[100 Million Stars in the Andromeda galaxy.]

INTERNATIONAL YEAR OF LIGHT 2015

May 23, 2015
Volume 5, Issue 21

Astronomy & Physics News

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Weekly news from around the world compiled by Dr. Ilias Fernini

Inside this issue:

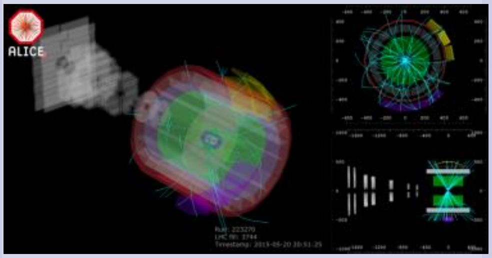
First images of LHC collisions at 13 TeV

On May 20, protons collided in the Large Hadron Collider (LHC) at the record-breaking energy of 13 TeV for the first time. These test collisions were to set up systems that protect the machine and detectors from particles that stray from the edges of the beam.

A key part of the process was the set-up of the collimators. These devices which absorb stray particles were adjusted in colliding-beam conditions. This set-up will give the accelerator team the data they need to ensure that the LHC magnets and detectors are fully protected.

Today the tests continue. Colliding beams will stay in the LHC for several hours. The LHC Operations team will continue to monitor beam quality and optimisation of the set-up.

This is an important part of the process that will allow the experimental teams running the detectors ALICE, ATLAS, CMS and LHCb to switch on their experiments fully. Data taking and the start the LHC's second run is planned for early June...***Read More***...



Protons collide at 13 TeV sending showers of particles through the ALICE detector. Credit: ALICE

WISE spacecraft discovers most luminous galaxy in universe

A remote galaxy shining with the light of more than 300 trillion suns has been discovered using data from NASA's Wide-field Infrared Survey Explorer (WISE). The galaxy is the most luminous galaxy found to date and belongs to a new class of objects recently discovered by WISE—extremely luminous infrared galaxies, or ELIRGs.

"We are looking at a very intense phase of galaxy evolution," said Chao-Wei Tsai of NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, lead author of a new report appearing in the May 22 issue of The Astrophysical Journal. "This dazzling light may be from the main growth spurt of the galaxy's black hole."

The brilliant galaxy, known as WISE J224607.57-052635.0, may have a behemoth black hole at its belly, gorging itself on gas. Supermassive black holes draw gas and matter into a disk around them, heating the disk to roaring temperatures of millions of degrees and blasting out high-energy, visible, ultraviolet, and X-ray light. The light is blocked by surrounding cocoons of dust. As the dust heats up, it radiates infrared ...***Read More***...

This artist's concept depicts the current record holder for the most luminous galaxy in the universe. The galaxy, named WISE J224607.57-052635.0, is erupting with light equal to more than 300 trillion suns. It was discovered by NASA's Wide-Field Infrared Survey Explorer, or WISE. The galaxy is smaller than the Milky Way, yet puts out 10,000 times more energy.

Syracuse physicists aid in discovery of subatomic process

Physicists in Syracuse University's College of Arts and Sciences have helped discover a rare subatomic process. Their findings, featured in the current issue of Nature magazine (Macmillan Publishers Ltd., 2015), stem from the study of proton collisions at the CERN Large Hadron Collider (LHC) in Geneva, Switzerland.

Distinguished Professor Sheldon Stone says the discovery came about when two LHC experiments recently combined their results and found overwhelming evidence of an extremely rare decay of a particle known as the Bs meson, which contains a bottom, or "b," quark and an anti-strange quark. (Quarks are the basic building blocks of protons and neutrons and come in six different types, or flavors, including bottom quarks and strange quarks.) Their findings not only provide an indirect way to test new models of new physics, but also shed light on the Standard Model, a theory describing the physical makeup of the Universe.

