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Inside this issue:

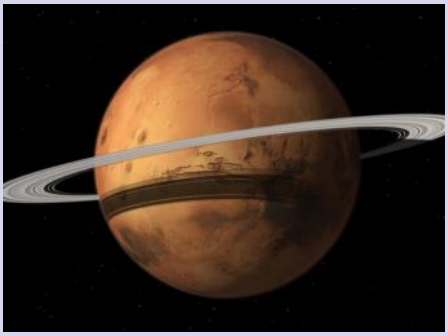
Mars to lose a moon, gain a ring

Mars' largest moon, Phobos, is slowly falling toward the planet. But rather than smash into the surface, Phobos will likely be torn to shreds by the planet's gravity and the pieces strewn about Mars in a ring, like the rings encircling Saturn, Jupiter, Uranus and Neptune.

Though inevitable, the demise of Phobos is not imminent, say scientists. It will probably happen in 20 to 40 million years, leaving a ring that will persist for anywhere from one million to 100 million years, according to two young earth scientists at the University of California, Berkeley.

In a paper appearing online in Nature Geoscience on November 23, 2015, the researchers estimate the cohesiveness of Phobos and conclude that it is insufficient to resist the tidal forces that will pull it apart when it gets closer to Mars.

Just as earth's moon pulls on our planet in different directions, raising tides in the oceans, for example, so too Mars tugs differently on different parts of Phobos. As Phobos gets closer to the planet, the tugs are enough to actually pull the moon apart, the scientists say. This is because Phobos is highly fractured, with lots of pores and rubble. Dismembering it is analogous to pulling apart a granola bar, Black said ...Read More...



Mars could gain a ring in 10-20 million years when its moon Phobos is torn to shreds by Mars gravity. Image of how Mars might look by Tushar Mittal using Celestia 2001-2010, Celestia Development Team.

The art and beauty of general relativity

One hundred years ago this month, an obscure German physicist named Albert Einstein presented to the Prussian Academy of Science his General Theory of Relativity. Nothing prior had prepared scientists for such a radical re-envisioning of the foundations of reality.

Encoded in a set of neat compact equations was the idea that our universe is constructed from a sort of magical mesh, now known as "spacetime". According to the theory, the structure of this mesh would be revealed in the bending of light around distant stars.

To everyone at the time, this seemed implausible, for physicists had long known that light travels in straight lines. Yet in 1919 observations of a solar eclipse revealed that on a cosmic scale light does bend, and overnight Einstein became a superstar.

Einstein is said to have reacted nonchalantly to the news that his theory had been verified. When asked how he'd have reacted if it hadn't been, he replied: "I would have felt sorry for the dear Lord. The theory is correct."

What made him so secure in this judgement was the extreme elegance of his equations: how could something so beautiful not be right?

The quantum theorist Paul Dirac would latter sum up this attitude to physics ...Read More...

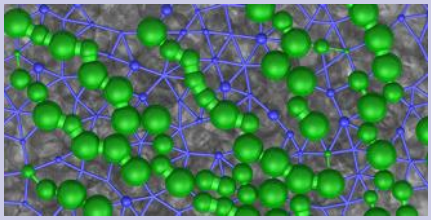
There is a beauty in spacetime. Credit: NASA, CC BY-NC

Experiment suggests friction at root of shear force thickening

A combined team of researchers from Cornell University in the U.S. and the University of Edinburgh in the U.K. believes they may have settled the debate on the cause of shear force thickening in colloidal products. In their paper uploaded to the Physical Review Letters website, the researches describe their simple experiment and results and why they believe it settles the debate.

Liquids that have particles suspended in them, called colloidal products, such as cornstarch, have a property known very well to grade-school science students—shear force thickening. It is what happens when the liquid is stirred very quickly or when after stirring it acts like a solid when struck with an object such as a hammer. Scientists have debated the nature of the phenomenon for many years and have come up with the two most likely theories. The first is that it happens because fast movement causes the particles to be pushed closer to each other making it more difficult for the liquid to get between them—at some point, it becomes impossible causing the liquid to behave as a solid. The second theory suggests it is all about friction, as the particles move closer to one another, they actually touch and it is the shearing force and friction that keep them that way. In this new effort, the researchers have conducted an experiment that has caused them to believe that the latter argument appears to be the one that is correct.

The experiment consisted of creating a colloid and then putting a cone in it that they caused to turn, measuring the torque as the ...Read More...



