



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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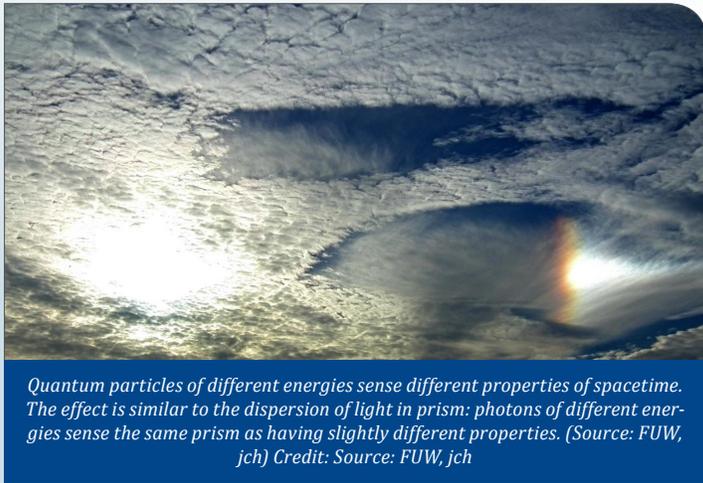
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FEATURE ARTICLES

[Physicists posit quantum gravity's rainbow](#)

[PhysOrg.com, 15JAN2016](#)



Quantum particles of different energies sense different properties of spacetime. The effect is similar to the dispersion of light in prism: photons of different energies sense the same prism as having slightly different properties. (Source: FUW, jch) Credit: Source: FUW, jch

For years now, it has been suspected that particles of different energies in models of the quantum universe essentially sense spacetime with slightly different structures. Earlier hypotheses were not derived from quantum theory but based on guesses. A team of researchers in Poland has formulated a generic mechanism, whereby the fabric of spacetime felt by a given particle must vary depending not only on its type, but even on its energy. Their model contains just two components: gravity and one type of matter.

TECHNICAL ARTICLE

Tags: Quantum science, Science without borders, Featured article

[New way to absorb electromagnetic radiation demonstrated](#)

[Science Daily, 14JAN2016](#)

It is believed that destructive interference is needed to fully absorb electromagnetic radiation, which therefore requires the use of anti-reflective coatings, substrates and other structures. An international team

of researchers (Russia, USA - Kansas State University, Naval Research Laboratory) used an anisotropic crystal—hexagonal boron nitride—as their specific absorbing system. They demonstrated that interference is not a compulsory requirement and perfect absorption can be achieved using simpler systems. This approach is currently only able to achieve perfect absorption for a fixed wavelength and angle of incidence, both of which are determined by the electronic properties of the material. The use of alternative strongly anisotropic materials such as biaxial absorbing media will likely help to bypass these limitations in the future, making this approach more flexible. **TECHNICAL ARTICLE**

Tags: Advanced materials, Sensors, Featured article

S&T NEWS ARTICLES

ADVANCED MATERIALS

[Bismuth-based nanoribbons show 'topological' transport, potential for new technologies](#)

[PhysOrg.com, 19JAN2016](#)

A team researchers in the US (Purdue University, UT Austin) showed that a magnetic field can be used to induce nanoribbons made of bismuth telluride to undergo a “topological transition,” switching between a material possessing a band gap on the surface and one that does not. They demonstrated a new variation on oscillation in topological insulator surfaces by inducing the spin helical mode of the electrons. The result is the ability to flip from constructive to destructive interference and back. By combining topological insulators with a superconductor, researchers may be able to build a practical quantum computer that is less susceptible to the environmental impurities and perturbations.

TECHNICAL ARTICLE

Tags: Advanced materials, Quantum science

continued...

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Physicists develop a cooling system for the processors of the future

PhysOrg.com, 19JAN2016

Researchers in Russia have demonstrated that high-performance optoelectronic chips can be cooled with thermal grease—high-performance thermal interfaces consisting of layers of thermally conductive materials placed between the chip and the cooling system. They demonstrated that multi-layered thermal interfaces of nano- and micrometer thickness, combined with simple cooling systems, can reduce the temperature of the chip from several hundred degrees to approximately ten degrees with respect to the ambient temperature.

