



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [Researchers design sounds that can be recorded by microphones but inaudible to humans](#)

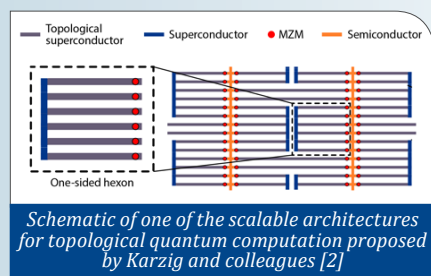
[Science Daily, 23JUN2017](#)

Researchers at the University of Illinois have designed a sound combining multiple tones and is transmitted from ultrasonic speakers, completely inaudible to humans. When interacting with the microphone's mechanics, it creates a "shadow," which is a sound that the microphones can detect. You can broadcast this inaudible signal, which translates to a white noise in the microphone, to prevent any spy microphones from recording voices. The technology could be used for secure and confidential meetings to protect from electronic eavesdropping, prevent unauthorized recording, send communication between Internet of Things (IoT) devices and protect users from unauthorized recording when communicating with voice-activated systems.

*Tags: Cyber security, Information technology, Featured Article*

### [Viewpoint: A Roadmap for a Scalable Topological Quantum Computer](#)

[American Physical Society Viewpoint, 21JUN2017](#)



The race to build a quantum computer has many competitors pursuing a variety of approaches, some of which appear to be on the verge of creating a small machine.

According to an international team of researchers (USA - UC Santa Barbara, Caltech, Denmark, Germany, Israel), small machines are unlikely to uncover truly macroscopic quantum phenomena. This will likely require a scalable approach to quantum computation. A new study brings together the expertise of a large and diverse group of physicists, ranging from experimentalists to

topologists, to lay out a roadmap for a scalable architecture based on one of the most popular approaches.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Quantum science, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

#### [Carbon Prints Amazing Materials](#)

[MIT Technology Review, 27JUN2017](#)

Researchers at MIT have developed a technology which enables Carbon to print polymer objects rapidly, in some cases thousands of times faster than other 3-D printers, and use a wider range of materials, including rubber-like elastomers and durable, hard plastics. They focused on overcoming the limitations of UV-curable polymers, developing blends that offer a wide range of properties. The system can now print with 12 classes of materials—some durable, some stretchy or squishy, some able to bear heavy weights.

*Tags: Advanced manufacturing*

#### [Computer scientists design flat sheets that transform themselves into smooth-surfaced, free-form objects](#)

[Physorg.com, 27JUN2017](#)

Researchers in Austria have developed both a material design and a new method of self-transformation they call "CurveUps." The computational tools were developed to take a user-provided 3D model and automatically create a 2D flattened template that, upon release, transforms into the original 3D version. As even small models will have hundreds or thousands of individual tiles, this represents an optimization problem of tremendous proportions. To get around this, the group implemented a two-step optimization procedure, which first gives an approximate solution, then performs local refinements before producing a final template. The research is a step toward the development of new fabrication technologies.

*Tags: Advanced manufacturing*

*continued...*

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**New 'gold standard' for flexible electronics**

Nanowerk, 27JUN2017

A team of researchers in the US (Missouri University of Science and Technology, Brown University) has developed a simple and inexpensive procedure in which gold was deposited from solution while applying an electric current onto an atomically ordered silicon wafer used as a template. The resulting gold film was crystalline. The ordered gold foil could be etched away. They demonstrated the viability of the gold films in flexible electronics applications by fabricating three types of devices.