"This new result confirms that a Bs meson decays into two muons, a rare process that is predicted to occur only four times out of every one billion decays," says Stone, who splits time between CERN and the University. "That we were able to get the same results from two different experiments significantly increases our confidence in the data."

Lately, Stone has been working at CERN, which is home to four large multinational experiments, each with its own detector for ...***Read More***...

Syracuse University Professor Sheldon Stone. Image courtesy Syracuse University.

Electricity generating nano-wizards

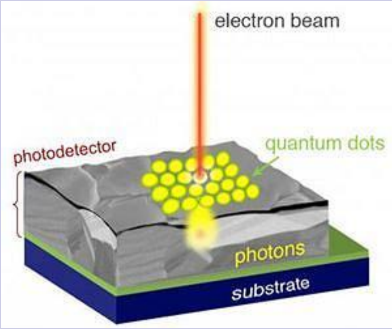
Just as alchemists always dreamed of turning common metal into gold, their 19th century physicist counterparts dreamed of efficiently turning heat into electricity, a field called thermoelectrics. Such scientists had long known that in conducting materials the flow of energy in the form of heat is accompanied by a flow of electrons.

What they did not know at the time is that it takes nanometric-scale systems for the flow of charge and heat to reach a level of efficiency that cannot be achieved with larger scale systems.

Now, in a paper published in EPJ B Barbara Szukiewicz and Karol Wysokiski from Marie Curie-Skodowska University, in Lublin, Poland have demonstrated the importance of thermoelectric effects, which are not easily modelled, in nanostructures.

Since the 1990s, scientists have looked into developing efficient energy generation from nanostructures such as quantum dots. Their advantage: they display a greater energy conversion efficiency leading to the emergence of nanoscale thermoelectrics.

The authors evaluate the thermoelectric performance of models made of two quantum dots - which are coupled electrostatically - connected to two electrodes kept at a different temperature and a single quantum dot with two levels….***Read More***...



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How supercooled water is prevented from turning into ice

Water behaves in mysterious ways. Especially below zero, where it is dubbed supercooled water, before it turns into ice. Physicists have recently observed the spontaneous first steps of the ice formation process, as tiny crystal clusters as small as 15 molecules start to exhibit the recognisable structural pattern of crystalline ice. This is part of a new study, which shows that liquid water does not become completely unstable as it becomes supercooled, prior to turning into ice crystals. The team reached this conclusion by proving that an energy barrier for crystal formation exists throughout the region in which supercooled water's compressibility continues to rise. Previous work argued that this barrier vanished as the liquid gets colder.

These findings have been published in EPJ E by Connor Buhariwalla from St. Francis Xavier University in Antigonish, Canada and colleagues.

Interestingly, liquid water becomes easier to compress, the colder it gets - unlike other substances, which become harder to compress as temperature drops. The origin of water's compressibility behaviour has been debated for decades. One possible explanation - still unconfirmed-for this unusual phenomenon stems from the presence of a transition, similar to the liquid-gas transition found when water becomes vapour. The difference: in supercooled water the transition is from one phase of liquid to another, very similar, phase of liquid water, upon cooling.

The problem is that in a normal experiment, supercooled .***Read More***...

Credit: George Hodan/public domain

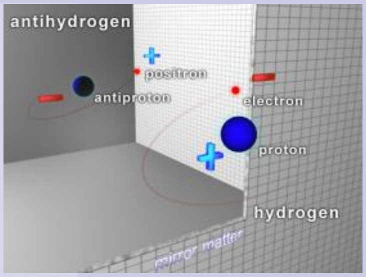
Physicists find ways to increase antihydrogen production

There are many experiments that physicists would like to perform on antimatter, from studying its properties with spectroscopic measurements to testing how it interacts with gravity. But in order to perform these experiments, scientists first need some antimatter. Of course, they won't be finding any in nature (due to antimatter's tendency to annihilate in a burst of energy when it comes in contact with ordinary matter), and creating it in the lab has proven to be very technically challenging for the same reasons.

