SCIENCE FLASH NEWS

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Understanding the interior of atomic nuclei

There is a lot going on inside atomic nuclei. Protons and neutrons are whizzing around and interacting with each other. The movement of the nuclear particles and their intrinsic angular momentum induce magnetic moments. Together, this can make atomic nuclei tiny magnets.

"Using laser spectroscopic methods the magnetic moment of even exotic, short-lived nuclei can be determined very precisely," explains physics professor Achim Schwenk from TU Darmstadt. As a theoretical physicist, he is interested in a first principles description of nuclei. However, the calculations of magnetic moments have not yet been satisfactory. The experimentally measured and calculated values differ for many nuclei.

Schwenk's team has now achieved a breakthrough. The calculated values of the magnetic moment are in better agreement with the measured values than ever before, as the researchers show in a paper published in the current issue of *Physical Review Letters*.

https://phys.org/news/2024-06-interior-atomic-nuclei.html

New paradigm in photothermal therapy: Researchers develop ultrasound-assisted photothermal therapy technology

Professor Jin-ho Chang's research team from the Department of Electrical Engineering and Computer Science at DGIST has developed "Ultrasound-assisted photothermal therapy (ULTRA-PTT)" technology that significantly enhances the performance of conventional photothermal therapy. The findings of the study were published in *Advanced Optical Materials*.

This technology was developed in collaboration with Senior Researcher Hye-min Kim from the Advanced Photonics Research Institute at GIST using the team's proprietary "ultrasound-induced optical clearing" technology.

Phototherapy, using light, is widely used in clinical settings for skin tightening, laser tattoo removal, and laser cancer therapy, since it can selectively improve or destroy targeted lesions. However, as light travels through biological tissues, optical scattering occurs, causing distortion of the light path and limiting the depth of light penetration.

https://phys.org/news/2024-06-paradigm-photothermal-therapy-ultrasound-technology.html

Physicists find a new way to represent π

While investigating how string theory can be used to explain certain physical phenomena, scientists at the Indian Institute of Science (IISc) have stumbled upon on a new series representation for the irrational number π. It provides an easier way to extract π from calculations involved in deciphering processes like the quantum scattering of high-energy particles.

The new formula under a certain limit closely reaches the representation of π suggested by Indian mathematician Sangamagrama Madhava in the 15th century, which was the first ever series for π recorded in history.

The study was carried out by Arnab Saha, a post-doc and Aninda Sinha, Professor at Center for High Energy Physics (CHEP), and has been published in *Physical Review Letters*.

https://phys.org/news/2024-06-physicists.html

Scientists Create The Thinnest Lens on Earth Using Quantum Physics

A quantum phenomenon has allowed scientists to develop a lens just three atoms thick, qualifying as the thinnest ever made.

Oddly, the innovative approach allows most wavelengths of light to pass right through – a feature that could see it have huge potential in optical fiber communication and gadgets like augmented reality glasses.

The researchers who invented the lens, from the University of Amsterdam in the Netherlands and Stanford University in the US, say that their innovation will progress research into lenses of this type, as well as miniature electronic systems.

"The lens can be used in applications where the view through the lens should not be disturbed, but a small part of the light can be tapped to collect information," says Jorik van de Groep, a nanoscientist at the University of Amsterdam.

The research has been published in *Nano Letters*.

https://www.sciencealert.com/scientists-create-the-thinnest-lens-on-earth-using-quantum-physics

New method enhances X-ray microscopy for detecting tiny defects

X-ray microscopes are essential for examining components and materials because they can be used to detect changes and details in the material. Until now, however, it has been difficult to detect small cracks or tiny inclusions in the images.

A new method, developed by researchers at the Helmholtz-Zentrum Hereon, allows them to visualize such changes in the nanometer regime. In particular, materials research and quality assurance will profit from this development.

Hereon researchers Sami Wirtensohn and Dr. Silja Flenner from Dr. Imke Greving's group have now succeeded in making such small structures visible in the nanometer range, using a new method. Unlike a conventional X-ray image, they do not use the attenuated light itself, but rather the light scattered by the object being X-rayed, which is deflected in different directions.

"Nanometer-sized structures such as tiny cracks scatter the light—and this scattering can be seen," explains Wirtensohn, first author of the study published in *Optica*. This makes details and structures visible that are normally difficult or impossible to see.

https://phys.org/news/2024-06-method-ray-microscopy-tiny-defects.html

A strikingly natural coincidence: Researchers find heating gallium nitride and magnesium forms a superlattice

GaN is an important wide bandgap semiconductor material that is poised to replace traditional silicon semiconductors in applications demanding higher power density and faster operating frequencies. These distinctive characteristics of GaN make it valuable in devices such as LEDs, laser diodes, and power electronics—including critical components in electric vehicles and fast chargers. The improved performance of GaN-based devices contributes to the realization of an energy-saving society and a carbon-neutral future.

A study led by Nagoya University in Japan revealed that a simple thermal reaction of gallium nitride (GaN) with metallic magnesium (Mg) results in the formation of a distinctive superlattice structure. This represents the first time researchers have identified the insertion of 2D metal layers into a bulk semiconductor.

By carefully observing the materials through various cutting-edge characterization techniques, the researchers uncovered new insights into the process of semiconductor doping and elastic strain engineering. They published their findings in the journal *Nature*.

https://phys.org/news/2024-06-natural-coincidence-gallium-nitride-magnesium.html

Calcium oxide's quantum secret: Nearly noiseless qubits

Calcium oxide is a cheap, chalky chemical compound commonly used in the manufacturing of cement, plaster, paper, and steel. But the material may soon have a more high-tech application.

UChicago Pritzker School of Molecular Engineering researchers and their collaborator in Sweden have used theoretical and computational approaches to discover how tiny, lone atoms of bismuth embedded within solid calcium oxide can act as qubits—the building blocks of quantum computers and quantum communication devices. These qubits are described today in *Nature Communications*.

"This system has even better properties than we expected," said Giulia Galli, Liew Family Professor at Pritzker Molecular Engineering and Chemistry and senior author of the new work. "It has an incredibly low level of noise, can hold information for a long time, and is not made with a fancy, expensive material."

https://phys.org/news/2024-06-calcium-oxide-quantum-secret-noiseless.html

Thank you!

Edited by

Adrian-Sorin Gruia, Ph.D