Volume 7, Issue 14 ■ 7APR2017

S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

FEATURE ARTICLES

New research into light particles challenges understanding of quantum theory

Physorg.com, 29MAR2017

Researchers in the UK have shown that when photons are created in pairs, they can emerge from different, rather than the same, location. The ground-breaking research could have significant implications for quantum physics. While studying spontaneous parametric down-conversion, they found that each photon pair can be emitted from spatially separated points introducing a new positional uncertainty of a fundamental quantum origin. The entanglement of the quantum states in each pair has important applications in quantum computing as well as other areas of quantum physics as they place limits on spatial resolution. TECHNICAL ARTICLE

Tags: Photonics, Quantum science, Featured Article

Reliable molecular toggle switch developed

Science Daily, 29MAR2017

The molecular contact can be switched on and off mechanically and electrostatically. Credit: KIT

An international team of researchers (Germany, Switzerland, China) has developed a tripodal platform with a cantilever arm and a nitrile group at its end that is lifted from the surface. The formation of a coordinative bond between the nitrile nitrogen and the gold tip of a scanning tunnelling microscope can be controlled by both electrical and mechanical means. The toggle switch can be actuated with high reproducibility. Replacing conventional silicon-based components, e.g. a switch, by individual molecules, future electronic circuits might be integrated on a space smaller by a factor of 100. OPEN ACCESS TECHNICAL ARTICLE

Tags: Microelectronics, Microelectronics, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

Built from the bottom up, nanoribbons pave the way to 'on-off' states for graphene

Technology Org, 31MAR2017

Graphene in sheets is an excellent electrical conductor, but narrowing graphene can turn the material into a semiconductor if the ribbons are made with a specific edge shape. Metal substrate hinders the ribbons' useful electronic properties. A team of researchers in the US (Oak Ridge National Laboratory, North Carolina State University) has grown graphene nanoribbons by injecting charge carriers that promote a chemical reaction that converts a polymer precursor into a graphene nanoribbon. At selected sites, this new technique can create interfaces between materials with different electronic properties. Such interfaces are the basis of semiconductor electronic devices from integrated circuits and transistors to light-emitting diodes and solar cells. OPEN ACCESS TECHNICAL ARTICLE

Tags: Advanced materials

Nanomagnets for future data storage

Science Daily, 30MAR2017

An international team of researchers (Switzerland, USA - Lawrence Berkeley National Laboratory, France) has developed a molecule with a dysprosium atom at its centre surrounded by a molecular scaffold that serves as a vehicle and a method for depositing such molecules on the surface of silica nanoparticles and fusing them by annealing at 400 degrees Celsius. The scientists showed that these atoms can be magnetised and can maintain their magnetic information. The magnetisation process currently only works at around minus 270 degrees Celsius (near absolute zero), and magnetisation can be maintained for up to one and a half minutes. OPEN ACCESS TECHNICAL ARTICLE

Tags: Advanced materials

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Researchers create tough material for next generation of powerful engines

Physorg.com, 30MAR2017

A team of researchers in the US (Rice University, NASA Glenn Research Center) embedded silicon carbide nanotubes and nanowires into the surface of silicon carbide fibers. The exposed parts of the fibers are curly and act like the hooks and loops that make Velcro which create very strong interlocking connections where the fibers tangle; this not only makes the composite less prone to cracking but also seals it to prevent oxygen from changing the fiber's chemical composition. In friction and compression tests it proved to be very strong, easily bounced back from high compression, resisted breaking down for longer periods of time and resisted temperatures of up to 1,000 C. The material has applications in next-generation rocket engines. TECHNICAL ARTICLE

Tags: Advanced materials, Space technology

Rotating molecules create a brighter future

Nanowerk, 30MAR2017

A fifth of the world's electricity is used for generating light. To overcome the inefficiency of organic light-emitting diodes, an international team of researchers (UK, Finland) has developed a new type of material where two different organic molecules are joined together by an atom of copper or gold. The resulting structure looks a bit like a propeller. By rotating their "propeller", dark states formed on these materials become twisted, which allows them to change their spin quickly. The process significantly increases the rate at which electrical energy is converted into light achieving an efficiency of almost 100% and preventing the damaging build-up of dark states. TECHNICAL ARTICLE

