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S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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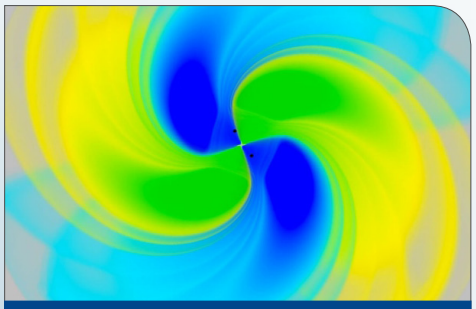
Feature Articles

Gravitational waves: 6 cosmic questions they can tackle

Nature News, 09FEB2016



Mergers between black holes (simulation) are expected to be strong sources of gravitational waves. Credit: S. Shapiro, R. Gold, V. Paschalidis, M. Ruiz, Z. Etienne & H. Pfeiffer. Movie: S. Shapiro, S. Connelly, A. Khan and L. Kong

The first direct detection of gravitational waves is now widely expected to be announced on 11 February by the Advanced Laser Interferometer Gravitational-Wave Observatory (LIGO). Using LIGO's twin giant detectors—one in Livingston, Louisiana, and the other in Hanford, Washington—researchers are said to have measured ripples in space-time produced by a collision between two black holes. Such an announcement would vindicate Albert Einstein's prediction of gravitational waves, which he made almost exactly 100 years ago as part of his general theory of relativity—but it would also have much further significance. Welcome to the field of gravitational-wave astronomy: we take a look at the questions and phenomena that it can explore.

Tags: Science without borders, Featured Article

New frontiers in communication systems

PhysOrg.com, 02FEB2016

An international team of researchers (Japan, UK) has designed, developed and prototyped a pioneering all-optical router that can unlock 80 THz of bandwidth across a newly defined frequency band named T-Band (thousand band) and O-Band (original band). The adjacent bands span from 1.0 μm (300 THz) to 1.36 μm (220 THz) and are able to support 1600 channels at 50 GHz spacing. The technology fabricated and tested is based on cascaded arrayed waveguide gratings and is designed to potentially construct a 1600 x 1600 wavelength router that can guide data at the speed of light. Specially designed quantum dot chips are used for light sources. TECHNICAL ARTICLE

Tags: Communications technology, Featured Article

S&T News Articles

ADVANCED MATERIALS

Scientists create laser-activated superconductor

PhysOrg.com, 08FEB2016

Currently superconductors only work at very low temperatures, requiring liquid nitrogen or helium to maintain their temperature. An international team of researchers (Germany, Italy, UK, Singapore) shone a laser at a material made up from potassium atoms and carbon atoms arranged in bucky ball structures and found it to still be superconducting at more than 100 degrees Kelvin—around minus 170 degrees Celsius. These findings could lead to new routes and insights into making better superconductors that work at higher temperatures. TECHNICAL ARTICLE

Tags: Advanced materials

Nanomaterial of a new class

Nanowerk, 05FEB2016

An international team of researchers (Germany, the Netherlands, Saudi Arabia) first employed a standard procedure, widely used when working with nanoparticles, whereby ceramic iron oxide nanoparticles are deposited in a regular array. This is done with the help of organic oleic acid, which seeps into the narrow gaps between the nanoparticles and holds them together. Their measurements showed that the oleic acid molecules survive the thermal treatment and form additional crosslinks during the process. This finding can serve as the basis for successfully modelling the mechanical properties of this novel material. TECHNICAL ARTICLE

Tags: Advanced materials

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Breakthrough for magnesium lightweight materials

PhysOrg.com, 04FEB2016

Magnesium is the lightest construction metal, but also the most reactive. Researchers in Sweden show a completely new way to improve the corrosion resistance of the alloys by manipulating the microstructure of the material, thereby increasing possibilities to lower the weight of vehicles. In cars, a transition to magnesium, which is 30 percent lighter than aluminium, would mean a great step forward to reduce fuel consumption. TECHNICAL ARTICLE

