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Astronomy & Physics News

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

100 Million Stars in the Andromeda galaxy.

Inside this issue:

Possible discovery in 2015 of a new particle in physics

The world's largest atom-smasher could help physicists understand mysterious dark matter in the universe, and later this year it may offer a discovery even more fascinating than the Higgs-Boson, researchers say.

The Large Hadron Collider, built by the European Organization for Nuclear Research (CERN), has undergone major upgrades this year will begin its second, three-year run.

CERN says that after a two-year break for upgrades, the LHC will be twice as powerful this time.

The collider is already credited with helping physicists discover the elusive Higgs boson, which helps explain how objects have mass, and which led to the award of the 2013 Nobel Prize for physics.

This year, the atom-smasher will restart at a beam energy that is substantially higher, with the goal of better understanding why nature prefers matter to antimatter.

A new discovery "could be as early as this year... if we are really lucky," said Beate Heinemann, professor of physics at the University of California, Berkeley, during a talk on ...***Read More***...

The Large Hadron Collider this year will begin its second, three-year run.

What if the universe had no beginning?

Reports of the death of the Big Bang have been greatly exaggerated. Big Bang theory is alive and well. At the same time, our universe may not have a beginning or end.

Are you seeing the stories this week suggesting that the Big Bang didn't happen? According to astrophysicist Brian Koberlein – a great science communicator at Rochester Institute of Technology with a popular page on G+ – that's not quite what the new research (published in early February 2015 Physics Letters B, has suggested. The new study isn't suggesting there was no Big Bang, Koberlein says. It's suggesting that the Big Bang did not start with asingularity – a point in space-time when matter is infinitely dense, as at the center of a black hole. How can this be? Koberlein explains on his website:

The catch is that by eliminating the singularity, the model predicts that the universe had no beginning. It existed forever as a kind of quantum potential before 'collapsing' into the hot dense state we call the Big Bang. Unfortunately many articles confuse 'no singularity' with 'no big bang.'

The new model – in which our universe has no beginning and no end – comes from Ahmed Farag Ali at Benha University in Egypt and coauthor Saurya Das at the University ...***Read More***...

Most of us understand the Big Bang as the idea that our entire universe came from a single point, what astrophysicists call a "singularity." But we might not need a singularity to have a Big Bang, according to a new study. Image via mondolithic.com

'Cloud' over Mars leaves scientists baffled

Plumes seen reaching high above the surface of Mars are causing a stir among scientists studying the atmosphere on the Red Planet.

On two separate occasions in March and April 2012, amateur astronomers reported definite plume-like features developing on the planet.

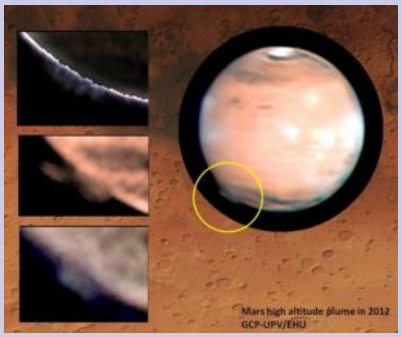
The plumes were seen rising to altitudes of over 250 km above the same region of Mars on both occasions. By comparison, similar features seen in the past have not exceeded 100 km.

"At about 250 km, the division between the atmosphere and outer space is very thin, so the reported plumes are extremely unexpected," says Agustin Sanchez-Lavega of the Universidad del País Vasco in Spain, lead author of the paper reporting the results in the journal Nature.

The features developed in less than 10 hours, covering an area of up to 1000 x 500 km, and remained visible for around 10 days, changing their structure from day to day.

None of the spacecraft orbiting Mars saw the features because of their viewing geometries and illumination conditions at the time.

However, checking archived Hubble Space Telescope images taken between 1995 and 1999 and of databases of amateur images spanning 2001 to 2014 revealed occasional clouds at the limb of Mars, albeit usually only up to 100 .km in altitude….***Read More***...



