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Inside this issue:

Bringing time, space together for universal symmetry 1

H.H Sheikh Sultan Al Qasimi opens phase II of SCASS 1

Anti-hydrogen origin revealed by collision simulation 2

Researchers create first self-assembled superconductor 2

New state of matter holds promise for ultracompact data storage and processing 2

Antarctic Fungi Survives Martian and Space Conditions 3

Giant gas cloud boomeranging back into Milky Way 3

New calibration tool will help astronomers look for habitable exoplanets 3

Heavy fermions get nuclear boost on way to superconductivity 4

The mysterious cataclysmic variable 4

Moon was produced by a head-on collision between Earth and a forming planet 4

Bringing time, space together for universal symmetry

New research from Griffith University's Centre for Quantum Dynamics is broadening perspectives on time and space. In a paper published in the prestigious journal Proceedings of the Royal Society A, Associate Professor Joan Vaccaro challenges the long-held presumption that time evolution — the incessant unfolding of the universe over time — is an elemental part of Nature. In Quantum asymmetry between time and space, she suggests there may be a deeper origin due to a difference between the two directions of time: to the future and to the past.

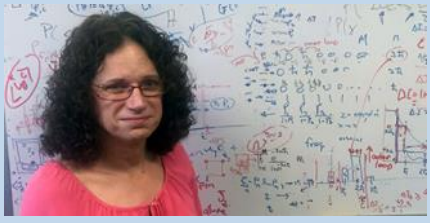
"If you want to know where the universe came from and where it's going, you need to know about time," says Associate Professor Vaccaro.

"Experiments on subatomic particles over the past 50 years ago show that Nature doesn't treat both directions of time equally.

"In particular, subatomic particles called K and B mesons behave slightly differently depending on the direction of time.

"When this subtle behavior is included in a model of the universe, what we see is the universe changing from being fixed at one moment in time to continuously evolving.

"In other words, the subtle behavior appears to be responsible for making the universe move forwards in time….Read More...



Associate Professor Joan Vaccaro, from Griffith's Centre for Quantum Dynamics

H.H. Dr. Sheikh Sultan Al Qasimi opens phase II of SCASS

H.H. Dr. Sheikh Sultan bin Mohammed Al Qasimi, Supreme Council Member, Ruler of Sharjah and president of the University of Sharjah, opened on Jan. 25 the 2nd phase of the Sharjah Center for Astronomy and Space Sciences.

Sheikh Sultan viewed at the visitors' entrance a life-size replica of the Apollo 11 spacecraft which landed the first astronauts on the moon in 1969. He also toured the facilities which were developed as part of the second phase of SCASS, adding new attractions to the planetarium, exhibition, space exhibition and the observatory.

Sheikh Sultan also stopped at the planetarium and watched, along with the officials and guests a documentary entitled Deen Al Qay-yimah (That is the Correct Religion), which he wrote. He also conducted live solar observations by opening the telescope and automatically directed the telescope to the Sun to observe sunspots and also solar flares.

H.H. Sheikh Dr. Sultan touring the Quran Exhibition Hall (top photo), and opening the telescope dome to observe the Sun (bottom photo). Images credits: GulfToday & Sharjah Media.

Anti-hydrogen origin revealed by collision simulation

Antihydrogen is a particular kind of atom, made up of the antiparticle of an electron - a Positron - and the antiparticle of a Proton - an antiproton. Scientists hope that studying the formation of anti hydrogen will ultimately help explain why there is more matter than antimatter in the universe.

In a new study published in EPJ D, Igor Bray and colleagues from Curtin University, Perth, Australia, demonstrate that the two different numerical calculation approaches they developed specifically to study collisions are in accordance. As such, their numerical approach could therefore be used to explain antihydrogen formation.

There are several methods of explaining antihydrogen creation. These involve calculating what happens when a particular kind of particle, made up of an electron and a positron bound together, called positronium, scatters on a proton or on an antiproton.

The trouble is that devising numerical simulations of such collision is particularly difficult due to the presence of two centres for the occurrence: the atomic level with the proton and at the positronium level.

The authors employed two very different calculations - using a method dubbed coherent close-coupling - for both one- and two-centre collisions respectively in positron scattering on hydrogen and helium.

Interestingly, they obtained independently convergent results for both approaches. .Read More..

File Image.

