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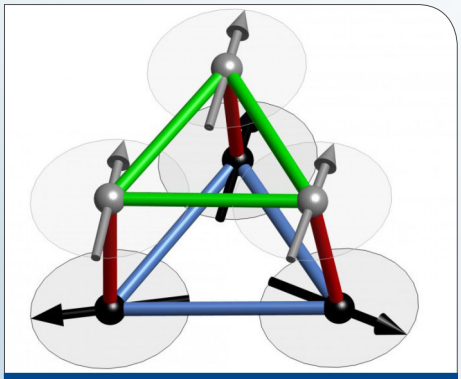
S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

FEATURE ARTICLES

Novel state of matter: Observation of a quantum spin liquid

Science Daily, 26JUL2016



This is a section from the crystal lattice of Calcium-chromium oxide showing how the spins are subject to conflicting demands. In this ball-and-stick model, the green and red sticks connecting the atoms (grey and black balls) represent ferromagnetic interactions while the blue sticks represent anti-ferromagnetic interactions. Credit: HZB

An international team of researchers (Germany, Switzerland, France, India, USA - NIST, University of Maryland) has produced and investigated the first monocrystals of calcium-chromium oxide. A complex set of isotropic magnetic interactions develop in this material that, according to conventional understanding, should prevent the existence of spin liquid behavior. Researchers have shown that the spins in these samples retain their collective motion even at temperatures as low as 20 millikelvin and behave like a quantum spin liquid. This could be important for the advancement of quantum computers. TECHNICAL ARTICLE

Tags: Advanced materials, Quantum science, Featured Article

Two Atoms Can Jointly Absorb One Photon

American Physical Society Focus, 22JUL2016

An international team of researchers (Italy, Japan, USA - University of Michigan) has shown theoretically that it's possible to excite two atoms—or even more—simultaneously by absorbing just a single photon between them. The process should be reversible, so that the atoms can return to a lower-energy state by collectively emitting one photon. This nonintuitive phenomenon might find applications in quantum information processing, the researchers say. TECHNICAL ARTICLE

Tags: Photonics, Quantum science, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

New lightweight shape-shifting alloy shows potential for a variety of applications

Science Daily, 25JUL2016

Researchers in Japan discovered that Magnesium -Scandium (Mg-Sc) shows shape memory (SMA) properties. They found that the operating temperature of Mg-Sc SMA can be varied by controlling Sc content, and confirmed that an Mg-Sc alloy with 18.3% Sc showed shape recovery upon heating from -30ºC to room temperature. It has a density of about 2g/cm$_3$ which is one-third less than that of practical TiNi SMAs. This could have significant impact on the aerospace industry. TECHNICAL ARTICLE

Tags: Advanced materials, S&T Japan

A hydrophobic membrane with nanopores for highly efficient energy storage

Nanowerk, 22JUL2016

To allow efficient commercial use of a redox flow batteries, the membrane has to separate the electrolytes to prevent energy loss by short-circuiting and allow protons to pass when the battery is charged or discharged. To combine both of these functions, an international team of researchers (Germany, South Korea) developed a hydrophobic membrane with tiny pores and channels which allow protons to travel through the membrane with high speed. They reached 99 percent energy efficiency depending on the current. TECHNICAL ARTICLE

Tags: Advanced materials, Energy

Artificial muscle for soft robotics: Low voltage, high hopes

Science Daily, 21JUL2016

Researchers at Harvard University built a dielectric elastomer based on the material developed by UCLA that eliminated the need for rigid components and an electrode of carbon nanotubes. This type of actuator could be used in everything from wearable devices to soft grippers, laparoscopic surgical tools, entirely soft

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robots or artificial muscles in more complex robotics. TECHNICAL ARTICLE

Tags: Advanced materials, Materials science

Making magnets flip like cats at room temperature

Science Daily, 21JUL2016

An international team of researchers (UK, Germany, Czech Republic) has demonstrated spin-orbit torques in NiMnSb crystal at room temperature. The research represents an important step towards improved magnetic random access memory architectures for technical applications that are all fully electrical, highly scalable, and require low power. TECHNICAL ARTICLE

Tags: Advanced materials, Materials science

Self-organizing smart materials that mimic swarm behavior

Science Daily, 21JUL2016

Through computer simulations, an international team of researchers (USA - University of Illinois, South Korea) demonstrated the self-organizing pattern formation in micron-sized spheres suspended in solution. The electrostatic interactions between the two sides of the self-propelled spheres could be manipulated by subjecting the colloids to an electric field. This caused the particles to self-organize into swarms, chains, clusters and isotropic gases. The research could open a new class of technologies with applications in medicine, chemistry, and engineering. TECHNICAL ARTICLE