TECHNICAL ARTICLE

Tags: Advanced materials, S&T Russia

Metamaterial-enabled antennas help improve satellite communications systems

PhysOrg.com, 15JAN2016

By employing functionalized metamaterial concepts, researchers at Pennsylvania State University have been able to devise a way to dynamically tune the frequency response and polarization for the antenna, while at the same time, providing a pathway to scaling the designs to low frequencies.

TECHNICAL ARTICLE

Tags: Advanced materials, Sensors

New type of animated crystal structure discovered

PhysOrg.com, 15JAN2016

An international team of researchers (Canada, USA - MIT, Princeton University) has discovered what they are calling a new type of crystal, one that is always moving. They acknowledge that it might be possible that they are in atomic nuclei or in electrons in solids—finding them would be a challenge. They also suggest that their new crystal structure could lead to some new math as was the case when static crystal structure math led to applications in number theory and even error correction in computer applications.

TECHNICAL ARTICLE

Tags: Advanced materials, Science without borders

Engineers invent a bubble-pen to write with nanoparticles (w/video)

Nanowerk, 14JAN2016

A team of researchers in the US (UT Austin, Pennsylvania State University) has developed a device and technique, called bubble-pen lithography that can efficiently handle nanoparticles and lock them into position without damaging them in nanomanufacturing. The new method relies on microbubbles to inscribe nanoparticles onto a surface. The technique will allow researchers to more easily build tiny machines, biomedical sensors, optical computers, solar panels and other devices.

TECHNICAL ARTICLE

Tags: Advanced materials

First all-antiferromagnetic memory device could get digital data storage in a spin

Science Daily, 14JAN2016

An international team of researchers (UK, Czech Republic, Germany, Poland) demonstrated the first electrical current control of antiferromagnets. It utilises an entirely new physical phenomenon, and in doing so demonstrates the first all-antiferromagnetic memory device. This could be hugely significant as antiferromagnets have an intriguing set of properties, including a theoretical switching speed limit approximately 1000 times faster than the best current memory technologies.

TECHNICAL ARTICLE

Tags: Advanced materials, Information technology

Nano-hybrid materials create magnetic effect

Science Daily, 13JAN2016

An international team of researchers (Canada, USA - Rice University) designed computer models that simulate how the intrinsic energies of atoms influence each other as they bond into molecules. For the new work, the researchers modeled hybrid structures of graphene and carbon nanotubes and of graphene and boron nitride nanotubes, laying the foundations for a range of tunable hybrid architectures, especially for boron nitride, which is as promising as graphene but much less explored.

TECHNICAL ARTICLE

Tags: Advanced materials

AUTONOMOUS SYSTEMS & ROBOTICS

Microbots individually controlled using magnetic fields

KurzweilAI, 15JAN2016

Researchers at Purdue University have developed a method to use magnetic fields to independently control individual microrobots operating within groups. The solution is an array of tiny coils that generate attractive or repulsive magnetic forces to move the microbots, which are magnetic disks that slide across the surface. Applications could include microelectromechanical systems for additive manufacturing, cell sorting, cell manipulation, and cancer cell detection in biopsy.

TECHNICAL ARTICLE

Tags: Autonomous systems & robotics

EmTech Digital Preview: How AI Impacts Us Now and In the Future

MIT Technology Review, 13JAN2016

This May, the fourth annual EmTech Digital program organized by MIT Technology Review will explore the growing implications of artificial intelligence on our connected environments at home, at work, and on the go. Program highlights will include talks from the organizations that are defining this new digital era, including Google, Twitter, Baidu, Tesla, Carnegie Mellon University, the Allen Institute for AI, and many more. Date: May 23-24, 2016; Place: San Francisco. Conference website

Tags: Autonomous systems & robotics, Artificial intelligence

continued...

“The good thing about science is that it’s true whether or not you believe in it.”

