



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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FEATURE ARTICLES

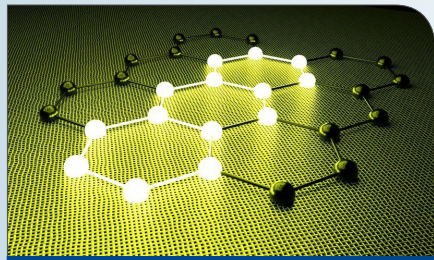
[Military Program Produces Gadget That Detects Machinery from Behind a Concrete Wall](#)

[MIT Technology Review, 23JAN2017](#)

Researchers in the UK working on “What’s inside that building?” project, sponsored by the U.K.’s Defence Science and Technology Laboratory (DSTL), have developed a portable gadget that can detect electric motors, combustion engines, turbines, air conditioning units and fans (including those inside computers) behind a concrete wall containing pipes and wires. The device consists of a cloud of rubidium atoms zapped by a laser to align their atomic spins with a constant magnetic field generated by the device. Any external magnetic field that is changing will then cause the atomic spins to “nutate,” or nod like a spinning top which can be detected by the light the atoms emit. The entire setup works at room temperature, requires no shielding and is suitcase-sized, with the potential to be made significantly smaller. The device is particularly good at frequencies below 15 Hz.

[OPEN ACCESS TECHNICAL ARTICLE](#)*Tags: Sensors, Military technology, S&T UK, Featured Article*

[Graphene’s sleeping superconductivity awakens](#)

[Science Daily, 19JAN2017](#)

Rendering of graphene. Credit: © sxsxw/Fotolia

An international team of researchers (UK, Israel, Norway) coupled graphene with praseodymium cerium copper oxide (PCCO). Their results suggested that

the electron pairs within graphene were in a p-wave state. Superconductivity was not coming from outside graphene therefore PCCO was only required to unleash the intrinsic superconductivity of graphene. In principle,

given the variety of chemical molecules that can bind to graphene’s surface, this research can result in the development of molecular electronics devices with novel functionalities based on superconducting graphene. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science, Advanced materials, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

[Hybrid perovskite LEDs break external quantum efficiency record](#)

[Nanotechweb, 20JAN2017](#)

Rough surfaces on perovskite semiconductors adversely affect their final electronic properties. Researchers at Princeton University have developed a solution process to form highly uniform, ultra-flat perovskite films. By adding long-chain iodine and bromine halides in the 3D perovskite precursor solution, they were able to inhibit the growth of 3D perovskite grains and dramatically decrease film roughness to just 1 nm. Iodine emits in the red to near-infrared part of the electromagnetic spectrum and bromine emits in the green. The researchers have made them both operate with an external quantum efficiency of roughly 10%. The devices are very stable when compared to those fabricated by more conventional methods and have a shelf life of months rather than just days. [TECHNICAL ARTICLE](#)

Tags: Advanced materials

[A toolkit for transformable materials](#)

[Science Daily, 18JAN2017](#)

An international team of researchers (USA - Harvard University, industry partner, the Netherlands) has developed a general framework to design reconfigurable metamaterials. As the design strategy is scale independent, it can be applied to everything from meter-scale architectures to reconfigurable nano-scale systems such as photonic crystals, waveguides and

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metamaterials to guide heat. By combining design and computational modeling, they were able to identify a wide range of different rearrangements and create a blueprint for building these materials in the future. This design framework could be useful for structural and aerospace engineers, material scientists, physicists, robotic engineers, biomedical engineers, designers and architects. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

AUTONOMOUS SYSTEMS & ROBOTICS

[Humans must overcome distrust of robots, say researchers](#)

[Physorg.com](#), 20JAN2017

In a human pedestrian situation, we all implicitly trust each other to behave in a competent manner. Researchers at Cornell University are trying to minimize uncertainty when people are around a robot that's moving. They modeled human's navigational patterns using the topological concept of braids. This leads to a framework that can consider possible alternate patterns so a robot can come up with a compatible navigational strategy.