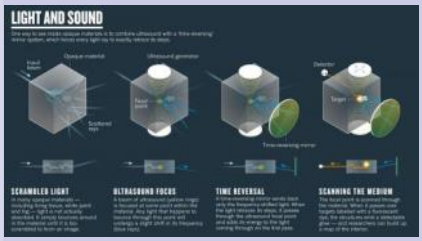
Mars with the plume at limb identified within the yellow circle, and at right, augmented views of the changing plume morphology in images taken by W. Jaeschke and D. Parker on March 21, 2012. On the background an area on Terra Cimmeria on Mars (longitude 207□ and latitude -32□) where the plume formed (Image source NOAA). Credit: Grupo Ciencias Planetarias (GCP) - UPV/EHU

Scientists making progress with techniques that allow for seeing through opaque materials

It has been a desire, if not a dream for many throughout human history, to create a device that allows for seeing through walls (ala Superman), inside the human body or through a shield so that the enemy can be seen without risk. Surprisingly, over the past several years, scientists have begun to find ways to do such things—this week author/journalist Zeeya Merali offers a News Feature in the journal Nature outlining research in this area and where she feels it might be heading.

As Meralis notes, it was just eight years ago that a pair of researchers (Allard Mosk and Ivo Vellekoop) working at the University of Twente in Enschede, the Netherlands found a way to shine a light through an opaque material, igniting a rush by others to investigate their discovery further. Their work, and the work done by others after them is all based on unscrambling light that has been scattered after running through a material.

In the original experiment, the researchers borrowed algorithms used by astronomers to resolve scattered light—called adaptive optics, it is a way to use a computer to make sense of the scattering that occurs and un-scatter it, allowing for a clear view of stars and other objects out in space. In the lab, the researchers covered a plate of glass with paint and then ran a beam of light through a spatial light modulator before it struck the target and passed through it—allowing them to measure a pinpoint of light on the other side...***Read More***...



Credit: (c) Jasiek Krzysztofiak/Nature

What is Hooke's Law?

The spring is a marvel of human engineering and creativity. For one, it comes in so many varieties – the compression spring, the extension spring, the torsion spring, the coil spring, etc. – all of which serve different and specific functions. These functions in turn allow for the creation of many man-made objects, most of which emerged as part of the Scientific Revolution during the late 17th and 18th centuries.

As an elastic object used to store mechanical energy, the applications for them are extensive, making possible such things as an automotive suspension systems, pendulum clocks, hand sheers, wind-up toys, watches, rat traps, digital micro-mirror devices, and of course, the Slinky.

Like so many other devices invented over the centuries, a basic understanding of the mechanics is required before it can so widely used. In terms of springs, this means understanding the laws of elasticity, torsion and force that come into play – which together are known as Hooke's Law.

Hooke's Law is a principle of physics that states that the that the force needed to extend or compress a spring by some distance is proportional to that distance. The law is named after 17th century British physicist Robert Hooke, who sought to demonstrate the relationship between the forces applied to a spring and its elasticity. He first stated the law in 1660 as a Latin anagram, and then published the solution in 1678 as ut tensio, sic vis – which translated, means "as the ...***Read More***...

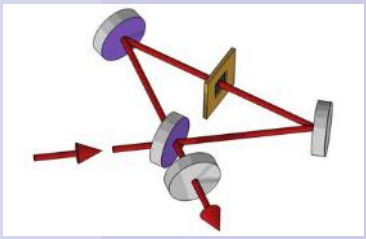
A historical reconstruction of what Robert Hooke looked like, painted in 2004 by Rita Greer. Credit: Wikipedia/Rita Greer/FAL

Physicists reveal new way of cooling large objects with light

A new technique for cooling a macroscopic object with laser light has been demonstrated by a team of physicists in Germany and Russia. Making clever use of the noise in an optical cavity, which normally heats an object up, the technique could lead to the development of "stable optical springs" that would boost the sensitivity of gravitational-wave detectors. It could also be used to create large quantum-mechanical oscillators for studying the quantum properties of macroscopic objects or to create components for quantum computers.

