



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [Physicists create first photonic Maxwell's demon](#)

[PhysOrg.com, 12FEB2016](#)

An international team of researchers (UK, Italy, Singapore) has shown that measurements made on two light beams can be used to create an energy imbalance between the beams from which work can be extracted. One of the interesting things about this experiment is that the extracted work can then be used to charge a battery, providing direct evidence of the “demon’s” activity. [TECHNICAL ARTICLE](#)

*Tags: Energy, Featured Article*

### [GPS tracking down to the centimeter](#)

[Science Daily, 11FEB2016](#)



*The new technology will enable users to access centimeter-level accuracy location data through their mobile phones and wearable technologies, without increasing the demand for processing power. Credit: UC Riverside*

High accuracy can be achieved by combining GPS measurements with data from an inertial measurement unit (IMU) and solving for the integers which is computationally expensive. Researchers at UC Riverside

have developed a new approach that results in highly accurate positioning information with several orders of magnitude fewer computations. The optimization will be used in the development of autonomous vehicles, improved aviation and naval navigation systems, and precision technologies. It will also enable users to access centimeter-level accuracy location data through their mobile phones and wearable technologies without increasing the demand for processing power.

[TECHNICAL ARTICLE](#)

*Tags: Sensors, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MATERIALS

#### [A new form of frozen water? Scientists reveal new ice with record-low density](#)

[PhysOrg.com, 12FEB2016](#)

An international team of researchers (China, USA - University of Nebraska) proposes a new molecular slippery form of ice which is about 25 percent less dense than a record-low form synthesized by a European team in 2014. They used a computational algorithm and molecular simulation to determine the ranges of extreme pressure and temperature under which water would freeze into the predicted configuration. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science*

#### [Graphene leans on glass to advance electronics](#)

[Science Daily, 12FEB2016](#)

A team of researchers in the US (Brookhaven National Laboratory, Stony Brook University, SUNY Polytechnic Institute) has developed a simple and powerful method for creating resilient, customized, and high-performing graphene by layering it on top of common glass. This scalable and inexpensive process helps pave the way for a new class of microelectronic and optoelectronic devices—everything from efficient solar cells to touch screens. [TECHNICAL ARTICLE](#)

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

#### [Scientists create ultrathin semiconductor heterostructures for new technologies](#)

[Science Daily, 12FEB2016](#)

By precisely aligning the crystal lattices of tungsten diselenide and molybdenum diselenide, an international team of researchers (USA - University of Washington, Oak Ridge National Laboratory, University of Tennessee, University of Washington, China) was able to excite the heterostructure with a laser and create optically active excitons between the two layers. The excitons at the interface can store valley information for orders of magnitude longer than either of the layers on their own.

*continued..*

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This may lead to further optical and electronic applications with valley functionality. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Government S&T*

### [Scientists discover electrons moving like honey in graphene](#)

Nanowerk, 12FEB2016

An international team of researchers (UK, Italy, the Netherlands) observed that the electric current in graphene did not flow along the applied electric field, as in other materials, but travelled backwards forming whirlpools where circular currents appeared. The electron fluid can be 100 times more viscous than honey, even at room temperature. The breakthrough is important for understanding how materials work at increasingly smaller sizes because such whirlpools are more likely to appear at micro and nanoscale. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science*

### [A metal that behaves like water](#)

Science Daily, 11FEB2016

The electrons in graphene act like massless relativistic objects, some with positive charge and some with negative charge. They move at incredible speed -- 1/300 of the speed of light -- and have been predicted to collide with each other ten trillion times a second at room temperature. An international team of researchers (USA - Harvard University, BBN, Canada, Japan) observed these intense interactions between charge particles for the first time. This research could lead to novel thermoelectric devices as well as provide a model system to explore exotic phenomena like black holes and high-energy plasmas.

[TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

### [A super-thin acoustic metasurface for perfect sound absorption](#)

Nanowerk, 11FEB2016

Researchers in France designed an acoustic absorber in which sound waves enter an internal coiled air channel through a perforated center hole. This forces the acoustic waves to travel through the channel, effectively increasing the total propagation length of the waves and leading to an effective low sound velocity and high acoustic refractive index. The technique has applications in tunable amplitude and phase profile for acoustic engineering, as well as manipulating particles with a vortex wavefront.

