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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

Shawwal 1437 AH Crescent Observations from Sharjah

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Juno probe succeeds in mission to orbit Jupiter: NASA

File Image.

NASA celebrated a key triumph on Tuesday as its $1.1 billion Juno spacecraft successfully slipped into orbit around Jupiter on a mission to probe the origin of the solar system.

NASA's Jet Propulsion Laboratory in Pasadena, California erupted in cheers as the solar observatory entered its aimed-for orbit around the biggest planet in our cosmic neighborhood at 11:53 pm (0353 GMT Tuesday).

"We are there. We are in orbit. We conquered Jupiter," said Scott Bolton, NASA's principal investigator from the Southwest Research Institute in San Antonio, Texas.

"It is almost like a dream coming true."

Juno launched five years ago from Cape Canaveral, Florida and has traveled 1.7 billion miles (2.7 billion kilometers) since then.

Its arrival marks the start of a 20-month mission, during which scientists hope to find out more about how much water Jupiter holds and the makeup of its core in order to figure out how the gas giant -- and other planets including Earth -- formed billions of years ago.

"This amazing universe that we see, how does that work and how did it begin?" asked NASA project scientist Steve Levin.

"That is one of the amazing things about working for NASA and working on big projects. You get to answer big questions." The spacecraft is equipped with nine science instruments, including a camera, which prior to orbit captured a video of Jupiter and its moons gliding around it at different speeds. ...Read More...

Quantum processor for single photons

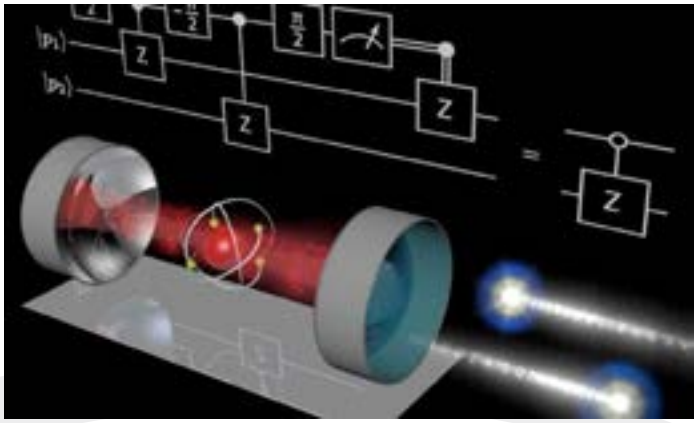
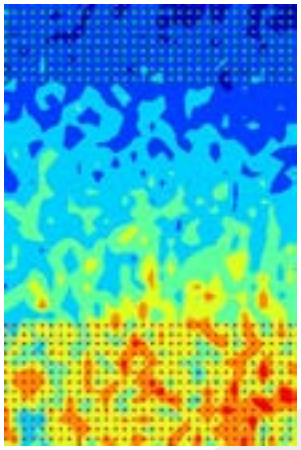


Illustration of the processes that take place during the logic gate operation: The photons (blue) successively impinge from the right onto the partially transparent mirror of a resonator which contains a single rubidium atom (symbolised by a red sphere with yellow electron orbitals). The atom in the resonator plays the role of a mediator which imparts a deterministic interaction between the two photons. The diagram in the background represents the entire gate protocol. Credit: Stephan Welte, MPQ, Quantum Dynamics Division

"Nothing is impossible!" In line with this motto, physicists from the Quantum Dynamics Division of Professor Gerhard Rempe (director at the Max Planck Institute of Quantum Optics) managed to realise a quantum logic gate in which two light quanta are the main actors. The difficulty of such an endeavour is that photons usually do not interact at all but pass each other undisturbed. This makes them ideal for the transmission of quantum information, but less suited for its processing. The scientists overcame this steep hurdle by bringing an ancillary third particle into play: a single atom trapped inside an optical resonator that takes on the role of a mediator. "The distinct feature of our gate implementation is that the interaction between the photons is deterministic", explains Dr. Stephan Ritter. "This is essential for future, more complex applications like scalable quantum computers or global quantum networks."

