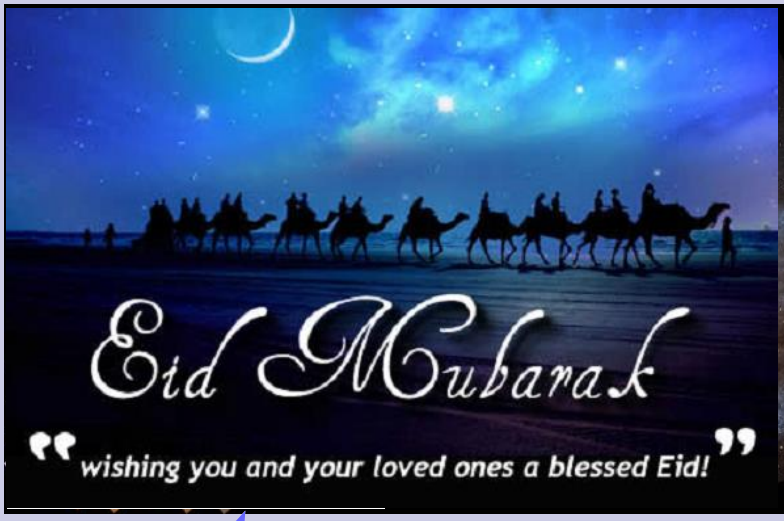

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Inside this issue:

Experiment confirms fundamental symmetry in nature

Scientists working with ALICE (A Large Ion Collider Experiment), a heavy-ion detector on the Large Hadron Collider (LHC) ring, have made precise measurements of particle mass and electric charge that confirm the existence of a fundamental symmetry in nature. The investigators include Brazilian researchers affiliated with the University of São Paulo (USP) and the University of Campinas (UNICAMP).

The findings, reported in a paper published online in Nature Physics on August 17, led the researchers to confirm a fundamental symmetry between the nuclei of the particles and their antiparticles in terms of charge, parity and time (CPT).

These measurements of particles produced in high-energy collisions of heavy ions in the LHC were made possible by the ALICE experiment's high-precision tracking and identification capabilities, as part of an investigation designed to detect subtle differences between the ways in which protons and neutrons join in nuclei while their antiparticles form antinuclei. ..Read More...

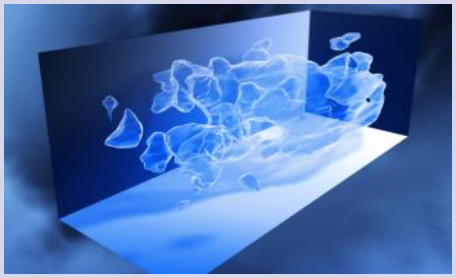
This is the "South Pillar" region of the star-forming region called the Carina Nebula. Like cracking open a watermelon and finding its seeds, the infrared telescope "busted open" this murky cloud to reveal star embryos tucked inside finger-like pillars of thick dust. Credit: NASA

New theory of stealth dark matter may explain universe's missing mass

Lawrence Livermore scientists have come up with a new theory that may identify why dark matter has evaded direct detection in Earth-based experiments.

A group of national particle physicists known as the Lattice Strong Dynamics Collaboration, led by a Lawrence Livermore National Laboratory team, has combined theoretical and computational physics techniques and used the Laboratory's massively parallel 2-petaflop Vulcan supercomputer to devise a new model of dark matter. It identifies it as naturally "stealthy" (i.e. like its namesake aircraft, difficult to detect) today, but would have been easy to see via interactions with ordinary matter in the extremely high-temperature plasma conditions that pervaded the early universe.

"These interactions in the early universe are important because ordinary and dark matter abundances today are strikingly similar in size, suggesting this occurred because of a balancing act performed between the two before the universe cooled," said Pavlos Vranas of LLNL, and one of the authors of the paper, "Direct Detection of Stealth Dark Matter through Electromagnetic Polarizability". The paper appears in..Read More..



This 3D map illustrates the large-scale distribution of dark matter, reconstructed from measurements of weak gravitational lensing by using the Hubble Space Telescope.

Engineers invent transparent coating that cools solar cells to boost efficiency

Every time you stroll outside you emit energy into the universe: Heat from the top of your head radiates into space as infrared light.

