INTERNATIONAL YEAR OF LIGHT 2015

100 Million Stars in the Andromeda galaxy.

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Astronomy & Physics News

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

Inside this issue:

UAE to unveil Mars mission plan

The National—Abu Dhabi - The UAE will unveil the scientific and logistical details of the first Arab mission to Mars next week, May 06.

The plan for the spacecraft's seven to nine-month journey across the solar system will be released during an event on Wednesday. It will be attended by Sheikh Mohammed bin Rashid, Vice President and Ruler of Dubai, and high-ranking officials.

Emirati engineers and scientists, who will be working on the project for the next five years, will be there to discuss the research that will take place when the spacecraft reaches Mars.

The UAE announced last July that it would create a space agency, with plans to send a probe to the Red Planet by 2021. The mission will coincide with the 50th anniversary of the country's formation.

"The UAE Mars probe represents the Islamic world's entry into the era of space exploration. We will prove that we are capable of new scientific contributions to humanity," the President, Sheikh Khalifa, said at the time.

He added that the plan was to make the UAE a world leader in aerospace by 2021.

The Mars mission will be led by Emiratis.

To date, the UAE has invested Dh20 billion in the aerospace industry, according to Mohammed Al Ahbabi, UAE Space Agency director general.

Sarah Amiri's Workshop at UAEU

Sarah Amiri, the Emirates Mars eXplorer Mission Science Lead from EIAST, gave on Apr. 29 a workshop at UAEU outlining the Mars mission. She emphasized on the Emirates nature of the mission and its goals to involve the students and faculty members of UAEU in the program.

Strong Evidence for Coronal Heating by Nanoflares

The Sun's surface is blisteringly hot at 6,000 kelvins or 10,340 degrees Fahrenheit - but its atmosphere is another 300 times hotter. This has led to an enduring mystery for those who study the Sun: What heats the atmosphere to such extreme temperatures? Normally when you move away from a hot source the environment gets cooler, but some mechanism is clearly at work in the solar atmosphere, the corona, to bring the temperatures up so high.

Clear evidence now suggests that the heating mechanism depends on regular, but intermittent explosive bursts of heat, rather than on continuous gradual heating. This solution to the coronal heating mystery was presented in a media briefing on April 28, 2015, at the Triennial Earth-Sun Summit, or TESS, meeting in Indianapolis, Indiana.

This is the inaugural meeting for TESS, which is a first of its kind: uniting the various research groups that study the Sun-Earth connection from explosions on the Sun to their effects near our home planet and all the way out to the edges of the solar system - a research ...***Read More***….

New evidence supports a theory that the Sun's corona is heated by tiny explosions called nanoflares.

From metal to insulator and back again

New work from Carnegie's Russell Hemley and Ivan Naumov hones in on the physics underlying the recently discovered fact that some metals stop being metallic under pressure. Their work is published in Physical Review Letters.

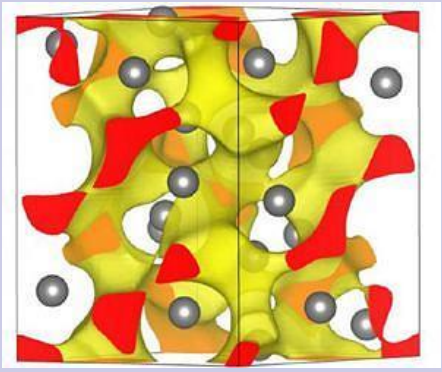
Metals are compounds that are capable of conducting the flow of electrons that make up an electric current. Other materials, called insulators, are not capable of conducting an electric current. At low temperatures, all materials can be classified as either insulators or metals.

Insulators can be pushed across the divide from insulator to metal by tuning their surrounding conditions, particularly by placing them under pressure. It was long believed that once such a material was converted into a metal under pressure, it would stay that way forever as the pressure was increased. This idea goes back to the birth of quantum mechanics in the early decades of the last century.

But it was recently discovered that certain groups of metals become insulating under pressure-a remarkable finding that was not previously thought possible.

For example, lithium goes from being a metallic conductor to a somewhat resistant semiconductor under around 790,000 times normal atmospheric pressure (80 gigapascals) and then becomes fully metallic again under around 1.2 million times normal atmospheric pressure (120 gigapascals).

