



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [Underwater Robots Learn a New Language, JANUS \(w/video\)](#)

[IEEE Spectrum, 08JUL2017](#)

NATO researchers have established the first international standard for underwater communications called JANUS. It creates a common protocol for an acoustic signal with which underwater systems can connect using a common frequency—11.5 kilohertz—over which all systems can announce their presence. Once two systems make contact through JANUS, they may decide to switch to a different frequency or protocol that could deliver higher data rates or travel further. Once deployed, aquatic systems could use JANUS to send data directly to each other, or to “gateway buoys” which could then use radio waves to relay that data to nearby control centers.

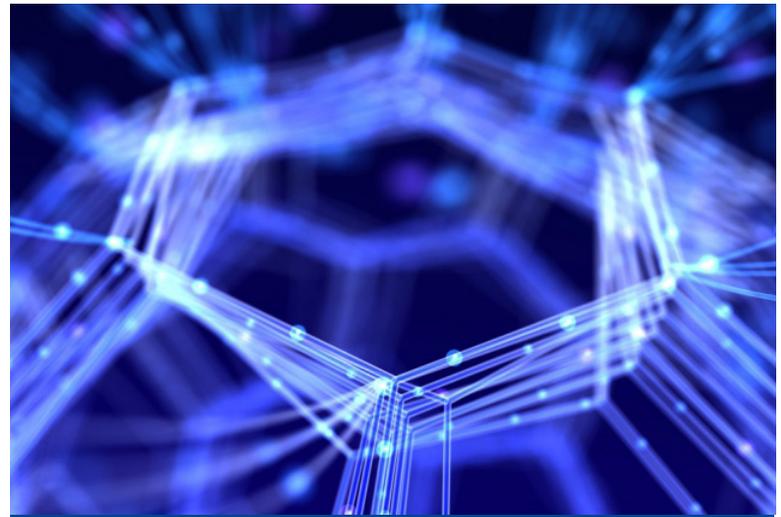
*Tags: Communications technology, Featured Article*

### [Giant enhancement of electromagnetic waves revealed within small dielectric particles](#)

[Eurekalert, 07JUL2017](#)

An international team of researchers (Russia, Australia) has experimentally demonstrated the enhancement of the intensity of the magnetic field in a high-index dielectric cylinder at the proximity of the dipolar Mie resonances by more than two orders of magnitude for both the TE and TM polarizations of the incident wave. They present a complete theoretical explanation of the effect and show that the phenomenon is very general—it should be observed for any high-index particles. The results explain the huge enhancement of nonlinear effects observed recently in optics, suggesting a new landscape for all-dielectric nonlinear nanoscale photonics. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Materials science, Featured Article*



*Instead of relying on silicon-based devices, a new chip uses carbon nanotubes and resistive random-access memory (RRAM) cells. The two are built vertically over one another, making a new, dense 3-D computer architecture with interleaving layers of logic and memory.*

### [New 3-D chip combines computing and data storage](#)

[MIT News, 06JUL2017](#)

Instead of relying on silicon-based devices, a team of researchers in the US (MIT, Stanford University) fabricated a new chip using carbon nanotubes and resistive random-access memory (RRAM) cells. The two are built vertically over one another, making a new, dense 3-D computer architecture with interleaving layers of logic and memory. They integrated over 1 million RRAM cells and 2 million carbon nanotube field-effect transistors, making the most complex nanoelectronic system ever made with emerging nanotechnologies. By inserting ultradense wires between these layers, this 3-D architecture promises to address the communication bottleneck. Benefits of the technique are—logic made from carbon nanotubes can be an order of magnitude more energy-efficient, and RRAM can be denser, faster, and more energy-efficient compared to DRAM. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics, Featured Article*

*continued...*

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## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

#### [Meniscus-assisted technique produces high efficiency perovskite PV films](#)

[Physorg.com](#), 07JUL2017

A team of researchers in the US (Georgia Institute of Technology, University of Nebraska) used a meniscus-assisted solution printing technique at low temperature to craft high quality perovskite films with much improved optoelectronic performance. The technique relies on capillary action to draw perovskite ink into a meniscus formed between two nearly parallel plates. The bottom plate moves continuously, allowing solvent to evaporate at the meniscus edge to form crystalline perovskite. The technique boosts power conversion efficiency to nearly 20 percent by controlling crystal size and orientation.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced manufacturing, Advanced materials*