Tags: Advanced materials

AUTONOMOUS SYSTEMS & ROBOTICS

One giant leap for space robotics

EurekAlert, 22JUL2016

Researchers in the UK report that autonomous robots capable of walking, swimming and climbing, will replicate insects, birds, animals and even humans on future missions of space exploration within decades. The rapid evolution of technologies powering space Robotic Autonomous Systems will have beneficial applications in sectors such as healthcare, mining and agriculture. OPEN ACCESS TECHNICAL ARTICLE

Tags: Autonomous systems & robotics, S&T UK

Video Friday: BratWurst Bot, Facebook Drone, and Powerline Ape

IEEE Spectrum, 22JUL2016

Does a solar-powered drone that can stay aloft indefinitely and provide internet to everyone below it make more sense than just setting up a bunch of ground infrastructure? Facebook is trying to find out.

Tags: Autonomous systems & robotics

BIOTECHNOLOGY

Asymmetrical magnetic microbeads transform into micro-robots

Science Daily, 26JUL2016

Researchers in Germany experimentally investigated large assemblies of microbead Janus particles with an optical microscope and performed numerical simulations based on a simple model featuring off-centred magnetic dipoles. Under an oscillating field, the particles continuously reverted back to standard magnetic behaviour. They concluded that the interactions between the off-centred dipoles with the changing external magnetic field transform larger particle clusters into different configurations. This could be harnessed, for instance, to create a zipper-style micro-muscle on a chip. TECHNICAL ARTICLE

Tags: Biotechnology

Scientists program cells to remember and respond to series of stimuli

MIT News, 21JUL2016

In a step toward devising much more complex cellular circuits, a team of researchers in the US (MIT, Harvard University, Wellesley College) has programmed cells to remember and respond to a series of events. These cells can remember, in the correct order, up to three different inputs, but this approach should be scalable to incorporate many more stimuli, the researchers say. Using this system, scientists can track cellular events that occur in a particular order, create environmental sensors that store complex histories, or program cellular trajectories. TECHNICAL ARTICLE

Tags: Biotechnology, Synthetic biology

Wiring Together Synthetic Bacterial Consortia to Create a Biological Integrated Circuit

ACS Synthetic Biology, 26JUN2016

The promise of adapting biology to information processing will not be realized until engineered gene circuits, operating in different cell populations, can be wired together to express a predictable function. Researchers at the University of Notre Dame assembled elementary biological integrated circuits, consisting of two sets of transmitter and receiver gene circuit modules with embedded memory placed in separate cell populations using live cell lithography and wired together by the mass transport of quorum-sensing signal molecules to form two isolated communication links.

Tags: Biotechnology, Synthetic biology

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"The only way to do great work is to love what you do." STEVE JOBS

COMMUNICATIONS TECHNOLOGY

Improving Internet with mid-wavelength infrared

PhysOrg.com, 26JUL2016

Researchers at Northwestern University have developed a phototransistor, an extremely sensitive mid-wavelength infrared photodetector that has the potential to replace near-infrared free-space optical communications links in many applications. It is a combination of an electronic transistor and optoelectronic photodiode. OPEN ACCESS TECHNICAL ARTICLE

Tags: Communications technology

ENERGY

New lithium-oxygen battery greatly improves energy efficiency, longevity

Science Daily, 25JUL2016

Conventional lithium-air batteries draw in oxygen from the outside air to drive a chemical reaction and this oxygen is then released again to the atmosphere during the reverse reaction in the charging cycle. An international team of researchers (USA - MIT, Argonne National Laboratory, China) has developed a variant without ever letting the oxygen revert to a gaseous form. Instead, the oxygen stays inside the solid reducing the voltage loss by a factor of five. This means faster charging for cars, as heat removal from the battery pack is less of a safety concern, as well as energy efficiency benefits. TECHNICAL ARTICLE

Tags: Energy, Battery

IMAGING TECHNOLOGY

Computer scientists find way to make all that glitters more realistic in computer graphics

Science Daily, 21JUL2016

Researchers at UC San Diego have created a method to improve how computer graphics software reproduces the way light interacts with extremely small details, called glints, on the surface of a wide range of materials, including metallic car paints, metal finishes for electronics and injection-molded plastic finishes. The key to the algorithm's speed is its ability to approximate this normal distribution at each surface location, called a "position-normal distribution." The method requires minimal computational resources and can be used in animations.

