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Dept. of Applied Physics & Astronomy - University of Sharjah
Compiled by **Dr. Ilias Fernini**

مركز الشارقة لعلوم الفضاء والفلك
Sharjah Center for Astronomy & Space Sciences

Top News

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Why China's artificial moon probably won't work

Jens Beste/Shutterstock

Launching a man-made night light into orbit and keeping it in place might be harder than it seems.

To step outside on a moonlit night is to see the darkness pushed back. The reflected sunlight from our natural satellite during a nearly full moon is enough to limn the nighttime landscape in silver and allow even human eyes to penetrate the gloom. But we can always do better, right? If one moon is good, surely two is even better.

One Chinese researcher thinks so, at least. Wu Chunfeng, head of the Tian Fu New Area Science Society, wants to use a satellite like an artificial moon, reflecting sunlight back to targeted areas of the Earth at night. The reflector would orbit above a city, providing enough illumination to replace lights on the ground with a steady glow and potentially saving on electricity costs.

Brighten the Night

He imagines a shiny satellite unfurling in space about 300 miles above the ground and orienting itself toward cities on the ground. One would be enough to light up around 20 square miles, he says, according to China Daily, and several working in concert could brighten up to 4,000 square miles. Wu says the first should be ready to launch in 2020, and three more in 2022, though the details of the project remain largely unknown.

The plan might not be all that sound, though, according to satellite experts. Based on the scant details available, in fact, the satellite would probably never work, says Ryan Russell, an associate professor of aerospace engineering at the University of Texas at Austin.

The biggest flaw? A satellite flying low enough to deliver that much light wouldn't be able to stay in one place.

"Their claim for 1 LEO sat at [300 miles] must be a typo or misinformed spokesperson," Russell says in an email. "The article I read implied you could hover a satellite over a particular city, which of course is not possible."

Satellites that stay over a fixed point on the Earth, what's called a geostationary orbit, sit much further away: about 22,000 miles. At that distance, the reflective surface would need to be massive to deliver ...Read More..

Hotspot discovery proves Canadian astrophysicist's black hole theory

File illustration only

The recent detection of flares circling black holes has proven a decade-old theory co-developed by a Canadian physicist about how black holes grow and consume matter.

"It's extremely exciting to see our theoretical musing come to life and that tracking these types of flares about black holes is possible," said Avery Broderick, an Associate Faculty member at Perimeter Institute and the University of Waterloo, who predicted the flares 13 years ago with collaborator Avi Loeb.

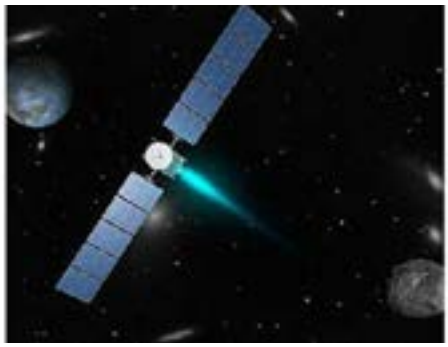
Recently, a discovery by the GRAVITY Collaboration has detailed the detection of three flares - visual hotspots - emanating from a black hole known as Sagittarius A*, or Sgr A*. The team detected a wobble of emissions coming from the flares, enabling the scientists to detect the growing orbit, known as an accretion disk, of the black hole itself.

The idea of using the emissions from visual hotspots to map the behaviour of black holes was first suggested by Broderick and Loeb in 2005 when both were working at the Harvard-Smithsonian Center for Astrophysics (CfA).

The pair's 2005 paper and a 2006 follow-up outlined computer models and highlighted their proposal that the flares were being caused by the confluence of two extreme events: the bending of light around the black hole and the generation of hot spots by magnetic reconfigurations, known as magnetic reconnection, which accelerated charged particles to relativistic speeds around Sgr A*. They showed how the hotspots could be used as visual probes to trace out structures in the accretion disk and spacetime itself.

"Black holes are gravitational masters of their domain, and anything that drifts too close will be blended into a superheated disk of plasma surrounding them," said Broderick. "The matter trapped in the black hole's growing retinue then flows towards the event horizon - the point at which no light can escape - and consumed by the black hold via mechanisms that aren't yet fully understood. "We believed if flare timescales were close to orbital timescales around a black hole, they could actually represent ...Read More...

