



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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FEATURE ARTICLES

[Researchers find path for light through opaque materials](#)

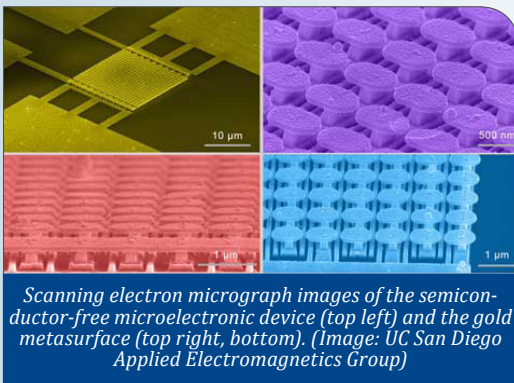
[PhysOrg.com, 08NOV2016](#)

Using repeated digital optical phase conjugation, researchers in the Netherlands discovered what shape the light wave must have in order to make its way through the material. The wave front shape determines the degree to which light can penetrate through the material. And the optimal shape of the wave front is different for every colour of light. How light travels along a special path provides insight into the transport of light through diffusive materials, which is extremely useful for looking into and through such materials. The results show there is a subtle relationship between transmission and transport delay time. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Photonics, Featured Article

[Semiconductor-free microelectronics are now possible, thanks to metamaterials \(w/video\)](#)

[Nanowerk, 08NOV2016](#)



Scanning electron micrograph images of the semiconductor-free microelectronic device (top left) and the gold metasurface (top right, bottom). (Image: UC San Diego Applied Electromagnetics Group)

The metasurface consists of an array of gold mushroom-like nanostructures on an array of parallel gold strips. When a low DC voltage (under 10 Volts) and a low power infrared laser are applied to the metasurface, it generates “hot spots” that provide enough energy to

pull electrons out from the metal and liberate them into space. The technology may find applications in photochemistry and photocatalysis enabling new kinds of photovoltaic devices. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Microelectronics, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

[Engineers develop new magnetic ink to print self-healing devices that heal in record time](#)

[PhysOrg.com, 02NOV2016](#)

The key ingredient for the ink, developed by researchers at UC San Diego, is microparticles oriented in a certain configuration by a magnetic field. Because of the way they're oriented, particles on both sides of a tear are magnetically attracted to one another, causing a device printed with the ink to heal itself. The devices repair tears as wide as 3 millimeters—a record in the field of self-healing systems. In the future, engineers envision making different inks with different ingredients for a wide range of applications. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Advanced materials

AUTONOMOUS SYSTEMS & ROBOTICS

[Video Friday: Rescue Robot, Gesture Control, and 1986 Self-Driving Van](#)

[IEEE Spectrum, 04NOV2016](#)

The legged robot ANYmal can support disaster relief teams with safer search and rescue operations. With its advanced locomotion capabilities, ANYmal can operate in rough outdoor environments, crawl through pipes, and access buildings over steps and stairs. With the help of laser sensors and thermal cameras, the robot can be used to check the safety of buildings and search for potential victims.

Tags: Autonomous systems & robotics

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BIOTECHNOLOGY

[Driving a single microtubule with light \(w/ video\)](#)

Nanowerk, 08NOV2016

Researchers in Japan synthesized a photo-switchable inhibitor for the motor protein kinesin which propels the microtubules by using the energy of ATP to demonstrate the controlled local concentration and dispersion of microtubules at any desired position and time without the need for any surface patterning. They developed a new illumination setup – emitting at two different wavelengths at the same time – which deactivates the inhibitor precisely at the location of a target single microtubule and activates the inhibitor in the surrounding area to stop all other microtubules. The work may have applications in medicine. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Biotechnology, S&T Japan*

[Laser particles could provide sharper images of tissues](#)

PhysOrg.com, 03NOV2016

To illuminate cellular structures in deep tissue and other dense and opaque materials, a team of researchers in the US (MIT, Harvard University, Mass General Hospital) synthesized tiny particles from lead iodide perovskite that efficiently absorb and trap light, and embedded them in deep tissue and other dense and opaque materials. They found that when the laser's power was tuned to a certain threshold and shone at the particles, the particles light up considerably, emitting much more laser light. According to the researchers, the new optical technique, which they have named LAsER particle Stimulated Emission (LASE) microscopy, could be used to image a specific focal plane, or a particular layer of biological tissue.

