



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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FEATURE ARTICLES

[Novel physical cryptographic technique may have applicability to future nuclear disarmament agreements](#)

[PhysOrg.com](#), 20SEP2016

An international team of researchers (USA - Princeton University, Yale University, Italy) has demonstrated a system that can compare physical objects while potentially protecting sensitive information about the objects themselves. They have translated a major method of modern cryptography devised originally for computational tasks for use in a physical system. The possibility of using such proofs to process classified and other sensitive physical data has attracted attention, especially in the field of nuclear arms control. [OPEN ACCESS](#)

[TECHNICAL ARTICLE](#)

Tags: Cyber security, Science without borders, Featured Article

[Closing in on high-temperature superconductivity](#)

[Science Daily](#), 19SEP2016

An international team of researchers (USA - MIT, San Jose State University, Ohio State University, Pennsylvania State University, Brazil) has made hundreds of observations of individual potassium atoms, cooled to just slightly above absolute zero, trapped by lasers in a two-dimensional grid, and interacting with each other in intriguing ways that could help to reveal the behaviors of superconducting electrons. The team suspects that electrons start forming pairs that “bunch” with empty spaces in the lattice. According to the researchers, if we can discover all the essential ingredients for superconductivity, we will have the opportunity to design recipes for making high-temperature superconducting materials that can have a wide range of practical and innovative uses. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science, Featured Article

[Inorganic double helix](#)

[Nanowerk](#), 12SEP2016



Needles of the flexible semiconducting material SnIP; on the left side residual black phosphorous and tin iodide (red). (Image: Andreas Battenberg / TUM)

Researchers in Germany have discovered a double helix structure in an inorganic material comprising tin, iodine and phosphorus (SnIP). It is a semiconductor

with extraordinary optical and electronic properties, as well as extreme mechanical flexibility. The centimeter-long fibers can be arbitrarily bent without breaking. Researchers attribute its properties to the double helix structure. SnIP can be easily produced on a gram scale and is, unlike gallium arsenide, which has similar electronic characteristics, far less toxic. The semiconducting properties of SnIP promise a wide range of application opportunities, from energy conversion in solar cells and thermoelectric elements to photocatalysts, sensors and optoelectronic elements. By doping with other elements, the electronic characteristics of the new material can be adapted to a wide range of applications. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, S&T Germany, Featured Article

S&T NEWS ARTICLES

ADVANCED MANUFACTURING

[New technique integrates graphene, graphene oxide and reduced graphene oxide onto silicon chips at room temperature](#)

[Nanowerk](#), 13SEP2016

In the new technique, researchers at North Carolina State University started with a silicon substrate,

continued...

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topped that with a layer of single-crystal titanium nitride, then placed a layer of copper-carbon alloy on top of the titanium nitride. Finally, they melted the surface of the alloy with nanosecond laser pulses, which pulls carbon to the surface. The advance raises the possibility of creating new electronic devices. The researchers are already planning to use the technique to create smart biomedical sensors. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced manufacturing, Materials science, Sensors

ADVANCED MATERIALS

[Magnetic polaron imaged for the first time](#)

[Nanowerk](#), 16SEP2016

An international team of researchers (USA - Lawrence Berkeley National Laboratory, UC Davis, Finland, Italy, South Korea, Chile) created artificial spin ice, metamaterial that consists of lithographically patterned nanomagnets in an ordered two-dimensional geometry. The individual magnetic building blocks of a spin ice lattice interact with each other via dipolar magnetic fields. They used photoemission electron microscopy to image the creation and decay of magnetic polarons. The experiments also demonstrate that magnetic excitations can be engineered at will by a clever choice of lattice geometry and the size and shape of individual nanomagnets. Artificial spin ice is a prime example of a designer material. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

[Researchers reveal that magnetic ‘rust’ performs as gold at the nanoscale](#)

[PhysOrg.com](#), 15SEP2016

Researchers at Savannah River National Laboratory used solution chemistry to reduce gold ions into a metallic gold structure using sodium citrate. During the transformation process the metallic gold structures nucleate and grow on the rust. The hybrid gold and rust nanostructures are able to photothermally heat the surrounding media as efficiently as pure gold nanoparticles, even with a significantly smaller concentration of gold. This could have a variety of biological applications such as tracking drug delivery or imaging inside the body. It could also be used for sensing, hyperthermia treatment, environmental cleaning, magnetic resonance imaging contrast agents, product detection and manipulation. [OPEN ACCESS TECHNICAL ARTICLE](#)

