INTERNATIONAL YEAR OF LIGHT 2015

100 Million Stars in the Andromeda galaxy.

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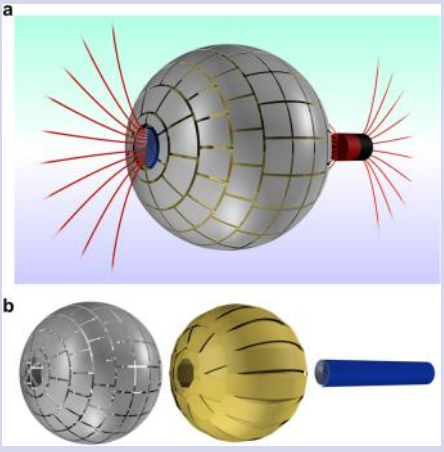
Trio create artificial magnetic wormhole

A trio of physicists with the Autonomous University of Barcelona has built what they claim is the first artificial magnetic wormhole. In their paper published in the journal Scientific Reports, Jordi Prat-Camps, Carles Navau and Alvaro Sanchez describe how they built the device and why they believe it might prove useful in building a more user-friendly MRI machine.

People have grown familiar with the term wormhole as it applies to physics and science-fiction. It has been described as a portal in space-time, where an object, or perhaps a person, could be transported from one region of space to another, nearly instantaneously. And while the theory has stood the test of time, no one has ever been able to prove that they actually exist. In this new effort, the researchers built a much ...***Read More***…



(a) The field of a magnetic source (right) is appearing as an isolated magnetic monopole when passing through the magnetostatic wormhole; the whole spherical device is magnetically undetectable. (b) The wormhole is composed of (from left to right) an outer spherical ferromagnetic metasurface, a spherical superconducting layer, and an inner spirally wound ferromagnetic sheet. Credit: Scientific Reports 5, Article number: 12488 (2015) doi:10.1038/srep12488

New theory—If we want to detect dark matter we might need a different approach

Physicists suggest a new way to look for dark matter: They believe that dark matter particles annihilate into so-called dark radiation when they collide. If true, then we should be able to detect the signals from this radiation.

The majority of the mass in the universe remains unknown. Despite knowing very little about dark matter, its overall abundance is precisely measured. In other words: Physicists know it is out there, but they have not yet detected it.

It is definitely worth looking for, argues Ian Shoemaker, former postdoctoral researcher at Centre for Cosmology and Particle Physics Phenomenology (CP3), Department of Physics, Chemistry and Pharmacy, University of Southern Denmark, now at Penn State, USA.

"There is no way of predicting what we can do with dark matter, if we detect it. But it might revolutionize our world. When scientists discovered quantum mechanics, it was considered a curiosity. Today, quantum mechanics plays an important role in computers," he says.

Ever since dark matter was first ...***Read More***...

The Large Underground Xenon (LUX) experiment is placed in this former mine almost 1500 m underground in South Dakota, USA. Credit: Matt Kapust, Sanford Underground Research Facility.

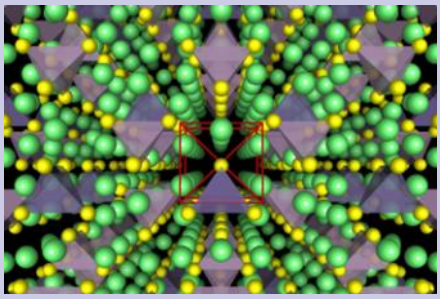
Going solid-state could make batteries safer and longer-lasting

If you pry open one of today's ubiquitous high-tech devices—whether a cell phone, a laptop or an electric car—you'll find that batteries take up most of the space inside. Indeed, the recent evolution of batteries has made it possible to pack ample power in small places.

But people still always want their devices to last even longer, or go further on a charge, so researchers work night and day to boost the power a given size battery can hold. Rare, but widely publicized, incidents of overheating or combustion in lithium-ion batteries have also highlighted the importance of safety in battery technology.

Now researchers at Massachusetts Institute of Technology (MIT) and Samsung, and in California and Maryland, have developed a new approach to one of the three basic components of batteries, the electrolyte. The new findings are based on the idea that a solid electrolyte, rather than the liquid used in today's most common rechargeables, could greatly improve both device lifetime and safety—while providing a significant boost in the amount of power stored in a given space.

