



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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FEATURE ARTICLES

[Magnetic invisibility cloak shields magnets from magnetic fields](#)

[PhysOrg.com, 03DEC2015](#)

An international team of researchers (China, Sweden) used a bilayer cloak that has a spherical structure consisting of two shells: a superconducting inner shell (made of single-crystal YBCO) and a ferromagnetic outer shell (made of a nickel zinc composite). As these two materials have opposite magnetic behaviors they have opposite effects on an external magnetic field: the inner YBCO shell expels the magnetic field, while the outer nickel zinc shell concentrates it. By carefully machining, etching, fine-tuning, and combining these materials, the researchers were able to completely cancel out the opposing effects, inducing the magnetic transparency effect. The cloaks could have applications in magnetically sensitive equipment, and anti-probe technology. [TECHNICAL ARTICLE](#)

Tags: Materials science, Sensors, Featured Article

[Storing electricity in paper](#)

[Science Daily, 03DEC2015](#)



*This piece of power paper can store 1F.
Credit: Photo Thor Balkhed*

Nanocellulose is the structural foundation of the material developed by an international team of researchers (Sweden, Denmark, USA - University of Kentucky). Cellulose fibres and electrically charged polymer are mixed in water to coat the fibers. The liquid in the mix functions as an electrolyte. One sheet, 15 centimetres in diameter and a few tenths of a millimetre thick, can store as much as 1 F, which is similar to the supercapacitors currently on the market. The material can be recharged hundreds of times and each charge only takes a few seconds. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

[Nanoscale 'drawbridges' open path to color displays](#)

[Science Daily, 04DEC2015](#)

An international team of researchers (USA - Rice University, Australia) have developed a drawbridge method for color switching which incorporates metal nanoparticles that absorb light energy and convert it into plasmons. The characteristic frequency of light absorbed or scattered by each plasmon can be shifted by minor changes. The research provides a valuable tool for precisely controlling the gaps between dimers and other multiparticle plasmonic configurations which is important for the development of active plasmonic devices. [TECHNICAL ARTICLE](#)

Tags: Advanced materials

[Measuring nanoscale features with fractions of light](#)

[Nanowerk, 03DEC2015](#)

Using a novel microscope that combines standard through-the-lens viewing with a technique called scatterfield imaging, researchers at NIST accurately measured patterned features on a silicon wafer that were 30 times smaller than the wavelength of light used to examine them. With the technique, they spotted variations in feature dimensions amounting to differences of a few atoms. The innovative optical approach could be a realistic solution to a very challenging problem facing chip makers and others aiming to harness advances in nanotechnology—nondestructive measurement of nanometer-scale structures with sub-nanometer sensitivity while still having high throughput. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Government S&T

[Nano-thin plates that can be picked up by hand](#)

[Nanowerk, 03DEC2015](#)

The plates made by researchers at the University of Pennsylvania are between 25 and 100 nanometers

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thick and are made of aluminum oxide, which is deposited one atomic layer at a time to achieve precise control of thickness and their distinctive honeycomb shape. The plates bend, twist, deform and recover their shape in such a way that you would think they are made out of plastic. Being able to stay in shape without additional support would allow this material, and others designed on its principles, to be used in aviation and other structural applications where low weight is at a premium.

TECHNICAL ARTICLE

Tags: Advanced materials

New research exploits extraordinary properties of graphene

Science Daily, 30NOV2015

An international team of researchers (Switzerland, UK, Germany) combined nano-ribbons of graphene, in which electrons are able to oscillate backwards and forwards, together with a type of antenna called a split ring resonator. They used long wavelengths to show that the new structure can be used as a type of optical switch to interrupt, and turn on and off, a beam of this light very quickly. The new metamaterial can be used as a test bed to explore the underlying science. It could have applications in ultra-high resolution spectroscopy. TECHNICAL

