



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

[Advanced materials \(6\)](#)

[Cyber security \(3\)](#)

[Microelectronics \(1\)](#)

[Sensors \(2\)](#)

[Big data \(1\)](#)

[Foreign S&T \(3\)](#)

[Photonics \(6\)](#)

[Communications technology \(3\)](#)

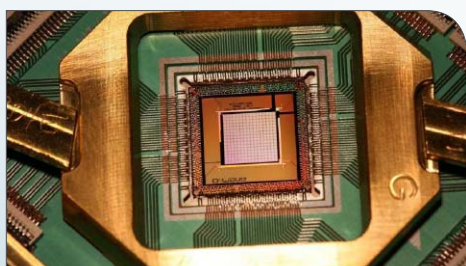
[Materials science \(4\)](#)

[Quantum science \(3\)](#)

FEATURE ARTICLES

[A new kind of quantum computer](#)

[Physorg.com](#), 06NOV2017



A photograph of D-Wave's 1000+ qubit computer chip under development. CfA scientists and their colleagues have proposed a new way to use photons of light instead of silicon chips as qubits, opening the door to new technologies. Credit: Google

An international team of researchers (USA - Harvard University, Austria) has proposed a new way to build a quantum computer using just a single atom. To use photons as information carriers, they must interact with

each other. Their idea is to allow light photons from an atom to interact with their own mirror image reflections with a very slight time delay. They show that the delay results in the combined waveform of the photons being so complex that in principle any quantum computation can be achieved by simply measuring the emitted photons. The theoretical discovery is a conceptual breakthrough in quantum optics and information and opens the door to new technology. [TECHNICAL ARTICLE](#)

Tags: Quantum science, Featured Article

[Synthetic material acts like an insect cloaking device](#)

[Physorg.com](#), 03NOV2017

Researchers at Pennsylvania State University have fabricated an antireflective surface that emulates the intricate surface architectures of leafhopper-produced brochosomes, soccer ball-like microscale granules with nanoscale indentations. The brochosome coatings (BCs) can be designed to exhibit strong omnidirectional antireflective performance of wavelengths from 250 to 2000 nm, comparable to the state-of-the-art antireflective coatings. The method is compatible with various materials including metals, metal oxides, and conductive polymers. The BCs may find applications in solar energy

harvesting, imaging, and sensing devices. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials, Biomimetics, Materials science, Featured Article

[Metasurface generates new states of light for fundamental research and applications](#)

[Physorg.com](#), 02NOV2017

Structured beams can tell scientists a lot about the physics of light and they have a wide range of applications from super-resolution imaging to molecular manipulation and communications. Researchers at Harvard University have developed a method for converting arbitrary spin angular momentum (SAM) states into total angular momentum states characterized by a superposition of independent orbital angular momentum (OAM). They designed a metasurface that converts left- and right-circular polarizations into states with independent values of OAM, and another device that performs this operation for elliptically polarized states. These results illustrate a general material-mediated connection between SAM and OAM of light and may find applications in producing complex structured light and optical communication. [TECHNICAL ARTICLE](#)

Tags: Photonics, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

[A new concept for a unidirectional waveguide](#)

[Physorg.com](#), 07NOV2017

An international team of researchers (Germany, USA - Caltech) has developed a detailed scheme for an experimental setup to realize a 2-dimensional topological insulator with classical optical networks. By preparing chiral photon modes at the boundary, it may be possible to build a one-way electromagnetic waveguide, in which light can only propagate in one direction. As these states are

continued...

[BACK TO TOP](#)

topologically protected, the states are very robust against imperfections, and electric currents can flow almost without any dissipation. This makes these materials extremely interesting for the task of quantum communication and quantum computing. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials

[Let there be \(white\) light: New materials shine out](#)

Nanowerk, 03NOV2017

Researchers at Northwestern University synthesized a series of new hybrid organic-inorganic lead bromide perovskites using different lengths of di-functional organic spacers. They showed that changing the length of the organic cations induces distortion of the 2-D perovskite inorganic layers in the material, making the layers take on a wavy or corrugated structure. As the distortion caused by the different cation lengths increases, the frequency bandwidth and the lifetime of the materials' photoluminescent emission increases. Understanding how spacers alter the light emitted could lead to new materials.

[TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

[Boron nitride nanosheets for clothing that cools](#)

Nanotechweb, 02NOV2017

Using materials based on boron nitride nanosheets and poly(vinyl alcohol) composite fibres, researchers at the University of Maryland fabricated a mid-infrared transparent nanoporous polyethylene fibre for making clothing and face masks that lowers body temperature by radiative cooling. They have also developed glass-polymer hybrid metamaterials that work on the same principle. It can cool a person down by up to 2°. The textile is easy to make using a simple, fast and scalable 3D printing method and has a thermal conductivity that is 55% higher than commercial cotton. This technique overcomes the problems associated with current technologies such as removing excess moisture, and reliance on phase change materials. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

[Graphene and other 2D materials: where are we now? \(podcast\)](#)

Nanotechweb, 02NOV2017

At the Enlighten Conference in Coventry, UK last month, the director of the Cambridge Graphene Centre presented a keynote talk on the material's applications in photonics and optoelectronics specifically.

Tags: Advanced materials

[Nanoflowers harness sunlight](#)

Nanotechweb, 02NOV2017

An international team of researchers (China, Singapore) combined ZnIn₂S₄ and MoSe₂ heterostructures to develop

photocatalysts for the production of hydrogen. The MoSe₂ nanonetworks have multiple pores and are in favour of the direct light absorption of ZnIn₂S₄, even though the ZnIn₂S₄ is hybridized with MoSe₂. The process has high chemical stability and catalytic activity. The hybridization of hierarchical nanoarchitectures has potential applications in energy storage and solar energy conversion applications. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Energy, Solar energy

BIG DATA

[TOP 10 insideBIGDATA Articles for October 2017](#)

Inside Big Data, 04NOV2017

A monthly heads-up for the top 10 most viewed articles appearing on insideBIGDATA.

Tags: Big data

COMMUNICATIONS TECHNOLOGY

[Milestone for ultra-fast communications and computing](#)

Science Daily, 06NOV2017

An international team of researchers (China, USA - University of Utah) deposited two-dimensional layered hybrid trihalide perovskites onto silicon substrates to create a system that would use the terahertz spectrum for communication. The absorption properties of these materials in the visible range can be tuned by changing the number of inorganic atomic layers in between the organic cation layers. Optical absorption in 2D perovskites occurs over a broad spectral range above the bandgap. The findings open new directions for creating active THz devices. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Communications technology

[Long-range backscatter system opens doors for remote data collection \(video run time 0:55\)](#)

Science 360, 03NOV2017

Devices that run on almost zero power and can transmit data across distances of up to 2.8 kilometers are breaking a long-held barrier and potentially enabling a vast array of interconnected devices. The long-range backscatter system in this study, which uses reflected radio signals to transmit data at extremely low power and low cost, achieved reliable coverage throughout a 4,800-square-foot house. Potential applications range from sensor arrays that could monitor pollution, noise or traffic in "smart" cities and medical devices that could wirelessly transmit information about a heart patient's condition around the clock.

Tags: Communications technology

[Beyond 5G - after the next generation](#)

Fraunhofer Research (Germany), 02NOV2017

Researchers in Germany and collaborators are working on 6G as part of the EU-sponsored TERRANOVA project. They are working on embedding terahertz wireless solutions into

continued...

“Scientific progress on a broad front results from the free play of free intellects, working on subjects of their own choice, in the manner dictated by their curiosity for exploration of the unknown.” VANNEVAR BUSH

fast fiber optic networks, developing new frequency bands and thereby laying the foundation for a resilient communications infrastructure. The focus is primarily on the wireless transmission and integration of wireless modules at chip level. The goal is to create a network connection in the terahertz frequency range that is sufficiently stable to allow for wireless data transmission at speeds of up to 400 gigabits a second.

Tags: Communications technology, S&T EU, S&T Policy

CYBER SECURITY

[A third of the Internet is under attack](#)

[Science Daily](#), 01NOV2017

According to an international team of researchers (USA - UC San Diego, the Netherlands, Germany) from March 2015 to February 2017, about one-third of the IPv4 address space was subject to some kind of DoS attacks. Two predominant types of DoS attacks, intended to overwhelm a service by a sheer mass of requests, are “Direct” attacks and “Reflection” attacks. Although their study employed state-of-the-art monitoring techniques, they could not capture some types of DoS attacks. As might be expected, more than a quarter of the targeted addresses in the study came in the United States. Their paper was presented at the 2017 ACM Internet Measurement Conference in London, UK.

