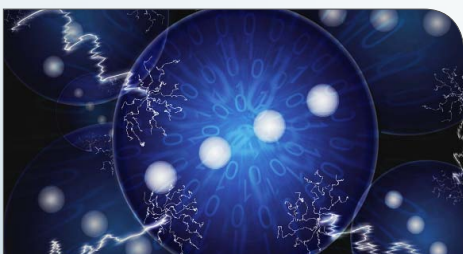


[Advanced materials \(4\)](#)[Cyber security \(3\)](#)[Environmental science \(2\)](#)[Imaging technology \(1\)](#)[Information technology \(1\)](#)[Materials science \(2\)](#)[Microelectronics \(1\)](#)[Neuroscience \(1\)](#)[Photonics \(2\)](#)[Quantum science \(8\)](#)[S&T policy \(1\)](#)[Science without borders \(3\)](#)[Sensors \(2\)](#)[STEM \(1\)](#)

FEATURE ARTICLES

[Ion qubits offer early glimpse of quantum error detection](#)

[Physorg.com, 09NOV2017](#)

An artist's rendering of a four-qubit error detecting code. These codes, along with their more powerful error correcting cousins, will be crucial to future quantum devices.
Credit: Nina Beier/JQI

An international team of researchers (USA - University of Maryland, Georgia Institute of Technology, UC Berkeley, UK) distributed the information of one qubit among four trapped ytterbium

ions using a fifth ion qubit to read out whether certain errors had occurred. They could link the fifth ion qubit with the other four at will. With this approach, the scientists detected nearly all the single-ion errors, performing more than 5000 runs of the full encoding and measurement procedure for a number of different quantum states. The encoding itself didn't appear to introduce errors on multiple ions at the same time. The research demonstrates the potential of qubit protection schemes with trapped ions and paves the way toward error detection and eventually error correction on a larger scale.

[OPEN ACCESS TECHNICAL ARTICLE](#)*Tags: Quantum science, Featured Article*

['Perfectly frustrated' metal provides possible path to superconductivity, other new quantum states](#)

[Physorg.com, 09NOV2017](#)

Frustrated magnets in which the spins fail to align into stable magnetic order are typically insulators. In perfectly frustrated magnets called spin liquids, the disordered magnetism persists even at very low temperatures, and their unique properties are of interest in the development of quantum computing

and high-temperature superconductivity. A team of researchers in the US (Iowa State University, Oak Ridge National Laboratory) was able to define a "perfectly frustrated" state in a metallic material, $\text{CaCo}_{1.86}\text{As}_2$. Some of the interactions that lead to frustration are mediated by conduction electrons, and a number of those can be very accurately tuned which may result in a superconductor, or some other novel quantum state. [TECHNICAL ARTICLE](#)

Tags: Quantum science, Advanced materials, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

[Innovative, ideal liquid-repellent surfaces developed by scientists](#)

[Science Daily, 14NOV2017](#)

Researchers in Hong Kong have developed well-defined porous membranes for durable omniphobic surfaces inspired by the springtail cuticles, soil-dwelling arthropods, whose habitats often experience rain and flooding. Using polyvinyl alcohol, the researchers designed porous surfaces composed of interconnected honeycomb-like microcavities with a re-entrant profile: interconnectivity ensures mechanical stability and the re-entrant structure yields robust liquid-repellency. The surface repels at least 10 types of liquid, including water, surfactant solutions, oils, and organic solvents and can recover its non-wetting state. As the material is flexible, it can be coated onto various objects. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials

[A flexible material that generates electricity when stressed](#)

[Physorg.com, 10NOV2017](#)

Researchers in Switzerland succeeded in giving elastomers piezoelectric properties. The rubber is a composite material made of polar nanoparticles and an elastomer (silicone in the prototype). They introduce internal

continued...[BACK TO TOP](#)

polarization using a strong electrical field. The film was heated until the glass transition temperature exceeded and the nanoparticles changed from a solid, glassy state into a rubbery, viscous one. The orientation was frozen by cooling the material to room temperature. The new material could have applications in sensors, medical devices, clothing or robots.

