



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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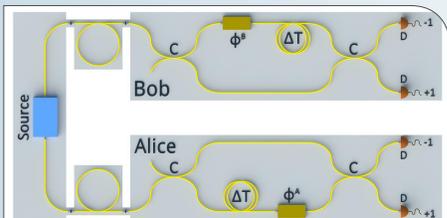
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FEATURE ARTICLES

[Some quantum cryptography systems vulnerable to hacking, study shows](#)

[PhysOrg.com, 18DEC2015](#)

Researchers in Sweden found that energy-time entanglement - the method that today forms the basis for many systems of quantum cryptography - is vulnerable to attack. They discovered this in their theoretical calculations, and demonstrated it experimentally. What they have revealed about energy-time entanglement is that if the photon source is replaced with a traditional light source, an eavesdropper can identify the key, the code string. Consequently



An experimental setup of the Franson interferometer. The setup consists of a source, 2×2 couplers (C), delay loops (ΔT), phase modulators ΦA and ΦB , and detectors (D). Credit: Jogenfors et al. *Sci. Adv.* 2015;1:e1500793

they can also read the message without detection. The security test, which is based on Bell's inequality, does not react - even though an attack is underway.

TECHNICAL ARTICLE

Tags: Quantum science, Cyber security, Featured Article

[Deep-learning algorithm predicts photos' memorability at "near-human" levels](#)

[MIT News, 16DEC2015](#)

Researchers at MIT previously developed a similar algorithm for facial memorability. What's notable about the new one, besides the fact that it can now perform at near-human levels, is that it uses techniques from deep-learning. For each photo, the "MemNet" algorithm also creates a heat map that identifies exactly which parts of the image are most memorable. Understanding memorability can help us make systems to capture the most important information, or, conversely, to store information that humans will most likely forget.

Tags: Imaging technology, Artificial intelligence, Featured Article

ADVANCED MATERIALS

[3D 'nanobridges' formed using electron beam writing with tiny jets of liquid precursor](#)

[Science Daily, 18DEC2015](#)

Researchers at Georgia Institute of Technology have developed a new process which generates structures that would be impossible to make using gas-phase focused electron beam-induced deposition (FEBID) techniques, and allows fabrication at rates up to five orders of magnitude faster than the gas-phase technique. And because it uses standard liquid solvents, the new process could take advantage of a broad range of precursor materials. Multiple materials can also be deposited simultaneously. **TECHNICAL ARTICLE**

Tags: Advanced materials

[Graphene nanoribbons get metallic](#)

[PhysOrg.com, 16DEC2015](#)

Researchers in Finland demonstrated fabrication of the GNRs and measured their electronic structure. The results suggest that these ribbons could be used as metallic interconnects in future microprocessors. Their results pave the way for using graphene in future electronic devices, where these ultra-narrow ribbons could replace copper as the interconnect material.

TECHNICAL ARTICLE

Tags: Advanced materials, S&T Finland

[New metamaterial manipulates sound to improve acoustic imaging](#)

[PhysOrg.com, 16DEC2015](#)

A team of researchers in the US (North Carolina State University, Drexel University) has developed a metamaterial made of paper and aluminum that can manipulate acoustic waves to more than double the resolution of acoustic imaging, focus acoustic waves, and control the angles at which sound passes through the metamaterial. Acoustic imaging tools are used in both medical diagnostics and in testing the structural integrity of everything from airplanes to bridges. **TECHNICAL ARTICLE**

Tags: Advanced materials, Imaging technology

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Designer crystals for next-gen electronics

Science Daily, 14DEC2015

Up until now MOFs could only be grown and applied using a liquid solvent, making them unsuitable for electronics applications. An international team of researchers (Belgium, Australia, Singapore) has developed a vapour method for growing and applying MOF crystals that overcomes this barrier and has the potential to disrupt the microelectronics industry. MOF crystals can be tailor-made to be different shapes and sizes, almost every atom is exposed to empty space: one gram of MOF crystals has a surface area of over 5000 square metres. This means we can fit a lot more transistors on a microchip, making it faster and far more powerful. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials, Microelectronics*

Hybrid material presents potential for 4-D-printed adaptive devices

Science Daily, 14DEC2015

Combining photo-responsive fibers with thermo-responsive gels, researchers at the University of Pittsburgh have modeled a new hybrid material that could reconfigure itself multiple times into different shapes when exposed to light and heat. In 4D printing, time is the fourth dimension that characterizes the structure of the material; namely, these materials can change shape even after they have been printed. The ability of a material to morph into a new shape alleviates the need to build a new part for every new application. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

New ceramic firefighting foam becomes stronger when temperature increases

Science Daily, 14DEC2015

The foam developed by researchers in Russia is based on silica nanoparticles, which create a polymer network when exposed to air. Such a network embraces and adheres to the burning object and momentarily cools it down. At the same time, the foam itself hardens. The inorganic origin of this polymer network allows it to resist temperatures above 1000 degrees Celsius, which ensures gigantic stability from the aggressive environment in the midst of a raging fire. Even when the foam accidentally enters living organisms, it does not pose any danger to them.