Tags: Cyber security

[‘Instant replay’ for computer systems shows cyber attack details](#)

[Eurekalert](#), 30OCT2017

Researchers at the Georgia Institute of Technology have developed a software system called Refinable Attack INvestigation (RAIN) which allows investigators to quickly and accurately pinpoint how intruders entered the network, what data they took, and which computer systems were compromised. It will provide forensic investigators a detailed record of an intrusion, even if the attackers attempted to cover their tracks. The system provides multiple levels of detail, facilitating automated searches through information at a high level to identify the specific events for which more detailed data is reproduced and analyzed. The RAIN system continuously monitors a system and logs events that it recognizes as potentially interesting. Their work was presented at an ACM conference in October.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Cyber security

[‘Combosquatting’ attack hides in plain sight to trick computer users](#)

[Eurekalert](#), 28OCT2017

According to an international team of researchers (USA - Georgia Institute of Technology, Stonybrook University, UK), the attack strategy, known as combosquatting, is a growing threat with millions of such domains set up for malicious purposes. They set out to find domain names that incorporated the trademarked name with additional words added at the start or end of 268 trademark-containing URLs. Searching through six years of active and passive DNS requests, they found 2.7 million combosquatting domains. The number of combosquatting domains registered grew every year between 2011 and 2016. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Cyber security

FOREIGN S&T

[China unveils massive island-building vessel](#)

[Physorg.com](#), 04NOV2017

China has unveiled Tian Kun Hao, a massive ship described as a “magic island maker” that is Asia’s largest dredging vessel capable of building artificial islands of the sort the country has constructed in the contested South China Sea. It is capable of digging 6,000 cubic meters an hour.

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

[Details of China’s future navy with hypersonic and laser weapons, new submarines targets Asia-wide dominance](#)

[Next Big Future](#), 03NOV2017

China’s unidentified 7,000-ton nuclear-powered attack submarine (SSN) will feature a new type of powerplant, new weapon system and electronic information system. It has a sound isolation raft and propulsor which should reduce its acoustic signature, 12 cruise missile tubes in front of the sail, and a bow and sail similar to the current Type 093 SSN. The 7,000 ton weight suggests it may reflect the lower-cost weight and capability balance seen in current U.S. and British SSNs.

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

[Technology breakthrough will let China’s aircraft carrier use electromagnetic jet launching system](#)

[Next Big Future](#), 30OCT2017

The development of the integrated propulsion system (IPS) would allow the vessel to be more efficient, allowing more

power for an electromagnetic catapult, without having to resort to nuclear power. The innovative design meant that high-energy consuming launch systems and weapons could now be used on a vessel driven by conventional power. The same technology could be used to launch not just aircraft, but also missiles and satellites, and maybe even power high-speed trains.

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

FEATURED RESOURCE

AI Topics

AI Topics is the Internet's largest collection of information about the research, the people, and the applications of Artificial Intelligence. A wide variety of curated and organized resources are gathered from across the web.

MATERIALS SCIENCE

[Ultrafast magnetic reversal points the way toward speedy, low-power computer memory](#)

[Physorg.com, 06NOV2017](#)

A major challenge for MRAM has been to speed up the writing of a single bit of information to less than 10 nanoseconds. A team of researchers in the US (UC Berkeley, UC Riverside, Lawrence Berkeley National Laboratory) found that in a magnetic alloy made of gadolinium and iron, the fast electrical pulses can switch the direction of the magnetism in less than 10 picoseconds. The electrical pulse temporarily increases the energy of the iron atom's electrons causing the magnetism in the iron and gadolinium atoms to exert torque on one another, and eventually leads to a reorientation of the metal's magnetic poles. The findings could lead to greatly increased performance and more energy-efficient computer memory and processing technologies. [TECHNICAL ARTICLE 1, 2](#)

Tags: Materials science, Information technology

[Physicists show how lifeless particles can become 'life-like' by switching behaviors \(w/ video\)](#)

[Physorg.com, 02NOV2017](#)

Many living systems switch behaviors collectively, firing on and then shutting off. Researchers at Emory University have demonstrated temporal switching between a crystalline, condensed state and a gas-like, excited state in a spatially extended, quasi-two-dimensional system of charged microparticles. Accompanying numerical simulations show that conservative forces, damping, and stochastic noise are sufficient to prevent steady-state

equilibrium, leading to switching between the two states over a range of time scales, from seconds to hours. Their findings provide a base to help understand more complex systems.

