SCIENCE FLASH NEWS

No. 9/2026
September

Mapping one atom's interaction with light uncovers an unbounded network of quantum states

A new graph-theoretic framework provides a unified description of atom-light interactions across regimes ranging from weak to deep-strong coupling.

A research team comprising professors Sunkyu Yu and Namkyoo Park of the Department of Electrical and Computer Engineering at Seoul National University College of Engineering and professor Xianji Piao of the University of Seoul has discovered that even the interaction between a single atom and light—one of the simplest settings in quantum physics—contains an enormous, intricately connected network.

The study was published Sept. 25 in the journal *Science Advances*.

By developing a mathematical framework that represents this hidden structure as a subway map, the researchers established a unified way to understand atom-light interactions across coupling regimes that previously required different theoretical approximations. The findings could open new possibilities for quantum computing and photonic neural networks.

The National Research Foundation of Korea (NRF), chaired by Won-Hwa Hong, announced that a research team led by Park and Yu of Seoul National University and Piao of the University of Seoul has developed a "magnetic graph" theory that quantifies atom-light interactions using a single measure.

https://phys.org/news/2026-09-atom-interaction-uncovers-unbounded-network.html

Rare quantum state reveals particles with quarter-electron charge

An electron's charge is normally fixed, like a coin you can't break into pieces. But if electrons are cooled close to absolute zero and trapped in a two-dimensional layer under a powerful magnetic field, they organize into a collective state of "quasiparticles" that seem to hold only a fraction of an electron's charge.

This state is known as the "fractional quantum Hall effect." A small number of these states, known as "even-denominator states," have drawn attention because some theories predict they could contain unusual quasiparticles called "non-Abelian anyons."

Why are these interesting? Because their quantum properties make them candidates for storing and processing information in fault-tolerant (error-resistant) topological quantum computers.

Now, scientists from the groups of Mitali Banerjee at EPFL, Moty Heiblum at the Weizmann Institute of Science and Mansour Shayegan at Princeton University have studied one such state, known as the ν = 1/2 fractional quantum Hall state. It forms in a wide layer of gallium arsenide, a material used in optoelectronics, wireless communication and even solar panels.

Their work is published in *Physical Review Letters*.

"For the first time in the history of this field, two different groups (Weizmann and EPFL) have measured the same values of fractional charge," says Banerjee.

https://phys.org/news/2026-09-rare-quantum-state-reveals-particles.html

Higher-dimensional black holes hide an exact symmetry in their ringing, and string-inspired gravity breaks it

Strike a bell, and it rings with a pitch and a fading that tell you about the bell: its size, its shape, the metal it is made of. Black holes ring too. When two merge, the newborn black hole shivers and sheds gravitational waves in a brief, dying chord, and since 2015, gravitational-wave detectors have been listening. The notes of that chord, which physicists call quasinormal modes, depend only on the black hole's mass and spin and on the law of gravity itself. Change the law, and the chord changes.

My colleague Davide Batić and I, both mathematicians at Khalifa University in Abu Dhabi, wanted to know how the chord changes when space has more dimensions than the three we see, and when Einstein's equations receive a correction suggested by string theory. We report the answer in a paper published in *Physical Review D*. Along the way, we met something we had not been looking for: two quite different kinds of waves that ring at exactly the same notes.

https://phys.org/news/2026-09-higher-dimensional-black-holes-exact.html

New catalogs map the quantum possibilities of atomically thin materials

Twistronics has become a new alchemy of materials. By choosing atomically thin layers, stacking them and changing their relative angle, researchers can create electronic behavior absent from the original ingredients. Twisted graphene and transition metal dichalcogenides have already yielded superconductivity and fractional Chern insulators, states with fractionally charged excitations. One of physics' most active frontiers now has a moonshot ambition: to design entirely new forms of quantum matter.

New families of twisted materials have repeatedly brought new rules for how electrons move and interact—a different Hamiltonian—and new kinds of quantum simulators. The team's recent *Nature* study of M-point twisting illustrates how changing the starting electronic structure opens different physics. Exploring other atomic architectures could therefore uncover quantum states and models that today's familiar platforms cannot reach.

Now, in two back-to-back papers to be published Sept. 24 in *Science*, an international collaboration provides both the building blocks and a guide to that vast search. The first maps the electronic structures and topology of nearly 9,000 two-dimensional entries, whether topological or not. The second identifies more than 1,600 candidates for twisting, with different electronic starting points that could enable entirely new kinds of quantum simulators.

https://phys.org/news/2026-09-quantum-possibilities-atomically-thin-materials.html

Could negative mass exist and be observed?

Unlike electric charge, as far as we know all mass is positive, and positive masses attract one another. Could negative mass exist, and if so, what would be the ramifications?

Antigravity between a positive mass and a hypothetical negative mass has received a fair bit of attention in both physics and science fiction over the years. For example, in 1901's "First Men in the Moon" author H. G. Wells imagines a substance he calls "cavorite" which creates a negative force of gravity and thus acts as a gravity shield. In Newton's theory of gravity, negative mass would effectively appear as his same equation but with the gravitational constant G replaced by -G. But Einstein's version of gravity, general relativity, is not so kind, and does not seem to consistently allow anti-gravity.

In a new paper in *Physics of the Dark Universe*, Shin'ichi Nojiri from Japan and S.D. Odintsovc from Spain dig deeper into the possibility of negative mass objects (NMOs) and conclude that the idea may not be as exotic as is thought. Using theoretical tools, they show that negative mass "does not always lead to any inconsistency."

https://phys.org/news/2026-09-negative-mass.html

Thank you!

Edited by

Adrian-Sorin Gruia, Ph.D