

Space News Update – June 2019

By Pat Williams

IN THIS EDITION:

- Curiosity detects unusually high methane levels.
- Scientists find largest meteorite impact in the British Isles.
- Space station mould survives high doses of ionizing radiation.
- NASA selects missions to study our Sun, its effects on space weather.
- Subaru Telescope identifies the outermost edge of our Milky Way system.
- Links to other space and astronomy news published in June 2019.

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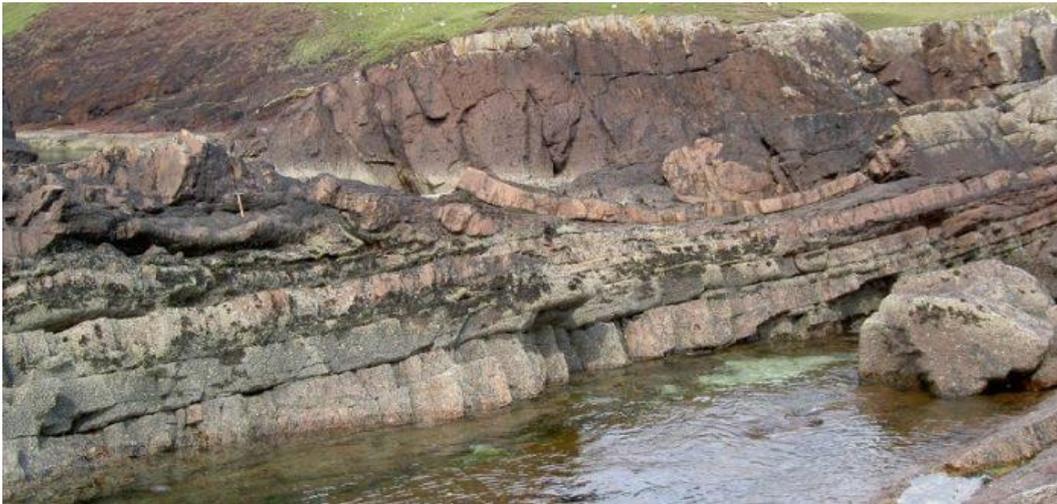
CURIOSITY DETECTS UNUSUALLY HIGH METHANE LEVELS



This image was taken by the left Navcam on NASA's Curiosity Mars rover on June 18, 2019, the 2,440th Martian day, or sol, of the mission. It shows part of "Teal Ridge," which the rover has been studying within a region called the "clay-bearing unit." Credits: NASA/JPL-Caltech

Curiosity's team conducted a follow-on methane experiment. The results show that the methane levels have sharply decreased, with less than 1 part per billion by volume detected. That's a value close to the background levels Curiosity sees all the time. The finding suggest the previous week's methane detection, the largest amount of the gas Curiosity has ever found, was one of the transient methane plumes that have been observed in the past. While scientists have observed the background levels rise and fall seasonally, they haven't found a pattern in the occurrence of these transient plumes. The methane mystery continues. Curiosity doesn't have instruments that can definitively say whether the source of the methane is biological or geological. A clearer understanding of these plumes, combined with coordinated measurements from other missions, could help scientists determine where they're located on Mars. (JPL) [Curiosity detects unusually high methane levels](#) (23 June 2019)

SCIENTISTS FIND LARGEST METEORITE IMPACT IN THE BRITISH ISLES



In the middle of the photo taken at Stoer is the impact deposit (12m thick at this location) that contains "rafts" of deformed pink sandstone. Credit: Ken Amor.

Researchers have located the epicentre of an ancient meteorite impact along the Scottish coast, the largest impact in the British Isles. Evidence for the ancient, 1.2 billion years old, meteorite strike, was first discovered in 2008 near Ullapool, NW Scotland by scientists from Oxford and Aberdeen Universities. The thickness and extent of the debris deposit they found suggested the impact crater, made by a meteorite estimated at 1km wide, was close to the coast, but its precise location remained a mystery. A team led by Dr Ken Amor from the Department of Earth Sciences at Oxford University show how they have identified the crater location 15-20km west of a remote part of the Scottish coastline. It is buried beneath both water and younger rocks in the Minch Basin. The material excavated during a giant meteorite impact is rarely preserved on Earth, because it is rapidly eroded, so this is a really exciting discovery. It was purely by chance this one landed in an ancient rift valley where fresh sediment quickly covered the debris to preserve it. The next step will be a detailed geophysical survey in our target area of the Minch Basin. Using a combination of field observations, the distribution of broken rock fragments known as basement clasts and the alignment of magnetic particles, the team was able to gauge the direction the meteorite material took at several locations and plotted the likely source of the crater. 1.2 billion years ago most of life on Earth was still in the oceans and there were no plants on the land. At that time Scotland would have been quite close to the equator and in a semi-arid environment. The landscape would have looked a bit like Mars when it had water at the surface. Earth and other planets may have suffered a higher rate of meteorite impacts in the distant past, as they collided with debris left over from the formation of the early solar system. However, there is a possibility that a similar event will happen in the future given the number of asteroid and comet fragments floating around in the solar system. Much smaller impacts, where the meteorite is only a few meters across are thought to be relatively common perhaps occurring about once every 25 years on average. It is thought that collisions with an object about 1 km across occur between once every 100,000 years to once every million years, but estimates vary. One of the reasons for this is that our terrestrial record of large impacts is poorly known because craters are obliterated by erosion, burial and plate tectonics. (Oxford University) [Scientists find largest meteorite impact in the British Isles](#) (20 June 2019)

SPACE STATION MOULD SURVIVES HIGH DOSES OF IONIZING RADIATION



Mold grows on the International Space Station on a panel where exercise clothes were hung to dry. Credit: NASA

The International Space Station has a nagging mould problem. Astronauts on the ISS spend hours every week cleaning the inside of the station's walls to prevent mould from becoming a health problem. New research finds mould spores may also survive on the outside walls of spacecraft. Spores of the two most common types of mould on the ISS, *Aspergillus* and *Pennicillium*, survive X-ray exposure at 200 times the dose that would kill a human.