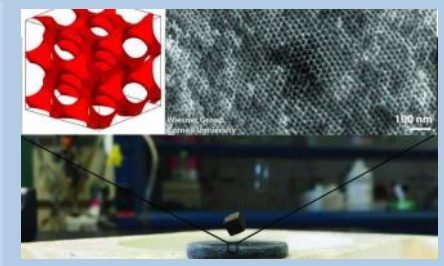
Researchers create first self-assembled superconductor

Building on nearly two decades' worth of research, a multidisciplinary team at Cornell has blazed a new trail by creating a self-assembled, three-dimensional gyroidal superconductor.

Ulrich Wiesner, a materials science and engineering professor who led the group, says it's the first time a superconductor, in this case niobium nitride (NbN), has self-assembled into a porous, 3-D gyroidal structure. The gyroid is a complex cubic structure based on a surface that divides space into two separate volumes that are interpenetrating and contain various spirals. Pores and the superconducting material have structural dimensions of only around 10 nanometers, which could lead to entirely novel property profiles of superconductors.

Currently, superconductivity for practical uses such as in magnetic resonance imaging (MRI) scanners and fusion reactors is only possible at near absolute zero (-459.67 degrees Fahrenheit), although recent experimentation has yielded superconducting at a comparatively balmy -70 degrees C (-94 degrees F).

"There's this effort in research to get superconducting at higher temperatures, so that you don't have to cool anymore," Wiesner said. "That would revolutionize everything. There's a huge impetus to get that." Wiesner and his co-author Sol Gruner had been dreaming for over two decades about making a gyroidal superconductor in order to explore how this would affect the superconducting properties. The ...Read More...



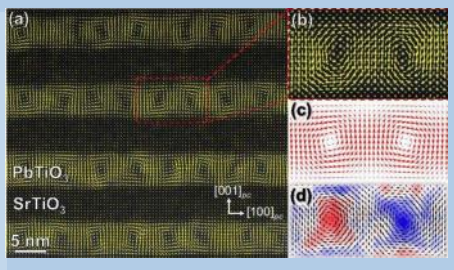
The Wiesner Group at Cornell University has synthesized the first block copolymer self-assembly-derived nanostructured superconductor. Shown is an example of a bismuth-based superconductor levitating a magnet, with simulated and electron microscope images of the nanostructured material. Credit: Cornell University

New state of matter holds promise for ultracompact data storage and processing

The observation in a ferroelectric material of "polar vortices" that appear to be the electrical cousins of magnetic skyrmions holds intriguing possibilities for advanced electronic devices. These polar vortices, which were theoretically predicted more than a decade ago, could also "rewrite our basic understanding of ferroelectrics" according to the researchers who observed them.

A team of scientists with the U.S. Department of Energy (DOE)'s Lawrence Berkeley National Laboratory (Berkeley Lab) and the University of California (UC) Berkeley have recorded the first ever observations of rotating topologies of electrical polarization that are similar to the discrete swirls of magnetism known as "skyrmions." If these smoothly rotating vortex/anti-vortex topologies prove to be electrical skyrmions, they could find potential applications in ultracompact data storage and processing, and could also lead to the production of new states of matter and associated phenomena in ferroic materials.

"It has long been thought that rotating topological structures are confined to magnetic systems and aren't possible in ferroelectric materials, but through the creation of artificial superlattices, we have controlled the various energies of a ferroelectric material to promote competition that lead to such new states of matter and polarization arrangements," says Ramamoorthy ...Read More...



The first ever observations of polar vortices in a ferroelectric material could find potential applications in ultracompact data storage and processing and the production of new states of matter.

Antarctic Fungi Survives Martian and Space Conditions

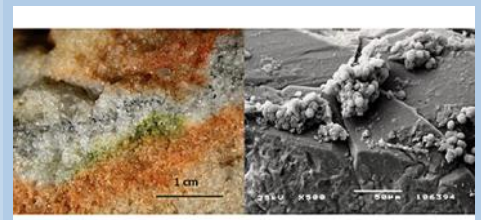
For 18 months, the organisms were subjected to Mars-like conditions. The atmosphere was 95% carbon dioxide, 1.6% argon, 0.15% oxygen, 2.7% nitrogen, and 370 ppm water, with a pressure of 1,000 pascals. Additionally, they were exposed to ultra-violet radiation similar to that on Mars. And they returned alive.

European scientists recently tested the viability of Antarctic fungi in both Martian and space conditions aboard the International Space Station (ISS).

