



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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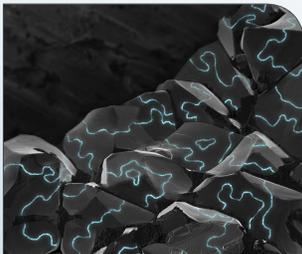
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## FEATURE ARTICLES

### [Scientists get first glimpse of conductivity that could break size barriers for memory](#)

[PhysOrg.com, 30OCT2015](#)



An illustration of electrically conductive areas (blue) along the boundaries of tiny magnetic regions, or domains, in chunky grains of a material that normally doesn't conduct electricity. Credit: Eric Yue Ma/Stanford University

An international team of researchers (USA - Stanford University, Lawrence Berkeley National Laboratory, Japan, China) used a combination of neodymium, iridium and oxygen to make the first direct images showing that electrical currents can flow along the boundaries between tiny magnetic regions of a material that normally doesn't conduct electricity. The concept of using this phenomenon to make new types of sensors and

very stable, high-density memory storage can potentially go beyond the size limitations of current technologies.

[TECHNICAL ARTICLE](#)

*Tags: Materials science, Information technology, Featured Article*

### [Tiny magnets could work in sensors, information encoding](#)

[PhysOrg.com, 27OCT2015](#)

A team of researchers in the US (Northeastern University, Harvard Medical School, Dana Farber Cancer Institute, MIT) has realized a nanoscale, artificial magnet by arranging an array of magnetic nano-islands along a geometry that is not found in natural magnets. The interaction of nano-islands induces a collective behavior that can be exploited for emergent properties. As temperature is lowered to room temperature, the magnet crosses over from being a 'standard' magnet into a new and exotic state where it exhibits 'dimensional reduction' with alternating ordered and disordered stripes, with distinct kinetic behaviors among the two. Applications might range from general magnetism, such as developing sensors, to information encoding. [TECHNICAL ARTICLE](#)

*Tags: Sensors, Materials science, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MATERIALS

#### [Revolutionary research work on glassy materials](#)

[Science Daily, 28NOV2015](#)

An international team of researchers (UK, Denmark, China, Japan, Germany) has managed to use a relatively new family of sponge-like porous materials to develop completely novel glasses. The liquids that are formed on the nanoscale, can be shaped and cast, that could enable substantial solid structures to be fabricated. It is the open atomic architecture, an atomic labyrinth, that should enable toxic or useful molecules to be selectively trapped or filtered. The discovery could lead to the production of 'designer glasses' with applications in advanced photonics, while also facilitating industrial scale carbon capture and storage. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Advanced manufacturing*

#### [Scientists demonstrate new semiconductor material for solar cell technology](#)

[PhysOrg.com, 30OCT2015](#)

An international team of researchers (USA - University of Buffalo, Binghamton University, Western Michigan University, UK) focused on the compound zinc tin nitride which has been recently synthesized by research groups around the world, using zinc and tin—metals which are readily available through mature recycling facilities—rather than expensive and rare metals. They found that the alloy's band gap can be "tuned" by altering the perfectly ordered crystalline lattice by introducing disorder in the form of randomly distributed zinc and tin atoms. The material could be used in solar cells instead of rare elements. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science*

#### [Extremely tiny, hugely versatile nanoglobules](#)

[PhysOrg.com, 27OCT2015](#)

Researchers in Germany have found a way to incorporate lipophilic organic light-absorbing substances

*continued...*

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into organic nanoparticles that form colloidal suspensions in aqueous media. The method could serve as the basis for the formulation of innovative sunscreens.

#### TECHNICAL ARTICLE

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

## AUTONOMOUS SYSTEMS & ROBOTICS

### [Bridging the human-computer interaction](#)

[Science Daily, 27NOV2015](#)

With the goal of revolutionizing everyday interactions between humans and computers, Colorado State University researchers are developing new technologies for making computers recognize not just traditional commands, but also non-verbal ones—gestures, body language and facial expressions. They proposed creating a library of what are called Elementary Composable Ideas (ECIs). Each ECI contains information about a gesture or facial expression, derived from human users, as well as a syntactical element that constrains how the information can be read.