ARTICLE

Tags: Advanced materials

AUTONOMOUS SYSTEMS & ROBOTICS

NASA Small Satellites to Demonstrate Swarm Communications and Autonomy

NASA News, 07DEC2015

The Nodes mission, which consists of two CubeSats weighing just 4.5 pounds each and measuring 4 inches by 4 inches by 6.5 inches, will test new network capabilities for operating swarms of spacecraft in the future. Nodes will demonstrate the ability to receive and distribute commands in space from the ground in addition to periodically exchanging scientific data from their onboard radiation instruments. The satellites will be able to configure their data network autonomously by determining which spacecraft is best suited to communicate with the ground each day of the mission.

Tags: Autonomous systems & robotics, Government S&T, NASA, Space technology

BIG DATA

A Search Engine for the Internet's Dirty Secrets

MIT Technology Review, 04DEC2015

Censys, a search engine aimed at helping security researchers find the Internet's dirty little secrets by tracking all the devices hooked up to it, was developed by researchers at the University of Michigan. Censys searches

data harvested by a software called ZMap. Every day Censys is updated with a fresh set of data collected after ZMap "pings" more than four billion of the numerical IP addresses allocated to devices connected to the Internet.

Tags: Big data, Information technology

CYBER SECURITY

Untraceable communication – guaranteed

MIT News, 07DEC2015

Researchers at MIT have developed a new, untraceable text-messaging system named Vuvuzela. Vuvuzela is a dead-drop system, in which one user leaves a message for another at a predefined location—in this case, a memory address on an Internet-connected server—and the other user retrieves it. But it adds several layers of obfuscation to cover the users' trails. According to experimental results, the system provides a strong mathematical guarantee of user anonymity while permitting the exchange of text messages once a minute or so. TECHNICAL ARTICLE

Tags: Cyber security, Information technology

ENERGY

Scientists see the light on graphene microsupercapacitors (w/video)

Nanowerk, 03DEC2015

An international team of researchers (USA - Rice University, China) manufactured microsupercapacitors by burning electrode patterns with a commercial laser into plastic sheets at room-temperature, eliminating the complex fabrication conditions that have limited the widespread application of microsupercapacitors. The microsupercapacitors charge 50 times faster than batteries, discharge more slowly than traditional capacitors and match commercial supercapacitors for both the amount of energy stored and power delivered. The devices displayed long life and mechanical stability when repeatedly bent 10,000 times. TECHNICAL ARTICLE

Tags: Energy, Battery

ENVIRONMENTAL SCIENCE

Evidence that our Sun could release 'superflares' 1000x greater than previously recorded

KurzweilAI, 02DEC2015

An international team of researchers (UK, Russia) have discovered a stellar "superflare" on a star observed by NASA's Kepler space telescope with wave patterns similar to those that have been observed in the Sun's solar flares. Typical solar flares can have energies equivalent to a 100 million megaton bombs, but a superflare on our Sun could release energy equivalent to 100 billion megaton bombs. The Earth's communications and energy systems could be at serious risk of failing, GPS and radio communication

“If anybody says he can think about quantum theory without getting giddy it merely shows that he hasn't understood the first thing about it!” **NIELS BOHR**

systems could be severely disrupted and there could be large-scale power blackouts as a result of strong electrical currents being induced in power grids. [TECHNICAL ARTICLE](#).

Tags: Environmental science

FORECASTING

[Rediscovering fundamental innovation](#)

[MIT News](#), 03DEC2015

According to Eugene Fitzgerald, technology research is actually an iterative process. Since there are few frameworks in place for sustained R&D, we're swimming in incremental improvements but have fewer and fewer heavy hitters in the pipeline. The lack of investment has cut off the more fundamental innovations that are required for very high economic growth. [Related book](#).

