

Astronomy & Physics Weekly News

Dept. of Applied Physics & Astronomy - University of Sharjah

Compiled by **Dr. Ilias Fernini**



Top News

First confirmed image of newborn planet caught with ESO's VLT

Einstein gets it right again—weak and strong gravity objects fall the same way **2**

Laser experiments shed light on Earth's core

NASA Spacecraft Gets Breathtakingly Close to Dwarf Planet **3**

Something Big Crashed into Uranus and Changed It Forever **4**

Cutting-Edge Heat Shield Installed on NASA's Parker Solar Probe

Ultracold atoms and ultra-fast lasers

Researchers see beam of light from first confirmed neutron star merger emerge from behind sun **5**

Game changing invention to revolutionise cybersecurity

Study reveals secret origins of asteroids and meteorites **6**

Major Collision Changed the Milky Way Galaxy

The toxic side of the Moon **7**

Special Read:

See How Huge the Monster Dust Storm on Mars Is in This Stunning Image

This Week's Sky at a Glance, July 07-13, 2018

9 Dhu'l Qiddah 1439 AH Crescent Report

8th SCASS SPACE CAMP SUMMER 2018 July 08-11, 2018



First confirmed image of newborn planet caught with ESO's VLT



This spectacular image from the SPHERE instrument on ESO's Very Large Telescope is the first clear image of a planet caught in the very act of formation around the dwarf star PDS 70. The planet stands clearly out, visible as a bright point to the right of the center of the image, which is blacked out by the coronagraph mask used to block the blinding light of the central star. Credit: ESO/A. Müller et al.

Astronomers led by a group at the Max Planck Institute for Astronomy in Heidelberg, Germany have captured a spectacular snapshot of planetary formation around the young dwarf star PDS 70. By using the SPHERE instrument on ESO's Very Large Telescope (VLT)—one of the most powerful planet-hunting instruments in existence—the international team has made the first robust detection of a young planet, named PDS 70b, cleaving a path through the planet-forming material surrounding the young star.

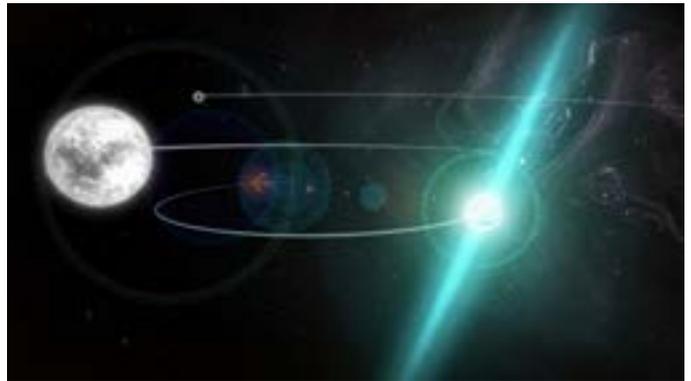
The SPHERE instrument also enabled the team to measure the brightness of the planet at different wavelengths, which allowed properties of its atmosphere to be deduced.

The planet stands out very clearly in the new observations, visible as a bright point to the right of the blackened centre of the image. It is located roughly three billion kilometres from the central star, roughly equivalent to the distance between Uranus and the Sun. The analysis shows that PDS 70b is a giant gas planet with a mass a few times that of Jupiter. The planet's surface has a temperature of around 1000°C, making it much hotter than any planet in our own Solar System.

The dark region at the centre of the image is due to a coronagraph, a mask which blocks the blinding light of the central star and allows astronomers to detect its much fainter disc and planetary companion. Without this mask, the faint light from the planet would be utterly overwhelmed by the intense brightness of PDS 70.