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

[On-surface chemistry leads to novel products](#)

[Science Daily](#), 13SEP2016

An international team of researchers (Japan, Switzerland, Finland) demonstrated that when a molecule consisting of three benzene rings joined by a triple bond is applied to a silver surface, the molecules arrange themselves in a consistent pattern—but there is no chemical reaction. But on a copper surface, when heated it leads to aromatic

hydrocarbon compounds, which had previously not been synthesized in solution chemistry. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials

BIOTECHNOLOGY

[High-capacity nanoparticle](#)

[Nanowerk](#), 15SEP2016

Researchers at MIT have shown that they can package three or more drugs into a novel type of nanoparticle. Their technique creates particles from building blocks that already contain drug molecules. They can join the building blocks together in a specific structure and precisely control how much of each drug is incorporated. The technique can be used for any drug as long as it has a functional group. It can be loaded into the particles in exactly the ratio needed, and have it release under any specified conditions. [TECHNICAL ARTICLE](#)

Tags: Biotechnology

[Uniform ‘hairy’ nanorods have potential energy, biomedical applications](#)

[PhysOrg.com](#), 15SEP2016

Researchers at the Georgia Institute of Technology have developed a new strategy for crafting one-dimensional nanorods from a wide range of precursor materials. Based on a cellulose backbone, the system relies on the growth of block copolymer “arms” that help create a compartment to serve as a nanometer-scale chemical reactor. The outer blocks of the arms prevent aggregation of the nanorods. The nanorods could have applications in such areas as electronics, sensory devices, energy conversion and storage, drug delivery, and cancer treatment. [TECHNICAL ARTICLE](#)

Tags: Biotechnology

[Unintended consequences of creating the world’s first semisynthetic organism](#)

[PhysOrg.com](#), 12SEP2016

In 2014, the incorporation of two artificial letters of genetic code into the DNA of *Escherichia coli* gave the bacteria the distinction of becoming the world’s first stable semisynthetic organism. In a new study, a team of researchers in the US (Case Western Reserve University, Columbia University) has discovered that the artificial base pair has an unintended consequence on living cells: phototoxicity. The new results show that the artificial base pair makes living cells more susceptible to damage from low doses of sunlight and standard fluorescent light bulbs, leading to a significant decrease in cell survival and growth. [TECHNICAL ARTICLE](#)

Tags: Biotechnology, Synthetic biology

COMMUNICATIONS TECHNOLOGY

[Optical fiber transmits one terabit per second](#)

[Technical University of Munich](#), 16SEP2016

Researchers in Germany have shown that the flexibility and performance of optical networks can be maximized when *continued...*

“Technology shapes society and society shapes technology.”

ROBERT W. WHITE

adjustable transmission rates are dynamically adapted to channel conditions and traffic demands. The breakthrough research could extend the capability of optical networks to meet surging data traffic demands.

Tags: Communications technology, S&T Germany

[Analysis of the impact of solar activity on radio signals in the atmosphere boosted by new research](#)

Science Daily, 14SEP2016

An international team of researchers (UK, Finland) developed and demonstrated a process for continuous electron density measurement of the previously unexplored D region of the ionosphere. The new study combined a statistical approach implemented in a unique software modeling programme called IONONEST. The new methodology uses a statistical technique called nested sampling to invert the multi-frequency data and recover parameterised height profiles of the electron density through the D-region of the ionosphere. [TECHNICAL ARTICLE](#)

Tags: Communications technology

[Pioneering research paves the way towards exascale optical networks](#)

Science Daily, 14SEP2016

Multicore fibres, comprised of tens of heterogeneous cores, are able to exhibit links of unprecedented capacity, in the range of multiple petabits per second (1 Pbit/sec = 1,000,000 Gbit/sec). The solutions proposed by an international team of researchers (UK, Japan) which uses the space dimension, as well as frequency and time, have the ability to combine multiple streams of frequency/time multiplexed data in the same fibre structure, by either using different cores or/and light modes.