Credit: Chris Ness/University of Edinburgh, via Physics

Electron partitioning process in graphene observed

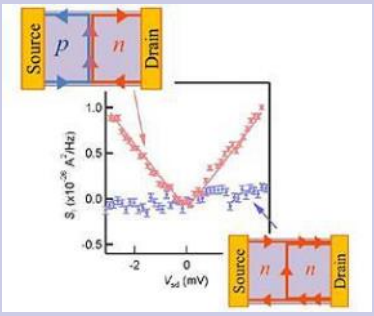
Graphene, a single atomic layer of graphite with a carbon-layered structure, has been drawing much attention because of its abundant electronic properties and the possibilities of application due to its unique electronic structure. Andre Geim and Konstantin Novoselov extracted single-atom-thick crystallites from bulk graphite in 2004 for the first time. This results earned them the Nobel Prize in physics 2010.

A group of researchers from Osaka University, the University of Tokyo, Kyoto University, and the National Institute for Materials Science precisely examined current-fluctuation ("shot noise") in the graphene p-n junction in the Quantum Hall (QH) regime and succeeded in observing electron partitioning taking place on the region along the p-n junction as current fluctuation. (See upper-left of Figure 1. Electron Partition Process.)

In addition, this group also clarified that electron partitioning did not take place under the absence of the p-n junction even in the QH regime.

It is expected that this group's achievement will lead to the clarification of the electron partition process in the graphene p-n junction in the QH regime because of its spin freedom and valley freedom and the realization of electron interference devices using the graphene p-n junction in the QH regime.

Kensuke Kobayashi (Professor, Graduate School of Science, Osaka University) ...Read More...



This is the result of the shot noise measured in our device. Non-zero shot noise due to the electron partition process is observed in the p-n junction case (red dots). On the other hand, there appears no noise in the unipolar regime (blue dots). Image courtesy Osaka University.

Bringing the chaos in light sources under control

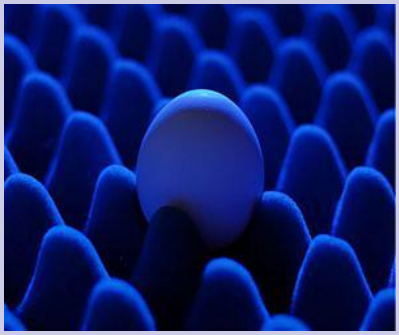
Noise is an issue in optical telecommunications. And findings means of controlling noise is key to physicists investigating light-emitting diodes or lasers. Now, an Italo-Iraqi team has worked on a particular type of light source, called the quantum dot light-emitting diode (QDLED).

In a study published in EPJ D, Kais Al Namee from the National Institute of Optics, in Florence, Italy and colleagues, demonstrate that modulating bias current of the QDLED could lead to countering the noise. This, in turn, leads to stabilising such light sources, making them better suited for optical telecommunications.

Most light sources exhibit fluctuations due to the quantum nature of the process underlying the emission of light. However, experiments show that these fluctuations - often described as quantum noise - are inherently chaotic and subject to oscillations, dubbed mixed mode oscillations.

The authors have developed a theoretical model, which they show is able to reproduce the chaotic and oscillating phenomena observed experimentally. This can help them understand the nature of such phenomena.

They found that spiking competition of quantum dots in the part of the diode that emits lights enhances the way in which the diode receives its own self-feedback in terms of the light ...Read More...



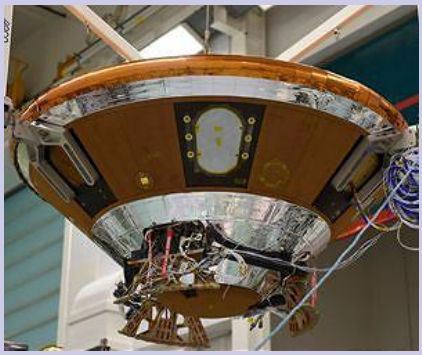
File image.

ExoMars prepares to leave Europe for launch site

The two ExoMars spacecraft of the 2016 mission are being prepared for shipping to the Baikonur Cosmodrome in Kazakhstan ahead of their launch in March.
A joint endeavour with Russia's Roscosmos space agency, ExoMars comprises two missions. The Trace Gas Orbiter (TGO) and Schiaparelli make up the 2016 mission, while the 2018 mission will combine a rover and a surface science platform. Both missions will be launched on Russian Proton rockets from Baikonur.

