



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

[Advanced materials \(3\)](#)

[Autonomous systems & robotics \(1\)](#)

[Biotechnology \(3\)](#)

[Communications technology \(2\)](#)

[Counter WMD \(1\)](#)

[Cyber security \(2\)](#)

[Energy \(2\)](#)

[Information technology \(2\)](#)

[Materials science \(3\)](#)

[Microelectronics \(1\)](#)

[Neuroscience \(3\)](#)

[Photonics \(2\)](#)

[Quantum science \(3\)](#)

[S&T policy \(1\)](#)

[Science without borders \(1\)](#)

[Sensors \(2\)](#)

## FEATURE ARTICLES

### [Nobel Prizes 2016](#)

[Nobelprize.org](#), 04OCT2016



Nobel Prize Medal

On 27 November 1895, Alfred Nobel signed his last will and testament, giving the largest share of his fortune to a series of prizes in Physics, Chemistry,

Physiology or Medicine, Literature and Peace - the Nobel Prizes. In 1968, Sveriges Riksbank (Sweden's central bank) established The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel.

Tags: [Science without borders](#), [Featured Article](#)

### [‘Nano-kebab’ fabric breaks down chemical warfare agents](#)

[Nanowerk](#), 30SEP2016

A team of researchers in the US (North Carolina State University, Edgewood Chemical Biological Center, industry partner) deposited a thin film of titanium oxide onto a fabric made of nanoscale fibers. The titanium oxide serves as a nucleation layer, which enables the researchers to apply various zirconium-based MOFs onto the nanofibers in an evenly distributed way. The MOFs formed on the nanofibers in a kebab-like structure, with the MOFs uniformly covering the entire nanofibers. They found that, when exposed to the nano-kebab fabric, the half-life of the CWA simulant was as brief as 7.3 minutes. The half-life of the soman was as short as 2.3 minutes. [TECHNICAL ARTICLE](#)

Tags: [Counter WMD](#), [Military technology](#), [Featured Article](#)

### [Universal flu vaccine designed by scientists](#)

[Science Daily](#), 30SEP2016

An international team of researchers (UK, Spain) applied ground-breaking computational techniques to design universal vaccines, a USA-specific vaccine with coverage of 95% of known US influenza strains and a universal vaccine with coverage of 88% of known flu strains globally. They have found a way to select short flu virus fragments, called epitopes that are already known to be recognized by the immune system which would be the components of a universal flu vaccine. According to the researchers, a universal flu vaccine is potentially within reach. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: [Biotechnology](#), [Breakthrough technology](#), [Medical technology](#), [Featured Article](#)

## S&T NEWS ARTICLES

### ADVANCED MATERIALS

#### [Correlated magnets made out of single atoms](#)

[Nanowerk](#), 29SEP2016

Researchers in Germany have observed the emergence of antiferromagnetic order over a correlation length of several lattice sites in a chain of fermionic atoms. Contrary to the ferromagnetism we experience in everyday life, these antiferromagnets are characterized by an alternating alignment of the elementary magnetic moment associated with each electron or atom. By approaching the conditions prevailing in macroscopic crystals with fermionic quantum many-body systems, one hopes to achieve a better understanding of high-temperature superconductivity. [TECHNICAL ARTICLE](#)

Tags: [Advanced materials](#), [S&T Germany](#)

[continued...](#)

[BACK TO TOP](#)

**Mass producing graphene using microwaves****Science Daily, 27SEP2016**

An international team of researchers (USA - Rutgers University, South Korea, France) has proved that it is now possible to produce high quality graphene, using a microwave oven. The partially reduced graphene oxides absorb microwave energy, produced inside a microwave oven. This not only efficiently eliminates oxygen functional groups from graphene oxides, but is also capable of rearranging defective graphene films. The results indicate that the new graphene exhibits substantially reduced oxygen concentration of 4%, much lower than the currently existing graphene with an oxygen content in the range of 15% to 25%. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials***Discovery: A new form of light****Science Daily, 26SEP2016**

A team of researchers in the US (Dartmouth College, University of Vermont) found that when they put strange molecules, called molecular rotors in a mixture of glycerol and ethylene glycol the fluorescent light from these molecular rotors glow brightly, in a vivid green color nearer the blue end of the spectrum. This is because the paddle-shaped part of the rotor must rotate freely in order to turn on the chemical pathway that allows it to give off heat energy—but this rotation is suppressed in a thick solution. The thicker the solution, the less the molecular paddles rotate, the more light can be emitted. The new light may have many promising applications including novel kinds of LED bulbs and medical dyes that can sense viscosity within a cell. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science***AUTONOMOUS SYSTEMS & ROBOTICS****Tech Titans Join Forces to Stop AI from Behaving Badly****MIT Technology Review, 28SEP2016**

