100 Million Stars in the Andromeda galaxy.

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Weekly Scientific News Compiled by Dr. Ilias Fernini

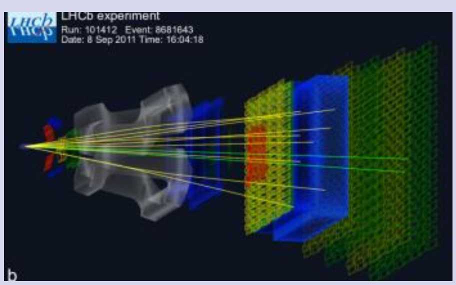
Inside this issue:

Evidence suggests subatomic particles could defy the standard model

The Standard Model of particle physics, which explains most of the known behaviors and interactions of fundamental subatomic particles, has held up remarkably well over several decades. This far-reaching theory does have a few shortcomings, however—most notably that it doesn't account for gravity. In hopes of revealing new, non-standard particles and forces, physicists have been on the hunt for conditions and behaviors that directly violate the Standard Model.

Now, a team of physicists working at CERN's Large Hadron Collider (LHC) has found new hints of particles—leptons, to be more precise—being treated in strange ways not predicted by the Standard Model. The discovery, scheduled for publication in the September 4, 2015 issue of the journal Physical Review Letters, could prove to be a significant lead in the search for non-standard phenomena.

The team, which includes physicists from the University of Maryland who made key contributions to the study, analyzed data collected by the LHCb detector during the first run ...Read More...



In this event display from the LHCb experiment at CERN's Large Hadron Collider, proton-proton collisions at the interaction point (far left) result in a shower of leptons and other charged particles. The yellow and green lines are computer-generated reconstructions of the particles' trajectories through the layers of the LHCb detector. Credit: CERN/LHCb Collaboration.

Eyeing the stars: Ethiopia's space program

High above the crowded streets of Addis Ababa, among fields where farmers lead oxen dragging wooden ploughs, sits Ethiopia's space program.

Perched on the top of the 3,200-metre (10,500-foot) high Mount Entoto, two metal domes house telescopes, each a meter in diameter. Operational for only a few months, the specialized equipment -- the first in eastern Africa -- has propelled Ethiopia into an elite club of African countries to have embarked on a space program.

For Ethiopia, Africa's second most populous nation, the program is aimed to give it a technological boost to aid the country's already rapid development. "Science is part of any development cycle -- without science and technology nothing can be achieved," said Abinet Ezra, communications director for the Ethiopian Space Science Society (ESSS). "Our main priority is to inspire the young generation to be involved in science and technology."

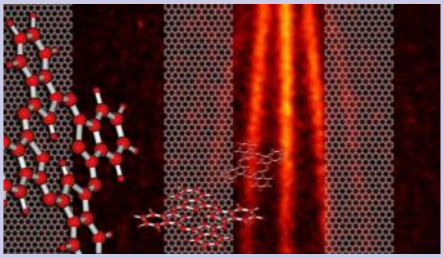
ESSS, funded by Ethiopian-Saudi business tycoon Mohammed Alamoudi, was set up in 2004 to promote astronomy….Read More…

Physicists build stable diffraction structure in atomically thin graphene

Quantum physics tell us that even massive particles can behave like waves, as if they could be in several places at once. This phenomenon is typically proven in the diffraction of a matter wave at a grating. In a European collaboration, researchers carried this idea to the extreme and observed the delocalization of molecules at the thinnest possible grating, a mask milled into a single layer of atoms. The presented experiments explore the technical limits of matter wave technologies and respond to a famous Gedanken experiment by Einstein and Bohr of almost 80 years ago. The results are published in the journal Nature Nanotechnology.

The quantum mechanical wave nature of matter is the basis for a number of modern technologies like high resolution electron microscopy, neutron-based studies on solid state materials or highly sensitive inertial sensors working with atoms. The research in the group around Prof. Markus Arndt at the University of Vienna is focused on how one can extend such technologies to large molecules and cluster.

