



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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FEATURE ARTICLE

[Electron rivers](#)

[Nanowerk, 17MAR2016](#)

Researchers in the Netherlands found that PdCoO₂ has an astonishingly high electrical conductivity, making it possible to look for hydrodynamic effects. The team sculpted successively narrower channels, and studied how easily the electrons could flow through them. By combining their results with a special theory that is able to model hydrodynamic effects, they were able to show that they had indeed created the long-predicted electron rivers. The research opens new frontiers in research into electron behavior in ultra-pure materials.

[TECHNICAL ARTICLE](#)

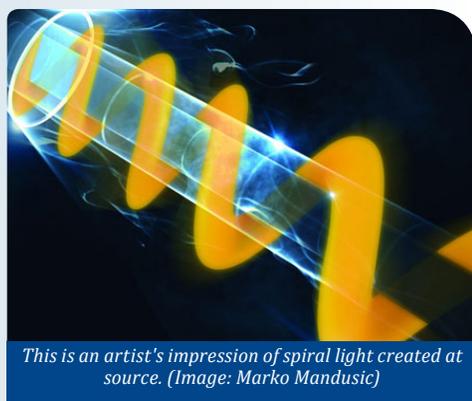
Tags: Materials science, Featured Article

[Laser beams with a 'twist'](#)

[Nanowerk, 15MAR2016](#)

Light carrying orbital angular momentum (OAM) is created by twisting the phase of light into a helical shape, forming a spiral. Because the twisting of the pattern gets tighter and tighter as you move towards the centre of the beam, the light disappears and such beams are often called doughnut beams or vortex beams. By using custom-geometric phase optics to map polarisation to OAM, an international team of researchers (South Africa, Italy) designed a laser that could tell the difference between the clockwise and anticlockwise light. Vector and scalar vortex beams that exist on the higher-order Poincaré sphere have many applications, such as microscopy, imaging, laser machining, and communication in free space and in fibres. [TECHNICAL ARTICLE](#)

Tags: Photonics, Featured Article



This is an artist's impression of spiral light created at source. (Image: Marko Mandusic)

S&T NEWS ARTICLES

ADVANCED MANUFACTURING

[A roadmap for the next generation of additive manufacturing materials and processes](#)

[KurzweilAI, 17MAR2016](#)

The road-mapping effort, funded by NIST, involved more than 120 participants from industry, government and academia. It organizes research and activities into five strategic thrusts: enabling integrated design methodologies for materials, processes and parts; developing AM process-structure-property relationships; establishing part and feedstock testing protocols; building AM process analytics capabilities; and exploring next-generation AM materials and processes. According to the researchers, most of the feedstock materials currently used in 3D printing are costly, not readily available, and limited. There is also a limited understating and inadequate compatibility with current AM processing technologies.

Tags: Advanced manufacturing, S&T Policy

ADVANCED MATERIALS

[Replacement for silicon devices looms big with new discovery](#)

[Science Daily, 17MAR2016](#)

A team of researchers in the US (Oak Ridge National Laboratory, University of Tennessee) used a helium ion microscope on a layered ferroelectric surface of a bulk copper indium thiophosphate that resulted in the discovery of a material with tailored properties potentially useful for phones, photovoltaics, flexible electronics and screens. Their work could establish a path to replace silicon as the choice for semiconductors in some applications. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Government S&T

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Making electronics safer with perovskites

Science Daily, 16MAR2016

Researchers in Japan sintered the perovskite powder SrTaO₂N and annealed it by heating it with flowing ammonia. They found that after this process the surface of the material (but not its interior) displayed ferroelectricity. This was the first time that a ferroelectric response has been observed on oxynitride perovskite ceramics making it promising as a new dielectric material for multi-layered ceramic capacitors. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, S&T Japan

Nanostructures promise big impact on higher-speed, lower-power optical devices

Nanowerk, 15MAR2016

Researchers at the University of Cincinnati have shown that by using a combination of materials like indium gallium arsenide and indium phosphide, it is possible to develop thin nanowire cores with protective outer shells. These unique nanowire materials have unusually large spin-orbit interactions, which the researchers find can conduct electricity really well and may allow the use of spin to enable new computing paradigms. According to the researchers, this new nanowire technology is unique because it can turn different wavelengths of light into an electrical signal. The findings will be presented at an upcoming American Physical Society meeting.

