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## FEATURE ARTICLES

### [First experimental observation of new type of entanglement in a 2-D quantum material](#)

[Science Daily, 17JUL2017](#)



The neutron spectrometer used in this study. Credit: EPFL/PSI

An international team of researchers (Switzerland, Qatar, UK, Brazil, Austria, Singapore, France, Russia, Germany) has experimentally realized a new quantum many body

state in  $\text{Sr}_2\text{Cu}(\text{BO}_3)_2$  representing the theoretical “Shastry-Sutherland” model. They found that in the new quantum phase the atomic magnets appear quantum-entangled in sets of four—so-called plaquette singlets. Their system may allow further investigations of this state and the nature of the transition into the state. Better methods to tackle quantum many-body phenomena would have implications from materials science to quantum information technology. [TECHNICAL ARTICLE](#)

*Tags: Quantum science, Featured Article*

### [Smart design carries sound one way](#)

[Physorg.com, 17JUL2017](#)

An international team of researchers (the Netherlands, France) has designed metamaterials that carry sound exclusively one way and are immune to fabrication errors. The metamaterials break time-reversal symmetry using lattices composed of annular channels filled with a spontaneously flowing active liquid. Such active metamaterials support topologically protected sound modes that propagate unidirectionally, without backscattering, along either sample edges or domain walls and despite overdamped particle dynamics. The concept could be useful for designing ultrasound equipment that is immune to fabrication errors, devices for non-invasive surgery, sound-proof walls and optical fiber, because the principle works just as well for light waves. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Featured Article*

### [The multi-colored photons that might change quantum information science](#)

[Physorg.com, 28JUN2017](#)

An international team of researchers (Canada, UK, Italy, China, Australia) demonstrates on-chip generation of entangled qudit states, where the photons are created in a coherent superposition of multiple high-purity frequency modes. They confirmed the realization of a quantum system with at least one hundred dimensions, formed by two entangled qudits. Using off-the-shelf telecommunications components, they introduced a coherent manipulation platform capable of performing deterministic high-dimensional gate operations. The research enables the generation and processing of high-dimensional quantum states in a single spatial mode. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Quantum science, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MATERIALS

#### [New class of insulating crystals hosts quantized electric multipole moments](#)

[Science Daily, 07JUL2017](#)

A team of researchers in the US (University of Illinois at Urbana-Champaign, Princeton University) theoretically predicted a new class of insulating phases of matter in crystalline materials, pinpointed where they might be found in nature, and in the process generalized the fundamental quantum theory of Berry phases in solid state systems. The insulators generate electric quadrupole or octupole moments which can be thought of as very specific electric fields that are quantized. The work opens many possibilities for new topological systems that were hidden before. They have a sharp connection to real physical observables and there may be other physical phenomena in these materials that would be interesting to explore. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science*

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## **Chances of hypersonic travel heat up with new materials discovery**

[Physorg.com](#), 06JUL2017

An international team of researchers (China, UK) has designed and fabricated a new carbide coating that is vastly superior in resisting temperatures up to 3,000 °C, and surface degradation compared to existing ultra-high temperature ceramics. The improved performance of the coating is due to its unique structural make-up, improved oxidation resistance and carbon-carbon composite reinforcement. The reactive melt infiltration (RMI) process reduces fabrication time. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Materials science*

## **AUTONOMOUS SYSTEMS & ROBOTICS**

### **Robots take inspiration from insects to track targets**

[Physorg.com](#), 17JUL2017

Insects, are capable of remarkably complex behaviour, yet have a miniature brain consuming tiny amounts of power compared with even the most efficient digital processors. An international team of researchers (Australia, Sweden) used recordings from the 'small target motion detector' neurons in the brain of a dragonfly to develop a closed-loop target detection and tracking algorithm. They implemented the model on a robotic platform that uses active pursuit strategies based on insect behaviour. The robot performed very well in closed-loop pursuit of targets, despite a range of challenging conditions - low contrast targets, heavily cluttered environments and the presence of distracters. They hope their hardware implementation will provide a platform for better understanding the sensorimotor system of the insect, as well as a prototype for engineering applications. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics, Biomimetics, Neuroscience*