Tags: Forecasting, Science without borders

IMAGING TECHNOLOGY

[The amazing camera that can see around corners \(w/ video\)](#)

[PhysOrg.com](#), 08DEC2015

Researchers in the UK found that there is a way to tease out information on an object even from apparently random scattered light. Their method relies on laser range-finding technology. The prototype camera system allows the object's position behind the wall to be localised to within a centimetre or two, and by making measurements every few seconds the camera can also detect the speed of a moving object. In contrast to previous methods, which required long data processing times, the new method can track moving objects in real time. [TECHNICAL ARTICLE](#)

Tags: Imaging technology, S&T UK

[Terahertz wave manipulation using graphene cut-wires](#)

[Nanotechweb](#), 07DEC2015

Researchers in China propose a graphene metasurface, consisting of nano-patterned graphene cut-wires. This metasurface can dynamically modulate the wave front of incident infrared and terahertz waves to enable new functionality, such as anomalously reflecting and focusing with a relatively high efficiency of about 60%. Integrated phase modulation devices are critical to the application of terahertz technology, such as imaging and communication. [TECHNICAL ARTICLE](#)

Tags: Imaging technology, Communications technology, S&T China, Terahertz technology

INFORMATION TECHNOLOGY

[How Supercomputing Can Survive Beyond Moore's Law](#)

[IEEE Spectrum](#), 02DEC2015

Today's technology makes a 1-exaflop supercomputer capable of performing 1 million trillion floating-point operations per second almost inevitable. But pushing supercomputing beyond that point to 10 exaflops or more will require major changes in both computing technologies and computer architectures. In an interview with IEEE Spectrum, researchers from the Sandia National Laboratory outlined several possible technology paths for supercomputing—the millivolt switch, 3-D integration, and specialized architecture.

Tags: Information technology, Microelectronics

[The inside story on wearable electronics](#)

[Nature News](#), 01DEC2015

Researchers in Sweden have developed a skin-surface and implanted sensors, as well as an in-body intranet that can link devices while keeping them private. According to them, sensors woven into the body are a natural extension of handheld smartphones and wearable devices. It is migrating closer and closer and it is a very natural thing to imagine that they will eventually become intimately integrated with the body.

Tags: Information technology, Flexible electronics, S&T Sweden

MATERIALS SCIENCE

[Shaking bosons into fermions](#)

[PhysOrg.com](#), 04DEC2015

An international team of researchers (USA - University of Minnesota, University of Maryland, Australia) has proposed an elegant method for making bosons act like fermions. The experiment harnesses the strengths of atom-optical systems, such as using bosons and established measurement techniques. Physicists are interested in modifying the energy bands to perhaps uncover more complex phases of matter. [TECHNICAL ARTICLE](#)

Tags: Materials science

[Shape shifters: Demonstrating tunable phase shifting](#)

[Science Daily](#), 04DEC2015

Researchers at New York University devised a new approach that balances attractions between particles and promises to become a useful tool to create designer materials that can repair damage. The discovery of a cross point between temperature-dependent interactions between particles opens the doors for more nimble synthesis. They discovered that a liquid polymer-colloid

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mixture forms different solid phases reversibly on cooling and heating. [TECHNICAL ARTICLE](#)

Tags: Materials science

[Conductor turned insulator amid disorder](#)

[PhysOrg.com](#), 02DEC2015

An international team of researchers (Germany, USA - Missouri University of Science and Technology) performed large-scale computer simulations to show that the electron wave functions have a most peculiar spatial structure when the material is right at the threshold between conductor and insulator. They obtained a fingerprint of its spatial structure, which in turn opened the door to understanding how the disorder turns the material from conductor to insulator. [TECHNICAL](#)

[ARTICLE](#)

Tags: Materials science

FEATURED RESOURCE

[Directory of Open Access Journals \(DOAJ\)](#)

DOAJ is a white list of open access journals and aims to be the starting point for all information searches for quality, peer reviewed open access material. [RSS](#)

[Pushing the limits of solar cells](#)

[Science Daily](#), 02DEC2015

Researchers at Florida State University assembled two molecules, an acceptor and sensitizer, on a surface. Once assembled, the molecules work in concert to perform photon upconversion combining two low energy green photons to generate a higher energy blue photon which can then be used to generate electricity. Using this process they were able to increase the maximum efficiency of the solar cell from 33 percent to more than 45 percent.