### ADVANCED MATERIALS

#### [Breakthrough high temperature ceramic for hypersonic planes and much more](#)

[Next Big Future](#), 07JUL2017

An international team of researchers (China, UK) has developed a carbide coating reinforced with carbon-carbon composite that is 12 times better than the conventional Zirconium carbide. The much improved performance of the coating is due to its unique structural make-up, extremely good heat resistance and massively improved oxidation resistance. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

#### [Zero gravity: Graphene for space applications](#)

[Physorg.com](#), 07JUL2017

Under the EU Graphene Flagship, a team of researchers from EU countries is testing graphene in zero-gravity conditions to determine its potential in space applications including light propulsion and thermal management. They are running experiments to investigate how graphene can improve efficiency in heat transfer in loop heat pipes—cooling systems used extensively in satellites and aerospace instruments. The idea is to use graphene to improve the thermal conductivity and the capillary pressure by growing a sponge in the pores of the wicks. [More information](#)

*Tags: Advanced materials, S&T EU*

#### [New class of 'soft' semiconductors could transform HD displays](#)

[Nanowerk](#), 26JUN2017

A team of researchers in the US (UC Berkeley, Lawrence Berkeley National Laboratory) used a common

nanofabrication technique combined with anion exchange chemistry to swap out the halide ions from cesium lead halide perovskite to create cesium lead iodide, bromide, and chloride perovskites. Each variation emitted a different color. Multiple heterojunctions could be engineered on a single nanowire. They were able to achieve a pixel size down to 500 nanometers, and the color of the material was tunable throughout the entire range of visible light. The research could influence the development of new applications in optoelectronics, photovoltaics, nanoscopic lasers, and ultrasensitive photodetectors, among others. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Imaging technology*

### AUTONOMOUS SYSTEMS & ROBOTICS

#### [New Army technology enables simultaneous multiple drone control](#)

[Defense Systems](#), 06JUL2017

The new system, called Supervisory Controller for Optimal Role Allocation for Cueing of Human Operators (SCORCH) gives in-flight helicopter crews the ability to view multiple drone feeds simultaneously. This is an expansion of the Manned-Unmanned Teaming (MUM-T) operations. MUM-T Operations are made possible by the introduction of a standardized interoperability protocol supporting video/data transmissions between ground-manned-unmanned platforms.

*Tags: Autonomous systems & robotics, Military technology*

### BIG DATA

#### [Deep-Learning the Landscape](#)

[ArXiv](#), 08JUN2017

An international team of researchers (UK, China) propose a paradigm to deep-learn the ever-expanding databases which have emerged in mathematical physics and particle phenomenology, as diverse as the statistics of string vacua or combinatorial and algebraic geometry. They established multi-layer neural networks as both classifiers and predictors and trained them with a host of available data ranging from Calabi-Yau manifolds and vector bundles, to quiver representations for gauge theories. They found that even a relatively simple neural network can learn many significant quantities to astounding accuracy in a matter of minutes and can also predict heretofore unencountered results. This paradigm should prove a valuable tool in various investigations in landscapes in physics as well as pure mathematics. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Big data, Artificial intelligence*

“Science is the process that takes us from confusion to understanding in a manner that’s precise, predictive and reliable.” —BRIAN GREENE

## COMMUNICATIONS TECHNOLOGY

### World’s first demonstration of space quantum communication using a microsatellite

Science Daily, 10JUL2017

Researchers in Japan have developed and demonstrated the world’s smallest and lightest quantum-communication transmitter (SOTA) onboard the microsatellite SOCRATES. Information was received from a satellite in a single-photon regime in an optical ground station. SOTA weighs 6 kg and measures 17.8 cm length, 11.4 cm width and 26.8 cm height. The signal is transmitted at a rate of 10 million bits per second from an altitude of 600 km at a speed of 7 km/s. They succeeded in correctly detecting the communication signal from SOTA moving at this fast speed. This is a major step toward building a global long-haul and truly-secure satellite communication network. [TECHNICAL ARTICLE](#)

Tags: Communications technology, S&T Japan

## COUNTER WMD

### IARPA seeks tech to ID bioengineered life forms

Federal Computer Week, 05JUL2017

IARPA’s Finding Engineering-Linked Indicators (FELIX) program looks to develop a suite of tools to detect a range of engineered bio-organisms from viruses, bacteria, insects, animals and plants that have been developed from natural organisms that are either purposefully or accidentally developed and/or released with the potential to cause harm. The technologies it wants to discuss include novel methods and high throughput techniques in genomics, systems biology, bioinformatics and evolutionary biology. [Proposers’ day](#) is on July 27.

