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Astronomy & Physics Weekly News

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Top News

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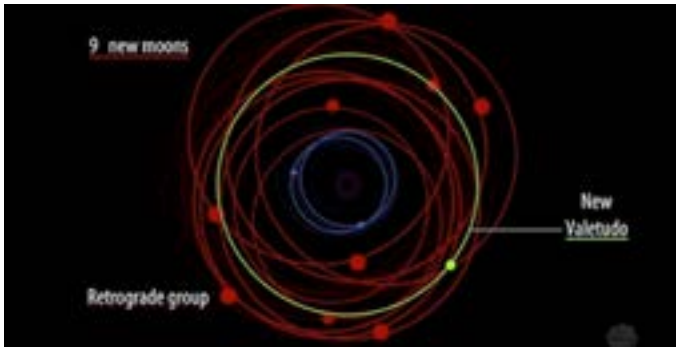
Scientists discover 12 more moons of Jupiter, including a really weird one



This picture shows, in red, the orbits of nine of the newly discovered moons as well as the 'oddball' Valetudo, in green, moving in the opposite direction. The other two moons are closer to the planet, shown in blue. Roberto Molar-Candanosa / Carnegie Institution for Science

Twelve new moons have been discovered orbiting Jupiter, raising the number of natural satellites known to be circling our solar system's biggest planet to 79.

One of the newfound moons, provisionally named "Valetudo" for the Roman goddess of health and hygiene and the great-granddaughter of the god Jupiter, is being called an oddball because it orbits Jupiter in the opposite direction of nearby moons.

"'Valetudo' is like driving down the highway on the wrong side of the road," astronomer Scott S. Sheppard, a staff scientist at the Carnegie Institution for Science in Washington and the leader of the team of astronomers who made the discovery, told NBC News MACH in an email.

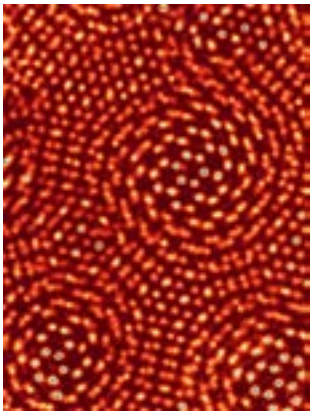
The astronomers spied the moons in the spring of 2017 while using a giant telescope in Chile to search for Planet X, a massive and as-yet-undiscovered planet that is believed to orbit the sun far beyond Pluto.

"Jupiter just happened to be in the sky near the search fields where we were looking for extremely distant solar system objects, so we were serendipitously able to look for new moons around Jupiter while at the same time looking for planets at the fringes of our solar system," Sheppard said in a statement.

The discovery, which was confirmed by observations made with several other telescopes, delighted other astronomers.

"I love this result," Jackie Faherty, an astronomer with the American Museum of Natural History in New York who was not part of the team, said in an email. "We've been studying this planet for as long as we have been looking up, and it is still yielding surprises for us. It also reminds me that the question of 'what is out there' is always an open one to be explored." ..Read More...

Electron microscope detector achieves record resolution



A ptychographic image of two sheets of molybdenum disulfide, with one rotated by 6.8 degrees with respect to the other. The distances between individual atoms range from a full atomic bond length down to complete overlap. Credit: Cornell University

Electron microscopy has allowed scientists to see individual atoms, but even at that resolution not everything is clear.

The lenses of electron microscopes have intrinsic imperfections known as aberrations, and special aberration correctors – "like eye glasses for your microscope," said David Muller, the Samuel B. Eckert Professor of Engineering in the Department of Applied and Engineering Physics (AEP) – have been developed over the years to correct these defects.

Aberration correctors only go so far, however, and to correct multiple aberrations, you need an ever-expanding collector of corrector elements. It's like putting glasses on glasses on glasses – it becomes a bit unwieldy.

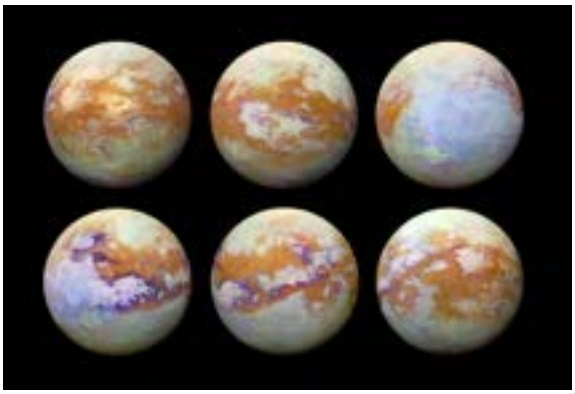
Muller – along with Sol Gruner, the John L. Wetherill Professor of Physics, and Veit Elser, professor of physics – have developed a method for achieving ultra-high resolution without the need for "corrective lenses" for their microscope.

