the sky. In conventional imaging, those photons are typically detected immediately at each pixel or telescope and the resulting classical counts are combined later in software. However, the act of detection collapses the photon's quantum state and largely discards the phase relationships that are most useful for distinguishing a planet's signal from overwhelming stellar glare.

The proposed quantum approach is designed to preserve that information longer: a quantum memory would first store the incoming light's state (effectively "mapping" it onto qubits), after which a small quantum processor could coherently combine signals in an interferometry-like way while the phase information remains intact, and only then perform the final measurement.

If this can be engineered, it could cut observing time, improve separation from stellar glare, and make it easier to detect spectral fingerprints (e.g., atmospheric molecules).

In this way, "quantum astronomy" could bring us closer to characterising faint, Earth-like worlds that are currently beyond the reach of conventional imaging.

RESEARCH

Subatomic Quantum Sensing

In January 2025, a team at the University of Pennsylvania School of Engineering and Applied Science achieved a major advance in quantum sensing by developing a method capable of detecting nuclear quadrupolar resonance (NQR) signals from individual atoms, something previously thought impossible with conventional spectroscopy. Traditional NQR and related magnetic resonance techniques rely on signals averaged over trillions of atoms, which obscures fine details about single nuclei that can be crucial for understanding molecular structure and interactions. The Penn group, led by Associate Professor Lee C. Bassett, used nitrogen-vacancy (NV) center quantum sensors in diamond to isolate and measure the tiny signals produced by a single nuclear spin at room temperature.

This quantum sensing breakthrough offers a way to observe sub-atomic variations and molecular "fingerprints" that were previously invisible, opening potential new pathways in drug development, protein research, and nanoscale materials science. Unlike ensemble measurements, this technique reveals unique properties of a single nucleus, giving researchers an unprecedented level of detail about atomic-scale structure and dynamics.

By: Defne Aydin, Ethan Kao, George Szucsany

Q-Newsletter

MARKET

U.S. DOE Expands Quantum-in-Space Collaboration

The U.S. Department of Energy Office of Technology Commercialization has expanded its Quantum-in-Space Collaboration, adding three new partners: IonQ, Honeywell, and the Electric Power Board of Chattanooga. This expansion strengthens an existing public-private partnership designed to accelerate the transition of quantum technologies from research environments into practical space-based applications.

The Quantum-in-Space Collaboration was established to address the gap between laboratory demonstrations and operational deployment, a major challenge for emerging quantum technologies. Through coordinated feasibility studies, pilot projects, and industry engagement, the initiative supports the development of quantum sensing, communications, and computing systems that could operate in the harsh conditions of space. These technologies have the potential to enhance secure communications, improve navigation and timing capabilities, and enable new scientific and commercial missions in orbit.

By bringing in additional industry partners with expertise in quantum systems, aerospace technologies, and infrastructure, DOE aims to reduce technical risk and accelerate commercialization timelines. The expanded collaboration reflects a broader federal strategy to maintain U.S. leadership in both quantum science and the growing space economy, while laying the foundation for future space-based infrastructure that supports national security, scientific research, and economic competitiveness.

By: Defne Aydin, Ethan Kao, George Szucsany