



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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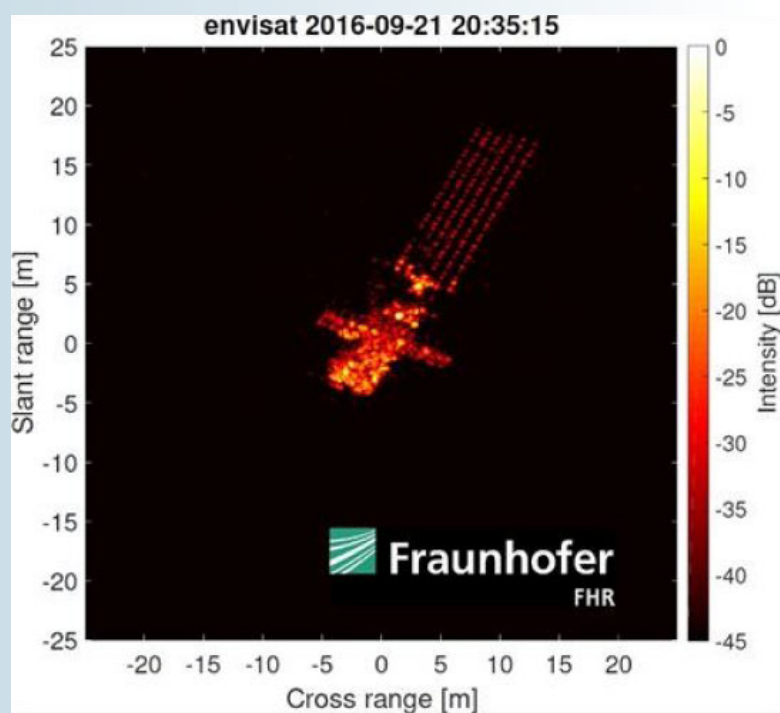
## FEATURE ARTICLES

### [Defunct satellites: Reliably determine and predict attitude motion](#)

[Science Daily, 04AUG2017](#)

European environmental satellite ENVISAT has been adrift in orbit since 2012. “De-orbiting missions” can only be successful if the satellite’s attitude motion parameters can be determined correctly. TIRA radar, developed by a team of researchers in Germany, combines Ku band imaging radar and L band tracking radar. The system offers the unique possibility to image space objects at high resolutions using ISAR techniques. In contrast to optical systems, the new radar system offers complete independence from weather conditions, day and night use, image resolution which is completely independent of the distance of the object and it can determine the rotational speed of fast rotating objects.

*Tags: Environmental science, Satellite technology, Space technology, Featured Article*



A correctly scaled radar reconstruction of the ENVISAT satellite.

Credit: © Photo Fraunhofer FHR

### [Biological Teleporter Could Seed Life Through Galaxy](#)

[MIT Technology Review, 02AUG2017](#)

SGI’s BioXP 3200 is a digital-to-biological converter developed by researchers at Synthetic Genomics Inc. (SGI). Using the device, they were able to send the genetic instructions sent to the device from elsewhere in the building to automatically manufacture the DNA of the common flu virus. They also produced a functional bacteriophage, a virus that infects bacterial cells. Though still a prototype, such instruments could one day broadcast biological information from sites of a disease outbreak to vaccine manufacturers, or print out on-demand personalized medicines at patients’ bedsides.

*Tags: Biotechnology, Disruptive technology, Emerging technology, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MATERIALS

#### [Materials governed by light](#)

[Physorg.com, 07AUG2017](#)

Hybrid materials combine components of differing origins (organic and inorganic) in order to obtain unconventional materials with new or improved properties deriving from the synergistic effect between the components. Researchers in Spain have developed and exhaustively characterised hybrid, photoactive materials that respond when exposed to light. They demonstrated that hybrid materials have applications in other fields, such as biomedicine. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

*continued...*

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## [The power of perovskite](#)

Nanowerk, 04AUG2017

A “perovskite structure” uses a different combination of atoms but keeps the general 3-dimensional structure originally observed in the mineral. However, anomalous hysteresis and unsatisfactory stability hinder their industrialization. Researchers in Japan found that surface modification of a TiO<sub>2</sub> compact layer can give insight into interface interaction in perovskite solar cells. Highest power conversion efficiency (PCE) of 18.5% was obtained using anatase TiO<sub>2</sub>, but the device was not stable and degraded rapidly. With an amorphous TiO<sub>2</sub> compact layer, the devices showed a prolonged lifetime but a lower PCE and more pronounced hysteresis. The work highlights the importance of interface structure and paves the way for further optimization of PCEs and stability of perovskite solar cells. [TECHNICAL ARTICLE](#)

