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Astronomy & Physics Weekly News

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Top News

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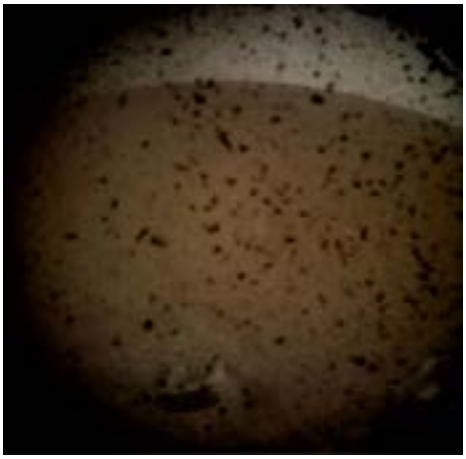
InSight has landed! Inside the dramatic touchdown



InSight's first photo from the martian surface.

Touchdown on Mars
NASA's InSight lander has endured almost seven months in space, traveling over 300 million miles (480 million kilometers) in a carefully calculated path from Earth to Mars. After its lengthy journey, the probe has finally and successfully touched down on the martian surface.

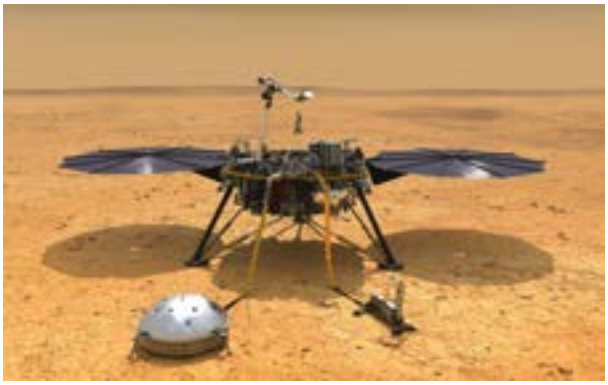
The InSight probe launched May 5 from the Vandenberg Air Force Base on California's central coast. With a host of scientific instruments on board, the lander will study the Red Planet's interior, gathering groundbreaking data about Mars' composition and the planet's tectonic activity.

At 2:54 EST, InSight — which stands for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport — landed on Mars. During its descent towards the martian surface, the probe first entered Mars' atmosphere 80 miles (129 km) above the surface. At about seven miles (11 km) up, InSight deployed its giant parachute to decrease speed as the craft neared the surface. Less than a minute later, InSight cut its parachute free and its 12 retrorockets fired, providing the probe with an additional braking force and allowing it to settle neatly onto the planet's surface.

A Tense Landing
NASA engineers were forced to wait until the landing was over to know whether it was successful, as there's an eight-minute delay in communications between Mars and Earth and the landing only took about seven minutes. So, from the time when the craft entered Mars' atmosphere until touchdown, JPL engineers anxiously crossed their fingers, not knowing the real-time status of the craft. For these seven long minutes, dubbed the "seven minutes of terror," the engineers waited to confirm whether the probe had landed safely — which, thankfully, it had. "It was intense, and you could feel the emotion," NASA Administrator Jim Bridenstine said in a NASA livestream about the landing's success. This tension quickly turned to excitement once InSight landed, however. "The enthusiasm here is incredible," Bridenstine said.

The InSight mission team waited and "watched" for the probe's landing by monitoring InSight's radio signals with radio telescopes on Earth and a variety of spacecraft, according to a NASA press release. ...Read More...

No, Mars InSight Won't Be Searching for Alien Life. Here's What It IS Looking For.



An artist's concept depicts NASA's InSight lander after it has deployed its instruments on the Martian surface.
Credit: NASA/JPL-Caltech

Hurrah, NASA's sent another robot to Mars!

InSight touched down on Mars today (Nov. 26), joining Mars' other robotic inhabitants: Curiosity, Opportunity and Spirit (though only Curiosity is currently "live," sending signals back to Earth).