[TECHNICAL ARTICLE](#)

*Tags: Advanced materials, S&T France*

## AUTONOMOUS SYSTEMS & ROBOTICS

### [Intelligent robots threaten millions of jobs](#)

PhysOrg.com, 14FEB2016

According to researchers at Rice University advances in artificial intelligence will soon lead to robots that are capable of doing nearly everything humans do,

threatening tens of millions of jobs in the coming 30 years. What is concerning about these new technologies is their ability to analyze data and execute complex tasks. This raises concerns about whether humans might one day lose control of the artificial intelligence they once built.

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

### [Using stories to teach human values to artificial agents](#)

PhysOrg.com, 12FEB2016

The rapid pace of AI has raised fears about whether robots could act unethically or soon choose to harm humans. Researchers at the Georgia Institute of Technology have developed a technique called Quixote for aligning an AI's goals with human values by placing rewards on socially appropriate behavior. It builds upon their prior research, the Scheherazade system, which demonstrated how artificial intelligence can gather a correct sequence of actions by crowdsourcing story plots from the Internet.

[TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics, Artificial intelligence*

## BIOTECHNOLOGY

### [Scientists prove feasibility of 'printing' replacement tissue](#)

Science Daily, 15FEB2016

Using a sophisticated, custom-designed 3-D printer, researchers at Wake Forest School of Medicine have proved that it is feasible to print living tissue structures to replace injured or diseased tissue in patients. It can fabricate stable, human-scale tissue of any shape. With further development, this technology could potentially be used to print living tissue and organ structures for surgical implantation. [TECHNICAL ARTICLE](#)

*Tags: Biotechnology*

### [Researchers create 'mini-brains' in lab to study neurological diseases](#)

Science Daily, 12FEB2016

Researchers at Johns Hopkins University have created three-dimensional "mini-brains" using induced pluripotent stem cells. They are very small—at 350 micrometers in diameter, or about the size of the eye of a housefly. Performing research using these balls of brain cells that grow and form brain-like structures on their own over the course of eight weeks should be superior to studying mice and rats because they are derived from human cells instead of rodents.

*Tags: Biotechnology, Neuroscience*

### [By switching 'bait,' biologists trick plants' bacterial defense into attacking virus](#)

Science Daily, 11FEB2016

Researchers at Indiana University have modified a single, minor gene in a plant that normally fights bacterial

*continued...*

“The only way to do great work is to love what you do.”

STEVE JOBS

infection to confer resistance to a virus. Their results suggest this method is broadly applicable to a wide swath of diseases affecting plants of economic importance. This not only includes viral and bacterial infections but also diseases caused by fungi, oomycetes and nematode worms. Globally, crop diseases affect billions of people each year through lost revenue and food supply. [TECHNICAL ARTICLE](#)

*Tags: Biotechnology*

## COMMUNICATIONS TECHNOLOGY

### [Record for fastest data rate set](#)

[Science Daily, 11FEB2016](#)

While current state-of-the-art commercial optical transmission systems are capable of receiving single channel data rates of up to 100 gigabits per second, researchers in the UK are designing the next generation core networking and communications systems that can handle data signals at rates in excess of 1 terabit per second. They achieved a rate of 1.125 Tb/s as part of research on the capacity limits of optical transmission systems designed to address the growing demand for fast data rates. [TECHNICAL ARTICLE](#)

*Tags: Communications technology, S&T UK*

### [Silicon chip with integrated laser: Light from a nanowire](#)

[Science Daily, 11FEB2016](#)

Researchers in Germany have developed a nanolaser, a thousand times thinner than human hair. Thanks to an ingenious process, the nanowire lasers grow right on a silicon chip, making it possible to produce high-performance photonic components cost-effectively. This will pave the way for fast and efficient data processing with light in the future. [TECHNICAL ARTICLE 1, 2](#)

*Tags: Communications technology, Photonics, S&T Germany*

### [Terahertz wireless technology could bring fiber-optic speeds out of a fiber](#)

[Science Daily, 10FEB2016](#)

Researchers in Japan have developed a terahertz transmitter capable of signal transmission at a per-channel data rate of over ten gigabits per second over multiple channels at around 300 GHz. The aggregate multi-channel data rate exceeds one hundred gigabits per second. The transmitter was implemented as a silicon CMOS integrated circuit, which would have a great advantage for commercialization and consumer use.

