



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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FEATURE ARTICLES

[Ephemeral antimatter atoms pinned down in milestone laser test](#)

[Nature News, 19DEC2016](#)

Researchers at CERN have made the first measurements of how antimatter atoms absorb light. They trained an ultraviolet laser on antihydrogen, the antimatter counterpart of hydrogen and measured the frequency of light needed to jolt a positron from its lowest energy level to the next level up. There was no discrepancy with the corresponding energy transition in ordinary hydrogen. Next, the researchers hope to probe the antihydrogen with a large range of laser energies. This could provide a more stringent test of matter–antimatter equivalence and of charge-parity-time (CPT) symmetry. CPT symmetry predicts that energy levels in antimatter and matter should be the same. Even the tiniest violation of this rule would require a serious rethink of the standard model of particle physics.

Tags: Science without borders, Featured Article

[2016 in news: The science events that shaped the year](#)

[Nature News, 16DEC2016](#)



An emperor penguin in Antarctica's Ross Sea, which will now host the world's largest marine reserve. Credit: Paul Nicklen/NGC

Researchers announced some remarkable advances—the direct detection of gravitational waves, the birth of a baby with DNA from three people and an artificial intelligence that cracked the one board game that computers had yet to master. Climate accords, controversial assisted reproduction and the CRISPR patent battle are among the year's top stories.

Tags: Science without borders, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

[Energy cascades in quasicrystals trigger an avalanche of discovery](#)

[Nanowerk, 13DEC2016](#)

In an experiment, a team of researchers in the US (Argonne National Laboratory, Northwestern University) added extra energy to study its effect on the structure of quasicrystal. They found that unlike in a more conventional magnetic lattice, where the “avalanches” of energy redistribution occur only in a single direction, the spread of redistributed energy throughout the lattice takes on a tree-like appearance. Quasicrystals could provide a network made up of magnetic islands that can propagate and store information. The behavior of these kinds of networks depends upon the amount of energy that is put into the system. The discovery is essential for the development of next-generation computational devices. [OPEN ACCESS](#)

[TECHNICAL ARTICLE](#)

Tags: Advanced materials

AUTONOMOUS SYSTEMS & ROBOTICS

[Research team sets new mark for 'deep learning'](#)

[Science Daily, 16DEC2016](#)

The algorithm developed by a team of researchers in the US (Rice University, Baylor College) is a semisupervised “convolutional neural network”, a piece of software made up of layers of artificial neurons whose design was inspired by biological neurons. The artificial neurons are organized in layers. The first layer scans an image and does simple tasks, the second layer examines the output from the first layer and searches for more complex patterns. Many of the lower layer neurons train themselves to look for a specific pattern. The number of times you do a nonlinear transformation is essentially the depth of the network, and depth governs power. The deeper a network is, the more stuff it's able to disentangle. At the deeper layers, units are looking for very abstract things.

Tags: Autonomous systems & robotics, Artificial intelligence

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Taking a leap in bioinspired robotics

MIT News, 16DEC2016

Researchers at MIT are creating a robotic first responder that can potentially do more than a human. They are working to fuse the MIT Cheetah, a four-legged, 70-pound robot that runs and jumps over obstacles autonomously and HERMES, a two-legged, tele-operated robot, whose movements and balance are controlled remotely by a human operator. Borrowing principles from biomechanics, human decision-making, and mechanical design, their goal is to build a service robot that will eventually do real physical work such as opening doors, breaking through walls, or closing valves.

Tags: Autonomous systems & robotics

At the edge of a cognitive space

Science Daily, 12DEC2016

A team of researchers in the US (Rensselaer Polytechnic Institute, IBM) has developed a prototype of its cognitive and immersive environment for collaborative problem-solving. At the core of the “situation room” is a multi-agent architecture for a cognitive environment created by IBM to link human experience with technology. The team’s architecture makes it possible for the computer to register and track activities from multiple sensors for interpretation by multiple cognitive technologies through a message queue. The sensors and cognitive technologies work in concert, to register and interpret “multimodal” human behavior through multiple activities over an extended duration. The research helps build a symbiotic relationship between humans and machines.