The results are reported in Nature Materials in a paper by MIT postdoc Yan Wang, visiting professor of materials science and engineering Gerbrand Ceder and five others. They describe a new approach to the development of solid-state electrolytes that could simultaneously address the greatest challenges associated with improving lithium-ion batteries ...***Read More***...



Illustrations show the crystal structure of a superionic conductor. The backbone of the material is a body-centred cubic-like arrangement of sulphur anions. Lithium atoms are depicted in green, sulfur atoms in yellow, PS4 tetrahedra in purple, and GeS4 tetrahedra in blue. Researchers have revealed the fundamental relationship between anion packing and ionic transport in fast lithium-conducting materials. Image: Yan Wang

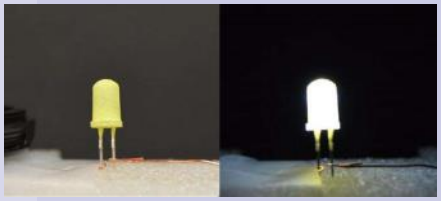
New technology can expand LED lighting, cutting energy use and greenhouse gas emissions

Highly efficient, light-emitting diodes (LEDs) could slash the world's electricity consumption. They are already sold in stores, but more widespread adoption of the technology has been hindered by high costs due to limited availability of raw materials and difficulties in achieving acceptable light quality. But researchers will report today that they have overcome these obstacles and have developed a less expensive, more sustainable white LED.

The scientists will discuss their research at the 250th National Meeting & Exposition of the American Chemical Society (ACS).

"If more people in the U.S. used LEDs in their homes and businesses, the country's electricity consumption could be cut in half," says Zhichao Hu, Ph.D., a member of the Rutgers University team that performed the research under the direction of Jing Li, Ph.D. At that time, he was a graduate student. He is now a postdoc at Rutgers and is studying the recovery of rare-earth elements there. Zhichao adds that studies show substituting one LED light for a common incandescent light bulb in every American household could save the nation $700 million annually in energy costs.

To achieve the common, soft white light that consumers expect, current LED technologies typically use a single semiconductor chip to produce light, usually blue, and then rely on a yellow-emitting "phosphor" coating to shift the color to white. That's because LEDs do not emit a white light. The phosphor is made from materials, such as ..***Read More***….



An LED coated with a yellow "phosphor" is shown turned off (left) and then turned on (right). This "green" LED is inexpensive and provides warm white light. Credit: Zhichao Hu, Ph.D.

New temperature record: Hydrogen sulfide becomes superconductive under high pressure at minus 70 degrees Celsius

Up until now, no material has been able to conduct current with no resistance at such high temperatures: Researchers at the Max Planck Institute for Chemistry in Mainz and the Johannes Gutenberg University Mainz observed that hydrogen sulfide becomes superconductive at minus 70 degree Celsius—when the substance is placed under a pressure of 1.5 million bar. This corresponds to half of the pressure of the earth's core. With their high pressure experiments the researchers in Mainz have thus not only set a new record for superconductivity—their findings have also highlighted a potential new way to transport current at room temperature with no loss.

For many solid-state physicists, superconductors that are suitable for use at room temperature are still a dream. Up until now, the only materials known to conduct current with no electrical resistance and thus no loss did so only at very low temperatures. Accordingly, special copper ceramics (cuprates) took the leading positions in terms of transition temperature—the temperature at which the material loses its resistance. The record for a ceramic of this type is roughly minus 140 degrees Celsius at normal air pressure and minus 109 degrees Celsius at high pressure. In the ceramics, a special, unconventional form of superconductivity occurs. For conventional superconductivity, temperatures of at least minus 234 degrees Celsius have so far been necessary….***Read More***...