Sodium enters an insulating state ...***Read More***...



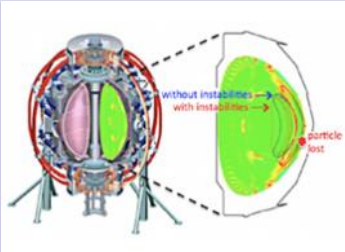
This is a view of the localized electrons in the unusual insulating state of Li under pressure, courtesy of Russell Hemley and Ivan Naumov. Image courtesy Russell Hemley and Ivan Naumov

An improvement to the global standard for modeling fusion plasmas

The gold standard for modeling the behavior of fusion plasmas may have just gotten better. Mario Podestà, a staff physicist at the U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL), has updated the worldwide computer program known as TRANSP to better simulate the interaction between energetic particles and instabilities—disturbances in plasma that can halt fusion reactions. The program's updates, reported this week in Nuclear Fusion, could lead to improved capability for predicting the effects of some types of instabilities in future facilities such as ITER, the international experiment under construction in France to demonstrate the feasibility of fusion power.

Podestà and co-authors saw a need for better modeling techniques when they noticed that while TRANSP could accurately simulate an entire plasma discharge, the code wasn't able to represent properly the interaction between energetic particles and instabilities. The reason was that TRANSP, which PPPL developed and has regularly updated, treated all fast-moving particles within the plasma the same way. Those instabilities, however, can affect different parts of the plasma in different ways through so-called "resonant processes."

The authors first figured out how to condense information from other codes that do model the interaction accurately—albeit over short time periods—so that TRANSP could incorporate that information into its simulations. Podestà then teamed up with TRANSP developer Marina ...***Read More***...



Schematic of NSTX tokamak at PPPL with a cross-section showing perturbations of the plasma profiles caused by instabilities. Without instabilities, energetic particles would follow closed trajectories and stay confined inside the plasma (blue orbit). With instabilities, trajectories can be modified and some particles may eventually be pushed out of the plasma boundary and lost (red orbit). Image by Mario Podesta.

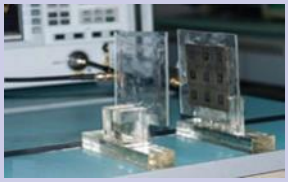
Wireless power transfer enhanced by metamaterials

Over the past decade, research on wireless power transfer has led to the development of several commercial applications, such as wireless charging of mobile devices and electric toothbrushes, as well as wireless powering of radio-frequency identification (RFID) tags. However, these applications are restricted by limitations on the distance and efficiency of current wireless power transfer technology.

In a new study published in EPL, scientists at Tongji University in Shanghai, China, have experimentally demonstrated a way to improve the efficiency of wireless power transfer by using magnetic metamaterials. The new method improves the efficiency of the design from a few percent to nearly 20% at a distance of 4 cm, which could pave the way toward new applications, including wireless charging of implanted pacemakers and electric vehicles.

The concept of wireless power transfer dates back to the 1890s, when Nikola Tesla began experimenting with wireless electricity with limited success. Now more than a century later, the idea has again attracted attention. In 2007, for example, MIT researchers demonstrated wireless power transfer and have been developing products under the start-up "Witricity."

Coincidentally, metamaterials have had a somewhat similar history. Around the turn of the 20th century, scientists began exploring the idea of artificial materials that could manipulate light in unusual ways, but not until the early 2000s ...***Read More***...



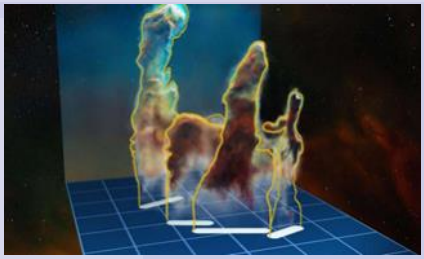
Wireless power transfer between two coils. The metamaterial is the gray 3 x 3 square embedded into the coil on the right. Credit: Q. Wu, et al. ©2015 EPLA

The Pillars of Creation revealed in 3-D

Using the MUSE instrument on ESO's Very Large Telescope (VLT), astronomers have produced the first complete three-dimensional view of the famous Pillars of Creation in the Eagle Nebula, Messier 16. The new observations demonstrate how the different dusty pillars of this iconic object are distributed in space and reveal many new details—including a previously unseen jet from a young star. Intense radiation and stellar winds from the cluster's brilliant stars have sculpted the dusty Pillars of Creation over time and should fully evaporate them in about three million years.

