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Astronomy & Physics Weekly News

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Top News

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The Milky Way galaxy may be much bigger than we thought

The Milky Way stretches across the sky above the European Southern Observatory's telescope in La Silla, Chile.Serge Brunier / ESO via EPA

It's no secret that the Milky Way is big, but new research shows that it may be much bigger than we ever imagined.

The research, described May 7 in the journal "Astronomy & Astrophysics," indicates that our spiral galaxy's vast rotating disk of stars spans at least 170,000 light-years, and possibly up to 200,000 light-years.

It's hard to fathom just how far that is. If you could ride a light beam from one side of the disk to the other, it would take 200,000 years to span the distance. If you could drive across and averaged 60 miles an hour, it would take more than 2 trillion years. That's about 150 times greater than the age of the universe, which is estimated to be about 13.8 billion years.

For many years, astronomers believed the Milky Way's disk spanned about 100,000 light-years. Then in 2015, researchers showed that a distance of 150,000 light-years was closer to the mark.

To arrive at the new number, researchers at the Canary Islands Institute of Astrophysics and the National Astronomical Observatories of Beijing turned to a pair of star atlases and studied the chemical composition of thousands of stars in the outermost parts of the galactic plane — the plane that extends through the center of the disk. The researchers used a statistical analysis to determine that the far-flung stars are chemically similar to the stars in the galactic disk and thus should be considered part of it.

"We were able to confirm that some stars of the outermost regions in the plane belong to the disk," Martin Lopez-Corredoira, a researcher at the institute and the first author of the article describing the research, told NBC News MACH in an email.

The finding offers further confirmation of the disk's complex structure, Heidi Newberg, an astrophysicist at Rensselaer Polytechnic Institute and the leader of the research team that revised the size estimate of the Milky Way in 2015, told NBC News MACH in an email. ..Read More...

Astronomers discover the first interstellar immigrant nestled in Jupiter's orbit

New research suggests the asteroid 2015 BZ509 may have originally traveled to the solar system from another star. NASA/JPL

Less than a year ago, astronomers discovered 'Oumuamua, the first known object from another star system to pass through our own. Now, in a new study published today in the Monthly Notices of the Royal Astronomical Society: Letters, astronomers announced the discovery of the first interstellar object known to have taken up permanent residence around the Sun.

A perfect fit

Astronomers first discovered the asteroid in question, which has the succinct name (413107) 2015 BZ509 (or Bee-Zed for short), back in 2015 using the Panoramic Survey Telescope and Rapid Response System (Pan-STARRS). Though the initial discovery team noticed Bee-Zed had a very peculiar, yet stable orbit — it shares a nearly perfect one-to-one resonance with Jupiter, but travels in the opposite direction — they were unable to explain why the asteroid has this 'retrograde' motion.

"How the asteroid came to move in this way while sharing Jupiter's orbit has until now been a mystery," said Fathi Namouni, the study's lead author, in a press release. "If 2015 BZ509 were a native of our system, it should have had the same original direction as all of the other planets and asteroids, inherited from the cloud of gas and dust that formed them."

Planets and smaller sub-planetary objects are thought to form out of a dense disk of debris that encircles a newly formed star, called a protoplanetary disk. The material that makes up this disk is mainly gas and dust that was too loosely held to be incorporated into the star, but it's still spinning in the same direction that the star spins. Over time, that disk of protoplanetary material begins to coalesce, ultimately forming a handful of planets, numerous moons, and countless asteroids and comets. However, all of these objects continue to travel in the same direction unless they are kicked out of their orbits through collisions, which does not seem to be the case for Bee-Zed. ...Read More...

NASA's Curiosity Rover on Mars Just Snagged Its 1st Drilled Samples Since 2016

NASA's Curiosity Mars rover captured this shot of the 2-inch-deep (5 centimeters) hole it drilled in a target called "Duluth" on May 20, 2018. It was the first rock sample captured by the drill since October 2016. Credit: NASA/JPL-Caltech/MSSS

It looks like Curiosity's drill is finally back in action.

NASA's Curiosity Mars rover bored 2 inches (5 centimeters) into a rock on Sunday (May 20), grabbing powdered Red Planet samples for the first time in more than 18 months, agency officials said.