NEIL DEGRASSE TYSON

COMMUNICATIONS TECHNOLOGY

Internet of Drones

arXiv, 06JAN2016

The Internet of Drones (IoD) is a layered network control architecture designed mainly for coordinating the access of unmanned aerial vehicles to controlled airspace, and providing navigation services between locations referred to as nodes. Researchers in Canada present a conceptual model of how such an architecture can be organized: extract key concepts from the air traffic control network, the cellular network, and the Internet and explore their connections to an architecture for drone traffic management. [TECHNICAL ARTICLE](#)

Tags: *Communications Technology, S&T Canada*

ENERGY

Cheaper solar cells with 20.2 percent efficiency

PhysOrg.com, 18JAN2016

An international team of researchers (Switzerland, Italy, Japan, Qatar) developed a molecularly engineered hole-transporting material, called FDT that can bring costs down while keeping efficiency up to competitive levels. Tests showed that the efficiency of FDT went up to 20.2% higher than the other two, more expensive alternatives. And because FDT can be easily modified, it acts as a blueprint for an entire generation of new low-cost hole-transporting materials. [TECHNICAL ARTICLE](#)

Tags: *Energy, Materials science, Solar energy*

Nanospikes for safer batteries (w/video)

Nanowerk, 13JAN2016

Researchers at Stanford University have designed the first battery that can be shut down and revived over repeated heating and cooling cycles without compromising performance. They coated the spiky nickel particles with graphene, an atom-thick layer of carbon, and embedded the particles in a thin film of elastic polyethylene which is connected to one of the battery electrodes. To conduct electricity, the spiky particles have to physically touch one another. But during thermal expansion, polyethylene stretches. That causes the particles to spread apart and stop the flow of electricity. [TECHNICAL ARTICLE](#)

Tags: *Energy, Battery*

Stable ‘superoxide’ opens the door to a new class of batteries

Nanowerk, 13JAN2016

All previous work on lithium-air batteries showed the same phenomenon: the formation of lithium peroxide (Li_2O_2), a solid precipitate that clogged the pores of the electrode. An

international team of researchers (USA - Argonne National Laboratory, University of Utah, University of Illinois at Chicago, University of Louisville, South Korea) were able to produce stable crystallized lithium superoxide (LiO_2) instead of lithium peroxide during battery discharging. Unlike lithium peroxide, lithium superoxide can easily dissociate into lithium and oxygen, leading to high efficiency and good cycle life. This discovery really opens a pathway for the potential development of a new kind of battery. [TECHNICAL ARTICLE](#)

Tags: *Energy, Battery, Materials science*

INFORMATION TECHNOLOGY

Magnetizing the Third Dimension

American Physical Society Synopsis, 12JAN2016

To meet ever-increasing data storage needs, future devices will need to move into the third dimension. Researchers in Japan have demonstrated a new 3D magnetic structure where the magnetization of each layer can be independently switched from one state to another in a single step. [TECHNICAL ARTICLE](#)

Tags: *Information Technology, S&T Japan*

MATERIALS SCIENCE

Defrosting a magnetic mystery

Nanowerk, 15JAN2016

By tweaking the composition and structure of incredibly thin layers of magnetic materials, researchers in Japan have created devices that make it easier to study the quantum anomalous Hall effect (QAHE). First observed in 2013, the QAHE causes electrons to flow in unusual ways. The new devices could reveal exotic physics that might be harnessed for low-power electronics. [TECHNICAL ARTICLE 1, 2](#)

Tags: *Materials science, S&T Japan*

Ferroelectricity - Ambiguity clarified, and resolved

Nanowerk, 15JAN2016

After conducting a detailed assessment of ferroelectricity, an international team of researchers (USA - Oak Ridge National Laboratory, University of Wisconsin, China, Japan) developed new experimental protocols that distinguish ferroelectricity from competing interactions. The new approach allows reliable study of new ferroelectric materials or ferroelectricity induced by external forces. It also provides the foundation for using a scanning probe to evaluate other properties of interest in electronic applications ranging from sensors to information technologies. [TECHNICAL ARTICLE](#)

Tags: *Materials science*

continued...