Tags: *Biotechnology, Photonics*

[Engineers design a new weapon against bacteria](#)

MIT News, 02NOV2016

Antimicrobial peptide can be composed of 20 different amino acids which can be tailored for specific functions. They have a positively charged region that allows them to poke through bacterial cell membranes, and a hydrophobic stretch that enables interaction with and translocation into membranes. An international team of researchers (Brazil, USA - MIT, Harvard, Canada) added a sequence of five amino acids to clavanin-A to make it even more hydrophobic. This new peptide, which they called clavanin-MO, was very potent against many bacterial strains. In tests in mice, it could kill strains of Escherichia coli and Staphylococcus aureus that are resistant to most antibiotics. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Biotechnology*

COMMUNICATIONS TECHNOLOGY

[Artificial atoms shed light on the future of security](#)

PhysOrg.com, 08NOV2016

An international team of researchers (Austria, Germany, USA - NIST) have developed a way to directly excite biexcitons in quantum dots using a sequence of laser pulses. The pulses make it possible to encode information in the pair of emitted photons, creating time-bin entanglement which does not degrade as easily as other types over long distances. To combat entanglement loss due to material imperfections surrounding the quantum dots, the team used a second laser to fill up the electron levels of the impurities and showed that this increased the number of photons released without compromising the entanglement between them. According to the researchers, the work is a step in the right direction to make quantum dots a viable source of entangled photons. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Communications technology, Quantum science*

[Paving the way for fast low-energy data communications](#)

PhysOrg.com, 08NOV2016

Researchers in Sweden expect to be able to transfer 100 Gb of data per second in a single fibre with one core, and several terabits per second in a cable with multiple fibres and cores. They are making the laser increasingly faster while consuming less and less energy on the transmitter side of the cable, finding more advanced ways of transferring the actual data, and coding the data into the optical signal to transfer even more bits per second using the speed the system already provides. Within three years, they expect to transmit several terabits of data per second and reduce power consumption to one tenth of today's level.

Tags: *Communications technology, S&T Sweden*

[Tiny graphene radios may lead to Internet of Nano-Things](#)

Nanowerk, 01NOV2016

Researchers at the University at Buffalo are developing graphene-based radios that could help overcome a problem with terahertz waves not being able to retain their power density over long distances. To make these radios viable outside the laboratory, the antennas need other electronic components, such as generators and detectors that work in the same environment. This is the work that the researchers are focusing on. The technology could ultimately reduce the time it takes to complete complex tasks, such as migrating files, implantable body nanosensors, and nanosensors placed on aging bridges in polluted waterways and other public locations to provide ultra-high-definition streaming.

Tags: *Communications technology, Sensors*

“The greatest enemy of knowledge is not ignorance, it is the illusion of knowledge.”

STEPHEN HAWKING

CYBER SECURITY

[Network traffic visualization tool will help thwart cyber attacks](#)

Science Daily, 08NOV2016

Researchers at Carnegie Mellon University have created a tool that allows one to visualize network traffic to more easily identify key changes and patterns. The researchers have used this tool to inspect network traffic during DDoS attacks and map out the structure of malware distribution networks. Based on these visualization graphs, analysts can focus on critical areas to help shut down a malware distribution network, or in the case of a DDoS attack, target a critical node to thwart the attack. Moving forward, the team aims to consider human factors in making the tool more usable, operate more efficiently, and to integrate it into a virtual reality platform so analysts can more easily explore the graphs with intuitive motions.

Tags: Cyber security

[Researchers want to use hardware to fight computer viruses](#)

Science Daily, 07NOV2016

Researchers at Binghamton University are working to modify a computer's CPU chip by adding low complexity machine learning to check for anomalies while running a program. Since the hardware detector is not 100-percent accurate, the alarm will trigger the execution of a heavy-weight software detector to carefully inspect suspicious programs. The software detector will make the final decision. The hardware guides the operation of the software.