In the McMurdo Dry Valleys of Antarctica, only the fittest organisms survive. And usually, they're microorganisms. A handful of years ago, scientists collected samples of the fungi Cryomyces antarcticus and Cryomyces minteri. Placed in cells 1.4 cm in diameter, the fungi were situated outside the ISS's Columbus module.

"More than 60% of the cells of the endolithic communities studied remained intact after 'exposure to Mars,' or rather, the stability of their cellular DNA was still high," said Rosa de la Torre, of Spain's National Institute of Aerospace Technology.

However, less than 10% of the retrieved fungi samples exposed to Martian conditions were capable of proliferating and forming colonies, the researchers reported.
The findings were published in Astrobiology.
The study was performed as part of the European Space Agency (ESA)'s Lichens and Fungi Experiment (LIFE)….Read More...

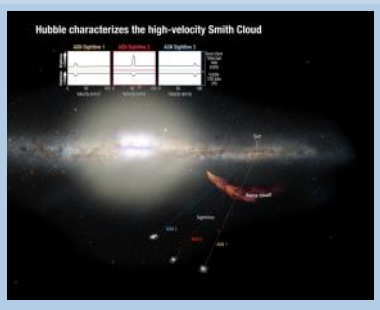


Section of rock coloniszed by cryptoendolithic microorganisms and the Cryomyces fungi in quartz crystals under an electron microscope. Courtesy of S. Onofri et al.

Giant gas cloud boomeranging back into Milky Way

Since astronomers discovered the Smith Cloud, a giant gas cloud plummeting toward the Milky Way, they have been unable to determine its composition, which would hold clues as to its origin. University of Notre Dame astrophysicist Nicolas Lehner and his collaborators have now determined that the cloud contains elements similar to our sun, which means the cloud originated in the Milky Way's outer edges and not in intergalactic space as some have speculated.

The Smith Cloud, discovered in the 1960s, is the only high-velocity cloud in the galaxy for which its orbit is well-determined, thanks in particular to studies with radio telescopes like the Green Bank Telescope (GBT). The starless gas cloud is traveling at nearly 700,000 miles per hour and is expected to crash into the Milky Way disk in 30 million years. If it were visible, the Smith Cloud would have an apparent size of about 30 times the diameter of the moon from tip to tail. Astronomers long thought that the Smith Cloud might be some starless galaxy or gas falling into the Milky Way from intergalactic space. If that were the case, the cloud composition would be mainly hydrogen and helium, not the heavier elements made by stars. Read More..



This graphic shows how researchers used the Hubble Space Telescope to view three distant galaxies through the Smith Cloud, a technique that helped them determine the makeup of the cloud.

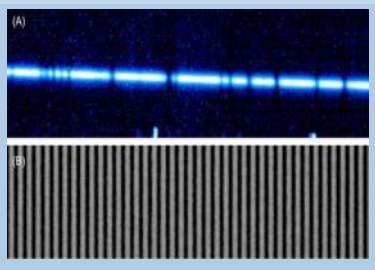
New calibration tool will help astronomers look for habitable exoplanets

Promising new calibration tools, called laser frequency combs, could allow astronomers to take a major step in discovering and characterizing earthlike planets around other stars. These devices generate evenly spaced lines of light, much like the teeth on a comb for styling hair or the tick marks on a ruler—hence their nickname of "optical rulers." The tick marks serve as stable reference points when making precision measurements such as those of the small shifts in starlight caused by planets pulling gravitationally on their parent stars.

Yet today's commercially available combs have a significant drawback. Because their tick marks are so finely spaced, the light output of these combs must be filtered to produce useful reference lines. This extra step adds complexity to the system and requires costly additional equipment.

To resolve these kinds of issues, Caltech researchers looked to a kind of comb not previously deployed for astronomy. The novel comb produces easily resolvable lines, without any need for filtering. Furthermore, the Caltech comb is built from off-the-shelf components developed by the telecommunications industry.

"We have demonstrated an alternative approach that is simple, reliable, and relatively inexpensive," says paper coauthor Kerry Vahala, the Ted and Ginger Jenkins Professor of Information Science and Technology and Applied Physics as well as the executive officer for Applied Physics and Materials Science in Caltech's Division of Engineering and Applied Science. The kind of frequency comb used by the researchers previously has been studied in the Vahala group in a different ...Read More...