*Tags: Autonomous systems & robotics, Artificial intelligence*

### [Robots Can Now Teach Each Other New Tricks](#)

[MIT Technology Review, 27OCT2015](#)

Researchers at Cornell University and Brown University have demonstrated the exchange of knowledge between robots they developed in their laboratories. The key challenge for knowledge transfer was that they are physically completely different, which means that low-level commands will not match the new task. According to researchers at MIT, it would be ideal for a robot to figure out how to translate information for itself. Increased bandwidth and cloud computing capacity may make this possible.

*Tags: Autonomous systems & robotics, Artificial intelligence*

## BIG DATA

### [Academic Search Engine Grasps for Meaning](#)

[MIT News, 02NOV2015](#)

The [Allen Institute for Artificial Intelligence](#) has developed a new tool called Semantic Scholar that can search through millions of computer science papers. The tool features ways of refining searches based on information extracted from the text of papers. Many academic search engines such as Google Scholar, Microsoft Academic Search, PubMed, and JSTOR typically only search through papers using keywords and other information that is clearly categorized, such as the publication date.

*Tags: Big data, Bibliometrics*

## BIOTECHNOLOGY

### [Engineers design magnetic cell sensors](#)

[MIT News, 02NOV2015](#)

Engineers have designed magnetic protein nanoparticles that can be used to track cells or to monitor interactions within cells. The new “hypermagnetic” protein nanoparticles can be produced within cells, allowing the cells to be imaged or sorted using magnetic techniques. This eliminates the need to tag cells with synthetic particles and allows the particles to sense other molecules inside cells.

*Tags: Biotechnology, Biology*

## CYBER SECURITY

### [4G mobile communications system is vulnerable to location tracking](#)

[Science Daily, 28OCT2015](#)

Researchers in Finland built a 4G fake base station and showed that most popular phones can be tricked into giving up location information or degrading their service level. The necessary equipment for all forms of attacks is inexpensive and readily available. They showed that the attacker can link to the target’s identity and degrade or deny service.

*Tags: Cyber security, S&T Finland*

### [A basis for all cryptography](#)

[PhysOrg.com, 28OCT2015](#)

Researchers at MIT showed that the problem of indistinguishability obfuscation is, in fact, a variation on a different cryptographic problem, called efficient functional encryption. While computer scientists don’t know how to do efficient functional encryption, they believe that they’re close—much closer than they thought they were to indistinguishability obfuscation. TECHNICAL ARTICLE

*Tags: Cyber security*

### [Technology to securely turn biometric data into a cryptographic key](#)

[PhysOrg.com, 27OCT2015](#)

Researchers in Japan have developed a technology that uses randomized numbers to convert biometric data into a cryptographic key for use in encryption and decryption. This makes it possible to simply and securely manage an individual’s confidential data using biometric data, while preventing the unconverted biometric data from passing through the network. They applied widely used error-correcting codes for the encryption method as the technology to compensate for errors that are typically generated in the transmission route.

*Tags: Cyber security, S&T Japan*

“Our job in physics is to see things simply, to understand a great many complicated phenomena, in terms of a few simple principles.” STEVEN WEINBERG

## ENERGY

### Monolithic perovskite/silicon tandem solar cell achieves record efficiency

PhysOrg.com, 28NOV2015

An international team of researchers (Germany, Switzerland) successfully combined a silicon heterojunction solar cell with a perovskite solar cell monolithically into a tandem device. The hybrid tandem cell showed an efficiency of 18 percent. There are even prospects for the efficiency to reach as much as 30 percent. In just six years, the efficiency of perovskite solar cells has increased five-fold; moreover, perovskite solar cells can be manufactured from solution and be cost-effectively printed on large areas in the future.

