

Space News Update – April 2019

By Pat Williams

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Disclaimer - I claim no authorship for the printed material; except where noted (PW).

ASTRONOMERS CAPTURE FIRST IMAGE OF A BLACK HOLE



The Event Horizon Telescope (EHT), a planet-scale array of eight ground-based radio telescopes forged through international collaboration, was designed to capture images of a black hole. Today (10 April 2019), in coordinated press conferences across the globe, EHT researchers reveal that they have succeeded, unveiling the first direct visual evidence of a supermassive black hole and its shadow. (ESO)

The image reveals the black hole at the centre of Messier 87, a massive galaxy in the nearby Virgo galaxy cluster. This black hole resides 55 million light-years from Earth and has a mass 6.5 billion times that of the Sun. The EHT links telescopes around the globe to form an unprecedented Earth-sized virtual telescope. The EHT offers scientists a new way to study the most extreme objects in the Universe predicted by Einstein’s general relativity during the centenary year of the historic experiment that first confirmed the theory. This image is an extraordinary scientific feat accomplished by a team of more than 200 researchers. Black holes are cosmic objects with enormous masses but extremely compact sizes. The presence of these objects affects their environment in extreme ways, warping spacetime and superheating any surrounding material. If immersed in a bright region, like a disc of glowing gas, we expect a black hole to create a dark region similar to a shadow, something predicted by

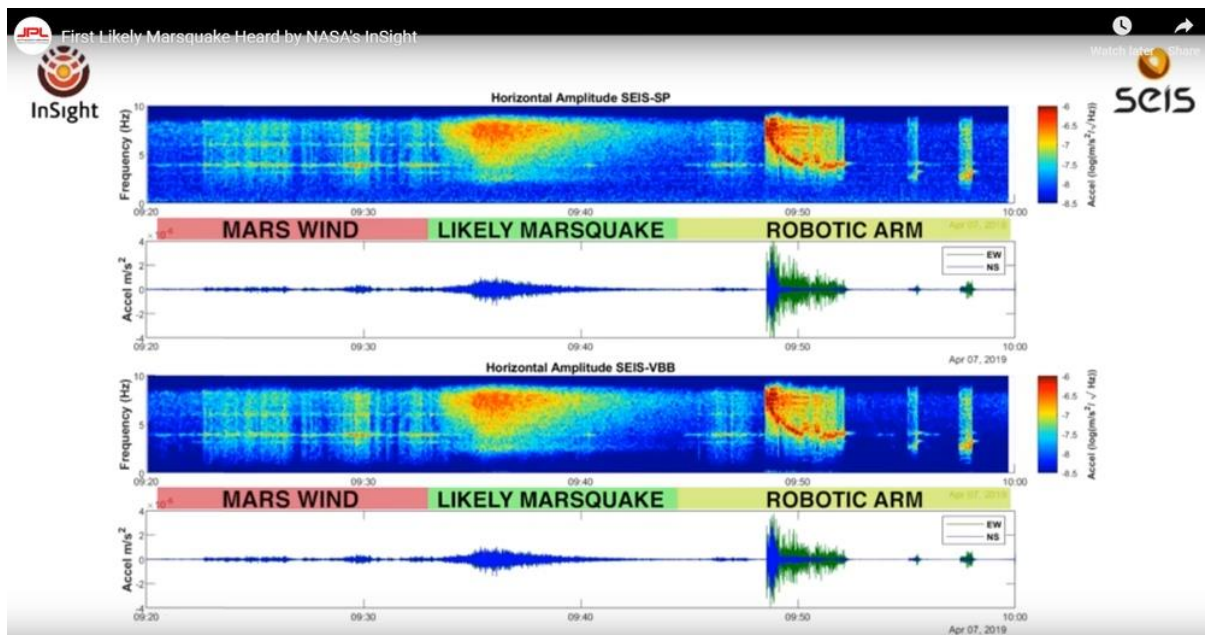
Einstein's general relativity that we've never seen before. This shadow, caused by the gravitational bending and capture of light by the event horizon, reveals a lot about the nature of these fascinating objects and has allowed us to measure the enormous mass of M87's black hole. Multiple calibration and imaging methods have revealed a ring-like structure with a dark central region, the black hole's shadow, that persisted over multiple independent EHT observations. [Astronomers capture first image of a black hole](#) (10 April 2019)

