



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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## FEATURE ARTICLES

### [Researchers transmit 10 bit of information with a single photon](#)

[Science Daily, 03FEB2017](#)

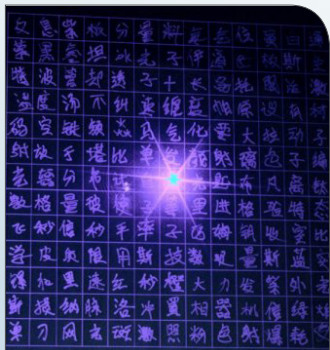


Illustration of a large alphabet of symbols that can be used to encode a lot of information (more than 10 bit in our case) into a single photon.

Credit: Image courtesy of University of Twente

There are many practical considerations that limit the amount of information per photon to 270 bits. Using an innovative method and creating an alphabet of 9072 characters, researchers in the Netherlands managed to transmit no less than 10.5 bits of information with a single photon. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: [Quantum science](#), [Featured Article](#)

### [These Paper Drones Are Built for One-Way Missions](#)

[MIT Technology Review, 01FEB2017](#)

Researchers working on the DARPA project ICARUS built prototype drones out of cardboard that are pre-programmed with their landing destination, then launched from a cargo plane or other aircraft. A small electronics package steers each craft to its target. But with no motors and no need of a battery or fuel, they are meant to have as much room as possible for payload. Drones have already delivered packages to paying Amazon customers and medicine to remote parts of Rwanda. The Department of Defense, too, is testing out drone swarms for a range of possible missions. Cardboard was only used to prove the design worked. The goal is to eventually make the drones' bodies out of mycelium fibers—that is, mushrooms.

Tags: [Autonomous systems & robotics](#), [Featured Article](#)

## ADVANCED MATERIALS

### [Full\(erene\) potential](#)

[Nanowerk, 02FEB2017](#)

Researchers at UC Santa Barbara demonstrate that with the addition of fullerene or copper tetrabenzoporphyrin molecules in strategic places, the charge carriers in semiconducting materials may be controlled and inverted for better device performance as well as economical manufacture. The additives create “traps” that can be used to master the properties of the semiconductor in a straightforward way. The potential uses of this method are in low-cost, low-power flexible electronics. [TECHNICAL ARTICLE 1, 2](#)

Tags: [Advanced materials](#), [Materials science](#)

## AUTONOMOUS SYSTEMS & ROBOTICS

### [This Robot Will Carry Your Stuff and Follow You Around \(w/video\)](#)

[MIT Technology Review, 02FEB2017](#)

Developed by a company in the US, the robot called Gita can carry 40 pounds, and balance itself as it travels, keeping its cargo level. It can run for eight hours and can be recharged in a regular outlet. Rather than more expensive sensors, the robot maps its environment using video cameras. It follows people not by tracking them, but by comparing its view of the world to one captured from a set of cameras on a belt that is worn by the person it is following. This allows the robot to follow a person's route long after he or she has traveled it. It has three different modes: following someone, driving autonomously, and platooning with other Gita vehicles. The underlying technology, as well as the potential applications, remain a bit unproven. Gita might be useful in some settings.

Tags: [Autonomous systems & robotics](#)

## S&T NEWS ARTICLES

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**Transparent, gel-based robots can catch and release live fish**[MIT News, 01FEB2017](#)

Researchers at MIT have created a robot which is an assemblage of hollow, precisely designed hydrogel structures connected to rubbery tubes. When the researchers pump water into the hydrogel robots, the structures quickly inflate in orientations that enable the bots to curl up or stretch out. Because the robots are both powered by and made almost entirely of water, they have similar visual and acoustic properties to water. For underwater applications, they may be virtually invisible. In experiments the structures could withstand repeated use of up to 1,000 cycles without rupturing or tearing.