They've employed their Cornell-developed electron microscope pixel array detector (EMPAD), which was introduced in March 2017. With it they've achieved what Muller, co-director of the Kavli Institute at Cornell for Nanoscale Science, said is a world record for image resolution – in this case using monolayer (one-atom-thick) molybdenum disulfide (MoS2).

Their achievement is reported in "Electron Ptychography of 2-D Materials to Deep Sub-Ångström Resolution," to be published July 19 in Nature. Co-lead authors were Yi Jiang, Ph.D. '18 (physics) and Zhen Chen, postdoctoral researcher in the Muller Group.

Electron wavelengths are many times smaller than those of visible light, but electron microscope lenses are not commensurately precise. Typically, Muller said, the resolution of an electron microscope is dependent in large part on the numerical aperture of the lens. ...Read More...

Dazzling Views Show Saturn Moon Titan's Surface Like Never Before



These mosaics of the Saturn moon Titan's surface were constructed using data gathered over 13 years by the Visual and Infrared Mapping Spectrometer instrument aboard NASA's Cassini spacecraft. Credit: NASA/JPL-Caltech/University of Nantes/University of Arizona

The mysterious surface of Saturn's huge moon Titan comes into gloriously sharp focus in newly released photos captured by NASA's Cassini spacecraft.

Cassini team members created the six-image set using data collected over 13 years by the Saturn-orbiting probe's Visual and Infrared Mapping Spectrometer (VIMS). As its name suggests, VIMS deals in long-wavelength infrared light, allowing the instrument to see through the thick Titanic haze that obscures visible-light views of the moon's frigid surface.

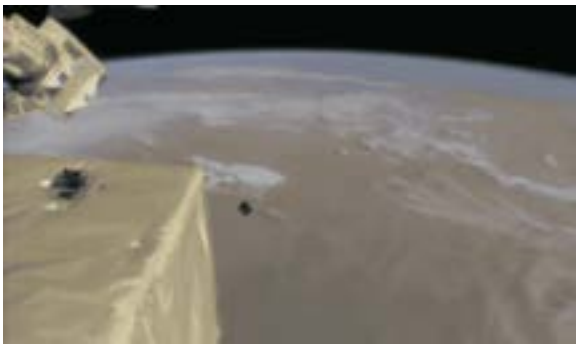
Cassini scientists have created VIMS mosaics before, but those previous efforts generally had prominent seams, NASA officials said. Such seams naturally result from the stitching together of images snapped during different Titan encounters, which featured different lighting conditions and flyby angles. [Amazing Photos: Titan, Saturn's Largest Moon]

But the new mosaics are pretty much seamless — a breakthrough made possible by a reanalysis of the VIMS data and laborious hand processing of the resulting mosaics, mission team members said.

"With the seams now gone, this new collection of images is by far the best representation of how the globe of Titan might appear to the casual observer if it weren't for the moon's hazy atmosphere, and it likely will not be superseded for some time to come," NASA officials wrote in a statement Wednesday (July 18).

Indeed, the photos give viewers a new appreciation for Titan's complex and varied surface, which boasts dunes of carbon-containing organic compounds, icy deposits and vast seas of liquid hydrocarbons. (Titan is the only extraterrestrial object known to harbor stable bodies of liquid on its surface.) ..Read More...

Tiny Satellite Begins Hunt for Missing Milky-Way Matter



The International Space Station deployed HaloSat, a tiny satellite that will study the Milky Way's halo, on July 13, 2018. Credit: NanoRacks/NASA

A tiny satellite has set out to investigate the halo of incredibly hot gas surrounding the Milky Way — and it could help scientists track down the huge amount of missing matter in the universe.

NASA deployed the 26-lb. (12 kilograms) satellite, called HaloSat, on July 13 from the International Space Station.