Tags: Counter WMD, Government S&T

## CYBER SECURITY

### Hackers Have Been Targeting U.S. Nukes

MIT Technology Review, 07JUL2017

New York Times reports that hacks targeting companies that run U.S. energy facilities gained access to office computer systems but failed to take control of devices that are used to operate any of the facilities. They have used phishing attacks, watering hole attacks, which compromise websites known to be used by targeted staff members. It is unclear what the motive behind the attacks was; they could at some point in the future shut down parts of the American energy grid, or, less likely, undermine safety systems on nuclear facilities.

Tags: Cyber security

### Quantum Technology Could Eliminate Counterfeiting

R&D Magazine, 07JUL2017

A team of researchers in the UK created unique atomic-scale identifications based on the irregularities found in 2D materials like graphene. When light is shone on graphene, tiny imperfections shine causing the material to emit light that can be measured as a signal, unique only to that small section of material, that can be turned into a digital fingerprint with a number sequence. It is possible to fingerprint them in simple electronic devices and optical tags. Because of the materials used, the small tags could be edible and coated onto medicines. Through a smartphone app, customers can scan the optical tag on the product against the manufacturer’s database to verify authenticity. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Cyber security, Materials science, S&T UK

### Survey: Cyber pros fear attack on critical infrastructure

Federal Computer Week, 06JUL2017

The Black Hat survey of nearly 600 security professionals, 40 percent of whom work in critical infrastructure sectors, showed that 60 percent believe a successful attack will happen within two years, and only 10 percent do not. Respondents said the top five activities that consume most of their time are combating phishing and social engineering efforts, measuring their organization’s security risk, maintaining industry and regulatory compliance, combating vulnerabilities introduced by in-house development teams and mitigating vulnerabilities from purchased applications or systems. While social engineering attacks remain the leading concern today, respondents said that the No. 1 future worry is internet-of-things security.

Tags: Cyber security

### This Circuit Board Will Self-Destruct in 5, 4, 3...

IEEE Spectrum, 06JUL2017

Researchers at Vanderbilt University have constructed simple circuit boards, including conductive traces and capacitors, that work above room temperature but rapidly disintegrate when cooled below 32°C (89°F). The system involves a series of silver nanowires held together by a polymer that is hydrophobic at room temperature or warmer, but hydrophilic at lower temps. The circuit requires a source of heat to remain viable and is destroyed and vanishes once this heat source is lost. The technology

may have applications for warfighters—if such a device embedded in the body is removed or the body loses heat, it will immediately dissolve. [TECHNICAL ARTICLE](#)

*Tags: Cyber security*

### [Hackers could use brainwaves to steal passwords, study finds](#)

[Science Daily, 01JUL2017](#)

EEG headsets are advertised as allowing users to use only their brains to control robotic toys and video games specifically developed to be played with an EEG headset. Researchers at the University of Alabama found that after a user entered 200 characters, algorithms within a malicious software program could make educated guesses about new characters the user entered by monitoring the EEG data recorded. The algorithm was able to shorten the odds of a hacker's guessing a four-digit numerical PIN from one in 10,000 to one in 20 and increased the chance of guessing a six-letter password from about 500,000 to roughly one in 500.

*Tags: Cyber security*

## FEATURED RESOURCE

### [DOE SciTech Connect](#)

SciTech Connect is a portal of free, publicly-available DOE-sponsored R&D results including technical reports, bibliographic citations, journal articles, conference papers, books, multimedia, software, and data information, and developed by DOE's Office of Scientific and Technical Information.