#### TECHNICAL ARTICLE

Tags: Energy, Advanced materials, Solar energy

### Researchers create technology to produce lighter, long-lasting batteries from silicon

Nanowerk, 26NOV2015

The most critical challenge with batteries using silicon was the loss of energy that occurs when silicon contracts and then expands by as much as 300 per cent with each charge cycle. The resulting increase and decrease in silicon volume forms cracks that reduce battery performance, create short circuits, and eventually cause the battery to stop operating. To overcome this problem, a team of researchers in Canada developed flash heat treatment for fabricated silicon-based lithium-ion electrodes that minimizes volume expansion while boosting the performance and cycle capability of lithium-ion batteries.

#### TECHNICAL ARTICLE

Tags: Energy, Battery, S&T Canada

## ENVIRONMENTAL SCIENCE

### Study explores wave-particle interaction in atmosphere

PhysOrg.com, 27NOV2015

A team of researchers in the US (Dartmouth College, Los Alamos National Laboratory, UCLA) sheds light on the impact of plasma waves on high-energy electrons streaking into Earth's magnetic field from space. The findings are important because relativistic electrons can lead to ozone depletion and threaten orbital satellites, spacecraft and astronauts, and understanding the evolution of Earth's radiation belts could help lessen the effects of these particles.

#### TECHNICAL ARTICLE

Tags: Environmental science

## INFORMATION TECHNOLOGY

### Alphabet's Stratospheric Loon Balloons to Start Serving Internet to Indonesia

MIT Technology Review, 28OCT2015

Project Loon and its three telecom partners are working on plans for a series of tests next year that will begin with small technical demonstrations and build up to using flocks of balloons to blanket large areas with Internet coverage. The Indonesian trials will test the most complex parts of Project Loon, which are required in order to provide reliable service with a fleet of constantly moving balloons, including having the balloons work together in "flocks" to maintain even coverage.

Tags: Information Technology

### Monuments to Failure

IEEE Spectrum, 28OCT2015

Little has changed since IEEE Spectrum's 2005 special issue on software failure. The project risk factors that can quickly lead to project death haven't changed. This graveyard is a testament to unrealistic and unarticulated project goals, badly defined system requirements, unbounded project complexity, poorly designed human interfaces, sloppy development practices, poor project management, vicious stakeholder politics, and unbridled commercial pressures, to name but a few.

Tags: Information Technology, S&T Policy

### Google scientist talks about RankBrain for search

Techexplore, 26OCT2015

RankBrain's usage of AI means it works differently than the other technologies in the search engine. Of the millions of queries it receives each second, about 15 percent of them are completely new to Google. RankBrain is one of the "hundreds" of signals that go into an algorithm that determines what results appear on a Google search page and where they are ranked. In the bigger picture, the addition of RankBrain to search is part of Google's push into AI.

Tags: Information Technology, Artificial intelligence, Big data

## MATERIALS SCIENCE

### Nanoquakes probe new 2-dimensional material

Science Daily, 26OCT2015

An international team of researchers (USA - UC Riverside, Pepperdine University, Germany) fabricated a single-atomic-layer-thin film of molybdenum disulfide on a substrate of lithium niobate. By applying electrical pulses

to LiNbO<sub>3</sub> they created surface acoustic waves that run along the surface of LiNbO<sub>3</sub>. They could 'hear' the LiNbO<sub>3</sub> sound waves and infer how much current the laser light allowed to flow in the MoS<sub>2</sub>. They fabricated transistor structures onto the MoS<sub>2</sub> films and proved that their analysis was correct. [TECHNICAL ARTICLE](#)

Tags: *Materials science*

## FEATURED RESOURCE

### [COSIS.net](#)

COSIS.net is an online community for scientists and their affiliated organizations for the exchange of information and the discussion of ideas and results. Membership is open to researchers affiliated with an organization.