Pennicillium and *Aspergillus* species are not usually harmful but inhaling their spores in large amounts can sicken people with weakened immune systems. Mould spores can withstand extreme temperatures, ultraviolet light, chemicals and dry conditions. This resiliency makes them hard to kill. We now know that fungal spores resist radiation much more than we thought they would, to the point where we need to take them into consideration when we are cleaning spacecraft, inside and outside. If we're planning a long duration mission, we can plan on having these mould spores with us because probably they will survive the space travel. But fungi aren't all bad. Scientists investigate fungal species' capacity to grow in the conditions of space with the aim of harnessing the microorganisms as biological factories for materials people might need on long space voyages. Fungi cells have complex inner structures, like ours, with the cellular equipment needed to build polymers, food, vitamins and other useful molecules astronauts may need on extended trips beyond Earth. Mould can be used to produce important things, compounds like antibiotics and vitamins. It's not only bad, a human pathogen and a food spoiler, it also can be used to produce antibiotics or other things needed on long missions. They simulated space radiation in the laboratory, hitting fungal spores with ionizing radiation from X-rays, heavy ions and a type of high-frequency ultraviolet light that doesn't reach Earth's surface but is present in space. Ionizing radiation kills cells by damaging their DNA and other essential cellular infrastructure. Earth's magnetic field protects spacecraft in low Earth orbit, like the ISS, from the heavy radiation out in interplanetary space. But spacecraft going to the Moon or Mars would be exposed. The spores survived exposure to X-rays up to 1000 gray, exposure to heavy ions at 500 gray and exposure to ultraviolet light up to 3000 joules per meter squared. Five gray is enough to kill a person. Half a gray is the threshold for radiation sickness. A 180-day voyage to Mars is expected to expose spacecraft and their passengers to a cumulative dose of about 0.7 gray. *Aspergillus* spores would be expected to easily survive this bombardment. The new research did not address their ability to withstand the combination of radiation, vacuum, cold, and low gravity in space. Experiments designed to test fungal growth in microgravity are set to launch in late 2019. (American Geophysical Union)

[Space station mould survives high doses of ionizing radiation](#) (27 June 2019)

NASA SELECTS MISSIONS TO STUDY OUR SUN, ITS EFFECTS ON SPACE WEATHER



A constant outflow of solar material streams out from the Sun, depicted here in an artist's rendering. On June 20, 2019, NASA selected two new missions – the Polarimeter to Unify the Corona and Heliosphere (PUNCH) mission and Tandem Reconnection and Cusp Electrodynamics Reconnaissance Satellites (TRACERS) – to study the origins of this solar wind and how it affects Earth. Together, the missions support NASA's mandate to protect astronauts and technology in space from such radiation. Credits: NASA

NASA has selected two new missions to advance our understanding of the Sun and its dynamic effects on space. One of the selected missions will study how the Sun drives particles and energy into the solar system and a second will study Earth's response. The Sun generates a vast outpouring of solar particles known as the solar wind, which can create a dynamic system of radiation in space called space weather. Near Earth, where such particles interact with our planet's magnetic field, the space weather system can lead to profound impacts on human interests, such as astronauts' safety, radio communications, GPS signals, and utility grids on the ground. The Polarimeter to Unify the Corona and Heliosphere, or **PUNCH**, mission will focus directly on the Sun's outer atmosphere, the corona, and how it generates the solar wind. Composed of four suitcase-sized satellites, PUNCH will image and track the solar wind as it leaves the Sun. The spacecraft also will track coronal mass ejections, large eruptions of solar material that can drive large space weather events near Earth, to better understand their evolution and develop new techniques for predicting such eruptions. The second mission is Tandem Reconnection and Cusp Electrodynamics Reconnaissance Satellites, or **TRACERS**. TRACERS will observe particles and fields at the Earth's northern magnetic cusp region, the region encircling Earth's pole, where our planet's magnetic field lines curve down toward Earth. Here, the field lines guide particles from the boundary between Earth's magnetic field and interplanetary space down into the atmosphere. In the cusp area, with its easy access to our boundary with interplanetary space, TRACERS will study how magnetic fields around Earth interact with those from the Sun. In a process known as magnetic reconnection, the field lines explosively reconfigure, sending particles out at speeds that can approach the speed of light. Some of these particles will be guided by the Earth's field into the region where TRACERS can observe them. Magnetic reconnection drives energetic events all over the universe, including coronal mass ejections and solar flares on the Sun. It also allows particles from the solar wind to push into near-Earth space, driving

space weather there. TRACERS will be the first space mission to explore this process in the cusp with two spacecraft, providing observations of how processes change over both space and time. The cusp vantage point also permits simultaneous observations of reconnection throughout near-Earth space. Thus, it can provide important context for NASA's Magnetospheric Multiscale mission, which gathers detailed, high-speed observations as it flies through single reconnection events at a time. TRACERS' unique measurements will help with NASA's mission to safeguard our technology and astronauts in space. TRACERS is funded for no more than \$115 million. Launch date for the two missions is no later than August 2022. (NASA)

[NASA selects missions to study our Sun, its effects on space weather](#) (20 June 2019)

SUBARU TELESCOPE IDENTIFIES THE OUTERMOST EDGE OF OUR MILKY WAY SYSTEM



Subaru Telescope Identifies the Outermost Edge of Our Milky Way System.

A team of researchers identified the outermost edge of the Milky Way Galaxy. Using the Subaru Telescope, the researchers examined the boundary of the stellar system that makes up our Galaxy. The ultimate size of our Galaxy is 520,000 light years in radius, 20 times larger than the distance between the Galactic Centre and our solar system (26,000 light years) Stars that reach these outermost regions of the Galaxy during their orbital motions are ancient stellar populations with ages as old as 12 billion years. The spatial extent in which these ancient stars wander is, therefore, important for our understanding of the Milky Way's formation. (Tohoku University)

[Subaru Telescope identifies the outermost edge of our Milky Way system](#) (21 June 2019)

LINKS TO OTHER SPACE NEWS PUBLISHED IN JUNE 2019

ASTERIODS

[VLT observes a passing double asteroid hurtling by Earth at 70000 km/h](#) (3 June 2019)

The unique capabilities of the SPHERE instrument on ESO's Very Large Telescope have

enabled it to obtain the sharpest images of a double asteroid as it flew by Earth on 25 May. While this double asteroid was not itself a threatening object, scientists used the opportunity to rehearse the response to a hazardous Near-Earth Object (NEO), proving that ESO's front-line technology could be critical in planetary defence. (ESO)

[Psyche mission has a metal world in its sights](#) (11 June 2019)

Designed to explore a metal asteroid that could be the heart of a planet, the Psyche mission is readying for a 2022 launch. The Psyche spacecraft will arrive at Asteroid Psyche on Jan. 31, 2026, after flying by Mars in 2023. Asteroid Psyche is one of the most intriguing targets in the main asteroid belt. While most asteroids are rocky or icy bodies, scientists think Psyche is composed mostly of iron and nickel, similar to Earth's core. They wonder whether Psyche could be the nickel-iron heart, or exposed core, of an early planet maybe as large as Mars that lost its rocky outer layers through violent collisions billions of years ago. If so, it would provide a unique look into the solar system's distant past, when the kind of high-speed protoplanet encounters that created Earth and the other terrestrial planets were common. The Psyche mission aims to understand the building blocks of planet formation by exploring first-hand a wholly new and uncharted type of world. Along with determining whether Psyche is the core of an early planet, the team wants to determine how old it is, whether it formed in similar ways to Earth's core and what its surface is like. (JPL)

[Uncovering the hidden history of Vesta](#) (13 June 2019)

