



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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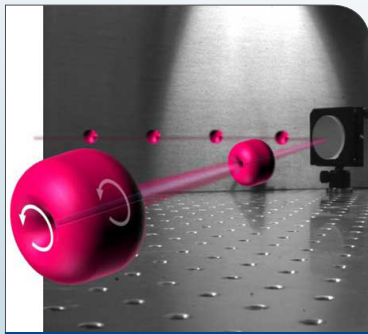
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## FEATURE ARTICLES

### [Physicists discover ‘smoke rings’ made of laser light](#)

[Nanowerk, 09SEP2016](#)



*Orbital angular momentum (OAM) vortices (pink ringlike objects) are three-dimensional laser light structures that rotate around a central beam, much like water circles around a drain. (Image: Howard Milchberg)*

Researchers at the University of Maryland have discovered that self-focused laser pulses also generate violent swirls, donut-shaped light structures of optical energy, known as “spatiotemporal optical vortices,” that strongly resemble smoke rings. In these the light energy flows through the inside of the ring and then loops back around the outside. The

vortices travel along with the laser pulse at the speed of light and control the energy flow around it. They may have even broader applications than previously known optical vortices, because they are time dynamic, meaning that they move along with the beam instead of remaining stationary. The rings may be useful for manipulating particles moving near the speed of light and have the potential to expand the effective bandwidth of fiber-optic communication lines. [TECHNICAL ARTICLE](#)

*Tags: Photonics, Featured Article*

### [The enigma machine takes a quantum leap](#)

[Science Daily, 06SEP2016](#)

Quantum data locking was thought to have limitations for securely encrypting messages, but researchers at the University of Rochester figured out how to make additional assumptions—namely those involving the boundary between light and matter—to make it a more secure method of sending data. While a binary system allows for only an on or off position with each bit of information, photon waves can be altered in many more ways: the angle of tilt can be changed, the wavelength

can be made longer or shorter, and the size of the amplitude can be modified. Since a photon has more variables—and there are fundamental uncertainties when it comes to quantum measurements—the quantum key for encrypting and deciphering a message can be shorter than the message itself.

*Tags: Communications technology, Quantum science, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MATERIALS

#### [Metal in chains](#)

[PhysOrg.com, 13SEP2016](#)

An international team of researchers (Switzerland, Russia) found iridium tetrafluoride to exhibit a hitherto unknown peculiarity. In it the energy bands touch along interconnected nodal loops, and those nodal loops form a chain. The nodal chains are dictated by the symmetries of the material’s crystal lattice. The properties could be technologically interesting. [OPEN ACCESS](#)

[TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

#### [Tuning materials and devices to adapt to their environment](#)

[PhysOrg.com, 13SEP2016](#)

By using extremely high-quality epitaxial materials, researchers at UC Santa Barbara were able to greatly reduce the dielectric loss in ferroelectric tunable radio-frequency capacitors. Advances at the fundamental level, such as this one, open the door for adaptive or reconfigurable electronic systems—particularly high-frequency communications. Barium strontium titanate devices can also be used to create low-cost phase-shifter devices for phased-array antennas in mobile satellite communication systems. [OPEN ACCESS](#)

[TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science*

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## [A versatile method to pattern functionalized nanowires](#)

Nanowerk, 09SEP2016

To create the tandem structure, researchers in Japan used structure-controllable amyloid peptides (SCAPs) to make initial amyloid fibrils which were used as a template and to allow another type of amyloid peptide to extend from the starting fibrils. Analysis showed a 67% tandem yield, three times higher than the efficiency yield of previous studies. A few geometrical patterns could be controlled by adjusting the peptide mix ratio. This method is applicable to the self-assembly of nano wires for nano electrodes created by lithography. It could also be used to prepare a wide variety of fibril patterns and hence open up new avenues for the development of novel self-assembled nano devices. [OPEN SOURCE TECHNICAL ARTICLE](#)

