

Astronomy & Physics News

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Weekly Scientific News Compiled by Dr. Ilias Fernini

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'Millennium physicist' ready to take helm at nuclear center

Fabiola Gianotti, who this week takes the helm at CERN, home to world's largest particle accelerator, is seen as a new breed of scientist. Initially trained in arts and literature, she came to physics relatively late. She enjoys cooking, jogging, music and keeping her eye on the news, and notes the importance of being "a citizen of the world."

Gianotti "embodies for me what's much more the millennium physicist," said Dr. Monica Dunford, senior scientist at Germany's University of Heidelberg, who spent six years at CERN, the European Center for Nuclear Research. "Not so geeky, much more well-rounded, diverse, passionate."

"Fabiola brings freshness to science: She's incredibly energetic, incredibly passionate, has a lot of different talents. ... She has a degree in piano in addition to physics," Dunford said. Gianotti, who succeeds Germany's Rolf Heuer as director-general on Jan. 1, becoming the first woman to hold the post, insists she doesn't ...[Read More...](#)



In this July 4, 2012 file photo Rolf Heuer, foreground, Director General of CERN, European Organization for Nuclear Research, and Fabiola Gianotti, left, ATLAS experiment spokesperson, attend a news conference in Meyrin near Geneva, Switzerland. On Jan. 1, 2016 the 55-year-old Italian becomes the first woman Director General at CERN the world's biggest particle accelerator that smashes together atoms and monitors the fallout to help understand the universe at the most infinitesimal scale. (Marial Trezzini/Keystone via AP, File)

Astronomers look to high-mass stars for clues to the origins of life

New research out of Japan promises to bolster the search for the origins of life in the distant cosmos.

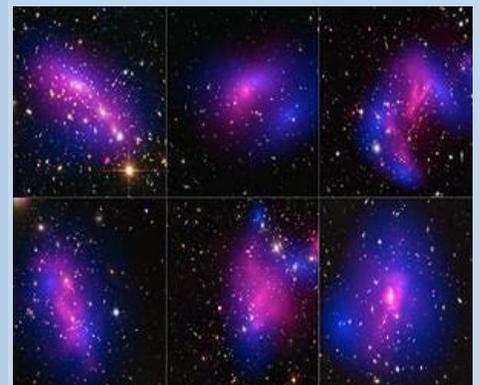
The chemical building blocks of biological life were born in the fiery formations of stars. But which stars, and where and how?

Astrophysicist Takeshi Sakai believes large stars born in the stellar clusters 10,000 light-years away hold clues to the origins of life. But studying these faraway bodies is a difficult task.

"I am using the Atacama Large Millimeter/Submillimeter Array, ALMA, facilities in Chile to study the formation of stars," Sakai explained in a recent press release.

"In particular I am looking at 'high-mass' stars formed in clusters that are approximately 10,000 light years from the Earth," Sakai added. "High mass stars play an important role in the evolution of galaxies and ultimately hold the secrets of the origins of life on Earth."

Researchers believe roughly 70 percent of all stars can be found in stellar clusters, but ...[Read More..](#)



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Mysterious radio signals from space discovered to be a much better test of Einstein's General

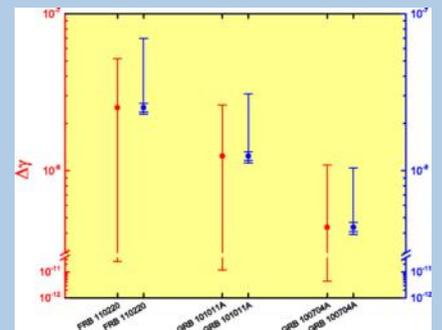
A new way to test one of the basic principles underlying Einstein's theory of General Relativity using brief blasts of rare radio signals from space called Fast Radio Bursts is ten times, to one-hundred times better than previous testing methods that used gamma-ray bursts, according to a paper just published in the journal *Physical Review Letters*. The paper received additional highlighting as an "Editor's Suggestion" due to "its particular importance, innovation, and broad appeal," according to the journal's editors.

The new method is considered to be a significant tribute to Einstein on the 100th anniversary of his first formulation of the Equivalence Principle, which is a key component of Einstein's theory of General Relativity. More broadly, it also is a key component of the

concept that the geometry of spacetime is curved by the mass density of individual galaxies, stars, planets, and other objects.

Fast Radio Bursts are super-brief blasts of energy—lasting just a few milliseconds. Until now, only about a dozen Fast Radio Bursts have been detected on Earth. They appear to be caused by mysterious events beyond our Milky Way Galaxy, and possibly even beyond the Local Group of galaxies that includes the Milky Way. The new technique will be important for analyzing the abundance of observations of Fast Radio Bursts that advanced radio-signal observatories, now being planned, are expected to detect.