Tags: Advanced materials

Organic-inorganic heterostructures with programmable electronic properties

Science Daily, 29MAR2017

An international team of researchers (France, Belgium, Germany) designed and synthesized molecular building blocks equipped with a long aliphatic tail, and a photo-reactive diazirine head group. Using these building blocks, they applied a supramolecular approach to form self-assembled organic molecular lattices with a controlled geometry and atomic precision on top of graphene, inducing 1D periodic potentials in the resulting organic-inorganic hybrid heterostructures. The period-icity, amplitude and sign of the induced potentials can be pre-programmed and adjusted by careful molecular design. The research opens a way to realize hybrid organic-inorganic multilayer materials with unique electronic and optical properties. OPEN ACCESS TECHNICAL ARTICLE

Tags: Advanced materials

AUTONOMOUS SYSTEMS & ROBOTICS

Controlling soft robots using magnetic fields

Science Daily, 29MAR2017

A team of researchers in the US (North Carolina State University, University of Tulsa, Elon University) introduced iron microparticles into a liquid polymer mixture and then applied a magnetic field to induce the microparticles to form parallel chains. The mixture was then dried, leaving behind an elastic polymer thin film embedded with the aligned chains of magnetic particles. The polymer can be remotely controlled by a magnetic field that affects the chains of magnetic particles. The chains respond by aligning themselves and the surrounding polymer in the same direction as the applied magnetic field. Possible applications for these devices range from remotely triggered pumps for drug delivery to the development of remotely deployable structures. TECHNICAL ARTICLE

Tags: Autonomous systems & robotics, Materials science

BIOTECHNOLOGY

A 'bionic leaf' could help feed the world

Physorg.com, 03APR2017

Researchers at Harvard University designed a system in which Xanthobacter bacteria fix hydrogen from the artificial leaf and carbon dioxide from the atmosphere to make a bioplastic that the bacteria store inside themselves as fuel. The bug can be put in the soil because it has already used the sunlight to make the bioplastic, it pulls nitrogen from the air and uses the bioplastic, which is basically stored hydrogen, to drive the fixation cycle to make ammonia for fertilizing crops. In tests, the vegetables receiving the bionic-leaf-derived fertilizer weigh 150 percent more than the control crops. The invention has applications in poorer countries that do not have a large centralized process and a massive infrastructure to easily make and deliver fertilizer.

Tags: Biotechnology, S&T Policy

COMMUNICATIONS TECHNOLOGY

Photonics breakthrough paving the way for improved wireless communication systems

Physorg.com, 31MAR2017

Researchers in Australia have developed an optical tuning approach to control and switch RF time delay from integrated optical ring resonators with a fast tuning speed. They have demonstrated seamless tuning between pulse delay and advancement, as well as gigahertz switch capability without modifying the properties of resonators. This scheme opens the possibility for wideband advanced time-delay manipulation of RF signals for phase-arrayed antennas and radar applications in a general and compatible approach. OPEN ACCESS TECHNICAL ARTICLE

Tags: Communications technology, S&T Australia

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"But the real glory of science is that we can find a way of thinking such that the law is evident." RICHARD FEYNMAN

Quantum communication: How to outwit noise

Science Daily, 29MAR2017

Quantum information transfer requires reliable information transfer from one quantum system to the other, which is extremely difficult to achieve. An international team of researchers (Austria, USA- Harvard University, Yale University) has been able to develop a transfer protocol that is immune to the inevitable noise, by adding another quantum system -- a microwave oscillator -- as a mediator at both ends of the protocol to couple the qubits instead of coupling them directly to the microwave waveguide. The noise affects both oscillators on both ends in the same way. According to their calculations, with this protocol, the qubits can be connected over several hundred meters. TECHNICAL ARTICLE 1, 2

Tags: Communications technology, Quantum science

ENERGY

Secret of nanomaterial that makes harvesting sunlight easier

Science Daily, 28APR2017

An international team of researchers (UK, Germany, China, USA - Harvard University, Rensselaer Polytechnic Institute) identified which areas of nanomaterial would be most suitable for transferring energy to chemical reactions, by tracking the locations of very small gold nanoparticles (used as markers) on the surface of the silver nanocatalytic material. Now that they know which regions are responsible for the process of harvesting light and transferring it to chemical reactions, the team hopes to be able to engineer the nanomaterial to increase these areas and make it more efficient. The research could ultimately help improve solar energy technologies and be used for using sunlight to break down harmful chemicals. OPEN ACCESS TECHNICAL ARTICLE