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

## [Using angles to improve the future of electronics](#)

Nanowerk, 03AUG2017

When two stacked layers are made of the same material, such as graphene, a special set of periodic 2D superlattices will emerge at specific angles. By using the sharp-tip of an atomic force microscope, researchers in Switzerland demonstrated that it is possible to precisely control the nano-sized key-shaped device and rotate it like hands on a lock from 0 to 360 degrees with great precision. This could be used as a switch to turn on and off the current of a tunnel field effect transistor, an important step in reducing energy leakage in electronic devices. [TECHNICAL ARTICLE](#)

Tags: *Advanced materials, Microelectronics*

## [Heat-conducting plastic could lead to lighter electronics, cars](#)

Science Daily, 02AUG2017

Plastics are made of long chains of molecules and they are poor conductors. As heat travels through the material, it must travel along and between these chains. An international team of researchers (USA - University of Michigan, South Korea) used a chemical process to expand and straighten the molecule chains making it easier for heat to travel through it. The process stiffens the polymer chains and helps them pack together more tightly, making them even more thermally conductive. They believe the concept of using electrolytes to thermally engineer polymers can be applied to other materials. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

## [Research and design for carbon quantum dots catalysts](#)

Science Daily, 02AUG2017

Researchers in China provide technique for facile fabrication of nanocomposites introducing CQDs into Bi<sub>2</sub>WO<sub>6</sub> photocatalysts. They found that the composites possessed much higher photocatalytic activity which was attributed to the excellent up-converted photoluminescence, photo-induced electron transfer and electron reservoir properties of CQDs. The technology has applications in hydrogen evolution. [OPEN ACCESS TECHNICAL ARTICLE](#)  
Tags: *Advanced materials, S&T China*

## [Unraveling Perovskite Solar Cells](#)

Optics and Photonics, 02AUG2017

Solar cells made with the synthetic perovskite methylammonium lead iodide exhibit efficiencies upwards of 20 percent, which could be improved with a greater understanding of the interactions between charge carriers and the underlying lattice. An international team of researchers (USA - SLAC National Accelerator Laboratory, University of Pennsylvania, Stanford University, Columbia University, Carnegie Mellon Institution for Science, Israel) found that the Iodine atoms surrounding the central lead atoms rotated around them while maintaining the same distance from the lead. In other words, photoexcitation caused the bond angles between the lead and iodine atoms to change. The results show that the inorganic parts of the perovskite lattice also have important interactions with charge carriers. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Advanced materials*

## AUTONOMOUS SYSTEMS & ROBOTICS

### [Army wants smarter computer AI for electronic warfare](#)

Defense Systems, 02AUG2017

In a recently issued [RFI](#) the Army is looking for solutions capable of using machine learning techniques to monitor and assess the threat Radio Frequency emissions to establish normal and abnormal patterns of life, characterize emitter types and signal structures, and that are capable of integrating with and analyzing Army data, both tactical network and Intelligence, ISR, electro-optical sensors and Electronic Support Radio Frequency Electronic Warfare sensors.

Tags: *Autonomous systems & robotics, Artificial intelligence, Military technology*

“ It is far better to grasp the Universe as it really is than to persist in delusion, however satisfying and reassuring. ” –CARL SAGAN

## BIOTECHNOLOGY

### [US defence agencies grapple with gene drives](#) Nature News, 21AUG2017

In June, the JASON group met to discuss the current state of CRISPR technology, the field as a whole and anticipated problems. Under the DARPA program Safe Gene, researchers plan to develop tools to counter rogue gene drives that spread out of control. Such methods include chemicals that block gene-editing or ‘anti-gene drives’ that can reverse a genetic modification or immunize unaltered wild organisms so they are resistant to a gene drive.