TGO and Schiaparelli are undergoing final preparations at Thales Alenia Space in Cannes, France, where they were on display for media to view for the last time before they leave Europe.
They will be shipped separately in the middle of next month, arriving at the cosmodrome on 21 and 23 December, respectively.

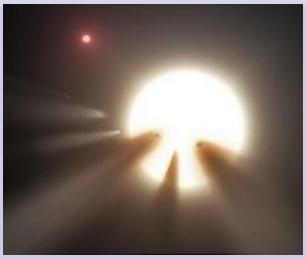
"It's been a long road for ExoMars to reach this point, but we are now ready to launch in spring next year," says Alvaro Gimenez, ESA Director of Science and Robotic Exploration.
"We are about to begin a new era of Mars exploration for Europe and our Russian partners."
Sergey Saveliev, Deputy General Director of Roscosmos, says: "ExoMars is a unique example of the Russian-European cooperation in deep-space exploration.
"The mission of 2016 is just the first stage of our cooperation and, in the future, Roscosmos and ESA plan many joint projects to explore near and deep space." ...Read More...



Schiaparelli, also known as the ExoMars Entry, descent and landing Demonstrator Module is seen here being installed at the top of the Trace Gas Orbiter, at Thales Alenia Space, in Cannes, France, on 25 November 2015. The first mission of the ExoMars programme, scheduled to arrive at Mars in 2016, consists of a Trace Gas Orbiter plus an Entry, Descent and Landing Demonstrator Module (EDM).

Comet fragments best explanation of mysterious dimming star

Was it a catastrophic collision in the star's asteroid belt? A giant impact that disrupted a nearby planet? A dusty cloud of rock and debris? A family of comets breaking apart? Or was it alien megastructures built to harvest the star's energy?
Just what caused the mysterious dimming of star KIC 8462852?
Massimo Marengo, an Iowa State University associate professor of physics and astronomy, wondered when he saw all the buzz about the mysterious star found by citizen scientists on the Planet Hunters website.
Those citizen scientists were highlighting measurements of star brightness recorded by NASA's Kepler spacecraft. Tiny dips in a star's brightness can indicate a planet is passing in front of the star. That's how Kepler astronomers - and citizen scientists using the internet to help analyze the light curves of stars - are looking for planets.
But this star had deep dips in brightness - up to 22 percent. The star's brightness also changed irregularly, sometimes for days and even months at a time. A search of the 150,000-plus stars in Kepler's database found nothing like this. So Marengo and two other astronomers decided to take a close look at ...Read More…



This illustration shows a star behind a shattered comet. Observations of the star KIC 8462852 by NASA's Kepler and Spitzer space telescopes suggest that its unusual light signals are likely from dusty comet fragments, which blocked the light of the star as they passed in front of it in 2011 and 2013. The comets are thought to be traveling around …..

First Mirror Installed on NASA's Webb Telescope, Final Assembly Phase Starts

After years of construction, the first of 18 primary flight mirrors has been installed onto NASA's James Webb Space Telescope (JWST) at the agency's Goddard Space Flight Center in Greenbelt, Maryland, signifying the start of the final assembly phase for the mammoth observatory that will eventually become the most powerful telescope ever sent to space.

The milestone first mirror installation was achieved this week just ahead of the Thanksgiving holiday as the engineering team, working inside the massive clean room at NASA Goddard, used a robotic arm to precisely lift and lower the gold coated mirror into place on the observatory's critical mirror holding backplane assembly.

Each of the 18 hexagonal-shaped primary mirror segments measures just over 4.2 feet (1.3 meters) across and weighs approximately 88 pounds (40 kilograms). In space, the individual mirrors will unfold into several sections and work together as one large mirror, unprecedented in size and light gathering capability.

"This fall we will start installing every mirror," said Sandra Irish, JWST lead structural engineer during a recent interview with Universe Today at the NASA Goddard clean room facility.

To complete the entire mirror installation process onto the backplane assembly will take several months and continue into early 2016. The flight structure and backplane assembly serve as the $8.6 Billion Webb telescopes backbone.

"Then next April 2016 we will install the ISIM science module inside the ...Read More...