"These discs around young stars are the birthplaces of planets, but so far only a handful of observations have detected hints of baby planets in them," explains Miriam Keppler, who led the team behind the discovery of PDS 70's still-forming planet. "The problem is that until now, most of these planet candidates could just have been features in the disc." [...Read More...](#)

Einstein gets it right again—weak and strong gravity objects fall the same way



Artist impression of the triple star system PSR J0337+1715, which is located about 4,200 light-years from Earth. This system provides a natural laboratory to test fundamental theories of gravity. Credit: NRAO/AUI/NSF; S. Dagnello

Einstein's understanding of gravity, as outlined in his general theory of relativity, predicts that all objects fall at the same rate, regardless of their mass or composition. This theory has passed test after test here on Earth, but does it still hold true for some of the most massive and dense objects in the known universe, an aspect of nature known as the Strong Equivalence Principle? An international team of astronomers has given this lingering question its most stringent test ever. Their findings, published in the journal *Nature*, show that Einstein's insights into gravity still hold sway, even in one of the most extreme scenarios the Universe can offer.

Take away all air, and a hammer and a feather will fall at the same rate—a concept explored by Galileo in the late 1500s and famously illustrated on the Moon by Apollo 15 astronaut David Scott.

Though a bedrock of Newtonian physics, it took Einstein's theory of gravity to express how and why this is so. To date, Einstein's equations have passed all tests, from careful laboratory studies to observations of planets in our solar system. But alternatives to Einstein's general theory of relativity predict that compact objects with extremely strong gravity, like neutron stars, fall a little differently than objects of lesser mass. That difference, these alternate theories predict, would be due to a compact object's so-called gravitational binding energy—the gravitational energy that holds it together.

In 2011, the National Science Foundation's (NSF) Green Bank Telescope (GBT) discovered a natural laboratory to test this theory in extreme conditions: a triple star system called PSR J0337+1715, located about 4,200 light-years from Earth. This system contains a neutron star in a 1.6-day orbit with a white dwarf star, and the pair in a 327-day orbit with another white dwarf further away.

"This is a unique star system," said Ryan Lynch of the Green Bank Observatory in West Virginia [...Read More...](#)

Laser experiments shed light on Earth's core



A composite image of the Western hemisphere of the Earth. Credit: NASA

Scientists have discovered fresh insights into the metallic core at the centre of our planet. The findings could aid understanding of how the Earth was formed from elements in space, some 10 billion years ago. They could also shed light on the fundamental physical nature of nitrogen, one of the most abundant elements in the atmosphere.

An international team of researchers carried out sophisticated experiments to replicate conditions at the Earth's core. Using high energy laser beams and optical sensors, they were able to observe how samples of nitrogen behaved at more than 1 million times normal atmospheric pressure and temperatures above 3,000C.

Their observations confirmed that, under such conditions, nitrogen exists as a liquid metal.

The findings give scientists valuable insight into how nitrogen behaves at extreme conditions, which could aid understanding of how the planets were formed.

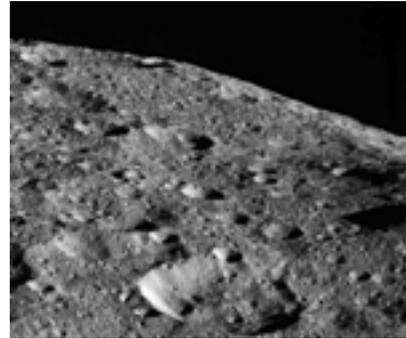
It may help to explain why Earth is the only planet known to have an abundance of nitrogen in its atmosphere—where it exists as a gas. Nitrogen in the air could emerge from deeper within the planet, where, for example, it could mix with other liquid metal.

The findings could also shed light on how the planet's atmosphere evolved and how it may develop in future.

Their study, carried out by the University of Edinburgh with researchers in China and the US, was published in *Nature Communications*. It was supported by the Engineering and Physical Science Research Council and the British Council.