NASA's Dawn asteroid mission ends as fuel runs out



Dawn - Archive - NASA

Dawn, a NASA spacecraft that launched 11 years ago and studied two of the largest objects in the asteroid belt, has ended its mission after running out of fuel, officials said Thursday.

Scientists have known for about a month that Dawn was essentially out of hydrazine, the fuel that kept the spacecraft's antennae oriented toward Earth and helped turn its solar panels to the Sun to recharge.

When the spacecraft missed scheduled communications with NASA's Deep Space Network on Wednesday and Thursday, the space agency formally declared it dead.

"The fact that my car's license plate frame proclaims, 'My other vehicle is in the main asteroid belt,' shows how much pride I take in Dawn," said mission director and chief engineer Marc Rayman at NASA's Jet Propulsion Laboratory.

"The demands we put on Dawn were tremendous, but it met the challenge every time. It's hard to say goodbye to this amazing spaceship, but it's time."

- "Astounding images" -

Thomas Zurbuchen, associate administrator of the NASA science mission directorate in Washington, hailed Dawn's "vital science" and "incredible technical achievements."

Dawn became the only spacecraft ever to orbit a cosmic body in the main asteroid belt between Mars and Jupiter in 2011 when it began circling the asteroid Vesta.

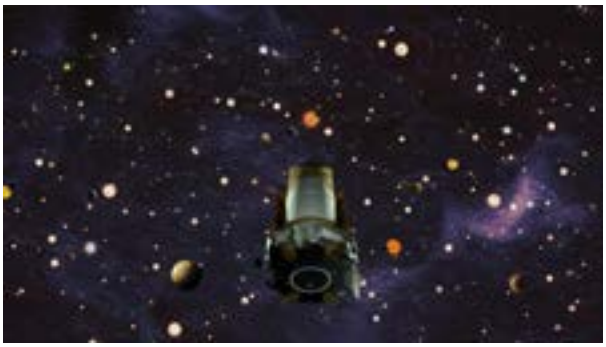
Then it moved on to the dwarf planet Ceres in 2015, becoming the first spacecraft to visit a dwarf planet and the only spacecraft to orbit one, NASA said.

The unmanned spacecraft has traveled 4.3 billion miles (6.9 billion kilometers) since launching in 2007.

It is expected to remain in orbit around Ceres for decades, but will no longer be able to communicate with Earth.

Zurbuchen said the scientific learning from Dawn's mission will go on. "The astounding images ...Read More...

Kepler planet-hunting space telescope's 'blockbuster' mission comes to end



NASA's Kepler Space Telescope discovered thousands of alien worlds around distant stars since its launch in 2009.Wendy Stenzel, Daniel Rutter / NASA

The most prolific planet-hunting machine in history has signed off.

NASA's Kepler space telescope, which has discovered 70 percent of the 3,800 confirmed alien worlds to date, has run out of fuel, agency officials announced on Oct. 30. Kepler can no longer reorient itself to study cosmic objects or beam its data home to Earth, so the legendary instrument's in-space work is done after nearly a decade.

And that work has been transformative.

"Kepler has taught us that planets are ubiquitous and incredibly diverse," Kepler project scientist Jessie Dotson, who's based at NASA's Ames Research Center in Moffett Field, California, told Space.com. "It's changed how we look at the night sky."

Today's announcement was not unexpected. Kepler has been running low on fuel for months, and mission managers put the spacecraft to sleep several times recently to extend its operational life as much as possible. But the end couldn't be forestalled forever; Kepler's tank finally went dry two weeks ago, mission team members said during a telecon with reporters today.

"This marks the end of spacecraft operations for Kepler, and the end of the collection of science data," Paul Hertz, head of NASA's Astrophysics Division, said during the telecon.

Leading the exoplanet revolution

Kepler hunted for alien worlds using the "transit method," finding the brightness dips caused when a planet crosses its star's face from the spacecraft's perspective.

Those dips are tiny — so tiny, in fact, that NASA officials were originally dubious that a spacecraft could make such measurements. The driving force behind Kepler, Ames' Bill Borucki, had four mission proposals rejected in the 1990s before finally breaking through in 2000, ...Read More...