Tags: Advanced materials, S&T Sweden

Quantum metamaterials in the microwave and optical ranges

arXiv, 25JAN2016

Quantum metamaterials generalize the concept of metamaterials to the case when their optical properties are determined by the interplay of quantum effects in the constituent 'artificial atoms' with the electromagnetic field modes in the system. An international team of researchers (UK, Russia, France) provides a summary of the principal features of quantum metamaterials and review the current state of research which bridges quantum optics, quantum condensed matter theory and quantum information processing. TECHNICAL ARTICLE

Tags: Advanced materials, Metamaterials

AUTONOMOUS SYSTEMS & ROBOTICS

Evolving our way to artificial intelligence

PhysOrg.com, 05FEB2016

Typically, AI is part of the domain of engineering and computer science, a field in which progress is measured not by how much we learned about nature or humans, but by achieving a well-defined goal. An international team of researchers (USA - Cal Tech, Keck Institute, Michigan State University, Allen Institute, University of Wisconsin, South Korea) describes the AI that they would like to have as a machine that has cognitive abilities comparable to that of a human. It is a very fuzzy goal, but that is the whole point. We can't engineer what we can't define, which is why the engineering approach to "human level cognition" isn't going to get us where we want to go. We might, therefore, need to incorporate the process of how we became us into the process of how we make our digital counterparts. TECHNICAL ARTICLE

Tags: Autonomous systems & robotics, Artificial intelligence

BIOTECHNOLOGY

Chemical nano-cages advance synthetic biology

Nanowerk, 10FEB2016

The technique developed by a team of researchers in the US (Arizona State University, Rutgers University, University of Michigan) involves the design of specialized, nanometer-scale cages, which self-assemble from lengths of DNA. The cages hold enzyme and substrate in close proximity, considerably accelerating the rate of reactions and shielding them from degradation. The research could have far-reaching applications in fields ranging from improving industrial efficiencies to pioneering new medical diagnostics, drug delivery and producing smart materials. TECHNICAL ARTICLE

Tags: Biotechnology, Synthetic biology

Scientists take key step toward custom-made nanoscale chemical factories

Nanowerk, 04FEB2016

Natural counterparts, known as bacterial microcompartments or BMCs, encase a wide variety of enzymes that carry out highly specialized chemistry in bacteria. A team of researchers in the US (Michigan State University, Pennsylvania State University, Lawrence Berkeley National Laboratory, Brooklyn College, City University of New York, UC Berkeley) devised synthetic shell structures derived from those found in a rod-shaped, ocean-dwelling bacterium and reengineered one of the shell proteins to serve as a scaffold for an iron-sulfur cluster found in many forms of life. This provides an entirely new functionality, greatly expanding the potential of nanocompartments to serve as custom-made chemical factories. TECHNICAL ARTICLE

Tags: Biotechnology

COMMUNICATIONS TECHNOLOGY

Leiden physicists entangle four rotating photons

PhysOrg.com, 03FEB2016

An international team of researchers (Austria, the Netherlands) entangled four photons in their orbital angular momentum. They sent a laser through a crystal, thereby creating four photons with coupled 'rotation'. So far this has only been achieved with two photons. The discovery makes uncrackable secret communication of complex information possible between multiple parties. TECHNICAL ARTICLE

Tags: Communications technology, Quantum science

CYBER SECURITY

Nation state actors dominate the changing cyberthreat landscape in new report

Fierce Government IT, 05FEB2016

According to Crowdstrike's 2015 Global Threat Report the primary motivation behind global cyber activity has now shifted from disparate activities carried out by individuals, groups and criminal gangs pursuing short-term financial gain, to skilled adversaries driven by strategic global conflicts. The report took a tactical approach to the

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"Time and space and gravitation have no separate existence from matter."

ALBERT EINSTEIN

geopolitical cyberthreats breaking down the geographic areas responsible for different threats and explaining the motives, operating methods and tactics for each one.