Tags: Communications technology

CYBER SECURITY

[Hacker-Proof Code Confirmed](#)

Quanta Magazine, 20SEP2016

Software engineers at Microsoft Research have two ambitious formal verification projects underway. The first, named Everest, is to create a verified version of HTTPS, the “Achilles heel of the internet.” The second is to create verified specifications for complex cyber-physical systems such as drones. Typical software follows discrete, unambiguous steps; the programs that tell a drone how to move use machine learning to make probabilistic decisions based on a continuous stream of environmental data. Microsoft is optimistic formal methods researchers are going to figure it out.

Tags: Cyber security

INFORMATION TECHNOLOGY

[Physicists develop new touchscreen technology](#)

Nanowerk, 14SEP2016

Researchers in the UK have shown that silver nanowires not only match the transmittances and conductivities of ITO films but exceed them, and that this type of nanomaterial is compatible with more demanding applications such as LCD and OLED displays. They applied a mathematical technique to work out the smallest subpixel size that can be made without affecting the properties of nanowire electrodes. The incorporation of silver nanowires into a multi-touch sensor actually reduces the production cost and energy usage. [TECHNICAL ARTICLE](#)

Tags: Information technology, S&T UK

MATERIALS SCIENCE

[Deep insight into interfaces](#)

Nanowerk, 16SEP2016

Transition-metal oxides exhibit many different properties. Forming interfaces between such materials yields a plethora of phenomena, which hold promise for novel applications such as different sensors, lossless computer memory and ultrafast processors. An international team of researchers (Germany, Canada, USA - Oak Ridge National Laboratory, South Korea) developed a new method and analysis software based on “resonant x-ray reflectometry” with the atomic-scale resolution of less than one nanometer. Exploiting the new method, the present work shows microscopic evidence that electronic reconstruction is indeed realized at transition-metal oxide interfaces. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science

[For the first time, researchers see individual atoms keep away from each other or bunch up as pairs](#)

PhysOrg.com, 15SEP2016

An international team of researchers (USA - MIT, San Jose State University, Ohio State University, Pennsylvania State University, Brazil) cooled a gas of potassium atoms to several nanokelvins and trapped the atoms within a two-dimensional sheet of an optical lattice created by crisscrossing lasers. Using a high-resolution microscope, the researchers took images of the cooled atoms residing in the lattice. Images showed that based on their position in the lattice, some atoms kept away from each other, while some bunched together with alternating magnetic orientations. The team believes that these spatial correlations may

continued...

shed light on the origins of superconducting behavior.

TECHNICAL ARTICLE

Tags: Materials science

Chemists report new insights about properties of matter at the nanoscale

Science Daily, 14SEP2016

An international team of researchers (USA - UCLA, China) designed three rotating metal-organic frameworks to study the motion of the rotors which allowed them to isolate the role a fluid's viscosity plays at the nanoscale. They found that two of the molecular rotors occupy a very small space and hinder one another's motion. But in the case of the third one, nothing slowed down the rotors inside the nanocage except molecules of liquid. They hope to design crystals that take advantage of properties of light. Applications could include advances in communications technology, optical computing, sensing and the field of photonics. TECHNICAL ARTICLE

Tags: Materials science

Peculiar metals? Insulator or conductor

Science Daily, 13SEP2016

An international team of researchers (Switzerland, Russia) predicted a new kind of solid they call "nodal chain metal" that is expected to have hitherto unknown properties. Scouring massive online databases they found iridium tetrafluoride to have intricate nodal chain. They predict that it is influenced by magneto-resistance and plays an important role in modern data storage technologies. The band structure of iridium tetrafluoride has certain peculiarities that have been connected with higher-temperature superconductivity. TECHNICAL ARTICLE

Tags: Materials science

FEATURED RESOURCE

Quanta Magazine

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MICROELECTRONICS

Reconfigurable chaos-based microchips offer possible solution to Moore's Law

Science Daily, 20SEP2016

Researchers at North Carolina State University propose utilizing chaos theory to enable transistor circuits to be programmed to perform different tasks. Different patterns that represent different functions coexist within the nonlinear dynamics of the system, and they are

selectable. They utilize these dynamics-level behaviors to perform different processing tasks using the same circuit. As a result we can get more out of less. According to the researchers, the potential of 100 morphable nonlinear chaos-based circuits doing work equivalent to 100 thousand circuits, or of 100 million transistors doing work equivalent to three billion transistors holds promise for extending Moore's law. TECHNICAL ARTICLE