Tags: Autonomous systems & robotics, Artificial intelligence

BIG DATA**Data diversity - Preserving variety in subsets of unmanageably large data sets should aid machine learning.**

MIT News, 16DEC2016

When data sets get too big, sometimes the only way to do anything useful with them is to extract much smaller subsets and analyze those instead. Researchers at MIT have developed an algorithm that begins with a small subset of data, chosen at random. Then it picks one point inside the subset and one point outside it and randomly selects one of three simple operations: swapping the points, adding the point outside the subset to the subset, or deleting the point inside the subset. This process repeats until the subset is adequately diverse. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Big data

Making big data manageable

MIT News, 14DEC2016

An international team of researchers (USA - MIT, Israel) has developed a technique that shrinks data sets while preserving their fundamental mathematical relationships.

The coresets-generation technique is tailored to a whole family of data analysis tools with applications in natural-language processing, computer vision, signal processing, recommendation systems, weather prediction, finance, and neuroscience, among many others. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Big data

BIOTECHNOLOGY**Self-adjusting synthetic gene circuit for correcting insulin resistance**

Nature Biomedical Engineering , 19DEC2016

An international team of researchers (Switzerland, China, France) has demonstrated that a self-adjusting synthetic gene circuit can be designed to sense and reverse the insulin-resistance syndrome in different mouse models. They designed and engineered a mammalian synthetic sensor-effector device that is exclusively activated by high insulin levels and triggers corresponding expression of a protein which reverses insulin resistance and its related metabolic effects. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Biotechnology, Synthetic biology

COMMUNICATIONS TECHNOLOGY**Researchers develop new amplifier that could double the capacity of fiber-optic cables**

Physorg.com, 15DEC2016

Researchers at Lawrence Livermore National Laboratory redesigned neodymium-doped optical-fiber laser to suppress laser action at both 1,064 nm and 920 nm. They discovered that from 1,390 nm to 1,460 nm there is significant positive optical gain. The new fiber generates laser power and optical gain with relatively good efficiency. This discovery opens up the potential for installed optical fibers to operate in E-band, in addition to the C and L bands where they currently operate—effectively doubling a single optical fiber’s information-carrying potential.

Tags: Communications technology, Government S&T

CYBER SECURITY**How Long Before AI Systems Are Hacked in Creative New Ways?**

MIT Technology Review, 15DEC2016

Several researchers speaking at a recent AI conference in Barcelona, Spain, said, attacking AI systems is easy. Researchers have demonstrated various ways in which machine-learning programs could be manipulated by exploiting their propensity to spot patterns in data. They are vulnerable, in part, because they lack actual intelligence. However, researchers are developing countermeasures. It is possible to train a machine-learning system to recognize and then ignore misleading examples. But it is tricky to protect against every possible assault.

Tags: Cyber security, Artificial intelligence

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“Advances are made with new insights, but the final arbitrator of any point of view are experiments that seek the unbiased truth, not information cherry picked to support a particular point of view.” STEVEN CHU

If Only AI Could Save Us from Ourselves

MIT Technology Review, 13DEC2016

A technology incubator says it intends to spot and remove digital harassment with an automated program called Conversation AI, an offshoot of Google Brain. But Conversation AI won't be able to defeat online abuse. It will primarily streamline the community moderation that is today performed by humans. So even if it is unable to neutralize the worst behavior online, it might foster more and better discourse on some sites.

Tags: Cyber security

ENERGY

Scalable energy harvesting of unused mechanical energy in the environment

Physorg.com, 16DEC2016

Researchers at the Pennsylvania State University have designed a mechanical energy transducer based on flexible, lightweight organic ionic diodes to turn low-frequency motion, such as human movement or ocean waves, into electricity. The device called ionic diode, is composed of two nanocomposite electrodes with opposite charged mobile ions separated by a polycarbonate membrane. The electrodes are a polymeric matrix filled with carbon nanotubes and infused with ionic liquids. When a mechanical force is applied, the ions diffuse across the membrane, creating a continuous direct current. The complete cycle operates at a frequency of one-tenth Hertz. According to the researchers, the device is expected to provide 40 percent of the energy required of the battery.

