Jan. 12, 2019 Jumada I 05, 1440 AH Volume 9, Issue 02

Astronomy & Physics Weekly News

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

جامعة الشارقة
UNIVERSITY OF SHARJAH

IAU
100 Years: Under One Sky

IT Support Issam Jami Design by Mohamed Bakir

Astronomers find the brightest quasar yet

Artist's concept showing how J043947.08+163415.7 – a very distant quasar powered by a supermassive black hole – might look close up. Image via ESA/Hubble/NASA/M. Kornmesser.

Researchers announced this week (January 9, 2019) at the 233rd meeting of the American Astronomical Society in Seattle, Washington, that they've discovered the brightest quasar yet known, detected from the period when the universe was just beginning to make luminous objects, such as stars and galaxies. Quasars are thought to be the bright cores of early active galaxies, powered by central, supermassive black holes. The extreme brightness of quasars – so bright that we can see them across a distance corresponding to most of the history of the universe – is believed to come from hot material falling into black holes. The newly discovered super-bright quasar is catalogued as J043947.08+163415.7. It shines with light equivalent to 600 trillion suns, from a distance 12.8 billion light-years from Earth.

It now holds the record for being the brightest quasar in the early universe, and, astronomers say, it might hold this record for some years to come. Astronomer Xiaohui Fan at the University of Arizona's Steward Observatory led the team that made the discovery. He commented:

We don't expect to find many quasars brighter than that in the whole observable universe.

This bright and remote quasar is rare. Astronomers say they searched for 20 years for such a distant quasar before finding this one. They found it via a lucky alignment; a dim galaxy is located between us and the quasar. The light of the intervening galaxy bends the light from the quasar and makes the quasar appear three times as large and 50 times as bright as it would be without this gravitational lensing effect.

Astronomer Fabio Pacucci at Yale – who co-led the discovery, plus led an analysis of its theoretical implications – commented:

For decades we thought that lensed quasars should be very common in the faraway universe, but this is the first source of this kind that we have found.

Pacucci used the term phantom quasar to describe this object, and said J043947.08+163415.7 ...Read More...

Scientists discover a process that stabilizes fusion plasmas

Physicists Allan Reiman, left, and Nat Fisch. Credit: Elle Starkman/ PPPL Office of Communications

Scientists seeking to bring the fusion reaction that powers the sun and stars to Earth must keep the superhot plasma free from disruptions. Now researchers at the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) have discovered a process that can help to control the disruptions thought to be most dangerous.

Replicating fusion, which releases boundless energy by fusing atomic nuclei in the state of matter known as plasma, could produce clean and virtually limitless power for generating electricity for cities and industries everywhere. Capturing and controlling fusion energy is therefore a key scientific and engineering challenge for researchers across the globe.

Creating magnetic islands

The PPPL finding, reported in Physical Review Letters, focuses on so-called tearing modes—instabilities in the plasma that create magnetic islands, a key source of plasma disruptions. These islands, bubble-like structures that form in the plasma, can grow and trigger disruptive events that halt fusion reactions and damage doughnut-shaped facilities called "tokamaks" that house the reactions.

Researchers found in the 1980s that using radio-frequency (RF) waves to drive current in the plasma could stabilize tearing modes and reduce the risk of disruptions. However, the researchers failed to notice that small changes—or perturbations—in the temperature of the plasma could improve the stabilization process, once a key threshold in power is exceeded. The physical mechanism that PPPL has identified works like this:

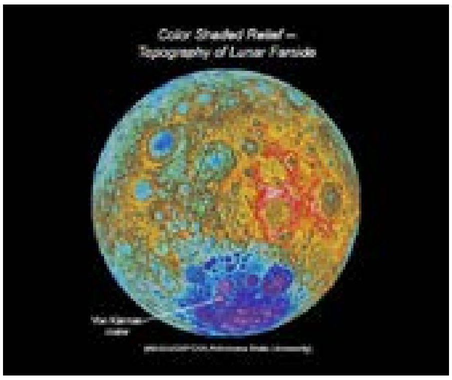
The temperature perturbations affect the strength of the current drive and the amount of RF power deposited in the islands.

The perturbations and their impact on the deposition of power feedback against each other in a complex—or nonlinear—manner.

When the feedback combines with the sensitivity of the current drive to temperature perturbations, the efficiency of the stabilization process increases.