In a remarkable feat of astronomical detective work, scientists have determined the precise timing of a large-scale collision on Vesta that helps explain the asteroid's lopsided shape. Their study pinpoints the collision to 4,525.4 million years ago. Vesta, the second largest body in the asteroid belt, is of immense interest to scientists investigating the origin and formation of planets. Unlike most asteroids, it has kept its original, differentiated structure, meaning it has a crust, mantle and metallic core, much like Earth. (Tokyo Tech)

[Tunguska revisited: 111-year-old mystery impact inspires new, more optimistic asteroid predictions](#) (26 June 2019)

The most promising candidate was a stony (not icy) body, between 164 and 262 feet in diameter, entering the atmosphere at around 34,000 miles per hour, depositing the energy of a 10 to 30 megaton explosion, equivalent to the blast energy of the 1980 Mount St. Helens eruption, at 6 to 9 miles altitude. When combined with the most recent asteroid population estimates, the researchers concluded the average interval between such impacts to be on the order of millennia, not centuries as had been thought previously, based on prior population and smaller size estimates. The new result reveals that the probability of an impact occurring on any day in our lifetime, or our kids' lifetimes, or our grandkid's lifetimes, etc., is smaller than we previously thought. Still, we still must remain aware of and prepare for the hazard. Asteroids have hit the Earth and more asteroids will hit again. The systems NASA is developing will ensure we can better prepare for and prevent dangerous impacts. (NASA Ames)

[NASA tracked small asteroid before it broke up in atmosphere](#) (27 June 2019)

When a lightning detector on a NOAA weather satellite detected something that wasn't lightning, a scientist at the Centre for Near Earth Object Studies at NASA's Jet Propulsion

Laboratory in Pasadena, California, did some detective work. Could a tiny, harmless object that broke up in the atmosphere in a bright flash be connected to a just-received automated alert of a potential near-Earth asteroid discovery? Although far below the size that NASA is tasked to detect and track, the event presented an ideal opportunity for NASA planetary defence teams to test their parts of the alert system. The outcome? The flow of alert data works, and the culprit was identified: It was an asteroid. Now designated 2019 MO, the asteroid was only about 16 feet (5 meters) in size and was detected at 9:45 UTC (2:45 a.m. PDT, 5:45 a.m. EDT) on Saturday, June 22, by the University of Hawaii's ATLAS survey telescope on Maunaloa in Hawaii. (NASA)

BLACK HOLES

[Magnetic field may be keeping Milky Way's black hole quiet](#) (11 June 2019)

Supermassive black holes exist at the centre of most galaxies, and our Milky Way is no exception. But many other galaxies have highly active black holes, meaning a lot of material is falling into them, emitting high-energy radiation in this “feeding” process. The Milky Way’s central black hole, on the other hand, is relatively quiet. New observations from NASA’s Stratospheric Observatory for Infrared Astronomy, SOFIA, are helping scientists understand the differences between active and quiet black holes. These results give unprecedented information about the strong magnetic field at the centre of the Milky Way galaxy. Scientists used SOFIA’s newest instrument, the High-resolution Airborne Wideband Camera-Plus, HAWC+, to make these measurements. Streamlines showing magnetic fields layered over a colour image of the dusty ring around the Milky Way’s massive black hole. The streamlines reveal that the magnetic field closely follows the shape of the dusty structure. Magnetic fields are invisible forces that influence the paths of charged particles and have significant effects on the motions and evolution of matter throughout the universe. But magnetic fields cannot be imaged directly, so their role is not well understood. The HAWC+ instrument detects polarized far-infrared light, which is invisible to human eyes, emitted by celestial dust grains. These grains align perpendicular to magnetic fields. From the SOFIA results, astronomers can map the shape and infer the strength of the otherwise invisible magnetic field, helping to visualize this fundamental force of nature. This is one of the first instances where we can really see how magnetic fields and interstellar matter interact with each other. HAWC+ is a game-changer. (NASA)

DARK ENERGY

[eROSITA – the hunt for Dark Energy begins](#) (18 June 2019)

On 21 June 2019 the Spektrum-Röntgen-Gamma spacecraft will be launched from the Kazakh steppe, marking the start of an exciting journey. SRG will be carrying the German ‘extended ROentgen Survey with an Imaging Telescope Array’ (eROSITA) X-ray telescope and its Russian ART-XC partner instrument. A Proton rocket will carry the spacecraft from the Baikonur Cosmodrome towards its destination, the second Lagrange point of the Sun-Earth system, L2, which is 1.5 million kilometres from Earth. In orbit around this equilibrium point, eROSITA will embark upon the largest ever survey of the hot Universe. The space telescope will use its seven X-ray detectors to observe the entire sky and search for and map hot sources such as galaxy clusters, active black holes, supernova remnants, X-ray binaries

and neutron stars. “eROSITA’s X-ray ‘eyes’ are the best that have ever been launched as part of a space telescope. Their unique combination of light-collecting area, field-of-view and resolution makes them approximately 20 times more sensitive than the ROSAT telescope that flew to space in the 1990s. ROSAT also incorporated advanced technology that was ‘made in Germany’. With its enhanced capabilities, eROSITA will help researchers gain a better understanding of the structure and development of the Universe, and also contribute towards investigations into the mystery of Dark Energy. (DLR)

DARK MATTER

[Heart of lonesome galaxy is brimming with dark matter](#) (3 June 2019)

Isolated for billions of years, a galaxy with more dark matter packed into its core than expected has been identified by astronomers using data from NASA’s Chandra X-ray Observatory. The galaxy, known as Markarian 1216 (abbreviated as Mrk 1216), contains stars that are within 10% the age of the universe, that is, almost as old as the universe itself. Scientists have found that it has gone through a different evolution than typical galaxies, both in terms of its stars and the invisible dark matter that, through gravity, holds the galaxy together. Dark matter accounts for about 85% of the matter in the universe, although it has only been detected indirectly. Mrk 1216 belongs to a family of elliptically shaped galaxies that are more densely packed with stars in their centres than most other galaxies. Astronomers think they have descended from reddish, compact galaxies called “red nuggets” that formed about a billion years after the big bang, but then stalled in their growth about 10 billion years ago. If this explanation is correct, then the dark matter in Mark 1216 and its galactic cousins should also be tightly packed. To test this idea for the first time, a pair of astronomers studied the X-ray brightness and temperature of hot gas at different distances from Mrk 1216’s centre, so they could “weigh” how much dark matter exists in the middle of the galaxy. When we compared the Chandra data to our computer models, we found a much stronger concentration of dark matter was required than we find in other galaxies of similar total mass. This tells us the history of Mrk 1216 is very different from the typical galaxy. Essentially all its stars and dark matter was assembled long ago with little added in the past 10 billion years. (NASA)

DWARF PLANETS

[A new and unusual type of volcanic activity](#) (11 June 2019)