Tags: Advanced materials

AUTONOMOUS SYSTEMS & ROBOTICS**This Factory Robot Learns a New Job Overnight**

MIT Technology Review, 18MAR2016

Industrial robots are capable of extreme precision and speed, but they normally need to be programmed very carefully. The robot built by researchers in Japan uses deep reinforcement learning to train itself how to learn a new task. It tries picking up objects while capturing video footage of the process. Each time it succeeds or fails, it remembers how the object looked, knowledge that is used to refine a deep learning model that controls its action. After eight hours or so it gets to 90 percent accuracy or above, which is almost the same as if an expert were to program it.

Tags: Autonomous systems & robotics, S&T Japan

Musclebound “Bio-bots” Move Around in Response to Light

MIT Technology Review, 14MAR2016

By wrapping rings of genetically engineered mouse muscle tissue around a variety of soft 3-D printed skeletons, a team of researchers in the US (University of Illinois at Urbana-Champaign, MIT) built what they call “bioactuators” that convert energy into motion when stimulated by a specific wavelength of light. The group built a few different

varieties of the millimeter-scale bio-bots and got them to jump around by shining flashes of light at them. They say the tiny machines could one day be used to deliver drugs inside the human body. [TECHNICAL ARTICLE](#)

Tags: Autonomous systems & robotics

CYBER SECURITY**Breakthrough technology to improve cyber security**

Science Daily, 21MAR2016

Having indistinguishable single photons on-demand is the fundamental challenge for quantum optical technologies. An international team of researchers (Australia, China) has demonstrated the multiplexing of photons from four temporal modes solely using fibre-integrated optics and off-the-shelf electronic components. They show a 100% enhancement to the single-photon output probability without introducing additional multi-photon noise. The demonstration paves the way for scalable multiplexing of many non-deterministic photon sources to a single near-deterministic source, which will be of benefit to future quantum photonic technologies. [TECHNICAL ARTICLE](#)

Tags: Cyber security, Quantum science

Cryptographic system lets users control access to their data

Science Daily, 18MAR2016

Researchers at MIT have developed a cryptographic application, called Sieve, that allows users to decide which applications access which aspects of their data. With Sieve, a Web user would store all of his or her personal data in encrypted form on the cloud. Any app that wanted to use specific data items would send a request to the user and receive a secret key that decrypts only those items. If the user wanted to revoke the app's access, Sieve would re-encrypt the data with a new key.

Tags: Cyber security

ENERGY**Nano plates as catalysts for solar fuels**

PhysOrg.com, 18MAR2016

The major problem of solar energy being converted into electric current is storage. Researchers in the Netherlands used tungstenoxide that is better capable of adsorbing sunlight. From this, they made special crystal structures, nanosized plates: on the surfaces, facets, of these plates the chemical reactions will take place. Although the results weren't as good as expected, photo deposition is still an attractive option for solar fuel generation. The use of these nano plates is also possible for other materials than tungsten oxide, which opens new lines of research for the future.

Tags: Energy, Advanced materials, Solar energy

“Be a yardstick of quality. Some people aren't used to an environment where excellence is expected.” STEVE JOBS

New method could unleash solar power potential

Science Daily, 15MAR2016

According to the researchers at Oak Ridge National Laboratory, the ability to identify what will be created after the solar cell absorbs a photon, either a pair of free charges or their bound form called an exciton, is crucial from both fundamental and applied perspectives. They found that both free charges and excitons are present, and the strength of our approach lies in not only identifying where they are but also determining what their relative contributions are when they are both present at a given spatial location. [TECHNICAL ARTICLE](#)

Tags: Energy, Government S&T, Solar energy

ENVIRONMENTAL SCIENCE

Researchers crack 50-year-old nuclear waste problem, make storage safer

Science Daily, 16MAR2016

Americium is one of the trickiest and most-difficult-to-remove elements in nuclear waste pools across the country. The technology, developed by a team of researchers in the US (University of North Carolina at Chapel Hill, Idaho National Laboratory), is closely related to the one used to tear electrons from water molecules. In the americium project it is adapted to tear electrons from americium, which requires twice as much energy input as splitting water. By removing those three electrons, americium behaves like plutonium and uranium, which is then easy to remove with existing technology. [TECHNICAL ARTICLE](#)