The original NASA/ESA Hubble Space Telescope image of the famous Pillars of Creation was taken two decades ago and immediately became one of its most famous and evocative pictures. Since then, these billowing clouds, which extend over a few light-years, have awed scientists and the public alike.

The jutting structures, along with the nearby star cluster, NGC 6611, are parts of a star formation region called the Eagle Nebula, also known as Messier 16 or M16. The nebula and its associated objects are located about 7000 light-years away in the constellation of Serpens (The Serpent).



The Pillars of Creation are a classic example of the column-like shapes that develop in the giant clouds of gas and dust that are the birthplaces of new stars. The columns arise when immense, freshly formed blue-white O and B stars give off intense ultraviolet radiation and stellar winds that blow away less dense materials from their vicinity.

Denser pockets of gas and dust, however, can resist this erosion for longer. Behind such thicker dust pockets, material is shielded ...***Read More***...

This visualization of the three-dimensional structure of the Pillars of Creation within the star formation region Messier 16 (also called the Eagle Nebula) is based on new observations of the object using the MUSE instrument on ESO's Very Large Telescope in Chile. The pillars actually consist of several …..

The Dark Matter 'conspiracy'

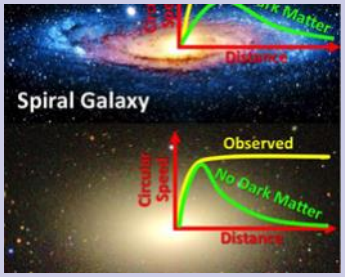
Surprising gravitational similarities between spiral and elliptical galaxies have been discovered by an international team, including astronomers from Swinburne University of Technology, implying the influence of hidden forces.

In the first such survey to capture large numbers of these galaxies, researchers have mapped out the motions of stars in the outer parts of elliptical galaxies using the world's largest optical telescope at W M Keck Observatory in Hawaii.

"By combining Keck telescope time from Swinburne and the University of California, we were able to investigate a larger number of galaxies which allowed us to make this important discovery," Swinburne's Professor Duncan Forbes said.

The team, led by Michele Cappellari from the University of Oxford, used the powerful DEIMOS (DEep Imaging and Multi-Object Spectrograph) to conduct a major survey of nearby galaxies called SLUGGS, which mapped out the speeds of their stars.

The scientists used Newton's law of gravity to translate these speed measurements into the amounts of matter distributed within the galaxies….***Read More***...



The speeds of stars on circular orbits have been measured around both spiral and elliptical galaxies. Without dark matter, the speeds should decrease with distance from the galaxy, at different rates for the two galaxy types.

Novel superconducting undulator provides first X-ray light at ANKA

Synchrotron radiation facilities provide insights into the world of very small structures like microbes, viruses or nanomaterials and rely on dedicated magnet technology, which is optimized to produce highest intensity beams. The ANKA synchrotron radiation facility at KIT and Babcock Noell GmbH now takes a technological leap forward: Researchers have successfully developed, installed, and tested a novel full-length superconducting undulator, for the first time providing higher peak magnetic fields for the production of x-rays than traditional permanent-magnet undulators currently in use in facilities around the world.

Synchrotron radiation is one of the most intense sources of x-rays and infrared radiation, and is a powerful tool for research in both industry and academia. It provides unique insights into the world of biology, medicine, chemistry and physics, and equips industrial researchers with non-destructive means of analysing materials or components of future devices and machines.

The ANKA synchrotron radiation facility at the Karlsruhe Institute of Technology (KIT) and its industrial partner Babcock Noell GmbH (BNG) have successfully developed, installed, and tested a novel superconducting undulator in the ANKA storage ring during the 2014/2015 winter shutdown.