You may be wondering if InSight will meet native forms of life during its stay on Mars; alas, that question will remain unanswered. The hardy little lander won't be spending its time searching for signs of Martian microbes. Instead, InSight will send a probe to burrow several feet below the planet's surface.

In doing so, InSight will provide a never-before-seen glimpse into Mars' internal structure, which could help scientists figure out how Mars — and other rocky planets, like Earth — took shape in a young solar system. [Mars Insight Photos: A Timeline to Landing on the Red Planet]

On the surface, Mars is covered in red dust that is rich in iron oxide; this coating earned it the nickname "Red Planet." Even when viewed from Earth without a telescope, Mars appears reddish in color as it hangs amid the stars — in fact, its bloody appearance inspired ancient astronomers to name the planet after the Roman god of war, according to NASA.

However, this signature red color doesn't extend very far below the surface, as Curiosity discovered in 2013. After drilling about 2.5 inches (6.4 centimeters) into a rocky outcrop, the rover extracted rock dust that was light gray, offering a first look at subsurface material on Mars.

But InSight will explore far beyond that, sinking a "self-hammering" probe that will dig itself into the ground to a depth of 10 to 16 feet (3 to 5 meters), for experiments measuring how the rock in the planet's interior conducts heat.

Curiosity, Opportunity and Spirit have already provided scientists with a wealth of data on Mars from samples collected on the planet's surface, revealing the composition of its minerals and showing that the planet ...Read More...

NASA chooses nine companies to bid on flying to Moon

Image Illustration - NASA.

The US space agency on Thursday announced nine private companies, mostly start-ups, that will bid on $2.6 billion in contacts to build spacecraft to carry payloads to the Moon as early as 2019.

The move is part of NASA's goal of sending people to the Moon in the next decade, for the first time since the Apollo era of the 1960s and '70s.

NASA Administrator Jim Bridenstine described the announcement as "tangible progress in America's return to the Moon's surface to stay."

Of the group, the only well-known name is aerospace giant Lockheed Martin, which has a long track record of success with NASA and built the InSight lander that touched down Monday on Mars.

The others are Astrobotic Technology, Inc.; Deep Space Systems; Draper; Firefly Aerospace, Inc.; Intuitive Machines, LLC; Masten Space Systems, Inc.; Moon Express; and Orbit Beyond.

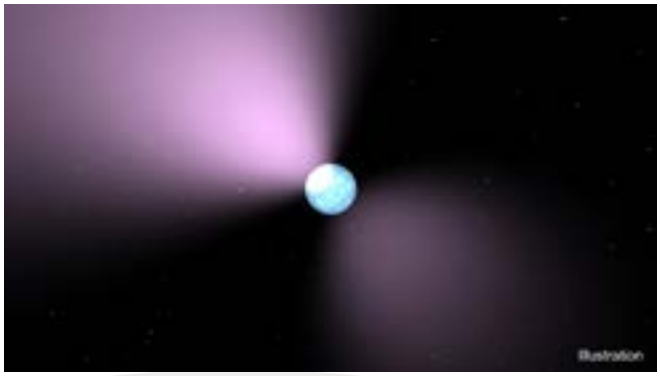
"The Commercial Lunar Payload Services contracts are indefinite delivery, indefinite quantity contracts with a combined maximum contract value of $2.6 billion during the next 10 years," said a NASA statement.

NASA has not given any specifics for the bidding process, other than to say it will "look at a number of factors when comparing the bids, such as technical feasibility, price and schedule."

The decision marks a stark change in NASA's mode of operation when it comes to America's Moon aspirations -- though private companies have been used for years to ferry gear to the International Space Station, and SpaceX and Boeing are working on spacecraft to carry astronauts to the Moon as early as 2019.

Instead of running a government-funded space program, like Apollo, the US space agency will buy services, essentially becoming a customer to private businesses that build their own spacecraft. The approach will allow NASA to cut costs, Bridenstine said. ..Read More...