The Milky Way Has a Gigantic Skeleton in Its Closet

An artist's depiction of the Gaia spacecraft mapping stars in the Milky Way. Credit: ESA/ATG MediaLab

Scientists have identified the corpse of a galaxy that fell into the Milky Way about 10 billion years ago in what was likely the last major overhaul to our home galaxy during its development.

That's the conclusion of new research based on 2 billion measurements of how stars within the Milky Way are moving. Those measurements let scientists identify about 33,000 stars that live in our galaxy but were born elsewhere, carried here during a giant galactic collision.

"The Milky Way is a cannibal. It has eaten many dwarf galaxies in the past, and we've just found a major one that it ate in the past," Kathryn Johnston, an astronomer at Columbia University in New York who wasn't involved in the new research, told Space.com. "This is like a police investigation — this one in particular, because it's not a galaxy that we can see today. It's a dead galaxy, so that makes it kind of fun.

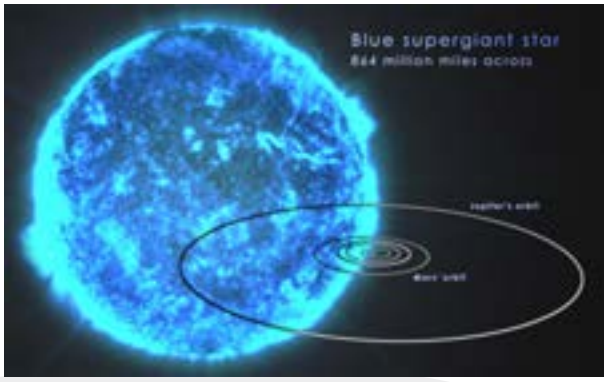
The research is possible because stars contain a fingerprint of sorts of their origin. "When you look at how stars move, they actually retain in their motions [a] memory of the place where they were born," Amina Helmi, an astronomer at the University of Groningen in the Netherlands who led the new research, told Space.com.

Helmi and her colleagues drew on data from a European project called Gaia, which is mapping the location of 1 billion stars in the Milky Way with unprecedented precision. The team identified a set of about 33,000 of those stars that are moving in a completely different manner compared to the bulk of the Milky Way.

The team also studied the chemistry of nearly 600 of those stars using ground-based telescope data, which confirmed that these stars had come from somewhere beyond the Milky Way. And the sheer amount of data at the team's fingertips let the scientists estimate the size and age of the colliding galaxy.

Given those numbers, the researchers said, the former galaxy was likely about a fifth the size of ...Read More...

The Violent Deaths of Giant Blue Stars May Spawn Exotic Matter



When a blue supergiant star explodes in a supernova, it can spawn exotic states of matter like quark-gluon plasma, scientists have found. Blue supergiant stars are colossal, growing to up to 1,000 times larger than our sun, as this NASA illustration shows. Credit: S. Wiessinger/NASA Goddard Space Flight Center

When the biggest stars in the universe die, they may form exotic states of matter generally not seen in the universe since fractions of a second after the Big Bang. These events may generate enough energy to create catastrophic explosions, a new study finds. A supernova is an explosion that can make a star briefly outshine all the other stars in its galaxy. These outbursts can happen when giant stars that are about 10 times the mass of the sun or more run out of fuel. Their cores then collapse under their own extraordinary weights, so that the objects form either black holes or neutron stars.

Previous work suggested that when a star's core implodes, a burst of ghostly particles known as neutrinos carries much of the energy from this collapse outward. When these neutrinos interact with the shell of material around the star's core, they heat it up and can drive it outward explosively as a supernova.

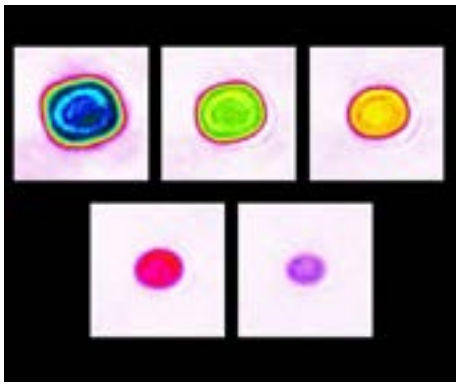
However, prior research could not explain how supernovas could occur from very massive blue-supergiant stars with masses 50 times that of the sun or more, even though astronomers have detected supernovas from these stars. Current state-of-the-art computer simulations suggested that core collapses of these stars should result in "failed supernovas." In these scenarios, a black hole forms without neutrinos heating the overlying shell enough for it to blast outward in a supernova.