Furthermore, the improved stabilization is less to likely to be affected by misaligned current drives that fail to hit the center of the island. ...Read More...

Scientists expect breakthrough findings on lunar far side



The SPA Basin, where the Chang'e-4 probe landed, is the largest and deepest basin in the solar system, with a diameter of 2,500 km and a depth of more than 10 km.

China's Chang'e-4 probe has landed on the South Pole-Aitken (SPA) Basin on the far side of the moon, regarded as a virgin territory by scientists expecting important discoveries.

"The far side of the moon has very unique features, and has never been explored in situ, so Chang'e-4 might bring us breakthrough findings," said Zou Yongliao, director of the lunar and deep space exploration division of the Chinese Academy of Sciences (CAS).

As a result of the tidal locking effect, the moon's revolution cycle is the same as its rotation cycle. It always faces the earth with the same side, and the far side was a mystery before the age of spacecraft.

About 60 years ago, the Luna 3 probe of the Soviet Union sent back the first image of the moon's far side. And about 50 years ago, three astronauts of the United States Apollo 8 mission became the first people to see the moon's far side with their own eyes.

More lunar missions showed the moon's two sides were very different: the near side has more and relatively flat lunar mares, while the far side is thickly dotted with impact craters at different sizes.

"There are great differences in terms of substance composition, terrain and landforms, structure and the age of rocks. For instance, about 60 percent of the near side is covered by mare basalt, but most part of the far side is covered by lunar highland anorthosite. Of the 22 lunar mares, 19 are located on the near side," said Zou.

Scientists infer that the lunar crust on the far side is much thicker than the near side. But why is still a mystery. Only in-situ exploration might reveal the secrets.

Exploration of the far side might help shed light on the early history of the moon, the earth and the solar system. The moon and the earth shared a similar "childhood." But the traces of the remote past on earth ...Read More...

Self-driving rovers could be the future of exploration on Mars

Rover testing at the Ibn Battuta Test Centre in Morocco.
UK Space Agency

The Future of Martian Bots

Mars has been home to robots since the 1990s. Rolling over the rocky terrain, martian robots have endured dust storms, radiation and the hardships of life on the Red Planet. New software from the UK could allow these robots to drive themselves around the rocky martian terrain and enable them to explore farther than ever before.

It currently takes about eight minutes (each way) for commands and communication to travel to or from Mars, so robots guided by humans on Earth can only travel a little more than a hundred feet (or a few dozen meters) per day. But this new software aims to enable future rovers to decide where they go and how to get there on their own, without the need for direct commands from Earth. Essentially, this software would give a martian rover self-driving capabilities.

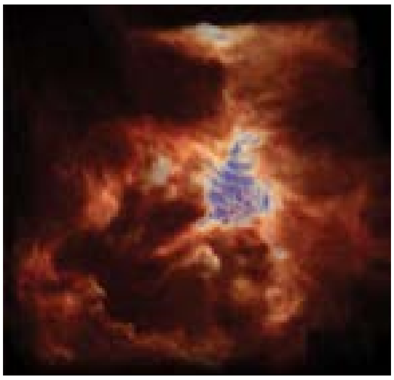
Cutting out the need for time-intensive commands to travel to and from Mars for every move, this advancement would free up martian robots to travel over half a mile (1 km) per day. By dramatically expanding the area that a rover covers every day, this software would also dramatically expand the amount of data the rover collects. This would greatly improve the research capabilities of future missions and it could even lead to more frequent scientific findings.

"Mars is a very difficult planet to land safely on, so it's essential to maximize the discoveries from each successful touchdown," said Catherine Mealing-Jones, Director of Growth at the UK Space Agency, in a statement. "New autonomous robot technology like this will help to further unlock Mars' mysteries and I'm delighted that the UK is a key player in this cutting-edge field."

Building a Robot

In testing, the self-driving software was mounted on a rover known as "Sherpa," provided by the German Robotics Innovation Center DFKI. Sherpa was allowed to roam around the Ibn Battuta Test Centre, located in Morocco. It's a popular site for testing martian rovers ...Read More...

"Orion's Dragon" captured in 3D by NASA's airborne observatory



By combining tens of hours of spectroscopic observations, astronomers have uncovered a feature in the Orion Nebula that they've dubbed "Orion's Dragon."
NASA/SOFIA

Using a telescope-mounted airplane, astronomers have uncovered a structure in the Orion Nebula that may shed light on one of the nebula's long-standing secrets.