Tags: Energy, Materials science, Solar energy

Bio-inspired energy storage: A new light for solar power

Science Daily, 31MAR2017

Researchers in Australia have developed a graphene-based electrode based on fractal shapes of the densely crammed veins in the leaves of the western swordfern. The new electrode is designed to work with supercapacitors. Combined with supercapacitors, the fractal-enabled laser-reduced graphene electrodes can hold the stored charge for longer periods, with minimal leakage. The research could boost the capacity of existing integrable storage technologies by 3000 per cent, lead to the development of flexible thin film all-in-one solar capture and storage and self-powering smart phones, laptops, cars and buildings. OPEN ACCESS TECHNICAL ARTICLE

Tags: Energy, S&T Australia, Solar energy

Next generation perovskite solar cells with new world-record performance

Physorg.com, 31MAR2017

An international team of researchers (South Korea, USA - MIT) has developed a method to fabricate perovskite solar cells (PSCs) satisfying both high efficiency (21.2%) and high photostability with photoelectrode materials synthesized by a very novel method under very mild conditions (below 200°C). They used methylammonium lead iodide perovskite materials for PSCs. The new material retains 93% of its initial performance after 1,000 hours of exposure to sunlight. They also proposed a manufacturing method that tightly adheres two objects by applying temperature and pressure. TECHNICAL ARTICLE

Tags: Energy, Materials science, Solar energy

Scientists Develop a Novel Technique for Storing Solar Energy in Liquids

Technology Org, 31MAR2017

Researchers in Sweden have built a prototype device that stores solar energy in the chemical bonds of a molecule. The device is capable of utilising up to 80 percent of incoming sunlight. The stored energy can be used immediately or delivered in small, precise amounts over a period of several months. To absorb photons with energies below a certain threshold, they used a hybrid two-layer system made of silica and quartz glass. According to the researchers, the device can store and release energy more than 100 times without any significant loss in efficiency. OPEN ACCESS TECHNICAL ARTICLE

Tags: Energy, S&T Sweden, Solar energy

Ultimate photon rocket - The Planck Photon Rocket

Next Big Future, 27MAR2017

In this paper from 1960, a Russian scientist describes a photon propulsion rocket and associated technical challenges. It looks at the ultimate limits of a photon propulsion rocket. The higher the exhaust velocity, the greater the velocity of a rocket vehicle; since light has the highest velocity in nature, it was conceived that photons could possibly be utilized to attain velocities approaching the speed of light. OPEN ACCESS TECHNICAL ARTICLE

Tags: Energy, Military technology

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ENVIRONMENTAL SCIENCE

Discovery of a source of fast magnetic reconnection

Science Daily, 31MAR2017

Magnetic reconnection triggers solar flares, northern lights and disrupts cell phone service and fusion experiments. Electrons that exert a varying degree of pressure form an important part of this process as reconnection takes place. An international team of researchers (USA - Princeton University, UK, Germany) found that variation in the electron pressure develops along the magnetic field lines in the region undergoing reconnection. This variation balances and keeps a strong electric current inside the plasma from growing out of control and halting the reconnection process. It is this balancing act that makes possible fast reconnection. The findings help better prediction of space storms, to protect satellite systems, electric grids and improve fusion performance. TECHNICAL ARTICLE

Tags: Environmental science, Space technology

Featured Resource

American Physical Society News

APS News provides daily news and commentary about a selection of papers from the APS journal collection. RSS

FOREIGN S&T

China could triple space science spending and has several startup rocket companies as well

Next Big Future, 29APR2017

Many analysts peg China's civilian space budget at around $3 billion annually in recent years, a fraction of the $19.3 billion the United States allocated to NASA in 2016. The current five-year plan (running through 2020) already calls for five major space exploration projects. These include a dark matter-seeking satellite that launched in December 2015 and an experimental quantum communications satellite that launched last year that could lead to significant breakthroughs in communications and cryptography. An ongoing build-out of geolocation and Earth observation satellites is also providing China with vast reserves of data.

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

IMAGING TECHNOLOGY

Finding faces in a crowd: Context is key when looking for small things in images

Physorg.com, 30MAR2017

Researchers at Carnegie Mellon University have developed a method to encode context using "foveal descriptors" to understand the patch shown in the high focus area of the human retina, but not so much that the computer becomes overwhelmed. This allows the system to make use of pixels that are relatively far away from the patch when deciding if it contains a tiny face. In addition to contextual reasoning, the researchers improved the ability to detect tiny objects by training separate detectors for different scales of objects.