Tags: Cyber security

[Smart Lightbulbs Could Help Take Down the Internet](#)

MIT Technology Review, 03NOV2016

A new study shows that it is possible to remotely hack modern smart-home hardware. The technique, demonstrated on Philips Hue smart lamps, injects a software worm that allows the researchers to control the device. The compromised hardware uses a low-power wireless system called ZigBee to create its own networks. The researchers say that it is possible for the worm to propagate from one device to another via these connections, causing it to “catastrophically spread everywhere within minutes,” in a kind of chain reaction.

Tags: Cyber security

ENERGY

[Battery challenges: cost and performance](#)

MIT News, 02NOV2016

At the Materials Day Symposium at MIT on Oct. 18, researchers from both MIT and industry offered solutions to problems ranging from small portable devices to large fixed installations. The wide range of demands for batteries differing in scale from small ones integrated with piezo-electric energy harvesting for remote autonomous sensors to large scale batteries for cars, buses, aircraft and energy storage at power generation sites, requires innovation in materials and the ways to make materials for electrodes and electrolytes. These innovations are required to reduce cost and also to improve performance. The right measures for tracking progress in battery research and development, they suggest, are “cost and performance.”

Tags: Energy, Battery

ENVIRONMENTAL SCIENCE

[Crack discovered in Earth's magnetic shield](#)

Science Daily, 03NOV2016

An international team of researchers (India, Japan) reported that a burst of galactic cosmic rays occurred when a giant cloud of plasma ejected from the solar corona. Moving with a speed of about 2.5 million kilometers per hour, it struck our planet, causing a severe compression of Earth's magnetosphere from 11 to 4 times the radius of Earth. It triggered a severe geomagnetic storm that generated aurora borealis, and radio signal blackouts in many high latitude countries. [TECHNICAL ARTICLE](#)

Tags: Environmental science

INFORMATION TECHNOLOGY

[Energy-saving data glasses](#)

Science Daily, 03NOV2016

Data glasses present the eye with information or images which are received using a radio link from the frame of the glasses without interfering with the wearer's vision; however, large data streams use up a lot of battery power. To overcome this problem, researchers in Germany used OELD technology to develop a technique to control the chip so that the entire video image is not constantly renewed. They have adapted the circuit so that it only lets through that portion of the data stream which changes. The prototype they developed uses two to three milliwatts compared to the 200 milliwatts required by other data glasses.

Tags: Information technology, S&T Germany

continued...

MATERIALS SCIENCE

Physicists gain new understanding of how materials break[Science Daily, 04NOV2016](#)

An international team of researchers (University of Chicago, the Netherlands) has demonstrated that material failure can be continuously tuned by varying the underlying rigidity of the material while holding the amount of disorder constant. As the rigidity transition is approached, failure due to the application of uniaxial stress evolves from brittle cracking to system-spanning diffuse breaking. This behavior can be parameterized by the width of the crack. As a system becomes more and more floppy, this crack width increases until it saturates at the system size. Thus, the spatial extent of the failure zone can be used as a direct probe for material rigidity. The findings provide a broader understanding of why materials fracture and opens up new areas of study, including how cracking and failure can be controlled.

[OPEN ACCESS TECHNICAL ARTICLE](#)*Tags: Materials science***Physicists induce superconductivity in non-superconducting materials**[Science Daily, 01NOV2016](#)

A team of researchers in the US (UT Houston, UT Dallas, Lawrence Berkeley National Laboratory) has demonstrated that high T_c superconductivity in the non-superconducting compound calcium iron arsenide can be induced by antiferromagnetic/metallic layer stacking and provided the most direct evidence to date for the interface-enhanced T_c in this compound. They exposed the undoped calcium iron arsenide compound to 350 degrees Centigrade. The compound formed two distinct phases, with one phase increasingly converted to the other the longer the sample was annealed. They were able to detect superconductivity at the point when the two phases coexist. According to the researchers, the method used to prove the concept offers a new direction in the search for more efficient, less expensive superconducting materials. [TECHNICAL ARTICLE](#)

Tags: Materials science

PHOTONICS

Lasers + anti-lasers: Marriage opens door to development of single device with exceptional range of optical capabilities[PhysOrg.com, 07NOV2016](#)