XPRIZE 'MOONSHOT AWARD' TO TEAM SPACEIL



The Moonshot Award, inspired by SpaceIL, was created to recognize an XPRIZE team achieving a “moonshot” technological feat outside the parameters or timeframe of an XPRIZE competition, with the funds coming directly from the XPRIZE Foundation. Future Moonshot Awards will be considered in other domains, recognizing both literal and figurative moonshots. XPRIZE will recognize SpaceIL's achievement with a \$1 million Moonshot Award for its successful entry into lunar orbit and for its attempt to land on the lunar surface; both of which are “firsts” for a privately-funded entity, marking a new era in space exploration. SpaceIL's robotic lander, Beresheet, Hebrew for “Genesis,” came very close to touching down on the Moon but ultimately failed to soft-land during its final descent. As it prepared for landing, Beresheet experienced a main engine failure and lost communication with mission control in Tel Aviv, suggesting the lander crashed into the surface. “SpaceIL's mission not only touched the Moon, it touched the lives and hearts of an entire world that was watching,” said Peter H. Diamandis, executive chairman and founder of XPRIZE. “The legacy SpaceIL will have on the future of the space industry is significant. This team's ability to build a lunar lander for \$100 million and less than 50 engineers is remarkable, a leap forward towards affordable and accessible space exploration. (XPRIZE) [XPRIZE 'Moonshot Award' to Team SpaceIL](#) (12 April 2019)

INSIGHT LANDER CAPTURES AUDIO OF FIRST LIKELY ‘QUAKE’ ON MARS



The seismic event detected by NASA's Mars InSight rover on April 6, 2019, the 128th Martian day, or sol, of the mission. Three distinct kinds of sounds can be heard, all of them detected as ground vibrations by the spacecraft's seismometer, called the Seismic Experiment for Interior Structure (SEIS): noise from Martian wind, the seismic event itself, and the spacecraft's robotic arm as it moves to take pictures. (courtesy: NASA/JPL-Caltech/CNES/IPGP/Imperial College London)

<https://youtu.be/DLBP-5KoSCc>

NASA's Mars InSight lander has measured and recorded for the first time ever a likely "marsquake." The faint seismic signal, detected by the lander's Seismic Experiment for Interior Structure (SEIS) instrument, was recorded on April 6, the lander's 128th Martian day, or sol. This is the first recorded trembling that appears to have come from inside the planet, as opposed to being caused by forces above the surface, such as wind. Scientists still are examining the data to determine the exact cause of the signal. The new seismic event was too small to provide solid data on the Martian interior, which is one of InSight's main objectives. The Martian surface is extremely quiet, allowing SEIS, InSight's specially designed seismometer, to pick up faint rumbles. In contrast, Earth's surface is quivering constantly from seismic noise created by oceans and weather. An event of this size in Southern California would be lost among dozens of tiny crackles that occur every day. The Martian Sol 128 event is exciting because its size and longer duration fit the profile of moonquakes detected on the lunar surface during the Apollo missions. NASA's Apollo astronauts installed five seismometers that measured thousands of quakes, revealing seismic activity on the Moon. Different materials can change the speed of seismic waves or reflect them, allowing scientists to use these waves to learn about the interior of the Moon and model its formation. InSight's seismometer, which the lander placed on the planet's surface on Dec. 19, 2018, will enable scientists to gather similar data about Mars. By studying the deep interior of Mars, they hope to learn how other rocky worlds, including Earth and the Moon, formed. (NASA)

[InSight lander captures audio of first likely 'quake' on Mars](https://www.nasa.gov/feature/in-sight-lander-captures-audio-of-first-likely-quake-on-mars) (23 April 2019)