In all modern computers, data processing is based on information being binary-coded and then processed using logical operations. This is done using so-called logic gates which assign predefined output values to each input via deterministic protocols. Likewise, for the information processing in quantum computers, quantum logic gates are the key elements. To realise a universal quantum computer, it is necessary that every input quantum bit can cause a maximal change of the other quantum bits. The practical difficulty lies in the special nature of quantum information: in contrast to classical bits, it cannot be copied. Therefore, classical methods for error correction cannot be applied, and the gate must function for every single photon that carries information. ...Read More...

Physicists find missing link between glass formation and crystallization



Solidification under sedimentation: The dynamic map illustrates the speed of the particles in the model system. Regions with low speeds are marked in red and orange while those with higher speeds are blue. Red dots show where a solid has already formed. Similar maps were taken during glass formation, but due to the overall homogeneity of the process they look somewhat more boring. Credit: KOMET336, Institute of Physics, JGU

Glasses are neither fluids nor crystals. They are amorphous solids and one of the big puzzles in condensed matter physics. For decades, the question of how glass forms has been a matter of controversy. Is it because some regions freeze their thermal motion? Or is it because there are particles or clusters which do not fit to form a crystal? At least for the model system of hard spheres, researchers at Johannes Gutenberg University Mainz (JGU) in Germany have now taken a major leap in reconciling these two opposing views.

Using a clever combination of light scattering and microscopy, they were able to demonstrate that within a melt of hard spheres small compacted regions form comprising a few hundred spheres. These so-called precursors are the starting point for both crystallization at moderate undercooling and glass formation at large undercooling. The researchers observed that the motility of particles within these precursors was extremely limited and decreased further with undercooling, while their number rapidly increased. With only few precursors present, crystallization may still start at the surface. However, the more of these precursors are present, the more of their surface they block. Moreover, with the precursor number still increasing in time, the system soon gets jammed and all further dynamics cease. This means that from a certain point in undercooling and time onwards, crystal formation is no longer possible. The results of this research work performed in the JGU Graduate School of Excellence "Materials Science in Mainz" (MAINZ) have recently been published in the journal Nature Physics as an advanced online publication. ...Read More...

Quantum fingerprinting surpasses classical limit

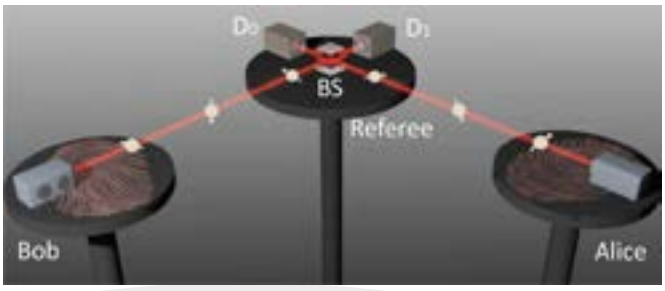


Illustration of the quantum fingerprinting protocol, which can transmit less information than the minimum required by the classical limit for solving a communication complexity problem. Credit: Guan et al. ©2016 American Physical Society

As the saying goes, no two fingerprints are alike, and the same is true for quantum fingerprints. Just as a human fingerprint is only a fraction of the size of a person, yet can be used to distinguish between any two people (at least in theory), quantum fingerprints are exponentially smaller than the string of information they represent, yet they can be used to distinguish between any two strings.

Ever since quantum fingerprinting was first proposed in 2001, it has for the most part remained an interesting theoretical concept, with only a handful of protocols having managed to experimentally demonstrate the idea.

Now in a new study, researchers have experimentally demonstrated a quantum fingerprinting protocol and shown that it can surpass the classical limit for solving communication complexity problems. In these problems, two parties each have a message, and they both share some of their message with a referee, who has to decide whether the two messages are the same or not. The classical limit requires that a minimum amount of information must be transmitted between each party and the referee in order for the referee to make this decision.

So far, the best communication complexity protocols have required transmitting an amount of data that is two orders of magnitude larger than the classical limit.

Now in the new study, the scientists showed that quantum fingerprinting can transmit less information than that required by the classical limit, in some cases up to 84% less, by transmitting only the tiny amount of information that is contained in a quantum fingerprint. The results set a new record for transmitting the smallest amount of information for any type of communication complexity protocol.