Scientists can't find a whopping one-third of all the matter that should exist in the universe. It's not dark matter; it's just ... missing. They've calculated how much matter was in the universe 400,000 years after the Big Bang based on information encoded in the cosmic microwave background. And they've calculated how much mass they see now in galaxies, stars, planets, dust and gas. But the numbers do not add up.

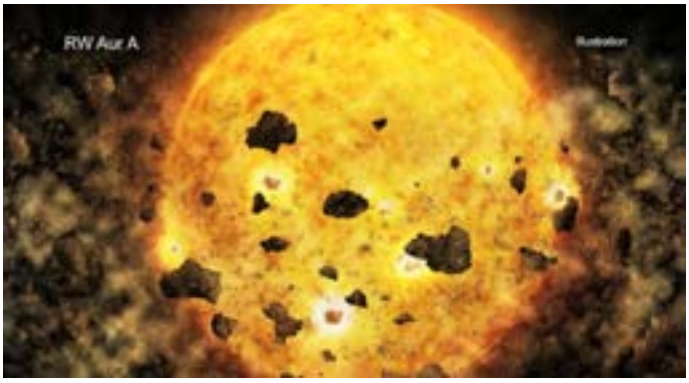
"We should have all the matter today that we had back when the universe was 400,000 years old," said Philip Kaaret, HaloSat's principal investigator and an astronomer at the University of Iowa, said in a NASA statement. "Where did it go?"

Scientists have made some progress in tracking down chunks of the missing matter, and they've narrowed it down to two hiding places: within galaxies themselves, or spread out in the space between them. So scientists are starting close to home, by searching for the matter that's missing from the Milky Way.

HaloSat will try to find the missing matter by mapping the galaxy's halo of superhot gas, which can reach 3.6 million degrees Fahrenheit (2 million degrees Celsius), according to NASA. That's hot enough for oxygen gas to produce X-rays, which HaloSat will measure across the sky to figure out the shape of the halo and determine whether it's spread evenly around the Milky Way or in a flattened disk, like a fried egg.

"If you think of the galactic halo in the fried egg model, it will have a different distribution of brightness when you look straight up out of it from Earth than when you look at wider angles," Keith Jahoda, a HaloSat co-investigator and a NASA astrophysicist, said in the ..Read More...

Young Star May Be Devouring a Planet



Researchers at NASA's Chandra X-ray Observatory may have watched a young star devouring a planet.

For decades, scientists have observed irregular dimming of RW Aur A, a young star in the Taurus-Auriga constellation. Questions about this star grew as it began to dim more frequently and for longer periods of time, according to Hans Moritz Guenther, a research scientist in MIT's Kavli Institute for Astrophysics and Space Research and lead author on the study. Physicists looking into the phenomenon have observed RW Aur A using NASA's Chandra X-ray Observatory, and the researchers believe that they may have found the reason for this dimming: This young star is "eating" a planet, Guenther told Space.com.

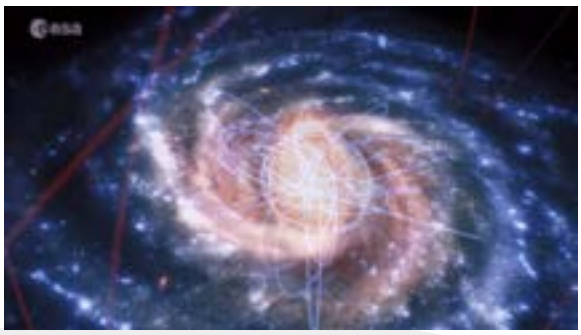
Based on new Chandra observations, Guenther's team thinks that two infant planetary bodies (at least one of which is big enough to be a planet) are colliding, and debris from this crash is falling into RW Aur A. This debris would create a "veil" of gas and dust that would obscure the star's light, according to a statement from Chandra.

"Computer simulations have long predicted that planets can fall into a young star, but we have never before observed that," Guenther said in the statement. "If our interpretation of the data is correct, this would be the first time that we directly observe a young star devouring a planet or planets."

In a previous observation of the young star in 2017, astronomers found 10 times more iron coming from the disk of dust and gas that continues to surround the star than a previous observation had found in 2013, according to the statement. And "that iron needs to come from somewhere," Guenther said to Space.com. Guenther and his colleagues suggest that this iron must have come from planetary debris around the star that had "broken off" in the collision between the two infant planetary bodies.

"Every time we've seen it [RW Aur A], it's looked vastly different from before," Guenther told Space.com, referring to the star's iron levels and brightness. Researchers think that previous dimming events with the young star could have also been caused by similar collisions, according to the statement. ...Read More...

