# SCIENCE FLASH NEWS

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# Diamond's newfound defect may tame vibrations that hinder quantum light sources

Researchers in the Department of Electrical and Computer Engineering at the University of Illinois Urbana-Champaign have discovered a new type of quantum light emitter in diamonds that could help overcome a number of challenges facing quantum technologies.

The research was led by ECE graduate student Swetapadma Sahoo in Assistant Professor Simeon Bogdanov's research group, with contributions from undergraduate students Jaden Li and Darwon Kim. The Illinois team also collaborated with researchers from Oak Ridge National Laboratory, UCLA and international partners in France and Russia.

The findings, published in *Nature Communications*, introduce a newly identified diamond color center, named IL1 after the University of Illinois. The IL1 center emits exceptionally bright, narrowband quantum light consisting of single photons while remaining remarkably insensitive to the crystal vibrations typical in a diamond lattice.

Bogdanov said, "Diamond is not just a beautiful gemstone. It is an important technological material for electronics, optics, machining and medicine."

https://phys.org/news/2026-07-diamond-newfound-defect-vibrations-hinder.html

# New open-source software predicts energy transfer between tiny defects in solid materials

The performance of many next-generation devices depends on controlling how energy flows at extremely small scales. In the field of microelectronics—where devices continue to shrink and new materials are introduced—small imperfections in solids can strongly influence how a material stores, transfers or loses energy. Those processes can either be used to improve device performance or create problems such as energy loss, information loss, signal disruption or reduced reliability.

Researchers at the U.S. Department of Energy's (DOE) Argonne National Laboratory and the University of Chicago have developed PyRET, an open-source software tool that helps scientists understand and predict how energy is transferred between tiny defects in solid materials. These defects can behave like small, light-responsive centers. Scientists are studying them for use in optical memory devices, quantum information systems and advanced microelectronics.

PyRET, short for Python package for Resonance Energy Transfer, was created to address a basic challenge in materials science: linking the behavior of electrons near a defect with the behavior of light, which interacts with a material over much larger distances in a device. Addressing processes that happen over such different scales is challenging.

*https://phys.org/news/2026-07-source-software-energy-tiny-defects.html*

# Two attosecond flashes capture electrons in motion

Electronic motion sets the stage for virtually every light-induced process in nature, from the first step of a chemical reaction to the flow of charge in a solid. Yet these processes unfold so rapidly that they can be observed only with flashes of light lasting a few hundred attoseconds—billionths of a billionth of a second.

Most previous attosecond experiments combined an attosecond pulse in the extreme ultraviolet (XUV) with a longer, often intense near-infrared pulse. Such fields can disturb the system under investigation and obscure its intrinsic electronic response. In the new approach, both the pump and probe are attosecond extreme-ultraviolet pulses, providing a potentially much cleaner view of the underlying dynamics.

The work is published in the journal *Nature Communications*.

The researchers generated pulses lasting approximately 270 attoseconds using a laboratory-based high-harmonic source. A precision split-and-delay system produced two pulse replicas with an independently adjustable delay. The first pulse removed an electron from a xenon atom and created the ion in a coherent superposition of two closely spaced electronic states. The resulting electron vacancy, or "hole," did not remain stationary but oscillated periodically within the ion.

*https://phys.org/news/2026-07-attosecond-capture-electrons-motion.html*

# New thermodynamic framework explains pressure and edge currents in spinning active particles

Physicists from Heinrich Heine University Düsseldorf (HHU), the Technical University of Darmstadt, Sapienza University in Rome and the University of Camerino (both in Italy) have calculated the fundamental laws of thermodynamics for a gas composed of spinning particles. In the scientific journal *Proceedings of the National Academy of Sciences* (*PNAS*), they demonstrate that the pressure of this gas is similar to that of a normal gas but at an elevated temperature. In addition, localized surface currents arise that can be used for targeted particle transport.

The so-called ideal gas law is one of the fundamentals of thermodynamics and states that the pressure of a gas is proportional to its density and temperature. From a microscopic perspective, pressure is the average force per unit area exerted by incoming particles on impact and reflection. At a higher temperature, the particles move more quickly and therefore exert greater pressure on impact.