Curiosity's drill, which sits at the end of the robot's 7-foot-long (2.1 meters) robotic arm, had been sidelined since late 2016, when a motor that extends two stabilizing posts on each side of the drill bit stopped working. Since then, engineers have been devising potential workarounds and testing them at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, which manages Curiosity's mission.

The most promising of these alternate drilling techniques keeps the drill bit extended beyond the stabilizing posts and then pushes it into the rock using force provided by the robotic arm. This method passed a multitude of tests here on Earth, and now it's aced its first bona fide run on Mars, on a rock target called "Duluth," mission team members said.

"The team used tremendous ingenuity to devise a new drilling technique and implement it on another planet," Curiosity deputy project manager Steve Lee, of JPL, said in a statement. "Those are two vital inches of innovation from 60 million miles [97 million kilometers] away. We're thrilled that the result was so successful."

Curiosity demonstrated the new technique in a limited fashion earlier this year, boring about 0.5 inches (1.3 cm) into a different Mars rock. But that hole wasn't deep enough to allow the rover to grab samples, NASA officials said.

Drilling is a vital part of Curiosity's $2.5 billion mission, which is investigating Mars' past potential to host life and how the Red Planet's climate has changed over time. Curiosity's analyses of drilled rock samples ...Read More...

Pluto May Have Formed from 1 Billion Comets

This view of Pluto's Sputnik Planitia nitrogen-ice plain was captured by NASA's New Horizons spacecraft during its flyby of the dwarf planet in July 2015.
Credit: NASA/JHUAPL/SwRI

At its heart, Pluto may be a gigantic comet.

Researchers have come up with a new theory about the dwarf planet's origins after taking a close look at Sputnik Planitia, the vast nitrogen-ice glacier that constitutes the left lobe of Pluto's famous "heart" feature.

"We found an intriguing consistency between the estimated amount of nitrogen inside the glacier and the amount that would be expected if Pluto was formed by the agglomeration of roughly a billion comets or other Kuiper Belt objects similar in chemical composition to 67P, the comet explored by Rosetta," Chris Glein, a scientist at the Southwest Research Institute (SwRI) in San Antonio, said in a statement.

The European Space Agency's Rosetta mission orbited Comet 67P/Churyumov-Gerasimenko from 2014 through 2016. The orbiting mothership also dropped a lander named Philae onto the icy body, pulling off the first-ever soft touchdown on a comet's surface. (The Kuiper Belt is the ring of frigid objects beyond Neptune's orbit; Pluto is the belt's largest resident.)

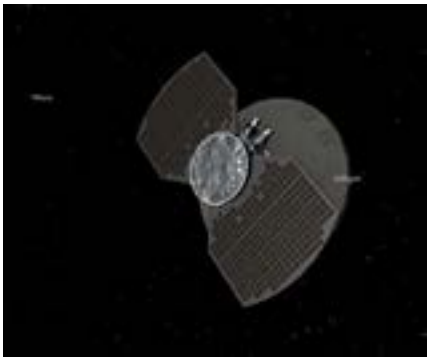
Glein and his SwRI colleague Hunter Waite devised the new Pluto-formation scenario after analyzing data from Rosetta and NASA's New Horizons mission, which flew by Pluto in July 2015.

The scientists also made some inferences about the dwarf planet's evolution in their new study, which was published online Wednesday (May 23) in the journal Icarus.

"Our research suggests that Pluto's initial chemical make-up, inherited from cometary building blocks, was chemically modified by liquid water, perhaps even in a subsurface ocean," Glein said.

Glein and Waite aren't claiming to have nailed down Pluto's origin definitively; a "solar model," in which the dwarf planet coalesced from cold ices with a chemical composition closer to that of the sun, also remains in play, the duo said. ..Read More...

NASA's InSight Steers Toward Mars



NASA's InSight spacecraft is currently cruising to Mars. Yesterday, it performed its first course correction guiding it to the Red Planet.Credit: NASA/JPL-Caltech

NASA's InSight lander has made its first course correction toward Mars.