*Tags: Biotechnology, Counter WMD, Synthetic biology*

## COMMUNICATIONS TECHNOLOGY

### [New CubeSat propulsion system uses water as propellant](#)

Purdue University, 07AUG2017

Researchers at Purdue University have developed a micro-propulsion system for CubeSats, called Film-Evaporation MEMS Tunable Array, or FEMTA thruster, that uses capillaries small enough to harness the microscopic properties of water. Because the capillaries are only about 10 micrometers in diameter, the surface tension of the fluid keeps it from flowing out, even in the vacuum of space. Activating small heaters located near the ends of the capillaries creates water vapor and provides thrust. In this way, the capillaries become valves that can be turned on and off by activating the heaters. Their work will be presented at an upcoming conference. [Video](#)

*Tags: Communications technology, Satellite technology, Sensors*

## COUNTER WMD

### [Vulnerability to a Bioterrorism Attack and the Potential of Directed Evolution as a Countermeasure](#)

Electronic Journal of Biology, 21APR2017

In this article, an international team of researchers (India, Dominica) consolidates the facts about natural and man-made biological warfare agents as well as the use of technology in the development of biological weapons, including near-term evolution in genetic engineering to prevent the potential havoc-wreaking events using biological agents. They suggest steps to tackle the vulnerability of humans to biological warfare and to provide a potential solution that incorporates Directed Evolution to attack the problem of biological weapon proliferation.

*Tags: Counter WMD*

## CYBER SECURITY

### [Cybersecurity for the travelling scientist](#) Nature News, 02AUG2017

Outside the confines of the lab and its relatively secure IT infrastructure, data and hardware are vulnerable to dangers such as hacking and theft. Researchers need to be on their guard, not just to protect their work, but also to protect confidential patient data or intellectual property. Cybersecurity concerns can be particularly acute when crossing international borders. Some regions have a reputation for hacking, and border guards might insist on seeing files. [Dos and dont's](#).

*Tags: Cyber security*

## ENVIRONMENTAL SCIENCE

### [Combining geoengineering approaches would keep constant temperatures and overall rainfall](#)

Next Big Future, 02AUG2017

Dispersion of light-scattering particles in the upper atmosphere and thinning of the cirrus clouds are some of the ways to mitigate the effects of greenhouse gases. An international team of researchers (China, India USA - Stanford University) used models to understand how effective a combined set of tools would be at reversing climate change, both globally and regionally. They found that if both methods are deployed in concert, it would decrease warming and rainfall to pre-industrial levels, but substantial differences remained locally. [TECHNICAL ARTICLE](#)

*Tags: Environmental science, Climatology*

## FOREIGN S&T

### [Russians developing anti-missile lasers and drones with microwave weapons](#)

Next Big Future, 31JUL2017

The Russian defense industry says it will deploy powerful lasers on its next generation fighters that will be able to “burn” enemy homing systems on projectiles fired in their direction to make them unable to hit a target. Drone technology is also a high priority for the Russian defense industry. Drones will carry microwave weapons, including guided electronic munitions while another drone will carry radio-electronic suppression and destruction means, and a third UAV will be armed with a set of standard weaponry.

*Tags: Foreign S&T, Military technology, S&T Policy, S&T Russia*



## INFORMATION TECHNOLOGY

**Team sets new record for magnetic tape storage—makes tape competitive for cloud storage**

Physorg.com, 03AUG2017

Tape storage is currently the most secure, energy efficient and cost-effective solution for storing enormous amounts of back-up and archival data. An international team of researchers (Switzerland, Japan) has developed a prototype sputtered magnetic tape which can store 201 Gigabits per square inch in areal density. They developed many new technologies including innovative signal-processing algorithms, a set of advanced servo control technologies and novel low friction tape head technology. The technology enables recording up to 330 terabytes of uncompressed data on a single tape cartridge. [TECHNICAL ARTICLE](#)

Tags: Information technology

## FEATURED RESOURCE

**Defense Systems**

Defense Systems delivers independent insight, analysis and perspective for decision makers who develop, acquire and manage network-based defense technologies that facilitate situational awareness and enterprise agility. [RSS](#)

**The future of search engines**

UT Austin, 03AUG2017

A team of researchers in the US (UT Austin, Northeastern University) developed a method for information retrieval based on combining AI with the insights of annotators and exploiting existing linguistic resources, such as lexical databases and ontologies via weight sharing to improve natural language processing models for automatic text classification. In tests, their approach consistently yielded improved performance on classification tasks. The papers will be presented at an upcoming ACM meeting. [OPEN ACCESS TECHNICAL ARTICLE 1, 2](#)

Tags: Information technology

## MICROELECTRONICS

**Logic2 circuits with diamond-based transistors**  
Science Daily, 02AUG2017

Researchers in Japan fabricated hydrogenated diamond not and nor logic circuits composed of depletion-mode and enhancement-mode MOSFETs by fabricating them on the same substrate using a threshold control technique. The circuits are promising devices to be used in the development of digital integrated circuits that are required to stably operate under extreme environments such as

high-temperature as well as exposure to radiation and cosmic rays. [TECHNICAL ARTICLE](#)