While flying more than seven miles above the surface of our planet, NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA) recently fixated on Earth's nearest star-forming region: the Orion Nebula.

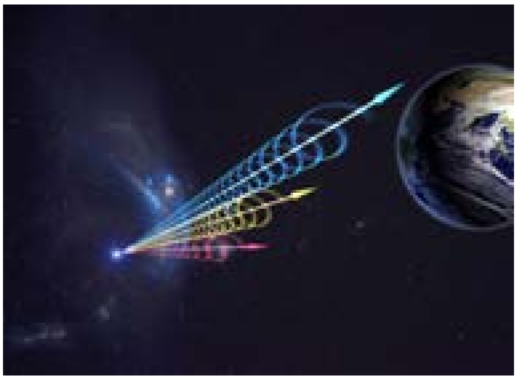
Based on the data collected by the jetliner, which is equipped with a 106-inch (2.7-meter) diameter telescope, researchers determined that strong stellar winds from a particularly young and active star are disrupting gas within the Orion Nebula, which is located some 1,300 light-years from Earth. These strong winds, in turn, are stifling star formation in the region.

To make their new finding, the team used the SOFIA data to create a stunning 3D view of the chaotic environment inside the nebula, a decision that also helped them uncover a newfound feature they've since dubbed "Orion's Dragon."

In total, SOFIA spent about 40 hours collecting spectroscopic observations of the Orion Nebula with a recently upgraded instrument called the German Receiver for Astronomy at Terahertz Frequencies, also known as GREAT. By collecting and combining millions of individual spectra, which measure the chemical fingerprints of light, the researchers were able to generate a three-dimensional data cube that contained both velocity and spatial information for gas within the nebula.

"As we rotated the data cube, we got our first glimpse of the structure that we've nicknamed Orion's Dragon," said Rhys Taylor, a scientist at the Astronomical Institute of the Czech Academy of Sciences and a consultant to the SOFIA team, in a press release. "A few people have said it looks like a sea horse or a pterodactyl, but it looks like a dragon to me." ...Read More...

Scientists Find 13 Mysterious Deep-Space Flashes, Including 2nd Known 'Repeater'



An artist's illustration of emissions from a fast radio burst reaching Earth. The different colors signify different wavelengths of light. Credit: Jingchuan Yu, Beijing Planetarium

Fast radio bursts (FRBs) may not remain mysterious for much longer.

Astronomers have spotted 13 more of these extragalactic light flashes, boosting the known population by about 20 percent. And the new haul includes the second repeating FRB ever discovered. (All others seen to date have been one-offs, flaring up just a single time.)

"Knowing that there is another [repeater] suggests that there could be more out there," discovery team member Ingrid Stairs, an astrophysicist at the University of British Columbia, said in a statement. "And with more repeaters and more sources available for study, we may be able to understand these cosmic puzzles — where they're from and what causes them.

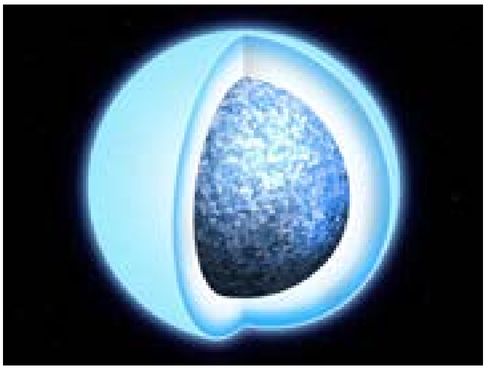
FRBs are brief but incredibly powerful phenomena; the milliseconds-long emissions are energetically comparable to the total output of our sun over a century. But, as Stairs noted, FRBs are as enigmatic as they are spectacular. Astronomers have offered a number of possible explanations for the bursts, including merging neutron stars and advanced alien civilizations.

The new results — which were announced today (Jan. 9) in two papers in the journal Nature, and in presentations at the 233rd American Astronomical Society meeting in Seattle — aren't great news for anyone holding out hope that E.T. is responsible. The more common a phenomenon is, after all, the more likely it is to have a natural explanation.

The discovery team analyzed observations by the Canadian Hydrogen Intensity Mapping Experiment (CHIME), an advanced new radio telescope in British Columbia's Okanagan Valley.

"CHIME reconstructs the image of the overhead sky by processing the radio signals recorded by thousands of antennas with a large signal-processing system," team member Kendrick Smith, of the Perimeter Institute for Theoretical Physics in Ontario, said in the same statement. "CHIME's signal-processing system is the largest of ...Read More...