The James Webb Space Telescope team successfully installed the first flight mirror onto the telescope structure at NASA's Goddard Space Flight Center in Greenbelt, Maryland. Credits: NASA/Chris Gunn

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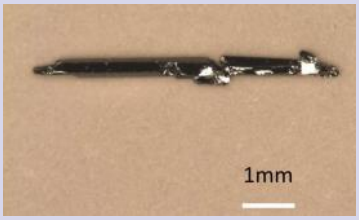
'Material universe' yields surprising new particle

An international team of researchers has predicted the existence of a new type of particle called the type-II Weyl fermion in metallic materials. When subjected to a magnetic field, the materials containing the particle act as insulators for current applied in some directions and as conductors for current applied in other directions. This behavior suggests a range of potential applications, from low-energy devices to efficient transistors.

The researchers theorize that the particle exists in a material known as tungsten ditelluride (WTe2), which the researchers liken to a "material universe" because it contains several particles, some of which exist under normal conditions in our universe and others that may exist only in these specialized types of crystals. The research appeared in the journal Nature this week.

The new particle is a cousin of the Weyl fermion, one of the particles in standard quantum field theory. However, the type-II particle exhibits very different responses to electromagnetic fields, being a near perfect conductor in some directions of the field and an insulator in others. ...Read More...

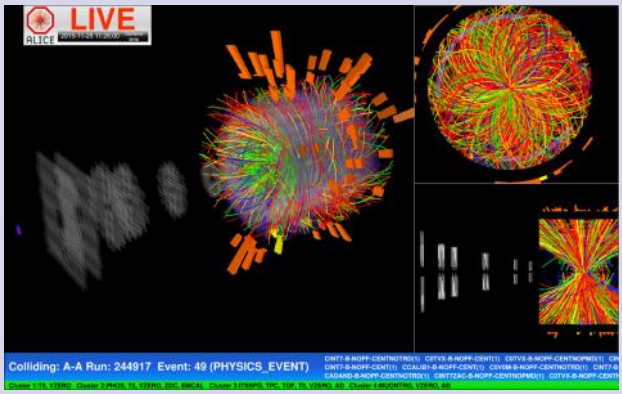


These tungsten ditelluride crystals behave as insulators for current applied in some directions and as conductors for current applied in other directions. The researchers found that this behavior is due to a newly theorized particle, the type-II Weyl fermion. Credit: Wudi Wang and N. Phuan Ong, Princeton University

CERN collides heavy nuclei at new record high energy

The world's most powerful accelerator, the 27 km long Large Hadron Collider (LHC) operating at CERN in Geneva established collisions between lead nuclei, this morning, at the highest energies ever. The LHC has been colliding protons at record high energy since the summer, but now the time has now come to collide large nuclei (nuclei of lead, Pb, consist of 208 neutrons and protons). The experiments aim at understanding and studying the properties of strongly interacting systems at high densities and thus the state of matter of the Universe shortly after the Big Bang.

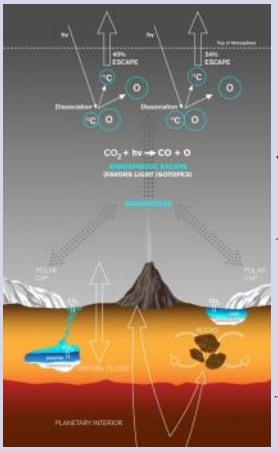
In the very beginning, just a few billionths of a second after the Big Bang, the Universe was made up of an extremely hot and dense 'primordial soup' consisting of the fundamental particles...Read More..



Tracking down the 'missing' carbon from the Martian atmosphere

Mars is blanketed by a thin, mostly carbon dioxide atmosphere--one that is far too thin to prevent large amounts of water on the surface of the planet from subliming or evaporating. But many researchers have suggested that the planet was once shrouded in an atmosphere many times thicker than Earth's. For decades that left the question, "Where did all the carbon go?"

Now a team of scientists from Caltech and JPL thinks they have a possible answer. The researchers suggest that 3.8 billion years ago, Mars might have had only a moderately dense atmosphere. They have identified a photochemical process that could have ...Read More….



Carbon dioxide to generate the atmosphere originates in the planet's mantle and is released through volcanoes or trapped in rocks crystallized from magmas. Once in the atmosphere, the CO2 can exchange with the polar caps, passing from gas to ice and back to gas again. The CO2 can also dissolve into waters, which can then precipitate out solid carbonates, either in lakes at the surface or in shallow aquifers. Importantly, CO2 gas in the atmosphere is continually lost to space at a rate controlled in part by the sun's activity. The ultraviolet (UV) photodissociation mechanism that we highlight occurs when UV radiation encounters a CO2 molecule, breaking the bonds to first form CO and then C atoms. Isotope fractionation occurs when the C atoms are lost to space because the lighter carbon-12 isotopes ….