TECHNICAL ARTICLE

Tags: *Advanced manufacturing***'Leadless' chip improves nanomanipulation**

Nanotechweb, 23JUN2017

Dielectrophoresis (DEP) is an established way to manipulate nanowires for nanoscale fabrication, but interference from the microelectrodes used to form the electric field can cause problems. Researchers in China have developed a "leadless" chip with a dot-matrix electrode pattern that produces a continuous, interference-free working area. The new device allows flexible and precise arrangement of nanowires into complex shapes. TECHNICAL ARTICLE

Tags: *Advanced manufacturing, China***ADVANCED MATERIALS****Ferroelectric domain walls make robust memories**

Nanotechweb, 23JUN2017

Ferroelectric domain walls are atomically sharp topological defects that separate regions of uniform polarization. The discovery of electrical conductivity in specific types of walls gave rise to "domain wall nanoelectronics," a technology in which the wall (rather than the domain) stores information. An international team of researchers (Australia, USA - Saint Louis University, University of Washington, China) demonstrates a prototype nonvolatile ferroelectric domain wall memory, scalable to below 100 nm, whose binary state is defined by the existence or absence of conductive walls. The device can be read out nondestructively at moderate voltages, exhibits relatively high OFF-ON ratios with excellent endurance and retention characteristics, and has multilevel data storage capacity. [OPEN ACCESS](#) TECHNICAL ARTICLE

Tags: *Advanced materials***Making ferromagnets stronger by adding non-magnetic elements**

Physorg.com, 23JUN2017

From computations, a team of researchers in the US (DOE's Ames National Research Laboratory) discovered that they could functionalize magnetic materials by adding scandium to a gadolinium-germanium alloy. They saw an unexpectedly large magnetic moment developing on its

lone 3d electron. The hybridization between gadolinium 5d and scandium 3d strengthens magnetism and transforms it to a ferromagnetic state. The discovery could create new tools for controlling, manipulating, and functionalizing useful magnetic rare-earth compounds. TECHNICAL ARTICLE

Tags: *Advanced materials, Government S&T***Highly sensitive nanofiber-embedded touchscreens**

Nanowerk, 22JUN2017

Commercial transparent plastic films used in touchscreen panels that provide a protective cover in flexible electronics have relatively low dielectric constants. Researchers in South Korea have fabricated transparent and flexible cellulose nanofiber films with high k values by incorporating ultralong metal nanofibers. According to the researchers, the new material provides a promising strategy for next-generation, wearable electronics. TECHNICAL ARTICLE

Tags: *Advanced materials***New screen coating makes reading in sunlight a lot easier—the secret? Moth eyes**

Physorg.com, 22JUN2017

An international team of researchers (USA- University of Central Florida, Taiwan) developed a fabrication technique that uses self-assembled nanospheres to form a precise template that can be used to create the moth-eye-like structure on a coating. The simplicity and precision of this process allowed fabrication of the intricate structure in a film large enough to apply to a mobile screen. The researchers also created a computational model to simulate the optical behavior of the coatings. It exhibited a more than four-fold improvement in contrast ratio. The coating is self-cleaning and has excellent mechanical strength. TECHNICAL ARTICLE

Tags: *Advanced materials***Quantum thermometer or optical refrigerator?**

Nanowerk, 22JUN2017

A team of researchers in the US (NIST, University of Maryland) proposed an approach for simultaneously reducing the thermal load on a mechanical resonator while improving its quality factor. They used the optical interaction to dynamically modify the dominant damping mechanism, providing an optomechanically induced effect analogous to a phononic band gap. They identified a realistic optomechanical design that has the potential to realize the novel cooling scheme. The technique could be used to make better metamaterials, complex composite objects that manipulate light or sound in new ways and could be used to make better lenses or invisibility cloaks. TECHNICAL ARTICLE 1, TECHNICAL ARTICLE 2

Tags: *Advanced materials*

“Never before in history has innovation offered promise of so much to so many in so short a time.” **BILL GATES**

## COMMUNICATIONS TECHNOLOGY

### **Digital to analog converters generate bipolar voltages when coupled to a polarity switchable double flux amplifier**

Physorg.com, 27JUN2017

Single-flux-quantum (SFQ)-based Digital to analog converters (DACs) fabricated using superconducting Josephson junctions generate voltages of quantum accuracy, which can be applied for metrological applications. Researchers in Japan have developed SFQ-based DACs producing only unipolar voltages. They have now attempted to develop their device by adding a simple fixture to the circuit. [TECHNICAL ARTICLE](#)