This strange star system is shooting off more gamma rays than expected



Pulsars are rapidly spinning neutron stars. Their intense magnetic fields can accelerate particles around them to high velocities; when these particles slam into anything nearby, they emit gamma rays. NASA/JPL-Caltech

A once-in-a-lifetime event is changing the way astronomers think some cosmic rays and gamma rays are created.

Our universe is filled with high-energy particles and light, which require immense energy from some of the most extreme objects and processes imaginable to create. One of the biggest challenges astronomers face is figuring out how these cosmic rays and gamma rays are produced. Now, a once-in-a-lifetime event has shed light on how pulsars accelerate particles around them to produce some of the highest-energy light, but the observations show our models of how this acceleration happens may need some revision.

The work was published October 31 in the Astrophysical Journal Letters. In it, astronomers observed the closest approach of a pulsar (a rapidly spinning neutron star emitting beams of radiation from its poles), PSR J2032+4127, to its massive Be star binary companion, MT91 213. The system, called a gamma-ray binary system because it produces high-energy light, is one of only two known such systems in which a pulsar and a massive star orbit each other. Further, there are only about 10 known binary systems with a massive star orbiting a neutron star – not all neutron stars are seen as pulsars, which are identified only if the neutron star is oriented in such a way that its poles sweep over Earth as it rotates.

Anticipating fireworks

The two stars in this system are on a 50-year orbit, with the most recent closest approach between the stars occurring November 13, 2017. When dust and gas from the massive companion gets too close to the pulsar, the particles are accelerated to near the speed of light by the pulsar's intense magnetic field. Those particles then slam into any other particles nearby, generating a flash of gamma rays, which astronomers can detect on Earth. As expected, the number of gamma rays seen from the system increased as the stars approached the closest point in their orbits. But unexpectedly, astronomers saw "a huge spike in the number of gamma rays" as ...Read More...

New Calculation Adds Up All the Starlight in the Universe

There's a good reason starlight fascinates us.
Credit: NASA/JPL-Caltech/STScI/IRAM

If you're a fan of really big numbers that don't actually tell you much about the world, Clemson University astrophysicist Marco Ajello has a great one for you: 4 x 10^84.

That's the total number of photons that have successfully escaped from stars and the dust that surrounds them into space over the history of the universe. You'd expect that value to be huge, of course, and there it is, in all its incomprehensible vastness. (For comparison, a recent estimate for how many atoms there are in the universe is just a few orders of magnitude smaller.)

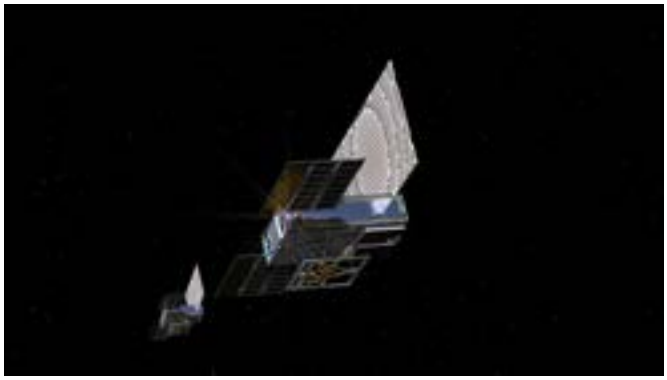
Being able to calculate that number, however, is just a nice side benefit to new research conducted by Ajello and his team. That research backs up previous theories about star-formation rates over the history of the universe, using information that is trapped in all that starlight — known formally as the extragalactic background light.

Extragalactic background light is, by definition, the portion of near-infrared, optical and ultraviolet radiation produced by stars that manages to make it out into space, rather than colliding with the dust that surrounds those stars. "It's basically starlight that ended up everywhere," Ajello told Space.com. "All the light emitted by stars that is able to escape to space basically becomes this background."

But extragalactic background light is difficult to measure, since it is spread so thinly across the universe and is outshone by bright light sources closer to Earth. So Ajello and his co-authors tried to parse out this background starlight by taking advantage of blazars — a type of galaxy that hides a supermassive black hole at its core that happens to be shooting a giant stream of high-energy material more or less in our direction. Their data about those blazars and the high-energy gamma-ray photons they emit come courtesy of NASA's Fermi Gamma-ray Space Telescope.