(A) A segment of the near infrared (IR) spectrum of a cool star as observed by the Keck II telescope's near infrared spectrometer (NIRSPEC). Dark bands represent absorption features in the star's atmosphere. (B) A segment of the near IR spectrum from the laser frequency comb, observed by NIRSPEC during daytime tests. Small shifts of the spectrum relative to the stable wavelength standard provided by the laser comb would yield a precision measurement of the wobble induced by an orbiting planet. Credit: Emily Martin

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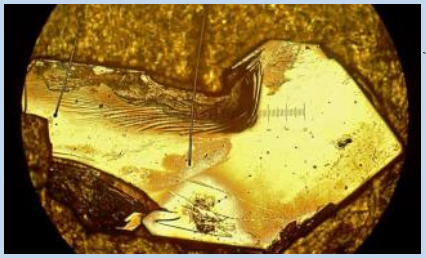
Heavy fermions get nuclear boost on way to superconductivity

In a surprising find, physicists from the United States, Germany and China have discovered that nuclear effects help bring about superconductivity in ytterbium dirhodium disilicide (YRS), one of the most-studied materials in a class of quantum critical compounds known as "heavy fermions."

The discovery, which is described in this week's issue of Science, marks the first time that superconductivity has been observed in YRS, a composite material that physicists have studied for more than a decade in an effort to probe the quantum effects believed to underlie high-temperature superconductivity.

Rice University physicist and study co-author Qimiao Si said the research provides further evidence that unconventional superconductivity arises from "quantum criticality."

"There is already compelling evidence that unconventional superconductivity is linked in both copper-based and iron-based high-temperature superconductors to quantum fluctuations that alter the magnetic order of the materials at 'quantum critical points,' watershed thresholds that mark the ...Read More...



This microscopic closeup shows a small sample of ytterbium dirhodium disilicide, one of the most-studied 'heavy fermion' composites. The scale bar in the center of the screen is one millimeter wide. Credit: Marc Tippmann/Technical University of Munich

The mysterious cataclysmic variable star Mu

Located about 510 light years from the Earth, Mu Centauri is a very interesting and mysterious cataclysmic variable star. It is a dwarf nova, a close binary star system in which a white dwarf accretes matter from its companion. Although little is know about Mu Centauri, we could observe temporal variations of its brightness and its flickering on a relatively low level. It was also found that this system's light curve contains odd consistent modulations on two different periods. A recent research paper published on Jan. 21 in the arXiv journal by Albert Bruch from the Laboratório Nacional de Astrofísica in Brazil, describes the mysterious nature of Mu Centauri.

Bruch used the 0.6-m Zeiss and the 0.6-m Boller & Chivens telescopes of the Observatorio do Pico dos Dias in Brazil, to observe the star. The photometric observations of its light curves were conducted during six nights in February, May and June 2015.

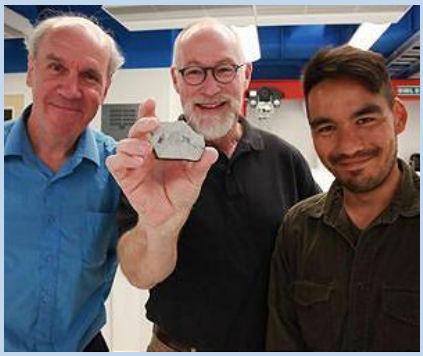
The brightness of Mu Centauri was measured as magnitude difference with respect to several comparison stars in the field. The observations showed a clear modulation on a time scale of about four hours. According to the author of the paper, this points to ...Read More...

Mu Centauri. Credit: Palomar Observatory/STScI/WikiSky

Moon was produced by a head-on collision between Earth and a forming planet

The moon was formed by a violent, head-on collision between the early Earth and a "planetary embryo" called Theia approximately 100 million years after the Earth formed, UCLA geochemists and colleagues report. Scientists had already known about this high-speed crash, which occurred almost 4.5 billion years ago, but many thought the Earth collided with Theia (pronounced THAY-eh) at an angle of 45 degrees or more - a powerful side-swipe (simulated in this 2012 YouTube video). New evidence reported Jan. 29 in the journal Science substantially strengthens the case for a head-on assault.

The researchers analyzed seven rocks brought to the Earth from the moon by the Apollo 12, 15 and 17 missions, as well as six volcanic rocks from the Earth's mantle - five from Hawaii and one from Arizona. The key to reconstructing the giant impact ...Read More…



This image shows from left Paul Warren, Edward Young and Issaku Kohl. Young is holding a sample of a rock from the moon. Image courtesy Christelle Snow/UCLA.