TECHNICAL ARTICLE

Tags: Energy, Battery

No more burning batteries? Scientists turn to AI to create safer lithium-ion batteries

Science Daily, 15DEC2016

Solid electrolytes are more stable than flammable liquid electrolytes in lithium-ion batteries. Instead of randomly testing individual compounds, researchers at Stanford University used AI and machine learning to build predictive models from experimental data to find solid electrolytes. They trained a computer algorithm to learn how to identify good and bad compounds based on existing data. The model used several criteria to screen promising materials, including stability, cost, abundance and their ability to conduct lithium ions and re-route electrons through the battery's circuit. They screened more than 12,000 lithium-containing compounds and ended up with 21 promising solid electrolytes. TECHNICAL ARTICLE

Tags: Energy, Battery, Materials science

FORECASTING

Waging a more effective war against viral outbreaks

Science Daily, 15DEC2016

An international team of researchers (USA - Arizona State University, California State University, Vassar College, Colombia, Ecuador) are considering two approaches for modeling outbreaks—economic epidemiological modeling (EEM) and the Lagrangian approach. EEM includes examining information flow in affected areas, and financial risk/reward perceptions that may drive movement of individuals to, from, and within affected “patches.” The Lagrangian approach also assists with projecting human crowd movement and behavior, but broadens the scope of patches considered related to a disease. Information from the two models can be layered for more accurate transmission projections. OPEN ACCESS TECHNICAL ARTICLE

Tags: Forecasting, Mathematics

INFORMATION TECHNOLOGY

Syncing data center computers at the speed of light

Physorg.com, 16DEC2016

In a data center, to achieve higher system performance, the clocks must be closely synchronized. Researchers at Cornell University have developed a system called “Datacenter Time Protocol” (DTP), in which signals sent at the speed of light over fiber-optic cables between computers enable them to stay in sync to within a few nanoseconds. DTP sends computers information about their time difference by directly modifying the pulses of light that travel through fiber-optic cables, with no effect on the higher level packets. In tests, DTP kept computers in sync to within 25.6 nanoseconds. According to the researchers, upgrading a data center to use the system would not be expensive.

Tags: Information technology, Big data

MATERIALS SCIENCE

Fundamental solid state phenomenon unravelled

Nanowerk, 16DEC2016

An international team of researchers (Germany, Japan, USA - NSF, Argonne National Laboratory) has discovered that the mutual repulsion of charged electrons, which are responsible for carrying electrical current, can cause a metal-insulator transition. It is not just the electrons which play a significant role in the phase transition but also the atomic lattice—the solid's scaffold. These experimental

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results will herald a paradigm shift in our understanding of one of the key phenomena of current condensed matter research. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Materials science

FEATURED RESOURCE

[IBM Big Data & Analytics Hub](#)

The Hub is the home for current content and conversation regarding big data and analytics for the enterprise from thought-leaders, subject matter experts and big data practitioners. [RSS](#)

[Researchers work to improve the lifecycle of materials](#)

[Science Daily, 14DEC2016](#)

Smart materials that mimic the ability of living systems to autonomously protect, report, heal and even regenerate in response to damage could increase the lifetime, safety and sustainability of many manufactured items. There are several approaches to achieving these functions using polymer-based materials, but making them work in highly variable, real-world situations is proving challenging. Researchers at the University of Illinois Urbana-Champaign review the state-of-the-art autonomous polymers and lay out future directions for the field. They identified five landscape-altering developments: self-protection, self-reporting, self-healing, regeneration, and controlled degradation. [TECHNICAL ARTICLE](#)

Tags: Materials science

[Nanoscale analysis of materials for future fusion reactors](#)

[Physorg.com, 13DEC2016](#)

Incredibly high demands are made on materials for thermonuclear reactors. Researchers in Russia have demonstrated experimentally how Ferrite-martensite steels based on Fe-Cr alloys and oxide dispersion-strengthened steels could be restructured at the atomic level and how the atoms were redistributed, leading to a substantial rise in fragility and loss of plasticity. Their research could be used to create materials for future energy installations.