Now, researchers suggest that blue supergiants can explode as supernovas, because they can form exotic states of matter created by disintegrating protons and neutrons. The resulting soup of particles has generally not been seen in the universe since an instant after the Big Bang.

Quark-y star explosions

The nuclei of atoms are made of particles known as nucleons, which include protons and neutrons. Nucleons are, in turn, each made up of trios of particles ...Read More...

JILA researchers see signs of interactive form of quantum matter



False-color images showing variations in atom numbers (1 to 5 atoms, left to right) and density in different lattice cells of JILA's strontium lattice atomic clock. JILA researchers observed shifts in the clock's frequency that arise from the emergence of multi-particle interactions when three or more atoms occupy a single cell.

JILA researchers have, for the first time, isolated groups of a few atoms and precisely measured their multi-particle interactions within an atomic clock. The advance will help scientists control interacting quantum matter, which is expected to boost the performance of atomic clocks, many other types of sensors, and quantum information systems.

The research is described in a Nature paper posted early online Oct. 31. JILA is jointly operated by the National Institute of Standards and Technology (NIST) and the University of Colorado Boulder.

NIST scientists have been predicting "many body" physics and its benefits for years, but the new JILA work provides the first quantitative evidence of exactly what happens when packing together a few fermions - atoms that cannot be in the same quantum state and location at the same time.

"We are trying to understand the emergence of complexity when multiple particles - atoms here - interact with each other," NIST and JILA Fellow Jun Ye said. "Even though we may understand the rules perfectly on how two atoms interact, when multiple atoms get together there are always surprises. We want to understand the surprises quantitatively."

Today's best tools for measuring quantities such as time and frequency are based on control of individual quantum particles. This is the case even when ensembles of thousands of atoms are used in an atomic clock. These measurements are approaching the so-called standard quantum limit - a "wall" preventing further improvements using independent particles.

Harnessing of many-particle interactions could push that wall back or even break through it, because an engineered quantum state could suppress atom collisions and protect quantum states against interference, or ..Read More...

New quantum criticality discovered in superconductivity

Credit: CC0 Public Domain

Using solid state nuclear magnetic resonance (ssNMR) techniques, scientists at the U.S. Department of Energy's Ames Laboratory discovered a new quantum criticality in a superconducting material, leading to a greater understanding of the link between magnetism and unconventional superconductivity.

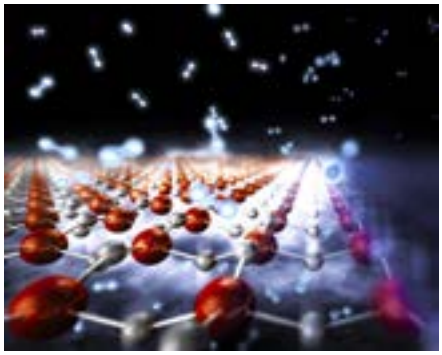
Most iron-arsenide superconductors display both magnetic and structural (or nematic) transitions, making it difficult to understand the role they play in superconducting states. But a compound of calcium, potassium, iron, and arsenic, and doped with small amounts of nickel, CaK(Fe1−xNix)4As4, first made at Ames Laboratory, has been discovered to exhibit a new magnetic state called a hedgehog spin-vortex crystal antiferromagnetic state without nematic transitions.

"Spin or nematic fluctuations can be considered to play an important role for unconventional superconductivity," said Yuji Furukawa, a senior scientist at Ames Laboratory and a professor of Physics and Astronomy at Iowa State University. "With this particular material, we were able to examine only the magnetic fluctuations, and NMR is one of the most sensitive techniques for examining them." He continued, "using 75As NMR, we discovered that CaK(Fe1−xNix)4As4 is located at a hedgehog spin-vortex crystal antiferromagnetic quantum critical point which is avoided due to superconductivity. The discovery of the magnetic quantum criticality without nematicity in CaK(Fe1−xNix)4As4 suggests that the spin fluctuations are the primary driver of superconductivity."

Furukawa's discovery was a collaboration between Ames Laboratory's world-leading SSNMR team and the lab's condensed matter physicists, including Paul Canfield, a senior scientist at Ames Laboratory and a Distinguished Professor and the Robert Allen Wright Professor of Physics and Astronomy at Iowa State University.