Now in a new paper published in Physical Review Letters, Alisher S. Kadyrov, et al., at Curtin University in Perth, Australia, and Swansea University in the UK, have theoretically found a method to enhance the rate of antihydrogen production by several orders of magnitude. They hope that their finding will guide antihydrogen programs toward achieving the production of large amounts of antihydrogen for long confinement times, and at cool temperatures, as required by future investigative experiments.

"Laws of physics predict equal amounts of matter and antimatter created after the Big Bang," Kadyrov, Associate Professor at Curtin University, told Phys.org. "One of science's mysteries is where did all the antimatter go? To unravel this mystery, scientists at CERN [the European Organization for Nuclear Research] plan to do gravitational and spectroscopic experiments with antimatter. The simplest example is antihydrogen. However, it is challenging and expensive to create and study antihydrogen in the laboratory."

Antihydrogen is an appealing form of antimatter for scientists to study in part because it is electrically neutral: it consists of an antiproton (a negatively charged proton) and ...***Read More***….



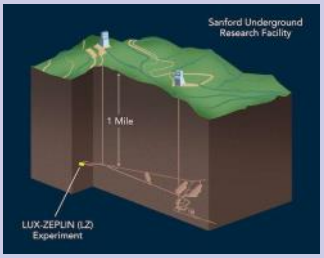
Antihydrogen consists of an antiproton and a positron. Credit: public domain

SLAC gears up for dark matter hunt with LUX-ZEPLIN

Researchers have come a step closer to building one of the world's best dark matter detectors: The U.S. Department of Energy (DOE) recently signed off on the conceptual design of the proposed LUX-ZEPLIN (LZ) experiment and gave the green light for the procurement of some of its components. DOE's SLAC National Accelerator Laboratory, a key member of the LZ collaboration, is setting up a test stand for the detector prototype and a facility to purify liquid xenon, which will be the detector's "eye" for dark matter.

If everything goes according to plan, LZ will be installed one mile underground in a cavern of the former Homestake gold mine in South Dakota. It promises to become the most sensitive tool for the direct detection of WIMPs – weakly interacting massive particles – that many researchers believe to be the fundamental components of dark matter. LZ will replace LUX, a dark matter experiment that holds the current record for looking for WIMPs of most possible masses.

"The positive DOE review is fabulous news," says Tom Abel, director of the Kavli Institute for Particle Astrophysics and Cosmology (KIPAC), a joint institute of SLAC and Stanford University that hosts SLAC's LZ team. "We look forward to contributing ...***Read More***...



In 2019, researchers plan to replace the current dark matter experiment LUX with the more sensitive LUX-ZEPLIN (LZ). It will be located one mile underground at the Sanford Underground Research Facility in South Dakota ….

Used MRI magnets get a second chance at life in high-energy physics experiments

When it comes to magnets, a doctor's trash is a physicist's treasure.

Researchers at the U.S. Department of Energy's (DOE) Argonne National Laboratory recently acquired two decommissioned magnets from magnetic resonance imaging (MRI) scanners from hospitals in Minnesota and California that will find a new home as proving grounds for instruments used in high-energy and nuclear physics experiments.

The two new magnets have a strength of 4 Tesla, not as strong as the newest generation of MRI magnets but ideal for benchmarking experiments that test instruments for the g minus 2 ("g-2") muon experiment currently being assembled at the DOE's Fermi National Accelerator Laboratory. The Muon g-2 experiment will use Fermilab's powerful accelerators to explore the interactions of muons, which are short-lived particles, with a strong magnetic field in "empty" space.

The experiment relies on highly precise measurements of the strong magnetic field; the magnets will greatly aid these measurements. "As we prepare for the g-2 experiment, we have to have a suitable test magnet to very carefully calibrate our magnetic field measuring probes ahead of time," said Argonne high-energy physicist Peter Winter, who was recently awarded a $2.5 million, five-year DOE Early Career Research Program Award.