Tags: Imaging technology, Information technology

MATERIALS SCIENCE

Ultra-flat circuits will have unique properties

EurekAlert, 25JUL2016

Materials like graphene may enable the ultimate in thin devices by building all the necessary circuits into an atom-thick layer. Researchers at Rice University analyzed hybrids that put 2-D materials like graphene and boron nitride side by side to see what happens at the border. 3-D materials have a narrow region for charge transfer at the p/n junction. They found that 2-D interfaces created "a highly nonlocalized charge transfer"—and an electric field along with it—that greatly increased the junction size. That could give them an advantage in photovoltaic applications like solar cells. TECHNICAL ARTICLE

Tags: Materials science

New record in materials research: One terapascals in a laboratory

PhysOrg.com, 22JUL2016

An international team of researchers (Germany, Belgium, France, USA - University of Chicago, Russia) synthesized spherical nano-crystalline diamonds which are extremely robust when external pressures are exerted on them. Using a focused ion beam, they split the diamond spheres in two, installed in a double-sided diamond anvil cell and applied pressure. The diffraction pattern revealed that the threshold of 1 terapascal had been reached and even exceeded. OPEN ACCESS TECHNICAL ARTICLE

Tags: Materials science

Newly discovered material property may lead to high temp superconductivity

PhysOrg.com, 22JUL2016

Electron-electron interactions are the likely origin of unconventional, high-temperature superconductivity such as found in copper- and iron-based compounds. An international team of researchers (USA - Ames Laboratory, University of Iowa, Rutgers University, China, Estonia) discovered an 'extraordinary' increase of charge density wave in a molybdenum oxide in transition temperature from 130K (-143°C) to 220K (-53 °C) and a huge increase of energy gap at the surface. Both are properties essential for charge density wave and high-temperature superconductivity. TECHNICAL ARTICLE

Tags: Materials science, Government S&T

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Electron beam switches nanodomains

Nanotechweb, 21JUL2016

Researchers in Australia report that a high-energy electron beam can be used to switch the polarization of ferroelectric domains with domain sizes of just a few nanometres across. They say that the technique could be used to produce memory devices that store information at densities 100 times higher than today's memories. TECHNICAL ARTICLE

Tags: Materials science, S&T Australia

MICROELECTRONICS

Doubling data density

PhysOrg.com, 25JUL2016

Researchers in Saudi Arabia created a ferroelectric tunnel junction containing a film of ferroelectric samarium-doped bismuth iron oxide (SBFO) that was just three to nine nanometers thick. One electrode was made of platinum and the other was niobium-doped strontium titanate (NSTO). They found that SBFO has low tunneling electroresistance in one polarization state but 100,000 times larger in the other polarization state. This means that we could acquire a total of four electronic states corresponding to polarization direction (left or right) and illumination condition (dark or light) thus doubling the data storage density. OPEN ACCESS TECHNICAL ARTICLE

Tags: Microelectronics, Information technology

Featured Resource

arXiv

arXiv, started in 1994, is an e-print service in the fields of physics, mathematics, non-linear science, computer science, quantitative biology, and more. It is owned and operated by Cornell University and funded by Cornell University Library and supporting user institutions. RSS

Transistors Will Stop Shrinking in 2021, Moore's Law Roadmap Predicts

IEEE Spectrum, 22JUL2016

According to the 2015 International Technology Roadmap for Semiconductors (ITRS), after 2021 it will no longer be economically desirable for companies to continue to shrink the dimensions of transistors in microprocessors. Some of the technology challenges were outlined in a recent SIA-Semiconductor Research Corporation report, Rebooting the IT Revolution, but work continues to define research gaps and implement new research programs. OPEN ACCESS ITRS

Tags: Microelectronics

Perfectly formed random-access memory

Science Daily, 19JUL2016

Researchers in Singapore have developed resistive random-access memory (RRAM) devices that uses tantalum oxide with electrical contacts made from either titanium nitride or tantalum. When using the more chemically reactive tantalum, the device is ready to use right away. Tantalum has a natural affinity to react with the oxygen that helps to prepare the material in the right state. They have demonstrated a forming-free RRAM cell with low operation voltages, a large resistance window and excellent thermal stability. TECHNICAL ARTICLE

Tags: Microelectronics, Information technology

Scientists glimpse inner workings of atomically thin transistors

Science Daily, 18JUL2016

Researchers at UT Austin report that a molybdenum disulfide 2-D transistor allows for on-off signaling on a single flat plane. Electric currents move in a more phased way, beginning first at the edges before appearing in the interior. This suggests the same current could be sent with less power and in an even tinier space, using a one-dimensional edge instead of the two-dimensional plane that could promote future energy savings in devices. TECHNICAL ARTICLE

Tags: Microelectronics, Advanced materials

PHOTONICS

Researchers nearly double the continuous output power of a type of terahertz laser