When scientists first saw this structure on the images taken by their camera on the Dawn space probe, they could hardly believe their eyes: from the crater-strewn surface of the dwarf planet Ceres rises an even, smooth and steep-sided mountain, towering over 4,000 metres high. It is the highest mountain on the thousand kilometre-diameter, almost spherical dwarf planet, and one of the most remarkable structures in the entire Solar System. A study involving scientists from the German Aerospace Centre (DLR) has now solved the mystery of how Ahuna Mons, as the mountain is called, was formed, using gravity measurements and investigations of the geometrical form of Ceres. A bubble made of a mixture of salt-water, mud and rock rose from within the dwarf planet. The bubble pushed the ice-rich crust upwards, and at a structural weak point the muddy substance, comprising salts and hydrogenated silicates, was pushed to the surface, solidified in the cold of space, in the

absence of any atmosphere, and piled up to form a mountain. Ahuna Mons is an enormous mud volcano. (DLR)

EARTH

[NASA prepares to launch twin satellites to study signal disruption from space](#) (10 June 2019)

NASA's twin E-TBEx CubeSats, short for Enhanced Tandem Beacon Experiment, are scheduled to launch in June 2019 aboard the Department of Defence's Space Test Program-2 launch. The launch includes a total of 24 satellites from government and research institutions. They will launch aboard a SpaceX Falcon Heavy from historic Launch Complex 39A at NASA's Kennedy Space Centre in Florida. The E-TBEx CubeSats focus on how radio signals that pass through Earth's upper atmosphere can be distorted by structured bubbles in this region, called the ionosphere. Especially problematic over the equator, these distortions can interfere with military and airline communications as well as GPS signals. The more we can learn about how these bubbles evolve, the more we can mitigate those problems but right now, scientists can't predict when these bubbles will form or how they'll change over time. What scientists learn from E-TBEx could help develop strategies to avoid signal distortion for instance, allowing airlines to choose a frequency less susceptible to disruption, or letting the military delay a key operation until a potentially disruptive ionospheric bubble has passed. (NASA Goddard)

[NASA's SET mission to study satellite protection is ready for launch](#) (10 June 2019)

Ready, SET, go. NASA's Space Environment Testbeds, or SET, will launch in June 2019 on its mission to study how to better protect satellites in space. SET will get a ride to space on a U.S. Air Force Research Lab spacecraft aboard a SpaceX Falcon Heavy rocket from NASA's Kennedy Space Centre in Florida. SET studies the very nature of space itself, which isn't completely empty, but brimming with radiation and how it affects spacecraft and electronics in orbit. Energetic particles from the Sun or deep space can spark memory damage or computer upsets on spacecraft, and over time, degrade hardware. SET seeks to better understand these effects in order to improve spacecraft design, engineering, and operations, and avoid future anomalies. Spacecraft protection is a key part of NASA's mission as the agency's Artemis program seeks to explore the Moon and beyond. Since space radiation is one of the primary hazards space missions encounter, researching ways to improve their abilities to survive in these harsh environments will increase the survivability of near-Earth missions as well as missions to the Moon and Mars. SET aims its sights on a part of near-Earth space called the slot region: the gap between two of Earth's vast radiation belts, also known as the Van Allen belts. The doughnut-shaped Van Allen belts seethe with radiation trapped by Earth's magnetic field. Where SET orbits is thought to be calmer, but known to vary during extreme space weather storms driven by the Sun. How much it changes exactly, and how quickly, remains uncertain. (NASA Goddard)

[CETel acquires Cobbett Hill Earth Station](#) (11 June 2019)

CETel, a leading global satellite communications and network service provider, announces the acquisition of UK-based Cobbett Hill Earth Station Limited ("Cobbett Hill") in terms of an asset purchase transaction for an undisclosed amount. Cobbett Hill is located only 25 miles from central London in the UK and occupies a seven-acre secure compound on 200

acres of land. Currently, it houses more than 25 antennas with active operations on 13 satellites plus spare capacity enabling quick turnaround times on even short-notice customer requirements. Due to the locations historical use by the British Ministry of Defence it has blanket planning permission for unlimited antenna installations within the 200 acres and operate within an RF exclusion zone preventing any local interference. (CETel)

[Cornell instruments gather radio 'disruption' data in ionosphere](#) (24 June 2019)

Two NASA sounding rockets soared into the late-night heavens above the small, lightly populated Kwajalein Atoll in the Marshall Islands. They deployed two tracers, one that forms artificial clouds, perfect for studying communication disruptions in the upper atmosphere. The rockets were sent to the edges of the atmosphere to gather information for the “Waves and Instabilities from a Neutral Dynamo” mission, better known as Too-WINDY. The data won't be intelligible until it has undergone considerable processing, which will take weeks or months. The scientists collected information on electron densities, as well as electric-field, magnetic-field and neutral-wind profiles in the upper atmosphere and ionosphere, the layer bombarded by solar and cosmic radiation, at altitudes between 80 and 350 kilometres. Some of the ionosphere's layers close to Earth's equator, considered a “low magnetic latitude” degrade radio and radar signals more than the rest of the ionosphere. Predicting these upper atmospheric and ionospheric disturbances ahead of time could help improve the reliability of space and ground-based communication systems. The goal of all this is to measure, understand and ultimately predict a kind of space weather that is common at low magnetic latitudes. (Cornell University)

EXOPLANETS

[A pair of fledgling planets directly seen growing around a young star](#) (3 June 2019)

Astronomers have directly imaged two exoplanets that are gravitationally carving out a wide gap within a planet-forming disk surrounding a young star. While over a dozen exoplanets have been directly imaged, this is only the second multi-planet system to be photographed. This is the first unambiguous detection of a two-planet system carving a disk gap. The host star, known as PDS 70, is located about 370 light-years from Earth. The young 6-million-year-old star is slightly smaller and less massive than our Sun and is still accreting gas. It is surrounded by a disk of gas and dust that has a large gap extending from about 1.9 to 3.8 billion miles. PDS 70 b, the innermost known planet, is located within the disk gap at a distance of about 2 billion miles from its star, similar to the orbit of Uranus in our solar system. The team estimates that it weighs anywhere from 4 to 17 times as much as Jupiter. It was first detected in 2018. PDS 70 c, the newly discovered planet, is located near the outer edge of the disk gap at about 3.3 billion miles from the star, similar to Neptune's distance from our Sun. It is less massive than planet b, weighing between 1 and 10 times as much as Jupiter. The two planetary orbits are near a 2-to-1 resonance, meaning that the inner planet circles the star twice in the time it takes the outer planet to go around once. The discovery of these two worlds is significant because it provides direct evidence that forming planets can sweep enough material out of a protoplanetary disk to create an observable gap. (STScI)

[Jupiter-like exoplanets found in sweet spot in most planetary systems](#) (12 June 2019)