Tags: *Communications technology, S&T Japan*

### **Atomic imperfections move quantum communication network closer to reality**

Physorg.com, 23JUN2017

An international team of researchers (USA - University of Chicago, Hungary, Sweden, Japan) found that silicon carbide semiconductor defects have a natural affinity for moving information between light and spin to light conversion which is of very high quality. The defect is a missing atom that causes nearby atoms in the material to rearrange their electrons creating an electronic state that researchers control with a tunable infrared laser. They could potentially generate up to 10,000 photons before the spin state is destroyed. The findings can be applied to existing optical fiber networks for secure communications and geographically distributed quantum computation. [TECHNICAL ARTICLE](#)

Tags: *Communications technology, Quantum science*

### **A 100-year-old physics problem has been solved at EPFL**

Physorg.com, 22JUN2017

An international team of researchers (Canada, China, Switzerland, USA - University of Illinois at Urbana-Champaign, University of Rochester) has challenged the long-held theory that the Q factor, according to which a resonator can either store energy for a long time or have a broad bandwidth, but not both at the same time. They came up with a hybrid resonant / wave-guiding system made of a magneto-optic material that, when a magnetic field is applied, can stop the wave and store it for a prolonged period, thereby accumulating large amounts of energy. When the magnetic field is switched off, the trapped pulse is released. The discovery has applications in telecommunications, optical detection systems and broadband energy harvesting among others. [TECHNICAL ARTICLE](#)

Tags: *Communications technology*

### **Could small satellite usage double by 2020?**

Defense Systems, 22JUN2017

Smallsats could not only extend the lifespan of military-use satellites, but also enhance force readiness by potentially performing upgrades and delivering new payloads. They have lower time and monetary costs, giving them an advantage in “speed.” They provide an opportunity to try out new concepts, such as on-orbit servicing and refueling, and even space manufacturing. Smallsats also provide the ability to disaggregate satellite communications and other military satellite functions between many small satellites.

Tags: *Communications technology, Satellite technology, Space technology*

## CYBER SECURITY

### **Microsoft and Kaspersky comment on newest ransomware attack**

Next Big Future, 27JUN2017

According to Kaspersky company’s telemetry, data organizations in Russia and the Ukraine are the most affected and they have also registered hits in Poland, Italy, the UK Germany France, the US and several other countries. Microsoft has commented on the newest ransomware attack. The attack is effecting airlines, banks, and utilities across Europe.

Tags: *Cyber security*

## ENERGY

### **Study demonstrates a better way to store renewable energy**

Physorg.com, 22JUN2017

Antiferroelectrics become ferroelectric with the application of a high enough electric field. By exploiting this characteristic, an international team of researchers (USA - University of Arkansas, Luxembourg) predicted that high energy density and efficiency can be achieved in antiferroelectrics, in particular with the rare-earth substituted bismuth ferrite material used in their study. They report improving the storage performance with further manipulation of the electric field. They were also able to create a model that explains the connection between energy density and the electric field, which points toward further research in the future. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Energy, Advanced materials*

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## [Graphene nanocapsules improve Li-S battery electrodes](#)

Nanotechweb, 21JUN2017

A team of researchers in the US (Argonne National Laboratory, Oregon State University) has made a new cathode architecture for lithium-sulphide batteries that consists of crystalline di-lithium sulphide nanoparticles encapsulated in few-layer graphene. The design allows the maximum amount of active sulphur species to be incorporated into the electrode to improve its electrical conductivity. It also overcomes the major challenges associated with existing sulphur electrodes and previously reported di-lithium composites. The process is scalable and potentially viable for commercialization.