Tags: *Advanced materials, Materials science, S&T Russia*

Taking a closer look at graphene edges

Nanotechweb, 10DEC2015

An international team of researchers (UK, South Korea) has probed silicon-carbon bonds in the most detail ever, and has shown that the Si atoms can bond to several different sites on the edges of graphene. Dopants in graphene, such as nitrogen, silicon and iron, can dramatically alter the electronic properties of the carbon sheet—even at extremely low doping levels. They can also play an important role in catalysis. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

AUTONOMOUS SYSTEMS & ROBOTICS

The drive towards ethical AI and responsible robots has begun

PhysOrg.com, 16DEC2015

The recently launched AI and robotics nonprofits, Foundation for Responsible Robotics (FRR) and Open AI, are responses to public concerns about the safety of AI and robotics in different ways. One aims to engage policymakers, create interdisciplinary teams of robotic, legal, ethical and societal scholars, work to explore what it means to be “responsible” as robotics researchers and designers, run workshops and engage the public. The other is more on research and on making advanced AI freely available. They seek to develop innovations in “deep learning.”

Tags: *Autonomous systems & robotics, S&T Policy*

BREAKTHROUGH TECHNOLOGY

Science magazine names CRISPR ‘Breakthrough of the Year’

Berkeley Magazine, 18DEC2015

According to the Science Magazine CRISPR, a runner-up in 2012 and 2013, the technology now revolutionizing genetic research and gene therapy broke away from the pack, revealing its true power in a series of spectacular achievements.

Tags: *Breakthrough technology, Biology, Biotechnology*

CYBER SECURITY

Encryption technologies for the era of quantum computers: Effective protection for microdevices

Science Daily, 18DEC2015

Researchers in Germany identified categories of cryptographic techniques which can ensure security even in the era of quantum computers. Security experts demonstrated that those techniques can also be implemented in microdevices, such as electronic health cards. To reduce the length of the cryptographic keys they used alternative representations of cryptographic techniques and optimized the algorithms for the respective target platform. In some cases they were able to merge the complex steps with other computations. [More information](#)

Tags: *Cyber security, S&T Germany*

WiFi signals can be exploited to detect attackers

Science Daily, 18DEC2015

An international team of researchers (UK, Germany) has created a method that analyses WiFi signals at multiple receivers to detect physical attacks. A change in the pattern of wireless signals—known as Channel State Information (CSI)—picked up by the receivers can indicate a tamper situation. The algorithm detects attacks despite

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“One thing I have learned in a long life: that all our science, measured against reality, is primitive and childlike and yet it is the most precious thing we have.” ALBERT EINSTEIN

signal noise caused by natural changes to the environment such as people walking through the communication paths.

TECHNICAL ARTICLE

Tags: Cyber security

ENERGY

Solar cells that can face almost any direction and keep themselves clean

[Nanowerk](#), 16DEC2015

An international team of researchers (Saudi Arabia, Taiwan) has developed a glass coating that incorporates ultrathin nanorods and honeycomb nanowalls that can help the underlying solar cells harvest sunlight from multiple angles. The cell efficiency can be boosted by 5.2 to 27.7 percent, depending on the angle of the light, and the efficiency enhancement can be up to 46 percent during long-term use. The material also repelled dust and pollution that would otherwise block some rays from getting absorbed and converted to electricity. TECHNICAL ARTICLE

Tags: Energy, Materials science, Solar energy

Building blocks for GaN power switches

[PhysOrg.com](#), 15DEC2015

A team of researchers in the US (Cornell University, University of Notre Dame, an industry partner) has created gallium nitride (GaN) power diodes with near-ideal performance in all aspects simultaneously: a unity ideality factor, avalanche breakdown voltage, and about a two-fold improvement in device figure-of-merits over previous records. One big surprise for the team came in the form of unexpectedly low differential-on-resistance of the GaN diode. Applications of their research span nearly all electronics products and electricity distribution infrastructures. TECHNICAL ARTICLE

Tags: Energy, Materials science

IMAGING TECHNOLOGY

Nanotechnology breakthrough revolutionizes laser printing

[Nanowerk](#), 16DEC2015

Researchers in Denmark used laser technology to print at a resolution of 127,000 DPI on a special nanoscale-structured surface. The structure consists of rows with small columns with a diameter of 100 nanometres each covered by 20 nanometres of aluminium. The intensity of the laser beam determines which colours are printed on the surface. The technology can be used to save data invisible to the naked eye, combat fraud and forgery among other uses.