Tags: Advanced materials, Materials science, S&T Switzerland

A gel that does not break or dry out

[Science Daily, 08NOV2017](#)

Researchers in Japan created a double network within ionic liquid, combining a network of inorganic silica particles with a network of organic polymers which dramatically improved the resilience and strength of the ion gel. When stress is applied to the gel, the brittle silica particle network breaks and dissipates the loaded energy. The physical interaction between the silica particles enables the network to self-recover. It can be stored in a stable condition for a long time and even exposed to high temperature without damage to its performance. Possible applications include, use as a CO₂ separation membrane or as electrolytes for rechargeable batteries. [TECHNICAL ARTICLE](#)

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

The flat and the curious

[Nanowerk, 06NOV2017](#)

Using machine learning algorithms, a team of researchers in the US (Argonne National Laboratory, University of Chicago) simulated the growth of silicene that has attractive electronic properties. Researchers can use the optimized set of conditions to test their model for the best structures and properties they desire, bringing them closer to realizing the applications of 2D materials in electronics, batteries and sensory devices. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

CYBER SECURITY

Chemist proposes 'sweat analysis' to better secure electronics

[Physorg.com, 10NOV2017](#)

A team of researchers in the US (SUNY Albany, Clarkson University) is developing a biometric-based authentication approach which relies on analyzing sweat to build an amino acid profile that is unique to the devices' owner. The profile would be stored within the device and used for identification purposes each time an attempt to unlock is made. The owner would be identified holding the device/wearing it. Individual and combinations of amino acids processed by biocatalytic cascades yield optical or electronic signals, providing a time-series of several outputs that, in their entirety, should suffice to authenticate a specific user based on standard statistical criteria. [TECHNICAL ARTICLE](#)

Tags: Cyber security, Sensors

A 'virtual wall' that improves wireless security and performance

[Science Daily, 08NOV2017](#)

To improve wireless signal strength for indoor spaces with multiple rooms, a team of researchers in the US (Dartmouth College, University of Washington, Columbia University, UC Irvine) has fabricated a customized reflector that directs wireless signals to enhance or suppress as needed. They developed an approach to simulate the radio signals interaction within an environment and an algorithm to optimize the reflector's shape for the environment. In tests, they could decrease the strength by up to 10 dB, and increase by 6 dB. In future work, they plan to study reflectors made of different materials to automatically adapt its shape to different environments and higher frequency bands. The research was presented at a recent conference.

Tags: Cyber security, Communications technology, Cyber security

Multi-racial facial recognition system provides more accurate results, says Surrey study

[Eurekalert, 06NOV2017](#)

An international team of researchers (UK, China) has developed a 3D morphing face model that has 'learned' from different racial faces and can better identify people in 2D pictures - even if a person's appearance is compromised by their pose, expression, lighting or poor image resolution. They found their aging effect technology - which is used to identify individuals after a long period of time has passed - more precise when it was taught to learn from models of different races. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Cyber security, Pattern recognition, Sensors

ENVIRONMENTAL SCIENCE

NSF awards \$2.8 million grant to develop advanced ocean and atmosphere simulator

[NSF, 08NOV2017](#)

Under a grant from the NSF, Scripps Institution of Oceanography in La Jolla, California is constructing a replica of the Earth's complex ocean-atmosphere system that will accurately duplicate ocean conditions capturing the interactions of wind, waves, microbial marine life and chemistry in a laboratory setting. It will enable a more detailed study of aerosols -- particles composed of sea salts, organic matter, viruses and bacteria that are ejected from the ocean surface when waves break and winds blow. Such particles directly seed and form clouds, they can change the properties of clouds, which in turn change the temperature of the planet. It should help address fundamental questions on the ecology of microbes at the air-sea interface which is important for predicting the future state of the ocean-atmosphere system.

Tags: Environmental science, S&T Policy

“One thing I have learned in a long life: that all our science, measured against reality, is primitive and childlike and yet it is the most precious thing we have.” ALBERT EINSTEIN

[Federal climate science report for U.S. released](#) NOAA, 03NOV2017

According to Volume I of the Fourth National Climate Assessment (NCA4), [Climate Science Special Report](#), in addition to warming, many other aspects of global climate are changing, primarily in response to human activities. Thousands of studies conducted by researchers around the world have documented changes in surface, atmospheric, and oceanic temperatures; melting glaciers; diminishing snow cover; shrinking sea ice; rising sea levels; ocean acidification; and increasing atmospheric water vapor. Changes in the characteristics of extreme events are particularly important for human safety, infrastructure, agriculture, water quality and quantity, and natural ecosystems.

