



S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

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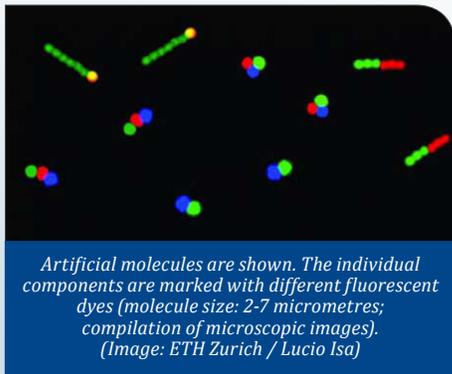
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FEATURE ARTICLES

[Artificial molecules](#)

[Nanowerk, 01APR2016](#)



Artificial molecules are shown. The individual components are marked with different fluorescent dyes (molecule size: 2-7 micrometres; compilation of microscopic images). (Image: ETH Zurich / Lucio Isa)

Researchers in Switzerland have developed a new technique that enables the manufacture of complexly structured micrometre size objects joining together microspheres. They are

produced in a modular fashion, making it possible to program their design in such a way that each component exhibits different physical properties. After fabrication, it is also very simple to bring them into solution. With the new method, it is possible to manufacture micro-objects with precisely defined magnetic, non-magnetic and differently charged areas. [TECHNICAL ARTICLE](#)

Tags: Materials science, S&T Switzerland, Featured Article

[Light helps develop programmable materials](#)

[Science Daily, 01APR2016](#)

An international team of researchers (Sweden, Germany, UK) developed a model in which patterns of light control the movement of active particles. The light makes synthetically produced particles as well as microorganisms, such as bacteria and algae, spontaneously form into something that can be compared to a pump. The active particles construct their own pump to move themselves around. By adjusting the light, it is possible to steer the particles in a different direction. This discovery can become significant in widely different areas such as environmental protection, medicine and the development of new materials which can be programmed. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Featured Article

S&T NEWS ARTICLES

ADVANCED MATERIALS

[Topological origami and kirigami techniques applied experimentally to metamaterials](#)

[Physics World, 05APR2016](#)

An international team of researchers (the Netherlands, USA - Cornell University, UMass Amherst, UC Merced, University of Wisconsin) used origami to construct a metamaterial that has two distinct topological phases while being made from a single base material, soft along one edge, while remaining stiff on the other. The team notes that bigger versions of the material could be made but only by applying kirigami techniques, i.e. cutting out certain sections. They suggest other materials could be created using similar techniques for mechanical or industrial applications. [TECHNICAL ARTICLE](#)

Tags: Advanced materials

[Heat and light get larger at the nanoscale](#)

[Science Daily, 31MAR2016](#)

A team of researchers in the US (Cornell University, Columbia University, Stanford University) demonstrated near-field radioactive heat transfer between parallel SiC nanobeams in the deep sub-wavelength regime. They used high-precision MEMS to control the distance between the beams and exploited the mechanical stability of nanobeams under high tensile stress to minimize thermal buckling effects. This means that we can control heat flow with a lot of the same techniques we have for manipulating light. There are a lot of interesting things we can do with light, such as converting it to electricity using photovoltaic cells. [TECHNICAL ARTICLE](#)

Tags: Advanced materials, Materials science

AUTONOMOUS SYSTEMS & ROBOTICS

[Video Friday: Dogs That Code, Robotic Football Team, and Self-Driving Bicycle](#)

[IEEE Spectrum, 01APR2016](#)

This 7-minute long animation from NASA imagines how a future of advanced space systems (including lots and

continued...

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lots of robots) will enable deep space exploration and colonization.

Tags: Autonomous systems & robotics

COMMUNICATIONS TECHNOLOGY

Changing the colour of single photons in a diamond quantum memory

[PhysOrg.com](#), 04APR2016

Changing the frequency a photon is necessary to optimally link components in a quantum network. Researchers in Canada demonstrated the conversion of both the frequency and bandwidth of single photons using room-temperature diamond quantum memory. The integrated platform for photon storage and spectral conversion could be used for frequency multiplexing in quantum communication, as well as build up a very large entangled state – something called a cluster state. Researchers are interested in exploiting cluster states as the resource for quantum computing driven entirely by measurements.