Tags: *Advanced materials, S&T Japan*

## [Containing our 'electromagnetic pollution'](#)

Science Daily, 08SEP2016

An international team of researchers (South Korea, Drexel University) suggest that a few-atoms thin titanium carbide, one of about 20 two-dimensional materials in the MXene family, can be more effective at blocking and containing electromagnetic interference. The key to MXene's performance lies in its high electrical conductivity and two-dimensional structure. When electromagnetic waves come in contact with MXene, some are immediately reflected from its surface, while others pass through the surface but they lose energy amidst the material's atomically thin layers. The lower energy electromagnetic waves are eventually reflected back and forth off the internal layers until they're completely absorbed in the structure. It is extremely thin and easily applied like paint. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

## [Sound-proof metamaterial inspired by spider webs](#)

PhysOrg.com, 07SEP2016

An international team of researchers (France, Italy, UK) found that the spider web architecture, combined with the variable elastic properties of radial and circumferential silk, is capable of attenuating and absorbing vibrations in wide frequency ranges, despite being lightweight. Combined with the stiffening mechanical properties and the heterogeneity of spider silk, the tunable acoustic properties demonstrated here suggest that spider-web-inspired metamaterials could lead to a new class of applications for controlling vibrations. Possibilities include earthquake protection for suspended bridges and buildings, noise reduction, sub-wavelength imaging, and acoustic cloaking. [OPEN SOURCE TECHNICAL ARTICLE](#)

Tags: *Advanced materials, Biomimetics*

## [Nanotubes morphed into tougher carbon for spacecraft, satellites](#)

Science Daily, 06SEP2016

An international team of researchers (USA - Rice University, Brazil) reports that ballistic fracturing of carbon nanotubes at different velocities caused atomic bonds in the nanotubes to break and sometimes recombine into different structures. Knowing how the atomic bonds of nanotubes can be recombined will give scientists clues to develop lightweight materials by rearranging those bonds. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

## [Researchers design solids that control heat with spinning superatoms](#)

Science Daily, 06SEP2016

Superatom crystals are periodic arrangements of C60 fullerenes with nearly identical formations, one that has rotating 60s and one that has fixed C60s. A team of researchers in the US (Columbia University, Carnegie Mellon University) discovered that the formation that contained rotating C60s has low thermal conductivity while the formation with fixed C60s has high thermal conductivity. Potential for applications of superatom crystals include sustainable energy generation, energy storage, and nanoelectronics. Additional research could lead to controlling rotational disorder in new kinds of thermal switches and transistors. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials, Materials science*

## AUTONOMOUS SYSTEMS & ROBOTICS

### [Team of robots learns to work together, without colliding](#)

Science Daily, 07SEP2016

When you have too many robots together, they get so focused on not colliding with each other that they eventually just stop moving. Algorithms developed by researchers at Georgia Institute of Technology allow any number of robots to move within inches of each other, without colliding, to complete their task. They are using a set of safe states and barrier certificates to ensure each stays in its own safe set throughout the entire maneuver. The system allows the robots to make the minimum amount of changes to their original behaviors in order to accomplish the task and not smack into each other. [OPEN SOURCE TECHNICAL ARTICLE](#)

Tags: *Autonomous systems & robotics*

## BIG DATA

### [Datacenter-on-chip: Researchers target a new paradigm for big data computing](#)

PhysOrg.com, 12SEP2016

A team of researchers in the USA (Carnegie Mellon University, Washington University) working on a NSF funded project propose a new Datacenter-on-a-Chip design

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“The greatest danger in modern technology isn’t that machines will begin to think like people, but that people will begin to think like machines.” UNKNOWN

consisting of thousands of cores that communicate via a new communication infrastructure, while provisioning the system resources for the necessary power, performance, and thermal trade-offs. From an intellectual perspective, this approach lies squarely at the intersection of two major trends in integrated systems design, namely low power and communication centric design.

*Tags: Big data*

## BIOTECHNOLOGY

### Singapore scientists develop DNA-altering technology to tackle diseases

[Science Daily, 13SEP2016](#)

Researchers in Singapore have developed a new protein named iCas that can be easily controlled by an external chemical input and thus solves some of the problems with CRISPR-Cas. It was found to outperform other chemical-inducible CRISPR-Cas technologies, with a much faster response time and an ability to be switched on and off repeatedly. The higher speed at which iCas reacts will enable tighter control over exactly where and when DNA editing takes place. [TECHNICAL ARTICLE](#)

*Tags: Biotechnology, Medical sciences*

## COMMUNICATIONS TECHNOLOGY

### Researchers use hardware to accelerate core-to-core on-chip communication

[Science Daily, 06SEP2016](#)

A team of researchers in the US (North Carolina State University, industry partner) has developed a chip design called core-to-core communication acceleration framework (CAF). The key to the CAF design is a queue management device (QMD), which is a small device attached to the processor network on a chip. The QMD is capable of simple computational functions and effectively keeps track of communication requests between cores without having to rely on software routines. It improves communication performance by two to 12 times.

