# United Nations declares 2025 the International Year of Quantum Science and Technology amid breakthrough innovations



Quantum science often perplexes even the brightest minds—Albert Einstein famously described certain aspects as "spooky action at a distance." However, far from being mere oddities of nature, phenomena like superposition and entanglement lie at the heart of groundbreaking advancements that could redefine our technological landscape. The field is gaining momentum, with a myriad of applications poised to transform various sectors, from medicine to national security.

As highlighted by a recent announcement, the United Nations has designated 2025 as the International Year of Quantum Science and Technology, coinciding with the centenary of quantum mechanics. This recognition reflects a growing urgency to harness quantum innovations, encompassing everything from medicines that could be designed within days to advanced weather forecasting systems capable of predicting natural disasters weeks ahead. Quantum technology’s implications extend to digital security as well, with powerful quantum computers posing significant challenges to existing encryption methods.

Quantum science harnesses the strange behaviours of subatomic particles. Everyday technologies, such as magnetic resonance imaging (MRI) machines and solar panels, already benefit from these quantum principles. In a nutshell, the particles that make up our world do not behave according to classical physics; their properties are dictated by quantum mechanics. As particles exist in a state called superposition, they can occupy multiple states or locations simultaneously until observed—a property that has profound implications for computing.

For instance, quantum computers manipulate quantum bits, or qubits, which can represent both one and zero at once due to superposition, and can entangle with one another, dramatically increasing their computational capabilities. This contrasts sharply with classical computers, which rely on binary bits. According to experts, while classical systems might take thousands of years to solve certain problems, quantum computers could achieve the same feat exponentially quicker. However, the path to this breakthrough is fraught with challenges. Current quantum computers are highly sensitive and typically require extreme cooling to reduce errors—issues that ongoing research aims to resolve.

Justin Earley, an assistant professor at Arizona State University, is one of those at the forefront of this research. He is investigating the application of natural molecules to develop quantum devices operational at room temperature, making quantum technology more accessible for mainstream use. This could pave the way for smartphones equipped with powerful artificial intelligence capabilities and advanced navigation systems that do not depend on GPS. Earley suggests these innovations signify a fundamental shift in how we engage with technology.

In enhancing these breakthroughs, quantum communication also offers transformative potential. By leveraging quantum key distribution (QKD), it becomes feasible to ensure encrypted messages can be sent securely; any interference in the quantum realm alerts the parties involved. Moreover, researchers are optimistic about creating a quantum internet, which would transmit information in a way that is inherently secure from conventional hacking methods.

Mouzhe Xie, also at ASU, is utilising quantum sensor technology that could fundamentally alter biological science. His team's efforts to enhance nuclear magnetic resonance (NMR) technologies aim to peer into biological minutiae, potentially enabling advancements in medical diagnostics. By innovating how magnetic waves interact with treated diamonds that house quantum particles, Xie’s research is at the intersection of biology and quantum physics, showcasing the collaborative nature of this emerging discipline.

However, the challenges of quantum technology are not limited to scientific hurdles. As quantum capabilities grow, so too do concerns surrounding data privacy. Experts warn of an impending crisis known as “Q-Day,” when quantum computers could render current encryption methods obsolete, threatening everything from personal emails to sensitive banking information. In response, researchers around the world are racing to devise post-quantum cryptographic methods to safeguard our data before quantum supremacy arrives, anticipated between 2030 and 2050.

To mitigate gaps in public understanding and facilitate interdisciplinary engagement, initiatives like World Quantum Day, celebrated each April 14, aim to heighten awareness about the significance and potential of quantum science. The event brings together scientists, educators, and the general public to discuss the lingering questions and future prospects of this revolutionary field.

As the quantum revolution continues to unfold, it becomes clear that collaboration across various fields—spanning technology, biology, and engineering—is crucial. Even those without a background in physics can contribute to the quantum ecosystem, with educational programs being developed to attract a diverse range of talents. Whether through research, education, or industry partnerships, the quantum community is expanding, fostering an inclusive environment where new innovations can bloom.

As we stand on the brink of this new era in science and technology, it is essential not only to celebrate the advancements made but also to prepare for the sweeping changes on the horizon. Harnessing the power of quantum science could lead us to solutions for some of humanity’s most pressing challenges, from healthcare to climate forecasting, proving that the weirdness of the quantum world could indeed yield wondrous benefits for society.

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* Paragraph 1 – [[1]](https://news.asu.edu/20250602-science-and-technology-your-crash-course-quantum-science), [[2]](https://www.tomsguide.com/computing/online-security/what-is-world-quantum-day)
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## Bibliography