"With abundant observational information in the future, we can gain a better understanding of the physical nature of Fast Radio ...[Read More...](#)



Limits on the differences of the γ values for three FRB observations. Credit: *Phys. Rev. Lett.* 115, 261101 – Published 23 December 2015. DOI: 10.1103/PhysRevLett.115.261101

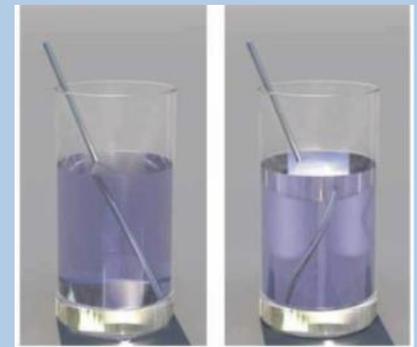
Scientists propose a metasurface for the anomalous scattering of visible light

A team of scientists from the Moscow Institute of Physics and Technology (MIPT) and the Landau Institute for Theoretical Physics at the Russian Academy of Sciences has proposed a two-dimensional metamaterial composed of silver elements that refracts light in an unusual way. The research has been published on November 18 in *Optical Material Express*. In the future, these structures may be used to develop compact optical devices, as well as to create an "invisibility cloak."

The results of computer simulations carried out by the authors showed that it would be a high performance material for light with a wavelength from 400-500nm (violet, blue and light blue). Efficiency in this case is defined as

the percentage of light scattered in a desired direction. The efficiency of the material is approximately 70 percent for refraction, and 80 percent for reflection of the light. Theoretically, the efficiency could reach 100 percent, but in real metals, there are losses due to ohm resistance.

A metamaterial is a material, the properties of which are created by an artificial periodic structure. The prefix "meta" (from the Greek μετά - beyond) indicates that the characteristics of the material are beyond what we see in nature. Most often, when we talk about metamaterials, we mean materials with a negative refractive index. When light is incident on the surface of such a material, the refracted light is on the same side of the normal to the surface as the ...[Read More...](#)



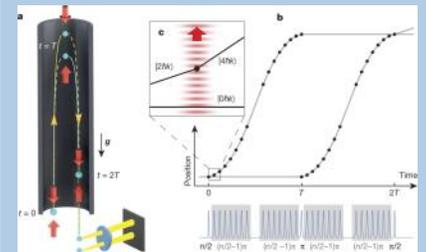
Medium with a positive (left) or negative (right) refractive index. Credit: *Russian-English Dictionary of Nanotechnology*

New half-meter record for quantum superposition at macroscopic level

A team of researchers working at Stanford University has extended the record for quantum superposition at the macroscopic level, from 1 to 54 centimeters. In their paper published in the journal *Nature*, the team describes the experiment they conducted, their results and also discuss what their findings might mean for researchers looking to find the cutoff point between superposition as it applies to macroscopic objects versus those that only exist at the quantum level. *Nature* has also published an editorial on the work done by the team, describing their experiment and summarizing their results.

Scientists entangling quantum particles and

even whole atoms has been in the news a lot over the past couple of years as experiments have been conducted with the goal of attempting to better understand the strange phenomenon—and much has been learned. But, as scientists figure out how to entangle two particles at ever greater distances apart there has come questions about the size of objects that can be entangled. Schrödinger's cat has come up in several such discussions as theorists and those in the applied fields seek to figure out if it might be truly possible to cause a whole cat to actually be in two places at once. In this new work, the team at Stanford has perhaps muddied the water even more as they have extended the record for supposition from a mere one centimeter to just over half a meter. ...[Read More...](#)



Fountain interferometer. Credit: *Nature* (2015). DOI: 10.1038/nature16155

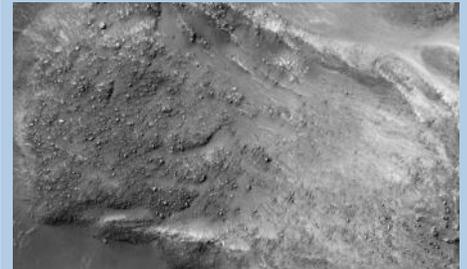
Image: Boulders on a Martian landslide

The striking feature in this image, acquired by the High Resolution Imaging Science Experiment (HiRISE) camera on NASA's Mars Reconnaissance Orbiter on March 19, 2014, is a boulder-covered landslide along a canyon wall. Landslides occur when steep slopes fail, sending a mass of soil and rock to flow downhill, leaving behind a scarp at the top of the slope. The mass of material comes to rest when it reaches shallower slopes, forming a lobe of material that ends in a well-defined edge called a toe.

This landslide is relatively fresh, as many individual boulders still stand out above the main deposit. Additionally, while several small impact craters are visible in the landslide lobe, they are smaller in size and fewer in number than those on the surrounding valley floor. The scarp itself

also looks fresh compared to the rest of the cliff: it, too, has boulders, and more varied topography than the adjacent dusty terrain. Just to the north of the landslide scarp is a similarly-shaped scar on the cliffside. However, there is no landslide material on the valley floor below it. The older landslide deposit has either been removed or buried, a further indicator of the relative youth of the bouldery landslide.

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Credit: NASA/JPL/University of Arizona

Five key findings from 15 years of the International Space Station

The International Space Station is the longest-running continuously inhabited human outpost in space – this year it celebrated its 15th anniversary. As the ISS orbits the Earth it is essentially in a state of free fall, counteracting the Earth's gravity and providing an ideal platform for science in space.