Tags: Microelectronics, Information technology

Complex materials can self-organize into circuits, may form basis for multifunction chips

Science Daily, 14SEP2016

A team of researchers in the US (Oak Ridge National Laboratory, University of Tennessee) shows that a single crystal complex oxide material, when confined to micro- and nanoscales, can act like a multi-component electrical circuit. This behavior stems from an unusual feature of certain complex oxides called phase separation, in which tiny regions in the material exhibit vastly different electronic and magnetic properties. Individual nanoscale regions in complex oxide materials can behave as self-organized circuit elements, which could support new multifunctional types of computing architectures. Devices are no longer forced to follow a one-chip-fits-all approach. TECHNICAL ARTICLE

Tags: Microelectronics, Government S&T

PHOTONICS

Scientists synthesize a new photo-activatable molecule

PhysOrg.com, 16SEP2016

Molecular photoswitches are chemical structures whose geometry can be regulated by means of light. Researchers in Germany have developed a molecular photoswitch derived from a compound classified as a hemithioindigo whose movements can be controlled with unprecedented precision. The new photoswitch is a two-dimensional one. In contrast to most other chemical switches, it can be operated in two modes. This is an essential prerequisite for the construction of complex molecular machines. TECHNICAL ARTICLE

Tags: Photonics, S&T Germany

Chirped laser pulses could deliver high-quality ion beams

Nanotechweb, 15SEP2016

An international team of researchers (Sweden, Russia) has come up with a new way of accelerating ions using intense laser pulses. The technique—which has not yet been tested in the lab—involves bouncing "chirped" pulses from a mirror. It promises to deliver much more intense ions beams than existing laser acceleration schemes. With further development, the method could be used to provide high-energy ions for cancer treatment. TECHNICAL ARTICLE

Tags: Photonics, Biotechnology

QUANTUM SCIENCE

[Physicists retrieve 'lost' information from quantum measurements](#)

PhysOrg.com, 19SEP2016

Projective measurement of an operator (i.e., a dynamical variable) selected from a prescribed set of operators is termed an unrecorded measurement when both the selected operator and the measurement outcome are unknown, i.e., "lost". Researchers in Israel have described a protocol that can retrieve some of the lost information. The research reveals new insight into the fundamental nature of quantum measurements, mainly by supporting the idea that quantum measurements contain both quantum and classical components. [TECHNICAL ARTICLE](#)

Tags: Quantum science

[A tight squeeze for electrons: Quantum effects observed in 'one-dimensional' wires](#)

Science Daily, 15SEP2016

Electrons in a quantum wire repel each other and cannot get past, so if one electron enters or leaves, it excites a compressive wave. Researchers in the UK devised a way of making contact to a set of 6000 narrow strips of metal that are used to create the quantum wires from gallium arsenide using an extra layer of metal in the shape of bridges between the strips. By varying the magnetic field and voltage, the tunnelling from the wires to an adjacent sheet of electrons could be mapped out, and this revealed evidence for the extra curves predicted, where it can be seen as an upside-down replica of the spin curve. These results will now be applied to better understand and control the behaviour of electrons in the building blocks of a quantum computer. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science, S&T UK

SCIENCE WITHOUT BORDERS

[The Strange Second Life of String Theory](#)

Quanta Magazine, 15SEP2016

String theory has so far failed to live up to its promise as a way to unite gravity and quantum mechanics. At the same time, it has blossomed into one of the most useful sets of tools in science.

Tags: Science without borders

SENSORS

[Detecting emotions with wireless signals](#)

MIT News, 20SEP2016

Researchers at MIT have developed "EQ-Radio," a device that can detect a person's emotions using wireless signals. Using wireless signals reflected off people's bodies, the device measures heartbeats as accurately as an ECG monitor, with a margin of error of approximately

0.3 percent. It then studies the waveforms within each heartbeat to match a person's behavior to how they previously acted in one of the four emotion-states. EQ-Radio is 87 percent accurate at detecting if a person is excited, happy, angry or sad—and can do so without on-body sensors. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Sensors

[Chip Changes Photon Color While Preserving Quantumness](#)