Nanodevice, build thyself

EurekAlert, 14JAN2016

In successful self-assembly the attractive and repulsive forces within molecules, between each molecule and its neighbors, and between molecules and the surface that supports them have to be taken into account. To better understand the self-assembly process, researchers in Germany studied interactions between a molecule called porphine and copper and silver surfaces. They found that the weak long-range van der Waals interactions yielded the largest contribution to the molecule-surface interaction. While interactions directly between molecules are negligible, they found indications for surface-mediated molecule-molecule interactions at higher molecular coverages. [TECHNICAL ARTICLE](#)

Tags: Materials science, S&T Germany

MICROELECTRONICS**High-speed transistor channel developed using a core-shell nanowire structure**

Nanowerk, 13JAN2016

An international team of researchers (Japan, USA - Georgia Institute of Technology) developed a double-layered (core-shell) nanowire, consisting of a germanium core and a silicon shell. By developing nanowires consisting of a Ge core and a Si shell, they succeeded in creating high mobility channels capable of separating impurity-doped regions from carrier transport regions, thereby suppressing impurity scattering. This is a major step toward the realization of a next-generation high-speed transistor. [TECHNICAL ARTICLE](#)

Tags: Microelectronics

FEATURED RESOURCE**Data.gov**

Data.gov is the home of the US government's open data. You can find Federal, state and local data, tools, and resources to conduct research, build apps, design data visualizations, and more.

PHOTONICS**A sense for infrared light**

Science Daily, 19JAN2016

Researchers in Germany have developed a measuring system that is able to determine laser pulses with a wide bandwidth in the infrared spectrum of light precisely. The new system can be used for the precise generation of attosecond-duration light bursts for the exploration of atomic systems, controlled dynamics of electrons in crystals and data transmission with light. [TECHNICAL ARTICLE](#)

Tags: Photonics, S&T Germany

Researchers investigate how light behaves in curved space

Science Daily, 15JAN2016

Instead of changing all four dimensions of spacetime, researchers in Germany reduced the problem to two dimensions and studied the propagation of light along curved surfaces. They examined the effects of intrinsic curvature of space on the propagation of light in their experiment. As the light propagated, it behaved in the same way that it does when deflected by huge masses. By changing the curvature of the surface it is possible to control the propagation of light. Conversely, it is also possible to learn about the curvature of a surface itself by analysing the propagation of light. The main goal of our research is to transfer findings based on the general theory of relativity to materials science by carefully modelling the surfaces of objects. [TECHNICAL ARTICLE](#)

Tags: Photonics, S&T Germany

Tunable materials clear the way for advanced optics

PhysOrg.com, 15JAN2016

An international team of researchers (Germany, USA - Harvard University, UC San Diego, Stony Brook University, Purdue University, University of Wisconsin) changed vanadium dioxide's intrinsic shift point from 155 degrees Fahrenheit to below 70 degrees. They successfully tuned the transition for that material across a variety of specific temperatures without introducing impurities to change the transition temperatures. This finding is going to open up new frontiers in photonic devices. [TECHNICAL ARTICLE](#)

Tags: Photonics, Advanced materials

Plasmons call the tune in new graphene-based terahertz laser

Physics World, 14JAN2016

Using the unique electronic properties of graphene, researchers in the UK have designed a semiconductor laser that operates in the terahertz band and can be easily tuned to output radiation at specific wavelengths. The team says that its research could lead to the development of compact devices for a variety of different applications, from security scanning to medical imaging. [TECHNICAL ARTICLE](#)

Tags: Photonics, S&T UK

Counting Photons...How Low Can You Go?

DARPA News, 13JAN2016

DARPA's Fundamental Limits of Photon Detection—or Detect—program aims to establish the first-principles limits of photon detector performance by developing new fully quantum models of photon detection in a variety of technology platforms, and by testing those models in proof-of-concept experiments. This is a fundamental research effort, but answers to these questions could radically change light detection as we know it and vastly improve the many

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tools and avenues of discovery that today rely on light detection. [BAA](#)

Tags: Photonics, DARPA

[Where now for plasmonics?](#)

[Nature Nanotechnology](#), 07JAN2016

This issue of Nature Nanotechnology looks at some of the strategies and, in particular, the alternative ways researchers are exploring to achieve control of the light-matter interaction at the nanoscale. The fundamental issue of optical losses has forced the community to come up with creative solutions, which have emerged by investigating unconventional approaches or looking out for materials, systems and interactions that may complement the strengths of plasmonics.