The study relies on an annoying characteristic of blazars: Some of the highest-energy light they produce bangs into much lower-energy particles of light, like the photons we humans can see. That collision turns a pair of mismatched photons into an electron and a positron, essentially disappearing that high-energy photon the ...Read More...

Success of Tiny Mars Probes Heralds New Era of Deep-Space Cubesats



An artist's illustration of NASA's tiny twin MarCO spacecraft on their way to Mars. Credit: NASA/JPL-Caltech

The era of the interplanetary cubesat has definitively dawned.

Less than seven months ago, no tiny spacecraft had ever voyaged beyond Earth orbit. But two briefcase-size probes just blazed a trail all the way to Mars, covering 301 million deep-space miles (484 million kilometers) and beaming home data from NASA's InSight lander during the latter's successful touchdown on the Red Planet Monday (Nov. 26).

The tiny NASA craft, known as MarCO-A and MarCO-B, even photographed Mars and helped researchers collect some data about the planet's atmosphere during their flyby, mission team members said.

"This team of really mostly part-timers on the project has proven the technology that we were trying to demonstrate with this mission," MarCO chief engineer Andy Klesh, of NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, said during a post-landing press briefing at JPL on Monday.

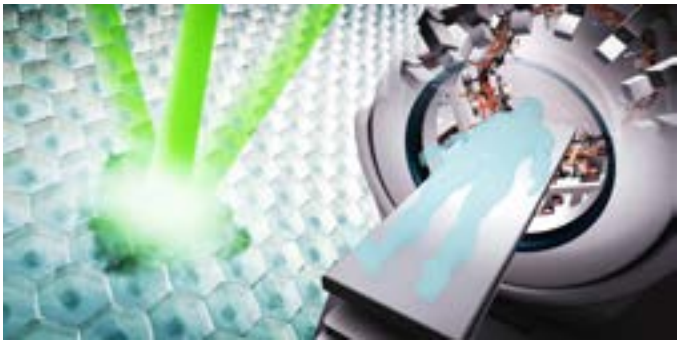
The main goals of the $18 million MarCO project (whose name is short for "Mars Cube One"), Klesh added, involve "being able to support a large craft like InSight, in order for it to perform its fantastic science," as well as showing "that we can take a smaller, focused more risk[y] mission out into the solar system," Klesh added.

The mission also aimed to "bring the community that we have built for these small spacecraft along with us," he said. That community included many young, early career engineers and scientists, a number of whom are still university undergraduates, Klesh said.

The MarCOs launched with InSight on May 5, atop a United Launch Alliance Atlas V rocket from Vandenberg Air Force Base in California. That was a first as well; every previous NASA interplanetary mission had lifted off from Florida's Space Coast.

The MarCOs weren't attached to InSight. They made their own way to Mars, so they could get into position for their data-relay work. This was an important task, because no NASA Mars orbiter would be in position to ...Read More...

The future of fighting cancer: Zapping tumors in less than a second



Researchers at SLAC and Stanford are developing new accelerator-based technology that aims to speed up cancer radiation therapy by hundreds of times and make related medical devices more compact. The approach could reduce side effects in patients and possibly make radiation therapy more accessible around the world. Credit: Greg Stewart/SLAC National Accelerator Laboratory

New accelerator-based technology being developed by the Department of Energy's SLAC National Accelerator Laboratory and Stanford University aims to reduce the side effects of cancer radiation therapy by shrinking its duration from minutes to under a second. Built into future compact medical devices, technology developed for high-energy physics could also help make radiation therapy more accessible around the world.

Now, the SLAC/Stanford team has received crucial funding to proceed with two projects to develop possible treatments for tumors—one using X-rays, the other using protons. The idea behind both is to blast cancer cells so quickly that organs and other tissues don't have time to move during the exposure—much like taking a single freeze frame from a video. This reduces the chance that radiation will hit and damage healthy tissue around tumors, making radiation therapy more precise.