MYSTERY OF THE UNIVERSE'S EXPANSION RATE WIDENS WITH NEW HUBBLE DATA



PR Image heic1908a LHA 120-N11 in the Large Magellanic Cloud

The new estimate of the Hubble constant is 74.03 kilometres per second per megaparsec. The number indicates that the Universe is expanding at a rate about 9 percent faster than that implied by Planck’s observations of the early Universe, which give a value for the Hubble constant of 67.4 kilometres per second per megaparsec. To reach this conclusion, scientists analysed the light from 70 Cepheid variables in the Large Magellanic Cloud. Because these stars brighten and dim at predictable rates, and the periods of these variations give us their luminosity and hence distance, astronomers use them as cosmic mileposts. The team used an efficient observing technique called Drift And Shift (DASH) using Hubble as a “point-and-shoot” camera to snap quick images of the bright stars. This avoids the more time-consuming step of anchoring the telescope with guide stars to observe each star. The results were combined with observations made by the Araucaria Project, a collaboration between astronomers from institutions in Europe, Chile, and the United States, to measure the distance to the Large Magellanic Cloud by observing the dimming of light as one star passes in front of its partner in a binary-star system. Because cosmological models suggest that observed values of the expansion of the Universe should be the same as those determined from the Cosmic Microwave Background, new physics may be needed to explain the disparity. Various scenarios have been proposed to explain the discrepancy, but there is yet to be a conclusive answer. An invisible form of matter called dark matter may interact more strongly with normal matter than astronomers previously thought. Or perhaps dark energy, an unknown form of energy that pervades space, is responsible for accelerating the expansion of the Universe. (STScI)

[Mystery of the Universe's expansion rate widens with new Hubble data](#) (25 April 2019)

NASA'S LANDMARK TWINS STUDY REVEALS RESILIENCE OF HUMAN BODY IN SPACE



Now retired twin astronauts, Scott and Mark Kelly, are subjects of NASA's Twins Study. Scott (right) spent a year in space while Mark (left) stayed on Earth as a control subject. Researchers looked at the effects of space travel on the human body.

Credits: Derek Storm, www.derekstorm.com

Key results from the NASA Twins Study include findings related to gene expression changes, immune system response, and telomere dynamics. Other changes noted in the integrated paper include broken chromosomes rearranging themselves in chromosomal inversions, and a change in cognitive function. Many of the findings are consistent with data collected in previous studies, and other research in progress. The telomeres in Scott's white blood cells, which are biomarkers of aging at the end of chromosomes, were unexpectedly longer in space then shorter after his return to Earth with average telomere length returning to normal six months later. In contrast, his brother's telomeres remained stable throughout the entire period. Because telomeres are important for cellular genomic stability, additional studies on telomere dynamics are planned for future one-year missions to see whether results are repeatable for long-duration missions. A second key finding is that Scott's immune system responded appropriately in space. For example, the flu vaccine administered in space worked exactly as it does on Earth. A fully functioning immune system during long-duration space missions is critical to protecting astronaut health from opportunistic microbes in the spacecraft environment. A third significant finding is the variability in gene expression, which reflects how a body reacts to its environment and will help inform how gene expression is related to health risks associated with spaceflight. While in space, researchers observed changes in the expression of Scott's genes, with the majority returning to normal after six months on Earth. However, a small percentage of genes related to the immune system and DNA repair did not return to baseline after his return to Earth. Further, the results identified key genes to target for use in monitoring the health of future astronauts and potentially developing personalized countermeasures. (NASA)

[NASA's landmark twins study reveals resilience of human body in space](#) (11 April 2019)

STARGAZING TECHNOLOGY USED TO SPOT CANCER



Title 3D mobile X-ray machine Released 05/04/2019 5:13 pm Copyright Adaptix Imaging