Dr. Stewart McWilliams, of the University of Edinburgh's School of Physics and Astronomy, who took part in the study, said: "Earth's atmosphere is the only one of all the planets where nitrogen is the main ingredient—greater even than oxygen. Our study shows this nitrogen could have emerged from deep inside the planet." [..Read More..](#)

NASA Spacecraft Gets Breathtakingly Close to Dwarf Planet



NASA's Dawn mission caught this view toward Ceres' horizon before lowering to an orbit just dozens of miles above the dwarf planet's surface. NASA/JPL-Caltech/UCLA/MPS/DLR/ID

NASA's Dawn spacecraft has entered its nearest orbit ever to the dwarf planet Ceres, an icy body in the asteroid belt left over from the formation of the solar system. And Dawn is already turning up stunning results. The latest images sent back by the spacecraft were captured just 22 miles above a site called Occator Crater. Before June, Dawn was orbiting hundreds of miles over the surface.

This bright region first stood out to astronomers when Dawn arrived at Ceres in 2015. While much of the dwarf planet is dark, the crater's center has several strange reflective spots that were easily visible from orbit. Scientists suspected that these formed as a mixture of salt and ice erupts onto the world's surface. Astronomers call this process cryovolcanism.

These new observations help confirm that those bright spots are the indeed the result of cryovolcanism. The salty material is sodium carbonate, or soda ash. And astronomers say it likely welled up from a reservoir of briny water below the surface of Ceres and spewed onto the surface. Going forward, the new orbit should give Dawn a view of what, if any, geologic activity is happening on Ceres today. The world is about one-fourth the size of Earth's own moon.

Closest Spacecraft Orbit

Dawn's new orbit is also one of the closest shaves of any NASA orbiter. The Lunar Prospector previously orbited the moon at just 20 miles above the surface of that body, and a few others have dipped below that line but not survived.

The Dawn spacecraft was originally launched in 2007. It arrived at the asteroid Vesta in 2011, where it studied that body in depth and found features associated with ancient water flows. It also found evidence of a massive collision that fragmented Vesta into its present potato-like shape.

In 2012, Dawn used its experimental ion engines to set a new course for Ceres, entering orbit in 2015. This made Dawn the first object to orbit two different bodies beyond the Earth-Moon system. [..Read More..](#)

Something Big Crashed into Uranus and Changed It Forever



Scientists used a high-resolution simulation to confirm that an object twice the size of Earth collided with Uranus and altered its tilt. Credit: Jacob Kegerreis/Durham University

It turns out that Uranus is so weird because of a massive collision billions of years ago.

A new study confirms that this collision with a huge object – which was approximately twice the size of Earth – could have led to the planet's extreme tilt and other odd attributes.

Uranus, the planet with the unforgettable name, is unique in a number of ways. "All of the planets in the solar system are spinning more or less in the same way ... yet Uranus is completely on its side," Jacob Kegerreis, the new study's lead author and a researcher at Durham University's Institute for Computational Cosmology in the U.K., told Space.com. And this isn't the only thing that makes the planet so strange.

Uranus also has a "very, very strange" magnetic field and is extremely cold, even though it "should" be warmer, according to Kegerreis. In this study, Kegerreis and his team of astronomers seek to explain many of the planet's odd features by attributing them to a collision with a massive, icy object about 4 billion years ago. [Photos of Uranus, the Tilted Giant]

To better understand how the impact affected Uranus' evolution, the team used a high-powered supercomputer to run a simulation of massive collisions – something that has never been done before. This study confirms an older study that suggested Uranus' significant tilt was caused by a collision with a massive object.

The researchers suspect that this object was probably a young protoplanet, made up of rock and ice. This collision is "pretty much the only way" that we can explain Uranus' tilt, Kegerreis said.

Amazingly, Uranus retained its atmosphere after this impact. The researchers think that this is because the object only grazed the planet, hitting it hard [...Read More...](#)

Cutting-Edge Heat Shield Installed on NASA's Parker Solar Probe



[The Thermal Protection System connects to the custom-welded truss on the Parker Solar Probe spacecraft at six points to minimize heat conduction.](#)

The launch of Parker Solar Probe, the mission that will get closer to the Sun than any human-made object has ever gone, is quickly approaching, and on June 27, 2018, Parker Solar Probe's heat shield - called the Thermal Protection System, or TPS - was installed on the spacecraft.