Tags: Imaging technology, Big data

New electron microscope sees more than an image

Nanowerk, 30MAR2017

Researchers at Cornell University have developed an electron microscope pixel array detector (EMPAD) that yields not just an image, but a wealth of information about the electrons that create the image and, from that, more about the structure of the sample. It is made up of a 128x128 array of electron-sensitive pixels bonded to an integrated circuit that reads out the signals. Its purpose is to detect the angles at which electrons emerge, as each electron hits a different pixel. Combined with the focused beam of the electron microscope, the detector allows researchers to build up a "four-dimensional" map of both position and momentum of the electrons as they pass through a sample to reveal the atomic structure and forces inside. It is fast, sensitive and records a wide range of intensities. It is useful in life sciences as using a less intense exposure to get an image limits damage to a living specimen.

Tags: Imaging technology

Team develops accurate contactless 3-D fingerprint identification system

Physorg.com, 30MAR2017

The minutiae features from the fingerprint ridges are universally considered to be the most reliable of fingerprint details, ensuring that each fingerprint is unique. Researchers in Hong Kong have developed a system for contactless 3D fingerprint identification by adopting a recovery and matching technology. They used a digital camera coupled with a few LED light sources controlled by a computer. This allows researchers to efficiently acquire high-frequency information in 3D fingerprints using advanced proprietary 3D fingerprint template generation algorithms to recover 3D minutiae features.

Tags: Imaging technology

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A faster single-pixel camera

MIT News, 29MAR2017

Researchers at MIT present a theoretical analysis of compressed sensing that uses time-of-flight information. They show how efficiently the technique can extract information about a visual scene, at different resolutions and with different numbers of sensors and distances between them. They describe a procedure for computing light patterns that minimizes the number of exposures. They are developing a prototype of the system to test their algorithm on real data. TECHNICAL ARTICLE

Tags: Imaging technology

MATERIALS SCIENCE

Flash nano: Long nanotubes are excellent heat conductors

Nanotechweb, 31MAR2017

Researchers in Taiwan found that thermal conductivity increases with the length of SWCNT and that some 1 mm long samples had conductivities that are approximately four times higher than diamond or graphene. Their findings suggest that the heat-carrying capacity of phonons play an important role in the thermal properties. The research could lead to the development of highly effective heat-management systems for tiny systems such as computer chips and open new regimes for wave engineering of heat as well as manipulating phonons at macroscopic scales. TECHNICAL ARTICLE

Tags: Materials science

Sculpting optical microstructures with slight changes in chemistry

Physorg.com, 30MAR2017

Controlled self-assembly of three-dimensional shapes holds great potential for the fabrication of functional materials. Motivated by a variety of bioinspired coprecipitation patterns of carbonate and silica, an international team of researchers (USA - Harvard University, Virginia Tech, the Netherlands) developed a geometrical theory for the kinetics of the growth front that leaves behind thin-walled complex structures. With this, a number of functional base shapes of optical microstructures can be designed and synthesized to demonstrate their light-guiding capabilities. The framework provides a way to understand and control the growth and form of functional precipitating microsculptures. OPEN ACCESS TECHNICAL ARTICLE

Tags: Materials science, Advanced materials

MICROELECTRONICS

New ultrafast flexible and transparent memory devices could herald new era of electronics

Physorg.com, 31MAR2017

An international team of researchers (UK, Switzerland) has developed new memory using a hybrid of graphene oxide and titanium oxide which is 50 nanometres long and 8 nanometres thick and can be written to and read from in less than five nanoseconds. They are perfectly suited for use in flexible electronic devices. They may also have the potential to offer a cheaper and more adaptable alternative to flash memory. Researchers have demonstrated that the device provides easily accessible multilevel (4-level, 2-bit per cell) storage capabilities along with excellent endurance and retention performance. OPEN ACCESS TECHNICAL ARTICLE

Tags: Microelectronics

NEUROSCIENCE

Multitasking—what goes in our brain when we try to do two or more things at once

Medical Express, 31MAR2017

Researchers at Tufts University believe the consequences of juggling multiple streams of information are more subtle, and that they sometimes even lead to an occasional positive effect on performance. Multiple tasks can be accomplished by task switching or dual tasking which are handled by different areas of the brain. Neural generators associated with task switching and dual tasking may be influenced by administering short bouts of non-invasive brain stimulation. Gaining a better understanding of these cross-sensory pairings could have huge implications for optimizing performance on different multitasking functions and man-machine technology.