The companies involved in a new organization called the [Partnership on Artificial Intelligence to Benefit People and Society](#) include Google, DeepMind, Facebook, Amazon, Microsoft, and IBM. The partnership is founded on eight tenets or principles, including the idea that AI should benefit as many people as possible; that the public should be involved in its development; that research should be conducted in an open way; and that AI systems should be able to explain their reasoning.

*Tags: Autonomous systems & robotics, Artificial intelligence***BIOTECHNOLOGY****Researchers generate proton beams using a combination of nanoparticles and laser light****PhysOrg.com, 30SEP2016**

An international team of researchers (Germany, USA - UT Austin) focused high-power laser light onto beads of

plastic, each bead consisting of about 50 billion carbon and hydrogen atoms. The laser radiation rips away some 15 per cent of the electrons bound in these atoms. The remaining, positively charged atomic nuclei are then violently repelled, and the nanospheres explode at speeds of around 10 per cent the speed of light. The radiation from the protons then spreads out in all directions. This mode of production of proton beams with laser light promises to open up new opportunities for nuclear medicine. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Biotechnology, Medical technology***Researchers suggest nanoscale electronic motion sensor as DNA sequencer****Nanowerk, 28SEP2016**

An international team of researchers (USA - NIST, Rice University, the Netherlands) propose a type of capacitor, which is a tiny ribbon of molybdenum disulfide suspended over a metal electrode and immersed in water. A single-stranded DNA containing a chain of bases is threaded through a hole in the ribbon. The ribbon flexes only when a DNA base pairs up with and then separates from a complementary base affixed to the hole. The membrane motion is detected as an electrical signal would identify the bases. They showed that the membrane would be 79 to 86 percent accurate in identifying DNA bases in a single measurement at speeds up to about 70 million bases per second. The results suggest such a device could be a fast, accurate and cost-effective DNA sequencer. [TECHNICAL ARTICLE](#)

*Tags: Biotechnology, Government S&T***COMMUNICATIONS TECHNOLOGY****Key component for wireless communication with terahertz frequencies****Science Daily, 04OCT2016**

THz signal waves in the fiber optic network are scrambled because standard modulation of laser light generates two sidebands that interfere with one another. Researchers in the Netherlands developed an Optical Single Side Band modulator that enables wireless THz waves to be transmitted unperturbed through the fiber network. The splitter splits both the THz waves and the infrared laser light in half, one of the two sidebands is reduced by a factor of over sixty, while the other sideband's intensity increases significantly. The modulator does not contain any moving parts or colour filters, and operates over an ultra-wide bandwidth from 0.3 to 1 THz. As THz signals in the air are strongly absorbed by water vapour, wireless THz communication will mostly be used for relatively short distances. [TECHNICAL ARTICLE](#)

*Tags: Communications technology***Optical fiber transmits one terabit per second****Science Daily, 28SEP2016**

Researchers in Germany used a novel modulation approach, known as Probabilistic Constellation Shaping (PCS) which



“Sometimes when you innovate, you make mistakes. It is best to admit them quickly, and get on with improving your other innovations.” STEVE JOBS

uses quadrature amplitude modulation formats to achieve higher transmission capacity over a given channel to significantly improve the spectral efficiency of optical communications. PCS cleverly uses constellation points with high amplitude less frequently than those with lesser amplitude to transmit signals that, on average, are more resilient to noise and other impairments. This allows the transmission rate to be tailored to ideally fit the transmission channel, delivering up to 30 percent greater reach. The breakthrough research could extend the capability of optical networks to meet surging data traffic demands.

*Tags: Communications technology, S&T Germany*

## CYBER SECURITY

### **The Internet of Things Goes Rogue**

[MIT Technology Review, 30SEP2016](#)

According to the Wall Street Journal, as many as one million security cameras, digital video recorders, and other connected devices have been employed by hackers to carry out a series of attacks. When corralled together, these pieces of hardware can be used as a so-called botnet, collectively sending data and Web page requests to servers with such ferocity that they're overwhelmed and ultimately crash. The scale of the new set of attacks is unprecedented. According to the BBC, this recent spate has been able to barrage servers with data at rates of over a terabit per second. The news raises fresh concerns about the security of Internet of things devices.