"Delivering the radiation dose of an entire therapy session with a single flash lasting less than a second would be the ultimate way of managing the constant motion of organs and tissues, and a major advance compared with methods we're using today," said Billy Loo, an associate professor of radiation oncology at the Stanford School of Medicine.

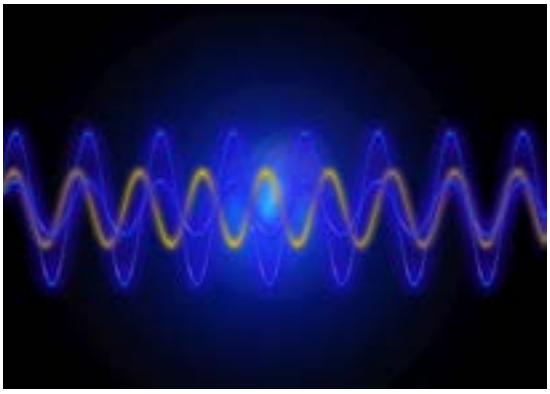
Sami Tantawi, a professor of particle physics and astrophysics and the chief scientist for the RF Accelerator Research Division in SLAC's Technology Innovation Directorate, who works with Loo on both projects, said, "In order to deliver high-intensity radiation efficiently enough, we need accelerator structures that are hundreds of times more powerful than today's technology. The funding we received will help us build these structures."

Blasting cancer with X-rays

The project called PHASER will develop a flash delivery system for X-rays.

In today's medical devices, electrons fly through a tube-like accelerator structure that's about a ....Read More...

Revealing hidden information in sound waves



Credit: CCO Public Domain

By essentially turning down the pitch of sound waves, University of Michigan engineering researchers have devised a way to unlock greater amounts of data from acoustic fields than ever before.

That additional information could boost performance of passive sonar and echolocation systems for detecting and tracking adversaries in the ocean, medical imaging devices, seismic surveying systems for locating oil and mineral deposits, and possibly radar systems as well.

"Acoustic fields are unexpectedly richer in information than is typically thought," said David Dowling, a professor in U-M's Department of Mechanical Engineering.

He likens his approach to solving the problem of human sensory overload.

Sitting in a room with your eyes closed, you would have little trouble locating someone speaking to you at normal volume without looking. Speech frequencies are right in the comfort zone for human hearing.

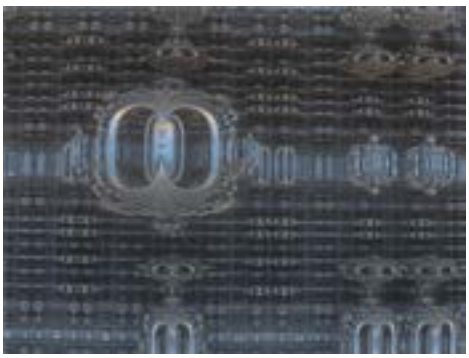
Now, imagine yourself in the same room when a smoke alarm goes off. That annoying screech is generated by sound waves at higher frequencies, and in the midst of them, it would be difficult for you to locate the source of the screech without opening your eyes for additional sensory information. The higher frequency of the smoke alarm sound creates directional confusion for the human ear.

"The techniques my students and I have developed will allow just about any signal to be shifted to a frequency range where you're no longer confused," said Dowling, whose research is primarily funded by the U.S. Navy.

Navy sonar arrays on submarines and surface ships deal with a similar kind of confusion as they search for vessels on the ocean surface and below the waves. The ability to detect and locate enemy ships at sea is a crucial task for naval vessels.

Sonar arrays are typically designed to record sounds in specific frequency ranges. Sounds with frequencies higher than an array's intended range may ...Read More...

Scientists find a way to enhance the performance of quantum computers



Credit: CC0 Public Domain

USC scientists have demonstrated a theoretical method to enhance the performance of quantum computers, an important step to scale a technology with potential to solve some of society's biggest challenges.