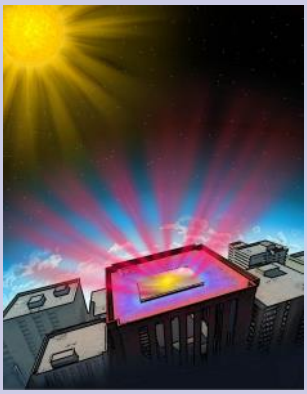
Now three Stanford engineers have developed a technology that improves on solar panel performance by exploiting this basic phenomenon. Their invention shunts away the heat generated by a solar cell under sunlight and cools it in a way that allows it to convert more photons into electricity.

The work by Shanhui Fan, a professor of electrical engineering at Stanford, research associate Aaswath P. Raman and doctoral candidate Linxiao Zhu is described in the current issue of Proceedings of the National Academy of Sciences.

The group's discovery, tested on a Stanford rooftop, addresses a problem that has long bedeviled the solar industry: The hotter solar cells get, the less efficient they become at converting the photons in light into useful electricity.

The Stanford solution is based on a thin, patterned silica material laid on top of a traditional solar cell. The material is transparent to the visible sunlight that powers solar cells, but captures and emits thermal radiation, or heat, from infrared rays.

"Solar arrays must face the sun to function, even though that heat is detrimental to efficiency," Fan said. "Our thermal overlay allows sunlight to pass through, preserving or even enhancing sunlight absorption, but it also cools the cell by radiating the heat out and improving the cell ...Read More..



Stanford engineers have invented a transparent material that improves the efficiency of solar cells by radiating thermal energy (heat) into space. Credit: Stanford Engineering

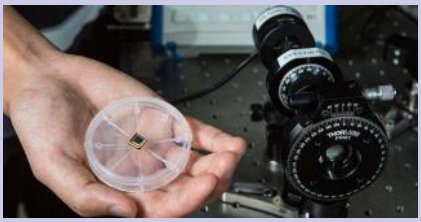
First circularly polarized light detector on a silicon chip

Invention of the first integrated circularly polarized light detector on a silicon chip opens the door for development of small, portable sensors that could expand the use of polarized light for drug screening, surveillance, optical communications and quantum computing, among other potential applications.

The new detector was developed by a team of Vanderbilt University engineers directed by Assistant Professor of Mechanical Engineering Jason Valentine working with researchers at Ohio University. The work is described in an article published on Sept. 22 in the online journal Nature Communications.

"Although it is largely invisible to human vision, the polarization state of light can provide a lot of valuable information," said Valentine. "However, the traditional way of detecting it requires several optical elements that are quite bulky and difficult to miniaturize. We have managed to get around this limitation by the use of 'metamaterials' - materials engineered to have properties that are not found in nature."

Polarized light comes in two basic forms: linear and circular. In a ray of unpolarized light, the electrical fields of individual photons are oriented in random directions. In linearly polarized light the fields of all the photons lie in the same plane. In circularly polarized light (CPL), the fields lie in a plane that continuously rotates through 360 degrees. As a result there are two types of circularly polarized light, right-handed ...Read More…



The circularly polarized light detector on a chip, on the left, performs the same function as the conventional, optically based detector on the right. Credit: Anne Rayner, Vanderbilt University

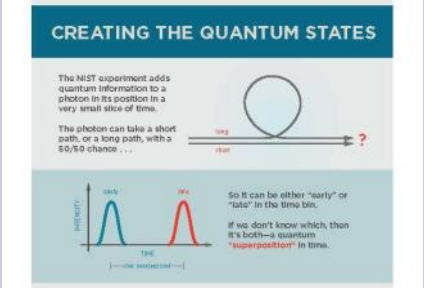
Physicists break distance record for quantum teleportation

Researchers at the National Institute of Standards and Technology (NIST) have "teleported" or transferred quantum information carried in light particles over 100 kilometers (km) of optical fiber, four times farther than the previous record.

The experiment confirmed that quantum communication is feasible over long distances in fiber. Other research groups have teleported quantum information over longer distances in free space, but the ability to do so over conventional fiber-optic lines offers more flexibility for network design.

Not to be confused with Star Trek's fictional "beaming up" of people, quantum teleportation involves the transfer, or remote reconstruction, of information encoded in quantum states of matter or light. Teleportation is useful in both quantum communications and quantum computing, which offer prospects for novel capabilities such as unbreakable encryption and advanced code-breaking, respectively. The basic method for quantum teleportation was first proposed more than 20 years ago and has been performed by a number of research groups, including one at NIST using atoms in 2004.