InSight, short for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport, is the first mission dedicated to exploring the deep interior of Mars.

The lander is currently encapsulated in a protective aeroshell, which launched on top of an Atlas V 401 rocket on May 5 from Vandenberg Air Force Base in Central California. Yesterday, the spacecraft fired its thrusters for the first time to change its flight path. This activity, called a trajectory correction maneuver, will happen a maximum of six times to guide the lander to Mars.

Every launch starts with a rocket. That's necessary to get a spacecraft out past Earth's gravity - but rockets don't complete the journey to other planets. Before launch, every piece of hardware headed to Mars is cleaned, limiting the number of Earth microbes that might travel on the spacecraft. However, the rocket and its upper stage, called a Centaur, don't get the same special treatment.

As a result, Mars launches involve aiming the rocket just off-target so that it flies off into space. Separately, the spacecraft performs a series of trajectory correction maneuvers guiding it to the Red Planet. This makes sure that only the clean spacecraft lands on the planet, while the upper stage does not come close.

Precise calculations are required for InSight to arrive at exactly the right spot in Mars' atmosphere at exactly the right time, resulting in a landing on Nov. 26. Every step of the way, a team of navigators estimates the position and velocity of the spacecraft. Then they design maneuvers to deliver it to an entry point at Mars. That navigation team is based at NASA's Jet Propulsion Laboratory in Pasadena, California, which leads the InSight mission.

"This first maneuver is the largest we'll conduct," said Fernando Abilleira of JPL, InSight's Deputy Mission Design and Navigation Manager. "The thrusters will fire for about 40 seconds to impart a velocity change of .Read More...

Radio Experiment Launches With China's Moon Orbiter

The lunar farside and Earth, as captured by the Chang'e 5 test mission that flew in 2014. Chinese National Space Administration / Xinhuanet

A Long March-4C rocket roared to life on May 20, lighting up the night skies over China and opening up the next chapter of lunar exploration. Aboard the rocket: an innovative lunar relay orbiter and a ground-breaking radio astronomy experiment.

The launch occurred at 21:28 UT from Xichang Space Center in Sichuan, China. This orbiter is part of China's ambitious first attempt to deploy a lander and rover on the farside of the Moon later this year. All lunar landings to date, including the Apollo missions and China's 2013 Yutu Jade Rabbit lander and rover, have been conducted on the Moon's near side, within sight of Earth and radio communications. Chang'e 4, however, will land and rove on the farside of the Moon, requiring a dedicated relay.

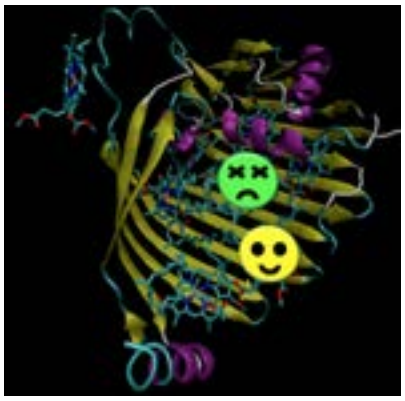
The relay orbiter is named Queqiao (pronounced Cheh-chow), Chinese for "Magpie Bridge." The name comes from a Chinese folktale of a bridge that formed once a year across a river (the Milky Way) to join two separated lovers, represented by the stars Vega and Altair.

The China National Space Administration (CNSA) reported that the orbiter successfully separated 25 minutes after launch, deployed its antennas (including a 5-meter-diameter antenna, the largest used to date for deep space exploration), and solar panels. Queqiao is now in an elliptical lunar transfer orbit and will eventually enter a lissajous (halo) orbit around the stable Lagrangian L2 point, which lies 283,000 miles (455,000 kilometers) from Earth and 37,300 miles (60,000 kilometers) beyond the Moon.

"The launch is a key step for China to realize its goal of being the first country to send a probe to soft-land on and rove the farside of the Moon," says Zhang Lihua (CNSA) in a recent press release.

A few innovative payloads hitched a ride as well, including the Netherlands-Chinese Low-Frequency Explorer (NCLE) fielded by the ASTRON, the Netherlands Institute for Astronomy, Innovative Solutions in Space (ISIS), and Radboud Radio Lab. ...Read More...