Tags: *Environmental science, Climatology*

IMAGING TECHNOLOGY

[New infrared camera goes multi-spectral](#) Nanotechweb, 06NOV2017

An international team of researchers (Canada, Russia) has developed a device from arrays of III-V nanowires that can support optical resonant modes and act as very effective waveguides that concentrate and absorb light over a length of just microns. The wavelength selectivity can be tuned continuously across the visible and IR wavelengths by adjusting the nanowire diameter. The device can be directly integrated with existing silicon sensors making it cost effective. It has applications in astronomy, automotive safety, surveillance, search and rescue, and defence. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Imaging technology*

INFORMATION TECHNOLOGY

[Fruit fly brains inform search engines of the future](#)

Science Daily, 09NOV2017

A team of researchers in the US (UC San Diego, Salk Institute, La Jolla, CA, Kavli Institute, La Jolla, CA) found that the fruit fly olfactory circuit solves a similarity search problem with a variant of the locality-sensitive hashing algorithm. The fly circuit assigns similar neural activity patterns to similar odors, so that behaviors learned from one odor can be applied when a similar odor is experienced. The fly algorithm, however, uses three computational strategies that depart from traditional approaches. These strategies can be translated to improve the performance of computational similarity searches. This provides a conceptually new algorithm for solving a fundamental computational problem. [TECHNICAL ARTICLE](#)

Tags: *Information technology, Biomimetics*

MATERIALS SCIENCE

[Liquid shock absorbers](#)

Science Daily, 08NOV2017

Colloids absorb surface shock and stiffen following an impact by firearms or micrometeorites. An international team of researchers (Switzerland, USA - Caltech, France) has shown that the way colloids work can change dramatically in response to very strong impacts. They created two-dimensional colloidal crystals of silica beads in a mixture of water and glycerine. They observed that when the shock is particularly intense, the liquid no longer flows between the beads, and they deform; the physical properties of the beads strongly influence shock absorption, and the usual equations no longer apply. For the particles to have an effect, the impact must be extremely intense, such as that caused by a firearm or micrometeorites. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Materials science*

[Atoms depart when oxides meet](#) Nanowerk, 06NOV2017

Researchers at the Pacific Northwest National Laboratory layered together thin film lanthanum iron oxide and strontium titanium oxide capped with a strontium oxide (SrO) titanium dioxide (TiO₂) plane, to produce a photocatalyst for solar water splitting. Through density functional theory calculations, they showed that the SrO layer was less stable than TiO₂ and that it could be lost by forming oxygen vacancies. The results could lead to more precise control of the properties and performance of key energy materials. [TECHNICAL ARTICLE](#)

Tags: *Materials science, Government S&T*

MICROELECTRONICS

[Highly flexible organic flash memory for foldable and disposable electronics](#)

Science Daily, 07NOV2017

Researchers in South Korea used thin polymeric insulators grown with chemical vapor deposition for the fabrication of flexible thin-film transistors bendable down to a radius of 300 micrometers. They used programming voltages around 10 V to produce flash memory. The researchers project data retention time of over 10 years, while maintaining its memory performance even at a mechanical strain of 2.8%. They demonstrated the technology by producing them on printing paper, opening a way for disposable smart electronic products. [TECHNICAL ARTICLE](#)

Tags: *Microelectronics, Flexible electronics*

continued...

NEUROSCIENCE

How challenges change the way you think

Science Daily, 09NOV2017

An international team of researchers (Austria, Denmark, Liechtenstein) investigated the short-term effects of challenging experiences on acquiring their context details. The team also investigated whether experiences coded as positive produced the same response as those coded as negative. Their findings support the hypothesis that challenging situations -- positive or negative -- cause the brain to drop nuanced, context-based cognition in favor of reflexive action. Reflexive reactions are less complex and demanding, and might stop individuals from making decisions based on unreliable information from unpredictable surroundings. The findings may have a better basis for understanding reactions to challenging situations - from witnessing a crime to fighting on a battlefield.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Neuroscience

FEATURED RESOURCE

Nature Asia-Pacific

An English language website highlighting some of the best research in the Asia-Pacific region as well as links to local language websites. [RSS](#)

PHOTONICS

Lasers go to the dark side

Nanotechweb, 09NOV2017

An international team of researchers (Greece, USA - Iowa State University) created a linear grating of silver strips, filling the space between the strips with a high-index dielectric with a gain medium embedded in it. When the gain medium is pumped by an external light source, the energy accumulates in the gain medium and lasing occurs directly in the dark bound state of the laser. Non-resonant scatterers on the surface of the grating scatter the energy in the dark mode creating the optical laser beam output. This approach separates the conceptual constituents of lasing action, cavity resonance and out-coupling to the emitted laser-radiation from one another, and allows the researchers to independently optimize the individual components. [TECHNICAL ARTICLE](#)