*Tags: Communications technology, S&T Japan*

## ENERGY

### [New photoelectrode that boosts the ability of solar water-splitting to produce hydrogen](#)

[Asia Research News, 15FEB2016](#)

Researchers in South Korea have developed a new type of multilayered (Au NPs/TiO<sub>2</sub>/Au) photoelectrode that boosts the ability of solar water-splitting to produce hydrogen. According to the research team, this special photoelectrode, inspired by the way plants convert sunlight into energy, is capable of absorbing visible light from the sun and using it to split water molecules into hydrogen and oxygen. [TECHNICAL ARTICLE](#)

*Tags: Energy*

### [UK science leads the way in nuclear research](#)

[PhysOrg.com, 14FEB2016](#)

Some radioactive wastes can take hundreds of thousands of years to decay to safe levels, so scientists are trying to uncover the long-term result of interaction between radionuclides and their surroundings over these long timescales. Researchers in the UK are studying the way cement—an important material used in the storage and disposal of radioactive waste—reacts with water as it becomes hydrated over a period of hundreds of years. This important work may help to inform the UK's policy on radioactive waste disposal.

*Tags: Energy, S&T Policy, S&T UK*

### [Power walk: Footsteps could charge mobile electronics](#)

[Science Daily, 11FEB2016](#)

The energy harvester technology, developed by researchers at the University of Wisconsin-Madison, is based on the bubbler method which combines reverse electrowetting with bubble growth and collapse. The proof-of-concept bubbler device generated around 10 watts per square meter in preliminary experiments. Theoretical estimates show that up to 10 kilowatts per square meter might be possible. The harvester could directly power various mobile devices through a charging cable, or it could be integrated with a broad range of electronic devices embedded in a shoe. [TECHNICAL ARTICLE](#)

*Tags: Energy, Battery*

### [Room-temperature lithium metal battery closer to reality](#)

[Science Daily, 10FEB2016](#)

To screen out dendrites, researchers at Cornell University

cross-linked the nanoparticle-tethered polyethylene oxide with polypropylene oxide to yield mechanically robust membranes that are easily infiltrated with liquid electrolytes. This produces structures with good conductivity at room temperature while still preventing dendrite growth.

#### TECHNICAL ARTICLE

*Tags: Energy, Battery, Materials science*

### **Spin waves out of waste heat: Researchers present new findings on magnetic spin waves**

Science Daily, 10FEB2016

Contrary to conventional thermoelectric effects, the spin Seebeck effect also enables the recovery of heat energy in magnetic insulators in combination with a thin metallic layer. An international team of researchers (Germany, Japan, the Netherlands) demonstrated that the origin of the spin Seebeck effect can be understood as thermally excited spin waves within the magnetic solid. The thermal spin waves present a way for recovering energy from waste heat. TECHNICAL ARTICLE

*Tags: Energy, Materials science*

## FEATURED RESOURCE

### **Inside Science**

Inside Science provides editorially independent research news and information on science, engineering, mathematics, and related fields for general audiences. [RSS](#)

## IMAGING TECHNOLOGY

### **New imaging system uses an open-ended bundle of optical fibers—no lenses, protective housing needed**

PhysOrg.com, 12FEB2016

In the new imaging device developed by researchers at MIT, a loose bundle of optical fibers are connected to an array of photosensors at one end; the opposite ends can be left to wave freely, so they could pass individually through micrometer-scale gaps in a porous membrane to image whatever is on the other side. The fibers could be fed through pipes and immersed in fluids, to image oil fields, aquifers, or plumbing, without risking damage to watertight housings. They propose to use time of flight to enable a new interface for imaging. TECHNICAL ARTICLE

*Tags: Imaging technology*

## INFORMATION TECHNOLOGY

### **Twisting magnets**

Nanowerk, 10FEB2016

An international team of researchers (Japan, UK, Russia) has succeeded in experimentally verifying the properties

of crystals of chiral magnetic materials which may lead to the development of new types of magnetic memories with unprecedented storage capacities. The capacity of a storage memory device composed of 10 new element devices made from chiral magnets, each of which has 10 discrete states, will be about 10 million times larger than that of a conventional magnetic storage memory with the same number of conventional element devices. TECHNICAL ARTICLE