Quantum effects observed in photosynthesis



The figure shows the photosynthetic complex of light-harvesting green sulfur bacteria the green and yellow circles highlight the two molecules simultaneously excited. Credit: dr. Thomas la Cour Jansen/University of Groningen

Molecules that are involved in photosynthesis exhibit the same quantum effects as non-living matter, concludes an international team of scientists including University of Groningen theoretical physicist Thomas la Cour Jansen. This is the first time that quantum mechanical behavior was proven to exist in biological systems that are involved in photosynthesis. The interpretation of these quantum effects in photosynthesis may help in the development of nature-inspired light-harvesting devices. The results were published in Nature Chemistry on 21 May.

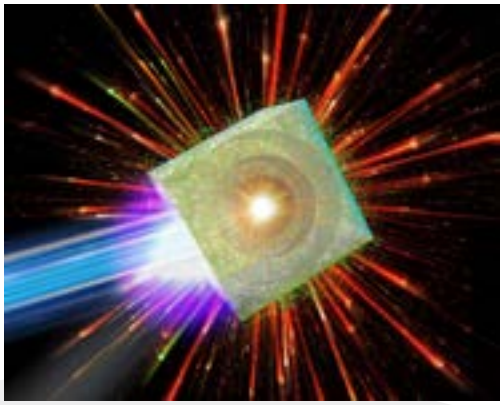
For several years now, there has been a debate about quantum effects in biological systems. The basic idea is that electrons in can be in two states at once, until they are observed. This may be compared to the thought experiment known as Schrödinger's Cat. The cat is locked in a box with a vial of a toxic substance. If the cap of the vial is locked with a quantum system, it may simultaneously be open or closed, so the cat is in a mixture of the states "dead" and "alive," until we open the box and observe the system. This is precisely the apparent behavior of electrons.

Vibrations

In earlier research, scientists had already found signals suggesting that light-harvesting molecules in bacteria may be excited into two states simultaneously. In itself this proved the involvement of quantum mechanical effects, however in those experiments, that excited state supposedly lasted more than 1 picosecond (0.000 000 000 001 second). This is much longer than one would expect on the basis of quantum mechanical theory.

Jansen and his colleagues show in their publication that this earlier observation is wrong. "We have shown that the quantum effects they reported were simply regular vibrations of the molecules." Therefore, the team continued the search. "We wondered if we might be able to observe that Schrödinger cat situation." ...Read More...

Could a particle accelerator using laser-driven implosion become a reality?



Schematic view of a bubble implosion, which is an envisioned picture showing the whole main events integrated, i.e., laser illumination, hot electron spread, implosion, and proton flash. Credit: M. Murakami

Laser pulse compression technology invented in the late 1980s resulted in high-power, short-pulse laser techniques, enhancing laser intensity 10 million-fold in a quarter of a century.

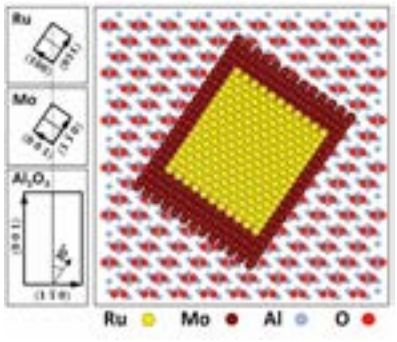
Scientists at Osaka University discovered a novel particle acceleration mechanism they describe as a micro-bubble implosion, in which super-high energy hydrogen ions (relativistic protons) are emitted at the moment when bubbles shrink to atomic size through the irradiation of hydrides with micron-sized spherical bubbles by ultraintense laser pulses. Their research results were published in Scientific Reports.

The group led by Masakatsu Murakami has reported an astonishing physical phenomenon: When shrinking matter to unprecedented density, comparable to a mass the size of a sugar cube weighing more than 100 kilograms, high-energy protons are emitted from the positively-charged nanoscale clusters, a world first. Usually, an acceleration distance of several tens to hundreds of meters is necessary for conventional accelerators to generate such huge energy.