*Tags: Cyber security*

### **Encryption method takes authentication to a new level, improves privacy protection**

[Science Daily, 29SEP2016](#)

The encryption method, developed by researchers in Finland, combines safety, usability and privacy protection. It stores data in the database in an encrypted form and all comparisons between measuring results and the database are conducted using encrypted messages so there is no need to open any biometric data at this stage of the process. The method integrates new kinds of encryption methods, such as homomorphic cryptography and secure exchange of cryptographic keys, to known measuring methods of typing styles.

*Tags: Cyber security, S&T Finland*

## ENERGY

### **Panasonic develops bendable, twistable, flexible lithium-ion battery**

[PhysOrg.com, 30SEP2016](#)

Researchers in Japan have developed a rechargeable Flexible Lithium-ion Battery with a thickness of only

0.55mm, or about 0.022 inches. It can withstand bending and twisting beyond the Japanese Industrial Standards for identification cards. When used in card devices such as smart cards and card keys that work on batteries, as well as body worn devices and smart clothing, this battery can retain its characteristics even if the device is frequently bent or twisted.

*Tags: Energy, Battery, Flexible electronics, S&T Japan*

### **Nanotechnology for energy materials: Electrodes like leaf veins**

[Nanowerk, 29SEP2016](#)

An ideal network window electrode for photovoltaic applications should provide an optimal surface coverage, a uniform current density and a minimum of the overall resistance for a given shading ratio. An international team of researchers (China, Germany, USA - Boston College, University of Houston) shows that metallic networks with quasi-fractal structure provides a near-perfect practical realization of such an ideal electrode. They found that a leaf venation network, which possesses key characteristics of the optimal structure, outperforms other networks. The elements of hierarchical topology, rather than details of the branching geometry, are of primary importance in optimizing the networks. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Energy, Solar energy*

## INFORMATION TECHNOLOGY

### **Turning to the brain to reboot computing**

[PhysOrg.com, 03OCT2016](#)

The integrated circuits that powered the past 50 years of technological revolution are reaching their physical limits. Researchers at Sandia National Laboratory argue for continual learning and suggest the use of game theory 1) to bring precision to the decision of when an algorithm should learn; 2) propose that if researchers think of a traditional scientific computing problem, matrix decomposition, as a dynamical system, they could solve them rigorously on neuro-inspired systems; and 3) even as the brain uses spikes of electricity to communicate they suggest using the careful arrangement of spiking neuron-like nodes in the algorithms to perform precise computations.

*Tags: Information technology, Government S&T*

### **Effective plasmonic generation brings scientists closer to creating ultracompact light-based computers**

[PhysOrg.com, 30SEP2016](#)

An international team of researchers (Russia, Japan) have theoretically demonstrated the possibility of creating compact sources of coherent plasmons, which are the

*continued...*

basic building blocks for future optoelectronic circuits. The theoretical device is based on the unique properties of van der Waals heterostructures. The researchers show that a heterostructure comprising two graphene layers separated by a thin layer of tungsten disulphide not only supports the compact two-dimensional plasmons, but can also generate them upon the application of interlayer voltage. [TECHNICAL ARTICLE](#)

*Tags: Information technology*

## FEATURED RESOURCE

### [Futurity](#)

Futurity features the latest discoveries by scientists at top research universities in the US, UK, Canada, and Australia. It is supported solely by its university partners.

## MATERIALS SCIENCE

### [Negative refraction of electrons spotted in graphene](#)

[Physics World, 03OCT2016](#)

Negative refraction is a property of some artificial metamaterials. However making practical metamaterials has proven to be very difficult. In graphene, the vast majority of electrons are reflected at the junction rather than being transmitted across and therefore refracted. An international team of researchers (USA - Columbia University, University of Virginia, Cornell University, Industry partner, Japan, China) fashioned a junction using the natural edge of a graphene flake and controlled the angle at which electrons approached the boundary. By comparing their measurements with computer models, they obtained clear evidence of negative refraction.