Tags: Autonomous systems & robotics

[Making AI systems that see the world as humans do](#)

[Eurekalert](#), 19JAN2017

The ability to use and understand sophisticated relational representations is a key to higher-order cognition. Researchers at Northwestern University present a computational model of visual problem solving, designed to solve problems from the Raven's Progressive Matrices intelligence test. The model builds on the claim that analogical reasoning lies at the heart of visual problem solving and intelligence more broadly. They show that model operations involving abstraction and representation are particularly difficult for people, suggesting that these operations may be critical for performing visual problem solving, and reasoning more generally, at the highest level. The research provides an important step toward understanding visual reasoning more broadly. [TECHNICAL ARTICLE](#)

Tags: Autonomous systems & robotics, Artificial intelligence

[AI Software Learns to Make AI Software](#)

[MIT Technology Review](#), 18JAN2017

Leading researchers are finding that they can make software that can learn to do the task of designing machine-learning software. The availability of computing power and the advent of deep learning are what's making the approach work. But it requires such extreme computing power that it's not yet practical to think about lightening the load, or partially replacing, machine-learning experts. Google Brain's researchers describe using 800 high-powered graphics processors to power software that came up with designs for image recognition

systems that rivaled the best designed by humans.

Tags: Autonomous systems & robotics, Artificial intelligence

BIG DATA

[Taming data](#)

[MIT News](#), 19JAN2017

Before analyzing large data sets, the target data has to be aggregated, organized and cleaned up. An international team of researchers (USA - MIT, Germany, Singapore, Qatar, Canada) has developed a system called Data Civilizer, which automatically finds connections among many different data tables and allows users to perform database-style queries across all of them. Data Civilizer assumes that the data is arranged in tables. By analyzing every column of every table at its disposal it compares all of the column summaries against each other, assigns every pair of columns a similarity score and produces a map. When a user composes a query, the Data Civilizer will traverse the map on the fly to find related data. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Big data

COMMUNICATIONS TECHNOLOGY

[Highest core density realized with 12-core single-mode optical fiber](#)

[Physorg.com](#), 20JAN2017

Single-mode optical fibers are approaching capacity limits. Multi-mode fibers suffer from dispersion and limitations over a long-haul network. An international team of researchers (USA - MIT, Japan) has developed multi-core fiber (MCF) with small core pitches to maximize the number of cores within the fiber. They employed a coupled core arrangement within the fiber's 125-micrometer cladding and put in the casement a total of 12 cores, arranging them with a special twisting of the fibers in a randomly coupled MCF to maximize capacity. They detail how they solved the spatial mode dispersion in their paper which will be presented at the Optical Fiber Communication Conference in March.

Tags: Communications technology

[Chip-sized, high-speed terahertz modulator raises possibility of faster data transmission](#)

[Nanowerk](#), 19JAN2017

The terahertz band has been underutilized in part because of lack of compact, on-chip components, such as modulators, transmitters and receivers. Researchers at Tufts University have invented a chip-sized, high-speed modulator that operates at terahertz frequencies and at room temperature at low voltages without consuming DC power. The device works through the interaction of confined THz waves in a novel slot waveguide with tunable, two-dimensional electron gas. The prototype device operates within the frequency band of 0.22-0.325 THz. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Communications technology

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“A science is not mere knowledge, it is knowledge which has undergone a process of intellectual digestion.” JOHN HENRY NEWMAN

CYBER SECURITY

Cybersecurity Experts Uncover Dormant Botnet of 350,000 Twitter Accounts

MIT Technology Review, 20JAN2017

Researchers in the UK have stumbled upon a Twitter botnet, they call “Star Wars botnet”, consisting of more than 350,000 automated accounts that have existed undetected since 2013. They say that its longevity raises serious questions about the potential impact of botnets and the way they are tracked and monitored. A significant number of tweets, some 23,000 of them, were geo-located in uninhabited regions close to Europe and the U.S., such as in deserts and in oceans. When plotted on a map, these locations were bounded by sharp edges and corners that formed two rectangles, one around the U.S. and the other around Europe. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Cyber security, S&T UK

Rethinking general-purpose computing—toward an internet of secure things

Physorg.com, 19JAN2017

Alan Turing did not foresee the security threat that arises from the universality of computing. “Might fundamental changes in hardware or software architectures shift the balance of cyber race” was the chief goal of a recent two-day working group, “Circumventing Turing’s Achilles Heel,” held in Santa Fe, in November. Participants from industry, government and academia focused on two possible directions for fundamentally reframing the problem: The first, termed “formal methods,” focusing on computer hardware and software systems to ensure systems execute only as intended. The second, termed “executable space protection,” uses hardware strategies to keep certain areas of memory “unwritable” to prevent execution of unintended code.