In a micro-bubble implosion, a unique phenomenon occurs in which ions (charged particles) converge to a single point in space at half the speed of light. This phenomenon, which looks like the opposite of the Big Bang, is essentially different from any previously discovered or proposed acceleration principles.

This new concept will clarify unknown space physics of grand scales of time and space, such as the origins of high-energy protons in stars and distributed in space. In addition, as a compact source of neutron radiation through nuclear fusion, this concept will be used in a variety of applications in medical treatment and industry in the future, such as proton radiotherapy to treat cancer, the development of new energy with laser nuclear fusion, cross-sectional photos for developing fuel cells ...Read More...

Scientists discover new magnetic element



This schematic illustrates how a tetragonal phase of Ru has been forced using ultra thin film growth methods. Credit: University of Minnesota, Quarterman et al, Nature Communications

A new experimental discovery, led by researchers at the University of Minnesota, demonstrates that the chemical element ruthenium (Ru) is the fourth single element to have unique magnetic properties at room temperature. The discovery could be used to improve sensors, devices in the computer memory and logic industry, or other devices using magnetic materials.

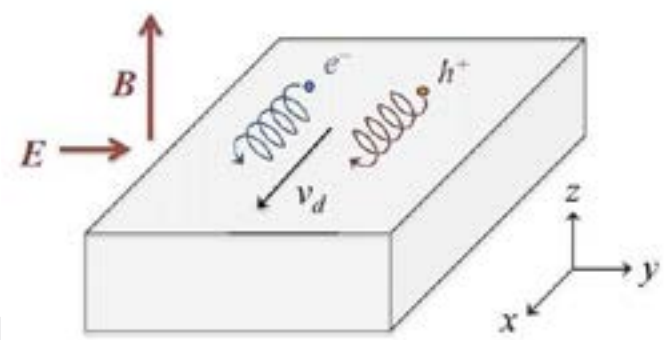
The use of ferromagnetism, or the basic mechanism by which certain materials (such as iron) form permanent magnets or are attracted to magnets, reaches back as far as ancient times when lodestone was used for navigation. Since then only three elements on the periodic table have been found to be ferromagnetic at room temperature—iron (Fe), cobalt (Co), and nickel (Ni). The rare earth element gadolinium (Gd) nearly misses by only 8 degrees Celsius.

Magnetic materials are very important in industry and modern technology and have been used for fundamental studies and in many everyday applications such as sensors, electric motors, generators, hard disk media, and most recently spintronic memories. As thin film growth has improved over the past few decades, so has the ability to control the structure of crystal lattices—or even force structures that are impossible in nature. This new study demonstrates that Ru can be the fourth single element ferromagnetic material by using ultra-thin films to force the ferromagnetic phase.

The details of their work are published in the most recent issue of Nature Communications. The lead author of the paper is a recent University of Minnesota Ph.D. graduate Patrick Quarterman, who is a National Research Council (NRC) postdoctoral fellow at the National Institute of Standards and Technology (NIST).

"Magnetism is always amazing. It proves itself again. We are excited and grateful to be the first group to experimentally demonstrate and add the fourth ferromagnetic element at room temperature to the periodic table," said University of Minnesota Robert F. Hartmann professor of electrical and computer engineering Jian-Ping Wang, the corresponding author for the paper and Quarterman's advisor. ...Read More...

New materials, heated under high magnetic fields, could produce record levels of energy, model shows



Lab Schematic depiction of the E × B drift of carriers in a strong magnetic field. Electrons (labeled e−) and holes (labeled h+) drift in the same direction under the influence of crossed electric and magnetic fields. Both signs of carrier contribute additively to the heat current in the x direction and subtractively to the electric current in the x direction, which leads to a large Peltier heat Pxx and therefore to a large thermopower Sxx. Credit: Science Advances (2018). advances.sciencemag.org/content/4/5/eaat2621

Imagine being able to power your car partly from the heat that its engine gives off. Or what if you could get a portion of your home's electricity from the heat that a power plant emits? Such energy-efficient scenarios may one day be possible with improvements in thermoelectric materials—which spontaneously produce electricity when one side of the material is heated.