Milky Way Galaxy Is 'Disturbed' and More Revealed in ESA Gaia Mission Data (Video)



The orbits of four globular clusters (NGC 104, NGC 288, NGC 362 and NGC 1851), shown in blue, and three dwarf galaxies (Carina, Bootes I and Draco), shown in red, around the Milky Way, as imaged by the Gaia spacecraft.
Credit: ESA/Gaia/DPAC

The European Gaia spacecraft recently released a catalog of the positions of 1.7 billion stars, mapping our stellar neighbors around the Milky Way with unprecedented precision. The star map not only looks stunning but also includes a wealth of information about the evolution of our galaxy, the European Space Agency (ESA) said in a recent video.

The video, posted to YouTube in May, took place at the Paris Observatory. There, in 1887, astronomers attempted to map hundreds of thousands of stars in an effort called the Carte du Ciel (the Map of the Sky). Gaia is therefore part of a long line of star mappers, both on the ground and in space. But for all of our efforts, astronomers said in the video, we still have much to learn about the Milky Way — such as why certain stars' motion is "disturbed," and how the arms were formed.

Finnish astronomer Timo Prusti, Gaia project scientist, gestured toward Gaia's new map of the Milky Way and told video viewers what the spacecraft is revealing: "We see a flattened structure," he said. "That's the Milky Way; that's our Milky Way disk. We see some dark patches on top of it. What does it mean? It means that there, we see less stars. There are more stars [in that location], but there is dust in front of them, and that's why we don't see the stars."

But the spacecraft is also revealing some mysteries that will require further investigation. Previously, astronomers thought that the stars rotating around the Milky Way's center did so in an orderly fashion, no matter how far they were from our sun. Gaia, however, shows that some of these stars' motions are "disturbed," particularly for those that are far from the sun, Prusti said. Why that happens is a complete mystery.

Astronomers are also uncertain about how the arms of the Milky Way came to be, added François Mignard, one of the founders of Gaia and an emeritus ..Read More...

No more zigzags: Scientists uncover mechanism that stabilizes fusion plasmas

Physicist Isabel Krebs. Credit: Elle Starkman/PPPL Office of Communications

Sawtooth swings—up-and-down ripples found in everything from stock prices on Wall Street to ocean waves—occur periodically in the temperature and density of the plasma that fuels fusion reactions in doughnut-shaped facilities called tokamaks. These swings can sometimes combine with other instabilities in the plasma to produce a perfect storm that halts the reactions. However, some plasmas are free of sawtooth gyrations thanks to a mechanism that has long puzzled physicists.

Researchers at the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) have recently produced complex simulations of the process that may show the physics behind this mechanism, which is called "magnetic flux pumping." Unraveling the process could advance the development of fusion energy.

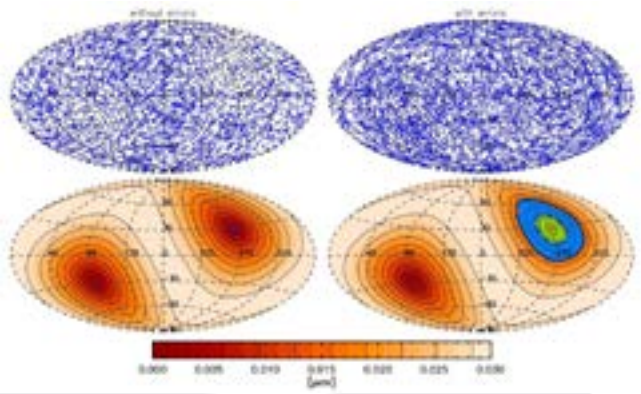
Fusion drives the sun and stars

Fusion, the power that drives the sun and stars, is the fusing of light elements in the form of plasma—the hot, charged state of matter composed of free electrons and atomic nuclei—that generates massive amounts of energy. Scientists are seeking to replicate fusion on Earth for a virtually inexhaustible supply of power to generate electricity.

The flux pumping mechanism limits the current in the core of the plasma that completes the magnetic field that confines the hot, charged gas that produces the reactions. This development, found in some fusion plasmas, keeps the current from becoming strong enough to trigger the sawtooth instability.