Tags: Cyber security

ENERGY

Scientists lay foundations for new type of solar cell

Physorg.com, 24JAN2017

In conventional solar cells, the interaction between the electrons and the lattice vibrations can lead to unwanted losses. Researchers in Germany report that the polaron excitations in the perovskite solar cell can be created with a fractal structure at certain operating temperatures and last long enough for a pronounced photovoltaic effect to occur. The perovskite solar cells they studied had to be cooled in the laboratory to around minus 35 degrees Celsius, in order for the effect to take place. For practical applications,

it will be necessary to produce ordered polaron states at higher temperatures. They are trying to modify and optimise the material in order to achieve a higher operating temperature. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Energy, Materials science, S&T Germany, Solar energy

ENVIRONMENTAL SCIENCE

Why storms are becoming more dangerous as the climate warms

sd, 24JAN2017

An international team of researchers (USA - University of Houston, Caltech, China) used three independent meteorological datasets to track variables including three-dimensional wind field, geopotential-height field and temperature field at points across the globe from 1979 to 2013. They used the data to compute the Lorenz energy cycle of the global atmosphere. They found that the efficiency of Earth’s global atmosphere as a heat engine is increasing during the past four decades in response to climate change. More potential energy is being converted to kinetic energy driving atmospheric movement resulting in a greater potential for destructive storms in regions where the conversion takes place. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Environmental science, Climatology

Treated carbon pulls radioactive elements from water

Physorg.com, 19JAN2017

An international team of researchers (Russia, USA - Rice University) has prepared two kinds of oxidatively modified carbon (OMC) material, one from coke-derived carbon and the other from shungite, which absorb radioactive metal cations, including cesium and strontium. Just passing contaminated water through OMC filters will extract the radioactive elements and permit safe discharge to the ocean. The discovery could help purify the hundreds of millions of gallons of contaminated water stored after the Fukushima nuclear plant accident. [TECHNICAL ARTICLE](#)

Tags: Environmental science

IMAGING TECHNOLOGY

Superfast Camera Sees Shockwave From Light

IEEE Spectrum, 20JAN2017

An international team of researchers (USA - University of Washington, University of Illinois Urbana-Champaign, China) reports single-shot ultrafast video recording of a light-induced photonic Mach cone propagating in an engineered scattering plate assembly. The event was captured in a single camera exposure by lossless-encoding

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compressed ultrafast photography at 100 billion frames per second. This technology holds great promise for next-generation biomedical imaging instrumentation. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Imaging technology, Photonics

FEATURED RESOURCE

[Science News \(The Society for Science and the Public\)](#)

The Society is dedicated to providing concise, accurate, and inspirational science news and opportunities for millions of online visitors and social media followers. [RSS](#)

INFORMATION TECHNOLOGY

[Magnetic recording with light and no heat](#) [Science Daily, 18JAN2017](#)

Magnetic recording performs well but data centres are getting overheated due to the sharp rise in the demand for cloud storage. A lot of energy is needed to cool their processors. To increase the sensitivity to optical excitation, an international team of researchers (the Netherlands, Poland) used yttrium iron garnet (YIG) doped with Co-ions. Co-ions strongly couple magnetic moments to the orbital motion of electron. Light can effectively change orbital motion of the electrons in the ions and thus affect magnetism. They found that in the Co-substituted garnet film, a single linearly polarized femtosecond laser pulse promotes switching of spins between different states. It could be an interesting option for the big data warehouses of Google and Facebook and the like. [TECHNICAL ARTICLE](#)

Tags: Information technology

MATERIALS SCIENCE

[New system for exploring superconductivity](#) [Nanowerk, 20JAN2017](#)

Mott insulators superconduct under different conditions for dopants with excess positive charges than for dopants with negatively charged electrons, but the complex crystal framework of most cuprates prevents this. Using organic Mott insulators in combination with field-effect transistors and applying a electric field, researchers in Japan were able to precisely dope the sample. They found the Hall coefficients to be three times larger on the hole-doped side. Excess hole doping caused 'pseudogap' states to form. Pseudogaps can be precursors for the superconducting state. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science, S&T Japan

[Scientists develop first catalysed reaction using iron salts](#)