In order to demonstrate the quantum mechanical nature of a massive object it has to be delocalized first. This is achieved by virtue of Heisenberg's uncertainty relation: If molecules are emitted from a point-like source, they start to 'forget' their position after a while and delocalize. If you place a grating into their way, they cannot know, not even in principle, through which slit they are flying. It is as if they traversed several slits at the same time. This results in a characteristic distribution of particles behind the ...Read More...



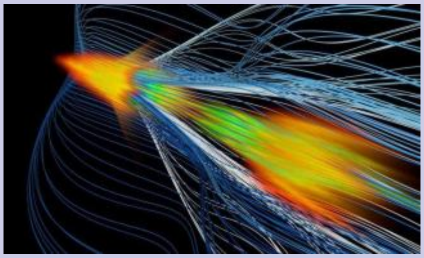
Modern fabrication methods allow to make atomically thin nanomasks which prove to be sufficiently robust for experiments in molecular quantum optics. Credit: Quantennanophysik, Fakultät für Physik, Universität Wien; Bild-Design: Christian Knobloch

Antimatter catches a wave: Accelerating positrons with plasma is a step toward smaller, cheaper particle colliders

A study led by researchers from the U.S. Department of Energy's (DOE) SLAC National Accelerator Laboratory and the University of California, Los Angeles has demonstrated a new, efficient way to accelerate positrons, the antimatter opposites of electrons. The method may help boost the energy and shrink the size of future linear particle colliders - powerful accelerators that could be used to unravel the properties of nature's fundamental building blocks.

The scientists had previously shown that boosting the energy of charged particles by having them "surf" a wave of ionized gas, or plasma, works well for electrons. While this method by itself could lead to smaller accelerators, electrons are only half the equation for future colliders. Now the researchers have hit another milestone by applying the technique to positrons at SLAC's Facility for Advanced Accelerator Experimental Tests (FACET), a DOE Office of Science User Facility.

"Together with our previous achievement, the new study is a very important step toward making smaller, less expensive next-generation electron-positron colliders," said SLAC's Mark Hogan, co-author of the study published today in Nature. "FACET is the only place in the world where we can accelerate positrons and electrons with this method." ...Read More...



Simulation of high-energy positron acceleration in an ionized gas, or plasma -- a new method that could help power next-generation particle colliders. The image shows the formation of a high-density plasma (green/orange color) around a positron beam moving from the bottom right to the top left. Plasma electrons pass by the positron beam on wave-like trajectories (lines) Credit: W. An/UCLA

Tri Alpha Energy reportedly makes important breakthrough in developing fusion reactor

Science Magazine is reporting that physicists working at Tri Alpha Energy in Los Angeles have succeeded in building a device that held a ball of superheated hydrogen and boron for five milliseconds, longer than any other effort before, offering proof that it is possible to hold such gases in a steady state. The development represents a possible breakthrough in the development of a fusion reactor as the process involved is a move towards developing technology that can hold gases at temperatures high enough to sustain a fusion reaction. true fusion reactor, if one can be built, would of course represent a transformative event in human history—it is believed such reactors could provide the energy needed to relieve our reliance on coal, and nuclear fission. The idea is relatively simple—it is the implementation that has proven to be difficult. A gas is heated to a temperature high enough so that its atoms lose their electrons creating a mass of ions and electrons, i.e. plasma. If those ions run into each other with enough force, they fuse together, causing some of their mass to be converted into energy (as happens in the sun). The trick is in heating the gas to such a high temperature that no known material could hold it—to get around that, researchers have two main possibilities, cause an implosion that occurs so quickly that the material holding it would not be impacted, or use a magnetic field—the researchers at Tri Alpha are reportedly using the second approach, but with a twist, they put magnets around a cigar shaped field-reversed configuration that allows for ...Read More...

Dying star suffers "irregular heartbeats"

Some dying stars suffer from "irregular heartbeats," research led by astronomers at the Univ. of Warwick has discovered.

The research confirms rapid brightening events in otherwise normal pulsating white dwarfs, which are stars in the final stage of their lifecycles.

In addition to the regular rhythm from pulsations they expected on the white dwarf PG1149+057, which cause the star to get a few percent brighter and fainter every few minutes, the researchers also observed something completely unexpected every few days: arrhythmic, massive outbursts, which broke the star's regular pulse and significantly heated up its surface for many hours.