[TECHNICAL ARTICLE](#)

Tags: Materials science

[Unlocking the potential of magnetic skyrmions](#)

[Physorg.com, 02NOV2017](#)

An international team of researchers (Singapore, USA - Lawrence Berkeley National Laboratory, South Korea) fabricated an ultrathin film with sequential layers of iridium, iron, cobalt, and platinum on a silicon substrate. By varying the thickness of the layers, they could modulate the physical properties, such as the size, density, and stability of the skyrmions. The platform allows us to directly control the magnetic interactions that govern skyrmion properties by simply varying the thickness of the constituent layers, and provides skyrmion configurations tailored to the specific requirements of applications. They could then be easily integrated into microchips using existing manufacturing processes commonly used in the electronics industry.

[TECHNICAL ARTICLE](#)

Tags: Materials science, Advanced materials

[Liquids take a shine to terahertz radiation](#)

[Science Daily, 30OCT2017](#)

An international team of researchers (India, Qatar, Russia, Greece, France) irradiated common laboratory liquids like methanol, acetone, dichloroethane, carbon disulphide and even water, with moderate energy femtosecond laser pulses ionizing the liquid and forming long plasma channels called filaments. They measured energies as high as 50 microjoules, thousands of times larger than the energies emitted by most existing sources and 10-20 times larger than those produced from air. The experimental conditions were simpler than those needed for air. The femtosecond laser pulse induces secondary emissions in the liquid which would then combine with the incident laser pulse to produce the observed terahertz radiation. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science, Terahertz technology

MICROELECTRONICS

[Fully integrated circuits printed directly onto fabric](#)

[Eurekalert, 08NOV2017](#)

An international team of researchers (UK, China, Italy) working under the EU Graphene Flagship designed low-boiling point inks, which were directly printed onto polyester fabric. They found that modifying the roughness of the fabric improved the performance of the printed devices. The versatility of this process allowed them to combine active and passive components. The printed components are flexible, washable and require low power, essential requirements for applications in wearable electronics. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Microelectronics, Flexible electronics

continued...

PHOTONICS

A continuous-wave maser is the first to run at room temperature[Physics World, 03NOV2017](#)

Researchers in the UK have demonstrated a continuous-wave room-temperature maser oscillator using optically pumped charged nitrogen-vacancy defect centres in diamond. This demonstration unlocks the potential of room-temperature solid-state masers for use in a new generation of microwave devices. The research paves the way for a new class of maser that could find applications in medicine, security and sensing, taking advantage of its sensitivity and low noise. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Photonics, S&T UK, Sensors***New Laser Technique Promises Photonic Devices Inside of Silicon**[IEEE Spectrum, 03NOV2017](#)

An international team of researchers (Turkey, USA - MIT, Germany) has developed a 3D laser fabrication technique for nonlinear feedback mechanisms between the laser beam and the materials modified by the laser. When a positive feedback is set up, it becomes possible for even subtle changes to build up iteratively, rapidly, and often exponentially. The key to the researchers' approach is to exploit nonlinearities in the form of positive feedback loops. The rod-like structures, generated due to the nonlinear feedback effects elongate along the direction of beam propagation, can be assembled to create a 2D layer, or even more complex 3D shapes. The technique can be used for silicon-based photonics components for near- and mid-IR photonics. [TECHNICAL ARTICLE](#)

*Tags: Photonics***Optoelectronics without glass**[Physorg.com, 03NOV2017](#)

An international team of researchers (Switzerland, USA - University of Washington) fabricated a plasmonic modulator from a single layer of gold using a substrate-independent process. They created a device with a 3 x 36 micrometres footprint and with modulation rates exceeding 100 GHz. It could be used for telecommunications applications, computers, displays and optical sensors. [TECHNICAL ARTICLE](#)

*Tags: Photonics, Communications technology***Nanoscale 'abacus' uses pulses of light instead of wooden beads to perform calculations**[Nanowerk, 02NOV2017](#)