*Tags: Communications technology, Microelectronics*

## CYBER SECURITY

### Setting up a decoy network may help deflect a hacker’s hits

[Science Daily, 09SEP2016](#)

Researchers at Pennsylvania State University created a computer defense system that senses possible malicious probes of the network and then redirects that attack to a virtual network that offers little information about the real network. They simulated both the attack and defense without using an actual network. The prototype was able

to sense the incoming scan and deflect it to a shadow network. As the reflector can act as a regular network device when no malicious attacks are present, there should be little effect on the real network’s performance and functionality.

*Tags: Cyber security*

## ENERGY

### En route to better transformers

[PhysOrg.com, 07SEP2016](#)

An international team of researchers (Switzerland, Germany) report that magnetic orientation within each domain is uniform. A transformer’s iron core is re-magnetized 100 times per second, being re-poled from north to south and vice versa in rapid succession. The greater the domain wall (boundaries between the domains) flexibility, the better the transformer performs. Improving transformer efficiency by even just a few percent would lead to savings equating to the power production of several power stations. [TECHNICAL ARTICLE 1, 2](#)

*Tags: Energy, S&T EU*

### New applications for ultracapacitors

[MIT News, 07SEP2016](#)

Ultracapacitors have recently become attractive forms of energy storage: They recharge in seconds, have very long lifespans, work with close to 100 percent efficiency, and are much lighter and less volatile than batteries. But they suffer from low energy-storage capacity. Based on MIT research, a company in the US has developed ultracapacitors which store up to 10 times the energy, achieve 10 times the power density of commercial counterparts and withstand temperatures reaching as high as 300 degrees Celsius and as low as minus 110 C.

*Tags: Energy*

### Body heat as a power source

[Nanowerk, 06SEP2016](#)

It is not easy to make use of body heat our muscle activity and metabolism produce. Researchers in China are making use of the potential difference generated in the thermogalvanic effect. They arranged two types of cells into a checkerboard pattern. The cells were connected to each other by metal plates alternating above and below, to link them into a series. They then integrated this “checkerboard” into a glove. When the glove is worn, the desired temperature difference results between the upper and lower plates. This produces a voltage between neighboring cells, and the voltage adds up, making it possible to generate current to power a device or charge a battery. [TECHNICAL ARTICLE](#)

*Tags: Energy, S&T China*

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## ENVIRONMENTAL SCIENCE

**Unprecedented atmospheric behavior disrupts one of Earth's most regular climate cycles**[Science Daily, 08SEP2016](#)

The normal flow of stratospheric winds high above the equator, known as the quasi-biennial oscillation, was seen to break down earlier this year. The quasi-biennial oscillation alternate every 28 to 29 months, making them very predictable in the long term. An international team of researchers (UK, USA - University of Hawaii, Canada) show that this unexpected change in wind direction was caused by atmospheric waves in the Northern Hemisphere. This is important as it is one of the factors that will influence the coming winter. International research groups will meet in Oxford to discuss the origins and implications of this event. [TECHNICAL ARTICLE](#)

*Tags: Environmental science, Climatology*

## FEATURED RESOURCE

**Chinese Academy of Sciences**

CAS has 117 institutes, more than 100 national key laboratories and national engineering research centers, and about 1,000 field stations throughout the country. Links to many English language journals and contents and English abstracts of Chinese articles authored by CAS scientists are provided.

## INFORMATION TECHNOLOGY

**MEPhI helps to create memory nanoelements for satellites**[PhysOrg.com, 07SEP2016](#)

An international team of researchers (Russia, USA - University of Georgia) has developed a new technology for creating iron-nickel alloy magnetic memory elements which have magnetic properties that allow changing the form of the triangular nanostructure. Such magnetic nanostructures can function as logic cells because the state of magnetization in its top is explained by the magnetization of two other tops. The memory arrays are radiation resistant, have high stability of information storage and energy efficiency. Their power consumption is about 0.1 microwatt, which is an order less than CMOS transistors.