The Sun Will Turn Into a Giant Crystal Ball After It Dies



An artist's illustration of a white dwarf in the process of solidifying. Credit: University of Warwick/Mark Garlick

Billions of years in the future, our dead sun will morph into a giant cosmic jewel, a new study suggests. Like the vast majority of stars in our Milky Way galaxy, the sun will eventually collapse into a white dwarf, an exotic object about 200,000 times denser than Earth. To put that in perspective: A mere teaspoon of white-dwarf material would weigh about as much as an elephant, if you could somehow transport the stuff to our planet.

Half a century ago, theorists predicted that white dwarfs solidify into crystal over time — and the new research has found that this is indeed the case. [Death of a Sunlike Star: How It Will Destroy Earth (Infographic)]

"All white dwarfs will crystallize at some point in their evolution, although more massive white dwarfs go through the process sooner," study lead author Pier-Emmanuel Tremblay, a physicist at the University of Warwick in England, said in a statement.

"This means that billions of white dwarfs in our galaxy have already completed the process and are essentially crystal spheres in the sky," Tremblay added. "The sun itself will become a crystal white dwarf in about 10 billion years."

Tremblay and his colleagues analyzed data gathered by the European Space Agency's Gaia spacecraft, which launched in December 2013 to help researchers construct the best-ever 3D map of the Milky Way. Gaia does this by precisely monitoring the positions of huge numbers of stars; the mission team aims to study 1 billion stars over the spacecraft's operational lifetime.

For the new study, the researchers looked at Gaia measurements of about 15,000 white dwarfs, all of which lie within 330 light-years of the sun. These data revealed an odd "pileup" — an overabundance of white dwarfs with certain colors and brightnesses that cannot be explained by the objects' ages or masses.

Modeling work suggested that the pileup was caused by crystallization of the white dwarfs' interiors, which released enough heat to slow down the ...Read More...

Probing the magnetar at the center of our galaxy

Illustration of a magnetar — a rotating neutron star with incredibly powerful magnetic fields. Image via NASA/CXC/M.Weiss.

Researchers from MIT and elsewhere have recorded, for the first time, the "temporal coherence" of a graphene qubit - meaning how long it can maintain a special state that allows it to represent two logical states simultaneously. The demonstration, which used a new kind of graphene-based qubit, represents a critical step forward for practical quantum computing, the researchers say.

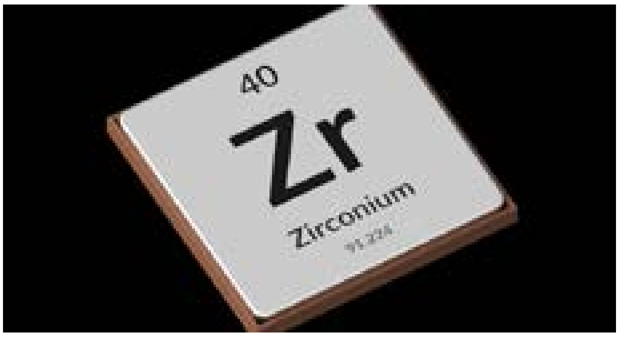
Superconducting quantum bits (simply, qubits) are artificial atoms that use various methods to produce bits of quantum information, the fundamental component of quantum computers. Similar to traditional binary circuits in computers, qubits can maintain one of two states corresponding to the classic binary bits, a 0 or 1. But these qubits can also be a superposition of both states simultaneously, which could allow quantum computers to solve complex problems that are practically impossible for traditional computers.

The amount of time that these qubits stay in this superposition state is referred to as their "coherence time." The longer the coherence time, the greater the ability for the qubit to compute complex problems.

Recently, researchers have been incorporating graphene-based materials into superconducting quantum computing devices, which promise faster, more efficient computing, among other perks. Until now, however, there's been no recorded coherence for these advanced qubits, so there's no knowing if they're feasible for practical quantum computing.

In a paper published Dec 31 in Nature Nanotechnology, the researchers demonstrate, for the first time, a coherent qubit made from graphene and exotic materials. These materials enable the qubit to change states through voltage, much like transistors in today's traditional computer chips - and unlike most other types of superconducting qubits. Moreover, the researchers put a number to that coherence, clocking it at 55 nanoseconds, before the qubit returns to its ground state. ...Read More...