Spearheading the research that uncovered the process was physicist Isabel Krebs, lead author of a Physics of Plasmas paper describing the mechanism that was published last September and made into a DOE Office of Science highlight in June that summarizes the findings. Krebs, a post-doctoral associate, used the PPPL-developed M3D-C1 code to simulate the process on the ...Read More...

A possibly better way to measure our own galaxy speed moving through space



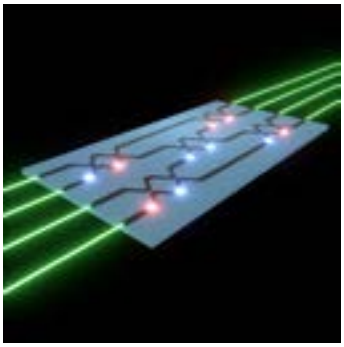
Top: all-sky isotropic distribution of a Monte Carlo simulated sample of distant extragalactic objects. On the left panel, 2-dimensional blue vectors show the (out of scale) CAD signal expected for the LG moving towards the apex of the CMB temperature dipole, while on the right panel a random, and dominant, error component, illustrating astrometric imprecisions is added. Bottom: we simulate the CAD signal reconstructed from a sample of 2·106 sources with an EoM astrometric accuracy on proper motions of σ = 0.6 and 1.4 μas yr−1 respectively. The red color scale shows the amplitude of the signal (the red diamond represents the simulated direction of the observer's motion), while the green/blue regions display the solid angle within which 68% of the reconstructed apex directions lie. The imprecision in the dipole position is estimated using 10000 Monte Carlo realisations and compared to the analytical predictions given in the text (thick black lines). Credit: arXiv:1802.04495 [astro-ph.CO]

A pair of physicists at Aix-Marseille University has offered a possible way to measure the speed of our own galaxy more accurately as it moves through space. In their paper published in the journal Physical Review Letters, Julien Bel and Christian Marinoni describe their theory and how it might be tested.

Most people know that our planet is moving not just around the sun, but through space as part of the Milky Way galaxy. Prior research has suggested that our galaxy is moving through space at over 1 million miles per hour. Such estimates are based on measuring changes in the position of the Earth relative to very distant objects in the night sky by measuring the amount of redshift and then comparing them against each other. Bel and Marinoni argue that it should be possible to get betters estimates of our galaxy speed by studying objects that are much closer to us.

The researchers suggest that the key to measuring our own speed is to measure our own acceleration relative to the acceleration of other objects in the universe (they note both instances of acceleration are due to dark energy-driven universal expansion and gravitational pull between objects). They suggest it could be done by watching and measuring other galaxies very closely and tracking just how much their positions relative to Earth change over time. They note that doing so would not be easy—some might even claim it is impossible with ...Read More...

Researchers move closer to completely optical artificial neural network



Researchers have shown a neural network can be trained using an optical circuit (blue rectangle in the illustration). In the full network there would be several of these linked together. The laser inputs (green) encode information that is carried through the chip by optical waveguides (black). The chip performs operations crucial to the artificial neural network using tunable beam splitters, which are represented by the curved sections in the waveguides. These sections couple two adjacent waveguides together and are tuned by adjusting the settings of optical phase shifters (red and blue glowing objects), which act like 'knobs' that can be adjusted during training to perform a given task. Credit: Tyler W. Hughes, Stanford University

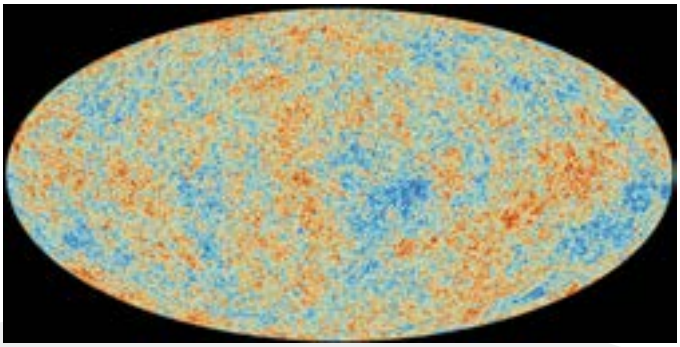
Researchers have shown that it is possible to train artificial neural networks directly on an optical chip. The significant breakthrough demonstrates that an optical circuit can perform a critical function of an electronics-based artificial neural network and could lead to less expensive, faster and more energy efficient ways to perform complex tasks such as speech or image recognition.