"For the first time, we have demonstrated the quantum advantage over classic information processing in communication complexity," coauthor Qiang Zhang...Read More...

Huge helium discovery 'a life-saving find'

File Image.

A new approach to gas exploration has discovered a huge helium gas field, which could address the increasingly critical shortage of this vital yet rare element.

Helium doesn't just make your voice squeaky - it is critical to many things we take for granted, including MRI scanners in medicine, welding, industrial leak detection and nuclear energy. However, known reserves are quickly running out. Until now helium has never been found intentionally - being accidentally discovered in small quantities during oil and gas drilling.

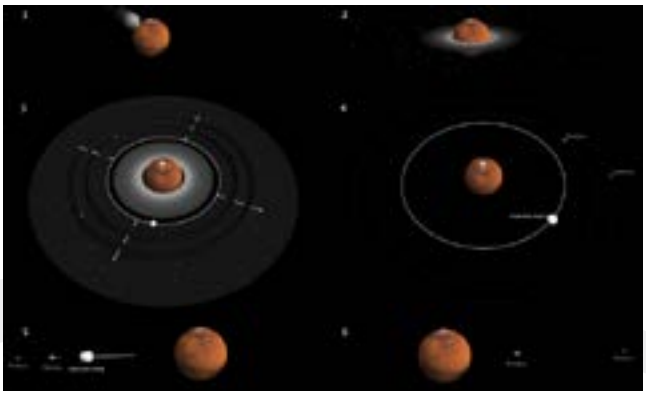
Now, a research group from Oxford and Durham universities, working with Helium One, a helium exploration company headquartered in Norway, has developed a brand new exploration approach. The first use of this method has resulted in the discovery of a world-class helium gas field in Tanzania.

Their research shows that volcanic activity provides the intense heat necessary to release the gas from ancient, helium-bearing rocks. Within the Tanzanian East African Rift Valley, volcanoes have released helium from ancient deep rocks and have trapped this helium in shallower gas fields. The research is being presented by Durham University PhD student Diveena Danabalan at the Goldschmidt geochemistry conference in Yokohama, Japan.

Diveena Danabalan, of Durham University's Department of Earth Sciences, said: 'We show that volcanoes in the Rift play an important role in the formation of viable helium reserves. Volcanic activity likely provides the heat necessary to release the helium accumulated in ancient crustal rocks.

However, if gas traps are located too close to a given volcano, they run the risk of helium being heavily diluted by volcanic gases such as carbon dioxide, just as we see in thermal springs from the region. We are now working to identify the 'goldilocks-zone' between the ancient crust and the modern volcanoes where the balance between helium release and volcanic dilution is 'just right'.' ... Read More...

A giant impact: Solving the mystery of how Mars' moons formed

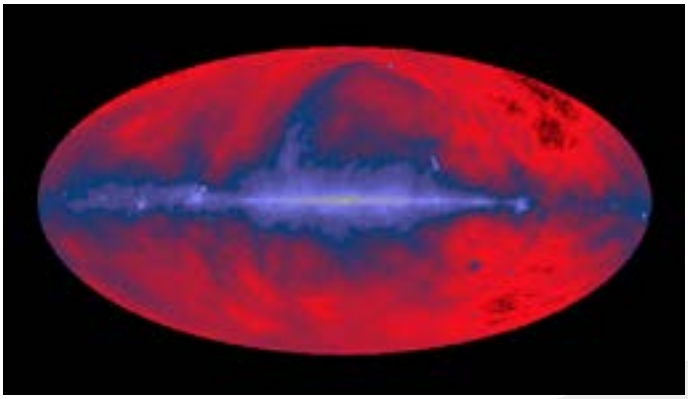


Chronology of events that may have created Phobos and Deimos. Mars is struck by a protoplanet one-third its size (1). A debris disk forms within a few hours. The elementary building blocks of Phobos and Deimos (grains smaller than a micrometer) condense directly from gas in the outer part of the disk (2). The debris disk soon produces a moon near Mars that moves further away and propagates its two areas of dynamical influence like ripples (3), which over the course of a few thousand years causes the accretion of more dispersed debris into two small moons, Phobos and Deimos (4). Under the effect of the tidal pull of Mars, the large moon falls back to the planet within approximately five million years (5), while smaller Phobos and Deimos take up their current positions in the ensuing billions of years (6). Credit: Antony Trinh / Royal Observatory of Belgium