[TECHNICAL ARTICLE](#)

*Tags: Materials science, Advanced materials*

### [Vibrating oxides](#)

[Nanowerk, 03OCT2016](#)

An international team of researchers (USA - MIT, Brookhaven National Laboratory, Switzerland) report that when you pump low pressure water vapor into perovskite BSCF (barium, strontium, cobalt, iron), bubbles form and shrink and the oxide begins to oscillate. The magnitude and frequency of the oscillations depend on the pressure of the vapor in the system and the reaction can be switched on and off at will by controlling the electron beams. When the reaction stops, the material still has its original perovskite structure. Researchers still don't understand it in full detail. The phenomenon may turn out to have some practical applications. [TECHNICAL ARTICLE](#)

[ARTICLE](#)

*Tags: Materials science, Advanced materials*

### [Scientists visualize quantum behavior of hot electrons for first time](#)

[Science Daily, 28SEP2016](#)

Researchers in the UK injected electrons into a silicon surface, decorated with toluene molecules. As the injected charge propagated from the tip, it induced the molecules to react and 'lift off' from the surface. By measuring the precise atomic positions from which molecules departed on injection, the team was able to identify that electrons were governed by quantum mechanics close to the tip, and then by more classical behavior further away. They show that the quantum behavior of electrons persist under room temperature and over a "large" 15 nanometre scale. The implications of being able to manipulate the behavior of hot electrons are far-reaching; from improving the efficiency of solar energy, to improving the targeting of radiotherapy for cancer treatment. [TECHNICAL ARTICLE](#)

*Tags: Materials science*

## MICROELECTRONICS

### [Quantum metal model system](#)

[Science Daily, 27SEP2016](#)

Researchers at NIST report that by manipulating the intensity of the laser responsible for spin-orbit coupling, the state of the cold Sr atoms can change from an insulator to a quantum metal with mobile, interacting Sr atoms. Spin-orbit coupling is just one of three key ingredients for creating the exotic metallic state with Sr atoms. The other two ingredients are atomic spin and strong interatomic interactions. All three work together. The spin-orbit coupling generated by the laser creates a landscape of energy barriers that stop all atom movement. However, when the intensity of the laser is "just right," the atoms start moving again, creating a "mass" current. This ability to create and control spin transport may be a key ingredient in the development of spintronics. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics*

## NEUROSCIENCE

### [Scientists uncover how a fluctuating brain network may make us better thinkers](#)

[Medical Express, 30SEP2016](#)

Rather than having strictly defined routes of communication between different areas, the level of coordination between different parts of the brain seems to ebb and flow. An international team of researchers (USA - Stanford University, Australia, Switzerland) found that when different regions of the brain are more integrated people do better on complex tasks. The brain is inherently dynamic but further statistical analysis in this study revealed that the brain was most interconnected in people who performed the test fastest and with the greatest accuracy. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Neuroscience*



**Memristor behaves like a synapse****Nanotechweb, 29SEP2016**

An international team of researchers (USA - University of Massachusetts at Amherst, Air Force Research Lab at Rome, Brookhaven National Laboratory, industry partner, UK) made a “diffusive” silver-in-oxide memristor with two Pt or Au inert electrodes sandwiching a switching layer of a dielectric film with embedded Ag nanoclusters. The device is essentially a volatile memristor where Ag atoms diffuse under the influence of electrical bias. Metallic atoms like silver or copper diffuse through dielectric oxide materials similar to the way  $\text{Ca}^{2+}$  diffuses through channels in biological synapses. The devices might find use in a variety of applications in both neuromorphic computing and biology. [TECHNICAL ARTICLE](#)

*Tags: Neuroscience***Brain-sensing technology developed by Stanford scientists allows typing at 12 words per minute****EurekAlert, 12SEP2016**

The technology, developed by researchers at Stanford University, directly reads brain signals to drive a cursor moving over a keyboard. It involves a multi-electrode array implanted in the brain to directly read signals from a region that ordinarily directs hand and arm movements used to move a computer mouse. In addition to proving the technology, this study showed that the implanted sensor could be stable for several years.