TECHNICAL ARTICLE

Tags: Communications technology, Quantum science, S&T Canada

CYBER SECURITY

A direct view on spin-waves

[PhysOrg.com](#), 05APR2016

Spin-waves are promising candidates for future information processing schemes as there is almost no frictional heating in magnetic transport. Information encoding is only possible in spin-wave packets. Researchers in Germany have succeeded in creating and capturing defined wave-packets in slow-motion videos. In addition, the experiment generated a wave-motion which approaches the excitation region from a distance rather than emerging out of it. **TECHNICAL ARTICLE**

Tags: Cyber security, S&T Germany

Laser technique promises super-fast and super-secure quantum cryptography

[PhysOrg.com](#), 05APR2016

By ‘seeding’ one laser beam inside another, researchers in the UK have demonstrated that it is possible to distribute encryption keys at rates between two and six orders of magnitude higher than earlier attempts at a real-world quantum cryptography system. **TECHNICAL ARTICLE**

Tags: Cyber security, Communications technology, Quantum science

Hard mathematical problems as basis for new cryptographic techniques

[Science Daily](#), 01APR2016

Researchers in Germany have developed algorithms that are based on the hardness of the following lattice problem: imagine a lattice to have a zero point in one specific location. The challenge is to find the point where two

lattice lines intersect and that is closest to zero point. In a lattice with approx. 500 dimensions, it is impossible to solve this problem efficiently. The researchers test various parameters that render the lattice problem simpler or harder and use it as basis for developing a cryptographic algorithm which could be implemented even in small devices.

Tags: Cyber security, Mathematics, S&T Germany

ENERGY

Graphene Could Help Generate Power From Rain

[Science Daily](#), 06APR2016

Researchers in China added graphene to a dye-sensitized solar cell, a kind of inexpensive thin-film solar cell, then put them on a flexible, transparent backing of indium tin oxide and plastic. The resulting flexible solar cell demonstrated a solar-to-electric conversion efficiency of up to 6.53 percent, and generated hundreds of microvolts from slightly salty water that was used to simulate rainwater. Future solar cells may produce electricity in all weather. **TECHNICAL ARTICLE**

Tags: Energy, Advanced materials, S&T China, Solar energy

For rechargeable batteries that crush the competition, crush this material

[PhysOrg.com](#), 01APR2016

An international team of researchers (USA - NIST, University of Maryland, Sandia National Laboratory, Japan) reports that replacing one of the boron atoms with carbon in a compound made primarily of hydrogen, boron and either lithium or sodium improved their ability to conduct charged particles about 10 times. The team found that pulverizing the compounds into nanometer-scale particles resulted in materials that could still perform well at room temperature and far below. **TECHNICAL ARTICLE**

Tags: Energy, Battery, Metamaterials

ENVIRONMENTAL SCIENCE

The Moon may play a major role in maintaining Earth’s magnetic field

[Science Daily](#), 01APR2016

The Earth’s magnetic field permanently protects us from the charged particles and radiation that originate in the Sun. The shield is produced by the geodynamo, the rapid motion of huge quantities of liquid iron alloy in the Earth’s outer core. The classical model required the Earth’s core to have cooled by around 3 000 °C over the past 4.3 billion years. Now, researchers in France report that, on the contrary, its temperature has fallen by only 300 °C. The action of the Moon, overlooked until now, is thought to have compensated for this difference and kept the geodynamo active. **TECHNICAL ARTICLE**

Tags: Environmental science, S&T France

“Sometimes when you innovate, you make mistakes. It is best to admit them quickly, and get on with improving your other innovations.” STEVE JOBS

Size Matters: NASA Measures Raindrop Sizes From Space to Understand Storms

NASA News, 31MAR2016

In order to accurately know how much precipitation is falling in a storm, scientists need to understand the ratio of large drops to smaller or medium sized drops. The joint NASA and Japan Aerospace Exploration Agency Global Precipitation Measurement mission provides three-dimensional snapshots of raindrops and snowflakes around the world from space. Scientists can improve rainfall estimates from satellite data and in numerical weather forecast models, helping us better understand and prepare for extreme weather events.

Tags: *Environmental science, Climatology, Government S&T, NASA*

IMAGING TECHNOLOGY

High dynamic range imaging via robust multi-exposure image fusion

PhysOrg.com, 01APR2016

Researchers in Hong Kong have developed a method which decomposes an image patch into three conceptually independent components: signal strength, signal structure and mean intensity. By fusing these components separately, this approach can produce fused images with more vivid color appearances and fewer artifacts in both static and dynamic situations.