To measure and calibrate the custom-built probes, Winter and his colleagues needed a magnet that could provide not only a strong field but one that was uniform and stable. Solenoid MRI magnets like the ones Argonne has acquired are perfect for that ….***Read More***….

Argonne high-energy physicist Peter Winter, who recently won a DOE Early Career Award, is reusing old MRI magnets, like the one seen above, to benchmark instrumentation for new high-energy physics experiments. Credit: Mark Lopez

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The Moon or Mars: Flawed Debate, False Choice - Part One

The Moon or Mars debate continues despite every single report or recommendation from NASA, NRC or other independent study that point to the Moon as the next logical destination for human space exploration and settlement. Once we hone the technologies to live there, "this time to stay" as the Bush administration of yore put it, we would have all the tools to live on Mars, return resources from the asteroids, homestead on Ceres or even the much prettier outer gems in our solar system like the satellites of Jupiter or Saturn, where the vistas are far more spectacular and seasonal changes more dynamic than anything that Mars or Venus can offer.

The physical facts are right above us in the skies every night, right in front of our eyes, for those doubting Thomases. The Moon is our closest celestial neighbor, a lifeless and barren continent, that orbits the Earth, just a quarter million miles away whereas planet Mars is at least five hundred times more distant, depending on orbital alignments. Literally and symbolically the Moon is a highly visible orb in our skies, compared to a peach pale dot that planet Mars is, that many who advocate cannot even locate in the empyrean….***Read More***...

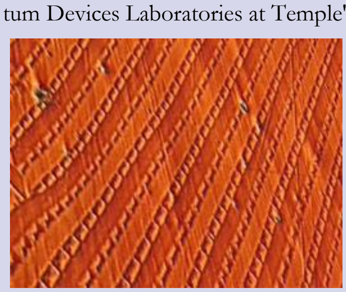
File Image.

New class of magnets could energize the world

A new class of magnets that expand their volume when placed in a magnetic field and generate negligible amounts of wasteful heat during energy harvesting, has been discovered by researchers at Temple Univ. and the Univ. of Maryland.

The researchers, Harsh Deep Chopra, professor and chair of mechanical engineering at Temple, and Manfred Wuttig, professor of materials science and engineering at Maryland, published their findings in Nature.

This transformative breakthrough has the potential to not only displace existing technologies but create altogether new applications due to the unusual combination of magnetic properties. "Our findings fundamentally change the way we think about a certain type of magnetism that has been in place since 1841," said Chopra, who also runs the Materials Genomics and Quantum Devices Laboratories at Temple's ...***Read More***...



This image shows a never before seen highly periodic magnetic "cells" or "domains" in iron-gallium alloys responsible for non-Joulian magnetism. Image: Harsh Deep Chopra/Temple Univ.

Gauging materials' physical properties from video

Last summer (2014), Massachusetts Institute of Technology (MIT) researchers published a paper describing an algorithm that can recover intelligible speech from the analysis of the minute vibrations of objects in video captured through soundproof glass.

In June, at the Conference on Computer Vision and Pattern Recognition, researchers from the same groups will describe how the technique can be adapted to infer material properties of physical objects, such as stiffness and weight, from video.

The technique could have application in the field of "nondestructive testing," or determining materials' physical properties without extracting samples from them or subjecting them to damaging physical tests. It might be possible, for instance, to identify structural defects in an airplane's wing by analyzing video of its vibration during flight….***Read More***...

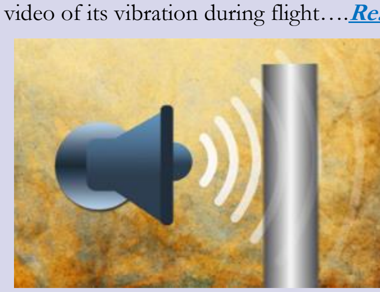


Image: Christine Daniloff/MIT