"Using an optical chip to perform neural network computations more efficiently than is possible with digital computers could allow more complex problems to be solved," said research team leader Shanhui Fan of Stanford University. "This would enhance the capability of artificial neural networks to perform tasks required for self-driving cars or to formulate an appropriate response to a spoken question, for example. It could also improve our lives in ways we can't imagine now."

An artificial neural network is a type of artificial intelligence that uses connected units to process information in a manner similar to the way the brain processes information. Using these networks to perform a complex task, for instance voice recognition, requires the critical step of training the algorithms to categorize inputs, such as different words.

Although optical artificial neural networks were recently demonstrated experimentally, the training step was performed using a model on a traditional digital computer and the final settings were then imported into the optical circuit. In Optica, The Optical Society's journal for high impact research, Stanford University researchers report a method for training these networks directly in the device by implementing an optical analogue of the 'backpropagation' algorithm, which is the standard way to ...Read More...

Observations of the Early Universe Reaffirm the Existence of Dark Matter and Dark Energy



The cosmic microwave background, as seen by Europe's Planck satellite. Credit: ESA/Planck Collaboration

Dark matter and dark energy may be weird and (as of now) inexplicable, but they do seem to exist.

The final data release from Europe's Planck mission, which mapped the universe's oldest light in unprecedented detail from 2009 through 2013, reaffirms the "standard model of cosmology," European Space Agency (ESA) officials announced Tuesday (July 17). And dark matter and dark energy are key features of the standard model.

"This is the most important legacy of Planck," Jan Tauber, ESA's Planck project scientist, said in a statement. "So far, the standard model of cosmology has survived all the tests, and Planck has made the measurements that show it."

Mapping ancient light

Like two NASA space missions before it — the Cosmic Background Explorer and the Wilkinson Microwave Anisotropy Probe — Planck studied the cosmic microwave background (CMB). The CMB began streaming through the universe about 380,000 years after the Big Bang — long before the first stars began to shine. Tiny fluctuations observable in the CMB are evidence of seeds that grew into the cosmos' larger structure, so scrutinizing this light can reveal key insights about the universe's very early days.

And this work has indeed been productive. For example, Planck's first data release, in March 2013, showed that the universe is 13.82 billion years old — about 100 million years older than previously thought. The observations also provided strong support for cosmic inflation, the idea that the universe expanded much faster than the speed of light in the first few tiny fractions of a second after the Big Bang.

The 2013 release was based solely on Planck's measurements of CMB temperature, and used data from just the mission's first two (out of a total of eight) sky surveys. A second release, in 2015, combined ...Read More...

In a Rare Feat, Scientists Anticipate and Recover an Incoming Asteroid

The small meteorite recovered from the impact of asteroid 2018 LA.

We have swarms of scientists searching the skies for space oddities, but it's rare that they actually find one in the act of plunging to Earth.

On June 23, a group of international geoscientists discovered a meteorite in Botswana that had been dwelling in space just weeks earlier. The fresh fragment broke off of asteroid 2018 LA as it plummeted to Earth on June 2, turning into a fiery meteor and exploding as it entered our atmosphere.

Treasure Hunt

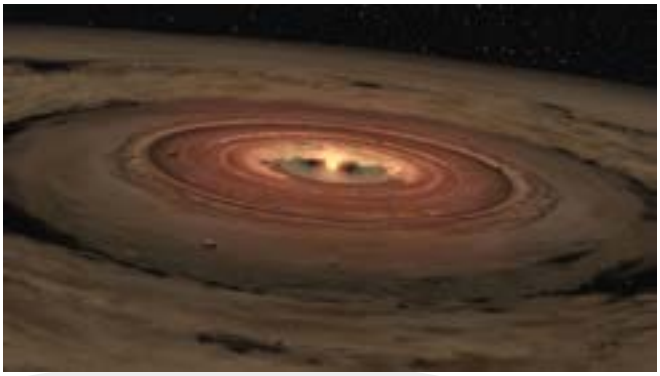
The geoscientists spent five days combing the land beneath the meteor's impact area before finding the tiny meteorite — marking only the second time remnants from a predicted asteroid impact have been recovered. Since such freshly fallen meteorites are so uncommonly found, researchers now have the rare opportunity to study its properties and composition first-hand.

The Catalina Sky Survey in Tucson, a NASA funded Planetary Defense project that locates and tracks near-Earth objects, discovered the asteroid only eight hours before it made impact with Earth. Any potential threat was quickly dismissed, though, when telescope observations deemed it to be just 6 feet (2 meters) in diameter, making it small enough to safely break apart in Earth's atmosphere.