A weird type of zirconium soaks up neutrons like a sponge



NEUTRON HUNGRY - A version of the element zirconium absorbs neutrons with a fervor unrivaled by almost any other type of known atom.

When radiochemist Jennifer Shusterman and her colleagues got the first results of their experiment, no one expected what they saw: Atoms of a weird version of the element zirconium had enthusiastically absorbed neutrons.

"People were quite surprised and we had lots of discussions," says Shusterman, of Hunter College of the City University of New York.

The source of this fuss was zirconium-88. That's a particular type, or isotope, of zirconium, distinguished by the number of neutrons it contains. Garden-variety zirconium typically contains about 50 neutrons, but zirconium-88, which is radioactive and not found naturally on Earth, has fewer than normal, with 48 neutrons.

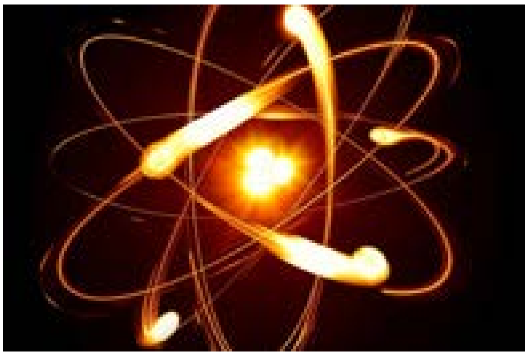
When irradiated with low-energy neutrons from a nuclear reactor, each atom of zirconium-88 had a high probability of absorbing a neutron into its nucleus, causing the element to transform into another isotope, zirconium-89. The reaction was about 85,000 times as likely to occur as predicted, the researchers report online January 7 in Nature.

That result was the highest neutron capture probability measured in 70 years. Only one other isotope, xenon-135, is known to be better at capturing neutrons. Previously studied versions of zirconium are much more reluctant to take on another neutron, with absorption probabilities about a millionth that of zirconium-88, or less.

Isotopes with a high neutron capture probability can be used to control nuclear reactors by sopping up loose neutrons, slowing the rate of reactions. But it's not clear if zirconium-88 will find a purpose.

Scientists still don't know why certain isotopes have such an extreme affinity for neutrons. A project now under construction at Michigan State University in East Lansing, known as the Facility for Rare Isotope Beams, will allow scientists to study the properties of even more isotopes. Additional surprises may be in store. ...Read More...

What a Tiny Electron Reveals About the Structure of the Universe



Credit: Shutterstock

What is the shape of an electron? If you recall pictures from your high school science books, the answer seems quite clear: an electron is a small ball of negative charge that is smaller than an atom. This, however, is quite far from the truth.

The electron is commonly known as one of the main components of atoms making up the world around us. It is the electrons surrounding the nucleus of every atom that determine how chemical reactions proceed. Their uses in industry are abundant: from electronics and welding to imaging and advanced particle accelerators. Recently, however, a physics experiment called Advanced Cold Molecule Electron EDM (ACME) put an electron on the center stage of scientific inquiry. The question that the ACME collaboration tried to address was deceptively simple: What is the shape of an electron?

Classical and quantum shapes?

As far as physicists currently know, electrons have no internal structure — and thus no shape in the classical meaning of this word. In the modern language of particle physics, which tackles the behavior of objects smaller than an atomic nucleus, the fundamental blocks of matter are continuous fluid-like substances known as "quantum fields" that permeate the whole space around us. In this language, an electron is perceived as a quantum, or a particle, of the "electron field." Knowing this, does it even make sense to talk about an electron's shape if we cannot see it directly in a microscope — or any other optical device for that matter?

To answer this question we must adapt our definition of shape so it can be used at incredibly small distances, or in other words, in the realm of quantum physics. Seeing different shapes in our macroscopic world really means detecting, with our eyes, the rays of light bouncing off different objects around us.

Simply put, we define shapes by seeing how objects react when we shine light onto them. While this might be a weird way to think about the shapes, it becomes very useful in the subatomic world of quantum particles. It gives us a way to define an electron's properties such that they mimic how we describe shapes in the classical world. ...Read More...

Scientists Find the 'Missing' Dark Matter from the Early Universe

Credit: Shutterstock

Dark matter, it seems, has been clinging to galaxies for a very long time. Most galaxies that existed 10 billion years ago had about as much dark matter as galaxies do today, contradicting earlier studies that suggested less dark matter lurked around galaxies in the early universe.