An international team of researchers (Germany, UK) has developed a nanoscale optical 'abacus' which provides multistate compute-and-store operation by integrating functional phase-change materials with nanophotonic chips. With picosecond optical pulses they performed the fundamental arithmetic operations of addition, subtraction,

multiplication, and division, including a carryover into multiple cells. This basic processing unit is embedded into a scalable phase-change photonic network and addressed optically through a two-pulse random access scheme. The framework provides first steps towards light-based non-von Neumann arithmetic. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Photonics, Breakthrough technology***Wave properties of particles can manifest in collisions**[Physorg.com, 02NOV2017](#)

Researchers in Russia have demonstrated that when you shine a simple beam on an atom, the electrons begin to dissipate, absorb, or do something else. And if we focus two superimposed beams on a hydrogen atom in the area between the beams, the atom reacts differently because there is destructive interference. This leads to a change in the properties of the scattered electrons and can be observed experimentally. The experiment was conducted at room temperature. The research can open new perspectives for noninvasive electron microscopy, quantum tomography and particle physics. [TECHNICAL ARTICLE](#)

Tags: Photonics, S&T Russia

QUANTUM SCIENCE

Researchers develop data bus for quantum computer[Science Daily, 08NOV2017](#)

Researchers in Austria propose locally modifying specific elements of the encoded quantum bits. This process, called lattice surgery, is used to couple systems such as quantum processors and memories. Once the systems are temporarily "sewed" together, quantum information can be teleported from the processor to the memory and vice versa. The method can be used for the fault-tolerant transfer of quantum information between arbitrary topological subsystem codes in two dimensions and beyond. It can be employed to create a simple interface, a quantum bus, between noise resilient surface code memories and flexible color code processors. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Quantum science***A bit of a 'quantum magic trick': Experiment shows how to speed up frequency measurement**[Science Daily, 02NOV2017](#)

A team of researchers in the US (Washington University, University of Rochester, Chapman University) used a superconducting quantum system where an external oscillating signal with unknown frequency caused the quantum system to undergo periodic changes. By applying quantum pulses on top of the oscillating signal, the state of the system could be controlled so that the final readout of the

quantum system became highly sensitive to the precise value of the oscillation frequency. They demonstrated that by measuring for 10 times as long, the frequency uncertainty can be reduced by a factor of 100. Advances in timekeeping continue to have profound impact on fundamental science and technology such as navigation and MRI medical imaging devices. [TECHNICAL ARTICLE](#)

Tags: Quantum science, Science without borders

SENSORS

[On-board computers and sensors could stop the next car-based attack](#)

[The Conversation](#), 03NOV2017

Existing systems can identify the danger and whether it's headed toward the car (or if the car's headed toward it). It is hard to defend against physical alteration of a car's safety equipment, but manufacturers could prevent cars from starting or limit the speed and distance they can travel, if the vehicle detects tampering. To protect pedestrians from vehicle attacks, the system could be programmed to override the driver when humans are in the way. The existing technology could do this, but isn't currently used that way.

Tags: Sensors

[Chip-based sensors with incredible sensitivity](#)

[Physorg.com](#), 02NOV2017

Researchers at Pennsylvania State University have developed a new way to make optical whispering gallery mode resonators. Using a glassblowing technique, hollow borosilicate glass spheres were blown from sealed and pressurized cylindrical cavities etched into a silicon substrate. Under high heat and external vacuum pressure, the thin glass wafer forms an almost perfect bubble. The bottom of the sphere was thinned until it is basically a hole. The light can be on the outside of the sphere and all the chemistry on the inner face of the shell. The device can be used for chemical sensing, vapor sensing, biophysical sensing, pressure sensing and temperature sensing. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Sensors ■

ABOUT THIS PUBLICATION

The appearance of external hyperlinks in this publication does not constitute endorsement by the United States Department of Defense (DoD) of the linked web sites, nor the information, products or services contained therein. In addition, the content featured does not necessarily reflect DoD's views or priorities.

To [SUBSCRIBE](#) or [UNSUBSCRIBE](#), visit <https://tin-ly.sainc.com/ASDRE/Subscription>. To provide feedback or ask questions, contact us at asdre-st-bulletin-reply@sainc.com. This publication is authored and distributed by:

Ryan Zelnio, Ph.D., Associate Director - Tech Watch / Horizon Scans, Office of Net Technical Assessments, OSD AT&L/OASD(R&E)

Ms. Hema Viswanath, TW/HS, ONTA Corporate Librarian