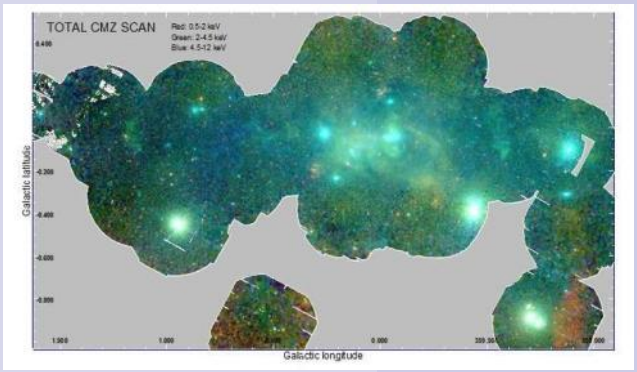
The apparatus the team led by Mikhail Eremets at the Max Planck Institute for Chemistry in Mainz uses to generate extremely high pressures, is amazingly handy. The researchers press the metal cell with Allen screws together. The high pressure thus created in the center of the cell, only diamonds resist. The gems operate like anvils that compress a sample. Credit: Thomas Hartmann

Astronomers observe the events around the black hole at the center of our galaxy

Who left the deep scars on the heart of our Milky Way? In their hunt for elusive clues that might reveal the culprit, an international team of astronomers at the Max Planck Institute for Extraterrestrial Physics has been scouring cosmic images of the X-ray satellite XMM-Newton. The prime suspect is the supermassive black hole lurking at the center of the Milky Way. But a number of massive stars and supernovae do not appear entirely innocent, either.

The study of the X-ray emission from the Galactic center is of primary importance for astronomy. One of the first large projects approved and performed by the X-ray satellite XMM-Newton, right after launch, was a scan of the Galactic cente. A team lead by scientists at the Max Planck Institute for Extraterrestrial Physics (MPE) has recently obtained a new scan with XMM-Newton and connected these observations to all archival data to obtain the best maps in both X -ray continuum and line emission produced so far.

With this, the team was able to characterise in detail the fallout from catastrophic events that have released vast amounts of energy. The forensic study led in particular to the discovery of how enormous X-ray emitting bubbles of plasma, tens of light years across, are impacting their ...***Read More***...



Glimpse into the heart of the Milky Way: this X-ray broad-band mosaic image consists of more than a hundred individual XMM-Newton observations within the central degree of the Milky Way. The colours indicate observations at different energies; this map covers a region about 500 hundred light years across. In addition to the X-ray emission from the regions around the supermassive black hole at the centre of the Milky Way this map reveals X-ray binaries, star clusters, supernova remnants, bubbles and superbubbles, non-thermal filaments and many other sources. Credit: MPE / ESA

NASA reassures public that there is no asteroid threatening Earth

Numerous recent blogs and web postings are erroneously claiming that an asteroid will impact Earth sometime between Sept. 15 and 28, 2015. On one of those dates, as rumors go, there will be an impact—"evidently" near Puerto Rico—causing wanton destruction to the Atlantic and Gulf coasts of the United States and Mexico, as well as Central and South America.

That's the rumor that has gone viral—now here are the facts.

"There is no scientific basis—not one shred of evidence—that an asteroid or any other celestial object will impact Earth on those dates," said Paul Chodas, manager of NASA's Near-Earth Object office at the Jet Propulsion Laboratory in Pasadena, California.

In fact, NASA's Near-Earth Object Observations Program says there have been no asteroids or comets observed that would impact Earth anytime in the foreseeable future. All known Potentially Hazardous Asteroids have less than a 0.01% chance of impacting Earth in the next 100 years.

The Near-Earth Object office at JPL is a key group involved with the international collaboration ...***Read More***...

This view of Earth comes from NASA's Moderate Resolution Imaging Spectroradiometer aboard the Terra satellite. Credit: NASA

LADEE spacecraft finds neon in lunar atmosphere

The moon's thin atmosphere contains neon, a gas commonly used in electric signs on Earth because of its intense glow. While scientists have speculated on the presence of neon in the lunar atmosphere for decades, NASA's Lunar Atmosphere and Dust Environment Explorer (LADEE) spacecraft has confirmed its existence for the first time.

"The presence of neon in the exosphere of the moon has been a subject of speculation since the Apollo missions, but no credible detections were made," said Mehdi Benna of NASA's Goddard Space Flight Center in Greenbelt, Maryland and the University of Maryland, Baltimore County. "We were very pleased to not only finally confirm its presence, but to show that it is relatively abundant." Benna is lead author of a paper describing observations from LADEE's Neutral Mass Spectrometer (NMS) instrument published May 28 in Geophysical Research Letters.