Tags: Photonics

Flexible, stretchable photonic devices

Science Daily, 08NOV2017

Most current photonics devices are fabricated from rigid materials on rigid substrates. An international team of researchers (USA - MIT, University of Central Florida, UK) formed chalcogenide into a spring-like coil allowing it to stretch and bend freely while maintaining its desirable optical properties. Tests have shown that such spring-like configurations, made directly on a polymer substrate, can undergo thousands of stretching cycles with no detectable degradation in their optical performance. They demonstrated a series of high-performance glass-on-graphene devices including ultra-broadband on-chip polarizers, energy-efficient thermo-optic switches, as well as graphene-based mid-infrared waveguide-integrated photodetectors and modulators. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Photonics, Flexible electronics

QUANTUM SCIENCE

Field-Free Spin Patterns

American Physical Society Focus, 10NOV2017

Skyrmions, which could be used to store data, often require an external magnetic field for stability. An international team of researchers (Germany, USA - University of New Hampshire, China) fabricated a disk made of FeGe with a width comparable to the typical size of a skyrmion in FeGe. In numerical simulations, the researchers showed that the lowest energy state in this confined geometry is the desired target pattern: a single skyrmion surrounded by a concentric ring where the spins continue the rotations of the skyrmion's swirling pattern. This ring creates a magnetic field opposite to that of the skyrmion and that essentially provides the same stabilization as an applied external field. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science

IBM Announces Advances to IBM Quantum Systems & Ecosystem

IBM, New York, 10NOV2017

IBM has announced two significant quantum processor upgrades for its IBM Q. Clients will have a 20-qubit processor featuring improvements in superconducting qubit design, connectivity and packaging. They successfully built and measured an operational prototype 50-qubit processor with similar performance metrics. This new processor expands upon the 20-qubit architecture and will be made available in the next generation IBM Q systems.

Tags: Quantum science, Information technology

[Superconducting quantum computer achieves ten-qubit entanglement](#)

Physics World, 10NOV2017

An international team of researchers (China, USA - University of Kansas) reports a superconducting architecture in which information is encoded as transmons – a form of charge qubit especially robust to noise. They used a bus resonator to mediate qubit–qubit coupling, and showed that a single collective interaction could produce a ten-qubit GHZ state from initially non-entangled qubits. According to the team, the efficient generation of entanglement, and the ability to operate on different qubit pairs in parallel, makes their approach a promising route to achieving a large-scale quantum computer. [TECHNICAL ARTICLE](#)

Tags: *Quantum science*

[New architecture could prove essential for high-performance quantum photonic circuits](#)

Physorg.com, 08NOV2017

An international team of researchers (USA - NIST, University of Maryland, China, UK, Brazil) has developed an architecture using indium arsenide quantum dot to generate individual photons on the same chip as the optical waveguides made from silicon nitride. The photons are confined in nanoscale spaces speeding up the photon emission rate. This enables the quantum dots to directly assist with the processing of information rather than simply produce streams of photons. The passive waveguides made of silicon nitride transmit photons across a chip's surface with very low photon loss. This allows quantum-dot-generated photons to efficiently coalesce with other photons at a beam splitter, modulators and detectors. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Quantum science, Microelectronics*

[Quantum computing on the move](#)

Physorg.com, 07NOV2017

Based on the moving ions in a micro-structured trap, an international team of researchers (Germany, Argentina) has demonstrated the operation of a four-qubit register composed of atomic ions trapped in microchip trap. The ion qubits can be freely positioned within the trap, such that laser-driven quantum operations at high accuracy remain possible. The entangled states of four qubits are distributed across macroscopic scales of up to several millimeters. Each of the qubits loses its individual identity, but the register does have a well-defined state. [TECHNICAL ARTICLE](#)

Tags: *Quantum science*

[A quasiparticle quest](#)

Science Daily, 06NOV2017

An international team of researchers (USA - UC Santa Barbara, Princeton University, Japan) used graphene to develop an extremely low-defect, highly tunable device in which non-Abelian anyons should be much more accessible. By aligning and stacking these flat and perfect crystals

of the material on top of each other, the team achieved not only a very low-disorder system, but one that is also extremely tunable. The experiments so far are consistent with theory, which indicates that some of the states they observed should be non-Abelian, but they don't have an experimental confirmation. The existence of Abelian anyons would pave the way toward major advances in topological quantum computing. [TECHNICAL ARTICLE](#)

Tags: *Quantum science*

S&T POLICY

[DARPA is looking for advanced war gaming](#)