[Physorg.com, 20JAN2017](#)

Most of the catalytes that are in current use are scarce metals such as rhodium, palladium, platinum or iridium. Researchers in the UK have developed an efficient and sustainable new iron catalyse reaction that could prove to be a thousand times cheaper than an equivalent process using scarce and costly metals. Iron is non-toxic. [TECHNICAL ARTICLE](#)

Tags: Materials science, S&T UK

[Theorists propose new class of topological metals with exotic electronic properties](#)

[Science Daily, 19JAN2017](#)

An international team of researchers (USA - Princeton University, Yale University, Switzerland) established the symmorphic and nonsymmorphic symmetries of WTe_2 . They mathematically characterized all possible electronic states having this symmetry and classified those states that can be smoothly deformed into each other as topologically equivalent. From this classification, they found WTe_2 belongs to a new class of metals which they coined nonsymmorphic topological metals. The theory-based approach could help scientists find other similarly-endowed materials. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science

[Topological photonic crystal made of silicon](#) [Nanowerk, 19JAN2017](#)

Topology of a material can be defined in its electronic states and can be used to describe its unique properties. Based on this new approach, researchers in Japan elucidated a new principle which makes electromagnetic waves, including light, propagate on the edge in a two-dimensional photonic crystal without being scattered. This makes it possible to realize a topological photonic crystal by merely adjusting the positions of insulator or semiconductor nanorods in a honeycomb lattice, without using any special material or complicated structure. The research can lead to the development of new functions and devices. [TECHNICAL ARTICLE](#)

Tags: Materials science, S&T Japan

MICROELECTRONICS

[The speed limit for intra-chip communications in future microprocessors](#)

[Nanotechweb, 20JAN2017](#)

The main obstacle currently faced by plasmonics is signal attenuation due to noise. Researchers in Russia have developed a theoretical framework to evaluate the influence of spontaneous emission which can be applied to waveguide structures of any shape and level of mode confinement. They take into account the spectrum of spontaneous emission which can be very broad and nonuniform. High optical gain in the active medium is required to compensate for strong

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absorption in the metal. It is possible to decrease the noise to a level sufficient for practical applications at telecom and mid-infrared wavelengths. [TECHNICAL ARTICLE](#)

Tags: Microelectronics, S&T Russia

[New research helps to meet the challenges of nanotechnology](#)

[Eurekalert](#), 19JAN2017

Traditional methods of engineering electrical contacts have been applied to nanomaterials but they often neglect the nanoscale effects. Researchers in the UK found that simple changes to the catalyst edge can turn-on or turn-off the dominant electrical conduction and most importantly reveal a powerful technique that will allow nanoengineers to select the properties of manufacturable nanowire devices. Understanding these new effects will allow engineers in the future to reliably produce electrical contacts for nanomaterials. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Microelectronics, S&T UK

PHOTONICS

[Researchers review the state of printed organic electronics](#)

[Physorg.com](#), 19JAN2017

In this review article, researchers in Japan focus on organic LEDs and organic photovoltaic devices which provide useful examples of the state of the field. It covers several milestones that made possible great changes in the performance of these devices, such as efficiencies and ease of printing. They suggest that materials development will be key to future progress but no single technology alone will lead to the commercialization of practical products. Hybrid technology will be most significant in future development. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Photonics, S&T Japan

QUANTUM SCIENCE

[Physicists show that real-time error correction in quantum communications is possible](#)

[Physorg.com](#), 23JAN2017

Entanglement decays due to perturbations corrupting quantum links that cannot be repaired without performing quantum tomography on the channel. But the channel tomography is not possible without a working link. An international team of researchers (South Africa, Mexico) overcome this problem characterizing quantum channels by means of classical light. Using free-space communication in a turbulent atmosphere as an example, they showed that the state evolution of classically entangled degrees of freedom is equivalent to that of quantum entangled photons. The analysis of

quantum channels by means of classical light in real time unravels stochastic dynamics in terms of pure state trajectories, and thus enables precise quantum error correction in short- and long-haul optical communication in free space and fibre. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science, Communications technology

[Traffic jam in empty space](#)