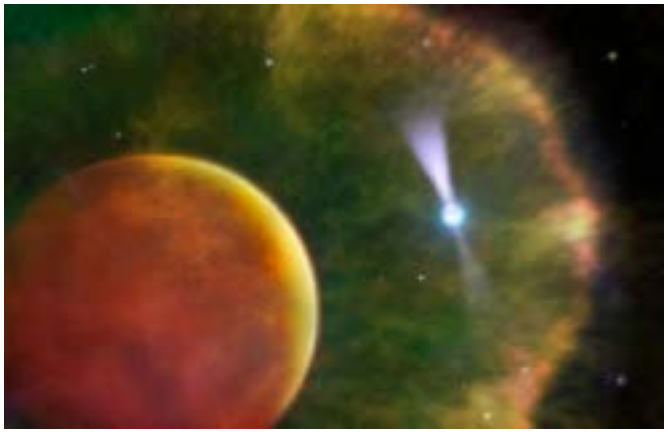
Over the last 60 years or so, scientists have studied a number of materials to characterize their thermoelectric potential, or the efficiency with which they convert heat to power. But to date, most of these materials have yielded efficiencies that are too low for any widespread practical use.

MIT physicists have now found a way to significantly boost thermoelectricity's potential, with a theoretical method that they report today in Science Advances. The material they model with this method is five times more efficient, and could potentially generate twice the amount of energy, as the best thermoelectric materials that exist today.

"If everything works out to our wildest dreams, then suddenly, a lot of things that right now are too inefficient to do will become more efficient," says lead author Brian Skinner, a postdoc in MIT's Research Laboratory of Electronics. "You might see in people's cars little thermoelectric recoverers that take that waste heat your car engine is putting off, and use it to recharge the battery. Or these devices may be put around power plants so that heat that was formerly wasted by your nuclear reactor or coal power plant now gets recovered and put into the electric grid."

Skinner's co-author on the paper is Liang Fu, the Sarah W. Biedenharn Career Development Associate Professor of Physics at MIT. ...Read More...

A Magnifying Glass for a Pulsar



The pulsar PSR B1957+20 is seen in the background through the cloud of gas enveloping its brown dwarf star companion.
Mark A. Garlick / Dunlap Institute for Astronomy & Astrophysics, Univ. of Toronto

In a system 6,500 light-years away, a pulsar and brown dwarf are dancing a cosmic dervish, whipping around each other every nine hours. Their dance won't last – in addition to its lighthouse-like beam of radio waves, the pulsar PSR B1957+20 is giving off a fierce wind of particles that's slowly blasting away its companion. For this reason, the pulsar has earned the name "black widow," after the species of spider that eats its mate.

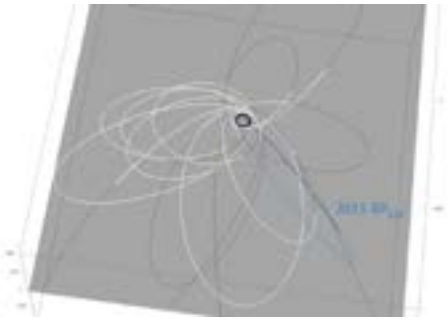
But before the meal is complete, the brown dwarf has something to offer us: a magnifying glass that exposes the pulsar in incredible detail.

The entire system is tiny: The brown dwarf is the size of Jupiter and the pulsar is only the size of Manhattan; the distance that separates them is roughly five times the distance between Earth and the Moon. From Earth's point of view, the brown dwarf is big enough to eclipse the pulsar for 40 minutes every time they circle each other.

It's this fortunate geometry that gives the brown dwarf its magnifying power. If you've ever admired the beautiful patterns of light along a shoreline, you've watched light bend as it passes through water. Waves in the water concentrate sunlight to create those wiggling patterns on the sand. The cocoon of plasma around the brown dwarf has a similar effect on the pulsar's lighthouse beam – when everything lines up just right, we see the pulse of radio waves pass through the plasma, which concentrates the radiation.