But exactly where the asteroid would strike was still unknown. Researchers were able to loosely estimate impact sites above New Guinea, Southern Africa and the Indian Ocean, but nothing was certain. However, speculation was squashed when a quick, luminous flash in the low sky took multiple Botswana residents and area surveillance cameras by surprise. The unexpected spark turned out to be the blazing asteroid, entering the atmosphere at 10 miles (17 kilometers) per second.

Upon impact, the meteor fragmented into numerous pieces and scattered over the vast area below. To find the resulting meteorites, research scientist Peter Jenniskens of California's SETI Institute used sky survey data and video footage to calculate the landing area ...Read More...

The fate of giant planets depends on where they grow up



The protoplanetary disk around AA Tauri, a possible planetary system located 460 light-years away, is shown here in this artist's concept.
NASA

Astronomers generally agree that planets form out of the dusty debris disks that surround most newborn stars. When one of these so-called protoplanetary disks rotates around a nascent star, globs of material clump together. Over the course of a few million years, these clumps (called planetesimals) grow larger and larger, forming a protoplanet that eventually clears out its orbital path within the disk. And when a protoplanet gets massive enough, gravity forces it into a spherical shape, finally cementing its status as a true planet. However, what happens after these planets form is still a bit of a mystery.

This is especially true for giant planets. Although all of our solar system's most massive planets orbit relatively far from the Sun, in other star systems, enormous exoplanets are found very, very close to their parent stars. But why is this? Shouldn't all giant planets end up in similar locations?

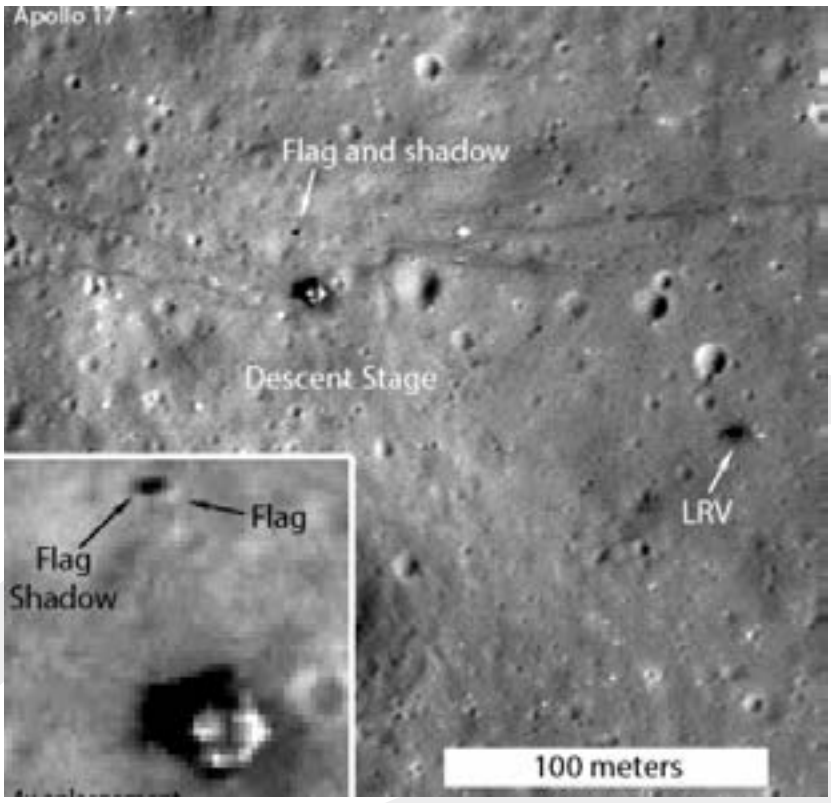
In a new study recently published in The Monthly Notices of the Royal Astronomical Society, a team of researchers investigated this long-standing mystery. Specifically, the team used simulations to study the various ways a newly formed giant planet can migrate through its host system over time.

Although the team verified that some planets travel inward toward their parent stars after they form (as previous research has shown), the team was surprised to find that a significant fraction of growing giants can be dragged away from their host stars, leading to the type of setup we see in our own solar system today.