## ENERGY

### [In the fast lane—conductive electrodes are key to fast-charging batteries](#)

[EurekaAlert, 10JUL2017](#)

An international team of researchers (USA - Drexel University, France, Israel) created new electrode designs from a highly conductive, two-dimensional material called MXene. They produced a hydrogel electrode design with more redox active sites, which allow it to store as much charge for its volume as a battery. The electrode architectures with open macroporosity makes each redox active site in the MXene material readily accessible to ions. They demonstrated charging MXene electrodes in tens of milliseconds. The research paves the way to develop ultrafast energy storage devices that can be charged and discharged within seconds, and store much more energy than conventional supercapacitors. [TECHNICAL ARTICLE](#)

*Tags: Energy, Battery*

## INFORMATION TECHNOLOGY

### [Google Stakes Its Future on a Piece of Software](#)

[MIT Technology Review, 27JUN2017](#)

Early in 2015, artificial-intelligence researchers at Google created an obscure piece of software called TensorFlow which makes it much easier for the company's engineers to translate new approaches to artificial intelligence into practical code, improving services such as search and the accuracy of speech recognition. Once you've built something with TensorFlow, you can run it anywhere—but it's especially easy to transfer it to Google's cloud platform. Google's tool is also becoming firmly lodged in the minds of the next generation of artificial-intelligence researchers and entrepreneurs.

*Tags: Information technology*

## MATERIALS SCIENCE

### [Iron secrets behind superconductors unlocked](#)

[Science Daily, 07JUL2017](#)

Due to magnetism, iron should—theoretically—be a poor superconductor. An international team of researchers (USA - Cornell University, Brookhaven National Laboratory, Ames Laboratory, Iowa State University, Binghamton University, University of Florida, Denmark, Germany, Scotland, Ireland, India) has established that the five unbound electrons found in iron facilitate superconductivity. They interact with a particular intensity and have a pronounced tendency to become magnetic. These are the very electrons behind the efficacy of iron-based superconductors. The findings widen the general understanding of copper-based superconductors and could be instrumental in future attempts to build new and more efficient superconductors. [TECHNICAL ARTICLE](#)

*Tags: Materials science*

### ['Shape memory' effect demonstrated in gold particles](#)

[Nanowerk, 07JUL2017](#)

The annealing of the deformed particles at elevated temperatures leads to nearly full recovery of their initial asymmetric polyhedral shape. An international team of researchers (Israel, Germany) has shown that the shape recovery of the particles is controlled by the self-diffusion of gold atoms along the terrace ledges formed during the particles indentation which leads to shape recovery by the irreversible diffusion process. The findings could lead to the development of micro- and nano-robots capable of self-repair, mechanically stable and damage-tolerant components and devices and targeted drug delivery.

[TECHNICAL ARTICLE](#)

*Tags: Materials science*

## MICROELECTRONICS

**Using chip memory more efficiently**

MIT News, 07JUL2017

A team of researchers in the US (MIT, Carnegie Mellon University) designed a system they call Jenga that reallocates cache access on the fly, to create new “cache hierarchies” tailored to the needs of particular programs. In tests they found that, compared to its best-performing predecessors, the system increased processing speed by 20 to 30 percent while reducing energy consumption by 30 to 85 percent. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Microelectronics, Information technology*

## NEUROSCIENCE

**Researchers Revolutionize Brain-Computer Interfaces Using Silicon Electronics**

Columbia University, 10JUL2017

Researchers at Columbia University are leading a team, working under DARPA’s Neural Engineering System Design (NESD) program to design an implantable brain-interface device at the scale of one million channels to enable recording and stimulation from the sensory cortex. They think the only way to achieve this is to use an all-electrical approach that involves a massive surface-recording array with more than one million electrodes fabricated as a monolithic device on a single CMOS integrated circuit.

Tags: *Neuroscience, Artificial intelligence, DARPA*

## PHOTONICS

**Compact meta-lens doublet works in the visible**

Nanotechweb, 10JUL2017

Researchers at Harvard University have developed a new compact meta-lens doublet by patterning two metasurfaces on both sides of a glass substrate. This lens, which works in the visible region, has a numerical aperture of 0.44, a focal length of 342.5  $\mu\text{m}$  and field of view of 50°, and allows for diffraction-limited imaging along the entire focal plane of the lens. [TECHNICAL ARTICLE](#)

Tags: *Photonics, Imaging technology*

## QUANTUM SCIENCE

**Majorana-highway on a chip**

Nanowerk, 07JUL2017

Quantum chips based on Majorana fermions promise error-protected quantum computations. An international team of researchers (the Netherlands, Poland, Japan) has demonstrated ballistic superconductivity in InSb semiconductor nanowires. Structural and chemical analyses show a high-quality interface between the nanowire and a NbTiN superconductor that enables ballistic transport. The novel methods open doors to quantum computations based on Majorana fermions, allow for the exploration of new

quantum effects in such materials and can have future applications in energy-efficient electronics. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Quantum science, Microelectronics*