An X-ray machine which uses space technology to generate crystal clear images that doctors can use to detect the early signs of cancer has been prioritised for €1.2m of funding by the European Space Agency and the UK Space Agency. Cancers are often missed on normal X-rays, which produce slightly fuzzy images that can be difficult to interpret. This can mean the disease is more advanced and difficult to treat by the time it is discovered. Engineers from UK company Adaptix have used technology developed for space to produce three-dimensional scans that generate much clearer images. The device employs X-ray optics deployed on spacecraft such as ESA's XMM-Newton mission, which launched in 1999 and is observing stars at X-ray wavelengths. Miniaturised, portable and connected through satellites, the machine should also allow patients to be scanned in GPs' surgeries, reducing the need for trips to hospital and shortening waiting times for patients. (ESA)

[Stargazing technology used to spot cancer](#) (8 April 2019)

LINKS TO OTHER SPACE NEWS PUBLISHED IN APRIL 2019

ASTERIODS

[Hayabusa2's impactor hits asteroid Ryugu](#) (5 April 2019)

JAXA confirms Hayabusa 2 has now dropped the 5.5-pound (2.5kilogramsm) Small Carry-on Impactor (SCI). The SCI is a self-contained launching platform with a shaped HMX explosive charge that propels the impactor at 2 kilometres per second. Hayabusa 2 deployed the SCI and then moved to a safe location on the other side of the asteroid before JAXA launched the SCI at the surface. Images from the probe confirm the SCI hit Ryugu, blasting material into space. Hayabusa 2 will wait a bit before it heads back to the impact site, but JAXA hopes it will find a crater several meters across. The floor of the crater should have pristine asteroid regolith that hasn't been bombarded by radiation for uncountable eons. It's as close as we can come to getting a sample of the early solar system. Hayabusa 2 will eventually descend to the surface in order to collect a sample from the crater. It also carries another small tantalum bullet to excavate another surface sample. Hayabusa 2 isn't collecting pieces of Ryugu to keep them in deep space. The probe has a sample-return container, which JAXA plans to launch back to Earth in the coming months. It might contain as much as 100 milligrams of asteroid material when it gets here in late 2020. (JAXA)

[Self-driving spacecraft set for planetary defence expedition](#) (5 April 2019)

Engineers designing ESA's Hera planetary defence mission to the Didymos asteroid pair are developing advanced technology to let the spacecraft steer itself through space, taking a similar approach to self-driving cars. While the mission is designed to be fully operated manually from ground, the new technology will be tested once the core mission objectives are achieved and higher risks can be taken. Hera is currently the subject of detailed design work, ahead of being presented to Europe's space ministers at the Space19+ Ministerial Council this November. The spacecraft will survey a tiny 160-m diameter moon of the 780-m diameter Didymos asteroid, in the aftermath of a pioneering planetary defence experiment. (ESA)

ASTROPHYSICS

[First astrophysical detection of the helium hydride ion](#) (17 April 2019)

HeH⁺ was the first molecule that formed when, almost 14 billion years ago, falling temperatures in the young Universe allowed recombination of the light elements produced in the Big Bang. At that time, ionized hydrogen and neutral helium atoms reacted to form HeH⁺. Despite its importance in the history of the early Universe, HeH⁺ has so far escaped detection in astrophysical nebulae. Operating the GREAT far-infrared spectrometer onboard the flying observatory SOFIA, an international research team reports the unambiguous detection of the molecule towards the planetary nebula NGC 7027.

(Max Planck Institute for Radio Astronomy)

BROWN DWARFS

[Are brown dwarfs failed stars or super-planets?](#)(9 April 2019)

ν Ophiuchi is being orbited by two brown dwarfs with an orbital period of approximately 530 and 3,185 days, which puts them in a 6:1 resonant configuration. So, the brown dwarf closest to ν Ophiuchi orbits its star exactly six times while the other, more distant brown dwarf completes only one orbit. That is what the extensive dynamic analyses for possible configurations of the ν Ophiuchi system suggest. This superplanetary system is the first of its kind as well as the first sure sign that brown dwarfs can form in a protoplanetary disk.