Tags: *Imaging technology*

INFORMATION TECHNOLOGY

Research team discovers novel way of transferring magnetic information

PhysOrg.com, 05APR2016

Researchers in Singapore found that the use of polar oxide insulator enables the range of the magnetic coupling to jump from about one nanometer to ten, and its strength varies up and down with spacer thickness. Instead of spin magnetism being carried across directly by messenger electrons, it is the orbital magnetism that is passed along from atom to the next across the insulator. This novel technique enables magnetic information to make their way from one magnetic layer to another, synonymous to the encoding and transmission of data.

Tags: *Information technology*

Technicolor stores Hollywood history in a bottle

PhysOrg.com, 05APR2016

Building on research by scientists at Harvard University, who in 2012 successfully stored 5.5 petabits of

data—around 700 terabytes—in a single gram of DNA, researchers at a company based in California have encoded the 1902 French silent film “A Trip to the Moon,” the first movie to use visual effects, into artificial “non-biological” DNA.

Tags: *Information technology*

MATERIALS SCIENCE

Insulator-superconductor transition of copper-oxide compound studied in fine detail

Science Daily, 05APR2016

An international team of researchers (USA - Brookhaven National Laboratory, Yale University, China) synthesized ultrathin films containing multiple samples of a copper-oxide compound to study the compound’s electronic behavior at near absolute zero. They reported that the superconducting state competes with another state of electronic order characterized by the random distribution of many small charge clusters. Unlike the free-flowing electrons in metals and superconductors, the electrons in these clusters are localized and pinned to particular atoms, rendering them immobile and unable to carry current when an electric field is applied. [TECHNICAL ARTICLE](#)

Tags: *Materials science*

Researchers develop formula describing.. ghostly transfer of heat

PhysOrg.com, 05APR2016

A team of researchers in the US (MIT, Princeton University) has come up with a formula that describes the maximum heat transfer in very close quarters such as nano-scale electronics and solar electricity cells where heat transfer is critical. Surprisingly—and encouragingly—the formula suggests that a million times more heat transfer is possible between close objects. [TECHNICAL ARTICLE](#)

Tags: *Materials science*

Tiny tubes move into the fast lane

Lawrence Livermore National Laboratory, 04APR2016

A team of researchers in the US (Lawrence Livermore National Laboratory, UC Berkeley) has shown that carbon nanotubes as small as eight-tenths of a nanometer in diameter can transport protons faster than bulk water, by an order of magnitude. Practical applications include proton exchange membranes, proton-based signaling in biological systems and the emerging field of proton bioelectronics. [TECHNICAL ARTICLE](#)

Tags: *Materials science, Government S&T*

[A key to development of materials for the foundation of quantum computers](#)

Science Daily, 31MAR2016

An international team of researchers (Japan, China) observed a state in copper oxides in which orbital degrees of freedom did not freeze at low temperatures and electrons fluctuated due to quantum fluctuations. The group also clarified the time scale of these quantum fluctuations in multifrequency electron spin resonance experiments in a strong magnetic field. [TECHNICAL ARTICLE](#)

Tags: *Materials science, Quantum science*

[Magnetic field affects electrons during etching](#)

University of Tokyo, 31MAR2016

Using surface polishing employing light with a controlled direction of oscillation, an international team of researchers (Japan, France) has demonstrated that a magnetic field with extremely high frequency (in the petahertz range) can be used for nanofabrication. The technology to create nanoscale flat surfaces is essential for the development of electronic devices and optical devices. [TECHNICAL ARTICLE](#)

Tags: *Materials science, Microelectronics*

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PHOTONICS

[Researchers demonstrate a new way to characterize twisted light](#)

Nanowerk, 01APR2016

Orbital angular momentum (OAM), one of the defining parameters of twisted light, makes it attractive for encoding quantum information. Before any particular system can be used in quantum communication, researchers need to be able to measure it and describe it. An international team of researchers (USA - University of Rochester; Canada) report that their technique is particularly suitable for quantum information applications involving a large number of orbital OAM states. [TECHNICAL ARTICLE](#)

Tags: *Photonics, Communications technology, Quantum science*

QUANTUM SCIENCE

[All quantum communication involves nonlocality](#)

PhysOrg.com, 01APR2016

It has been suspected that all advantages in quantum communication are ultimately based on violations of Bell's inequality, and therefore result from nonlocal correlations. Until now, violations of Bell's inequality were only proven for a handful of quantum protocols. An international team of researchers (the Netherlands, Poland) provide a universal method that derives a violation of Bell's inequality in every case in which there is a (sufficiently large) quantum communication advantage. This result is an important step in quantum communication theory, and deepens the understanding of the link between non-locality and quantum communication protocols. [TECHNICAL ARTICLE](#)