*Tags: Autonomous systems & robotics***BIOTECHNOLOGY****Ionomics as an emerging research discipline**[Physorg.com, 03FEB2017](#)

Ionomics is defined as a research discipline dealing with the studies of ions in liquids (or liquid phases) and stipulated with fundamental differences of ionic interactions. Researchers in Russia review the biological activities of ionic liquids, with a special emphasis on their potential employment in pharmaceuticals and medicine. Studies on ionic interactions drive the development of many demanding applications in biology, chemistry and material science. Applications include ionic channels and ion control in living cells, ionic drugs and drug delivery systems, ion batteries, ionic liquids and electrolytes. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Biotechnology, Emerging technology, S&T Russia***Microbial manufacturing**[MIT News, 03FEB2017](#)

Using multivariate modular metabolic engineering (MMME), a company in the US has created a low-cost process for engineering microbes with complex metabolic pathways borrowed from plants, which can produce an array of rare and expensive ingredients used for consumer products including therapeutics. MMME uses enzymes to cut the linear pathway into a network of separate, distinct modules that can be more easily controlled and modified. They engineered bacteria to mimic the stevia plant's (zero-calorie sweetener) metabolic pathway where the bacteria produced the compound at greater than 95 percent purity. The process could lead to discoveries of new compound ingredients.

*Tags: Biotechnology***Tuberculosis-resistant cows developed for the first time using CRISPR technology**[Physorg.com, 31JAN2017](#)

Researchers in China used a novel version of the CRISPR system called CRISPR/Cas9n to successfully insert a

tuberculosis resistant gene, called NRAMP1, into the cow genome. They were able to successfully develop live cows carrying increased resistance to tuberculosis. The method produced no off-target effects on the cow genetics meaning that the CRISPR technology they employed may be better suited for producing transgenic livestock with purposefully manipulated genetics. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Biotechnology, S&T China, Synthetic biology***COMMUNICATIONS TECHNOLOGY****Terahertz wireless could make spaceborne satellite links as fast as fiber-optic links**[Physorg.com, 06FEB2017](#)

Researchers in Japan have developed a transmitter that achieves communication speed of 105 gigabits per second using the frequency range from 290 GHz to 315 GHz. This range of frequencies is currently unallocated, but falls within the frequency range whose usage will be discussed at the World Radio Communication Conference 2019. They will present details of the technology at the 2017 International Solid-State Circuits Conference.

*Tags: Communications technology, S&T Japan***Making the switch to polarization diversity**[Science Daily, 03FEB2017](#)

Researchers in Japan developed a device, a fully integrated non-duplicate polarization-diversity silicon-photonics switch, consisting of a single 8 x 8 grid of 2 x 2 element switches. Polarization splitter-rotators integrated onto the chip take input light signals with both horizontal and vertical polarizations, divide them into separate polarizations, and rotate one 90 degrees to match the orientation of the other. The switched polarizations are then recombined by the polarization splitter-rotator so that they return to their original state. The distance traveled by any signal passing through the 8 x 8 grid is identical, regardless of its path; the attenuation and delay of the signal are also the same, allowing for a consistently high-quality signal.

*Tags: Communications technology, S&T Japan***Researchers break data transfer efficiency record**[Science Daily, 01FEB2017](#)

Researchers at Oak Ridge National Laboratory demonstrated superdense coding over optical fiber links, taking advantage of a complete Bell-state measurement enabled by time-polarization hyperentanglement, linear optics, and common single-photon detectors and the highest single-qubit channel capacity to date utilizing linear optics. While the technology is at present largely experimental, practical applications could include a cost-effective way to condense and transfer information. [TECHNICAL ARTICLE](#)

*Tags: Communications technology, Government S&T*

“Science is simply common sense at its best, that is, rigidly accurate in observation, and merciless to fallacy in logic.” THOMAS HUXLEY

## COUNTER WMD

### [IARPA Seeks Technologies and Methods to Detect Genome Editing](#)

Global Biodefense, 02FEB2017

IARPA is seeking information on potential tools and methods that can be used to detect evidence of genome editing in biological organisms, including viruses. While genome editing technology will enable new biological breakthroughs, the unintentional or deliberate misuse of genome editing tools may have adverse economic, health, and national security implications. The fundamental components of many genome editing tools are found in nature, so detection requires the ability to distinguish engineered organisms from naturally-occurring background. [BAA](#)

Tags: Counter WMD

## CYBER SECURITY

### [Protecting quantum computing networks against hacking threats](#)

Physorg.com, 02FEB2017

An international team of researchers (Canada, USA - University of Rochester, Iran) was able to clone qubits. Their analyses showed that when larger amounts of quantum information are encoded on a single photon, the copies will get worse and hacking even simpler to detect. They showed that cloning attacks introduce specific, observable noises in a secure quantum communication channel. The research helps strengthen quantum computing networks against potential hacking threats.