Tags: Cyber security

Hack-proof RFID chips

MIT News, 03FEB2016

Researchers at MIT and their industry partner have developed a new type of RFID chip using a ferroelectric crystal chip to prevent so-called side-channel attacks. Two design innovations allow the chip to thwart power-glitch attacks: One is an on-chip power supply whose connection to the chip circuitry would be virtually impossible to cut, and the other is a set of "nonvolatile" memory cells that can store whatever data the chip is working on when it begins to lose power.

Tags: Cyber security, Microelectronics

ENERGY

Researchers propose high-efficiency wireless power transfer system

Science Daily, 03FEB2016

Most work on wireless power transfer relies on the resonance coupling of copper coils. Researchers in Russia replaced traditional copper coils with spherical dielectric resonators made of ceramic material with high permittivity and low loss. They used magnetic quadrupole mode which increased the efficiency of the system and made it less sensitive to the random orientation of the transmitter relative to the receiver. Their wireless power transfer system maintains up to 80 percent transfer efficiency across a distance of 20 centimeters. The new system is a good candidate for commercial applications. TECHNICAL ARTICLE

Tags: Energy, S&T Russia

ENVIRONMENTAL SCIENCE

NASA software to help avoid weather-related travel delays in the sky

PhysOrg.com, 08FEB2016

A team researchers in the US (NASA, FAA, industry partners) is developing Dynamic Weather Routes (DWR) software, that computes, updates and compares weather and air traffic data every 12 seconds and uses the information to find optional routes and to resolve possible air traffic conflicts. NASA's research shows that the software could potentially save 10 minutes per flight and, for some flights, up to 45 minutes.

Tags: Environmental science, Climatology, Government S&T

INFORMATION TECHNOLOGY

Laser pulses push spintronics and magnonics to the limit

Nanowerk, 09FEB2016

An international team of researchers (the Netherlands, Portugal, Germany) has demonstrated a complete and arbitrary manipulation of the phase and the amplitude of magnons. Even more remarkably, the length-scale of the magnons is on the order of 1 nm. These results pave the way to the unprecedented frequency range of 20 THz for magnetic recording devices, which can be employed also at the nanometer scale. TECHNICAL ARTICLE

Tags: Information technology, Microelectronics

Search engines will know what you want ... sooner

PhysOrg.com, 08FEB2016

The refined "node-weighted" algorithm developed by researchers at Cornell University looks for nodes that are "correlated" – representing similar interests, and with strong connections between them. They tested their method on a database of scholarly publications and a blog search system and found that it worked five orders of magnitude faster than currently used methods.

Tags: Information technology

Technology for instantaneous searches of a target image from a massive volume of images

PhysOrg.com, 03FEB2016

Researchers in Singapore have developed technology that dramatically improves server performance by configuring an accelerator that performs the necessary processing of image searches on an FPGA. It efficiently links it with software running on the CPU, creating a high-speed image search function. Using a prototype server, they confirmed that it could search through a database of over 10,000 images and retrieve matches of any desired portion in about one second.

Tags: Information technology

MATERIALS SCIENCE

Chiral magnetic effect generates quantum current

PhysOrg.com, 08FEB2016

A team of researchers in the US (Brookhaven National Laboratory, Stony Brook University) has discovered a new way to generate very low-resistance electric current in a new class of materials. The discovery, which relies on the separation of right- and left-"handed" particles, points to a range of potential applications in energy, quantum

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computing, medical imaging, and possibly even a new mechanism for inducing superconductivity.

Tags: Materials science, Government S&T

Physicists discover new properties of superconductivity

PhysOrg.com, 04FEB2016

An international team of researchers (Canada, USA - Brookhaven National Laboratory, France, Austria) probed electron scattering in specific layers in the cuprate crystalline structure. They identified some unexpected alignment of the electrons - a finding that is likely generic to the high temperature superconductors and in time may turn out be a key ingredient of the problem. The research is a key step in understanding how to harness the potential of materials that could provide lossless energy storage, levitating trains and ultra-fast supercomputers. TECHNICAL ARTICLE

Tags: Materials science

Featured Resource

Quantum Weekly

A weekly correlation of all things quantum - computing, cryptography, entanglement.