Where did the two natural satellites of Mars, Phobos and Deimos, come from? For a long time, their shape suggested that they were asteroids captured by Mars. However, the shape and course of their orbits contradict this hypothesis. Two independent and complementary studies provide an answer to this question. One of these studies, to be published in The Astrophysical Journal and predominantly conducted by researchers from the CNRS and Aix-Marseille Universite, rules out the capture of asteroids, and shows that the only scenario compatible with the surface properties of Phobos and Deimos is that of a giant collision. In the second study, a team of French, Belgian, and Japanese researchers used cutting-edge digital simulations to show how these satellites were able to form from the debris of a gigantic collision between Mars and a protoplanet one-third its size. This research, which is the result of collaboration between researchers from Université Paris Diderot and Royal Observatory of Belgium, in collaboration with the CNRS, Université de Rennes 1 and the Japanese Institute ELSI, is published on July 4, 2016 in the journal Nature Geoscience.

The origin of the two Martian moons, Phobos and Deimos, remained a mystery. Due to their small size and irregular shape, they strongly resembled asteroids, but no one understood how Mars could have " captured " them and made them into satellites with almost circular and equatorial orbits. According to a competing theory, toward the end of its formation Mars suffered a giant collision with a protoplanet: but why did the debris from such an impact create two small satellites instead of one enormous moon, like the Earth's? ..Read More...

The Dutch are going to the Moon with the Chinese



Radio image of the night sky. Credit: Max Planck Institute for Radio Astronomy, generated by Glyn Haslam.

One of the defining characteristics of the New Space era is partnerships. Whether it is between the private and public sector, different space agencies, or different institutions across the world, collaboration has become the cornerstone to success. Consider the recent agreement between the Netherlands Space Office (NSO) and the Chinese National Space Agency (CNSA) that was announced earlier this week.

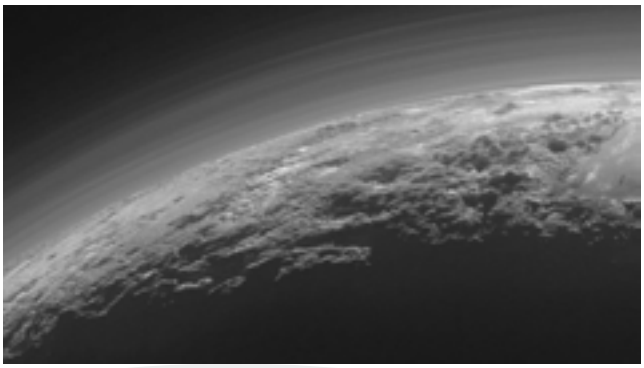
In an agreement made possible by the Memorandum of Understanding (MoU) signed in 2015 between the Netherlands and China, a Dutch-built radio antenna will travel to the Moon aboard the Chinese Chang'e 4 satellite, which is scheduled to launch in 2018. Once the lunar exploration mission reaches the Moon, it will deposit the radio antenna on the far side, where it will begin to provide scientists with fascinating new views of the Universe.

The radio antenna itself is also the result of collaboration, between scientists from Radboud University, the Netherlands Institute for Radio Astronomy (ASTRON) and the small satellite company Innovative Solutions in Space (ISIS). After years of research and development, these three organizations have produced an instrument which they hope will usher in a new era of radio astronomy.

Essentially, radio astronomy involves the study of celestial objects – ranging from stars and galaxies to pulsars, quasars, masers and the Cosmic Microwave Background (CMB) – at radio frequencies. Using radio antennas, radio telescopes, and radio interferometers, this method allows for the study of objects that might otherwise be invisible or hidden in other parts of the electromagnetic spectrum.

One drawback of radio astronomy is the potential for interference. Since only certain wavelengths can pass through the Earth's atmosphere, and local radio wave sources can throw off readings, radio antennas are ...Read More...