A research team led by Dr. Hartmut Löwen from the Institute for Theoretical Physics II at HHU asked whether the ideal gas law also applies to self-propelled, so-called "active" particles or whether the nonequilibrium state results in significant differences. In addition to the physicists in Düsseldorf, colleagues from Rome, Camerino and Darmstadt were also involved.

Löwen commented on the findings published in *PNAS*: "The answer to this question is both yes and no: Although the ideal gas law no longer applies, we can make the interpretation that an effectively higher temperature exists in the nonequilibrium state."

https://phys.org/news/2026-07-thermodynamic-framework-pressure-edge-currents.html

# Physicists turn to the universe's 'piano notes' to detect hidden particles

It's been said that a finely tuned ear knows the size and shape of a piano by merely listening to the instrument's notes. An international team of physicists has now devised an analogous approach to detect the universe's hidden particles at high energies—opening a potential pathway for discovering new laws of physics.

The work, which will appear in the journal *Physical Review Letters*, outlines how effective field theory (EFT) coefficients, which quantify how new laws of physics would influence known particle interactions at low energies, can be transformed into information about the nature of these hidden particles. CERN's Large Hadron Collider, the scientists note, already searches for values of EFT coefficients through its measurement of particle collisions, thereby providing ready-to-use data for this approach.

"Like deducing the shape and mechanism of a piano from the sound of its notes, this breakthrough provides the means to use collider measurements to deduce the details of hidden particles at high energies," explains Grant Remmen, the James Arthur Postdoctoral Fellow at New York University and one of the paper's authors. "This solves a classic open problem in particle physics in an elegant and useful way, providing powerful and sharp mathematical tools that bridge high-energy theory and particle physics experiments."

https://phys.org/news/2026-07-physicists-universe-piano-hidden-particles.html

# Shaking atoms to bring black-hole quantum chaos into the lab

Physicists have discovered a surprisingly simple way to reproduce one of the most fascinating models in modern physics—linked to black holes, quantum chaos and exotic electronic materials—using ultracold atoms trapped in light.

Instead of trying to build a highly complex system from scratch, the researchers show that gently "shaking" a standard optical lattice can transform it into an accurate simulator of the Sachdev–Ye–Kitaev (SYK) model, a theoretical model known for its extreme and unusual quantum behavior.

The findings are published in the journal *Physical Review Letters*.

In their approach, the team—Charles Creffield (Univ. Complutense, Madrid) and Nathan Goldman (Solvay Institutes, ULB and Collège de France, CNRS), together with Fernando Sols (Univ. Complutense, Madrid) and Marco Schiró (Collège de France, CNRS)—periodically modulates how atoms move between sites in the lattice. This carefully designed driving suppresses ordinary single-particle motion and instead creates effective interactions involving many particles at once, mimicking the SYK model's defining feature: dense, random-like connections between all particles.

Although the resulting system is not perfectly random, detailed numerical calculations show that it reproduces the key hallmarks of SYK physics, including strong quantum chaos and the rapid "scrambling" of information—behavior often associated with black holes.

https://phys.org/news/2026-07-atoms-black-hole-quantum-chaos.html

# How physics and mathematical modeling help us make better clothes

A new paper in the journal *Nature Physics* offers insights into the physics of liquid droplets—and while many people may not appreciate the mathematical accomplishment, they will benefit from the athletic wear and raincoats it makes possible. The recent article, "Tricky Tension," explores the intersection of physics and textiles and how wetting is influenced by the structure of tiny individual liquid droplets.

In physics, the cohesive force between two phases is called surface tension. This allows small insects to walk on water.

In a three-phase system—where gas, liquid and solid objects all interact—there is a less-understood phenomenon called the line tension of a liquid droplet. This refers to the force acting at the boundary where the liquid droplet, the air and the solid surface on which the droplet sits all meet. Learning more about the mechanics of droplets on solid surfaces, known as sessile droplets, is important for understanding the wetting and drying of textiles, especially for very small droplets.

"To understand what is happening with textiles, we need to have a better understanding of the physics involved when all three phases interact," says Warren Jasper, author of the *Nature Physics* paper and a professor in NC State's Wilson College of Textiles.

***https://phys.org/news/2026-07-physics-mathematical.html***

# Thank you!

**Edited by**

**Adrian-Sorin Gruia, Ph.D**