There's not enough neon to make the moon visibly glow because the moon's atmosphere is extremely tenuous, about 100 trillion times less dense than Earth's atmosphere at sea level. A dense atmosphere like Earth's is relatively rare in our solar system because an object has to be sufficiently massive to have enough gravity to hold onto it.

The behavior of a dense atmosphere is driven by collisions between its atoms and molecules. However, the moon's atmosphere is technically referred to as an exosphere because it's so thin, its atoms rarely collide. Exospheres are the most common type of atmosphere in our solar system, so scientists are interested in learning more about them. "It's critical to learn about the lunar exosphere before sustained human exploration substantially alters ...***Read More***...

Artist's concept of NASA's Lunar Atmosphere and Dust Environment Explorer (LADEE) spacecraft in orbit above the moon. Credit: NASA Ames / Dana Berry

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Mars Rovers and the Last Moonwalker to Invade Poland in September

Poland will once again host the biggest Mars rover competition in Europe. This year, from Sept. 5 to 6, the second edition of the European Rover Challenge (ERC) is expected to get even more publicity as Harrison "Jack" Schmitt, a member of the Apollo 17 crew and the last man to walk on the Moon will be a special guest of the event. ERC will also give the participants a unique opportunity to talk with Andy Weir, the author of the best-selling book "The Martian".

ERC will be held at the Regional Science and Technology Center in Podzamcze near Checiny, Poland. More than 300 designers in 34 teams from 12 countries will participate in the contest. ...***Read More***...

European Rover Challenge is the biggest space and robotics openair event in Europe. The event is addressed to a wide audience: adolescents, adults and families with children.

Scientists discover atomic-resolution details of brain signaling

Scientists have revealed never-before-seen details of how our brain sends rapid-fire messages between its cells. They mapped the 3-D atomic structure of a two-part protein complex that controls the release of signaling chemicals, called neurotransmitters, from brain cells. Understanding how cells release those signals in less than one-thousandth of a second could help launch a new wave of research on drugs for treating brain disorders.

The experiments, at the Linac Coherent Light Source (LCLS) X-ray laser at the Department of Energy's SLAC National Accelerator Laboratory, build upon decades of previous research at Stanford University, Stanford School of Medicine and SLAC. Researchers reported their latest findings today in the journal Nature.

"This is a very important, exciting advance that may open up possibilities for targeting new drugs to control neurotransmitter release. Many mental disorders, including depression, schizophrenia and anxiety, affect neurotransmitter systems," said Axel Brunger ...***Read More***….

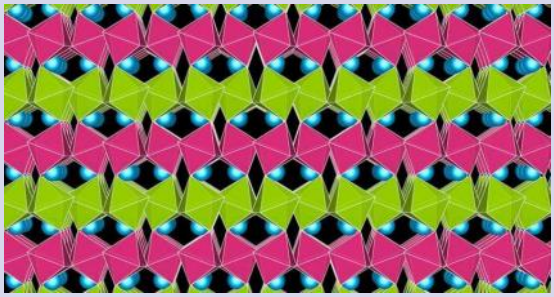
A protein complex at work in brain signaling. Its structure, which contains joined protein complexes known as SNARE and synaptotagmin-1, is shown in the foreground. This complex is responsible for the calcium-triggered release of neurotransmitters from our brain's

Superlattice design realizes elusive multiferroic properties

From the spinning disc of a computer's hard drive to the varying current in a transformer, many technological devices work by merging electricity and magnetism. But the search to find a single material that combines both electric polarizations and magnetizations remains challenging.

This elusive class of materials is called multiferroics, which combine two or more primary ferroic properties. Northwestern University's James Rondinelli and his research team are interested in combining ferromagnetism and ferroelectricity, which rarely coexist in one material at room temperature.

"Researchers have spent the past decade or more trying to find materials that exhibit these properties," said Rondinelli, assistant professor of materials science and engineering at ...***Read More***….



Superlattice structure of lithium osmate and lithium niobate