### **THOR Transformer Drone Hovers and Cruises With No Compromises**

[IEEE Spectrum](#), 17JUL2017

Researchers in Singapore have introduced and built a prototype of a flying robot called THOR: Transformable HOvering Rotorcraft, that manages to achieve very high structural efficiency by using all of its aerodynamic surfaces in both vertical and horizontal flight modes, transforming from a flying wing into a sort of whole-body spinning bi-copter. In the hovering mode, THOR spins in place with its airfoils rotated 180 degrees from each other, like the rotors on a helicopter. In cruise mode (C-MOD), the airfoils are both aligned in the same direction, and you get a flying wing. With the exception of the servo and bearing used for wing rotation, THOR uses every other structural component in both hovering and cruising modes, making it highly efficient relative to hybrid designs. They presented their work at the 2017 International Conference on Robotics and Automation in Singapore.

*Tags: Autonomous systems & robotics*

## **Embodied Flight with a Drone**

[ArXiv](#), 06JUL2017

Most human-robot interfaces, such as joysticks and keyboards, require training. Embodied interactions, instead of interfaces, could bridge the gap between humans and robots, allowing humans to naturally perceive and act through a distal robotic body. Researchers in Switzerland describe a natural and immersive embodied interaction that allows users to control and experience drone flight with their own bodies. The setup uses a commercial flight simulator that tracks hand movements and provides haptic and visual feedback. The paper discusses how to integrate the simulator with a real drone and how to map body movement with drone motion. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics, S&T Switzerland*

## **BIG DATA**

### **Text Launches New Artificial Intelligence (AI) Platform to Enable Business Insight**

[Inside Big Data](#), 12JUL2017

OpenText Magellan is a cost-effective solution built on a cohesive, highly scalable infrastructure equipped for handling massive amounts of structured and unstructured data. Powered by OpenText Analytics, and Apache Spark, OpenText Magellan integrates across any EIM architecture to dramatically reduce the time, effort and expertise required to leverage the value of advanced analytics in decision making and task automation.

*Tags: Big data*

## **BIOTECHNOLOGY**

### **How Canadian researchers reconstituted an extinct poxvirus for \$100,000 using mail-order DNA**

[Science Daily](#), 06JUL2017

Researchers in Canada have synthesized the horsepox virus, a relative of smallpox, from genetic pieces ordered in the mail. Horsepox is not known to harm humans and, like smallpox, it no longer exists in nature and is not seen as a major agricultural threat. According to the researchers, their technique could be used to unravel the origins of a centuries-old smallpox vaccine and lead to new, better vaccines or even cancer therapeutics.

*Tags: Biotechnology, Counter WMD, S&T Canada*

## **COUNTER WMD**

### **Biosecurity Stakeholders Offer Recommendations For National Biodefense Strategy**

[Johns Hopkins University](#), 12JUL2017

More than 50 public and private sector biosecurity stakeholders gathered at a meeting convened by the

*continued...*

“No doubt those who really founded modern science were usually those whose love of truth exceeded their love of power” C. S. LEWIS

Johns Hopkins Center for Health Security on June 22 in Washington, DC to engage in a discussion about US biodefense capabilities and offer recommendations for the forthcoming National Biodefense Strategy and Implementation Plan. When it is delivered to Congress this fall, the strategy and implementation plan will review, assess, and identify opportunities to strengthen biodefense policies, practices, programs, and initiatives across the federal government.

[Summary of key Recommendations](#)

*Tags: Counter WMD, Bioweapons*

## ENERGY

[Scientists design solar cell that captures nearly all energy of solar spectrum](#)

[Science Daily, 11JUL2017](#)

A team of researchers in the US (George Washington University, Naval Research Laboratory, University of Illinois Urbana-Champaign, industry partners) has designed and constructed a prototype for a new solar cell that integrates multiple cells stacked into a single device. The stacked cell acts almost like a sieve for sunlight, with the specialized materials in each layer absorbing the energy of a specific set of wavelengths. By the time the light is funneled through the stack, just under half of the available energy has been converted into electricity. The new design converts direct sunlight to electricity with 44.5 percent efficiency.