*Tags: Information technology*

**Intelligent technology—the evolution and future of automation**[PhysOrg.com, 31AUG2016](#)

According to researchers in China, IT is no longer “information technology”—the new IT is intelligent technology.

They argue that core principles of automation and AI must be reconsidered as the world navigates an IT paradigm shift. They sketch the progress of robotic and neural machine-human interaction in a timeline of five “control” eras.

*Tags: Information technology, Artificial intelligence, S&T China*

## MATERIALS SCIENCE

**Breakthrough in materials science: Research team can bond metals with nearly all surfaces**[PhysOrg.com, 07SEP2016](#)

Researchers in Germany developed a process to convert the surface of a metal into a semiconductor, which can be chemically etched and thereby specifically modified as desired. Unlike other etching processes, their process does not damage the metals, and does not affect their stability. Through this process it is possible to permanently connect metals which could previously not be directly joined, such as copper and aluminium. [TECHNICAL ARTICLE](#)

*Tags: Materials science, S&T Germany*

**Expanding when it shouldn't: New material with exceptional negative compressibility**[Science Daily, 07SEP2016](#)

Researchers in Poland found that sodium amidoborane, Na(NH<sub>2</sub>BH<sub>3</sub>) has very high negative compressibility, of up to 10% in one direction. The elongation occurred abruptly at a pressure of approx. 30 thousand atmospheres. The negative compressibility of sodium amidoborane crystals has to be a consequence of the elongation of the chemical bonds between nitrogen and hydrogen and boron and nitrogen, caused by the abrupt formation of new hydrogen bonds between adjacent molecules in the crystal. The discovery opens up interesting avenues in the search for new materials with similarly exotic physical properties. Potential applications include components of detectors, and bulletproof vests. [TECHNICAL ARTICLE](#)

*Tags: Materials science, Advanced materials*

**New breed of optical soliton wave discovered**[PhysOrg.com, 06SEP2016](#)

Researchers at CalTech describe the new type of soliton, dubbed the “Stokes soliton” which rides along with another soliton—essentially, in the other soliton’s wake. It also siphons energy off of the other soliton so that it is self-sustaining. It can eventually grow larger than its host. Solitons have applications in the creation of highly accurate optical clocks, and can be used in microwave oscillators that are used for navigation and radar systems. [TECHNICAL ARTICLE](#)

*Tags: Materials science*



## PHOTONICS

**[Plasmonics - Lighting the way to miniature devices](#)**

Nanowerk, 09SEP2016

Researchers in Singapore created plasmons by applying a voltage across a thin thiol layer. Although thiol is an insulator, the layer was thin enough for electrons to quantum tunnel between the electrodes, exciting plasmons on the thiol layer's surface in the process. The plasmons then decayed into photons. The light came from very small spots that blink at different frequencies. The light was polarized, and both the polarization and the wavelength of the light varied with the voltage applied across the junction. The research opens up the potential to integrate plasmonic light sources on to silicon-based circuits, replacing large external light sources such as a laser. [TECHNICAL ARTICLE](#)

Tags: Photonics

**[Light pushes liquid uphill](#)**

Physics World, 08SEP2016

Researchers in China have devised a new way of sending tiny amounts of liquid uphill and around bends. They do so using very narrow, artery-like structures made from a liquid crystal polymer that changes shape when exposed to light. Light can impart energy to fluids without direct contact, can be tuned over a wide range of wavelengths and power levels, provides excellent spatial and temporal resolution and is biocompatible. The technology could be used in laboratories-on-a-chip or in tiny mechanical systems activated by light. [TECHNICAL ARTICLE](#)

Tags: Photonics, S&amp;T China

## QUANTUM SCIENCE

**[A Chip-Scale Source for Quantum Random Number Generators](#)**

IEEE Spectrum, 08SEP2016

An international team of researchers (Spain, Italy) created a chip using fabrication techniques used to construct photonic integrated circuits. A small, pulsed indium phosphide laser infuses the system with randomness. Through spontaneous emission, the laser emits photons which create light with random phase. To transform these random phases into something usable, the pulsed light is mixed with light from a second indium phosphide laser on the chip. The phase of the first laser's pulses will ultimately impact how light from the two laser sources interfere with one another, creating certain brightness differences that can be read out by a photodetector. [OPEN SOURCE TECHNICAL ARTICLE](#)