(Heidelberg University)

COMETS

[Tiny fragments of a comet found inside Antarctic meteorite](#) (15 April 2019)

Asteroids and comets both formed from the disk of gas and dust that once surrounded the young Sun, but they aggregated at different distances from it, which affected their chemical makeup. Compared to asteroids, comets contain larger fractions of water ice and far more carbon, and typically formed farther from the Sun where the environment was colder. By studying a meteorite's chemistry and mineralogy researchers can unlock details about its formation and how much heating and other chemical processing it experienced during the solar system's formative years. Inside the LaPaz meteorite, the team found a very carbon-rich slice of primitive material. It bears some striking similarities to extra-terrestrial dust particles that are thought to have originated in comets that formed near the solar system's outer edges. Approximately 3 to 3.5 million years after the solar system formed, but while Earth was still growing, this tiny object, about one tenth of a millimetre across, was captured by the growing asteroid from which the meteorite originated. (Arizona State University)

DARK ENERGY

[Dark energy instrument's lenses see the night sky for the first time](#) (3 April 2019)

On April 1, the dome of the Mayall Telescope near Tucson, Arizona, opened to the night sky, and starlight poured through the assembly of six large lenses that were carefully packaged and aligned for a new instrument that will launch later this year. Just hours later, scientists produced the first focused images with these precision lenses, the largest is 1.1 meters in diameter, during this early test spin, marking an important "first light" milestone for the Dark Energy Spectroscopic Instrument, or DESI. This first batch of images homed in on the Whirlpool Galaxy to demonstrate the quality of the new lenses. (Berkeley Lab)

EARTH

[More than a carbon copy: OCO-3 on the space station](#) (2 April 2019)

NASA is ready to launch a new space instrument that will use the vantage point of the International Space Station to monitor Earth's carbon cycle. A follow-on to the still-active OCO-2 mission, OCO-3 will bring not only a new vantage point but new techniques and new technologies to NASA's carbon dioxide observations. (JPL)

[Fireworks of blue lightning and gamma rays above thunderclouds](#) (9 April 2019)

After only one year in space, the Atmosphere-Space Interactions Monitor (ASIM) on the International Space Station has given researchers a new understanding of how lightning is created, and how thunderstorms can affect the atmosphere and the climate. The first measurements from the facility that is flying 400 km above Earth outside Europe's Columbus laboratory, reveal how so-called 'terrestrial gamma-flashes' form in the atmosphere. The flashes occur in connection with lightning and thunder storms and are short bursts of high-energy x- and gamma- rays. Researchers in the science team have also received unprecedented measurements showing a wealth of blue lightning above thunderclouds. In following papers this year researchers will describe in more detail how lightning creates terrestrial gamma-flashes, that were first discovered in 1993. (ESA)

[Lunar gravity 600 kilometres above Earth](#) (11 April 2019)

After the successful launch of the spacecraft, the solar panels deployed as planned. An image showing the unfolded panels was sent to Earth by SCORE, the first on-board computer developed at DLR. Once the spacecraft reached its target altitude of 600 kilometres, the DLR engineers set it rotating to simulate lunar gravity, which is 0.16 times Earth gravity. "The NASA experiment was started once this was achieved." For the experiment, which is installed on the exterior of the satellite, two species of bacteria are now being brought out of hibernation in space. Later in the course of the experiment, the bacteria will produce biological substances that could also be produced during a mission on the Moon or Mars. The PowerCell experiments are scheduled to be completed in the summer of 2019. (DLR)

[NASA technology pinpoints potent greenhouse gases](#) (19 April 2019)