[TECHNICAL ARTICLE](#)

*Tags: Energy, Advanced materials, Solar energy*

## FOREIGN S&T

[Russia launches 73 satellites into orbit](#)

[Physorg.com, 12JUL2017](#)

The primary payload, the Kanopus-V-IK satellite, is to provide wide-angle images of the Earth and will be used especially to detect forest fires or to update the topography of maps. The 72 small satellites include those made by Japan, Germany and Canada along with 62 nanosatellites known as CubeSats, developed by the United States.

*Tags: Foreign S&T, S&T Russia*

## IMAGING TECHNOLOGY

[Researchers develop blue-, yellow-, and red-emitting graphene quantum dots](#)

[Nanowerk, 15JUL2017](#)

Graphene quantum dots (GQDs) show great potential but their development is limited by photoluminescence (PL) properties. Researchers in China have synthesized PL-tunable GQDs with blue, yellow, and red emission colors by coating them with polyethyleneimine (PEI) of

different molecular weights. Characterization of size and morphology revealed that blue-emitting GQDs were monocoated and red-emitting GQDs were multicoated. They exhibited an excellent chemical stability and extremely low cytotoxicity. GQDs have applications in bioimaging and bioanalysis. [TECHNICAL ARTICLE](#)

*Tags: Imaging technology, Advanced materials, S&T China*

[Ultra-high-contrast digital sensing](#)

[MIT News, 14JUL2017](#)

An international team of researchers (USA - MIT, Germany) used a technique that allows for ADCs that reset rather than saturate, thus producing modulo samples. They proved sufficiency conditions and complement them with a stable recovery algorithm. The results are not limited to certain amplitude ranges. In fact, even the same circuit architecture allows for the recovery of arbitrary large amplitudes as long as some estimate of the signal norm is available when recovering. The technique could lead to cameras that can handle light of any intensity and audio that doesn't skip or pop. [TECHNICAL ARTICLE](#)

*Tags: Imaging technology*

[Scientists Create 3D Objects Made from Light](#)

[R&D Magazine, 10JUL2017](#)

Researchers at Southern Methodist University used a photoswitch molecule that switches between non-fluorescent and fluorescent in reaction to the presence or absence of ultraviolet light. They discovered the on-off switch for tuning the molecule's rate of thermal fading by adding to it the chemical amine base trimethylamine. The new technology differs from 3D movies or 3D computer design that are flat displays and use binocular disparity to make objects appear three-dimensional. The technology can have applications in biomedical imaging, education and engineering, tactical 3D replications of battlefields and movies and video games. [TECHNICAL ARTICLE](#)

*Tags: Imaging technology*

## MATERIALS SCIENCE

[Reduced oxygen nanocrystalline materials show improved performance](#)

[Science Daily, 17JUL2017](#)

A team of researchers in the US (North Carolina State University, University of Connecticut, Portland State University) synthesized nano-sized crystals of Iron-Chromium and Iron-Chromium-Hafnium with oxygen levels as low as 0.01 percent. These nearly oxygen-free alloy powders appeared to be much more stable than their commercial counterparts with higher oxygen content at

*continued...*

elevated temperatures and under high levels of stress. Various characterization techniques revealed a significant improvement in grain size stability at elevated temperatures. According to the researchers, this line of investigation could ultimately lead to developing faster jet engines, more capacity in semiconductors, and more sensitivity in biosensors. [TECHNICAL ARTICLE](#)

*Tags: Materials science*

### [Russian scientists develop technology for production of transparent aluminum](#)

[Physorg.com](#), 17JUL2017

Researchers in Russia used spark plasma sintering on aluminum oxynitride (ALON) to make transparent aluminum by passing electric current directly through the mold and pressing billet. Very rapid heating was achieved by pulsed current for an extremely short work-cycle time. ALON has a significantly high strength, withstands temperatures up to 2100 degree Celsius and is more scratch resistant. ALON can be used in several military and commercial applications, e.g., windows and domes for spacecraft and outer transparent armor. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Materials science, S&T Russia*

## FEATURED RESOURCE

### [R&D Magazine](#)

News stories and technical articles, reports on state-of-the-art scientific and technical advances and important trends in research management, funding, and policy.