Physicists already have ways of cooling tiny mirrors by placing them in an optical cavity containing laser light. When the mirror is warm, it vibrates – creating a series of "sidebands" that resonate with light at certain frequencies. The first lower sideband has a frequency equal to the difference between the resonant frequency of the cavity and the vibrational frequency of the mirror. So when a photon at that frequency enters the cavity, it can be absorbed and re-emitted with an extra quantum of vibrational energy. As a result of this "dispersive coupling" process, the mirror cools because energy from it is removed.

Dispersive coupling works best when the bandwidth of the cavity is much smaller than the vibrational frequency of the mirror. This is possible for relatively small mirrors with vibrational frequencies in the hundreds of megahertz. However, for more massive mirrors with vibrational frequencies in the hundreds of kilohertz, optical cavities with sufficiently narrow bandwidths are simply not available.



Cold light: Dispersive and dissipative coupling join forces

Cooling with noise

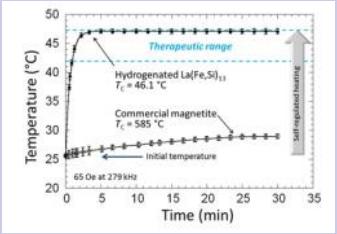
In this latest work, a large object was cooled using a new technique that involves "dissipative coupling" ...***Read More***....

Magnetic material's unusual heating effect could fry cancer cells at the perfect temperature

When exposed to a varying magnetic field, some conductive materials undergo a temperature increase of about 3-5 K over several minutes. This effect is called induction heating, and it occurs because small electric currents cause heating due to resistance. Now in a new study, scientists have found that, under the same conditions, the temperature of a certain magnetic material increases by more than 20 K in less than a minute—and then abruptly stops and does not increase any further. The large, self-regulated heating power occurs at just the right temperature to potentially enable it to be used as a safe and effective form of hyperthermia treatment of cancer cells.

The researchers, led by Professor Kiyonori Suzuki at Monash University, Australia, and Professor Karl G. Sandeman at CUNY-Brooklyn College, US, and Imperial College London, UK, have published their paper on the extraordinary heating effect of the magnetic material in a recent issue of Applied Physics Letters.

The material, La-Fe-Si-H, is a well-known magnetocaloric material, meaning it heats up when exposed to a magnetic field. La-Fe-Si-H is also ferromagnetic at room temperature, so that its magnetic dipoles align with an applied magnetic field and remain aligned even when the magnetic field is removed...***Read More***...



This graph shows the very large and self-regulated heating effect of La-Fe-Si-H (near the therapeutic temperature for cancer treatment) compared to another conductive material, magnetite. Credit: Barati, et al. ©2014 AIP Publishing

Atomic-resolution holography electron microscope with the world's highest point resolution

Hitachi today announced that it has developed an atomic-resolution holography electron microscope accelerated at a 1.2-megavolt ("MV") under the government-sponsored FIRST Program project named "Development and Application of an Atomic-resolution Holography Electron Microscope", and has achieved the world's highest point resolution of 43 picometers ("pm"), i.e., 43 trillionths of a meter. With its ability to measure electromagnetic fields at the atomic resolution, the developed microscope will contribute to the advancement of fundamental sciences by supporting the development of cutting-edge functional materials, through elucidating quantum phenomena that cause the functions and properties of high-performance materials, such as magnets, batteries, and superconductors.

In recent years, significant progress has been made in the development of technologies that enable the measurement of electromagnetic fields causing the functions and properties in and around materials at atomic resolutions.

For example, materials for magnets must have not only high magnetic performance at room temperatures, but they are also required to be usable under high temperatures and high magnetic fields. To develop such magnetic materials, the following procedures are required: evaluation of the atomic arrangements in those materials, determination of their magnetic properties, and acquisition of guiding principles for optimum material compositions and arrangements and manufacturing methods. For these purposes, electron microscopes with higher resolutions have been developed...***Read More***...