[Science Daily](#), 18JAN2017

Researchers in Germany have shown how to manipulate the electric vacuum field and thus generate deviations from the ground state of empty space which can only be understood in the context of the quantum theory of light. This essential scientific progress might make it possible to solve problems that physicists have grappled with for a long time, ranging from a deeper understanding of the quantum nature of radiation to research on attractive material properties such as high-temperature superconductivity. [TECHNICAL ARTICLE 1, 2](#)

Tags: Quantum science, Science without borders

S&T POLICY

[National cluster helps companies tap on new 3D printing technologies](#)

[Science Daily](#), 23JAN2017

National Additive Manufacturing Innovation Cluster (NAMIC) was formed by the Singapore National Research Foundation in 2015 to harness, strengthen and expand on Singapore's existing Additive Manufacturing capabilities as an integrated hub and to position the nation as a world leader in applying this technology. Since its inception, the cluster has reached out to about 400 local and international companies to help them adopt additive manufacturing, also known as 3D-printing, as part of their business. Over the next four years, NAMIC aims to reach out to over 1,000 companies through tailored engagements.

Tags: S&T policy, Foreign S&T

[Technological progress alone won't stem resource use](#)

[MIT News](#), 19JAN2017

Are humans taking more resources from the Earth than the planet can safely produce? An international team of researchers (USA - MIT, Portugal) found that consumers' demand for silicon has outpaced the rate of its technological change, and that the world's consumption of silicon has grown by 345 percent over the last four decades. They found similar trends in 56 other materials, goods, and services, from basic resources such as aluminum and formaldehyde to hardware and energy technologies such as hard disk drives, transistors, wind energy, and photovoltaics. To achieve a sustainable world social and cultural change, dialog and cooperation among people is needed.

[OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: S&T policy

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A Global Plan to Defend Against the Future's Deadliest Diseases

The Atlantic, 18JAN2017

University of Edinburgh, developed a list of 37 “priority viruses” that are most likely to cause major epidemics in the future. Developing vaccines is incredibly expensive. Pharmaceutical companies are unlikely to recoup that investment, especially when it comes to diseases like Ebola, which are rare and tend to hit poor countries. CEPI—the Coalition for Epidemic Preparedness Innovations is a global vaccine-development fund, devoted to readying pandemic defenses during peacetime. With \$460 million from the Wellcome Trust, the Bill & Melinda Gates Foundation, and the governments of Germany, Japan, and Norway, it will fund the development of vaccines against the likely pandemics of the future.

Tags: S&T policy, Counter WMD, Medical technology

SENSORS

New invisibility cloak to conceal objects in diffusive atmospheres

Physorg.com, 20JAN2017

Scattering-cancellation core-shell cloak, based on transformation optics, fail under pulsed illumination invalidating their use for a variety of applications. Researchers in Spain propose and numerically verify a simple cloak realization based on a layered stack of two isotropic materials. The studied devices have several applications including shielding from pulse-based detection techniques, cloaking undesired scattering elements in time-of-flight imaging or high-speed communication systems for diffusive environments, and building extreme optical security features. The cloaking strategy could also be applied to simplify the implementation of thermal cloaks. [TECHNICAL ARTICLE](#)

Tags: Sensors, Military technology

Probe for nanofibers has atom-scale sensitivity

Physorg.com, 19JAN2017

A team of researchers in the US (ARL, University of Maryland, NIST, NRL) has developed a novel method to measure how light propagates through a nanofiber, allowing them to determine the nanofiber's thickness to a precision of less than the width of an atom. The technique is direct, fast and, unlike the standard imaging method, preserves the integrity of the fiber. As a result, the probe can be used in-situ with the nanofiber fabrication equipment which will streamline implementation in quantum optics and quantum information experiments. Developing reliable and precise tools for this platform may enable nanofiber technology for sensing and metrology applications. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Sensors

Ultra-precise chip-scale sensor detects unprecedentedly small changes at the nanoscale

Science Daily, 18JAN2017

Optical sensors are limited in their performances in the short and long time regimes, primarily by environmental fluctuations and lack of miniaturized, scalable robust and precise methods of directly measuring optical frequencies. By utilizing a frequency-locked loop combined with a reference resonator, researches in Israel overcame these limitations and converted the measured signal from the optical domain to the radio-frequency domain. They achieved sensing precision approaching 10^{-8} in effective refractive index units, and 90 μ K in temperature. The research paves the way for single particle detection and high-precision chip-scale thermometry. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Sensors ■

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