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

Tags: Cyber security, Quantum science, S&T Canada

## ENERGY

### [Flipping the switch on ammonia production: Process generates electricity instead of consuming energy](#)

Physorg.com, 03FEB2017

Using nitrogenase and hydrogenase, an international team of researchers (USA - University of Utah, Ireland, Spain) replicated the biological process of nitrogen fixation. The cell consists of two compartments, connected via carbon paper electrodes. In one vial, hydrogen gas is oxidized by hydrogenase and electrons are carried to the anode. In the other, electrons come off the cathode and are combined with nitrogen, via nitrogenase, to create ammonia. The electrons move from the anode to the cathode via a circuit. Protons (oxidized hydrogen atoms) travel through a

membrane between the anodic and cathodic chambers, supplying the hydrogen atoms needed to synthesize ammonia. The movement of the electrons creates current.

[TECHNICAL ARTICLE](#)

Tags: Energy

### [Researchers flip script for Li-Ion electrolytes to simulate better batteries](#)

Science Daily, 01FEB2017

To maintain the efficiency of lithium-ion batteries during charge cycles, electrolytes must be stable and conductive to lithium ions. Researchers at Caltech ran hundreds of simulations in search of polymers that could enhance the performance of lithium-ion batteries and conduct lithium ions more quickly than polyethylene oxide. They first screened a set of 500 diverse classes of polymers to find ones that can produce an eight-fold increase in desired lithium conduction and a marked decrease in the unwanted anion conduction. [TECHNICAL ARTICLE](#)

Tags: Energy, Advanced materials, Battery

### [Toward all-solid lithium batteries](#)

MIT News, 01FEB2017

Liquid electrolytes tend to be chemically unstable, and can even be flammable. All-solid-state batteries, in which the liquid electrolyte would be replaced by a solid electrolyte, could enhance the batteries' energy density and safety. Researchers at MIT measured Young's modulus, hardness, and fracture toughness of sulfide-based solid electrolytes using a fine-tipped probe to poke into the material and monitor its responses instead of acoustic measurement techniques. The researchers found that the material has a combination of properties somewhat similar to silly putty or salt water taffy: When subjected to stress, it can deform easily, but at sufficiently high stress it can crack like a brittle piece of glass. [TECHNICAL ARTICLE](#)

Tags: Energy, Battery, Materials science

## ENVIRONMENTAL SCIENCE

### [Deadly new wheat disease threatens Europe's crops](#)

Nature News, 01FEB2017

Last year, stem rust fungus destroyed tens of thousands of hectares of crops in Sicily. What's particularly troubling, the researchers say, is that GRRC tests suggest the pathogen can infect dozens of laboratory-grown strains of wheat, including hardy varieties that are usually highly resistant to disease. The team is now studying whether commercial crops are just as susceptible. Researchers speculate that it could be down to warmer autumns and milder winters

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attributable to climate change, combined with changes in farming practices and increases in international travel—potentially spreading spores on clothing.

*Tags: Environmental science, Climatology*

## FOREIGN S&T

### China carrying forward with large scale development of nuclear energy from US research that has been underdeveloped

Next Big Future, 03FEB2017

According to a report by BMI Research (UK), China will almost triple its nuclear capacity to nearly 100 gigawatts by 2026. China has 20 reactors currently under construction, another 176 are either planned or proposed, far more than any other nation, according to the World Nuclear Association. Coal's share in the nation's energy mix will gradually fall to just under 54 percent by 2026 from its current 70 percent. China is building and spending over ten times more on building new energy generation and distribution than the USA. The US would be able to get closer to the scale of what China is doing in energy if the USA chose to replace all coal generation.