**Physicists devise new approach to manipulate silicon ‘qubits’**

Physorg.com, 07JUL2017

In silicon, valley states represent a degree of freedom in addition to spin and charge. Characterizing and controlling valley states is critical for the encoding and read-out of electrons-in-silicon-based qubits. Researchers at UCLA placed silicon quantum dots inside a cooling chamber at a temperature near absolute zero allowing them to rest in the lowest energy point in the valley. They moved single electrons in and out of the valleys, measured the difference in energy between the valleys and determined which valley the electron occupied. The research is an important step toward realizing an array of hundreds or thousands of qubits all working together to solve a difficult problem.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Quantum science*

## S&amp;T POLICY

**Navy moves Next-Gen Jammer electronic warfare to next phase**

Defense Systems, 10JUL2017

NAVAIR is asking industry to come up with technologies for low-band transmitters, which are used to jam early warning radars. Considering the pace of technological change and the extent to which cutting-edge air defenses are rapidly upgraded, Navy and industry engineers are planning for the emerging NGJ to be ready by the early 2020s. The NGJ consists of two 15-foot-long PODs beneath the EA-18G Growler aircraft designed to emit radar-jamming electronic signals; one jammer goes on each side of the aircraft.

Tags: *S&T policy, Military technology*

**To slow, or not to slow? New science in sub-second networks**

ArXiv, 27JUN2017

What happens when you slow down part of an ultrafast network that is operating quicker than the blink of an eye, e.g. electronic exchange network, navigational systems in driver-less vehicles, or even neuronal processes in the brain? This question just adopted immediate commercial, legal and political importance following U.S. financial regulators’ decision to allow a new network node to intentionally introduce delays of microseconds. According to researchers at the University of Miami, given that the navigational processing (in driver-less vehicles) underlying networks of sensors and software operates much faster

than human response times, what regulatory principles should be hardwired or encoded in individual vehicles, or fleets of vehicles, is challenging and contentious until the core scientific question is fully addressed. [OPEN ACCESS](#)

[TECHNICAL ARTICLE](#)

*Tags: S&T policy*

## SENSORS

### [Nanogenerator-powered acceleration sensor](#)

[Nanowerk](#), 08JUL2017

An international team of researchers (China, USA - Georgia Institute of Technology) has demonstrated a self-powered acceleration sensor based on liquid metal triboelectric nanogenerator (TENG), composed of an inner liquid metal droplet (mercury) and an outer acrylic shell. The liquid metal mercury drop could significantly enhance the stability and durability of the acceleration sensor. The output voltage and current show negligible decrease after nearly 200,000 cycles. The output voltage and current exhibit a good linear relationship with the external acceleration. According to the researchers their work expands TENG's application in self-powered sensing systems.

[TECHNICAL ARTICLE](#)

*Tags: Sensors*

### [Flexible sensors](#)

[Nanowerk](#), 07JUL2017

In a review article, an international team of researchers (China, Hong Kong) illustrates various types of flexible sensors. They summarize the recent state-of-the-art flexible electronics currently employed as flexible light sensors, flexible pH sensors, flexible ion sensors, and flexible biosensors. They include selections of materials and a detailed description of engineering technologies with an emphasis on flexible sensor fabrication. They present market analysis on the world sensor market, printed sensors, and wearable sensors. With the development of polymers, oxides, printing technologies, and CMOS technologies, flexible sensors will unlock a completely novel set of IoT products. [TECHNICAL ARTICLE](#)

*Tags: Sensors, Flexible electronics*

### [Powerful new photodetector can enable optoelectronics advances](#)

[Physorg.com](#), 07JUL2017

A team of researchers in the US (University of Wisconsin, University of Buffalo, Yale University) has fabricated a single-crystalline germanium nano-membrane photodetector on a nano-cavity substrate. The nano-cavities are made of an orderly series of tiny, interconnected molecules that reflect light increasing the amount of light that thin semiconducting materials like germanium can absorb. The technique can be applied to other semiconductors. By tuning the nano-cavity, the wavelength that is absorbed can be controlled. The technology may lead to a variety of optoelectronics that can go to even smaller footprints.

[OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

*Tags: Sensors, Energy*

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