"This is a new type of magnetic order," said Canfield. "You have this interesting interaction between superconductivity and magnetism from high temperatures in the normal state. This gives us some sense that this high temperature superconductivity may be coming from this ...Read More...

Scientists make first detailed measurements of key factors related to high-temperature superconductivity



A new study reveals how coordinated motions of copper (red) and oxygen (grey) atoms in a high-temperature superconductor boost the superconducting strength of pairs of electrons (white glow), allowing the material to conduct electricity without any loss at much higher temperatures. The discovery opens a new path to engineering higher-temperature superconductors. Credit: Greg Stewart/SLAC National Accelerator Laboratory

In superconducting materials, electrons pair up and condense into a quantum state that carries electrical current with no loss. This usually happens at very low temperatures. Scientists have mounted an all-out effort to develop new types of superconductors that work at close to room temperature, which would save huge amounts of energy and open a new route for designing quantum electronics. To get there, they need to figure out what triggers this high-temperature form of superconductivity and how to make it happen on demand.

Now, in independent studies reported in Science and Nature, scientists from the Department of Energy's SLAC National Accelerator Laboratory and Stanford University report two important advances: They measured collective vibrations of electrons for the first time and showed how collective interactions of the electrons with other factors appear to boost superconductivity.

Carried out with different copper-based materials and with different cutting-edge techniques, the experiments lay out new approaches for investigating how unconventional superconductors operate.

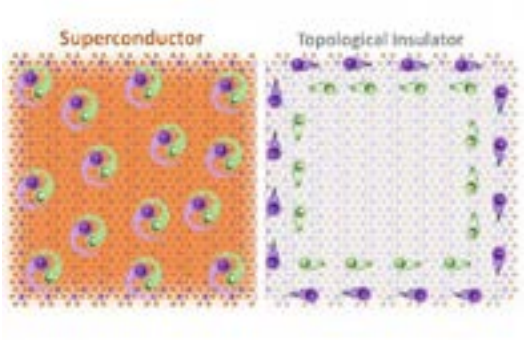
"Basically, what we're trying to do is understand what makes a good superconductor," said co-author Thomas Devereaux, a professor at SLAC and Stanford and director of SIMES, the Stanford Institute for Materials and Energy Sciences, whose investigators led both studies.

"What are the ingredients that could give rise to superconductivity at temperatures well above what they are today?" he said. "These and other recent studies indicate that the atomic lattice plays an important role, giving us hope that we are gaining ground in answering that question."

The high-temperature puzzle

Conventional superconductors were discovered in 1911, and scientists know how they work: ...Read More...

First two-dimensional material that performs as both topological insulator and superconductor



In two-dimensional tungsten ditelluride, two different states of matter — topological insulator and superconductor — can be chosen at will, MIT researchers discovered. Credit: Sanfeng Wu

A transistor based on the 2-D material tungsten ditelluride (WTe2) sandwiched between boron nitride can switch between two different electronic states—one that conducts current only along its edges, making it a topological insulator, and one that conducts current with no resistance, making it a superconductor—researchers at MIT and colleagues from four other institutions have demonstrated.

Using four-probe measurements, a common quantum electronic transport technique to measure the electronic behavior of materials, the researchers plotted the current carrying capacity and resistance characteristics of the two-dimensional tungsten ditelluride transistor and confirmed their findings across a range of applied voltages and external magnetic fields at extremely low temperatures.

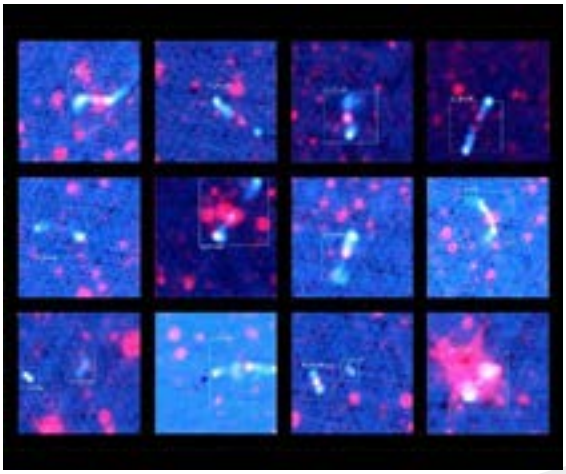
"This is the first time that the exact same material can be tuned either to a topological insulator or to a superconductor," says Pablo Jarillo-Herrero, the Cecil and Ida Green Professor of Physics at MIT. "We can do this by regular electric field effect using regular, standard dielectrics, so basically the same type of technology you use in standard semiconductor electronics."