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

## FEATURED RESOURCE

### Global Biodefense

Global Biodefense publishes the latest news and insights on health security from pathogens, emerging infectious diseases and CBRN agents. [RSS](#)

### China test launches an ICBM with 10 independent warheads

Next Big Future, 02FEB2017

The flight test of the DF-5C missile was carried out earlier this month using 10 multiple independently targetable reentry vehicles. The missile was fired from the Taiyuan Space Launch Center in central China and flew to an impact range in the western Chinese desert. The DF-5C missile has a range of 12,000 kilometers and can carry 12 nuclear warheads.

*Tags: Foreign S&T, Military technology, S&T China*

### China's first home built aircraft carrier could eventually deploy to the South China Sea

Next Big Future, 01FEB2017

China's second carrier, currently called the 001A, has a revised flight deck arrangement and other features, but retains the ski-jump bow used for launching aircraft. The

ship is expected to be launched in late 2017. Images recently surfaced on Chinese social media platforms suggesting that Beijing may be developing a carrier with Catapult Assisted Take-Off But Arrested Recovery (CATOBAR), that can accommodate carrier onboard delivery (COD) aircraft, AEW and other large aircraft. Reports are that the new aircraft carrier would eventually deploy to the South China Sea. However, this would not be until after a lengthy testing phase.

*Tags: Foreign S&T, Military technology, S&T China*

## INFORMATION TECHNOLOGY

### Watching computers think

Science Daily, 06FEB2017

Neural networks are, in a sense, black boxes - computer programs that people feed values into and that reliably return results. A team of researchers in Germany has developed software that allows them to watch the work of the neural networks in reverse: they work through the program backwards, starting from the result. They can see exactly where a certain group of neurons made a certain decision, and how strongly this decision impacted the result. The researchers have already impressively demonstrated—multiple times—that the method works. They will present their software at CeBIT in Hannover from March 20 to 24, 2017.

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

### Google Word Lens translates written Japanese in realtime

Next Big Future, 04FEB2017

With Word Lens, you just need to fire up the Translate app, point your camera at the Japanese text, and the English translations will appear overlaid on your screen—even if you don't have an Internet or data connection. Word Lens has support for Chinese, and with Japanese, now translates about 30 languages. Word Lens can translate both Simplified and Traditional Chinese to English, or the other way around.

*Tags: Information technology*

## MATERIALS SCIENCE

### Coordinates of more than 23,000 atoms in technologically important material mapped

Science Daily, 01FEB2017

An international team of researchers (USA - UCLA, Lawrence Berkeley National Laboratory, State University of New York, Oak Ridge National Laboratory, Taiwan, UK) took multiple images of iron-platinum nanoparticle and determined the precise three-dimensional arrangement of atoms in the nanoparticle. They identified and located more than 6,500 iron and 16,600 platinum atoms and showed how the atoms are arranged in nine grains. They found that the grain boundaries are more disordered and observed abrupt changes in magnetic properties at the grain boundaries. This work makes significant advances in characterization

capabilities and expands our fundamental understanding of structure-property relationships, which is expected to find broad applications in physics, chemistry, materials science, nanoscience and nanotechnology.

#### [TECHNICAL ARTICLE](#)

*Tags: Materials science*

## MICROELECTRONICS

### [IBM Scientists Measure Heat-Transfer through Single Atoms](#)

[IBM News](#), 06FEB2017

Using a novel technique called “scanning probe thermometry ([video](#)) IBM researchers in Switzerland mapped heat loss and temperature distributions across a chip. According to the researchers, this will enable heat transport to be investigated not only in quantum point contacts of different metals, but also in molecular junctions, a fundamental scientific and technological step forward in managing and controlling heat at the nanoscale. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

*Tags: Microelectronics, S&T Switzerland*

### [Germanium outperforms silicon in energy-efficient transistors with n- and p-conduction](#)

[Eurekalert](#), 03FEB2017

Researchers in Germany have demonstrated a transistor based on germanium that can be programmed between electron and hole conduction. This enables to realize circuits with lower transistor count compared to state-of-the-art CMOS technologies. Transistors based on germanium can be operated at low supply voltages and reduced power consumption, due to the low band gap compared to silicon. They can be reconfigured between electron and hole conduction based on the voltage applied to one of the gate electrodes. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics, S&T Germany*