Tags: Microelectronics, S&T Japan

## NEUROSCIENCE

**Manipulating brain network to change cognitive functions: New breakthrough in neuroscience**

Science Daily, 07AUG2017

Based on the hypothesis that connectivity neurofeedback can induce the aimed direction of change in functional connectivity and the differential change in cognitive performance, an international team of researchers (Japan, UK) developed a technique called functional connectivity neurofeedback training. It uses fMRI brain scanning to monitor the functional connectivity between two brain regions. Using this method, they successfully induced the expected increase or decrease of functional connectivity. The technique could lead to important applications in clinical, rehabilitation and learning-assistive methods taking advantage of a neural plasticity. [OPEN ACCESS TECHNICAL ARTICLE 1, 2](#)

Tags: Neuroscience

## QUANTUM SCIENCE

**Physicists investigate fundamental limits of quantum engines**

Physorg.com, 04AUG2017

Previous research on the performance of quantum engines may be overestimating their advantages. An international team of researchers (Germany, UK) developed a method to compute the efficiency of quantum engines to show that the ultimate efficiency of quantum systems is subject to tighter fundamental limits than those imposed by the second law of thermodynamics because classical mechanics does not place restrictions on the speed of a process, whereas quantum mechanics does have speed restrictions, which are given by “quantum speed limits.” [TECHNICAL ARTICLE](#)

Tags: Quantum science

## S&amp;T POLICY

**China to launch world’s first quantum communication network**

Physorg.com, 04AUG2017

China is about to launch a computer network called Jinan. It is planned to be fully operational by the end of August 2017. It is the hub of the Beijing-Shanghai network for use in national defence, finance and other fields. They hope to spread it out as a pilot that if successful can be used across China and the whole world. The EU has invested EUR 550 million into quantum technologies and has provided policy support to researchers through the 2016 Quantum Manifesto.

Tags: S&T policy, Communications technology, S&T China

## [Multi-trillion dollar buildup of a China centric new world order for the 21st century](#)

Next Big Future, 04AUG2017

Beijing's Belt and Road initiative is part and parcel of a strategy to solidify China's emergence as a great economic and military power. The goal is to have China as "the uncontested leading presence in the region," extending far beyond its borders. They would use the wealth to attract more foreigners to invest with them and expand power and influence globally. While the EU and Russia have endorsed the concept, India is the only country refusing to endorse Belt and Road.

Tags: *S&T policy, Foreign S&T, S&T China*

## [Strategic Technology Office Outlines Vision for "Mosaic Warfare"](#)

DARPA, 04AUG2017

DARPA's Strategic Technology Office's has updated the strategy for winning or deterring future conflicts. The technology-based vision would enable highly complex, strategic moves by composing multiple contributing systems to enable what might be thought of as 'mosaic warfare,' in which individual components can respond to needs in real time to create desired outcomes. The goal is to fight as a network to create a chain of effects or 'effects webs' to deter and defeat adversaries across multiple scales of conflict intensity.

Tags: *S&T policy, DARPA, Military technology*

## [China Builds One of the World's Largest Geoenvironmental Research Programs](#)

MIT Technology Review, 03AUG2017

During the last three years, China has assembled one of the largest federally funded geoenvironmental research programs in the world. Across three institutions, researchers are assessing the impact of employing technological means of altering the climate and exploring related policy and governance issues. The effort explicitly does not include technology development, or outdoor experiments, in contrast with emerging U.S. research programs. An international team of researchers (China, India) focused on analyzing the potential impacts of geoenvironmental on polar ice sheets, sea levels, agriculture, and human health. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *S&T policy, Climatology, Foreign S&T*

## [Perspectives on Research in Artificial Intelligence and Artificial General Intelligence Relevant to DoD](#)

Federation of American Scientists , 01JAN2017

The JASON's study looks at AI research at the "6.1" level. All briefings to JASON were unclassified, and were largely from the academic community. It describes the technologies behind the remarkable recent advances in AI, explains

how they may relate (or may not relate) to hypothesized future advances in Artificial General Intelligence (AGI), and elucidates what special role the DoD may have in the support of basic research in these areas.