New class of materials

"This is the first of a new class of materials—topological insulators that can be tuned electrically into superconductors—which opens many possibilities which before there were significant obstacles to realize," Jarillo-Herrero says. "Having one material where you can do this seamlessly within the same material to transition between this topological insulator and superconductor is something which is potentially very attractive."

Tungsten ditelluride, which is one of the transition metal dichalcogenide materials, is classified as a semimetal and conducts electricity like metals in bulk form. The new findings detail that in a single-layer crystal form, at temperatures from less than 1 kelvin to liquid nitrogen range (-320.4 degrees Fahrenheit), tungsten ditelluride hosts three distinct phases: topologically insulating, superconducting, and metallic. An applied voltage ...Read More...

Artificial intelligence bot trained to recognize galaxies



Fourteen radio galaxy predictions ClaRAN made during its scan of radio and infrared data. All predictions were made with a high 'confidence' level, shown as the number above the detection box. A confidence of 1.00 indicates ClaRAN is extremely confident both that the source detected is a radio galaxy jet system and that it has classified it correctly.

Researchers have taught an artificial intelligence program used to recognise faces on Facebook to identify galaxies in deep space.

The result is an AI bot named ClaRAN that scans images taken by radio telescopes. Its job is to spot radio galaxies - galaxies that emit powerful radio jets from supermassive black holes at their centres.

ClaRAN is the brainchild of big data specialist Dr Chen Wu and astronomer Dr Ivy Wong, both from The University of Western Australia node of the International Centre for Radio Astronomy Research (ICRAR).

Dr Wong said black holes are found at the centre of most, if not all, galaxies. "These supermassive black holes occasionally burp out jets that can be seen with a radio telescope," she said.

"Over time, the jets can stretch a long way from their host galaxies, making it difficult for traditional computer programs to figure out where the galaxy is.

"That's what we're trying to teach ClaRAN to do."

Dr Wu said ClaRAN grew out of an open source version of Microsoft and Facebook's object detection software. He said the program was completely overhauled and trained to recognise galaxies instead of people.

ClaRAN itself is also open source and publicly available on GitHub. Dr Wong said the upcoming EMU survey using the WA-based Australian Square Kilometre Array Pathfinder (ASKAP) telescope is expected to observe up to 70 million galaxies across the history of the Universe.

She said traditional computer algorithms are able to correctly identify 90 per cent of the sources. ...Read More...

Hubble reveals a giant cosmic 'Bat Shadow'

Compass Image of HBC 672. Credit: ESA/Hubble Information Centre

Shadows on Earth can be mysterious and foreboding, but when they occur in space, they can convey information we otherwise could not know. In a stellar nursery called the Serpens Nebula, nearly 1,300 light-years away, a young star's game of shadow play is revealing secrets of its unseen planet-forming disk. The near-infrared vision of NASA's Hubble Space Telescope captured the shadow cast by the fledgling star's brilliant light being blocked by this disk.

Named HBC 672, this Sun-like star is surrounded by a debris ring of dust, rock, and ice—a disk that is too small and too distant to be seen, even by Hubble. But like a little fly that wanders into the beam of a flashlight shining on a wall, its shadow is projected large upon the cloud in which it was born.

In this Hubble image, the feature—nicknamed the "Bat Shadow"—spans approximately 200 times the length of our solar system. It is visible in the upper right portion of the picture.

"This is an analog of what the solar system looked like when it was only 1 or 2 million years old," explained Klaus Pontoppidan, an astronomer at the Space Telescope Science Institute (STScI) in Baltimore, Maryland. "For all we know, the solar system once created a shadow like this."

The presence of a shadow means that the disk is being viewed nearly edge-on. This is something that could not otherwise be known because of the disk's great distance from us, which makes it too small to be seen by Hubble.

The disk's shadow is similar to what is produced by a cylindrical lamp shade. Light escapes from the top and bottom of the shade, but along its circumference, dark cones of shadow form. Although the disk that gives rise to the shadow is a common object around young stars, the combination of an edge-on viewing angle and the surrounding nebula is rare.

