

# SCIENCE FLASH NEWS

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# A protocol to realize near-perfect atom-photon entanglement

The devices in a quantum network are connected via entanglement, a quantum effect via which distant quantum particles become inextricably linked and share a single correlated state. One way to create entanglement between different atomic quantum computers is to use an atom-cavity interface, a system in which atoms interact with light inside an optical cavity.

Over two decades ago, two physicists at the University of Aarhus introduced a protocol designed to produce high-quality entangled states, reliably connecting devices in a network. Despite its potential, this framework, known as the state-carving (SC) protocol, was found to only succeed in 50% of cases, which has so far prevented its application on a large scale.

Researchers at Academia Sinica in Taiwan, assisted by others at Harvard University, recently devised a modified version of this protocol that could achieve near-perfect entanglement between atoms and photons with far greater efficiency.

The revised protocol, introduced in a paper published in *Physical Review Letters*, does not require highly advanced or expensive equipment, and could potentially contribute to the realization of large quantum networks, including a quantum internet.

"Our recent work on efficient and high-fidelity entanglement generation was motivated by one of our previous papers published in *QST*, which was born from a collaboration between first author Sumit Goswami, a post-doc at the time, and Cheng-Hsuan Chien, a college student in our group," Hsiang-Hua Jen, senior author of the paper, told Phys.org.

<https://phys.org/news/2026-02-protocol-atom-photon-entanglement.html>

# Ion bombardment triggers a reliable quantum switch in tantalum disulfide crystals

When you toss a coin, you put it into a higher-energy state until it falls back down again. It can then end up in one of two possible states: heads or tails. No matter which state the coin was in before, after the toss both outcomes are equally likely. A team at TU Wien has analyzed a quantum system that also has two equivalent ground states. By supplying energy through ion bombardment, this state can be changed.

Remarkably, however, the system behaves very differently from a coin toss: it switches every single time. After ion impact, it reliably ends up in the opposite state. For the experiment, the ion-beam equipment of TU Wien was transported to DESY in Hamburg. The crystals studied were provided by Kiel University (CAU), which also participated in the experiments at DESY. The research is published in the journal *Nano Letters*.

## Two possible surface configurations

"We are investigating a very special material, tantalum disulfide, the quantum material 1T-TaS<sub>2</sub>," says Professor Richard Wilhelm from the Institute of Applied Physics at TU Wien. "The particles in this material behave very differently from objects in our everyday experience. The electrons are strongly correlated, meaning they cannot be considered independently. When we fire ions at this material, these ions do not merely interact with a single electron they happen to hit—they effectively interact with the entire collective of electrons at once."

<https://phys.org/news/2026-02-ion-bombardment-triggers-reliable-quantum.html>

# Quantum effect could power the next generation of battery-free devices

A new study has revealed how tiny imperfections and vibrations inside a promising quantum material could be used to control an unusual quantum effect, opening new possibilities for smaller, faster, and more efficient energy-harvesting devices.

The international team, led by Professor Dongchen Qi from the QUT School of Chemistry and Physics and Professor Xiao Renshaw Wang from Nanyang Technological University in Singapore, studied the mechanism governing the so-called nonlinear Hall effect (NLHE). The research is published in the journal *Newton*.

Unlike the classical Hall effect, this quantum version allows alternating electrical signals, like those found in wireless or ambient energy sources, to be converted directly into usable direct current without the need for traditional diodes or bulky components.

"The NLHE is a sophisticated quantum phenomenon in condensed matter physics where a voltage is generated perpendicular to an applied alternating current, even in the absence of a magnetic field," Professor Qi said.

"This effect allows us to convert alternating signals straight into direct current, which is what's needed to power electronic devices. In principle, it means sensors or chips that could operate without batteries, drawing energy from their environment."

<https://phys.org/news/2026-02-quantum-effect-power-generation-battery.html>

# AI develops easily understandable solutions for unusual experiments in quantum physics

Researchers at the University of Tuebingen, working with an international team, have developed an artificial intelligence that designs entirely new, sometimes unusual, experiments in quantum physics and presents them in a way that is easily understandable for researchers. This includes experimental setups that humans might never have considered. The new AI doesn't just create a single design proposal; instead, it writes computer code that generates a whole series of physical experiments, that is, groups of experiments with similar outputs. The study has been published in the journal *Nature Machine Intelligence*.