1. <https://news.asu.edu/20250602-science-and-technology-your-crash-course-quantum-science> - Please view link - unable to able to access data
2. <https://www.tomsguide.com/computing/online-security/what-is-world-quantum-day> - World Quantum Day, celebrated annually on April 14 since its official launch in 2022, aims to increase global public awareness and understanding of quantum science and technology. Initiated by scientists in over 65 countries, the event promotes discussions on how quantum science deepens our understanding of nature, impacts daily technologies, and drives future innovations. Activities span outreach talks, exhibitions, lab tours, and artistic projects involving diverse professionals. The event is especially significant in 2025, marking 100 years of quantum mechanics and designated the International Year of Quantum Science and Technology. One major focus is quantum computing, which utilizes qubits instead of traditional bits, leading to faster, more efficient data processing. However, this advancement poses serious cybersecurity threats. Quantum computers could potentially break modern encryption, endangering data privacy—a scenario experts call "Q-Day." While such a breakthrough is anticipated between 2030 and 2050, post-quantum encryption methods are already being developed to counteract these risks. World Quantum Day thus serves not only as a celebration but also a call to prepare for the coming quantum revolution and its implications on digital privacy.
3. <https://www.livescience.com/quantum-computing> - Quantum computers are advanced machines that leverage quantum mechanics to process information, fundamentally differing from classical computers. Unlike classical bits (0 or 1), quantum bits (qubits) can exist in multiple states simultaneously due to superposition and entanglement, making quantum computers potentially much more powerful for certain tasks. Their architecture includes a quantum data plane with qubits, a control and measurement plane, control processors, and quantum software. Applications range from optimizing complex problems and enhancing artificial intelligence to breakthroughs in drug discovery and material science. However, building quantum computers is extremely challenging due to their susceptibility to interference and errors (decoherence). They require ultra-cold temperatures near absolute zero to function reliably. Current models are prone to high error rates and are not yet scalable for practical widespread use. Still, ongoing advancements could eventually lead to "quantum supremacy," where quantum systems outperform classical ones in specific tasks. One significant implication is the potential to break existing cryptographic systems, prompting the emergence of quantum cryptography to secure sensitive information against future quantum threats.
4. <https://www.csis.org/analysis/quantum-technology-applications-and-implications> - Quantum communication applies the properties of quantum physics to provide better security and improved long-distance communications. Quantum communication provides two advantages for security. First, in conventional digital communication, messages are encrypted and decrypted using keys and transmitted as classical bits (zeros or ones). Quantum key distribution (QKD) allows the creation of encryption keys that are encoded and transmitted using qubits, making them more difficult to break. Second, qubits are incredibly sensitive. Any attempt to disrupt or even just observe them will force qubits to collapse. This means that if an outside observer tries to intercept or monitor communications that use QKD, their activity will be immediately noticed by the message recipient. Quantum communications therefore hold the potential to protect transmitted data and make it very difficult for eavesdroppers to evade detection. Wide deployment of quantum communications technology is still years away.
5. <https://www.gao.gov/products/gao-20-527sp> - Quantum technologies may enable the following advances, assuming extensive technological progress: Improve measurement. Quantum sensors may be able to locate previously invisible or stealth targets, or determine an object’s location and speed, even if GPS is jammed or spoofed, or if a satellite link is lost. Enable secure communication. Quantum communications may eventually allow for completely secure quantum digital signatures, secure sharing of sensitive and classified information, or other applications. Solve complex computational problems. Quantum computers may one day be able to quickly complete tasks that classical computers cannot carry out efficiently—such as factoring large numbers, a task central to cracking current cryptographic systems. Create a quantum internet. Future communication technologies may be able to securely transmit information between quantum computers. The resulting quantum internet would be inaccessible to outside computers, because any attempts to access the network would reveal a hacker’s presence.
6. <https://www.reuters.com/technology/novo-nordisk-owner-invest-200-million-quantum-computing-startups-2024-05-01/> - Novo Holdings, the controlling shareholder of Danish drugmaker Novo Nordisk, announced plans to invest $200 million in quantum computing startups, focusing on life sciences companies in Nordic countries. Quantum computing is seen as a revolutionary technological advancement that can perform complex calculations faster than current computers. This investment aims to leverage quantum computing in pharmaceuticals, significantly accelerating drug discovery. Soren Moller, managing partner of seed investments at Novo Holdings, highlighted that quantum computing could transform life sciences by modeling proteins, understanding complex datasets, and monitoring biological systems. Though the technology is in its early stages, Novo Holdings believes the timing is right to support its development.
7. <https://www.livescience.com/physics-mathematics/particle-physics/physicists-force-atoms-into-state-of-quantum-hyper-entanglement-using-tweezers-made-of-laser-light> - Caltech researchers have achieved a groundbreaking advancement in quantum physics by using laser-based optical tweezers to place atoms into a state of hyper-entanglement. Unlike traditional quantum entanglement, where particles share a single property, hyper-entanglement allows atoms to share multiple properties simultaneously. In their study, published in the journal Science, the team entangled both the motion and electronic states of two atoms, significantly increasing the amount of quantum information each atom can encode. This technique was made possible by cooling neutral alkaline earth atoms and actively correcting their thermal motion, allowing researchers to manipulate their position and energy levels precisely. The result is a more efficient and resource-effective method for developing quantum technologies. This innovation could enhance quantum computing, simulations, and measurement precision. Professor Manuel Endres, who co-led the study, emphasized the importance of mastering both internal and external atomic control, likening it to fully mastering an atomic "toy." The researchers anticipate that exploiting motional states in conjunction with electronic states could unlock numerous possibilities in the field of quantum technology.