[TECHNICAL ARTICLE](#)*Tags: Neuroscience, Biotechnology, Sensors***PHOTONICS****Focused light in the Terahertz regime consisting of a broad spectrum of wavelengths****PhysOrg.com, 30SEP2016**

Researchers in Austria drilled tiny holes into a quantum cascade laser at randomly selected positions, turning it into a random laser which led to a well-focused beam shining straight upwards. The reason lies in the way the different wavelengths add up to one single beam. Certain frequencies may be emitted in different directions, but if we look at the total intensity of all frequencies combined, almost all the radiation shines into the direction in which the holes were drilled. For the first time, a new kind of laser is available which emits broadband terahertz radiation into a well-defined direction—a crucial step towards practical applications of random lasers in everyday technology. The researchers are working to reach an even larger spectral bandwidth. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Photonics, Terahertz technology***Optical forces used to make rewritable 3-D holographic materials****PhysOrg.com, 30SEP2016**

An international team of researchers (UK, USA - MIT, Harvard Medical School) expanded the potential applications of optical forces by demonstrating that they can be applied to reversibly arrange large numbers of silver nanoparticles in well-defined 3D patterns inside a solid material. Information is stored in these patterns, and rearranging them depends on the number, energy, and angle of the laser pulses. The new material has potential applications in 3D holographic displays, large-scale volumetric data storage devices, biosensors, tunable lasers, optical lenses, and metamaterials. [OPEN ACCESS TECHNICAL ARTICLE 1](#), [TECHNICAL ARTICLE 2](#)

*Tags: Photonics***QUANTUM SCIENCE****Quantum research race lights up the world****PhysOrg.com, 30SEP2016**

At the forefront of the candidates to implement quantum technologies is the field of quantum photonics. An international team of researchers (Australia, USA - MIT) has laid out a road map showing what needs to be done to realise quantum emitters that are good enough for real-world technologies. The next frontier of research is the development of non-classical light sources: sources that produce streams of photons with controllable quantum relationships. It is therefore the right time to dedicate resources to scalability, optimisation and applicability of these emitters to real devices. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Quantum science, S&T Policy***First quantum photonic circuit with an electrically driven light source****Science Daily, 27SEP2016**

An international team of researchers (Germany, Poland, Russia) has succeeded in placing a complete quantum optical structure on a chip. They report the observation of antibunching in the light emitted from an electrically driven carbon nanotube embedded within a photonic quantum circuit. Non-classical light generated on chip is recorded under cryogenic conditions with waveguide-integrated superconducting single-photon detectors, without requiring optical filtering. Because exclusively scalable fabrication and deposition methods are used, their results establish carbon nanotubes as promising nanoscale single-photon emitters for hybrid quantum photonic devices. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

## [Quantum computing advances with researchers' control of entanglement](#)

Science Daily, 27SEP2016

By modifying the time-domain multiplexing experiment, an international team of researchers (Japan, Australia) demonstrated the successive generation of fully inseparable light modes for more than one million modes. The resulting multi-mode state is useful as a dual-rail continuous variable cluster state. They circumvented the previous problem of optical phase drifts, which has limited the number of fully inseparable light modes to around ten thousand, by continuous feedback control of the optical system. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Quantum science*

## S&T POLICY

### [Small Modular Nuclear Reactors Could Run in the U.K. by 2030](#)

MIT Technology Review, 30SEP2016

A new report by the U.K.'s government-backed Energy Technologies Institute outlines what it considers to be a reasonable timeline for the country to adopt the new reactors, estimating that they could be in use by 2030. Earlier this year, the Tennessee Valley Authority applied for a permit to build the first such reactor in the United States. If all goes as planned, the facility could be up and running by the mid-2020s.

Tags: *S&T policy, Nuclear energy*

## SENSORS

### [Algorithm could enable visible-light-based imaging for medical devices, autonomous vehicles](#)

PhysOrg.com, 30SEP2016

Researchers at MIT have developed a technique for recovering visual information from light that has scattered because of interactions with the environment—such as passing through human tissue. The technique could lead to medical-imaging systems that use visible light, which carries much more information than X-rays or ultrasound waves, or to computer vision systems that work in fog or drizzle. The development of such vision systems has been a major obstacle to self-driving cars. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Sensors*

## [Strange blackouts hits Space satellites near Equator](#)

Technical University of Denmark, 30SEP2016

The loss of signals occurs in particular when the satellites pass the equator between Africa and South-America. Researchers in Germany report that there is a direct link between these GPS blackouts and ionospheric 'thunderstorms' that appear frequently in space in this area some 300 to 600 kilometers above Earth. They typically occur for one or two hours between sunset and midnight, and cause loss of the GPS signal from the satellites for some minutes. An ionospheric thunderstorm appears as turbulence in the distribution of free electrons. The 'storm' tears away or scatters the electrons and creates small 'bubbles' with little or no ionized material. At these areas, the GPS' electromagnetic waves are bent and scattered so the signal to the satellite is lost. [TECHNICAL ARTICLE](#)

Tags: *Sensors, S&T Germany* ■

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