"There's a lot about the early years of young planets that we don't know," said Dimitris Stamatellos, an astronomer at the University of Central Lancashire (UCLan) and lead author of the new study, in a press release. "There is a very fine balance between the forces that push the planet towards its parent star and the forces that push the planet away from it." ...Read More...

Special Read:

Apollo and the moon-landing hoax



In 2012, the LRO mission captured images of the American flags planted at the Apollo landing sites. This one is from the Apollo 17 landing site, via NASA/GSFC/Arizona State University/Phys.org.

It's been nearly 50 years since the Apollo 11 mission landed the first human beings on the moon, and since astronaut Neil Armstrong took his famous first step onto the lunar surface, speaking the words:

That's one small step for man, one giant leap for mankind.

But not everyone believes he did that. In the video above, Roger Launius, now senior curator in the National Air and Space Museum's Space History Division, discusses the belief that the moon landings never actually happened.

How many today believe that the six manned moon landings (1969-72) were faked and that 12 Apollo astronauts did not actually walk on the moon? A 1999 Gallup poll found that only 6 percent of Americans doubted the Apollo 11 moon landing happened. But – as the 21st century brought a rise in internet use and a different standard of truth in media – that number has risen, so that Wikipedia's entry on this subject (Moon Landing Conspiracy Theories) now suggests:

Opinion polls taken in various locations have shown that between 6% and 20% of Americans, 25% of Britons, and 28% of Russians surveyed believe that the manned landings were faked.

One of the early promoters of the moon landing conspiracy theory was the Fox television network, which, in 2001, aired a documentary-style film titled Conspiracy Theory: Did We Land on the Moon?. It claimed that NASA faked the first landing in 1969 to win the Space Race. The film presented "evidence" of deception including photos showing no stars in the lunar sky and American flags rippling on the moon, despite the fact there's no air or wind. It showed photograph and film oddities. It presented what's become one of the most enduring claims by hoaxers: that astronauts could not have passed through the Van Allen radiation belts, in order to get to the moon.

All of these claims have been explained with the facts, of course, but – as has become increasingly apparent to all of us in recent years – human beings frequently don't base their conclusions on facts.

In recent years, NASA's Lunar Reconnaissance Orbiter (LRO) mission has returned images of the moon's surface – taken from orbit – showing the shadows of the various Apollo landers. LRO also acquired images of five of the six Apollo missions' American flags on the moon; only the first flag to be planted – by the Apollo 11 crew – now ...Read More...

Slooh in the UAE

Michael Paolucci, the founder of Slooh, visited the University of Sharjah and the Sharjah Center for Astronomy and Space Sciences and was impressed by all the accomplishments in the space sciences sector at Sharjah. His HE Prof. Hamid Al-Naimy, the Chancellor of the University of Sharjah and Director of SCASS, met Mr. Michael Paolucci on July 16. The two discussed possible collaborations in making astronomical observations easily accessed by the astronomy community worldwide via a network of online telescopes.

Slooh is a robotic telescope service that can be viewed live through a web browser with Flash plug-in. It is an online astronomy platform with live-views and telescope rental for a fee. Observations come from a global network of telescopes located in places including Spain, Chile, and hopefully in the UAE. Slooh makes offering astronomy engaging and affordable for schools without the requisite equipment or expertise on staff. The company provides direct access to astronomy educators and real-time viewing and control of robotic telescopes, including seven telescopes situated at one of the world's top observatory sites. As Mr. Michaeld Paolucci said: "With the dawn of the new space age, astronomy deserves more focus in schools, particularly because it is fascinating and inspiring to students." Slooh is designed to empower the students in class as a part of the curriculum, and also in a co-curricular or extracurricular manner so students can explore space on their own with direct support from a pool of world-known astronomy educators.

The name Slooh comes from the word "slew" to indicate the movement of a telescope, modified with "ooh" to express pleasure and surprise.

This Week's Sky at a Glance - July 21 - 28

Jul 21	Sa	03:57	Moon-Jupiter: 4.8° S
Jul 24	Tu	20:49	Mercury-Regulus: 7.4° S
Jul 25	We	10:10	Moon-Saturn: 2.2° S
Jul 26	Th	00:55	Moon South Dec.: 20.8° S
Jul 27	Fr	09:31	Mars Opposition
		09:44	Moon Apogee: 406200 km
Jul 28	Sa	00:21	Full Moon
		00:22	**Total Lunar Eclipse**
		02:40	Moon Descending Node
		12:50	Delta Aquarid Shower: ZHR = 20