As planets form in the swirling gas and dust around young stars, there seems to be a sweet

spot where most of the large, Jupiter-like gas giants congregate, centred around the orbit where Jupiter sits today in our own solar system. The location of this sweet spot is between 3 and 10 times the distance Earth sits from our sun (3-10 astronomical units, or AU). Jupiter is 5.2 AU from our sun. That's just one of the conclusions of an unprecedented analysis of 300 stars captured by the Gemini Planet Imager, or GPI, a sensitive infrared detector mounted on the 8-meter Gemini South telescope in Chile. The GPI Exoplanet Survey, or GPIES, is one of two large projects that search for exoplanets directly, by blocking stars' light and photographing the planets themselves, instead of looking for tell-tale wobbles in the star, the radial velocity method, or for planets crossing in front of the star, the transit technique. The GPI camera is sensitive to the heat given off by recently-formed planets and brown dwarfs, which are more massive than gas giant planets, but still too small to ignite fusion and become stars. (UC Berkeley)

[ALMA pinpoints the formation site of planet around nearest young star](#) (26 June 2019)

Researchers using ALMA (Atacama Large Millimeter/submillimeter Array) found a small dust concentration in the disk around TW Hydrae, the nearest young star. It is highly possible that a planet is growing or about to be formed in this concentration. This is the first time that the exact place where cold materials are forming the seed of a planet has been pinpointed in the disk around a young star. (NAOJ)

[TESS mission finds its smallest planet yet](#) (27 June 2019)

NASA's Transiting Exoplanet Survey Satellite (TESS) has discovered a world between the sizes of Mars and Earth orbiting a bright, cool, nearby star. The planet, called L 98-59b, marks the tiniest discovered by TESS to date. Two other worlds orbit the same star. While all three planets' sizes are known, further study with other telescopes will be needed to determine if they have atmospheres and, if so, which gases are present. The L 98-59 worlds nearly double the number of small exoplanets that is, planets beyond our solar system that have the best potential for this kind of follow-up. (NASA Goddard)

FUTURE PLANNED MISSIONS AND TERMINATING ONES

[How NASA's Spitzer has stayed alive for so long](#) (13 June 2019)

After nearly 16 years of exploring the cosmos in infrared light, NASA's Spitzer Space Telescope will be switched off permanently on Jan. 30, 2020. By then, the spacecraft will have operated for more than 11 years beyond its prime mission, thanks to the Spitzer engineering team's ability to address unique challenges as the telescope slips farther and farther from Earth. Spitzer is a small but transformational observatory. It captures infrared light, which is often emitted by "warm" objects that aren't quite hot enough to radiate visible light. Spitzer has lifted the veil on hidden objects in nearly every corner of the universe, from a new ring around Saturn to observations of some of the most distant galaxies known. It has spied stars in every stage of life, mapped our home galaxy, captured gorgeous images of nebulae and probed newly discovered planets orbiting distant stars. Spitzer orbits the Sun on a path similar to Earth's but moves slightly slower. Today it trails about 158 million miles (254 million kilometres) behind our planet, more than 600 times the distance between Earth and the Moon. That distance, along with the curve of Spitzer's orbit, means that when the spacecraft points its fixed antenna at Earth to download data or receive commands, its solar

panels tilt away from the Sun. During those periods, the spacecraft must rely on a combination of solar power and battery power to operate. The angle at which the panels point away from the Sun has increased every year that the mission has been operating. These days, to communicate with Earth, Spitzer has to position its panels at a 53-degree angle away from the Sun (90 degrees would be fully facing away), even though the mission planners never intended for it to tilt more than 30 degrees from the Sun. Spitzer can communicate with Earth for about 2.5 hours before it has to turn its solar panels back toward the Sun to recharge its batteries. That communications window would grow shorter year after year if Spitzer continued operating, which means there is a limit to how long it would be possible to operate the spacecraft efficiently. (JPL)

GALAXIES

[X-rays reveal how cosmic giants meet](#) (24 June 2019)

Scientists have uncovered an extremely powerful shock wave in a distant part of the Universe where two massive galaxy clusters appear to come into first contact ahead of merging. The study is based on data from several astronomical facilities, including ESA's XMM-Newton X-ray space observatory. The observations capture the unique moment when the two clusters touch each other for the very first time, something that has never been observed before. Collisions between galaxy clusters are the most energetic events in the Universe since the Big Bang. The shocks that arise during the merger are probably the most important particle accelerator in the Universe, releasing a huge amount of heat, radiation and high-energy cosmic rays. (ESA)

INTERNATIONAL SPACE STATION

[DoubleTree chocolate chip cookie to be first food baked in space](#) (24 June 2019)

DoubleTree by Hilton will take its iconic warm welcome to new heights when its famous chocolate chip Cookie becomes the first food baked in space inside a prototype oven designed to make long-duration space travel more hospitable. Later this year, DoubleTree by Hilton will make aerospace history when a batch of DoubleTree Cookie dough is launched along with the prototype oven in a rocket bound for the International Space Station (ISS) as part of a landmark microgravity experiment. Working in partnership with Zero G Kitchen, which creates appliances for microgravity use in long-duration space flights, and NanoRacks, a leading provider of commercial access to space, Hilton will be the first hospitality company to participate in research aboard the space station. That's only fitting for a hotel brand that at the height of the Space Race announced plans for a hotel on the moon. (DoubleTree by Hilton)

[Astronauts return from Space Station mission](#) (25 June 2019)

NASA astronaut Anne McClain and two of her Expedition 59 crewmates returned to Earth from the International Space Station. McClain, Expedition 59/Soyuz Commander Oleg Kononenko of the Russian space agency Roscosmos and David Saint-Jacques of the Canadian Space Agency launched Dec. 3, 2018. They arrived at the space station just six hours later to begin their 204-day mission, during which they orbited Earth 3,264 times

traveling 86,430,555 miles. The Expedition 59 crew contributed to hundreds of experiments in biology, biotechnology, physical science and Earth science, including investigations into small devices that replicate the structure and function of human organs, editing DNA in space for the first time and recycling 3D-printed material. McClain conducted two spacewalks totalling 13 hours and 8 minutes on her mission into space. Saint-Jacques, also on his first space mission and only the sixth Canadian astronaut to perform a spacewalk, joined McClain on her second outing, which totalled 6 hours and 29 minutes. Kononenko, on his fourth mission, conducted two spacewalks totalling 13 hours and 46 minutes, bringing his career total to 32 hours and 13 minutes spread over five spacewalks. (NASA)

INTERSTELLAR SPACE

[Hubble finds tiny “electric soccer balls” in space, helps solve interstellar mystery](#)

(25 June 2019)