TECHNICAL ARTICLE

Tags: Imaging technology

The tiniest color picture ever printed

[PhysOrg.com](#), 16DEC2015

Researchers in Switzerland printed layers of red, green and blue quantum dots at a resolution of 25'000 DPI, i.e. at an inter-pixel distance of 500 nanometers. To define the 24 bit color space the thickness of the deposited quantum dot layers had to be controlled with incredible sub-nanometer precision, at each pixel location. The technique highlights new avenues towards the use of nanostructured materials in future electronics and optics, particularly in the display sector.

Tags: Imaging technology, S&T Switzerland

MATERIALS SCIENCE

New research sheds light on sensor material behavior in harsh environments

[Nanowerk](#), 15DEC2015

Using X-ray photoelectron spectroscopy, researchers at DOE's National Energy Technology Laboratory gained insight into the sensing mechanism associated with yttria-stabilized zirconia nanocomposite films containing noble metal nanoparticles. The results of their work can be used to engineer new surface chemistries leading to more durable, corrosion-resistant, and sensitive optical gas sensors.

Tags: Materials science, Government S&T

MICROELECTRONICS

Electronics are getting small, and that is causing big problems

[PhysOrg.com](#), 17DEC2015

As the miniaturisation trend continues, the performance of electronic components is more and more influenced by what happens to electrons at the boundaries of materials. Researchers in Canada found that strong electronic differences between molecules at the edges and those in the centre with energy level shifts of up to 400 meV. This is due to the change in electrostatic environment at the boundaries of clusters, namely via polarization of neighbouring molecules. The observation of these strong shifts illustrates a crucial issue: interfacial energy level alignment can differ substantially from the bulk electronic structure in organic materials. TECHNICAL ARTICLE

Tags: Microelectronics, S&T Canada

NEUROSCIENCE

[Georgia Tech researchers demonstrate how the brain can handle so much data](#)[EurekaAlert](#), 15DEC2015

A team of researchers in the US (Georgia Institute of Technology, University of Washington) discovered that humans can categorize data using less than 1 percent of the original information, and validated an algorithm to explain human learning -- a method that also can be used for machine learning, data analysis and computer vision.

TECHNICAL ARTICLE

Tags: Neuroscience, Big data

FEATURED RESOURCE

[100 Best Science RSS Feeds](#)

In this list, find feeds that touch on everything from space exploration to sustainability to evolution.

PHOTONICS

[Researchers develop 'metasurface' laser for terahertz range](#)[PhysOrg.com](#), 18DEC2015

A team of researchers in the US (UCLA, their industry partner) has created the first vertical-external-cavity surface-emitting laser, or VECSEL, with a "reflectarray metasurface mirror." The device is made up of an array of many small antenna-coupled laser cavities such that when a terahertz wave hits the array, it doesn't "see" the cavities, but rather is reflected as if it were being reflected from a simple, flat mirror. Unlike a simple mirror however, the mirror amplifies terahertz waves as well as reflecting them. The breakthrough could lead to development of a new class of high-quality, powerful lasers for use in space exploration, military and law enforcement efforts and other applications. TECHNICAL ARTICLE

Tags: Photonics, Terahertz technology

[Controlling the thermodynamics of light](#)[PhysOrg.com](#), 17DEC2015

Researchers at the University of Maryland describe a generic approach to chemical potential for light. They illustrated their ideas by showing how a chemical-potential protocol can be implemented in a microcircuit array. Instead of crisscrossing a single cavity, the photons are set loose in an array of microwave transmission lines. And instead of interacting with a bath of dye molecules, the photons here interact with a network of tuned circuits. One likely benefit in using chemical potential as a controllable parameter will be carrying out quantum simulations of actual condensed-matter systems.