The new record, described in Optica ..Read More..



This graphic shows how to teleport quantum information over 100 km of fiber. Credit: Content By Martin Stevens/NIST, Design By Kelly Irvine/NIST

New Image of Rosy Nebula

In 1836, astronomer John Herschel published a sketch of a nebula located 5,500 light-years away. Against a black backdrop populated by specks of white, a hazy continuous stroke forms a distinct shape. Herschel noted the shape's resemblance to the Greek capital letter Omega.

Today, the European Southern Observatory (ESO) published a new image of Messier 17, a nebula with many nicknames, including the Omega Nebula, the Swan Nebula, the Horseshoe Nebula, the Lobster Nebula and the Checkmark Nebula.

In the new image, the nebula blossoms outwards. Its colors are a myriad of transparent reds, purples and pinks. The colors are the result of glowing hydrogen gas, according to the ESO. "The short-lived blue stars that recently formed Messier 17 emit enough ultraviolet light to heat up surrounding gas to the extent that it begins to glow brightly," reports ESO. "In the central region the colors are lighter, and some parts appear white," which "arises as a result of mixing light form the hottest gas with the starlight reflected by dust."

Messier 17 is located in the constellation of Sagittarius. Comprised of almost 800 stars, it's estimated to have a mass 30,000 times the mass of the sun. It measures 15 light-years across, and the dust and gas contained in it are fueling new star formations.

The new image was captured by Wide Field Imager on the MPG/ESO 2.2-meter telescope at ESO's La Silla Observatory in Chile.

The nebula was first discovered in 1745 by Swiss astronomer Jean-Philippe ...Read More...

This image of the rose-coloured star forming region Messier 17 was captured by the Wide Field Imager on the MPG/ESO 2.2-meter telescope at ESO's La Silla Observatory in Chile. It is one of the sharpest images showing the entire nebula and not only reveals its full size but also retains fine detail throughout the cosmic landscape of gas clouds, dust and newborn stars. Credit: ESO

The Fact and Fiction of Martian Dust Storms

For years, science fiction writers from Edgar Rice Burroughs to C. S. Lewis have imagined what it would be like for humans to walk on Mars. As mankind comes closer to taking its first steps on the Red Planet, authors' depictions of the experience have become more realistic.

Andy Weir's "The Martian" begins with a massive dust storm that strands fictional astronaut Mark Watney on Mars. In the scene, powerful wind rips an antenna out of a piece of equipment and destroys parts of the astronauts' camp. Mars is infamous for intense dust storms, which sometimes kick up enough dust to be seen by telescopes on Earth. "Every year there are some moderately big dust storms that pop up on Mars and they cover continent-sized areas and last for weeks at a time," said Michael Smith, a planetary scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

Beyond Mars' large annual storms are massive storms that occur more rarely but are much larger and more intense. "Once every three Mars years (about 5 and half Earth years), on average, normal storms grow into ..Read More..

A towering dust devil casts a serpentine shadow over the Martian surface in this image acquired by the High Resolution Imaging Science Experiment (HiRISE) camera on NASA's Mars Reconnaissance Orbiter.

Radio telescopes could spot stars hidden in the galactic center

The center of our Milky Way galaxy is a mysterious place. Not only is it thousands of light-years away, it's also cloaked in so much dust that most stars within are rendered invisible. Harvard researchers are proposing a new way to clear the fog and spot stars hiding there. They suggest looking for radio waves coming from supersonic stars.

"There's a lot we don't know about the galactic center, and a lot we want to learn," says lead author Idan Ginsburg of the Harvard-Smithsonian Center for Astrophysics (CfA). "Using this technique, we think we can find stars that no one has seen before."

The long path from the center of our galaxy to Earth is so choked with dust that out of every trillion photons of visible light coming our way, only one photon will reach our telescopes. Radio waves, from a different part of the electromagnetic spectrum, have lower energies and longer wavelengths. They can pass through the dust unimpeded.

On their own, stars aren't bright enough in the radio for us to detect them at such distances. However, if a star is traveling through gas faster than the speed of sound, the situation changes. Material blowing off of the star as a stellar wind can plow into the interstellar gases and create a shock wave. And through a process called synchrotron radiation, electrons accelerated by that shock wave produce radio emission that we could potentially detect. ...Read More...