Tags: Materials science, S&T Russia

MICROELECTRONICS

[Movable microplatform floats on a sea of droplets](#)

[Nanowerk, 16DEC2016](#)

Researchers at MIT have developed a system to fabricate MEMS using a layer of liquid droplets to support a tiny, movable platform which essentially floats on top of the droplets. The precise movements of the platform can

be controlled electrically, through a system that can alter the dimensions of the droplets to raise, lower, and tilt the platform. It can also be tilted by selectively changing different droplets by different amounts. The capability to operate the stage without solid-solid contact offers potential improvements for applications in micro-optics, actuators, and other MEMS devices. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Microelectronics

[World's smallest radio receiver has building blocks the size of two atoms](#)

[Nanowerk, 16DEC2016](#)

An international team of researchers (USA - Harvard University, UK) built a device in which electrons in diamond NV centers are powered by green light emitted from a laser. These electrons are sensitive to electromagnetic fields, including the waves used in FM radio. When the NV center receives radio waves it converts them and emits the audio signal as red light. A common photodiode converts that light into a current, which is then converted to sound through a simple speaker or headphone. The strong magnetic field around the diamond can be used to change the radio stations. The radio is extremely resilient; it successfully played music at 350 degrees Celsius. [TECHNICAL ARTICLE](#)

Tags: Microelectronics

[Lightning-fast switch for electron waves](#)

[Nanowerk, 13DEC2016](#)

An international team of researchers (Germany, Italy) designed a SiO₂/black phosphorus/SiO₂ heterostructure in which the surface phonon modes of the SiO₂ layers hybridize with surface plasmon modes in black phosphorus that can be activated by photo-induced interband excitation. They found that the surface mode can be activated within ~50 fs and disappears within 5 ps, as the electron-hole pairs in black phosphorus recombine. The excellent switching contrast and switching speed, the coherence properties and the constant wavelength of this transient mode make it a promising candidate for ultrafast nanophotonic devices. [TECHNICAL ARTICLE](#)

Tags: Microelectronics

QUANTUM SCIENCE

[Exotic quantum technology realized using normal silicon](#)

[Nanowerk, 16DEC2016](#)

Researchers in Japan have developed a spin qubit in industry-standard 'natural' silicon. They achieved this by confining an electron in a so-called double quantum dot, which traps two charged particles between electric fields generated by electrical contacts. To speed up qubit operation, they used a micromagnet to induce strong coupling of the spins of the two trapped electrons as silicon does not have an intrinsic spin driving mechanism. The micromagnet allowed the researchers to control the

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spin in their double quantum dot 100 times faster than previously possible. The research contributes to the realization of quantum computers. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science, S&T Japan

[The quantum computers of the future will work equally well with encrypted and unencrypted inputs](#)

[Physorg.com, 14DEC2016](#)

Using Gaussian displacement and squeezing operations, an international team of researchers (Canada, Denmark) theoretically investigated and demonstrated a quantum solution that achieves the security of a user's privacy. They demonstrated losses of up to 10 km both ways between the client and the server and show that security can still be achieved. The approach offers a number of practical benefits that could one day allow the potential widespread adoption of this quantum technology in future cloud-based computing networks. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: Quantum science, Information technology

[When Quantum Light Meets Matter](#)

[American Physical Society Synopsis, 13DEC2016](#)

An international team of researchers (Spain, Russia) reports a theoretical analysis of the interaction between quantum light and matter that, unlike most previous studies, doesn't solely apply to specific types of quantum light. The researchers find that quantum light offers advantages over its classical counterpart for certain systems and applications. They propose using chains of two-level systems, in which photon emission from one system drives the quantum excitation of the next, as a way to make better single-photon sources. [TECHNICAL ARTICLE 1, 2](#)