The new full-length, high-performance superconducting undulator, named "SCU15", is a 1.5 meter long device that forces electrons on an undulating path, using a periodic magnetic field with 100 periods of 15 millimeters each. "The installation and reliable operation of the ...***Read More***...

SCU15 is a unique superconducting undulator for production of high-brilliance x-rays installed in the ANKA storage ring. Credit: KIT/ANKA/BNG

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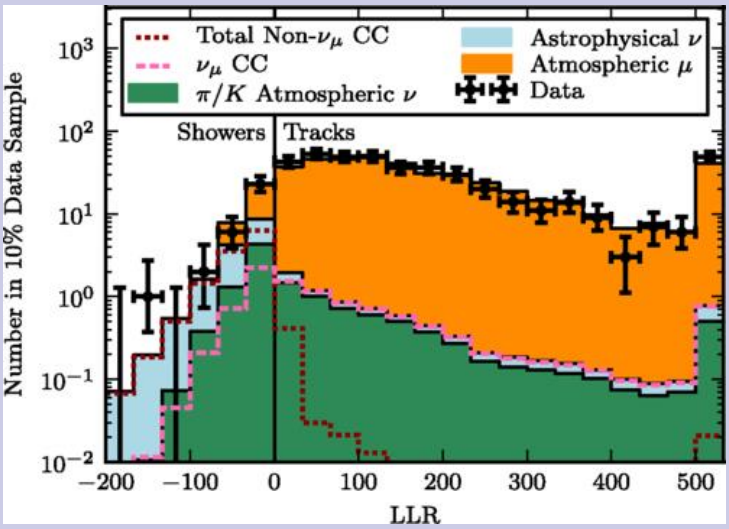
Two teams estimate the flavor of neutrinos detected by The IceCube Neutrino Observatory



The log-likelihood ratio between shower and track reconstructions for veto-passing events with more than 1500 photoelectrons. Error bars are 68% Feldman-Cousins intervals [51] and show upper limits for bins with no events. The solid-colored distributions are cumulative and result from the best-fit parameters of the distributions shown in Fig. 2. The contribution of muons is determined from a muon control sample. The dotted lines show the total contribution of νμ CC events (pink) and all non-νμ CC events (maroon) from the best-fit distributions of astrophysical and π/K neutrinos and are not cumulative with the solid-colored distributions. The last bin contains all overflow events with LLR>500. Credit: Phys. Rev. Lett. 114, 171102 – Published 28 April 2015. 10.1103/PhysRevLett.114.171102...***Read More***...

Compact synchrotron makes tumors visible

Soft tissue disorders like tumors are very difficult to recognize using normal X-ray machines. There is hardly any distinction between healthy tissue and tumors. Researchers at the Technische Universität München (TUM) have now developed a technology using a compact synchrotron source that measures not only X-ray absorption, but also phase shifts and scattering. Tissue that is hardly recognizable using traditional X-ray machines is now visible.

X-ray images have become an integral part of daily medical practice. Bones, for example, absorb large amounts of X-rays because of their high calcium content. This allows them to be differentiated from air-filled cavities like the lungs and surrounding soft tissue. However, because of their very similar absorption coefficients, soft tissue, organs and structures inside organs, like tumors, are hardly discernable from one another using the medical devices deployed in medicine today.

Now, a group of scientists headed by Franz Pfeiffer, Professor of Biomedical Physics in the Physics Department Department and the Faculty of Medicine at TU ...***Read More***….

The accelerator of the compact light source. Courtesy of Klaus Achterhold / TUM

NASA spacecraft crashes on Mercury after 11-year mission

An unmanned NASA spacecraft has crashed on the surface of the planet Mercury, after it ran out of fuel following a successful 11-year mission, the US space agency said Thursday.

The MESSENGER probe—short for MErcury Surface, Space ENvironment, GEochemistry, and Ranging—was the first spacecraft to orbit Mercury, and issued a final farewell on Twitter shortly before its demise at 3:26 pm (1926 GMT). "Well, I guess it's time to say goodbye to all my friends, family, support team. I will be making my final impact very soon."...***Read More***...

This image obtained from NASA on April 30, 2015 shows the surface of Mercury in one of the last images taken by the MESSENGER spacecraft on April 29.