In this infrared image from NASA's Spitzer Space Telescope, stellar winds flowing out from the fast-moving star Zeta Ophiuchi are creating a bow shock seen as glowing gossamer threads, which, for this star, are only seen in infrared light. A similar process in the galactic center could allow us to find stars we can't see any other way, according to new research. Image courtesy NASA/JPL-Caltech

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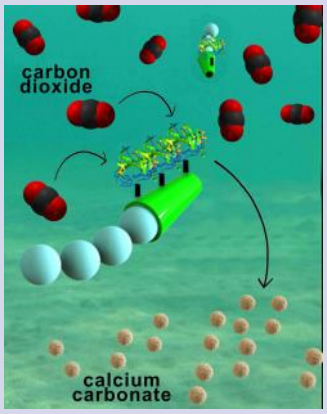
Zipping Micromotors Capture Carbon Dioxide from Water

Carbon dioxide stands as the primary greenhouse gas emitted by human activities. The Environmental Protection Agency (EPA) reported that in 2013 it accounted for 82% of the U.S.' gas emissions. Though naturally present in the atmosphere, human activity influences the carbon cycle. Such changes can be seen in the oceans, which store substantial amounts of carbon dioxide. And the EPA says heightened levels of dissolved carbon in seawater are changing its chemistry, thus increasing acidity.

Researchers from the Univ. of California, San Diego's Jacobs School of Engineering have designed carbon-capturing micromotors, which could zip around water cleaning carbon dioxide pollution. Composed of six-micrometer-long tubes, the micromotors quickly convert carbon dioxide into the solid calcium carbonate ...Read More...

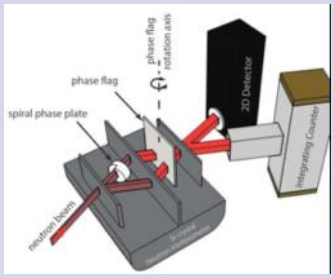


Nanoengineers have invented tiny tube-shaped micromotors that zoom around in water and efficiently remove carbon dioxide. The surfaces of the micromotors are functionalized with the enzyme carbonic anhydrase, which enables the motors to help rapidly convert carbon dioxide to calcium carbonate. Credit: Laboratory for Nanobioelectronics, UC San Diego Jacobs School of Engineering

Twisting neutrons: Orbital angular momentum of neutron waves can be controlled

It's easy to contemplate the wave nature of light in common experience. White light passing through a prism spreads out into constituent colors; it diffracts from atmospheric moisture into a rainbow; light passing across a sharp edge or a diffraction grating creates an interference pattern. It's harder to fathom the wave behavior of things usually thought of as particles, such as electrons and atoms. And yet these matter waves play a role in physics and in technology. For example, electron beams, manifested as waves, provide an important form of microscopy.

Neutrons, a basic constituent of atomic nuclei, have wave properties which are employed in a variety of research areas such as determining the structure of materials. A recent experiment provides a new handle for control of neutrons by demonstrating that a quantum variable called orbital angular momentum is accessible in beams ..Read More ...



An experiment by a team of researchers led from the University of Waterloo's Institute for Quantum Computing shows, for the first time, that a wave property of neutrons, Orbital Angular Momentum, can be controlled.This newfound control of neutron OAM states means that researchers can now use neutron OAM beams to see inside materials that optical, x-ray or electron OAM beams can't penetrate. ...

Total Eclipse of the Harvest Moon

In the days before light bulbs, farmers relied on moonlight to help them harvest their crops. Many crops ripen all at once in late summer and early autumn so farmers found themselves extremely busy at this time of year. They had to work after sundown. Moonlight became an essential part of farming, and thus, the Harvest Moon was born.

According to folklore, the Harvest Moon is the full Moon that falls closest to the autumnal equinox, the hectic beginning of northern autumn. In 2015, the Moon is full on Sept. 28th, less than a week after the equinox of Sept. 23rd. The coincidence sets the stage for a nice display of harvest moonlight. But wait. This year's Harvest Moon is not like the others. It's going to be eclipsed.

On Sep. 27-28, 2015, the super Harvest Moon will pass through the shadow of Earth, producing a lovely amber total lunar eclipse. On the night of Sept. 27 and into the early hours of Sept. 28, the full Moon will glide through the shadow of Earth ...Read More...

On Sep. 27-28, 2015, the super Harvest Moon will pass through the shadow of Earth, producing a lovely amber total lunar eclipse. Watch a video on eclipse of the Harvest Moon here.