[TECHNICAL ARTICLE](#)

*Tags: Energy, Battery*

## FEATURED RESOURCE

### [Defense Update](#)

Defense Update provides comprehensive coverage of particular defense-related topics, including Armored Fighting Vehicles, Future Combat Systems, Aero-space - and unmanned systems as well as robotics and Precision Strike Weapons. [RSS](#)

## FORECASTING

### [New research leverages big data to predict severe weather](#)

Science Daily, 21JUN2017

Bow echoes in radar images is a phenomenon associated with fierce and violent winds. A team of researchers in the US (Pennsylvania State University, industry partner) propose an automatic framework to detect these patterns with high accuracy by introducing novel skeletonization and shape matching approaches. They extract regions with high probability of occurring bow echo from radar images and apply the skeletonization method to extract the skeleton of those regions. Using fuzzy logic, the skeletons are pruned and bow echo features are extracted to use them in shape matching algorithm and classification. The output of classification indicates whether these regions are bow echo with over 97% accuracy. With faster, more precise forecasts, the potential impacts can be significant. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Forecasting, Climatology*

## IMAGING TECHNOLOGY

### [Ultra-thin camera creates images without lenses](#)

Physorg.com, 22JUN2017

Researchers at Caltech have created a single thin layer of integrated silicon photonics that emulates the lens and sensor of a digital camera, reducing the thickness and cost of digital cameras. It can mimic a regular lens, but can switch from a fish-eye to a telephoto lens instantaneously—with just a simple adjustment in the way the array receives light. Once scaled up, this technology can make lenses and thick cameras obsolete. It may even have implications for astronomy by enabling ultra-light, ultra-thin enormous flat telescopes on the ground or in space. [OPEN ACCESS](#)

[TECHNICAL ARTICLE](#)

*Tags: Imaging technology*

### [Two drones see through walls in 3D using WiFi signals](#)

Kurzweil AI, 21JUN2017

An international team of researchers (USA - UC Santa Barbara, Germany) demonstrated three-dimensional imaging of objects through walls using two drones which took off and flew outside an enclosed, four-sided brick structure whose interior was unknown to the drones. One drone continuously transmitted a WiFi signal; the other drone (located on a different side of the structure) received that signal and transmitted the changes in received signal strength during the flight to a computer, which then calculated 3D high-resolution images of the objects inside. Research has applications in emergency search-and-rescue, archaeological discovery, structural monitoring and law-enforcement surveillance. [OPEN ACCESS TECHNICAL ARTICLE 1, 2](#)

*Tags: Imaging technology*

## INFORMATION TECHNOLOGY

### [Switchable DNA mini-machines store information](#)

Science Daily, 22JUN2017

A team of researchers in the US (Emory University, Purdue University) has built simple machines out of DNA, consisting of arrays whose units switch reversibly between two different shapes. According to the researchers, the technique could be harnessed to make nanotech sensors or amplifiers. Potentially, they could be combined to form logic gates, the parts of a molecular computer. [TECHNICAL ARTICLE](#)

*Tags: Information technology, Biotechnology*

### [Chemical solution to shrink digital data storage](#)

Science Daily, 21JUN2017

Researchers at Case Western Reserve University present a new methodology to optically store data in a quaternary code of 0, 1, 2, 3 in a polymer containing a low loading of two small molecules, and using heat and UV light to write, and read fluorescence output. The flexible polymer film

remains colourless and transparent under ambient light after patterning, retains the stored data after exfoliation with sandpaper and can be removed from the substrate and mechanically deformed without detriment to the pattern. This straightforward and scalable system demonstrates the use of simple and robust chemical reactions to improve data storage capabilities and has the potential to exponentially increase information density. [TECHNICAL ARTICLE](#)

*Tags: Information technology*

## MATERIALS SCIENCE

### [Atomic magnet curve balls](#)

[Nanowerk](#), 27JUN2017

By using a current-induced spin Hall spin torque, an international team of researchers (USA - Argonne National Laboratory, UCLA, Oakland University, Bryn Mawr College, Northwestern University, China) experimentally demonstrated the skyrmion Hall effect, and the resultant skyrmion accumulation, by driving skyrmions from the creep-motion regime into the steady-flow-motion regime. They observed that skyrmions move in a curved trajectory at a well-defined angle with respect to the applied electric current direction. Further, the angle of the skyrmion's trajectory can be controlled by changing the strength of the electric current and by the sign of the applied magnetic field. In the future, magnetic skyrmions can be the information carriers within memory and logic devices that are low-power alternatives to current technologies. [TECHNICAL ARTICLE](#)