Defense Systems, 09NOV2017

The ultimate interest of DARPA's program, Foundations for Strategic Mechanism Design, is in acquiring capabilities to strategically assess and manage the actions of state and non-state actors. The development of strategic mechanisms will require the integration of recent advances in game theory, behavioral economics, computer science, and artificial intelligence. A big problem is that while games reward rational behavior such as maximizing a player's score, the behavior of nations is often anything but rational. DARPA researchers wonder whether advances in fields such as artificial intelligence and the social sciences, will allow a realistic simulation of irrationality. [BAA](#)

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

SCIENCE WITHOUT BORDERS

[The path length of light in opaque media](#)

Physorg.com, 10NOV2017

An international team of researchers (France, Austria) has experimentally verified the prediction that the average total distance covered by light inside a transparent or turbid substance is always the same. Light travels through the liquid as a wave rather than as a particle along a specific trajectory. It turns out, this does not change the main result. The mean length associated with light penetrating the liquid always stays the same, irrespective of how strongly the wave is scattered inside the medium. The result helps understand the propagation of waves in disordered media. It is a universal law, which in principle holds for any kind of wave, sound waves, or even gravity waves, travelling through a galaxy. [TECHNICAL ARTICLE](#)

Tags: *Science without borders*

[Four ethical priorities for neurotechnologies and AI](#)

Nature News, 08NOV2017

Neuroscientists, neurotechnologists, clinicians, ethicists and machine-intelligence engineers from international brain projects, and from academic and research institutions in the United States, Canada, Europe, Israel, China, Japan and Australia met at a recent workshop sponsored by NSF to discuss the ethics of neurotechnologies and machine intelligence. They believe that the existing guidelines are

continued...

insufficient. To address this deficit, they laid out recommendations relating to four areas of concern: privacy and consent; agency and identity; augmentation; and bias. They recommend governments create their own deliberative bodies to mediate open debate involving representatives from all sectors of society, and to determine how to translate these guidelines into policy, including specific laws and regulations.

Tags: Science without borders, Artificial intelligence, Neuroscience

New Research Aims to Solve the Problem of AI Bias in “Black Box” Algorithms

MIT Technology Review, 07NOV2017

AI is only as good as the data it's trained on, and in many cases, we end up baking our all-too-human biases into algorithms that have the potential to make a huge impact on people's lives. A team of researchers in the US (Cornell University, industry) proposes a transparent model distillation approach to understand and detect bias in such models. Model distillation was originally designed to distill knowledge from a large, complex model to a faster, simpler model without significant loss in prediction accuracy. They added a third restriction - transparency - and showed that it is possible to train transparent, yet accurate models to understand the predictions made by black-box models. [OPEN ACCESS](#)

[TECHNICAL ARTICLE](#)

Tags: Science without borders, Artificial intelligence

SENSORS

Walk this way—a better way to identify gait differences

Physorg.com, 09NOV2017

According to researchers in Japan, current convolutional neural network (CNN) based approaches are missing the aspects on verification versus identification, and the trade-off between spatial displacement, that is, when the subject moves from one location to another. They designed input/output architectures for CNN-based cross-view gait recognition employing a Siamese network for verification. In tests the proposed architectures outperformed the state-of-the-art benchmarks.

[TECHNICAL ARTICLE](#)

Tags: Sensors, Biometrics

Quantum tunneling in water opens the way to improved biosensing

Physorg.com, 07NOV2017

Researchers in Australia have applied quantum techniques to understanding the electrolysis of water. They measured the low-voltage current flows between gold electrodes in pure water and evaluated the relative contribution to the steady current arising from tunneling of electrons between the electrodes and ions in solution, and from the neutralization of ions adsorbed onto the electrode surface. They ascribed the larger current contribution to quantum tunneling of electrons to and from ions in solution near the electrodes. The findings have applications in biosensing and detecting biological elements in solution. [TECHNICAL ARTICLE](#)

Tags: Sensors, Materials science

STEM

Universities of the Asia Pacific prepare to lead in fourth industrial revolution

Eurekalert, 09NOV2017

This year's Association of Pacific Rim Universities (APRU) Forum focused on the Fourth Industrial Revolution, convening leading academic, industry and government leaders to address sustainability and skills challenges facing the region. It brought together global employers, university representatives and government from across APEC member economies to develop a set of workplace-ready competencies for Data Science & Analytics (DSA)-enabled workers. Wiley and the Business Higher Education Forum is building on this framework to develop tools, content and other resources to deploy these skills competencies in university and corporate settings.

Tags: STEM, S&T Policy ■

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