The method addresses a weakness that bedevils performance of the next-generation computers by suppressing erroneous calculations while increasing fidelity of results, a critical step before the machines can outperform classic computers as intended. Called "dynamical decoupling," it worked on two quantum computers, proved easier and more reliable than other remedies and could be accessed via the cloud, which is a first for dynamical decoupling.

The technique administers staccato bursts of tiny, focused energy pulses to offset ambient disturbances that muck sensitive computations. The researchers report they were able to sustain a quantum state up to three times longer than would otherwise occur in an uncontrolled state.

"This is a step forward," said Daniel Lidar, professor of electrical engineering, chemistry and physics at USC and director of the USC Center for Quantum Information Science and Technology (CQIST). "Without error suppression, there's no way quantum computing can overtake classical computing."

The results were published today in the journal Physical Review Letters. Lidar is the Viterbi Professor of Engineering at USC and corresponding author of the study; he led a team of researchers at CQIST, which is a collaboration between the USC Viterbi School of Engineering and the USC Dornsife School of Letters, Arts and Sciences. IBM and Bay Area startup Rigetti Computing provided cloud access to their quantum computers.

Quantum computers are fast, but fragile

Quantum computers have the potential to render obsolete today's super computers and propel breakthroughs in medicine, finance and defense capabilities. They harness the speed and behavior of atoms, which function radically different than silicon computer chips, to perform seemingly impossible calculations. ...Read More...

Study witnesses first moments of star dying in finest detail

Some theoretical models propose that an exploding white dwarf – a star that has exhausted its nuclear fuel – hits a neighbouring star to cause a supernova, which appears to be the cause of SN 2018oh. Credit: NASA/JPL-Caltech

An international research team including The Australian National University (ANU) has used the Kepler space telescope in coordination with ground-based telescopes to witness the first moments of a star dying in unprecedented detail.

The astronomers witnessed the star dying a long time ago in a galaxy far, far away, as part of a project that aims to solve the mystery of how stars explode.

Dr. Brad Tucker, one of the lead researchers of the survey, said about 170 million years later on 4 February 2018 the array of high-powered telescopes detected the light emanating from the exploding star, otherwise known as a supernova called SN 2018oh.

"Kepler—in its final days before running out of fuel and being retired—observed the minute changes in brightness of the star's explosion from its very beginnings, while the ground-based telescopes detected changes in colour and the atomic make-up of this dying star," said Dr. Tucker from the ANU Research School of Astronomy and Astrophysics.

"With the combined data from these telescopes, astronomers achieved what they had hoped for—an unprecedented observation of the onset of a star's death."

SN 2018oh is an example of a Type Ia supernova—the kind that astronomers use to measure the expansion of the Universe and probe the nature of dark energy. "Prior to Kepler, it was nearly impossible to study the early stages of a star explosion," Dr. Tucker said.

A typical Type Ia supernova brightens over the course of three weeks before gradually fading away, but this supernova brightened rapidly a few days after the initial explosion—about three times faster than a typical supernova at this time period.

The Dark Energy Camera at Cerro Tololo Inter-American Observatory in Chile and the Panoramic Survey Telescope and Rapid Response System at Haleakala Observatory in Hawaii revealed this supernova gleaming blue during this intense period of intensity, an indication ....Read More...

New evidence reveals how heavy elements were created after the Big Bang

Credit: CC0 Public Domain

The Big Bang theory and the question of how life on Earth began has fascinated scientists for decades, but now new research from The University of Western Australia suggests the conditions that resulted from the Big Bang are different to what we thought.

The Big Bang theory, developed in 1927 is considered the most credible scientific explanation of how the universe was created. It suggests that through a process of expansion and explosion hydrogen gas was created which led to the formation of stars, and their death (supernova) led to the creation of life.

Researchers Professor Snezhana Abarzhi and Ms Annie Naveh from UWA's School of Mathematical Sciences conducted a mathematical analysis of the conditions that were created from a supernova.