## PHOTONICS

### [A new physical mechanism allows “Phonon lasing” driven by optical forces at ambient conditions](#)

[Nanotechweb](#), 29OCT2015

Researchers in Spain report “phonon lasing” in a one-dimensional opto-mechanical crystal in response to an anharmonic modulation of the intracavity radiation pressure force. They show a new physical mechanism that allows phonon lasing under far more relaxed configurations. The system operates at ambient conditions of pressure and temperature in a silicon platform, which enables its exploitation in sensing, intra-chip metrology or time-keeping applications. The study opens new research avenues in the field of non-linear opto-mechanics. [TECHNICAL ARTICLE](#)

Tags: *Photonics*

### [The world’s fastest nanoscale photonics switch](#)

[PhysOrg.com](#), 28OCT2015

Silicon nanoparticles exhibit magnetic dipole resonances. An international team of researchers (Russia, Australia) created an ultrafast all-optical switch on silicon nanostructures, a disc 250 nm in diameter that is capable of switching optical pulses at femtosecond rates. If the pulses arrive at the nanostructure simultaneously, one of them interacts with the other and dampens it due to the effect of two-photon absorption. They were able to develop a structure in which the undesirable free-carrier effects are suppressed. This device may become a platform for future computers and permit to transfer data at an ultra-high speed. [TECHNICAL ARTICLE 1, 2](#)

Tags: *Photonics*

## QUANTUM SCIENCE

### [Bright Solid State Source of Photon Triplets](#) [arXiv](#), 20NOV2015

Multipartite states enable improved tests of the foundations of quantum mechanics as well as implementations of complex quantum optical networks and protocols. An international team of researchers (Canada, Austria, France) used the ground states of two optically active coupled quantum dots to directly produce photon triplets. The formation of a triexciton leads to a triple cascade recombination and sequential emission of three photons with strong correlations. The quantum dot molecule is embedded in an epitaxially grown nanowire engineered for single-mode waveguiding and improved extraction efficiency at the emission wavelength. They record 65.62 photon triplets per minute. [TECHNICAL ARTICLE](#)

Tags: *Quantum science*

### [Scientists design full-scale architecture for quantum computer in silicon](#)

[PhysOrg.com](#), 30OCT2015

One of the final hurdles to scaling up to an operational quantum computer is the architecture. Here it is necessary to figure out how to precisely control multiple qubits in parallel, across an array of many thousands of qubits, and constantly correct for ‘quantum’ errors in calculations. Researchers in Australia describe a new silicon architecture, which uses atomic-scale qubits aligned to control lines - which are essentially very narrow wires - inside a 3D design. They have been working towards a full-scale architecture where they can perform error correction protocols - providing a practical system that can be scaled up to larger numbers of qubits. [TECHNICAL ARTICLE](#)

Tags: *Quantum science, S&T Australia*

### [Physicists mimic quantum entanglement with laser pointer to double data speeds](#)

[PhysOrg.com](#), 28OCT2015

To make the laser beam’s shape and polarization nonseparable, an international team of researchers (USA - University of New York, industrial partner, UK) transformed it into a vector beam. Using off-the-shelf components to ‘touch’ only its polarization, they showed it could be encoded as two bits of information. Surprisingly, this was twice as much information that could be encoded as when the laser beam was separable. In principal, this could be used to double the data speed of laser communication. [TECHNICAL ARTICLE](#)

Tags: *Quantum science*

## S&amp;T POLICY

**Nanotech tools open market for more miniature electronics**[PhysOrg.com, 28OCT2015](#)

The two-year EU-funded project has developed innovative atomic layer deposition materials and tools in order to facilitate the mass production of high density and high voltage capacitors opening new opportunities for creating miniaturised high performance electronics across a range of sectors. The key long term objective of the project is to meet specific needs of end users such as aeronautics and medical instruments.