A mission 60 years in the making, Parker Solar Probe will make a historic journey to the Sun's corona, a region of the solar atmosphere. With the help of its revolutionary heat shield, now permanently attached to the spacecraft in preparation for its August 2018 launch, the spacecraft's orbit will carry it to within 4 million miles of the Sun's fiercely hot surface, where it will collect unprecedented data about the inner workings of the corona.

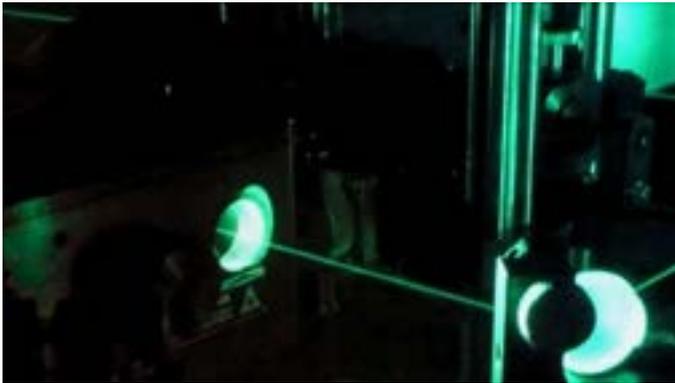
The eight-foot-diameter heat shield will safeguard everything within its umbra, the shadow it casts on the spacecraft. At Parker Solar Probe's closest approach to the Sun, temperatures on the heat shield will reach nearly 2,500 degrees Fahrenheit, but the spacecraft and its instruments will be kept at a relatively comfortable temperature of about 85 degrees Fahrenheit.

The heat shield is made of two panels of superheated carbon-carbon composite sandwiching a lightweight 4.5-inch-thick carbon foam core. The Sun-facing side of the heat shield is also sprayed with a specially formulated white coating to reflect as much of the Sun's energy away from the spacecraft as possible.

The heat shield itself weighs only about 160 pounds - here on Earth, the foam core is 97 percent air. Because Parker Solar Probe travels so fast - 430,000 miles per hour at its closest approach to the Sun, fast enough to travel from Philadelphia to Washington, D.C., in about one second - the shield and spacecraft have to be light to achieve the needed orbit.

The reinstallation of the Thermal Protection System - which was briefly attached to the spacecraft during testing at the Johns Hopkins Applied Physics Lab in Laurel, Maryland, in fall 2017 - marks the first [...Read More...](#)

Ultracold atoms and ultrafast lasers



Ultrashort laser pulses for studying the strong-field ionization of ultracold atoms. Credit: UHH/Wessels

Two separate research fields have been united in Hamburg for the very first time. Ultrashort laser pulses enable us to observe and manipulate matter on very short time scales, whereas ultracold atoms permit experiments with high precision and controllability. Scientists from Universität Hamburg have united the two research fields and succeeded in observing the emergence of ions in ultracold atoms. Their findings have been published in the new scientific journal *Communications Physics*.

More than a century ago, Albert Einstein published his theoretical work on the photo-effect, which fundamentally describes the photoionization of matter, or the process of dissolving electrons from atoms by using light. This discovery earned him a Nobel Prize in 1921. However, it turns out that the process is very complicated in detail. Up until now it has been nigh impossible to carry out experimental measurements of the absolute ionization probability, e.g., the percentage of atoms ionized after light irradiation. The teams of scientists led by Prof. Dr. Markus Drescher and Prof. Dr. Klaus Sengstock have uniquely combined expertise in ultracold atoms with phenomena of ultrafast physics, which has opened up a fundamentally new experimental approach.

Ultrashort laser pulses can be so intense that they rip atoms apart. This process is called strong-field ionization and the details depend on the energy and color of the laser light. Up until now, it was not always possible to know which ionization regime dominates. The scientists have now succeeded in observing this in detail by using ultracold atoms. As there is hardly any atomic motion after the ionization process, it is possible to accurately measure the regimes.