Science aboard the ISS is decidedly cross-disciplinary, including fields as diverse as microbiology, space science, fundamental physics, human biology, astronomy, meteorology and Earth observation to name a few. But let's take a look at some of the biggest findings.

1. The fragility of the human body

The effects of the space environment on the human body during long duration spaceflight are of significant interest if we want to one day venture far beyond the Earth. A crewed journey to Mars, for example, may take a year, and the same time again for the return leg.

Microgravity research on the ISS has demonstrated that the human body would lose considerable bone and muscle mass on such a mission. Mitigation technology, involving [...Read More...](#)



Credit: NASA/wikimedia

The top 101 astronomical events for 2016

Here it is... our year end look at upcoming events in a sky near you. This is not a top 10 listicle, and not a full-fledged almanac, but hopefully, something special and unique in between. And as always, some of the events listed will be seen by a large swath of humanity, while others grace the hinterlands and may well go unrecorded by human eyes. We'll explain our reasoning for drilling down each category, and give a handy list of resources at the end.

Here's our quick picks for the very best astronomical events for 2016:

- Comet C/2013 US10 Catalina continues to perform as a binocular comet through January.
- Mars reaches opposition on May 22nd.
- Mercury transits the Sun on May 9th, the first

time it has done so since 2006.

- A close grouping of Venus and Jupiter on August 27th.
- A total solar eclipse of the Sun crossing southeast Asia on March 9th.
- A fine series of occultations of the bright star Aldebaran by the Moon continues, including a fine nighttime event on January 20th for North America.
- An annular solar eclipse across central Africa on September 1st.

No dawn or dusk elongations of the planet Venus occur in 2016. The last time Venus experienced an 'elongationless year' was 2008, and the next is 2024, right in step with the 8-year cycle of Venus. 2016 also sees the [...Read More..](#)



Camping out under dark skies. Credit: Michelle Nixon/MNixon Photography

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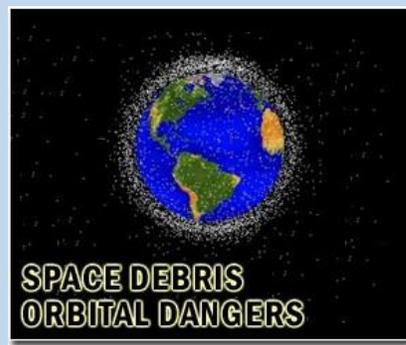
Watch: Six decades worth of space junk orbit Earth

In 1957, the discarded rocket that carried the Soviet Union's Sputnik 1 satellite into orbit became the first piece of space trash. Today, pieces of space debris total in the thousands.

NASA reports that as of 2013 there were more than 500,000 pieces of space junk the size of a marble or larger. Nearly 20,000 pieces are bigger than a softball -- tracked by NASA, ESA and others.

With every new launch or retired satellite, small pieces are added to the orbital trash heap. Just last spring, a NOAA weather satellite exploded into 43 pieces.

Recently, Stuart Grey, a researcher at the University College London, created a map of all of Earth's traceable space debris, using data on the junk's location from space-track.org. Grey has been locating and modeling the trajectory of space debris for several years ...[Read More..](#)



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NASA Reaches New Heights

In 2015, NASA explored the expanse of our solar system and beyond, and the complex processes of our home planet, while also advancing the technologies for our journey to Mars, and new aviation systems as the agency reached new milestones aboard the International Space Station.

"It was a fantastic year that brought us even closer to Mars," said NASA Administrator Charles Bolden. "Our space program welcomed advances from commercial partners who will soon launch astronauts from the United States to the International Space Station, and progress on new technologies and missions to take us into deep space, improve aviation and explore our universe and home planet." Solar System and Beyond.

NASA is exploring our solar system and beyond to unravel the mysteries of our universe. After a decade-long journey, the agency's New Horizons spacecraft completed a historic flyby of Pluto in July, making it the first-ever space mission to explore a world ...[Read More...](#)



The sparkling centerpiece of Hubble's anniversary fireworks is a giant cluster of about 3,000 stars called Westerlund 2, named for Swedish astronomer Bengt Westerlund who discovered the grouping in the 1960s. Image courtesy NASA/ESA.

How to Catch a Glimpse of a New Year's Comet

Did you get a telescope or pair of binoculars under the Christmas tree? If so, you can put them to the test by searching the Eastern sky for a view of a fuzzy comet on or shortly after New Year's Day.

Comet Catalina, formally known as C/2013 US10, is currently perched in the pre-dawn skies as it returns to the depths of space following a recent visit to the inner part of our solar system. Named for the NASA-funded Catalina Sky Survey at the University of Arizona in Tucson, the comet was discovered on Oct. 31, 2013.

Shortly after its discovery, precise orbit determination showed that Comet Catalina likely originated from the Oort Cloud, a spherical cloud of many billions of icy objects chaotically and loosely bound to the solar system. The passage of a relatively close star or fluctuations of gravitational tides from within our Milky Way galaxy can send these icy bodies on a journey inward. ...[Read More...](#)



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