It wasn't obvious that this should happen. But in 2014 Robert Main (University of Toronto) and colleagues observed a full 9.2-hour orbit using the 305-meter William E. Gordon Telescope at Arecibo Observatory. Just before and just after every pulsar eclipse, they saw the radio pulses brighten. Moreover, the pulses brightened in different ways at different frequencies, exactly as expected for a lensing event. "The other spectacular thing that happens," Main explains, "is that the emission from the two poles of the pulsar is not amplified equally. ...Read More...

New evidence for existence of Planet Nine



A visual representation of the orbit of 2015 BP519, plotted with the other ETNOs as comparisons. For each orbit, the darker regions on the curve denote where an object falls below the plane of the solar system. 2015 BP519 has the highest inclination of any extreme TNO discovered to date. The full, interactive 3D orbit visualization can be found at smillholland.github.io/BP519/ . Credit: arXiv:1805.05355 [astro-ph.EP]

A large international team of researchers has found what they are describing as more evidence of the existence of Planet Nine. In their paper posted on the arXiv preprint server, the group describes the behavior of a newly discovered distant object as suggestive of an influence of a large planet.

It was just two years ago that astronomers at Caltech proposed the possible existence of a large planet circling the sun–which would make it the ninth known planet in our solar system. The researchers made their prediction based on observations of icy objects that exist at the edge of the solar system–their orbits were clearly being warped by a gravitational mass. They suggested a very distant planet roughly four times the size of Earth, but with 10 times its mass, could account for the odd behavior. If such a planet does exist, it would be quite distant, taking from 10,000 to 20,000 years to make one trip around the sun. Since announcing their initial findings, the team at Caltech has published papers offering more evidence of the planet–the possibility that it could have played a role in tilting the other planets in our solar system, for example. They have also suggested it as an explanation for why objects in the Kuiper Belt orbit in an opposite direction to everything else.

In this new effort, the researchers suggest the behavior of a certain Trans-Neptunian object could very well be due to gravity from Planet Nine. The object, called 2015 BP519 (Caju for short), was first noted approximately three years ago, but it was only recently that the shape of its orbit was found to be very unusual–it lies nearly perpendicular to the plane established by the known planets. What makes the find so compelling is that the team of researchers who first proposed the existence of Planet Nine created a simulation that predicted the orbital angle of just such an object. And it just happened to match with what has been found. ...Read More...

Special Read:

Take a Virtual Trip to a Strange New World with NASA

The Exoplanet Travel Bureau was developed by NASA's Exoplanet Exploration Program communications team and program chief scientists. Based at the agency's Jet Propulsion Laboratory in Pasadena, California, which is a division of Caltech, the program is NASA's search for habitable planets and life beyond our solar system. The program develops technology and mission concepts, maintains exoplanet data archives and conducts ground-based exoplanet science for NASA missions.

Are you looking for an exotic destination to visit this summer? Why not take a virtual trip to an Earth-size planet beyond our solar system with NASA's interactive Exoplanet Travel Bureau?

We live in a universe teeming with exoplanets, or planets outside our solar system. Unfortunately, even the nearest exoplanets are light-years away, so sending spacecraft and humans to these intriguing worlds remains a distant dream.

But on NASA's Exoplanet Exploration website, you can explore an imagined surface of an alien world via 360-degree, interactive visualizations. As you investigate each planet's surface, you'll discover fascinating features, like the blood-red sky of TRAPPIST-1d, or stand on a hypothetical moon of the massive planet Kepler-16b, which appears larger than either of the planet's two suns. The view from each planet's surface is an artist's impression based on the limited data that is available; no real photos of these planets exist.

The newest planet to feature this 360-degree surface visualization is Kepler-186f, an Earth-size planet orbiting a star much cooler and redder than the Sun. Scientists don't know if Kepler-186f has an atmosphere, but with the NASA visualization tool, you can see how the presence or absence of an atmosphere would change the view of the sky from the planet's surface. ...Read More...

This Week's Sky at a Glance
May 26 - June 01, 2018

May 27	Su	21:39	Moon-Jupiter: 4.3° S
May 29	Tu	18:20	Full Moon
Jun 01	Fr	05:20	Moon-Saturn: 1.8° S
		11:09	Moon South Dec.: 20.7° S