The scientists used laser light to cool rubidium atoms to ultracold temperatures of 100 nanokelvins, only slightly above absolute zero temperature of -273.15° Celsius. An intense ultrashort laser pulse illuminated parts of the cloud of rubidium atoms for a very short time of 215 femtoseconds (a femtosecond is one millionth of one billionth of a second) and ionized a fraction of the [...Read More...](#)

Researchers see beam of light from first confirmed neutron star merger emerge from behind sun



Artist's impression of jets of material from first confirmed neutron star merger. Credit: Mark Garlick/University of Warwick

A research team led by astronomers at the University of Warwick had to wait over 100 days for the sight of the first of confirmed neutron star merger to reemerge from behind the glare of the sun.

They were rewarded with the first confirmed visual sighting of a jet of material that was still streaming out from merged star exactly 110 days after that initial cataclysmic merger event was first observed. Their observations confirm a key prediction about the aftermath of neutron star mergers.

The binary neutron star merger GW170817 occurred 130 million light years away in a galaxy named NGC 4993. It was detected in August 2017 by the Advanced Laser Interferometer Gravitational-Wave Observatory (Adv-LIGO), and by Gamma Ray Burst (GRB) observations, and then became the first ever neutron star merger to be observed and confirmed by visual astronomy.

After a few weeks the merged star then passed behind the glare of our sun leaving it effectively hidden from astronomers until it reemerged from that glare 100 days after the merger event. It was at that point that the University of Warwick research team were able to use the Hubble Space Telescope to see the star was still generating a powerful beam of light in a direction that, while off centre to the Earth, was starting to spread out in our direction.

Their research has just been published in a paper entitled: "The optical afterglow of the short gamma-ray burst associated with GW170817" in *Nature Astronomy's* website at 4pm UK time on Monday 02 July 2018.

The lead author of the paper, Dr. Joe Lyman from the University of Warwick's Department of Physics, said:

"Early on, we saw visible light powered by radioactive decay of heavy elements, over a hundred days later and this has gone, but now we see a jet of material, ejected at an angle to us, but at almost of the [...Read More...](#)

Game changing invention to revolutionise cybersecurity



Random numbers underlie cryptocurrencies like Bitcoin. Credit: Lancaster University

Cyberattacks may become impossible with the creation of the first practical quantum random number generator.

Patented by Quantum Base and Lancaster University, it will provide 100% provable quantum security for authentication and communication when integrated in microelectronic products.

Chosen for inclusion in the prestigious Royal Society Summer Exhibition 2018, this device overcomes the weaknesses of current QRNGs which are typically slow, expensive or large.

The Quantum Base QRNG can be embedded within any electronic device without increasing cost or complexity and with a very high maximum speed.

Phillip Speed, CEO of Quantum Base said: "We have created a small, low power device that produces pure random numbers. It can be incorporated into any electronic product with little or no incremental cost once volume production is achieved."

With the number of smart devices expected to reach up to 50bn by 2020, security is of vital importance.

Globally, the bill for cybercrime will reach \$6 trillion by 2021 while the bill for ransomware attacks - like the WannaCry attack on the NHS in 2017- could reach \$11.5bn by 2019.

Hackers have been able to exploit weaknesses in the generation method of the 'pseudo' random numbers that are commonly used to underpin digital network device security.

One ingenious attempt even involved hackers trying to steal data from a casino using an internet connected fishtank.

A Vital Defence: the role of "True" Random Numbers

Random numbers underpin the algorithms which lie behind every electronic communication. Many current applications rely on what is termed 'pseudo' [...Read More...](#)

Study reveals secret origins of asteroids and meteorites



Illustration of a large asteroid splintering. Credit: Don Davis

Most asteroids and meteorites originate from the splintering of a handful of minor planets formed during the infancy of our solar system, a new study shows.