The discovery was made possible by using the planet-hunting spacecraft Kepler, which stares unblinkingly at a small patch of sky, uninterrupted by clouds or sunrises.

Led by Dr. J.J. Hermes of the Univ. of Warwick's Astrophysics Group, the astronomers targeted the Kepler spacecraft on a specific star in the constellation Virgo, PG1149+057, which is roughly 120 light-years from Earth.

Dr. Hermes explains: "We have essentially found rogue ...Read More...

This is the "South Pillar" region of the star-forming region called the Carina Nebula. Like cracking open a watermelon and finding its seeds, the infrared telescope "busted open" this murky cloud to reveal star embryos tucked inside finger-like pillars of thick dust. Image: NASA

Dawn Sends Sharper Scenes from Ceres

The closest-yet views of Ceres, delivered by NASA's Dawn spacecraft, show the small world's features in unprecedented detail, including Ceres' tall, conical mountain; crater formation features and narrow, braided fractures.

"Dawn is performing flawlessly in this new orbit as it conducts its ambitious exploration. The spacecraft's view is now three times as sharp as in its previous mapping orbit, revealing exciting new details of this intriguing dwarf planet," said Marc Rayman, Dawn's chief engineer and mission director, based at NASA's Jet Propulsion Laboratory, Pasadena, California.

At its current orbital altitude of 915 miles (1,470 kilometers), Dawn takes 11 days to capture and return images of Ceres' whole surface. Each 11-day cycle consists of 14 orbits. Over the next two months, the spacecraft will map the entirety of Ceres six times.

The spacecraft is using its framing camera to extensively map the surface, enabling 3-D modeling. Every image from this orbit has a resolution of 450 feet (140 meters) per pixel, and covers less than 1 percent of the surface of Ceres.

At the same time, Dawn's visible and ...Read More...

NASA's Dawn spacecraft spotted this tall, conical mountain on Ceres from a distance of 915 miles (1,470 kilometers). The mountain, located in the southern hemisphere, stands 4 miles (6 kilometers) high. Image courtesy JPL.

NASA Funds Plasma Rocket Technology for Superfast Space Travel

Superfast journeys to Mars may be one big step closer for humanity, as NASA has sponsored a private company to develop a high-tech, plasma engine.

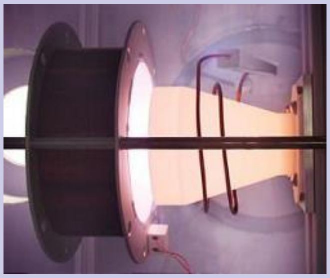
Ad Astra Rocket Company, specializing in the development of plasma rocket propulsion technology, has finished contract negotiations with NASA. As part of the Next Space Technology Exploration Partnerships (NextSTEP) award, the space agency will cover half of Ad Astra's testing expenses over the next three years.

Known as the Variable Specific Impulse Magnetoplasma Rocket, or VASIMR, the engine uses plasma technology to accelerate rockets to previously unattainable speeds. To create plasma, the proposed engines will heat pressurized gas to extremely high temperatures with radio waves. The resulting plasma is kept under control with magnetic fields.

"These experiments aim to demonstrate the engine's new proprietary core design and thermal control subsystem and to better estimate component lifetime," reads a statement from Ad Astra.

If the company successfully develops VASIMR, it could be possible for humans to reach Mars in less than two months.

Under the terms of the partnership agreement, Ad Astra has to demonstrate that its engine is capable of sustaining a power level of 100 Kilowatts for at least 100 hours. These prototype tests will be conducted in the company's Texas facility "Webster." Even before receiving NASA funding, Ad Astra had successfully ...Read More...



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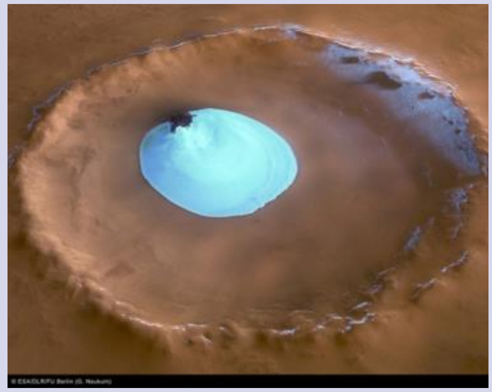
Liquid water elsewhere in our solar system?