Since stars and planets form from collapsing clouds of gas and dust in space, the diffuse ISM can be considered as the starting point for the chemical processes that ultimately give rise to planets and life. So fully identifying its contents provides information on the ingredients available to create stars and planets. The molecules are a form of carbon called “Buckminsterfullerene,” also known as “Buckyballs,” which consists of 60 carbon atoms (C₆₀) arranged in a hollow sphere. C₆₀ has been found in some rare cases on Earth in rocks and minerals and can also turn up in high-temperature combustion soot. C₆₀ has been seen in space before. However, this is the first time an electrically charged (ionized) version has been confirmed to be present in the diffuse ISM. The C₆₀ gets ionized when ultraviolet light from stars tears off an electron from the molecule, giving the C₆₀ a positive charge (C₆₀⁺). The diffuse ISM was historically considered too harsh and tenuous an environment for appreciable abundances of large molecules to occur. Prior to the detection of C₆₀, the largest known molecules in space were only 12 atoms in size. The confirmation of C₆₀⁺ shows just how complex astrochemistry can get, even in the lowest density, most strongly ultraviolet-irradiated environments in the Galaxy. Life as we know it is based on carbon-bearing molecules, and this discovery shows complex carbon molecules can form and survive in the harsh environment of interstellar space. The presence of C₆₀ unequivocally demonstrates a high level of chemical complexity intrinsic to space environments, and points toward a strong likelihood for other extremely complex, carbon-bearing molecules arising spontaneously in space. Most of the ISM is hydrogen and helium, but it’s spiked with many compounds that haven’t been identified. Since interstellar space is so remote, scientists study how it affects the light from distant stars to identify its contents. As starlight passes through space, elements and compounds in the ISM absorb and block certain colours (wavelengths) of the light. When scientists analyse starlight by separating it into its component colours (spectrum), the colours that have been absorbed appear dim or are absent. Each element or compound has a unique absorption pattern that acts as a fingerprint allowing it to be identified. However, some absorption patterns from the ISM cover a broader range of colours, which appear different from any known atom or molecule on Earth. These absorption patterns are called Diffuse Interstellar Bands (DIBs). Their identity has remained a mystery ever since they were discovered by Mary Lea Heger, who published observations of the first two DIBs in 1922. (NASA Goddard)

JUPITER AND MOONS

[Sodium chloride spotted on Europa](#) (12 June 2019)

A familiar ingredient has been hiding in plain sight on the surface of Jupiter's moon Europa. Using a visible-light spectral analysis, planetary scientists have discovered that the yellow colour visible on portions of the surface of Europa is actually sodium chloride, a compound known on Earth as table salt, which is also the principal component of sea salt. The discovery suggests that the salty subsurface ocean of Europa may chemically resemble Earth's oceans more than previously thought, challenging decades of supposition about the composition of those waters. (JPL)

[Arianespace and ESA announce the JUICE \(JUperiter ICy moons Explorer\) launch contract](#) (17 June 2019)

The Jupiter Icy Moons Explorer, Juice, will ride into space on an Ariane launch vehicle, Arianespace and ESA confirmed. Juice is the first large-class mission in ESA's Cosmic Vision 2015–2025 programme. Its mission is devoted to completing a unique tour of the Jupiter system. Juice will spend at least three years making detailed observations of the giant gaseous planet Jupiter and in-depth studies of three of its largest moons and potentially ocean-bearing satellites, Ganymede, Europa and Callisto. The launch period for Juice will start in mid-2022 aboard an Ariane 5 or an Ariane 64 launch vehicle. (Arianespace)

LAUNCH SERVICES AND VEHICLES

[NASA reaches new milestone on complex, large rocket](#) (3 June 2019)

NASA achieved a significant milestone in manufacturing the first large, complex core stage that will help power the Space Launch System (SLS) rocket on upcoming missions to the Moon. NASA and lead contractor Boeing have assembled four-fifths of the massive core stage needed to launch SLS and the Orion spacecraft on their first mission to the Moon: Artemis 1. The Artemis program will send the first woman and the next man to the Moon by 2024 and develop a sustainable human presence on the Moon by 2028. The program takes its name from the twin sister of Apollo and goddess of the Moon in Greek mythology. (NASA)

[European reusable launch systems for more sustainability in spaceflight](#) (18 June 2019)

The German Aerospace Centre and five European companies have teamed up in the RETro Propulsion Assisted Landing Technologies (RETALT) project to jointly advance the research and development of key technologies for European vertical-landing launch vehicles. The consortium will spend three years examining the aerodynamics, aerothermodynamics, that is, in-flight surface temperatures, flight dynamics during both the outward and return flight phases, and navigation and control, as well as structural components, materials and mechanisms. Reusable space transport systems equipped with retropropulsion are already being used in the United States. The images and videos from SpaceX were a global sensation. It might therefore be surprising to learn that the physical phenomena underlying the technologies are not yet fully understood. Lacking are high-quality, experimental data from wind tunnel tests and ground-based demonstrations. By combining these data with numerical simulations, they will acquire a better understanding of the physics and take a leap towards reusable rockets in Europe. Only close and intense cooperation between the research community and the industrial sector can yield the expertise required for the fastest possible implementation of the necessary technologies. (DLR)

[NASA technology missions launch on SpaceX Falcon Heavy](#) (25 June 2019)

NASA technology demonstrations, which one day could help the agency get astronauts to Mars, and science missions, which will look at the space environment around Earth and how it affects us, have launched into space on a Falcon Heavy rocket. The missions, each with a unique set of objectives, will aid in smarter spacecraft design and benefit the agency's Moon to Mars exploration plans by providing greater insight into the effects of radiation in space and testing an atomic clock that could change how spacecraft navigate. With launch and deployments complete, the missions will start to power on, communicate with Earth and collect data. They each will operate for about a year, providing enough time to mature the technologies and collect valuable science data. Below is more information about each mission, including notional timelines for key milestones.

- Enhanced Tandem Beacon Experiment
- Deep Space Atomic Clock
- Green Propellant Infusion Mission
- Space Environment Testbeds (NASA)

MANNED SPACE

[Space Rider: Europe's reusable space transport system](#) (5 June 2019)

Launched on Vega-C, Space Rider will serve as an uncrewed high-tech space laboratory operating for periods longer than two months in low orbit. It will then re-enter the Earth's atmosphere and land, returning its valuable payload to eager engineers and scientists at the landing site. After minimal refurbishment it will be ready for its next mission with new payloads and a new mission. Space Rider combines reusability, in-orbit operations and transportation, and precise descent of a re-entry vehicle able to safely traverse and land close to inhabited zones. These are major developments, set to extend European knowhow across a host of applications allowing industry to open up new markets. Up to 800 kg of payloads can fit inside the environmentally controlled cargo bay that offers 1200 litres of payload volume and provides services including 600 watts of power along with thermal, control, data-handling and telemetry capability. Offering an array of orbit altitudes and inclinations, Space Rider will enable a large variety of experiments in microgravity, open opportunities for educational missions, and help prove technologies for Earth observation, science, telecommunication and robotic exploration. (ESA)

MARS

[InSight's team tries new strategy to help the 'Mole'](#) (5 June 2019)

Scientists and engineers have a new plan for getting NASA InSight's heat probe, also known as the "mole," digging again on Mars. Part of an instrument called the Heat Flow and Physical Properties Package (HP3), the mole is a self-hammering spike designed to dig as much as 16 feet (5 meters) below the surface and record temperature. But the mole hasn't been able to dig deeper than about 12 inches (30 centimetres) below the Martian surface since Feb. 28, 2019. The device's support structure blocks the lander's cameras from viewing the mole, so the team plans to use InSight's robotic arm to lift the structure out of the way. Depending on what they see, the team might use InSight's robotic arm to help the mole further later this summer. (JPL)