A study appearing online today in Nature Astronomy found at least 85 percent of 200,000 asteroids in the inner asteroid belt—the main source of Earth's meteorites—originate from five or six ancient minor planets. The other 15 percent may also trace their origins to the same group of primordial bodies, said Stanley Dermott, lead author and a theoretical astronomer at the University of Florida.

The discovery is important for understanding the materials that shaped our own rocky planet, Dermott said. The finding provides a more robust understanding of the evolutionary history of asteroids and the materials that form them—information Dermott says could prove essential to protecting the Earth and ourselves from meteorites the size of the Statue of Liberty and asteroids more powerful than atomic bombs.

"These large bodies whiz by the Earth, so of course we're very concerned about how many of these there are and what types of material are in them," said Dermott, professor emeritus in UF's College of Liberal Arts and Sciences. "If ever one of these comes towards the earth, and we want to deflect it, we need to know what its nature is."

Dermott's team demonstrated that the type of orbit an asteroid has depends on the size of the asteroid. This finding suggests that differences in meteorites found on Earth appear because of the evolutionary changes that occurred inside a few large, precursor bodies that existed more than four billion years ago, Dermott said.

"I wouldn't be surprised if we eventually trace the origins of all asteroids in the main asteroid belt, not just those in the inner belt, to a small number of known parent bodies," Dermott said.

Building knowledge of the evolutionary history of bodies that formed our early solar system helps theoretical astronomers answer questions related to where planets like our own might exist in the universe, Dermott said. But, first, he said we have to understand the processes that produced the planet we live on. [...Read More...](#)

Major Collision Changed the Milky Way Galaxy

The toxic side of the Moon



Sausage Galaxy: An impression of the encounter between the Milky Way galaxy and the smaller Sausage galaxy about 8 billion to 10 billion years ago. The record of this ancient encounter is still preserved in the velocities and chemistry of the stars.

An international team of astronomers has discovered an ancient and dramatic head-on collision between the Milky Way and a smaller object, dubbed the "Sausage" galaxy. The cosmic crash was a defining event in the early history of the Milky Way and reshaped the structure of our galaxy, fashioning both its inner bulge and its outer halo, the astronomers report in a series of new papers.

The astronomers propose that around 8 billion to 10 billion years ago, an unknown dwarf galaxy smashed into our own Milky Way. The dwarf did not survive the impact: It quickly fell apart, and the wreckage is now all around us.

"The collision ripped the dwarf to shreds, leaving its stars moving in very radial orbits" that are long and narrow like needles, said Vasily Belokurov of the University of Cambridge and the Center for Computational Astrophysics at the Flatiron Institute in New York City.

The stars' paths take them "very close to the centre of our galaxy. This is a telltale sign that the dwarf galaxy came in on a really eccentric orbit and its fate was sealed."

The new papers in the Monthly Notices of the Royal Astronomical Society, The Astrophysical Journal Letters and arXiv.org outline the salient features of this extraordinary event. Several of the papers were led by Cambridge graduate student GyuChul Myeong.

He and colleagues used data from the European Space Agency's Gaia satellite. This spacecraft has been mapping the stellar content of our galaxy, recording the journeys of stars as they travel through the Milky Way. Thanks to Gaia, astronomers now know the positions and trajectories of our celestial neighbours with unprecedented accuracy.

The paths of the stars from the galactic merger earned them the moniker "the Gaia Sausage," explained Wyn Evans of Cambridge. "We plotted the velocities of the stars, and the sausage shape just jumped out at us. As the smaller galaxy broke up, its stars were thrown onto very radial orbits. These Sausage stars are what's left of the last major merger of the Milky Way." [...Read More...](#)



[Credit: ESA/NASA](#)

When the Apollo astronauts returned from the Moon, the dust that clung to their spacesuits made their throats sore and their eyes water. Lunar dust is made of sharp, abrasive and nasty particles, but how toxic is it for humans?