Tags: Quantum science, Cyber security

## SCIENCE WITHOUT BORDERS

**[Researchers build world's largest database of crystal surfaces and shapes](#)**

PhysOrg.com, 13SEP2016

A team of researchers in the US (University of California San Diego, Lawrence Berkeley National Laboratory) has created the world's largest database of elemental crystal surfaces and shapes to date. Dubbed [Crystalium](#), this new open-source database can help researchers design new materials for technologies in which surfaces and interfaces play an important role, such as fuel cells, catalytic converters in cars, computer microchips, nanomaterials and solid-state batteries. [OPEN ACCESS TECHNICAL ARTICLE](#)  
Tags: Science without borders, Materials science

**[Breakthrough in moving small objects using acoustics \(w/video\)](#)**

PhysOrg.com, 09SEP2016

The prevailing view has been that the particle motion is random on the plate before they reached the nodal line. Researchers in Finland have shown that the motion is also predictable away from the nodal lines allowing more freedom in controlling its motion. The researchers have achieved independent control of up to six objects simultaneously using just one single actuator. The new method has been applied to manipulate a wide range of miniature objects including electronic components, water droplets, plant seeds, candy balls and metal parts. Some of the practical applications include conveying and sorting microelectronic chips, delivering drug-loaded particles for pharmaceutical applications or handling small liquid volumes for lab on chips. [OPEN SOURCE TECHNICAL ARTICLE](#)  
Tags: Science without borders

**[NIST and Navy tests suggest telecom networks could back up GPS time signals](#)**

PhysOrg.com, 08SEP2016

A team of researchers at NIST and Navy have identified a commercial fiber-optic telecommunications networks as a practical backup possibility if GPS goes down. In an experiment, time signals were sent at regular intervals in both directions between two locations. Researchers measured the differences between the remote (transmitted) and local time. The results showed UTC could be transferred with a stability of under 100 nanoseconds which meets a new telecommunications standard.

Tags: Science without borders, Government S&amp;T

**[R&D 100 Special Recognition Awards Finalists Announced](#)**

R&amp;D Magazine, 08SEP2016

For the second year, the R&D 100 Awards Committee will honor excellence in these four special recognition categories—Market Disruptor Services, Market Disruptor

Products, Corporate Social Responsibility, and Green Tech. The Special Recognition Market Disruptor Services Award is designed to highlight any service from any category as one that forever changed the R&D industry or a particular vertical within the industry. The Special Recognition Market Disruptor Products Award highlights any product from any category as one that has changed the game in any industry in the last year. [Detailed list of the 2016 R&D 100 Special Recognition Awards Finalists](#)

*Tags: Science without borders*

### [The Ethics of Human Enhancement](#)

[MIT Technology Review, 08SEP2016](#)

Recent scientific advancements increasingly allow humans to improve everything from memory to appearance. The most pressing issue is the degree to which the use of human enhancements requires a global response, rather than just domestic policy. While such work has led to research leadership in multiple countries, there's much more to do before we can achieve a clear sense of the global implications of human enhancement and formulate a reasonable strategy for managing it. [OPEN SOURCE](#)

[TECHNICAL ARTICLE](#)

*Tags: Science without borders*

### [New article-level metric measures the influence of scientific research](#)

[Science Daily, 06SEP2016](#)

Researchers at NIST have developed a new metric, known as the Relative Citation Ratio (RCR), which will allow researchers and funders to quantify and compare the influence of a scientific article. RCR measures a scientific publication's influence in a way that is article-level and field-independent. They describe a novel method for field-normalization: the co-citation network which is formed from the reference lists of articles that cite the article in question. The authors argue that this unique benchmarking step is particularly important as it allows 'apple to apples' comparisons in comparing groups of papers, e.g. comparing research output between similar types of institutions or between developing nations. [OPEN SOURCE](#)  
[TECHNICAL ARTICLE](#)

*Tags: Science without borders, Biomimetics, Government S&T* ■

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