The newly developed AI uses a programming language that researchers can easily understand. This allows them to figure out the underlying idea behind the AI's processes much more easily than before. "AI systems usually deliver their solutions without explaining how they work," says Mario Krenn, Professor of Machine Learning in Science at the University of Tuebingen and senior author of the study. "We scientists have to try to understand the solutions afterward. This often took us days or weeks—if we understood them at all."

Language models expert in quantum physics

"For our study, we trained a language model that functions a bit like ChatGPT," says Soeren Arlt, a doctoral student in Krenn's research group and first author of the study. "Our language model is an expert at writing computer code for quantum physics, specifically in the Python programming language."

<https://phys.org/news/2026-02-ai-easily-solutions-unusual-quantum.html>

# Living tissues are shaped by self-propelled topological defects, biophysicists find

With a new mathematical model, a team of biophysicists has revealed fresh insights into how biological tissues are shaped by the active motion of structural imperfections known as "topological defects." Published in *Physical Review Letters*, the results build on our latest understanding of tissue formation and could even help resolve long-standing experimental mysteries surrounding our own organs.

Topological defects are structural imperfections that emerge in systems hosting multiple, incompatible configurations of particles. They can be found in many different kinds of systems—both natural and manmade—but are especially important for describing "active fluids," which are composed of particles that constantly harvest energy from their surroundings and convert it into motion, generating their own propulsion.

This behavior also underpins the physics of liquid crystal displays, where topological defects emerge in 2D systems of rod-shaped molecules and help determine how light is modulated to produce the images and colors we see every day on our phones, laptops, and TV screens.

<https://phys.org/news/2026-02-tissues-propelled-topological-defects-biophysicists.html>

# Measuring chaos: Researchers quantify the quantum butterfly effect

For the first time, researchers in China have accurately quantified how chaos increases in a quantum many-body system as it evolves over time. Combining experiments and theory, a team led by Yu-Chen Li at the University of Science and Technology of China showed that the level of chaos grows exponentially when time reversal is applied to these systems—matching predictions of their extreme sensitivity to errors. The research has been published in *Physical Review Letters*.

## The quantum butterfly effect

The butterfly effect is a well-known expression of chaos theory. It describes how a complex system can quickly become unpredictable as it evolves: make just a few small errors when specifying the system's starting conditions, and it may look completely different from your calculations a short time later.

This effect is especially relevant in many-body quantum systems, where entanglement creates intricate webs of interconnection between particles—even in relatively small systems. As the system evolves, information about its initial state becomes increasingly dispersed across these connections.

The same rules apply when researchers attempt to turn back the clock on a quantum many-body system to recover its starting conditions. While the equations of quantum mechanics are reversible in principle, errors are inevitable when implementing a time-reversed evolution in practice.

<https://phys.org/news/2026-02-chaos-quantify-quantum-butterfly-effect.html>

# Proton's width measured to unparalleled precision, narrowing the path to new physics

Physicists in Germany have carried out the most accurate measurement to date of the width of the proton. By examining a previously unexplored energy-level transition in the hydrogen atom, Lothar Maisenbacher and colleagues at the Max Planck Institute of Quantum Optics have shown that the Standard Model continues to hold up under extraordinarily tight scrutiny, leaving even less room than before for rival theories that contradict our best understanding of how the universe behaves. The research has been published in *Nature*.

## The size of a proton

To date, quantum electrodynamics (QED) is our most successful framework for describing how light and matter interact at a fundamental level. As a central pillar of the Standard Model, it forms part of the broader effort to describe all observable matter in terms of elementary particles and the fundamental forces through which they interact.

For any theory in physics to remain viable, its predictions need to be confirmed by real experiments. Over decades of increasingly precise measurements, researchers have repeatedly tested QED's predictions—often with strikingly similar results. But at the same time, they have searched for even the tiniest deviations that might hint at cracks in the Standard Model and point toward new, unexplained physics.

One such test involves measuring the proton's width, or "charge radius." In recent years, different experimental techniques have produced slightly conflicting values for this quantity, which have limited physicists' ability to push QED tests to their ultimate precision.

<https://phys.org/news/2026-02-proton-width-unparalleled-precision-narrowing.html>

Thank you

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