[NASA Awards Contract for Second Mobile Launcher at Kennedy Space Centre](#)

(25 June 2019)

NASA has selected Bechtel National, Inc. to design and build a second mobile launcher, known as Mobile Launcher 2 or ML2, for Exploration Ground Systems at the agency's Kennedy Space Centre in Florida. The cost-plus-award-fee end item contract has a total value of approximately \$383 million. Bechtel National will complete the design, build, test, and commissioning of the mobile launcher within a 44-month period beginning July 1. ML2 is the ground structure that will be used to assemble, process, and launch NASA's Space Launch System (SLS) Block 1B rocket and Orion spacecraft from Launch Pad 39B at Kennedy for missions under NASA's Moon to Mars exploration approach. It will consist of a base structure, the platform for SLS, and a tower equipped with a number of connection lines called umbilicals, as well as launch accessories that will provide SLS and Orion with power, communications, coolant, fuel, and stabilization prior to launch. (NASA)

[Aurorae Chaos – terrain collapse due to water run-off?](#) (27 June 2019)

Such chaotic areas bear witness to the complex transport, storage and release of large amounts of water ice and liquid water on Mars in the past. The theory most widely held by scientists is that chaotic terrain is formed when underground ice reservoirs melt due to heating, suddenly releasing large quantities of water. The heat may have come from nearby volcanoes or been released as the result of major asteroid impacts. Once the water has drained away, the surface collapses into the newly-formed cavities. Scientists have used crater size and frequency measurements to estimate the age of the bottom of the huge Aurorae Chaos depression at 3.5 billion years. The collapse process occurred a very long time ago. Groundwater and magma may also have escaped during the collapse, in addition to meltwater. There are numerous mineralogical indications of the early presence of water, which would have flowed in and around Mars' chaotic terrains. Sulphate-containing layers of sediment that have been identified in some of the basins with chaotic structures indicate the formation and accumulation of this mineral due to the evaporation of relatively acidic water. Clay mineral deposits on the plateau areas of Margaritifer Terra, which predate the sulphate-containing deposits, may be related to fissures and groundwater run-off. The formation of clay minerals would have required the presence of standing, pH-neutral water. (DLR)

MOON

[Mass anomaly detected under the Moon's largest crater](#) (10 June 2019)

A mysterious large mass of material has been discovered beneath the largest crater in our solar system, the Moon's South Pole-Aitken basin, and may contain metal from an asteroid that crashed into the Moon and formed the crater, according to a Baylor University study. Imagine taking a pile of metal five times larger than the Big Island of Hawaii and burying it underground. That's roughly how much unexpected mass was detected. The crater itself is oval-shaped, as wide as 2,000 kilometres roughly the distance between Waco, Texas, and Washington, D.C. and several miles deep. Despite its size, it cannot be seen from Earth because it is on the far side of the Moon. (Baylor University)

[Astrobotic awarded NASA study contract for polar mission to the Moon](#) (18 June 2019)

Astrobotic was selected today by NASA's Commercial Lunar Payload Services (CLPS)

program to deliver 14 payloads to the Moon on its Peregrine lunar lander in July 2021. With this \$79.5 million CLPS award, Astrobotic has now secured 28 payloads (from 8 nations) for lunar delivery as part of its first mission. Fifty years after Apollo 11, Pittsburgh's Astrobotic is returning America back to the Moon in partnership with NASA. (Astrobotic)

[NASA eyes GPS at the Moon for Artemis missions](#) (28 June 2019)

GPS, a satellite-based navigation system used by an estimated four billion people worldwide to figure out where they are on Earth at any moment, could be used to pilot in and around lunar orbit during future Artemis missions. A team at NASA is developing a special receiver that would be able to pick up location signals provided by the 24 to 32 operational Global Positioning System satellites, better known as GPS. GPS is operated by the U.S. military about 12,550 miles above Earth's surface and is open to anyone with a GPS receiver. These same GPS signals provide location data used in vehicle navigation systems, interactive maps, and tracking devices of all types, among many other applications. Such a capability could soon also provide navigational solutions to astronauts and ground controllers operating the Orion spacecraft, the Gateway in orbit around the Moon, and lunar surface missions. GPS is a system made up of three parts: satellites, ground stations, and receivers. The ground stations monitor the satellites, and a receiver, like those found in a phone or car, is constantly listening for a signal from those satellites. The receiver calculates its distance from four or more satellites to pinpoint a location. Instead of navigating streets on Earth, a spacecraft equipped with an advanced GPS receiver may soon be paired with precise mapping data to help astronauts track their locations in the vast ocean of space between the shores of Earth and the Moon, or across the craterous lunar surface. (NASA Goddard)

SATELLITES

[Dosvedanya and farewell, RadioAstron](#) (11 June 2019)

On May 30, 2019, the Russian RadioAstron satellite, the farthest element of an Earth-to-space radio-telescope system, ended its service. During its mission, RadioAstron helped to capture some of astronomy's highest-resolution images and studied the extreme physics of astronomical objects by working with telescopes around the world, including the National Science Foundation's Green Bank Telescope in Green Bank, W.Va. Launched in July 2011, RadioAstron used the 43 Meter (140 Foot) Telescope at the Green Bank Observatory as one of only two sites to download data for the Russian-made satellite. RadioAstron excited the international scientific community for the unique science it enabled. Its high resolution was achieved through a technique known as "Very Long Baseline Interferometry," which linked various radio antennas on Earth with the orbiting RadioAstron satellite to create a single, virtual telescope that extended into space. RadioAstron's achievements included observing a black hole's jet in the centre of the giant galaxy NGC 1275 (also known as radio source Perseus A, or 3C 84) revealing the jet structure 10 times closer to the black hole than previously known; the discovery of galactic water masers as small as the Sun, the smallest maser sources ever observed; and the detection of low frequency interference fringes on long baselines, giving a new understanding of the ionized interstellar medium. (NRAO)

[Melting a satellite, a piece at a time](#) (17 June 2019)

Researchers took one of the densest parts of an Earth-orbiting satellite, placed it in a plasma wind tunnel then proceeded to melt it into vapour. Their goal was to better understand how

satellites burn up during re-entry, to minimise the risk of endangering anyone on the ground. The rod-shaped magnetotorquer was heated to several thousands of degrees Celsius within the hypersonic plasma. They observed the behaviour of the equipment at different heat flux set-ups for the plasma wind tunnel in order to derive more information about materials properties and demisability. The magnetotorquer reached a complete demise at high heat flux level. (ESA)

SATURN AND MOONS

[Cassini reveals new sculpting in Saturn rings](#) (13 June 2019)