The "lunar hay fever", as NASA astronaut Harrison Schmitt described it during the Apollo 17 mission created symptoms in all 12 people who have stepped on the Moon. From sneezing to nasal congestion, in some cases it took days for the reactions to fade. Inside the spacecraft, the dust smelt like burnt gunpowder.

The Moon missions left an unanswered question of lunar exploration - one that could affect humanity's next steps in the Solar System: can lunar dust jeopardise human health?

An ambitious ESA research programme with experts from around the planet is now addressing the issues related to lunar dust.

"We don't know how bad this dust is. It all comes down to an effort to estimate the degree of risk involved," says Kim Prisk, a pulmonary physiologist from the University of California with over 20 years of experience in human spaceflight - one of the 12 scientists taking part in ESA's research.

Nasty dust

Lunar dust has silicate in it, a material commonly found on planetary bodies with volcanic activity. Miners on Earth suffer from inflamed and scarred lungs from inhaling silicate. On the Moon, the dust is so abrasive that it ate away layers of spacesuit boots and destroyed the vacuum seals of Apollo sample containers.

Fine like powder, but sharp like glass. The low gravity of the Moon, one sixth of what we have on Earth, allows tiny particles to stay suspended for longer and penetrate more deeply into the lung.

"Particles 50 times smaller than a human hair can hang around for months inside your lungs. The longer the particle stays, the greater the chance [...Read More...](#)

Special Read:

See How Huge the Monster Dust Storm on Mars Is in This Stunning Image



A frame from the animation created by astrophotographer Damian Peach that shows how a global dust storm has overtaken Mars. Credit: Damian Peach

If you have a hard time visualizing a planet-wide dust storm on Mars, take a look at this. Astrophotographer Damian Peach created an animation showing the dramatic effects of the global dust storm that has plunged the Martian surface deep into darkness.

"The animation was created using my image from June 28th taken from Chile using a 1-meter telescope and the MGS basemap of the exact same longitude," Peach told Space.com via email. (MGS is NASA's Mars Global Surveyor spacecraft, which studied the Red Planet from orbit from 1997 to 2006.)

"I carefully matched them together to show a gradual change of the normal clear view of this hemisphere to how it appears now," Peach added. "It shows the large scale-obscuration due to airborne dust." Peach posted the image online via Twitter. [...Read More...](#)

This Week's Sky at a Glance July 07 - 13, 2018

Jul 10 Tu	03:34	Venus-Regulus: 1° N
	13:30	Moon-Aldebaran: 1.1° S
Jul 12 Th	08:59	Mercury Elongation: 26.4° E
	16:01	Moon North Dec.: 20.8° N
Jul 13 Fr	06:48	New Moon
	07:01	Partial Solar Eclipse - Not visible from UAE
	12:28	Moon Perigee: 357400 km

Dhu'l Qiddah 1439 AH Crescent Report

Basic Astronomical Information about the observations of the crescent of Dhu'l Qiddah 1439 AH:

	July 13, 2018	July 14, 2018
New Moon	06:48	--
Sunset (Azimuth)	19:11 (295°)	19:11 (294°)
Moonset (Azimuth)	19:33 (292°)	20:30 (289°)
Moon's Altitude	4.1°	15.9°
Lag Time ((Minutes)	22	79
Age (Hrs, Min)	12h 24m	36h 24 m

Summary:

A difficult setting for the crescent to be observed on Jul. 13 with the naked eye but not an impossible situation with a telescope. We should expect the first day of Dhu'l Qiddah 1439 AH to be on Saturday Jul. 14, 2018.

8th SCASS SPACE CAMP SUMMER 2018

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

The 8th
Space
Camp
2018

التاريخ : من 08 إلى 11 يوليو
العمر : من 14 سنة إلى 18 سنة
Date : from 08 to 11, July
Age : from 14 yrs. to 18 yrs.

رسوم التسجيل : 200 AED

For More Information Contact Us
Email: SCASS@SCASS.ae
Phone: +971 6 33 66 000