PhysOrg.com, 26JUL2016

By optimizing the material growth and manufacturing process for terahertz quantum cascade lasers, researchers in China made a laser with a record output power of up to 230 milliwatts in continuous wave mode. The previous record was 138 milliwatts. It could be used in air, a challenge for lower-powered lasers since particles in the air can scatter or absorb the laser light before it reaches its target. It has potential applications in medical imaging and airport security. OPEN ACCESS TECHNICAL ARTICLE

Tags: Photonics, S&T China

QUANTUM SCIENCE

Friction-like effect observed in quantum system

Nanowerk, 22JUL2016

An international team of researchers (Taiwan, Japan, Russia) found that applying a voltage to an array of electrons hovering above a sea of liquid helium causes the electron lattice to undergo 'stick-slip' motion resembling that between two sliding rough surfaces. They report that the motion of the electron crystal is restricted by the emission of 'ripplons'—field quanta of capillary waves that form on the helium surface. The electrons transfer momentum to the

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ripplons, and in so doing their own motion is slowed. At the critical electric field, the electron lattice overcomes a 'sound barrier' and all the ripplons are left behind, drastically reducing the lattice mobility. TECHNICAL ARTICLE

Tags: Quantum science

Researchers make leap in measuring quantum states

Nanowerk, 21JUL2016

Researchers in Australia demonstrate a technique where the quantum state is iteratively learned by treating tomography as a projection measurement optimization problem. They experimentally demonstrate robustness against both statistical noise and experimental errors on both single qubit and entangled two-qubit states. Their demonstration provides a method of full quantum state characterization in current and near-future experiments where standard techniques are unfeasible. OPEN ACCESS TECHNICAL ARTICLE

Tags: Quantum science, S&T Australia

Researchers make leap in measuring quantum states

PhysOrg.com, 21JUL2016

The full characterisation (tomography) of quantum states is a necessity for future quantum computing. Researchers in Australia experimentally characterise quantum states encoded in single photons. The method can be applied to other quantum computing architectures, such as ion traps and superconducting qubits. They engineer the level of noise up to extreme levels to test the performance of our algorithm. We show that self-guided quantum tomography is significantly more robust against noise than standard tomography. TECHNICAL ARTICLE

Tags: Quantum science, S&T Australia

Weird quantum effects stretch across hundreds of miles

Science Daily, 19JUL2016

Researchers at MIT found that as neutrinos sped between the reactor and detector, located hundreds of miles apart, they were statistically most likely to be in a state of superposition, with no definite flavor or identity. It appears we can't escape quantum mechanics, even when we describe processes that happen over large distances. We can't stop our quantum mechanical description even when these things leave one state and enter another, traveling hundreds of miles. TECHNICAL ARTICLE

Tags: Quantum science

S&T POLICY

Ways to share key data between researchers, business practitioners

Science Daily, 21JUL2016

Academic researchers study many aspects of business, but business practitioners rarely make use of that research. A team of researchers in the US (North Carolina State University, Virginia Commonwealth University, University of Iowa) reports that researchers and practitioners share more interests than either group realizes and outlines ways that the two groups can collaborate more effectively to address shared challenges. TECHNICAL ARTICLE

Tags: S&T policy, Science without borders

SCIENCE WITHOUT BORDERS

'Radiation friction' could make huge magnetic fields with lasers

PhysOrg.com, 19JUL2016

An international team of researchers (Germany, Italy, Russia) suggests that the mysterious phenomenon of "radiation friction" plays a crucial role in generating the magnetic field. Measuring such magnetic fields could offer physicists a new way of studying this poorly understood effect, which is believed to play a crucial role in the physics underlying astrophysical objects such as gamma-ray flares. OPEN ACCESS TECHNICAL ARTICLE

Tags: Science without borders

SENSORS

Selective sensing of harmful molecules with light

Science Daily, 25JUL2016

Researchers in Ireland designed a simple Bloch surface waves sensor, employing silicon as its surface material, which they believe has practical advantages due to the ease with which it delivers and detects light waves and they are detecting even smaller changes in the material's refractive index. They are used for detecting biomarkers of disease, discovering drugs, analyzing chemicals, ensuring food quality and safety, and detecting environmental pollutants. OPEN ACCESS TECHNICAL ARTICLE

Tags: Sensors

Ultrasensitive sensor using N-doped graphene

Nanowerk, 22JUL2016

An international team of researchers (USA - Pennsylvania State University, Brazil, China, Japan) has developed a chemical sensor based on Raman spectroscopy using nitrogen-doped graphene as a substrate. By controlling nitrogen doping, they can shift the energy gap of the graphene, and the shift creates a resonance effect that significantly enhances the molecule's vibrational Raman modes. This technique can detect trace amounts of

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molecules in a solution at very low concentrations, some 10,000 times more diluted than can be seen by the naked eye. Open Access TECHNICAL ARTICLE

Tags: Sensors, Advanced materials ■

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