TECHNICAL ARTICLE

Tags: Photonics, Quantum science

QUANTUM SCIENCE

[Team adds to quantum computing toolkit with mixed-atom logic operations](#)[PhysOrg.com](#), 16DEC2015

Researchers at NIST have demonstrated an entangling quantum gate between ions of different elements which can serve as an important building block of QIP, quantum networking, precision spectroscopy, metrology, and quantum simulation. They also demonstrate the robustness of these gates against thermal excitation and show improved detection in quantum logic spectroscopy. TECHNICAL ARTICLE

TECHNICAL ARTICLE

Tags: Quantum science, Government S&T

[Advances in quantum machine learning](#)[arXiv](#), 09DEC2015

In this article researchers in the UK offer a hybrid discussion; both reviewing the field as it is currently, and suggesting directions for further research. They include both algorithms and experimental implementations in the discussion. The field's outlook is generally positive, showing significant promise. However, they believe there are appreciable hurdles to overcome before one can claim that it is a primary application of quantum computation. TECHNICAL ARTICLE

TECHNICAL ARTICLE

Tags: Quantum science, S&T UK

SCIENCE WITHOUT BORDERS

[Special Report: 2016 Top Tech to Watch](#)[IEEE Spectrum](#), 18DEC2015

Spectrum's annual special report for the technologies to watch this year.

Tags: Science without borders

[The world of physics in 2016](#)[Physics World](#), 17DEC2015

Editors of Physics World make predictions for key events in physics for 2016. Massive projects include particle physics, astronomy, and cosmology. Predicting what will happen across the rest of physics and in the physics-based industry is harder, where progress is vital but fragmented across myriad groups, sectors and businesses. Some areas mentioned are "Li-Fi", graphene and other 2D materials.

Tags: Science without borders

[LHC restart provides tantalizing hints of a possible new particle](#)[Science News](#), 15DEC2015

Two analyses of proton collisions in the retooled LHC, which restarted at record energy in June after a two-year hiatus, have failed to yield any discoveries. The results do contain at least one intriguing hint of a new particle, but it will require more collisions to evaluate that possibility. Physicists are hoping the revamped machine exposes new particles that would expand the standard model, the catalog of nature's fundamental components.

Tags: Science without borders, Particle physics

continued...

SENSORS

A Miniature Radar Enables Smart Phones To See Through Walls**Defense Update, 16DEC2015**

The radar being developed by researchers in Israel is based around MIMO technology. The new sensor is a radar system on a chip operating in the ultra wide band spanning over the 3-10 GHz frequency spectrum. The sensor uses multiple antennas operating in different polarization, over multiple wavelengths and measuring multipath returns, along with doppler measurements, analysing target location, speed and movement. The system also provides RF imaging and relative permittivity measurements, to analyse the composition of transparent or opaque liquids.

*Tags: Sensors***A molecular light switch?... Just add water****Nanowerk, 16DEC2015**

A team of researchers in the US (Drexel University, University of Pennsylvania, University of Illinois at Urbana-Champaign, UC Berkeley, Temple University) studying a sample of lanthanum aluminate film on a strontium titanate crystal discovered that the sample was beginning to emit intense levels of UV light due to water molecules inside the material. It can be made stronger by increasing the distance between the molecules and surface and the buried interface, by using thicker films, for example. Connections between reversible chemisorption, fast electron transfer, and quantum-well luminescence suggest a new model for surface chemically reconfigurable solid-state UV optoelectronics and molecular sensing. **TECHNICAL ARTICLE**

*Tags: Sensors, Materials science***Clues on the development of magnetic sensors with pure spin current****PhysOrg.com, 16DEC2015**

An international team of researchers (Japan, France) investigated magnetic fluctuations in spin glass (CuMnBi alloy). As the temperature approaches the spin glass temperature T_g , the fluctuations become slower and then the magnetic moments are frozen at T_g . An anomaly was observed far above T_g . This result indicates that pure spin current can detect fluctuating magnetic moments in a much more sensitive way than conventional magnetization measurements. In the near future, magnetic sensors with pure spin current would be developed and replace the SQUID. **TECHNICAL ARTICLE**

*Tags: Sensors, Materials science***Spider signal threads reveal remote sensing design secrets****PhysOrg.com, 16DEC2015**

Researchers in the UK showed that fibres in a spider web closely interact with each other to form a signal thread that behaves as one unit – which gives a comparatively simple vibration signal to the spider. The signal threads could provide inspiration for the development of new remote sensing technologies, they could be useful in micro-electronic-mechanical systems. **TECHNICAL ARTICLE**

*Tags: Sensors, Biomimetics, S&T UK***Nanocurve-based sensor reads facial expressions****Nanowerk, 15DEC2015**

One of the challenges of fabricating flexible electronics has been the trade-off between a material's high flexibility and adaptability, and its conductivity. Researchers in China have developed a facile printing strategy to assemble silver nanoparticles into micro- and nano-curve structures via a pillar-patterned silicon template. The curves with various tortuosity morphologies have differential resistive strain sensitivity, which can be integrated into a multi-analysis flexible sensor to perform complex-recognition of human facial expressions. **TECHNICAL ARTICLE**

*Tags: Sensors, S&T China ■***ABOUT THIS PUBLICATION**

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