Lasing is a key attribute for many important applications in optical communications, medicine and defence. Conversely, anti-lasing represents the time-reversed counterpart of laser emission, where incoming radiation is coherently absorbed. An international team of researchers (USA - UC Berkeley, Lawrence Livermore National Laboratory, SUNY Buffalo, Saudi Arabia) experimentally realized lasing and anti-lasing at the same frequency in a single cavity using parity-time symmetry. Because of the time-reversal property, the demonstrated lasing and anti-lasing resonances share common resonant features, such as identical frequency dependence, coherent in-phase response and fine spectral resolution. Lasing and anti-lasing in a single device offers a new route for light modulation with high contrast approaching the ultimate limit. [TECHNICAL ARTICLE](#)

*Tags: Photonics***Laser produces infrared beams over an unprecedented range of wavelengths**[PhysOrg.com, 02NOV2016](#)

An international team of researchers (Singapore, China) developed an all-fiber laser whose key component is a glass tube. Doping the core with thulium atoms as a gain medium, they achieved a widely-tunable laser in the mid-infrared wavelength band, with a range of 136 nanometers. They used nonlinear polarization evolution, that picks out pulses of light at the desired wavelength and channels them into the output beam. They also used bidirectional pumping to ensure a high optical power for as wide a range of

FEATURED RESOURCE

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Hot on the heels of quasiparticles[PhysOrg.com, 02NOV2016](#)

To find out the nature of quasiparticles that appear in a certain type of semiconductors in which electrons can only move in two dimensions, a team of researchers in the US (Emory University, Harvard University) took a single layer of molybdenum diselenide and sandwiched it between two disks of boron nitride. They added a layer of graphene in order to apply an electric voltage with which the density of electrons in the material could be controlled. They placed everything between two mirrors that formed an optical cavity. They found that when the semiconductor structure is optically excited, Fermi-polarons are formed - and not excitons or trions, as previously thought. The finding would have important implications for basic research. [TECHNICAL ARTICLE](#)

Tags: Materials science

wavelengths as possible. According to the researchers, their laser could be used in combination with high power amplifiers to generate other forms of laser including extreme ultraviolet and soft X-ray beams.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Photonics

QUANTUM SCIENCE

[Scientists overcome bottleneck in fabricating quantum dot displays](#)

[PhysOrg.com, 02NOV2016](#)

Researchers in South Korea have developed a method that uses light to pattern quantum dots with high resolution and layer-by-layer assembly, which uses electric charges of the quantum dots to uniformly deposit them in layers over a large area. They expect that the new method will provide a practical, low-cost solution to the bottleneck in fabricating high-resolution, large-scale quantum dot devices that is compatible with conventional semiconductor fabrication processes.

[TECHNICAL ARTICLE](#)

Tags: Quantum science

[Quantum processing: Coherence vs. Control](#)

[Science Daily, 01NOV2016](#)

To help solve the particular many-body problem in a quantum system, a team of researchers in the US (UC Santa Barbara, CUNY, Tulane University, industry partner) created an artificial magnetic field affecting their closed loop of three qubits, causing the photons to interact strongly with not only each other, but also with the pseudo-magnetic field. The more control they have over a quantum system, the more complex algorithms they would be able to run. Their project involves putting individual parts of a quantum processor together in a basic building block that can be fully controlled and potentially scaled up into a functional quantum computer. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science

[The IBM Quantum Computer and the IBM Quantum Experience](#)

[arXiv, 22OCT2016](#)

Researchers in Brazil show the main tool (quantum gates) present in the IBM Quantum Experience (IBM-QE) and, through a simple strategy, they discuss a possible decoherence source in the IBM 5 q-bit chips. As an example of application, they show how to implement the quantum teleportation using the IBM-QE. [OPEN ACCESS TECHNICAL ARTICLE](#)

[TECHNICAL ARTICLE](#)

Tags: Quantum science

S&T POLICY

[Quantifying the evolution of individual scientific impact](#)

[Science Magazine, 04NOV2016](#)

An international team of researchers (USA - Northeastern University, Northwestern University, University of Miami, Harvard Medical School, Dana-Farber Cancer Institute, Hungary, Belgium) analyzed the publications of 2887 physicists and data on scientists publishing in a variety of fields. They developed a quantitative model of impact, based on an element of randomness, productivity, and a factor Q. The random-impact rule and the Q parameter, representing two fundamental characteristics of a scientific career, offer a rigorous quantitative framework to explore the evolution of individual careers and understand the emergence of scientific excellence. They found that the process of generating a high-impact paper is not an entirely random one. Such understanding could help us better gauge scientific performance and offers a path toward nurturing high-impact scientists, potentially informing future policy decisions. [TECHNICAL ARTICLE](#)