"Dark matter was similarly abundant in star-forming galaxies in the distant past as it is in the present day," said Alfred Tiley, an astronomer at Durham University in England and lead author on the new study. The research was recently submitted to the journal Monthly Notices of the Royal Astronomical Society and published Nov. 16 in the preprint journal arXiv. "It wasn't a complete surprise, but in reality, we didn't know whether the observational reality would align with expectations from theory."

Dark matter makes up approximately 85 percent of the total mass in our known universe, but the mysterious substance does not interact with light, leaving scientists in the dark about the its precise nature. So, instead of viewing it, astronomers must rely on dark matter's gravitational pull on the normal matter, called baryonic matter, that makes up the stars, nebulas and planets we see in the night sky, as well as all the trees, rocks and people on Earth.

Dark matter tends to clump into halos around galaxies; astronomers discovered this by measuring how fast galaxies rotate. According to Newton's law of gravity, stars on the outskirts of a galaxy should rotate much more slowly than those at the center. But in the 1960s, astronomers found speedy suburban stars on the fringe of the Milky Way that hinted at extra matter hiding out beyond those stars' galactic orbits.

Studies have since measured thousands of rotation rates across the universe, confirming the presence of these dark matter halos.

In the new study, researchers used data from two surveys of 1,500 star-forming galaxies to calculate rotation rates for galaxies going back 10 billion years. Precisely measuring galactic rotation far in the cosmic past is difficult, because these ancient galaxies are incredibly distant and faint. So, the scientists estimated an average by clumping the galaxies by distance and then ...Read More...

Laser-Blasted Plasma Is Cooler Than Deep Space... Literally

Rice University physicists reported the first laser-cooled neutral plasma, a breakthrough that could lead to simulators for exotic states of matter that occur at the center of Jupiter or white dwarf stars. Credit: Brandon Martin/Rice University

Researchers who make the coldest plasmas in the universe just found a way to make them even colder — by blasting them with lasers.

The scientists cooled the plasma to around 50-thousandths of a degree above absolute zero, about 50 times colder than in deep space.

This chilly plasma could reveal how similar plasmas behave at the centers of white dwarf stars and deep in the core of gas planets like our cosmic neighbor, Jupiter, researchers reported in a new study.

Plasma is a type of gas, but it's different enough to be recognized as one of the four fundamental states of matter (alongside gas, liquid and solid). In plasma, a significant number of electrons have been separated from their atoms, creating a state where free electrons zip around ions, or atoms that have either a positive or negative charge.

Temperatures in naturally occurring plasma are typically very high; for example, plasma on the surface of the sun seethes at 10,800 degrees Fahrenheit (6,000 degrees Celsius). By cooling plasma, scientists can make more detailed observations in order to better understand its behavior under extreme conditions, like those roiling our gas giant neighbors.

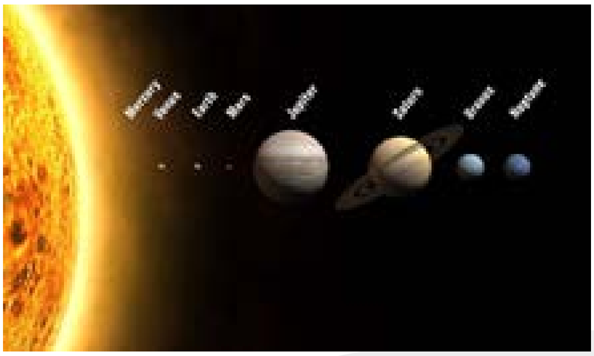
Be more chill

So why use lasers to help the plasma chill out? "The laser cooling takes advantage of the fact that light has momentum," lead study author Thomas Killian, a professor of physics and astronomy at Rice University in Texas, told Live Science. "If I have an ion in the plasma and I have a laser beam scattering light off that ion, every time that ion scatters a photon it gets a push in the direction of the laser beam," Killian said.

This means that if a laser beam opposes the ion's natural motion, every time the ion scatters light...Read More...

Special Read:

How did all the planets with their moons get their names?



WikiMedia Commons

The five naked-eye planets – Mercury, Venus, Mars, Jupiter, and Saturn – have been known since antiquity. The Greeks called them Hermes, Aphrodite, Ares, Zeus, and Cronus, respectively.