American Physical Society, 16SEP2016

Researchers at Yale University fabricated device-on-a-chip from aluminum nitride that converts visible light to infrared wavelengths in a way that preserves the quantum states of the photons. The device consists of a tiny ring of semiconductor (microring) that, when hit with intense infrared laser light, causes visible photons in the ring to convert to infrared. Together, many microrings on a chip could enable easy conversion of the large numbers of photons that a future quantum computer might need to transmit. With this device, one could imagine a very small chip with lots of functionality, including not just data communication, but also spectroscopy and sensing. [TECHNICAL ARTICLE](#)

Tags: Sensors

[Levitating nanoparticle improves 'torque sensing', might bring new research into fundamentals of quantum theory](#)

Nanowerk, 16SEP2016

An international team of researchers (China, USA - Purdue University) used an oblong-shaped nanodiamond levitated by a laser beam in a vacuum chamber to serve as the bar, and the laser beam as the wire in their experiment. A change in the orientation of the nanodiamond caused the polarization of the laser beam to twist. Torsion balances have played historic roles in the development of modern physics. Now an optically levitated ellipsoidal nanodiamond in a vacuum provides a new nanoscale torsion balance that will be many times more sensitive. The research could aid efforts to study quantum theory and realize potential applications in quantum information processing and high-precision measurement for sensors. [TECHNICAL ARTICLE](#)

Tags: Sensors, Quantum science

[New all fiber-optic system for monitoring structural integrity in harsh environments](#)

PhysOrg.com, 16SEP2016

The system, developed by an international team of researchers (USA -Virginia Tech, China, Hong Kong, UK), uses two optical fibers to serially connect multiple active fiber-optic non-destructive evaluation elements that are attached to the surface of the structure being monitored. Each sensing element consists of an acoustic-generation

unit and an acoustic-detection unit within a fiber-optic housing. When excited by a fiber-transmitted laser pulse, the acoustic-generation unit produces acoustic vibrations that propagate in the structure forming the acoustic signature of the structure. By analyzing the acoustic signature and additional information from the detection unit, multiple environment parameters can be monitored. [OPEN ACCESS TECHNICAL ARTICLE 1](#), [OPEN ACCESS TECHNICAL ARTICLE 2](#)

Tags: Sensors

[Resonator with nanoscale features detects dangerous chemicals in the environment](#)

[Nanowerk](#), 16SEP2016

When using resonators as sensors, most people want to get rid of dissipation or friction because it's considered highly undesirable. Researchers in Canada made it useful by designing experiments involving a "forest" of tiny hairs on a thin vibrating crystal chip, similar to the hair on insects body surfaces, for sensing chemicals without chemical receptors. The idea is that any object moving rapidly through the air can probe the properties of the surrounding environment. With the nanostructures, it is possible to detect tiny changes in the air surrounding the resonator. This sensitivity makes the device useful for detecting a wide variety of chemicals. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Sensors, Biomimetics, S&T Canada

[Single-photon detector for potential encryption and sensing apps](#)

[PhysOrg.com](#), 16SEP2016

A team of researchers in the US (Cal Tech, University of Maryland) has developed a method based on electronic interferometry to detect the photons that arrive when the gates are either open or closed. The new detector can count individual photons at a very high maximum rate—several hundred million per second—and at higher than normal efficiency, while maintaining low noise. Its efficiency is at least 50 percent for photons in the near infrared, the standard wavelength range used in telecommunications. Commercial detectors operate with only 20 to 30 percent efficiency. The added ability to detect photons that arrive when the gate is closed increases the detector's efficiency. The invention could allow higher rates of transmission of encrypted electronic information and improved detection of greenhouse gases in the atmosphere. [OPEN SOURCE PATENT](#)

Tags: Sensors, Photonics

[New optofluidic platform features tunable optics and novel 'lightvalves'](#)

[Science Daily](#), 14SEP2016

Using multilayer soft lithography techniques, researchers at UC Santa Cruz have developed a device using polydimethylsiloxane, a soft, flexible material used in microfluidics which allows for biological sample processing. Chips contain both solid-core and hollow-core waveguides for guiding light signals as well as fluidic microvalves to control the movement of liquid samples. It allows for novel ways of controlling both light and fluids on the chip. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Sensors, Biotechnology ■

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