### [Thinking thin brings new layering and thermal abilities to the semiconductor industry](#)

[Science Daily](#), 11JUL2017

Researchers at IBM Watson Research Center used controlled spalling to produce thin layers from thick GaN crystals without causing crystalline damage. The technique, based on fracture, also makes it possible to measure basic physical properties of the material system, like strain-induced optical effects and fracture toughness, which are otherwise difficult to measure. They demonstrated the transfer of silicon, germanium, gallium arsenide, gallium nitride/sapphire, and even amorphous materials like glass, and it can be applied at nearly any time in the fabrication flow, from starting materials to partially or fully finished circuits. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Materials science*

## MICROELECTRONICS

### [Researchers develop new transistor concept](#) [Nanowerk](#), 14JUL2017

Researchers in Germany deposited used metal nanoparticles which are so small that they no longer show their metallic character under current flow but exhibit an energy gap caused by the Coulomb repulsion of the electrons among one another. By controlling voltage, this gap can be shifted energetically and the current can thus be switched on and off as desired. The technique is controllable and scalable, provides very small nanocrystals that can be stored in solvents and are easy to process, provides high-quality monolayered films and can also be implemented on an industrial scale. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Microelectronics, S&T Germany*

### [Breakthrough in spintronics](#) [EurekAlert](#), 10JUL2017

As the temperature of a topological insulator increases, all quantum effects are washed out and with them the special properties of the electrically conducting edges. Researchers in Germany have theoretically achieved a room-temperature regime with a large energy gap with an ultra-thin film consisting of a single layer of bismuth atoms deposited on a silicon carbide substrate. Bismuthene forms a chemical bond to the substrate which plays a central role in the new concept to provide the material with the desired electronic properties. The research demonstrates a concept for a quantum spin Hall wide-gap scenario, where the chemical potential resides in the global system gap, ensuring robust edge conductance. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics, Quantum science, S&T Germany*

## NEUROSCIENCE

### [Artificial intelligence helps build brain atlas of fly behavior](#)

[Science Daily](#), 13JUL2017

Researchers at Howard Hughes Medical Institute in Virginia used a machine-vision and learning program, Janelia Automatic Animal Behavior Annotator (JAABA), to create a brain-wide atlas of fruit fly behavior. JAABA tracked the position and cataloged the behaviors of 400,000 fruit flies, in more than 225 days of video footage, helping researchers match specific behaviors to different groups of neurons. It would have taken humans some 3,800 years. According to the researchers, the new results highlight the advantages of blending different scientific disciplines. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Neuroscience, Artificial intelligence*

## PHOTONICS

**Researchers develop a novel type of optical fiber that preserves the properties of light**

Nanowerk, 17JUL2017

An international team of researchers (Russia, Finland) has demonstrated a novel type of tapered large mode area polarization-maintaining fiber. The birefringent fibers have an elliptical inner cladding and a core diameter that increases adiabatically. The polarization maintaining ability of the fiber samples was investigated by measuring the spatial distribution of polarization beat length.

There is no significant coupling of polarization modes or transverse modes in the tested fibers and, therefore, the linear polarization state of propagating light is preserved. The results of the study are promising for constructing high-power pulsed fiber lasers and amplifiers, as well as polarization-sensitive sensors. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Photonics, Advanced materials

**'Upconverted' light has a bright future in medicine, security, solar cells**

Nanowerk, 17JUL2017

Researchers at Stanford University used GaN/InGaN quantum wells decorated with gold and silver nanoparticles to demonstrate a new photon upconversion technique mediated by hot carriers in plasmonic nanostructures. Hot holes and hot electrons generated via plasmon decay are injected into an adjacent semiconductor quantum well where they radiatively recombine to emit higher-energy photons. They showed upconversion from 2.4 to 2.8 eV. The technique has the potential to impact bioimaging, on-chip wavelength conversion, and high-efficiency photovoltaics. [TECHNICAL ARTICLE](#)

Tags: Photonics

## QUANTUM SCIENCE

**Maxwell's demon extracts work from quantum measurement**

Physorg.com, 10JUL2017

Researchers in France propose a new type of Maxwell's demon which is not thermally driven, but measurement-driven. The measurements not only extract information about the state of the system, but they are also the "fuel" for extracting work from the system. When the demon performs a measurement on a qubit, the measurement projects the qubit from one state into a superposition of states, which provides energy to the qubit simply due to the measurement process. The researchers propose an experiment in which projective quantum non-demolition measurements can be performed with light pulses repeated every 70 nanoseconds or so. The findings provide a new paradigm to analyze quantum heat engines and work extraction in the quantum world. [TECHNICAL ARTICLE](#)

Tags: Quantum science, S&amp;T France

## S&amp;T POLICY

**Is America's digital leadership on the wane?**

Physorg.com, 17JUL2017

According to a report by researchers at Tufts University, while the U.S. has a very advanced digital environment, the pace of American investment and innovation is slowing. Other countries are building significant public and private efforts that are expected to become foundations for future generations of innovation and successful startup businesses. If the US government invests in key aspects of digital infrastructure, either directly or by creating subsidies and tax incentives, that lays the groundwork for massive private investment and innovation that can transform the economy.