Tags: Environmental science, Government S&T

GOVERNMENT S&T

NASA Principal Technologist lays out strategy to develop advanced space propulsion over the next 25 years

Next Big Future, 18MAR2016

NASA researchers review key deep space transport mission capability objectives in relation to the Space Technology Mission Directorate (STMD) technology portfolio needs. The advanced propulsion technology solution landscape is examined including open questions, technical challenges, and developmental prospects. Options for potential future investment across the full complement of STMD programs are presented based on an informed awareness of complementary activities in industry, academia, OGAs, and NASA mission directorates. [TECHNICAL ARTICLE](#)

Tags: Government S&T, NASA, Space technology

INFORMATION TECHNOLOGY

Scientific breakthrough protects computers from cosmic radiation

PhysOrg.com, 18MAR2016

The EU project CATRENE OPTIMISE brought together a huge consortium of 19 partners, drawn from academia, manufacturing, technology development and end-users in France and Spain, with the objective of protecting both power electronic and digital electronic systems from their radiation environments. The consortium was able to design and patent both fault-tolerant application-specific integrated circuits and fault-tolerant controllers for high-density memories.

Tags: Information technology, Space technology

Wrangler Supercomputer speeds through big data

Science Daily, 17MAR2016

Wrangler, a supercomputer designed by researchers at UT Austin, fills a gap in the supercomputing resources of the Extreme Science and Engineering Discovery Environment (XSEDE) supported by NSF. XSEDE is a collection of advanced digital resources that scientists can easily use to share and analyze massive datasets. At the heart of Wrangler lie 600 terabytes of flash memory shared via PCI interconnect across Wrangler's over 3,000 Haswell compute cores. All parts of the system can access the same storage, they can work in parallel together on the data that are stored inside the high-speed storage system to get larger results they couldn't get otherwise.

Tags: Information technology

An AI with 30 Years' Worth of Knowledge Finally Goes to Work

MIT Technology Review, 14MAR2016

Cyc is a knowledge base of semantic information designed to give computers some understanding of how things work in the real world. Recent advances, which have enabled computers to process images and audio with human-like skills, are somewhat limited. Deep learning is mainly about perception, but there is a lot of inference involved in everyday human reasoning, and Cyc represents a serious effort to grapple with the subtlety of that inference.

Tags: Information technology, Artificial intelligence

MATERIALS SCIENCE

[Recent advances in optical materials](#)[Asia Research News, 17MAR2016](#)

Researchers in Japan have reviewed recent progress in advanced optical materials based on gadolinium aluminate garnet (GAG), while pointing out the knowledge gaps that need to be filled to improve their optical performance. Ce³⁺ doped GAG-based single crystals and transparent ceramics are also shown to simultaneously possess the advantages of high theoretical density, fast scintillation decay, and high light yields, and hold great potential as scintillators for a wide range of applications. The unresolved issues are also pointed out. [TECHNICAL ARTICLE](#)

Tags: Materials science, S&T Japan

FEATURED RESOURCE

[Forecasting Principles](#)

The Forecasting Principles site summarizes all useful knowledge about forecasting. This site describes all evidenced-based principles on forecasting and provides sources to support the principles. [RSS](#)

MICROELECTRONICS

[Direct Control of Nanowire Self-Assembly Leads to New Devices](#)[IEEE Spectrum, 17MAR2016](#)

An international team of researchers (Sweden, UK, USA - IBM, New York) combined top-down manufacturing techniques—like lithography—with bottom-up techniques that “grow” electronics through self-assembly to create a single approach that produces nanowires with specific electrical properties. They achieved this combination of self-assembly and imposed patterning by using catalytic particles. Having control over the properties of nanowires makes it possible to better target them for various devices, like single-electron transistors. [TECHNICAL ARTICLE](#)

Tags: Microelectronics, Advanced materials

PHOTONICS

[Super-powerful light beams and the butterfly effect](#)[PhysOrg.com, 18MAR2016](#)