Tags: Quantum science, Photonics

S&T POLICY

[China installed anti-aircraft and anti-missile systems on all seven major artificial south china sea islands](#)

[Next Big Future, 14DEC2016](#)

China appears to have built significant point-defense capabilities, in the form of large anti-aircraft guns and probable close-in weapons systems (CIWS) at each of its outposts in the Spratly Islands. China has built nearly identical headquarters buildings at each of its four smaller artificial islands. The end of each of these arms sports a hexagonal platform, approximately 30 feet wide. The northeastern and southwestern arms host what are most likely anti-aircraft guns. The other two platforms hold smaller objects without clearly visible barrels. These cannot be definitively identified, but are likely CIWS to protect against cruise missile strikes.

Tags: S&T policy, Military technology, S&T China

[Technology communication: Worries through information?](#)

[Science Daily, 14DEC2016](#)

It is crucial to enable adequate communication between science and society, which does not only consider scientific findings, but also concerns of the population. An international team of researchers (Germany, Australia) found that information on efficient precautions was found to lead to an increased risk perception by the recipients of the information. It may also cause worries where they do not seem appropriate. The study concludes that messages on precautions and information are a double-edged sword in terms of subjective risk perception. Their use should be far better understood. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: S&T policy

[Pentagon to unveil new electronic warfare strategy](#)

[Defense Systems, 07DEC2016](#)

A key part of the calculus for this strategy will be to integrate new EW technologies with existing Army, Navy and Air Force emerging EW weapons. Key elements featured in the report include increasing EW attack technology, integrating cost concerns, "hardening" weapons and training and equipping EW forces. Improving electronic warfare modeling and simulation to prepare for emerging weapons systems is also a key element of the strategy.

Tags: S&T policy, Military technology

SCIENCE WITHOUT BORDERS

[Nature's 10](#)

[Nature News, 19DEC2016](#)

Ten people who mattered this year.

Tags: Science without borders

SENSORS

[State of the art on graphene-based biosensors](#)

[Nanowerk, 16DEC2016](#)

Researchers in Spain discuss the main properties of graphene derivatives facilitating optical and electrical biosensing platforms, along with how the integration of graphene derivatives, plastic, and paper can lead to innovative devices in order to simplify biosensing technology and manufacture easy-to-use biosensors. Some crucial issues to overcome in order to bring graphene-based biosensors to the market are also underscored. Electric and optical sensor platforms are highlighted. [TECHNICAL ARTICLE](#)

Tags: Sensors

Ultra-high-speed optical fiber sensor enables detection of structural damage in real time

Science Daily, 15DEC2016

The highest sampling rate reported for Brillouin optical correlation-domain reflectometry was 19 Hz, resulting in a relatively long total time of distributed measurement. Researchers in Japan have demonstrated real-time distributed measurement with an intrinsically one-end-access reflectometry configuration by using a correlation-domain technique. In this method, the Brillouin gain spectrum is obtained at high speed and the Brillouin frequency shift is converted into a phase delay of a synchronous sinusoidal waveform; the phase delay is subsequently converted into a voltage, which can be directly measured. They achieved a sampling rate of 100 kHz, an improvement of over 5,000 times the conventional rate. [OPEN ACCESS TECHNICAL ARTICLE](#)

Tags: *Sensors, S&T Japan*

The trouble with facial recognition technology (in the real world)

Physorg.com, 14DEC2016

In relatively easy situations, where faces are front-on and reasonably clear, computer algorithms can now outperform humans. But in much harder conditions when faces are pictured from different angles or in poor lighting, humans still come out on top. It seems, the difficulty arises from the enormous amount of variability we see across different images of the same person. Looking to the future, for automatic face recognition systems there is increasing evidence that using “face averages” may improve identification rates. The averages are computer-generated images, made by combining several photographs of the same person.

Tags: *Sensors* ■

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