Phosphine as a superconductor? Sure, but the story may be complicated

PhysOrg.com, 03FEB2016

In 2015, scientists reported that they had liquefied and squeezed phosphine under high pressure in a diamond vise to achieve superconductivity. Now researchers at State University of New York at Buffalo say that according to their calculations, phosphine's superconductivity under pressure likely arose due to the compound decomposing into other chemical products that contain phosphorus and hydrogen. The findings could assist scientists in their quest to find or create new commercially feasible superconductors. TECHNICAL ARTICLE

Tags: Materials science

MICROELECTRONICS

The chips are down for Moore's law

Nature News, 09FEB2016

The semiconductor industry road map to be released next month will for the first time lay out a research and development plan that is not centred on Moore's law. Instead, it will follow what might be called the More than Moore strategy: rather than making the chips better and letting the applications follow, it will start with applications and work downwards to see what chips are needed to support them.

Tags: Microelectronics, S&T Policy

Energy-friendly chip can perform powerful artificial-intelligence tasks

MIT News, 03FEB2016

Neural networks are typically implemented using graphics processing units. Researchers at MIT have developed a new chip "Eyeriss" designed specifically to implement neural networks. It is 10 times as efficient as a mobile GPU, so it could enable mobile devices to run powerful artificial-intelligence algorithms locally, rather than uploading data to the Internet for processing. The chip could also help usher in the "Internet of things". On-board neural networks would be useful to battery-powered autonomous robots.

Tags: Microelectronics, Artificial intelligence

Researchers make an ideal memristor based on molybdenum disulfide nanosheets

Nanowerk, 03FEB2016

A team of researchers in the US (Michigan Technological University, University of Michigan) started with bulk molybdenum disulfide, then manipulated the atomic, structural arrangements and peeled back the molecular layers. This exfoliation process resulted in nanosheets to exhibit a reversible change in resistance relative to voltage. The nanosheets were dispersed on the two sides of a silver foil to form a symmetric memristor. TECHNICAL ARTICLE

Tags: Microelectronics

Small, low-cost and low-power chip for multi-gigabit 60GHz communication

PhysOrg.com, 03FEB2016

The 60GHz transceiver architecture, presented by researchers in Belgium, features direct conversion and analog baseband beamforming with four antennas. The architecture is inherently simple and is not affected by image frequency interference. Moreover, a 24GHz phase-locked loop that subharmonically locks a 60GHz quadrature oscillator is inherently immune to the pulling disturbance of the 60GHz power amplifier. The transceiver is a breakthrough in developing a small, low-cost, and low power solution for multi-gigabit communication targeting WiGig as well as 60GHz wireless backhaul applications.

Tags: Microelectronics

New method for producing tiny cracks in electrodes may mean big boost for nanoelectronics

Nanowerk, 02FEB2016

The next generation of electronics, as well as ultra-sensitive medical diagnostics, could depend on nanogaps in electrodes. In the method developed by researchers in Sweden, there is no need to pattern the material directly to define the nanogaps. Instead, they arise automatically once certain criteria are met. Patterns are created around the area where the gaps should be. This pattern in the material structure is substantially larger than the gaps, and

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thus simple to create. The new method allows for mass production of nanogap arrays with individually defined gap widths. TECHNICAL ARTICLE

Tags: Microelectronics, Nanoelectronics, S&T Sweden

NEUROSCIENCE

Modelling how the brain makes complex decisions

Science Daily, 04FEB2016

There are two main types of decisions: habit-based and goal-based. Habit-based decisions have been thoroughly studied by neuroscientists and are fairly well-understood. The mechanisms behind goal-based decisions however, remain elusive because there are so many more variables. An international team of researchers (UK, Hungary) has shown mathematically how a network of neurons can identify the best decision in a given situation and its future cumulative reward. The results could aid in the understanding of conditions from obsessive compulsive disorder and addiction to Parkinson's disease. TECHNICAL ARTICLE