Pluto spacecraft gets new mission



Just 15 minutes after sweeping closest to Pluto on July 14, 2015, the New Horizons spacecraft looked back and captured this near-sunset view of rugged, icy mountains and flat ice plains extending to Pluto's horizon. Image via NASA/JHUAPL/SwRI/New Horizons.

In a late-day Friday announcement on July 1, 2016, NASA said that the first-ever spacecraft to visit the dwarf planet Pluto – NASA's New Horizons spacecraft – has received the nod to fly onward to an object deeper in the Kuiper Belt, known as 2014 MU69. This object had not even been discovered when New Horizons was launched in 2006.

The spacecraft will rendezvous with 2014 MU69 on January 1, 2019.

NASA's Director of Planetary Science Jim Green said:

The New Horizons mission to Pluto exceeded our expectations and even today the data from the spacecraft continue to surprise. We're excited to continue onward into the dark depths of the outer solar system.

NASA also announced this week that – Based upon the 2016 Planetary Mission Senior Review Panel report – it has directed nine extended missions to plan for continued operations through fiscal years 2017 and 2018. However, NASA said:

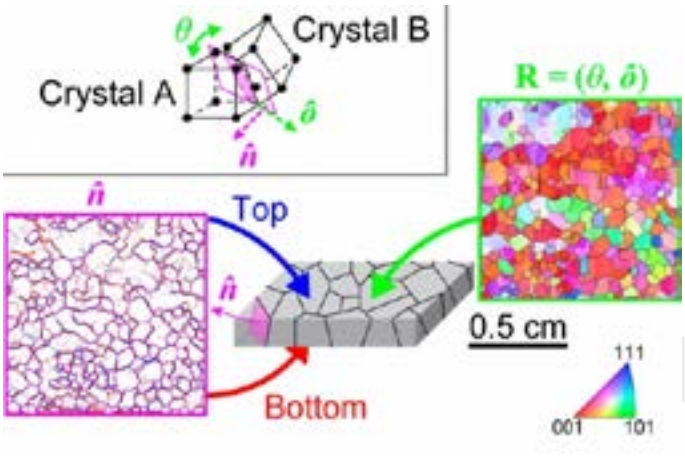
Final decisions on mission extensions are contingent on the outcome of the annual budget process.

In addition to the extension of the New Horizons mission, NASA determined that the Dawn spacecraft should remain at the dwarf planet Ceres, rather than changing course to the main belt asteroid Adeona.

Green commented:

The long-term monitoring of Ceres, particularly as it gets closer to perihelion – the part of its orbit with the shortest distance to the sun – has the potential to provide more significant science discoveries than a flyby of Adeona.
...Read More...

New technique provides detailed views of metals' crystal structure



The method combines optical microscopy techniques (left, in pink) with electron backscatter diffraction (right, in green) to measure characteristics of the boundaries between crystal grains, which help determine the material's overall properties. Credit: Matteo Seita

Researchers at MIT and elsewhere have developed a new combination of methods that can provide detailed information about the microstructure of polycrystalline metals.

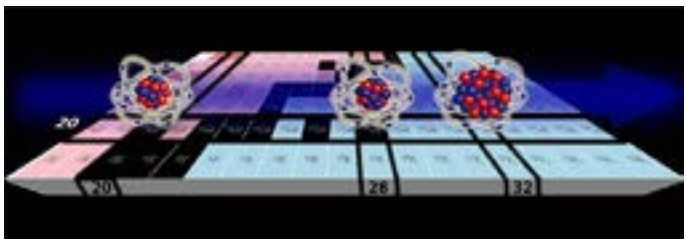
Such materials—composed of a random matrix of multiple small crystals rather than one single large crystal—are widely used for such applications as nuclear reactors, civil infrastructure, and aircraft. However understanding the details of their crystal structure and the boundaries between the crystal areas has been difficult.

The new findings are published in the journal Nature Computational Materials, in a paper by Matteo Seita, an MIT postdoc; Michael Demkowicz, a professor of materials science and engineering; Christopher Schuh, the Danae and Vasilis Salapatas Professor of Metallurgy, and five others.

"This is a unique combination of different technologies," Seita explains. The new approach he and the team developed addresses "one of the most common problems in materials science: How do we quantify the characteristics of materials in a high-throughput fashion?"