*Tags: S&T policy, S&T EU*

## SCIENCE WITHOUT BORDERS

**May the Fifth Force be with you**[Science Daily, 27OCT2015](#)

In the 1980s, researchers at Purdue University published a study uncovering the tantalizing possibility of the existence of a fifth force in the universe. About thirty years of research later, there is no evidence for the existence of any deviation from the predictions of standard gravity at any distance scale. However, it remains possible that a different kind of fifth force, of a different nature than originally envisaged, could still exist. This hypothetical force has led to the development of many new theories and novel experiments.

**TECHNICAL ARTICLE**

*Tags: Science without borders*

**Simulator of human behavior advances research**[Science Daily, 27OCT2015](#)

The research project, called IBSEN (Bridging the gap: from individual behaviour to the socio-technical Man), is part of a call for “novel ideas for radically new technologies” by the European Union’s Horizon 2020 program. As a part of this project, researchers in Spain are investigating how to build a system that recreates human behavior. This technology could be applied to anticipate behavior in socioeconomic crises, create more human-like robots or develop avatars of artificial intelligence which are almost indistinguishable from those that represent people.

*Tags: Science without borders*

**Sonic tractor beam invented (w/ Video)**[PhysOrg.com, 27OCT2015](#)

An international team of researchers (Spain, UK) used an array of 64 miniature loudspeakers to create high-pitch and high-intensity sound waves. The tractor beam works by surrounding the object with high-intensity sound and this creates a force field that keeps the objects in place. By carefully controlling the output of the loudspeakers

the object can be held in place, moved or rotated. The technique could be used for a sonic production line to transport delicate objects and assemble them, or a miniature version could grip and transport drug capsules or microsurgical instruments through living tissue.

**TECHNICAL ARTICLE**

*Tags: Science without borders*

**Assessing the role of negative citations in science**[Science Daily, 26OCT2015](#)

In their study, an international team of researchers (USA - MIT, Georgia Institute of Technology, Canada) found that negative citations may point out limitations, inconsistencies or flaws in previous work. Negative citations were more likely to criticize highly-read papers, and that the criticisms focused on specific sections of the papers. They created a set of citations that was used to train a natural language processing program which classified the remainder of the citations as either objective or negative. The process identified about 2.4 percent of the total citations studied.

**TECHNICAL ARTICLE**

*Tags: Science without borders, Bibliometrics*

## SENSORS

**Engineers reveal record-setting flexible phototransistor**[PhysOrg.com, 30OCT2015](#)

Researchers at the University of Wisconsin created a flexible silicon phototransistor using an innovative “flip-transfer” fabrication method, in which their final step is to invert the finished phototransistor onto a plastic substrate. At that point, a reflective metal layer is on the bottom. In this structure light absorption can be much more efficient because light is not blocked by any metal layers or other materials. The metal layer and electrodes each act as reflectors and improve light absorption without the need for an external amplifier. The technique could improve the performance of products that rely on electronic light sensors.

**TECHNICAL ARTICLE**

*Tags: Sensors*

**Perovskite-based triboelectric photodetector a new weapon in air pollution fight**[Nanowerk, 28OCT2015](#)

The sensor, developed by an international team of researchers (China, USA - Georgia Institute of Technology, University of Washington), operates by physically absorbing nitrogen dioxide gas molecules onto flakes of tin disulphide. The large surface area of these flakes has a high affinity to nitrogen dioxide molecules that allows its highly selective absorption.

**TECHNICAL ARTICLE**

*Tags: Sensors, Environment*

## Coating cancels acoustic scattering from odd-shaped objects

PhysOrg.com, 27OCT2015

Using a coating that consists of two thin fluid layers, a team of researchers in the US (Naval Research Laboratory, UT Austin) theoretically demonstrated a significant reduction in scattering strength and confirmed it via 3-D finite element model simulations. The key significance of their work is the formulation of a more general approach using acoustic scattering cancellation for complex, odd-shaped objects. Scattering cancellation allows the scattered field outside of the coated object to be significantly reduced without reducing the field on the interior. This makes an ideal acoustic hydrophone possible. TECHNICAL ARTICLE

Tags: Sensors, Government S&T ■

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