*Tags: Information technology, Advanced materials*

## MATERIALS SCIENCE

### **Bumpy liquid films could simplify fabrication of microlenses**

Science Daily, 11FEB2016

Researchers in Germany combined the highly regular convection pattern that forms in thicker layers with strong interfacial deformations possible only in much thinner liquid films. The flow pattern in the thicker layer deforms the thinner film beneath. The technique has applications in fabricating microlens arrays, unconventional photolithography, and photovoltaic systems. TECHNICAL ARTICLE

*Tags: Materials science, S&T Germany*

### **Scientists gain insights into ‘forbidden’ chemistry**

Science Daily, 10FEB2016

An international team of researchers (Russia, USA - Stony Brook University, China) found that reorganisation of the chemical interactions results in the stability of the ‘new’ structure of the compounds. They derived a simple model and formulated the basic principles of stability of ‘forbidden’ substances. In addition, the scientists updated the phase diagram of compounds formed by Na and Cl: they added one new compound, Na<sub>4</sub>Cl<sub>3</sub>, and two new phases of Na<sub>3</sub>Cl. TECHNICAL ARTICLE

*Tags: Materials science*

*Tags: Materials science, S&T France*

## PHOTONICS

### **Optical rogue waves reveal insight into real ones**

PhysOrg.com, 10FEB2016

Researchers in the UK propose a new mechanism where optical rogue waves could form by a sequence of events that starts with a small instability in the regular wave pattern. The pattern instability first leads to a phase instability, then leads to an amplitude instability and eventually creates swirling vortices. If there are enough vortices, then multi-vortex collisions can occur and produce a large, short-lived spike—the optical equivalent of a rogue wave. The research could help ships avoid rogue waves. TECHNICAL ARTICLE

*Tags: Photonics, S&T UK*

## QUANTUM SCIENCE

### [A new spin on quantum computing: Scientists train electrons with microwaves](#)

Science Daily, 15FEB2016

An international team of researchers (France, UK, Israel, USA - Lawrence Berkeley National Laboratory) has switched an intrinsic property of electrons from an excited state to a relaxed state on demand using a device that served as a microwave 'tuning fork.' The findings could also lead to enhancements in magnetic resonance techniques, which are widely used to explore the structure of materials and biomolecules, and for medical imaging. [TECHNICAL ARTICLE](#)

Tags: *Quantum science, Information technology*

### [Crunching quantum code](#)

MIT News, 12FEB2016

Researchers at MIT propose an error correction method for quantum computing based on Majorana fermions. They utilized quantum phase slips in an array of Josephson-coupled mesoscopic topological superconductors, which can be implemented in a wide range of solid-state systems, including topological insulators, nanowires, or two-dimensional electron gases, proximitized by s-wave superconductors. Their model finds a natural application as a Majorana fermion surface code for universal quantum computation, with a single-step stabilizer measurement requiring no physical ancilla qubits, increased error tolerance, and simpler logical gates than a surface code with bosonic physical qubits.

[TECHNICAL ARTICLE](#)

Tags: *Quantum science*

### [Quantum potential: Where light and matter co-exist](#)

Science Daily, 09FEB2016

Plasmons can strongly modify the behavior of nearby light, and could be instrumental in building some of the key components of a quantum circuit. To understand how light and matter interact in the vicinity of plasmonic nanoparticles, researchers at Rensselaer Polytechnic Institute use super-resolution imaging.

Tags: *Quantum science*

## S&T POLICY

### [China says it'll have a meltdown-proof nuclear reactor ready by next year](#)

Science Alert, 15FEB2016

The reactor is what's known as a high-temperature, gas-cooled, pebbled-bed reactor, and it prevents meltdown from happening in two ways. Firstly, the uranium fuel is encased in graphite spheres, roughly the size of tennis balls—these are the pebbles—which means the fuel can't break down, even if the temperature does pass a certain threshold. But more importantly, the reactor is constantly blasted with helium gas to keep the system running at 950 degrees Celsius. While the technology behind the reactor originated in Germany decades ago, this is the first time the design will be built on a commercial scale anywhere in the world.

Tags: *S&T policy, Nuclear energy, S&T China*

## SCIENCE WITHOUT BORDERS

### [You've heard of string theory. What about knot theory?](#)

Science Daily, 10FEB2016

Knot theory seeks to encode information about knots into algebraic expressions that can distinguish one knot from another. A formula capable of describing every knot uniquely remains elusive. The study of knots could have applications in surprising areas—it could enable security firms to create better encryption systems, or elucidate the mysteries of how the body unravels DNA.

Tags: *Science without borders, Mathematics* ■

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