Tags: Neuroscience

PHOTONICS

Optically excited structural transition fastest electronic switch ever observed

Physorg.com, 30MAR2017

Phase transition speed is constrained by the speed at which energy can enter a system. To test the limits of transition speed, researchers in Germany cooled samples of indium on silicon to 30K and then measured the electron diffraction pattern of the surface and found it to be an insulator. They then fired a laser at the sample repeatedly varying the time between laser firings and found that for times longer than 350fs the insulator became a metal. By varying the power of the laser, they found that more power resulted in faster transition and became constant at the quantum limit. This technique could potentially be used to tune the dynamic response of a solid to optical excitation, and has widespread potential application, for example in ultrafast detectors. TECHNICAL ARTICLE

Tags: Photonics, Materials science

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QUANTUM SCIENCE

Quantum Coherence as a Resource

ArXiv, 17APR2017

Quantum coherence in many-body systems embodies the essence of entanglement and is an essential ingredient for a plethora of physical phenomena in quantum optics, quantum information, solid state physics and nanoscale thermodynamics. At a colloquium, an international team of researchers (Poland, Spain, Germany, UK) discussed and reviewed the development of this rapidly growing research field that encompasses the characterization, quantification, manipulation, dynamical evolution, and operational application of quantum coherence. Open Access TECHNICAL ARTICLE

Tags: Quantum science

Quantum memory is made from doped silicon

Physics World, 31MAR2017

An international team of researchers (Australia, Japan, Canada, the Netherlands, USA - Oak Ridge National Laboratory) has demonstrated storage and retrieval of quantum information from a single donor electron spin to its host phosphorus nucleus in isotopically enriched silicon. They reported an overall process fidelity of approx. 81%, and memory storage times up to 80 ms. These values are limited by a transient shift of the electron spin resonance frequency following high-power radio frequency pulses. According to the researchers, this kind of memory could be an important ingredient in silicon-based quantum computers with the potential to be more scalable, compact and easier to mass-produce than devices based on rival technologies. Open Access TECHNICAL ARTICLE

Tags: Quantum science

S&T POLICY

NIH funding generates large numbers of private-sector patents

MIT News, 30MAR2017

A team of researchers in the US (Harvard University, MIT, National Bureau of Economic Research, a non-profit organization, Columbia University) used data on patents linked to NIH grants over a 27-year period to provide a large-scale accounting of linkages between public research investments and subsequent patenting. About 10% of NIH grants generate a patent directly but 30% generate articles that are subsequently cited by patents. They found no systematic relationship between the "basic" versus "applied" research focus of a grant and its propensity to be cited by a patent. Open Access TECHNICAL ARTICLE

Tags: S&T policy

Is Artificial Intelligence Stuck in A Rut?

MIT Technology Review, 29MAR2017

Speakers at MIT Technology Review's EmTech Digital conference in San Francisco, expressed differing views. According to one speaker, despite recent technical advances there are many simple things that computers cannot do, and that these limitations are holding back efforts to make progress towards real general intelligence and corporate investment in AI might not be such a good thing for the field's long-term goals. In times past, a lack of progress caused investment in AI to dry up. This time around too much investment might cause researchers to lose sight of the long-term goals. Another speaker suggested that general, or human-level, AI might not be so far away.

Tags: S&T policy, Artificial intelligence

SENSORS

Smell, the Glove

IEEE Spectrum, 30MAR2017

An international team of researchers (USA - UCSD, Australia) printed a thin carbon disk that would collect the chemical residue on the thumb tip of a commercial medical exam glove and printed two electrodes on the index finger with stretchable carbon ink. One electrode is soaked with an enzyme that binds to organophosphate compounds; the other serves as a counter electrode. Finally, they coated the circuit with a stretchy, insulating adhesive layer. To test a surface for an agent, the thumb is rubbed on the surface to collect the sample in the disk and then touch the index finger. When the sample comes in contact with the enzyme, it generates an electric current that is sent to an adjustable ring-like bandage worn on the index finger. The ring, in turn, is wired to a small Bluetooth device on the back of the glove, which transmits data wirelessly to a mobile device. The gloves could detect contaminants at a concentration of 200 micromolar on the surfaces of various fruits and vegetables, glass, wood, plastic, and steel. Open Access TECHNICAL ARTICLE

Tags: Sensors, Counter WMD ■

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