Researchers in Spain report that when there is a chaotic attractor, such as the butterfly-shaped chaotic attractor, the filament shows the disorderly intermittency along its way and any fluctuation in generation conditions will allow researchers to predict where the attractor will appear or disappear. This new understanding of the phenomenon

from the approach of complex systems and the chaos theory will boost new research to improve the control of light filaments and their applications. [TECHNICAL ARTICLE](#)

Tags: Photonics

[Toward a Better Polariton Laser](#)[Optics and Photonics News, 18MAR2016](#)

Polariton lasers hold the prospect of dramatically reducing the input power required for lasing. An international team of researchers (USA—University of Michigan, Germany, UK) has demonstrated that a polariton laser can achieve coherence comparable to that of traditional, purely photonic lasers. The team accomplished the feat through an unconventional design that throttles back competition between spatial modes in the polariton laser cavity, dramatically decreasing intensity instability and boosting coherence. [TECHNICAL ARTICLE](#)

Tags: Photonics

[Reconfigurable building blocks for the construction of photonic devices](#)[Science Daily, 16MAR2016](#)

The fluidity of liquid crystals (LC) severely limits the ease of processing and structural stability, restricting their applications. To overcome this limitation, researchers in South Korea encapsulated the LCs in an elastic membrane. A droplet of LCs is enclosed in another droplet of elastomer precursors using a microfluidic technology. Such a drop-in-drop structure, called a double-emulsion drop, yields stable microcapsule as the precursors are polymerized. This class of photonic ink capsules has great potential as new building blocks for the construction of photonic devices. [TECHNICAL ARTICLE](#)

Tags: Photonics

QUANTUM SCIENCE

[Two defining features of quantum mechanics never appear together](#)[PhysOrg.com, 21MAR2016](#)

Previously, physicists have theoretically shown that nonlocality and contextuality cannot simultaneously exist in a quantum system. An international team of researchers (China, Canada) has attempted to violate both inequalities at the same time, but have found that only one inequality can be violated at once. Their experiment uses entangled photons to generate photonic qutrit-qubit systems (a qubit is a superposition of two states, whereas a qutrit is a superposition of three states). By performing various measurements on these photons, the researchers could violate the inequalities separately, but not at the same time. The work provides experimental evidence of the assumption that quantum entanglement and contextuality are intertwined quantum resources. [TECHNICAL ARTICLE](#)

Tags: Quantum science

New quantum computer device takes advantage of a loophole in causality

Science Alert, 18MAR2016

Researchers in Finland benchmark the stimulated Raman adiabatic passage for circuit quantum electrodynamics by employing the first three levels of a transmon qubit. In this ladder configuration, they demonstrate a population transfer efficiency >80% between the ground state and the second excited state using two adiabatic Gaussian-shaped control microwave pulses. By doing quantum tomography at successive moments during the Raman pulses, we investigate the transfer of the population in time domain.

TECHNICAL ARTICLE

Tags: Quantum science, S&T Finland

New strategy helps quantum bits stay on task

PhysOrg.com, 17MAR2016

An international team of researchers (USA - Florida State University, Spain) describes a new way to significantly reduce this decoherence in magnetic molecules. It turns out that chemists can assemble molecules with special spin states that, when placed in a magnetic field, are immune to magnetic disturbances. This sweet spot that allows qubits to interact without interference is called an atomic clock transition, or ACT. The team was able to keep its holmium qubit working coherently for 8.4 microseconds—long enough for it to potentially perform useful computational tasks. The research may lead to the assembly of molecules that can create a coherence sweet spot for qubits.

TECHNICAL ARTICLE

Tags: Quantum science

Semiconductor-inspired superconducting quantum computing devices

Science Daily, 17MAR2016

Researchers at the University of Maryland have shown that modern superconducting qubits called transmons or fluxmons, which can be tuned individually, require only two physical qubits per encoded qubit. They showed that a similar two-qubit gate can be accomplished using only one two-qubit pulse. This means that all quantum logic gates can be performed with fast DC pulses instead of relying on microwave-driven qubit rotations. They claim that their scheme can be implemented with current superconducting qubits and control methods. TECHNICAL ARTICLE

Tags: Quantum science

The quest for spin liquids: new connections between exotic states of matter

Science Daily, 15MAR2016

Researchers in Japan show that it is possible to map one of the most studied spin liquids onto two different and mostly unexplored models that are the chiral counterparts

of each other. This shows that the other two models are also spin liquids, but with new exciting magnetic properties. Therefore, it could be possible to find spin liquids in new materials corresponding to these two new models. The group's research suggests that this could be a step in finding similar patterns between the different branches of physics.