Tags: Neuroscience

PHOTONICS

Superfast light pulses able to measure response time of electrons to light

PhysOrg.com, 04FEB2016

As scientists have begun preparing for the day when photons will replace electrons in high speed computers, work is being done to better understand the link between the two. One important aspect of this is learning what happens when photons strike electrons that remain in their atom specifically, how long does it take them to respond. An international team of researchers (Germany, USA - Texas A&M University, Russia) describes their use of a light field synthesizer to create pulses of light so fast that they were able to reveal the time it took for electrons in an atom to respond when struck. TECHNICAL ARTICLE

Tags: Photonics

QUANTUM SCIENCE

Quantum-limited heat conduction smashes long-distance record

Physics World, 08FEB2016

By directing photons along a superconducting waveguide, researchers in Finland transferred heat between two resistors spaced up to a metre apart – some 10,000 times further than previously possible at the quantum limit. They say their technique could someday be used to cool chips inside quantum computers. TECHNICAL ARTICLE

Tags: Quantum science, S&T Finland

On Quantum Obfuscation

arXiv, 04FEB2016

In this work, an international team of researchers (Denmark, USA - University of Maryland) initializes the rigorous study of obfuscating programs via quantum-mechanical means. They define notions of quantum obfuscation which encompass several natural variants. The input to the obfuscator can describe classical or quantum functionality, and the output can be a circuit description or a quantum state. They discuss many applications, including CPA-secure quantum encryption, quantum fully-homomorphic encryption, and public-key quantum money. TECHNICAL ARTICLE

Tags: Quantum science, Cyber security

S&T POLICY

South Korea stretches lead in research investment

Nature News, 08FEB2016

South Korea has opened up a clear lead as the world's most research-intensive economy, according to figures released last week by the OECD. In 2014, South Korea invested 4.29% of its GDP in research and development stretching ahead of Israel. The increase in South Korea is largely due to rising industrial investment, and the country is aiming to spend 5% of its GDP on research by 2017. OECD Science and Technology Indicators

Tags: S&T policy

SCIENCE WITHOUT BORDERS

Multinational companies perform majority of U.S. business R&D

NSF News, 08FEB2016

In 2010, U.S.-located businesses performed $279 billion in R&D. Seventy-one percent of that, or $197 billion, was performed by the parents of U.S. multinational companies. Their share of federally funded R&D was even higher, at 75 percent of total $34.2 billion. These parent companies also employed 788,000, or 56 percent, of 1.4 million U.S. business R&D workers. REPORT

Tags: Science without borders

Biotech giant publishes failures to confirm high-profile science

Nature News, 04FEB2016

A biotechnology firm is releasing data on three failed efforts to confirm findings in high-profile scientific journals—details that the industry usually keeps secret. It hopes the move will encourage others in industry and academia to describe their own replication attempts, and thus help the scientific community to get to the bottom of work that other labs are having trouble verifying. The data are posted online at a newly launched channel dedicated to quickly publishing efforts to confirm scientific findings.

Tags: Science without borders

SENSORS

New material lights up when detecting explosives

PhysOrg.com, 04FEB2016

An international team of researchers (Denmark, Spain, USA - UT Austin) has created a new material, consisting of the molecules TTF-C[4]P and TNDCF, which fluores when encountering explosives molecules in their vicinity. The new material consists of molecules held together by weak bonds which are difficult to control. It turns fluorescent when exposed to molecules from the explosive TNB and some specific salts, such as those based on chlorine or fluorine. TECHNICAL ARTICLE

Tags: Sensors

Nuclear research team develops methodology for tracing illegal nuclear material to source

PhysOrg.com, 04FEB2016

Researchers at Texas A&M University have developed a new method in nuclear forensics research to determine the reactor origins of weapons-grade plutonium. In the neutron spectrum of nuclear reactors there are two extremes: thermal reactors and fast reactors, with some variants between. Based on a number of variables, different reactor types leave different signatures in the plutonium that is created from spent nuclear fuel. Using this information, government agencies will look at possible countries in which the material could have been produced and attempt to track how the plutonium may have been transported and illegally acquired.

Tags: Sensors ■

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