Aphrodite (Venus to the Romans – and us) caused some problems until the third century b.c. Greek observers had named it Phosphorus when it appeared in the morning sky and Hesperus for its evening apparitions. It was Aristarchus of Samos, born around 310 b.c., who realized that these two objects were one and the same.

Centuries later, the Romans adopted the planets of the Greeks and simply changed their names to Mercury, Venus, Mars, Jupiter, and Saturn.

All was well until 1781, when German-born English astronomer William Herschel discovered a planet beyond Saturn. For more than half a century, there was no agreement on a name, and astronomers often referred to it as the planet Herschel. Cooler heads finally prevailed, and the name Uranus was added to the list.

In 1846, the English and French mathematicians John Couch Adams and Urbain Jean Joseph Le Verrier simultaneously predicted the position of an eighth planet, which astronomers found easily. After much wrangling, astronomers agreed on the name Neptune. Finally, in 1930, a young English girl named far-flung Pluto through an international appeal for suggestions. Uranus, Neptune, and Pluto are all names of Roman gods, so their choices preserved the overall naming scheme of the solar system.

Galileo Galilei discovered the first planetary moons around Jupiter in 1609. He wanted to name them the Medician Stars after his benefactor, Cosimo de' Medici. However, the classical nomenclature that had prevailed for more than 2,000 years won out. Classical names were applied as more and more planetary moons were discovered.

The mold was broken at Uranus, however, when planetary scientists named its moons after characters found in the works of Shakespeare and Alexander Pope. Neptune's moons got their names from Greek water gods, and the names of Pluto's moons came from mythological inhabitants of the underworld.

The Greeks gave our Moon the name Selene, and Earth was Gaia. Both our modern words Earth and Moon derive from Middle English. So rather than Gaia or Selene, we have just plain old Earth and the Moon.

..Read More...

This Week's Sky at a Glance - Jan. 12-18, 2019

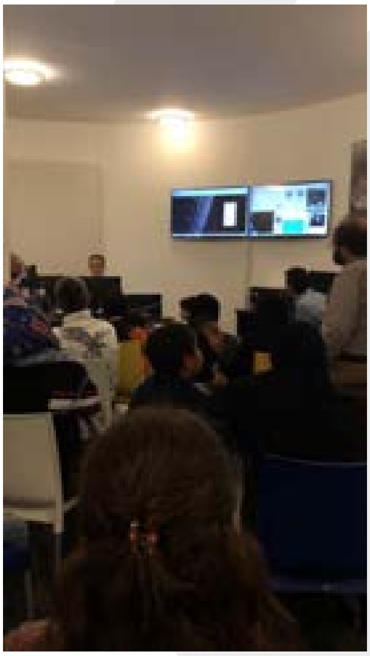
Jan. 14	Mo	10:46	First Quarter
Jan. 17	Th	22:20	Moon-Aldebaran: 1.6° S

SCASS Holds 3rd CubeSat Workshop Week (Jan. 06-10, 2019)

As part of its CubeSat program, the Sharjah Center for Astronomy and Space Sciences organized the third week (Jan. 06-10, 2019) of a CubeSat course as part of a six-week workshop for the students of the University of Sharjah and SCASS's research assistants. Prof. Alim and Mr. Bogac from Istanbul Technical Institute presented the workshop. The workshop falls under the University of Sharjah and SCASS to develop Sharjah-Sat-1's CubeSat programmed to be launched Spring 2020.

Photo credit: Mr. Mohamed Bakir

1st Observatory Open House for 2019 (Jan. 10, 2019)



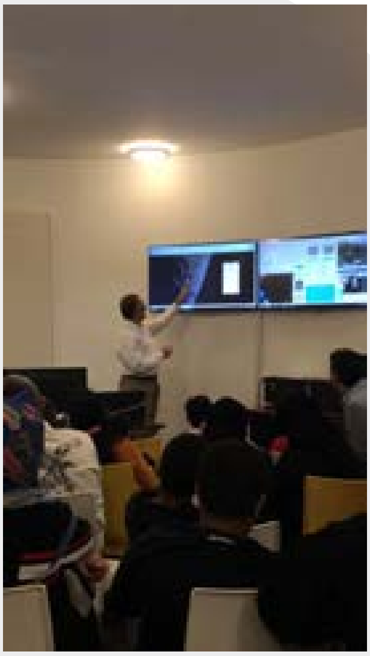


Photo credit: Ms. Rama Rezq AlJ-aber