Professor Abarzhi said although the supernova explosion was violent it wasn't as turbulent and quick as previously thought.

"It is traditionally considered that turbulence was the mechanism for energy transfer and accumulation which resulted in chemicals being formed in the supernova," Professor Abarzhi said.

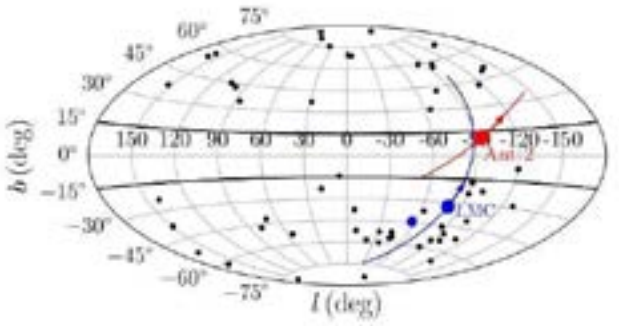
"However our research has revealed it wasn't turbulent but actually a slow process where hot spots of energy were localised and trapped, resulting in the formation of, for example iron, gold and silver from atoms produced by the Big Bang.

"The findings are important because they challenge our understanding of the Big Bang theory and how life formed."

Professor Abarzhi said it was fascinating to see the complexity of how the universe might have been formed.

"Human beings essentially started as hydrogen atoms and energy, swirling around to create other chemicals and these interactions resulted in life," she said. ...Read More...

Enormous dwarf satellite galaxy of Milky Way discovered



Distribution of the MW dwarf satellites in Galactocentric coordinates. The position of Ant 2 is shown as a red filled circle. The positions of the Magellanic clouds are shown in blue. Other MW dwarf galaxies are shown in black. Image credit: Torrealba et al., 2018.

Using data from ESA's Gaia spacecraft, astronomers have discovered a new Milky Way satellite in the constellation Antlia. The newly found dwarf galaxy, named Antlia 2, is several times larger when compared to other systems of similar luminosity. The finding is detailed in a paper published November 9 on arXiv.org.

The Milky Way is known to be orbited by dozens of smaller, gravitationally bound galaxies. Although the list of identified satellites is relatively long, astronomers believe that some are still undetected.

With the aim of expanding the list of the Milky Way's satellites, a team of astronomers led by Gabriel Torrealba of Academia Sinica in Taipei, Taiwan, has conducted a search for new satellites, especially dwarf galaxies. For their study, the researchers used a combination of astrometry, photometry and variability data provided by Gaia Data Release 2 (DR2).

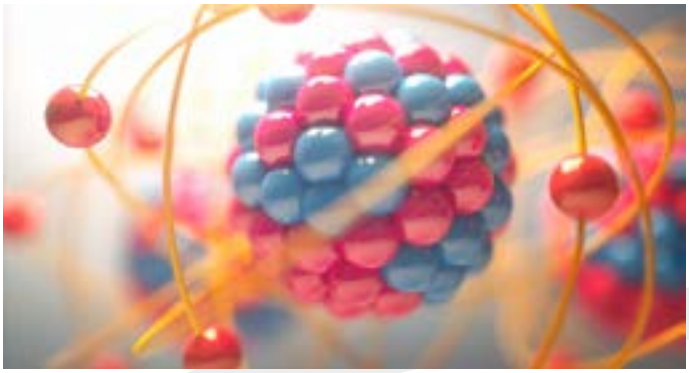
The search resulted in the finding of an enormous, faint dwarf galaxy orbiting the Milky Way, which has received the designation Antlia 2 (or Ant 2 for short). Its nature was confirmed by spectroscopic observations with the 2dF+AAOmega Spectrograph on the 3.9 m Anglo-Australian Telescope and archival DECam imaging. The astronomers refer to the newly found satellite as "the hidden giant," given that the galaxy turned out to be significantly much larger than other systems in the Local Group with similar luminosity.