Tags: S&T policy, Science without borders

[Federal Government releases 2016 National Nanotechnology Initiative Strategic Plan](#)

[Nanowerk, 03NOV2016](#)

The [2016 National Nanotechnology Initiative Strategic Plan](#) builds upon the collaborations and prior accomplishments of the National Nanotechnology Initiative to develop and nurture that ecosystem and to move the NNI into its next phase. The plan provides a framework under which individual agencies conduct their own mission-specific nanotechnology programs, coordinate these activities with those of other NNI agencies, and collaborate.

Tags: S&T policy, Advanced materials

[New US Robotics Roadmap calls for increased regulations, education and research](#)

[PhysOrg.com, 02NOV2016](#)

The goal of the [U.S. Robotics Roadmap 2016](#) is to determine how researchers can make a difference and solve societal problems in the United States. The document provides an overview of robotics in a wide range of areas, from manufacturing to consumer services, healthcare, autonomous vehicles and defense. The roadmap's authors make a recommendation to ensure that the United States will continue to lead in the field of robotics, both in terms of research innovation, technology and policies. The report was partially sponsored by the NSF, the University of California San Diego, Oregon State University and the Georgia Institute of Technology and authored by more than 150 researchers from around the nation.

Tags: S&T policy, Autonomous systems & robotics

SCIENCE WITHOUT BORDERS

Good data are not enough

Nature News, 02NOV2016

Most research funding is allocated assuming that the highest-quality data will inevitably deliver useful scientific interpretation and theoretical concepts which can be tested and refined by future data. Fields from particle physics to genomics do the same. The consequences of a closed scientific culture are wasted resources and misguided 'progress'—witness the dead end that was Soviet evolutionary biology. To truly move forward, free thought must be encouraged outside the mainstream. Multiple interpretations of existing data and alternative motivations for collecting new data must be supported.

Tags: *Science without borders*

SENSORS

Liquid crystal design method could speed development of cheap chemical sensors

Science Daily, 03NOV2016

Researchers at the University of Wisconsin used a thin film of metal salt, with liquid crystals anchored to the surface all pointing in the same direction to build a sensor. They designed specific liquid crystal molecules and metal cations so that small amounts of analyte would disrupt the interactions of the liquid crystals with the surface, and throw the ordered arrangement into disarray. The change in the liquid crystal would be a visible indicator of the analyte's presence. These sensors are portable, wearable and inexpensive. The researchers plan to explore new combinations for additional analytes and develop new liquid crystalline molecules, in combination with other metal salts and solvents, to make even more sensitive and selective sensors. [OPEN ACCESS](#)

TECHNICAL ARTICLE

Tags: *Sensors***Nanosensors on the alert for terrorist threats**

PhysOrg.com, 03NOV2016

A team of international researchers (Russia, University of Florida) has demonstrated that sensors based on binary metal oxide nanocomposites in which one component provides a high density of conductive electrons and the other is a strong catalyst, are sensitive enough to identify terrorist threats and detect environmental pollutants.

An electron donor and a substance "accommodating" the reaction is necessary for gas detection and the formation of chemisorption centers contributes to faster sensor response.

TECHNICAL ARTICLE

Tags: *Sensors, Advanced materials***A quantum effect allows infrared measurements to be performed by detecting visible light**

PhysOrg.com, 02NOV2016

An international team of researchers (Singapore, Russia) used a special crystal to create a pair of entangled photons, a visible one and an infrared one. The infrared photon passed through a sample and the optical one did not. The two photons then crossed at a second crystal and the visible photon was detected. Since any changes that the sample induced in the infrared photon were reflected in the visible photon, the team could infer information about the sample's infrared properties by measuring only the visible photon. The team intends to extend the technique to longer wavelengths in the terahertz and far-infrared ranges and integrate the system on single platform. According to the team, their research could have applications in environmental monitoring and health diagnostics.

TECHNICAL ARTICLE

Tags: *Sensors* ■

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