[TECHNICAL ARTICLE](#)

Tags: Materials science, Solar energy

[Steering the flow of light](#)

[Nanowerk](#), 02DEC2015

By doing detailed numerical investigation of the light scattering characteristics of dielectric nanoparticles of different shapes with high refractive indexes, an international team of researchers (Singapore, Russia) discovered they could use the interference between the particle's electric and magnetic dipole resonances to control and optimize the strength and direction of its light scattering. The discovery could lead to simpler and smaller optical nanoantennas with improved directivity and efficiency — crucial components for the next generation of advanced photonic devices. [TECHNICAL ARTICLE](#)

Tags: Materials science, Photonics

PHOTONICS

[Optical metacage blocks light from entering or escaping](#)

[PhysOrg.com](#), 02DEC2015

Researchers in Australia have introduced a new class of optical and electromagnetic shielding structures, called metacages, based on nanowires. They can provide either wide or narrow band electromagnetic shielding. Metacages can be designed with large gaps between the nanowires, with enough space for liquids and gases to freely pass through. The discrete nature of metacages offers great flexibility in designing shielding structures of almost arbitrary shapes. They could have applications including protecting microorganisms from radiation, optically shielding nanophotonics components, and laser-driven drug delivery.

[TECHNICAL ARTICLE](#)

Tags: Photonics, S&T Australia

[Future ultra-fast high power lasers will deliver unprecedented accelerating power and efficiency](#)

[PhysOrg.com](#), 01DEC2015

In this article, researchers in France present the work of the International Coherent Amplification Network research collaboration. They explore the requirements necessary to make ultra-fast high power laser accelerators a reality. Some potential applications include future colliders, solutions for vacuum physics, and design of Higgs-particle factories. They open the door to solutions in nuclear pharmacology and proton therapy as well as orbital debris remediation.

[TECHNICAL ARTICLE](#)

Tags: Photonics, S&T France

QUANTUM SCIENCE

[Einstein's 'spooky' steering needed for secure quantum teleportation](#)

[PhysOrg.com](#), 07DEC2015

An international team of researchers (China, Australia, UK) has demonstrated that a very special form of quantum entanglement, known as 'Einstein-Podolsky-Rosen steering' is required for secure quantum teleportation. Secure quantum teleportation is essential for a future quantum internet that allows information to be transmitted with absolute security. [TECHNICAL ARTICLE](#)

Tags: Quantum science

[A way to study entanglement entropy between multi-body systems](#)

[PhysOrg.com](#), 03DEC2015

Researchers at Harvard University used lasers to create an optical lattice that caused the creation of four individual compartments in one system where each compartment held just one atom. The compartments arrangement allowed for the creation of a many-body state. By creating two such

continued...

identical systems and comparing the whole systems and portions of it they were able to conclude that there was entanglement in the system. These experiments pave the way for using entanglement to characterize quantum phases and dynamics of strongly correlated many-body systems. [TECHNICAL ARTICLE](#)

Tags: Quantum science

[Quantum computer made of standard semiconductor materials](#)

[PhysOrg.com, 02DEC2015](#)

An international team of researchers (Germany, USA - Los Alamos National Laboratory, Stanford University) has presented a system comprised of a single electron trapped in a semiconductor nanostructure. Here, the electron's spin serves as the information carrier. They demonstrated the existence of different data loss mechanisms and showed that stored information can nonetheless be retained using an external magnetic field. [TECHNICAL ARTICLE](#)

Tags: Quantum science, Information technology

Tags: Quantum science, Information technology

[Quantum spin on molecular computers](#)

[Science Daily, 02DEC2015](#)