"In this paper, we use Gaia Data Release 2 (GDR2, Gaia Collaboration et al. 2018b) to discover and analyze a new dwarf satellite galaxy orbiting the Milky Way. The discovery was made at the Flatiron Gaia Sprint 2018," the researchers wrote in the paper.

Ant 2 is located some 424,000 light years away from the Earth and is estimated to be about 11.2 billion years old. The galaxy has an angular half-light radius of approximately 9,300 light years and a magnitude ..Read More...

Special Read:

Physicists finally calculated where the proton's mass comes from



MASSIVE UNDERTAKING Using a technique called lattice QCD, scientists figured out how protons (illustrated here in the nucleus of an atom) get their mass.

Only 9 percent of the subatomic particle's bulk comes from the mass of its quarks.

A proton's mass is more than just the sum of its parts. And now scientists know just what accounts for the subatomic particle's heft.

Protons are made up of even smaller particles called quarks, so you might expect that simply adding up the quarks' masses should give you the proton's mass. However, that sum is much too small to explain the proton's bulk. And new, detailed calculations show that only 9 percent of the proton's heft comes from the mass of constituent quarks. The rest of the proton's mass comes from complicated effects occurring inside the particle, researchers report in the Nov. 23 Physical Review Letters.

Quarks get their masses from a process connected to the Higgs boson, an elementary particle first detected in 2012. But "the quark masses are tiny," says study coauthor and theoretical physicist Keh-Fei Liu of the University of Kentucky in Lexington. So, for protons, the Higgs explanation falls short.

Instead, most of the proton's 938 million electron volts of mass is due to complexities of quantum chromodynamics, or QCD, the theory which accounts for the churning of particles within the proton. Making calculations with QCD is extremely difficult, so to study the proton's properties theoretically, scientists rely on a technique called lattice QCD, in which space and time are broken up into a grid, upon which the quarks reside.

Using this technique, physicists had previously calculated the proton's mass. But scientists hadn't divvied up where that mass comes from until now, says theoretical physicist André Walker-Loud of Lawrence Berkeley National Laboratory in California. "It's exciting because it's a sign that ... we've really hit this new era" in which lattice QCD can be used to better understand nuclear physics.

In addition to the 9 percent of the proton's mass that comes from quarks' heft, 32 percent comes from the energy of the quarks zipping around inside the proton, Liu and colleagues found. (That's because energy and mass are two sides of the same coin, thanks to Einstein's famous equation, $E=mc^2$.) Other occupants of the proton, massless particles called gluons that help hold quarks together, contribute another 36 percent via their energy.

The remaining 23 percent arises due to quantum effects that occur when quarks and gluons interact in complicated ways within the proton. Those interactions cause QCD to flout a principle called scale invariance. In scale invariant theories, stretching or shrinking space and time makes no difference to the theories' results. Massive particles provide the theory with a scale, so when QCD defies scale invariance, protons also gain mass.

The results of the study aren't surprising, says theoretical physicist Andreas Kronfeld of Fermilab in Batavia, Ill. Scientists have long suspected that the proton's mass was made up in this way. But, he says, "this kind of calculation replaces a belief with scientific knowledge." ..Read More...

This Week's Sky at a Glance - Dec. 01-07, 2018

Dec 03	Mo	22:42	Moon-Venus: 3.8° S
Dec 07	Fr	11:20	New Moon

Second Week of a CubeSat Workshop for UoS/SCASS Students (Nov. 25-29, 2018)

The research laboratories at the Sharjah Center for Astronomy and Space Sciences organized the second week of a six-week CubeSat course in collaboration with Istanbul Technical University. The course is a training workshop for the University of Sharjah students into the techniques of a CubeSat. This falls under the preparation of SHARJAH-SAT-1 which will be a 3U X-ray CubeSat intended to study the solar corona and X-ray stars. In addition, a 2U GNSS CubeSat is also on the pipeline. Students had the chance to go over the CubeSat development, theoretically and practically. Simulations were carried out to simulate a real CubeSat in terms of all of its subsystems.