TECHNICAL ARTICLE

Tags: Quantum science, Materials science, S&T Japan

S&T POLICY

Envisioning supercomputers of the future

PhysOrg.com, 18MAR2018

The Argo Project is a three-year collaborative effort, funded by the Department of Energy, to develop a new approach for extreme-scale system software. A team of researchers in the US (University of Oregon, Lawrence Livermore National Laboratory, Argonne National Laboratory, University of Chicago) is working with industry partners, including Cray, Intel and IBM, to explore which techniques and features would be best suited for the Department of Energy's next supercomputer. To test their new ideas, the research team is using Chameleon, an experimental environment for large-scale cloud computing research supported by NSF.

TECHNICAL ARTICLE

Tags: S&T policy, Government S&T

What China's latest five-year plan means for science

Nature News, 18MAR2016

On 16 March, China approved its 13th Five-Year Plan. The draft version, as well as statements by key politicians, makes it clear that innovation through science and technology is a priority. China also intends for its research expenditure to rise to 2.5% of gross domestic product by 2020, from less than 2.2% over the past five years. Reductions in energy use and the development of low-carbon energy sources are featured in the latest five-year plan.

Tags: S&T policy, S&T China

'Quantum manifesto' for Europe calls for €1bn in funding

PhysOrg.com, 17MAR2016

The quantum manifesto, written by researchers across the EU, calls for a "flagship-scale initiative"—similar to the EU's 10 year €1bn Graphene Flagship initiative—to begin in 2018, which would invest in education, science, engineering and innovation to unlock the full potential of quantum technologies.

Tags: S&T policy, S&T EU

SENSORS

All-in-one, 3D-printed space antenna**PhysOrg.com, 18MAR2016**

ESA is incorporating a corrugated feedhorn and two reflectors that have been printed all-in-one in a polymer, then plated with copper to meet its RF performance requirements. By using this same model to 3D print it in a single piece, any source of assembly misalignments and errors are removed, enabling excellent results. As a next step, they aim at more complex geometries and target higher frequencies.

Tags: Sensors, S&T EU

New technology for land mine detection**Science Daily, 18MAR2016**

Researchers in Denmark analysed the simulated radar signals to identify properties that are typical for mines, but are not generated by other objects, such as stones or shrapnel. This information is fed into the analysis of the gathered radar data; this is how they set up their system to perform an automated search for properties that are typical for mines. In the long run, they are aiming at creating a handheld device that will detect different mine types on rough terrain without fail and which can be used in the same way as metal detectors.

Tags: Sensors

New gas-signature models can help inspectors locate and identify underground nuclear tests**Lawrence Livermore National Laboratory, 16MAR2016**

Through experiments and computer models of gas releases, Lawrence Livermore National Laboratory scientists have simulated signatures of gases from underground nuclear

explosions (UNEs) that may be carried by winds far from the point of detonation. The work will help international inspectors locate and identify a clandestine UNE site within a 1,000 square kilometer search area during an on-site inspection. In addition, the technique can potentially help interpret noble gas signals captured in the atmosphere.

Tags: Sensors, Government S&T

New graphene-coated e-fabrics detect noxious gases**Nanowerk, 15MAR2016**

An international team of researchers (Singapore, North Korea) coated cotton and polyester yarn with a nanoglue called bovine serum albumin (BSA). The yarns were then wrapped in graphene oxide sheets. Finally, the graphene oxide yarns were exposed to a chemical reduction process, which involves the gaining of electrons. The reduced-graphene-oxide-coated materials were found to be particularly sensitive to detecting nitrogen dioxide. The materials could also be incorporated with air-purifying filters to act as "smart filters" that can both detect and filter harmful gas from air. [TECHNICAL ARTICLE](#)

Tags: Sensors

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