Some techniques offer a great deal of detail about structures, but they take time to carry out and can't reveal rapid changes within the material. Others work rapidly but provide much less structural detail, and still other methods provide both spatial and temporal detail but are prohibitively expensive or only available in limited places. The new combination of techniques, Seita says, can help resolve these limitations by providing fast, high-resolution, and low-cost imaging of the materials. ...Read More...

Physics researchers question calcium-52's magic



The image above shows the chain of the studied calcium isotopes. The "doubly magic" isotopes with mass numbers 40 (Ca-40) and 48 (Ca-48) exhibit equal charge radii. The first measurement of the charge radius in Ca-52 yielded an unexpectedly large result. Credit: COLLAPS Collaboration/Ronald Fernando Garcia Ruiz

For decades nuclear physicists have tried to learn more about which elements, or their various isotopes, are "magic."

This is not to say that they display supernatural powers. Magic atomic nuclei are composed of "magic" numbers of protons and neutrons—collectively called nucleons—such as 2, 8, 20, and 28. These specific numbers of nucleons define shells inside the nucleus, which, when closed, make it far more strongly bound, and stable, than other nuclei.

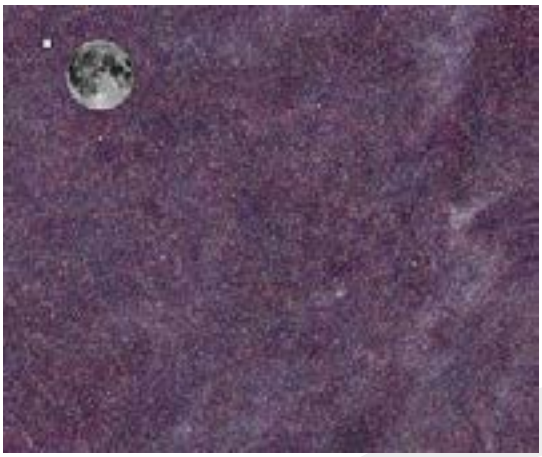
If both protons and neutrons have a magic number, the atomic nucleus is said to be doubly magic, making it particularly strongly bound and simple in its structure. For instance, calcium-48, with 20 protons and 28 neutrons, is doubly magic.

Atomic nuclei make up the vast majority of visible matter in the universe, and understanding the interactions between the neutrons and protons that comprise nuclei has an impact on research spanning from the subatomic realm to astrophysical objects such as neutron stars.

For a nucleus to be considered magic, it must exhibit several properties. Researchers look at its excitation energy, the energy needed to move the nucleus to a higher energy state. In addition, researchers measure its separation energy, the energy needed to remove a nucleon from the nucleus. Finally, measuring the charge radius, or the distribution of protons in the nucleus, allows scientists to track trends that would indicate whether a nucleus is magic.

Recently a multi-institution team led by Gaute Hagen at the Department of Energy's Oak Ridge National Laboratory computed the size of the atomic nucleus calcium-48—a magic isotope—and found it had a significantly thinner neutron skin than was previously thought. The results challenge researchers' understanding of the basic properties of atomic nuclei, such as the evolution of shell structure in neutron-rich nuclei and its connection to the distribution of charge and stability. The team's research was published in Nature Physics. After the work on calcium-48, the team continued by moving to a larger, heavier, and more complex isotope—calcium-52—and the results ...Read More...

Universe becoming cleaner as cosmic dust gets mopped up by stars, astronomers reveal



A small glimpse of one region, a tenth of the full area of the Herschel ATLAS images. Everything in this image, apart from the picture of the moon, which has just been placed there to show the area of sky covered by the survey and the small square that shows the area covered by the Hubble Deep Field, consists of far-infrared emission from cosmic dust. Image courtesy The Herschel ATLAS team and the European Space Agency.

The Universe is becoming gradually cleaner as more and more cosmic dust is being mopped up by the formation of stars within galaxies, an international team of astronomers has revealed.

Peering back 12 billion years using the Herschel space telescope to produce far-infrared images of the sky, the team led by researchers at Cardiff University has been able to observe the very early formation of galaxies and compare them to galaxies that have formed much more recently.