## QUANTUM SCIENCE

### [Cleaning up quantum devices](#)

[Physorg.com](#), 03FEB2017

One of the biggest problems with quantum devices is the presence of intrinsic noise. An international team of researchers (Sweden, Latvia, UK) shows that the same hyperfine signatures of atomic Hydrogen reveal themselves in very small quantities in these tiny ultracold quantum circuits. The identification of these spins sheds new light on the origin of magnetic noise in quantum circuits, showing great promise for its mitigation. The detection technique can also be applied in a wider context to study the surface chemistry of commonly used oxide surfaces. [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

### [Researchers investigate the potential of metal grids for future electronic components](#)

[Physorg.com](#), 03FEB2017

An international team of researchers (Germany, Russia, Australia, Singapore) created approximately 250 nanometer-sized holes (antidots) at regular intervals in a cobalt layer. They discovered that with the aid of an externally applied magnetic field, three distinct magnetic states around each hole could be configured—“G”, “C” and “Q”. By optimizing the antidot geometry, they showed that the spins could be reliably programmed around the holes. Perforated grids could also operate as components for future circuits working with spin-waves. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

*Tags: Quantum science, Materials science*

### [Quantum RAM: Modelling the big questions with the very small](#)

[Science Daily](#), 02FEB2017

An international team of researchers (Australia, Singapore) constructed a proof-of-principle quantum simulator using a photon interacting with another photon to show that when it comes to simulating complex processes in the macroscopic world, quantum mechanics can provide an unexpected advantage. Compared with the fundamental memory requirements of a classical simulator, they showed that the quantum system could complete the task with much less information stored than the classical computer—a factor of 20 improvement at the best point. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

### [Physicists propose football-pitch-sized quantum computer](#)

[Nature News](#), 01FEB2017

An international team of researchers (UK, USA - Google, Denmark, Germany) presents a blueprint for a trapped ion-based scalable quantum computer module, making it possible to create a scalable quantum computer architecture based on long-wavelength radiation quantum gates. The modules control all operations as stand-alone units, constructed using silicon microfabrication techniques, and within the reach of current technology. With appropriate adjustments, the proposed modules are also suitable for alternative trapped ion quantum computer architectures, such as schemes using photonic interconnects. [OPEN ACCESS](#) [TECHNICAL ARTICLE](#)

*Tags: Quantum science*

## S&amp;T POLICY

**Climate change may overload US electrical grid: study****Physorg.com, 06FEB2017**

According to a report by an international team of researchers (USA - UC Berkeley, National Bureau of Economic Research, Stanford University, University of Michigan, Canada), as the planet warms due to climate change and hot days become more common, the cost to upgrade the US electrical grid to cope with peak demands may be on the order of \$180 billion. Much of the cost to upgrade the grid would involve capacity, storage and transmission investments—not simply the cost of generating electricity. The current study also factors in the effect of ever-more frequent and intense heat when it comes to peak electricity demand. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: S&T policy, Climatology***Launch of the Helmholtz Pioneer campus****Physorg.com, 06FEB2017**

The visionary enterprise at Helmholtz Zentrum München is recruiting top international researchers from different disciplines to form an integrated operation taking on major disease challenges of our times. The first pioneer divisions will start as early as 2017 to search for technological breakthroughs to advance medical research. The appointment of internationally experienced science managers will largely free the research pioneers from administrative work and allow them to entirely focus on collaborative research. The world's comparable models include the Howard Hughes Janelia Research Campus or the Koch Institute (both USA).

*Tags: S&T policy, S&T Germany***China is now the world's largest solar producer****Digital Trends, 05FEB2017**

As it stands, solar energy represents only one percent of China's energy output. But this may soon change as China devotes more and more of its attention towards clean energy. According to China's National Energy Administration, China will seek to add more than 110 gigawatts within the next three years which could help the nation up the proportion of its renewable energy use to 20 percent by 2030. Today, it stands at 11 percent.

*Tags: S&T policy, S&T China, Solar energy ■***ABOUT THIS PUBLICATION**

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