NASA's Cassini spacecraft has provided intricate detail on the workings of Saturn's complex rings, new analysis shows. Although the mission ended in 2017, science continues to flow from the data collected. A new paper describes results from four Cassini instruments taking their closest-ever observations of the main rings. Findings include fine details of features sculpted by masses embedded within the rings. Textures and patterns, from clumpy to straw-like, pop out of the images, raising questions about the interactions that shaped them. New maps reveal how colours, chemistry and temperature change across the rings. (NASA)

[Abundance of gases in Enceladus's ocean are a potential fuel — if life is there to consume it](#) (19 June 2019)

The subsurface ocean of Saturn's moon Enceladus probably has higher than previously known concentrations of carbon dioxide and hydrogen and a more Earthlike pH level, possibly providing conditions favourable to life. The presence of such high concentrations could provide fuel, a sort of chemical "free lunch", for living microbes. Or, it could mean "that there is hardly anyone around to eat it." The new information about the composition of Enceladus' ocean gives planetary scientists a better understanding of the ocean world's capacity to host life. Enceladus is a small moon, an ocean world about 310 miles (500 kilometres) across. Its salty subsurface ocean is of interest because of the similarity in pH, salinity and temperature to Earth's oceans. Plumes of water vapor and ice particles, spotted and studied by the Cassini spacecraft, erupting hundreds of miles into space from the ocean through cracks in Enceladus's ice-encased surface provide a tantalizing glimpse into what the moon's subsurface ocean might contain. (University of Washington)

[NASA selects flying mission to study Titan for origins, signs of life](#) (27 June 2019)

NASA has announced that our next destination in the solar system is the unique, richly organic world Titan. Advancing our search for the building blocks of life, the Dragonfly mission will fly multiple sorties to sample and examine sites around Saturn's icy moon. Dragonfly will launch in 2026 and arrive in 2034. The rotorcraft will fly to dozens of promising locations on Titan looking for prebiotic chemical processes common on both Titan and Earth. Dragonfly marks the first time NASA will fly a multi-rotor vehicle for science on another planet; it has eight rotors and flies like a large drone. It will take advantage of Titan's dense atmosphere, four times denser than Earth's, to become the first vehicle ever to fly its entire science payload to new places for repeatable and targeted access to surface material. Titan is an analogue to the very early Earth and can provide clues to how life may have arisen on our planet. During its 2.7-year baseline mission, Dragonfly will explore diverse environments from organic dunes to the floor of an impact crater where liquid water and complex organic materials key to life once existed together for possibly tens of thousands of

years. Its instruments will study how far prebiotic chemistry may have progressed. They also will investigate the moon's atmospheric and surface properties and its subsurface ocean and liquid reservoirs. Additionally, instruments will search for chemical evidence of past or extant life. (JPL)

TECHNOLOGY

[How an atomic clock will get humans to Mars on time](#) (14 June 2019)

NASA navigators are helping build a future where spacecraft could safely and autonomously fly themselves to destinations like the Moon and Mars. Navigators today tell a spacecraft where to go by calculating its position from Earth and sending the location data to space in a two-way relay system that can take anywhere from minutes to hours to deliver directions. This method of navigation means that no matter how far a mission travels through the solar system, our spacecraft are still tethered to the ground, waiting for commands from our planet. That limitation poses obvious problems for a future crewed mission to another planet. How can astronauts navigate far from Earth if they don't have immediate control over where they're going? And how can they accurately land on another planet when there's a communication delay that affects how quickly they can adjust their trajectory into the atmosphere? NASA's Deep Space Atomic Clock is a toaster-size device that aims to answer those questions. It's the first GPS-like instrument small and stable enough to fly on a spacecraft. The technology demonstration enables the spacecraft to know where it is without needing to rely on that data from Earth. In late June, the clock will launch on the SpaceX Falcon Heavy rocket into Earth's orbit for one year, where it will test whether it can help spacecraft locate themselves in space. If the Deep Space Atomic Clock's trial year in space goes well, it could pave the way for a future of one-way navigation in which astronauts are guided by a GPS-like system across the surface of the Moon or can safely fly their own missions to Mars and beyond. (JPL)

TELESCOPES

[Main instrument for NASA's WFIRST mission completes milestone review](#) (26 June 2019)

In order to know how the universe will end, we must know what has happened to it so far. This is just one mystery NASA's forthcoming Wide Field Infrared Survey Telescope (WFIRST) mission will tackle as it explores the distant cosmos. The spacecraft's giant camera, the Wide Field Instrument (WFI), will be fundamental to this exploration. WFIRST is a next-generation space telescope that will survey the infrared universe from beyond the orbit of the Moon. Its two instruments are a technology demonstration called a coronagraph, and the WFI. The WFI features the same angular resolution as Hubble but with 100 times the field of view. Data it gathers will enable scientists to discover new and uniquely detailed information about planetary systems around other stars. The WFI will also map how matter is structured and distributed throughout the cosmos, which should ultimately allow scientists to discover the fate of the universe. (NASA Goddard)

UNIVERSE

[Planck finds no new evidence for cosmic anomalies](#) (6 June 2019)

ESA's Planck satellite has found no new evidence for the puzzling cosmic anomalies that appeared in its temperature map of the Universe. The latest study does not rule out the potential relevance of the anomalies, but they do mean astronomers must work even harder to understand the origin of these puzzling features. Planck's latest results come from an analysis of the polarisation of the Cosmic Microwave Background (CMB) radiation, the most ancient light in cosmic history, released when the Universe was just 380 000 years old. The satellite's initial analysis, which was made public in 2013, concentrated on the temperature of this radiation across the sky. This allows astronomers to investigate the origin and evolution of the cosmos. While it mostly confirmed the standard picture of how our Universe evolves, Planck's first map also revealed a number of anomalies that are difficult to explain within the standard model of cosmology. The anomalies are faint features on the sky that appear at large angular scales. They are definitely not artefacts produced by the behaviour of the satellite or the data processing, but they are faint enough that they could be statistical flukes, fluctuations which are extremely rare but not entirely ruled out by the standard model. Alternatively, the anomalies might be a sign of 'new physics', the term used for as-yet unrecognised natural processes that would extend the known laws of physics. (ESA)

URANUS

Planetary rings of Uranus 'glow' in cold light (20 June 2019)

Using both ALMA and the VLT, astronomers have imaged the cold, rock-strewn rings encircling the planet Uranus. Rather than observing the reflected sunlight from these rings, ALMA and the VLT imaged the millimetre and mid-infrared "glow" naturally emitted by the frigidly cold particles of the rings themselves. The rings of Uranus are invisible to all but the largest telescopes, they weren't even discovered until 1977, and they stand out as surprisingly bright in new thermal images of the planet taken by two large telescopes in Chile. Telescope (VLT) allowed the team for the first time to measure the temperature of the rings: a cool 77 Kelvin, or 77 degrees above absolute zero, the boiling temperature of liquid nitrogen and equivalent to 320 degrees below zero Fahrenheit. (NRAO)

Pat Williams June 2019