The results showed that stars were forming inside galaxies much faster in the past compared to today, and that this rapid star birth is using up more and more of the cosmic dust that is ubiquitous in the Universe. Cosmic dust is comprised of tiny solid particles that are found everywhere in space between the stars. The dust and the gas in the universe is the raw material out of which stars and galaxies form.

Though this blanket of material is key to the formation of stars and galaxies, it also acts as a sponge, absorbing almost half of the light emitted by stellar objects and making them impossible to observe with standard optical telescopes.

With the launch of the Herschel space telescope in 2009, researchers were provided with the perfect tool for probing this hidden universe. Owing to a collection of sensitive instruments, mirrors and filters, the Herschel telescope had the capacity to detect the dust through the far-infrared emission it emits, revealing the existence of stars and galaxies hidden by the dust. ...Read More...

For Galaxies, It's Not Easy Being Green

Composite image of blue, green and red galaxies: L-R Virtual images of blue, green and red galaxies produced by the EAGLE simulations. The green galaxy is caught in the act of transforming from blue to red as its gas supply runs out. Credit: James Trayford/EAGLE/Durham University.

Scientists may have answered why green galaxies are rare in our universe and why their color could reveal a troubled past. Their research is presented 30 June at the National Astronomy Meeting at the University of Nottingham.

The international team, led from Durham University's Institute for Computational Cosmology, used new computer modeling of the universe to investigate the colors that galaxies have and what those colors might tell us about how galaxies evolve. Using the state of the art EAGLE simulations, the researchers modeled how both the ages of stars in galaxies and what those stars are made from translate into the color of light that they produce.

The team said their simulations showed that colors of galaxies can also help diagnose how they evolve. While red and blue galaxies are relatively common, rare green galaxies are likely to be at an important stage in their evolution, when they are rapidly turning from blue - when new stars and planets are being born - to red as stars begin to burn themselves out.

Lead researcher James Trayford, PhD student in the ICC, said: "Galaxies emit a healthy blue glow while new stars and planets are being born. However, if the formation of stars is halted galaxies turn red as stars begin to age and die.

"In the real universe we see many blue and red galaxies, but these intermediate 'green' galaxies are more rare.

"This suggests that the few green galaxies we catch are likely to be at a critical stage in their evolution; rapidly turning from blue to red."

Because stars form from dense gas, a powerful process is needed to rapidly destroy their gas supply and cause such dramatic changes in color, the research found.

James added: "In a recent study we followed simulated galaxies as they changed color, and investigated what processes caused them to change. ...Read More...

Shawwal 1437 AH Crescent Report:

Basic Astronomical Information about the observations of the crescent of Shawwal 1437 AH:

	Mon., Jul. 04, 2016	**Tue., Jul. 05, 2016**
	Sun/Moon data	Sun/Moon Data
New Moon	15:00	--
Sunset (Azimuth - Degrees)	19:13 (296)	19:13 (296)
Moonset (Azimuth - Degrees)	19:06 (290)	19:59 (288)
Moon's Altitude (Degrees)	-2.6	8.6
Lag Time (Minutes)	--	46
Age (Hrs, Min)	4h 13	28h 13m

The crescent was not observed on Tuesday because of its low altitude. On Wednesday, it was an easy target for the naked eye.

Tuesday - July 05, 2016 - Time: 19:05
Very thick haze above the western horizon

Tuesday - July 05, 2016 - Time: 19:13
No sign of the very low and thin crescent

Wednesday - July 06, 2016 - Time: 19:19
A very thin crescent can be seen in the middle of the picture

Wednesday - July 06, 2016 - Time: 19:33
A very thin crescent can be seen just to the right of the palm tree

مركز الشارقة لعلوم الفضاء والفلك
Sharjah Center for Astronomy & Space Sciences
Sharjah Center for Astronomy and Space Sciences
Sharjah, United Arab Emirates
Phone: 00-971-6-5166000
Website: www.scass.ae
E-mail: scass@scass.ae

جامعة الشارقة
UNIVERSITY OF SHARJAH
College of Sciences - University of Sharjah
POB 27272 - Sharjah, United Arab Emirates
Phone: 00-971-6-5050351
Email: physics@sharjah.ac.ae