Fig.1 Appearance of an atomic-resolution holography electron microscope

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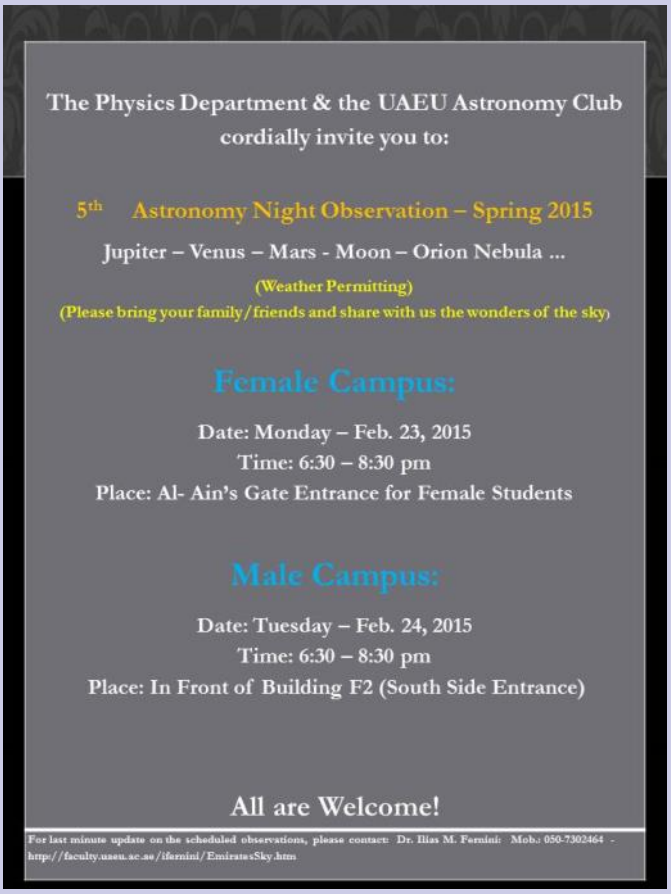


SETI scientists say it's time to send messages to ET

Scientists want to contact extraterrestrial civilizations. Some applause the effort. Others say this is not a good plan at all. The idea is for messages encoded in radio signals to be sent repeatedly for hundreds of years to planets in habitable zones around stars, said a report in The Guardian. Repeated signals would be beamed at nearby planets that were chosen for their odds of harboring life. The scientists are from the Search for Extraterrestrial Intelligence (SETI) Institute in California.

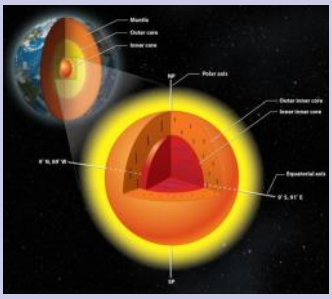
The BBC said that SETI's researchers have been listening for signals from outer space for more than 30 years using radio telescope facilities. So far there has been no sign. Writing in Science Insider, Eric Hand said, "Since the SETI movement began in the 1960s, it has mostly involved using radio telescopes to listen to bands in the electromagnetic spectrum for something out of the ordinary." Seth Shostak, director of the SETI Institute, believes that it is time to step up the search from listening to broadcasting. "Some of us at the institute are interested in 'active Seti', not just listening but broadcasting something to some nearby stars because maybe there is some chance that if you wake somebody up you'll get a response," he told BBC ...***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

Earth's surprise inside: Geologists unlock mysteries of the planet's inner core

Seismic waves are helping scientists to plumb the world's deepest mystery: the planet's inner core.

Thanks to a novel application of earthquake-reading technology, a research team at the University of Illinois and colleagues at Nanjing University in China have found that the Earth's inner core has an inner core of its own, which has surprising properties that could reveal information about our planet….***Read More***...



A research team from the University of Illinois and colleagues in China found earth's inner core has an inner core of its own, with crystals aligned in a different direction.