Tags: S&amp;T policy

**DFG approves seven new research units and one new clinical research unit**

EurekAlert, 12JUL2017

In 2016, the German Research Foundation funded more than 31,000 research projects with a total funding volume of around €3 billion. The number of overall funded projects increased by more than 3% and the total approved sum by more than 6%. Life sciences received the most funding with around €1 billion (34.7% of the total sum awarded). German research enjoyed the support of "broad political and public trust". This is markedly and positively distinct from the authoritarian or populist attacks on science and its freedom. [Annual report](#)

Tags: S&amp;T policy, Foreign S&amp;T, S&amp;T Germany

**How universities are fostering innovation, entrepreneurship**

Science Daily, 07JUL2017

The responsibility to drive economic growth through creation and implementation of new ideas that generate 'value' for public use falls not just on corporations but also on universities. In recent years, many universities have focused on developing initiatives to inspire, nurture, and guide future innovators (faculty and students). The article zeroes in on what universities are currently doing to foster growth in those areas both for their success and the success of the communities and regions to which they are connected.

Tags: S&amp;T policy

## SENSORS

**Low-Cost Pliable Materials Transform Glove Into Sign-to-Text Machine**

IEEE Spectrum, 17JUL2017

Researchers at UC San Diego have made a low-cost smart glove that can translate the American Sign Language alphabet into text and send the messages via Bluetooth to a smartphone or computer. The glove can also be used to control a virtual hand. The key components of the

new glove are flexible strain sensors made of a rubbery polymer. In tests, the glove could translate all 26 letters of the American Sign Language alphabet into text. The research team also used the glove to control a virtual hand to sign the ASL letters. According to the researchers, the glove could prove valuable for virtual and augmented reality, remote surgery, and defense uses like controlling bomb-diffusing robots. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Sensors, Advanced materials*

### [Biodegradable temperature sensors for the Internet of Things](#)

[Nanowerk, 12JUL2017](#)

Researchers in Switzerland used magnesium as an active layer while a flexible polymer acted as encapsulation to fabricate fully biodegradable temperature sensors whose layout and ultrathin format confer a dynamic response of 10 ms and high mechanical stability. They integrated an array of sensors onto a fluidic device made of the same polymer to yield a smart biodegradable system for flow mapping. The technique provides routes for a smart biodegradable system for flow mapping. [TECHNICAL ARTICLE](#)

*Tags: Sensors, S&T Switzerland*

### [Signature analysis of single molecules using their noise signal](#)

[Nanowerk, 12JUL2017](#)

Researchers in Japan fabricated simple devices consisting of a carbon nanotube bridging two electrodes. The devices were exposed to different large molecules, causing some to bind to the carbon nanotube surface. It was found that different molecules gave unique noise signals related to the properties of the molecules. They demonstrated that noise can be exploited to improve the signal detection ability of a device. Improved knowledge of the molecular-level origin of noise should lead to the development of electronics that use noise to improve their performance rather than degrade it. The findings are attractive for developing advanced sensing devices. [TECHNICAL ARTICLE](#)

*Tags: Sensors, S&T Japan*

### [A camera for single pixel acoustic compressive sensing in air](#)

[ArXiv, 22JUN2017](#)

Acoustic imaging typically relies on large sensor arrays that can be electronically complex and often have large data storage requirements to process element level data. A team of researchers in the US (Naval Research Laboratory, Jet Propulsion Laboratory) presents a method for creating an acoustic analog to the single-pixel-imager found in electromagnetics. A diffraction model is presented and incorporated into the single pixel framework. The method is experimentally validated with laboratory measurements made in air. [OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Sensors, Government S&T ■*

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