If so, where are we likely to find it? Could we ever get to it? Would we be able to drink it? A planetary geoscientist explains.

Science fiction movies about aliens threatening the Earth routinely ascribe them the motive of coming here to steal our resources, most often our water. This is ill thought-out, as water is actually extremely common. Any civilization coming to our solar system in need of water (either to drink or to make rocket fuel) would be foolish to plunge all the way inwards to the Earth, from where they'd have to haul their booty back against the pull of the sun's gravity. ...Read More...

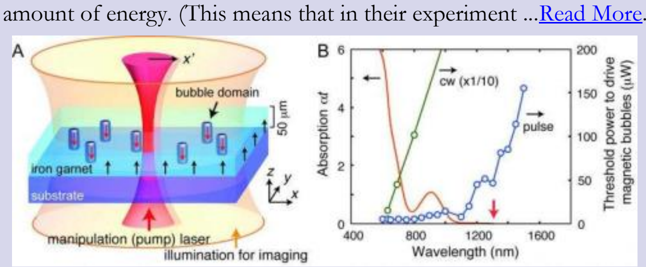


ESA's Mars Express obtained this perspective view of an unnamed impact crater located on Vastitas Borealis, a broad plain that covers much of Mars' far northern latitudes. The crater is 20 miles (35 km) wide. The circular patch of bright material located at the center of the crater is residual water ice. Image credit: ESA/DLR/FU Berlin (G. Neukum).

Magnon, meet phonon: Magnetoelastic waves can drive magnetic bubbles through photoexcitation

Research in spintronics (short for spin transport electronics – the study of the electron's intrinsic spin and associated magnetic moment in solid-state devices) continues to be focused on methods for exercising precise control of magnetic domain walls, which are topological solitons (that is, phase defects in the spin alignment separating magnetic domains). Moreover, spin momentum can be delivered to and exchanged with magnetic domain walls using magnons – quantized spin waves – in both metals and insulators.

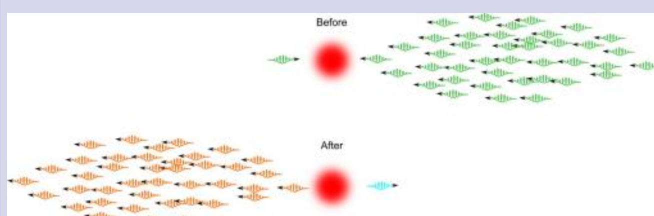
Recently, scientists at RIKEN Center for Emergent Matter Science, Japan reported that in iron garnet films, magnetoelastic waves (the coupled propagation of magnons and quantized acoustic quasiparticles known as phonons) can drive magnetic bubbles, or curved magnetic domain walls, using non-resonant photoexcitation where phonons are generated by impulsive stimulated Raman scattering (ISRS) – a process in which the incident photon in an ultrafast laser pulse is not absorbed in the material, but nevertheless imparts (or gains) a small amount of energy. (This means that in their experiment ...Read More..



A little light interaction leaves quantum physicists beaming

A team of physicists at the University of Toronto (U of T) have taken a step toward making the essential building block of quantum computers out of pure light. Their advance, described in a paper published this week in Nature Physics, has to do with a specific part of computer circuitry known as a "logic gate."

Logic gates perform operations on input data to create new outputs. In classical computers, logic gates take the form of diodes or transistors. But quantum computer components are made from individual atoms and subatomic particles. Information processing happens when the particles interact with one another according ...Read More..



Artist's rendition of what occurs when one photon goes through a carefully prepared atomic medium at the same time as a pulse including many photons. Change in the colors, represents nonlinear phase shifts picked up by each pulse that is proportional to the number of photons in the other pulse. A measurable nonlinear phase shift caused by a single photon on a pulse with many photons can enable deterministic two-qubit gates, an important missing part of the optical quantum information processing hardware. Credit: Amir Feizpour