Scientists can use the shadow to figure out the shape of the disk. For example, they now know that the disk is puffy, which implies that it is full of gas. ...Read More...

Special Read:

MHI launches UAE's KhalifaSat satellite

KhalifaSat is the first national satellite manufactured by the UAE.

Mitsubishi Heavy Industries has delivered UAE's KhalifaSat satellite into orbit Oct 29 via the H-IIA launch vehicle F40. The launch vehicle trajectory was executed as planned, and at about 24 minutes after liftoff, separation of the KhalifaSat satellite was confirmed.

This mission was performed along with Japan Aerospace Exploration Agency's (JAXA) Greenhouse gases Observing SATellite-2 "GOSAT-2" satellite, in which the separation of the GOSAT-2 satellite was also confirmed 16 minutes after liftoff.

KhalifaSat is the first national satellite manufactured by the UAE, thus the mission should prove to be a great step towards UAE's mid-and-long term plans in government space activities and industries. Additionally, MHI holds the launch service contract for the Emirates Mars Mission (EMM spacecraft, planned to be launched in 2020), through which it hopes to build upon a strong and lasting relationship with the MBRSC and UAESA (UAE Space Agency).

The H-IIA launch vehicle is Japan's flagship launch vehicle and one of the most reliable launch vehicles in the world. Monday's launch was the 41st consecutive successful H-IIA/H-IIB launch, with an accumulative success rate of 97.9%.

The successor to the H-IIA - the H3 Launch Vehicle - has been developed by MHI and JAXA. The concept of the H3 is highlighted to be much more customer-oriented by offering affordable pricing, relaxing environmental conditions for satellites and drastically reduced preparation time from contract to launch. It will allow for more flexible and cost-efficient launch services, and is scheduled to make its maiden flight in 2020.

His Excellency Hamad Obaid Al Mansoori, Chairman of the Mohammed bin Rashid Space Centre (MBRSC), said, "The successful launch of KhalifaSat; which bears the name of His Highness Sheikh Khalifa bin Zayed Al Nahyan, President of the UAE, marks a new milestone for the space sector in the UAE and the region. The first satellite fully manufactured in the United Arab Emirates at MBRSC facilities by Emirati engineers, is in line with the directives of our wise leadership in transforming the UAE into a regional and international hub for space science and technology.

"With its 5 patents, we believe that KhalifaSat will play an important role in aiding organizations around the world in getting accurate data related to environmental changes and urban planning as well as support relief efforts at times of natural disasters.

"We dedicate this achievement to our leadership and we appreciate the valuable role played by our Japanese partners and thank them for their support in all the stages of this major project, providing all the necessary facilities to ensure that KhalifaSat is delivered successfully into space."

"I would like to express my profound appreciation to all involved in the launch campaign for the devoted support and cooperation. In particular, I greatly appreciate that UAE's Space Agency and MBRSC continuously supported and cooperated with us throughout the 3 and half years since MHI received the contract in Feb., 2015.", said Naohiko Abe, Senior Vice President and Head of Integrated Defense and Space Systems of MHI.

"The UAE government is the third overseas customer for MHI's Launch Services. With the results of Monday's launch, the H-IIA and H-IIB have achieved 41 consecutive successful, on-time launches. We strongly intend to expand our launch services business as the leading company of the Japanese space industry.

"Moreover, MHI is developing the H3 in partnership with JAXA. In succession of the H-IIA/IIB, the H3 will be a reliable and affordable next generation launch vehicle. Its maiden flight is planned for 2020, and we expect to be awarded with H3 launch service contracts from potential customers in the upcoming days." ...Read More...

This Week's Sky at a Glance - Nov. 03-09, 2018

Nov 05	Mo	21:31	South Taurid Shower: ZHR = 10
Nov 06	Tu	18:59	Mercury Elongation: 23.3° E
Nov 07	We	20:02	New Moon
Nov 09	Fr	08:58	Mercury-Antares: 1.8° N

SCASS Seminar / Dr. Randa Asad
American University of Sharjah
Nov. 03 (6-7 pm - SCASS)
Nov. 04 (2-3 pm - M9 - Biruni-UoS)

SCASS Summer Students Seminar in Pictures (Oct. 28, 2018)