Tags: Photonics

QUANTUM SCIENCE

[Quantum knots are real!](#)

[Nanowerk](#), 18JAN2016

An international team of researchers (USA - Amherst College, Finland) created knotted solitary waves, or knot solitons, in the quantum-mechanical field of Bose-Einstein condensate. In contrast to knotted ropes, the created quantum knots exist in a field that assumes a certain direction at every point of space. The field segregates into an infinite number of linked rings, each with its own field direction. The resulting structure is topologically stable as it cannot be separated without breaking the rings. In other words, one cannot untie the knot within the superfluid unless one destroys the state of the quantum matter. [TECHNICAL ARTICLE](#)

Tags: Quantum science

[Physicists propose the first scheme to teleport the memory of an organism](#)

[PhysOrg.com](#), 14JAN2016

An international team of researchers (USA - Purdue University, China) proposed the first scheme to use electromechanical oscillators and superconducting circuits to teleport the internal quantum state (memory) and center-of-mass motion state of a microorganism. They also proposed a scheme to create a Schrödinger's cat state in which a microorganism can be in two places at the same time. [TECHNICAL ARTICLE](#)

Tags: Quantum science

[China's quantum space pioneer: We need to explore the unknown](#)

[Nature News](#), 12JAN2016

The world's first attempt to set up a quantum communications link between Earth and space is set to begin with the launch of a satellite in June. The satellite will

test whether the quantum property of entanglement extends over record-breaking distances of more than 1,000 kilometres, by beaming individual entangled photons between space and various ground stations on Earth. It will also test whether it is possible, using entangled photons, to teleport information securely between Earth and space.

Tags: Quantum science, S&T China, Space technology

S&T POLICY

[U.S. science and technology leadership increasingly challenged by advances in Asia](#)

[NSF News](#), 16JAN2016

According to the latest federal data, the U.S. science and engineering (S&E) enterprise still leads the world. The United States invests the most in research and development (R&D), produces the most advanced degrees in science and engineering and high-impact scientific publications, and remains the largest provider of information, financial, and business services. However, Southeast, South, and East Asia continue to rapidly ascend in many aspects of S&E. The region now accounts for 40 percent of global R&D, with China as the stand-out as it continues to strengthen its global S&E capacity.

Tags: S&T policy

[New lab to give nation's researchers remote access to robots](#)

[Science Daily](#), 14JAN2016

Under a grant from the NSF, Georgia Institute of Technology is building a new lab, called Robotarium that will allow roboticists from around the country to conduct experiments remotely. Researchers from other universities, as well as middle and high school students, will schedule experiments, upload their own programming code, watch the robots in real-time via streamed video feeds and receive scientific data demonstrating the results. The facility is expected to be operational by 2017.

Tags: S&T policy, Autonomous systems & robotics

[Drone swarms will change the face of modern warfare](#)

[wired \(UK\)](#), 07JAN2016

In the past, small numbers of extremely expensive manned aircraft were the norm, but, in the next few years, large numbers of cheap, expendable drones will be deployed in real-world situations. The US Navy's Low-Cost UAV Swarming Technology (LOCUST) programme is fusing unmanned aircraft into a swarm, and in the summer of 2016 will demonstrate 30 drones flying together somewhere over the ocean.

Tags: S&T policy, Military technology

SCIENCE WITHOUT BORDERS

Not so science fiction after all, the internet could out-evolve humanity[PhysOrg.com](#), 15JAN2016

Living things accumulate and reproduce information. That's really the driving principle behind life, and behind evolution. Digital information can copy itself perfectly, increases in copy number with every download or view, can be modified (mutated), or combined to generate novel information packets. And it can be expressed through artificial intelligence. These are characteristics similar to living things. So we should probably start thinking about digital technology as being like an organism that can evolve. [TECHNICAL ARTICLE](#)

Tags: Science without borders

The 2 most dangerous numbers in the Universe could signal the end of physics[Science Alert](#), 15JAN2016

According to a particle physicist at CERN, the two most dangerous numbers in the Universe, the strength of the Higgs field and the strength of dark energy are responsible for all the matter, structure, and life that we witness across the cosmos. And if these two numbers were even slightly different, says Cliff, the Universe would be an empty, lifeless place. A deeply disturbing and controversial line of thinking is the idea that we are reaching the absolute limit of what we can understand about the world around us through science. [TED talk](#)

Tags: Science without borders ■

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