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Electrical guardrails for charge carriers: A new approach to harness graphene for solar cells

Graphene is a single layer of carbon atoms in which electrons can move with high mobility, making it promising for high-speed electronic components. Yet it is not very efficient at converting light into electricity. While light absorbed by graphene does excite electrons, leaving behind positively charged carriers called 'holes,' the absorbed light energy cannot be harnessed effectively unless electrons and holes are separated and directed to different contacts.

Conventional solar cells use semiconductors such as silicon, whose bandgap plays a key role in converting light into electrical energy. Graphene does not have such a gap.

"That's why we have to come up with a different mechanism," says Ralf Schützhold, director of the HZDR Institute of Theoretical Physics. One option is to cut or fold the graphene to create tiny edges.

When light is absorbed by the material, creating charge carriers, a magnetic field applied to the graphene forces these carriers into circular paths. The edges act like guardrails, guiding the charge carriers in opposite directions—electrons and holes drift apart and are separated.

Creating such edges is challenging, however, and the approach is difficult to scale up to larger surfaces—a prerequisite for practical applications. That is why the HZDR team is proposing a new concept: "Instead of an edge, we propose using electrical voltages, generating potential barriers, as guardrails," explains Schützhold.

Specifically, the plan is to place narrow metal electrodes onto an insulating layer above or below the graphene. Applying voltages to the electrodes creates potential barriers in the graphene.

The research is published in the journal *Physical Review Applied*.

https://phys.org/news/2026-10-electrical-guardrails-carriers-approach-harness.html

Quantum gates set speed record at 6.8 nanoseconds with over 99.98% accuracy

Researchers from Jülich, Aachen and Cologne have performed a quantum operation on a qubit in just 6.8 nanoseconds—with more than 99.98% accuracy. Such operations typically take several tens of nanoseconds in superconducting quantum computers. The paper was published in *Nature Communications*.

6.8 nanoseconds—that's how long it takes light to travel a distance of around two meters (6.6 feet) in a vacuum. In this tiny fraction of a second, researchers at the Peter Grünberg Institute for Functional Quantum Systems (PGI-13) and Quantum Control (PGI-8) at Forschungszentrum Jülich have succeeded in performing elementary computing operations on a quantum bit, or qubit for short.

Switching speed is a critical factor in quantum computing. This is because qubits are sensitive and retain their quantum states for only a limited time. The faster individual operations can be performed, the more can fit into this time window. This is important for complex algorithms and for resource-intensive error correction.

However, the shorter the microwave pulses used to switch qubits, the stronger they must be. This increases the risk of unwanted excitation. This is because superconducting qubits possess more than the two energy states used for computation. If they are excited too strongly, they can unintentionally transition to higher energy levels.

To put it simply, you can think of it like an elevator in a tall building, meant to carry its load only between the ground floor and the first floor. Raise the load too briskly and it can overshoot.

https://phys.org/news/2026-10-quantum-gates-nanoseconds-accuracy.html

Diamond defects confirm 80-year-old theory of crystal stress

For the first time, researchers in Japan have directly mapped several components of the stress field surrounding an atomic-scale flaw in the crystal structure of diamond. Led by Tokuyuki Teraji at Japan's National Institute for Materials Science, the team achieved its result using nitrogen-vacancy (NV) centers in diamond, whose spin states respond differently to stress depending on how they are oriented relative to the stress field.

Published in *Applied Physics Letters*, the technique validates an 80-year-old theory about how miniature stress fields are distributed in diamond. It could also help improve the processes used to manufacture the high-quality diamond demanded by emerging technologies.

Even in otherwise orderly crystals like diamond, atomic-scale flaws can always be found, where neighboring rows of atoms are misaligned with each other. Named "dislocations," these flaws create minute stress fields which ripple out through the surrounding atoms. Across the whole lattice, they can strongly affect the material's mechanical, electrical and magnetic properties.

More than 80 years ago, physicists used elasticity theory to derive a mathematical description of these stress fields, known as a "stress tensor," which defines the stress at any given point surrounding a dislocation.

Since then, this description has underpinned our understanding of how dislocations behave, from the energy they store to the forces they exert on each other. However, measuring these microscopic stress fields directly has proven far more challenging: existing techniques can capture only some aspects of the stress, so the theory has never been fully tested.

https://phys.org/news/2026-10-diamond-defects-year-theory-crystal.html

Physicists reveal new paradigm for fiber growth in neurodegenerative diseases

Some proteins that are linked to neurodegenerative diseases can form both liquid droplets and amyloid fibers. But how are these two states connected, and where do the fibers grow? Leiden physicists Liru Feng and Louise Jawerth have discovered a counter-intuitive mechanism.

"We wanted to answer an open question: What happens to protein droplets as they age?" assistant professor Jawerth explains. "They look just like drops of oil in water, but they are droplets of proteins inside cells, also called condensates. Scientists have only relatively recently come to understand how they develop. Our findings on how they age—published in *Nature Physics* today—add an important piece to the puzzle."

The droplets are very complex materials; they are liquid-like and can turn into solids that are glassy or fibrous. Jawerth states, "For 10 years or so, we have known that there is a link between fiber growth from these proteins and neurodegenerative disorders like Alzheimer's disease or ALS. Our goal was to visualize, quantify and model this aging process, and we succeeded in doing so."

https://phys.org/news/2026-10-physicists-reveal-paradigm-fiber-growth.html

Lost Schrödinger manuscript reveals his true view of quantum randomness

Unlike classical physics, quantum mechanics generally cannot tell us exactly what will happen in an individual event. Instead, it predicts the probabilities of different outcomes. As one of the theory's early pioneers, Erwin Schrödinger played a key role in debates about what this randomness really means. However, part of his contribution has stayed hidden for more than 80 years.

In a new study posted on the *arXiv* preprint server, Flavio Del Santo at the University of Geneva has analyzed an unpublished manuscript by Schrödinger, shedding new light on his thinking.

In a classical event like a coin toss, the result only seems random because we can't measure every force acting on it. Since the early days of quantum mechanics, some physicists have wondered whether quantum randomness works the same way.

In these 'hidden-variable' theories, particles carry unobserved properties that secretly determine the outcome of each measurement. In 1932, however, mathematician John von Neumann published what many took as proof that such properties couldn't exist, and the idea was largely abandoned.

The question resurfaced in the following decade. In 1943, Edmund Taylor Whittaker argued that quantum mechanics had destroyed the classical idea of a predictable universe. To make his case, he imagined particles of light passing through a polarizer: a filter whose orientation determines how much light gets through.

If each particle carried a hidden instruction to pass or be blocked, Whittaker reasoned that rotating the filter after the light had already set off toward it couldn't change these instructions. In contrast, quantum mechanics predicts that the fraction passing through should change.

After Satyendra Nath Bose made a similar case in 1944, the question sparked a lively debate in the journal *Nature*. Among the responses, Heinrich Pelzer presented a model showing that Whittaker's argument didn't hold up.

https://phys.org/news/2026-10-lost-schrdinger-manuscript-reveals-true.html

Thank you!

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