Tags: *Quantum science, Communications technology*

[Scientists divide magnetic vortices into collectivists and individualists](#)

Science Daily, 01APR2016

Studying the behavior of skyrmions will help to create unique quantum devices based on new physical principles. Researchers in Russia succeeded in measuring the resistivity of solid manganese monosilicide to a very high degree of accuracy depending on the temperature and direction of the magnetic field. They showed that MnSi has two types of skyrmion lattices with a different physical nature. Spintronics, which is based on the use of individual quasi-particles or skyrmions, will open up new prospects for miniaturizing devices and will reduce control currents. [TECHNICAL ARTICLE](#)

Tags: *Quantum science, S&T Russia*

[Quantum time mirrors](#)

arXiv, 24MAR2016

An international team of researchers (Germany, UK, France) proposes two conceptually different realisations of instantaneous time mirrors for quantum systems, i.e. controlled time discontinuities acting through pulses on wavefronts and leading to distinct wave function echoes with high fidelities. [TECHNICAL ARTICLE](#)

Tags: *Quantum science*

S&T POLICY

[DOD unveils manufacturing center at MIT](#)

Federal Computer Week, 01APR2016

On April 1, the Defense Department unveiled a new manufacturing center called the Advanced Functional Fabrics of America Alliance in partnership with MIT. The aim is accelerating innovation in fibers and textiles that have defense applications. DOD is putting \$75 million toward the new institute, while a mix of private, state and other funding sources is adding nearly \$250 million to the cause. A consortium of 89 universities, manufacturers and nonprofit organizations will participate in the initiative.

Tags: *S&T policy*

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Easier access to patent data

MIT News, 01APR2016

The United States Patent and Trademark Office (USPTO) announced new initiatives that should provide easier access to troves of useful patent data. The measures include the USPTO's first-ever release of application program interfaces (APIs), tools that can be used to build applications that mine the office's data for useful information about existing patents. This will allow all the players in the innovation ecosystem to have better information to make smarter decisions.

Tags: S&T policy

SCIENCE WITHOUT BORDERS**Space Wave Gives Electrons a Shove**

American Physical Society Focus, 05APR2016

A recently launched multi-satellite mission has now flown through regions where magnetic fields break up and reconnect. An international team of researchers (USA - UC Berkeley, UCLA, SRI, University of Colorado, NASA, University of Orleans, University of New Hampshire, Ukraine, France, Russia) directly observed electron acceleration by fast-moving electric-field waves, suggesting a possible role for these waves in the production of high-energy particles. The new data may be an important step in unraveling the mysteries behind solar flares and other energetic cosmic events.

TECHNICAL ARTICLE

Tags: Science without borders, Space technology

Science relies on computer modelling—so what happens when it goes wrong?

PhysOrg.com, 01APR2016

Modelling is used across scientific fields—ranging from astrophysics and climate prediction to bioinformatics and economics. But there is increasing debate about the fact that this science is difficult to validate through reproduction. Even if the reader of a research paper can successfully interpret the writer's precise meaning, and then faultlessly translate it into a program, there are still pitfalls in executing it.

Tags: Science without borders, Simulation and modeling

SENSORS**Radar with 360° vision**

Science Daily, 01APR2016

Optical sensors have their limitations, for instance when plastic surfaces, dust or smoke obstruct their line of sight. Researchers in Germany have now developed a new, high-frequency radar scanner that cuts through these obstacles. It can monitor its environment in a 360-degree radius, making it ideal for safety applications wherever people and robots work together.

Tags: Sensors, S&T Germany

Ferroelectric localized field enhanced nanowire photodetectors

Nanowerk, 31MAR2016

One-dimensional semiconductor nanowires have been widely applied in photodetectors. However dark currents limit the detection performance of the photodetectors. Researchers in China have designed a high-performance nanowire photodetector with side-gated structure by combining ferroelectric materials and nanowires, and the as-fabricated device can be employed to reduce the dark current and increase the sensitivity of the photodetectors.

TECHNICAL ARTICLE

Tags: Sensors, S&T China

MIT turns Wi-Fi Into Indoor GPS

IEEE Spectrum, 31MAR2016

Researchers at MIT have developed a way for adjacent Wi-Fi devices, including smartphones, to locate each other within centimeters. The technology, called Chronos, relies on making the devices emulate multi-gigahertz wideband radios.

Tags: Sensors ■

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