Tags: *S&T policy, Artificial intelligence*

## SCIENCE WITHOUT BORDERS

### ['Perfect liquid' quark-gluon plasma is the most vortical fluid](#)

Physorg.com, 02AUG2017

New analysis of data from the Relativistic Heavy Ion Collider (RHIC) by an international team of researchers (Poland, USA, Russia and others) shows that the "vorticity" of the quark-gluon plasma (QGP) surpasses the fastest spin record held by nanodroplets of superfluid helium. By studying these properties and the factors that control them, scientists hope to unlock the secrets of the force responsible for binding quarks and gluons into the protons and neutrons that form most of the visible matter in the universe today.

### TECHNICAL ARTICLE

Tags: *Science without borders*

### [From flying warehouses to robot toilets - five technologies that could shape the future](#)

The Conversation, 27JUL2017

Based on recent advancements and current trends, here are five innovations that really could shape the future - Smart homes, Virtual secretaries, AI doctors, Care robots, Flying warehouses and self-driving cars.

Tags: *Science without borders*

## SENSORS

### [AI Makes Anthrax Bioterror Detection Easier](#)

IEEE Spectrum, 04AUG2017

Researchers in South Korea have developed a system based on holographic microscopy and deep learning called HoloConvNet. It represents a multilayered neural network loosely modeled on biological brains that can use deep learning to identify any single-cell organisms if the neural network gets to first run through the proper training datasets involving images of those particular organisms. It is trained from raw images instead of manually extracted features. The system can be trained to identify other pathogens.

### OPEN ACCESS TECHNICAL ARTICLE

Tags: *Sensors, Artificial intelligence, Counter WMD*

### [Riding the wave: Controlling high frequency sound waves](#)

Science Daily, 02AUG2017

Although surface acoustic waves (SAWs) form a key component of a host of technologies, they have proved extremely difficult to control with any degree of accuracy. Researchers in the UK present an approach for the realisation of robust, tailorable SAW phononic crystals,

based on annular holes patterned in a SAW substrate. Using simulations and experiments, they show that this geometry creates highly attenuating phononic bandgaps at frequencies up to an order-of-magnitude larger than that achieved with a pillar phononic crystal of the same size, enabling effective phononic crystals to be made up of smaller numbers of elements. This work paves the way for the next generation of novel SAW device concepts, such as lab-on-a-chip biosensors, and the crystals can be scaled up to provide protection from earth quakes. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Sensors, S&T UK*

### [Detecting radio waves with entangled atoms](#) Science Daily, 01AUG2017

An international team of researchers (Spain, Czech Republic) demonstrated a new technique for detecting waveform components with magnetic sensitivity beyond the standard quantum limit by combining quantum nondemolition measurements and stroboscopic probing. They were able to measure the weak rf magnetic-field signal with a 25% reduction in experimental noise due to the quantum entanglement of the atoms, and sensitivity comparable to the best rf magnetometers used to date. The technique may have applications in the detection of bio-magnetic fields, and characterization of micro-electronics. [TECHNICAL ARTICLE](#)

*Tags: Sensors*

### [New optical device could help detect drugs, bomb-making chemicals and more](#) Physorg.com, 31JUL2017

An international team of researchers (USA - University of Buffalo, University of Wisconsin, China) fabricated a metamaterial super absorber structure with sub-5 nm gaps fabricated using atomic layer deposition processes that can trap light efficiently within these extreme volumes. They demonstrated that at mid-infrared wavelengths the metamaterial patterns can significantly enhance light-matter interaction at the nanoscale, and by coating the structures with chemical/biological molecules, fingerprints

of the molecules can be significant. The technology will enable the development of novel on-chip energy harvesting/conversion and surface enhanced spectroscopy techniques for bio/chemical sensing. [TECHNICAL ARTICLE](#)

*Tags: Sensors*

## STEM

### [Future Tech dominance - China outnumber USA STEM Grads 8 to 1 and by 2030 15 to 1](#) Next Big Future, 02AUG2017

The World Economic Forum reported that China had 4.7 million recent STEM graduates in 2016. India had 2.6 million new STEM graduates last year while the U.S. had 568,000. Chinese STEM graduates outnumber US STEM grads 8.2 to 1. The gap is going to become even wider. Even modest predictions see the number of 25 to 34-year-old graduates in China rising by a further 300% by 2030, compared with an increase of around 30% expected in Europe and the United States. By 2030, China and India could account for more than 60% of the Stem graduates in major economies, compared with only 8% in Europe and 4% in the United States. [Report](#)

*Tags: STEM, S&T Policy*

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