*Tags: Materials science*

## NEUROSCIENCE

### [Lab-made synapses for artificial intelligence](#)

[Nanowerk](#), 28JUN2017

An international team of researchers (USA - University of Southern California, University of Florida, Yale University, industry partner, China) has developed a synaptic device that can reconfigure itself based on voltages applied at the input terminal of the device. A junction made of black phosphorus and tin selenide enables switching between the excitatory and inhibitory signals. The device is flexible and versatile and may simplify the design and functions of nervous system simulations. [TECHNICAL ARTICLE](#)

*Tags: Neuroscience, Artificial intelligence*

### [Select memories can be erased, leaving others intact](#)

[Science Daily](#), 22JUN2017

Brains create long-term memories, in part, by increasing the strength of connections between neurons and maintaining those connections over time. Previous research suggested that increases in synaptic strength in creating associative and non-associative memories share common properties. An international team of

researchers (USA - Columbia University, Canada) has tested the hypothesis that different types of memories stored in the same neuron can be selectively erased. The findings suggest that it may be possible to develop drugs to delete memories that trigger anxiety and PTSD without affecting other important memories of past events. [TECHNICAL ARTICLE](#)

*Tags: Neuroscience*

## PHOTONICS

### [Ultra-compact phase modulators based on graphene plasmons](#)

[Physorg.com](#), 27JUN2017

An international team of researchers (Spain, USA - Columbia University, Italy, Japan) has developed a phase modulator based on graphene capable of tuning the phase between 0 and  $2\pi$  in situ. The device length of 350 nm is more than 30 times shorter than the 10.6  $\mu\text{m}$  free-space wavelength. The modulation is achieved by spatially controlling the plasmon phase velocity in a device where the spatial carrier density profile is tunable. We provide a scattering theory for plasmons propagating through spatial density profiles. This work constitutes a first step towards two-dimensional transformation optics for ultracompact modulators and biosensing. [TECHNICAL ARTICLE](#)

*Tags: Photonics, Advanced materials*

## QUANTUM SCIENCE

### [Smooth propagation of spin waves using gold](#)

[Physorg.com](#), 23JUN2017

Spin waves (SW) that propagate through magnetic oxides have the advantage of low energy loss and a long transmission distance. SW reflected at the end of the material or interface, called SW noise, disturb the target spin wave which made SW unsuitable for application in the past. Researchers in Japan discovered that forming a gold film with sufficient length at the end of an yttrium iron garnet (YIG) suppresses the generation of unnecessary SWs. Their technology can be applied to SW devices such as multi-input/multi-output phase interference devices for SW in the future. [TECHNICAL ARTICLE](#)

*Tags: Quantum science, Information technology*

### [Quantum Annealer 10,000 times faster than classical computers by 2023](#)

[Next Big Future](#), 22JUN2017

University of Southern California will lead a team of international researchers working on an IARPA sponsored project to build and test 100 qubit quantum machines. The consortium will focus on the design and testing of algorithms and new hardware, computational framework and design quantum annealers, which are the specialized processors behind quantum optimization. They will design ways to connect the building blocks of quantum annealers,

qubits and the couplers. The team aims to design multi-qubit couplers to allow for various configurations that will enable faster paced calculations.

*Tags: Quantum science, Government S&T*

## SENSORS

### [New photoacoustic technique detects gases at parts-per-quadrillion level](#)

[Physorg.com](#), 27JUN2017

The photoacoustic effect refers to the generation of sound through a process of optical heat deposition followed by thermal expansion, resulting in a local pressure increase that produces outgoing acoustic waves. Researchers in China describe the application of this effect to trace gas detection using an optical grating that moves at the speed of sound inside of a resonator equipped with a resonant piezoelectric crystal detector yielding detection limits in the parts-per-quadrillion range. [TECHNICAL ARTICLE](#)

*Tags: Sensors, S&T China ■*

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