A team of researchers in the US (Northwestern University, Argonne National Laboratory) synthesized vanadium complexes with arms made of carbon and sulfur. As long as the system was kept cold, these molecules kept superposition longer than any metal complexes previously reported. They show that under the right conditions, inorganic complexes can function as viable qubits. It is possible that one day computers made of just a handful of small molecules will be used to make predictions about other molecules. [TECHNICAL ARTICLE](#)

Tags: Quantum science

[Physicists confirm thermodynamic irreversibility in a quantum system](#)

[PhysOrg.com, 01DEC2015](#)

An international team of researchers (Brazil, Austria, UK, Germany) measured the entropy change that occurs when applying an oscillating magnetic field to carbon-13 atoms in liquid chloroform. They first applied a magnetic field pulse that causes the atoms' nuclear spins to flip, and then applied the pulse in reverse to make the spins undergo the reversed dynamics. If the procedure were reversible, the spins would have returned to their starting points—but they didn't. The results have implications for understanding thermodynamics in quantum systems and, in turn, designing quantum computers and other quantum information technologies. [TECHNICAL ARTICLE](#)

Tags: Quantum science

S&T POLICY

[Cambridge University launches new centre to study AI and the future of intelligence](#)

[PhysOrg.com, 03DEC2015](#)

The Centre brings together computer scientists, philosophers, social scientists and others to examine the technical, practical and philosophical questions artificial intelligence raises for humanity in the coming century. According to the Center, machine intelligence will be one of the defining themes of our century, and the challenges of ensuring that we make good use of its opportunities are ones we all face together. At present, however, we have barely begun to consider its ramifications, good or bad. Collaborators include universities in the UK and UC Berkeley.

Tags: S&T policy, Artificial intelligence, S&T UK

SCIENCE WITHOUT BORDERS

[Six ways nature has inspired tech innovations](#)

[BBC News, 01DEC2015](#)

Biomimicry or biomimetics, has already given us well-known practical applications, such as cats' eyes for the road and Velcro for our fastenings. But more recent examples include superstrong mini-robots and prototype surgical needles. Studying nature's mechanics is helping us produce ever better man-made materials and structures.

Tags: Science without borders, Biomimetics

[What Is Disruptive Innovation?](#)

[Harvard Business Review, 01DEC2015](#)

Despite broad dissemination, the core concepts of disruption theory have been widely misunderstood and its basic tenets frequently misapplied. This article is part of an effort to capture the state of the art. We begin by exploring the basic tenets of disruptive innovation and examining whether they apply to Uber. Then we point out some common pitfalls in the theory's application, how these arise, and why correctly using the theory matters.

Tags: Science without borders, Disruptive technology, Emerging technology

SENSORS

[Hybrid solid-state chips and biological cells integrated at molecular level](#)

[KurzweilAI, 07DEC2015](#)

A team of researchers in the US (Columbia University, University of Puget Sound, Brown University) used a biological cell to power a conventional CMOS integrated circuit. An artificial lipid bilayer membrane containing adenosine triphosphate (ATP)-powered ion pumps was used as a source of ions which were converted to electrons to power the chip. The research opens the door to creating entirely new artificial biosystems. [TECHNICAL ARTICLE](#)

Tags: Sensors

Pancaking the Telescope: Seeking a new generation of light-based sensing systems

DARPA News, 04DEC2015

The primary goal of the newly-announced Modular Optical Aperture Building Blocks (MOABB) program is to develop advanced technologies it will take to build ultra-compact LIDAR systems. The first phase of the program calls for researchers to develop the fundamental devices that underlie the new LIDAR concept: speck-sized light-emitting and light-detecting cells capable of being readily integrated into larger arrays using typical semiconductor manufacturing processes. Phase 2 and Phase 3 of the project call for the integration of these cells into a 1 cm² array and a 10 cm² array comprising upwards of 100 and 10,000 unit cells, respectively. BAA

Tags: Sensors, DARPA, Government S&T ■

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