Whether they're idyllic floating cotton balls on an otherwise blue sky or ominous grey swirls that block the sun, clouds all begin as an invisible dot of water vapor. This elusive gas has been tricky to measure and track, until now. Research scientists at NASA's Langley Research Centre in Hampton, Virginia, have created a new airborne instrument that can directly measure water vapor and floating particles in the atmosphere. The new data will help check the accuracy of satellite measurements and improve weather and climate forecasts. The instrument is called the High Altitude Lidar Observatory (HALO). It uses light detection and

ranging (lidar), which works by shooting a pencil-thin laser beam through the atmosphere. Light from the pulsed laser bounces off molecules and particles suspended in the atmosphere, revealing what the human eye cannot see. The intensity of the signal reflected back to the lidar instrument gives the team the information they need to directly measure water vapour, as well as aerosol and cloud profiles. (NASA Goddard)

[Earthfence radar observes Intelsat 29e debris field](#) (19 April 2019)

Thoth Technology is using Earthfence deep space radar to observe the stricken spacecraft Intelsat 29e. Earthfence is the world's first commercial radar service to monitor events in geostationary orbits and to report results to spacecraft operators and other interested parties. Earthfence radar observes a debris field orbiting in the previously recorded location of the Intelsat 29e spacecraft. It is likely that the spacecraft has broken up into three or more smaller pieces. Intelsat 29e has been declared a total loss. Space Situational Awareness is critical to our national security and daily lives, and we are monitoring this significant event. (Thoth Technology)

[Auroral "speed bumps" are more complicated](#) (23 April 2019)

Scientists had long suspected that the aurora may be instigating the upwelling events affecting the lower altitude satellites because when they were flying through the aurora they would encounter "space speed bumps" caused by the heating up of the very high-altitude thermosphere. But since they occur at such high altitudes, these lower-energy auroras transfer more of their energy to the thin atmosphere at 250-400 kilometres (150-250 miles) above the ground, and produce more interesting effects than more familiar aurora, which sparkle at closer to 100 kilometres (60 miles) up. (University of New Hampshire)

[Scientists discover what powers celestial phenomenon STEVE](#) (25 April 2019)

Typical auroras, the northern and southern lights, are usually seen as swirling green ribbons spreading across the sky. But STEVE is a thin ribbon of pinkish-red or mauve-colored light stretching from east to west, farther south than where auroras usually appear. In the new study, researchers wanted to find out what powers STEVE and if it occurs in both the Northern and Southern Hemispheres at the same time. They analyzed data from several satellites passing overhead during STEVE events in April 2008 and May 2016 to measure the electric and magnetic fields in Earth's magnetosphere at the time. The researchers then coupled the satellite data with photos of STEVE taken by amateur auroral photographers to figure out what causes the unusual glow. They found that during STEVE, a flowing "river" of charged particles in Earth's ionosphere collide, creating friction that heats the particles and causes them to emit mauve light. Incandescent light bulbs work in much the same way, where electricity heats a filament of tungsten until it's hot enough to glow. Even more strange, STEVE is sometimes joined by green vertical columns of light nicknamed the "picket fence." The satellite data showed high-frequency waves moving from Earth's magnetosphere to its ionosphere can energize electrons and knock them out of the magnetosphere to create the striped picket fence display. The researchers found the picket fence occurs in both hemispheres at the same time, supporting the conclusion that its source is high enough above Earth to feed energy to both hemispheres simultaneously. (AGU)

EXOPLANETS

[Delivery of first detectors for PLATO's exoplanet mission](#) (11 April 2019)

PLATO, or PLANetary Transits and Oscillations of stars, is the second ESA-led mission to be

dedicated to exoplanets and the third with ESA participation. Currently planned to be launched in 2026, PLATO will follow in the footsteps of CHEOPS, the CHAracterising ExOPlanet Satellite mission, scheduled for launch later this year, and the CNES-led CoRoT mission, which operated between 2006 and 2014. PLATO's primary task will be to search for rocky, Earth-like planets orbiting relatively nearby stars that are similar to the Sun. Over periods of months to years, PLATO will utilise highly sensitive light detectors, rather like advanced versions of the CCDs used in digital cameras, to monitor the changing brightness of thousands of stars. (ESA)

GALAXIES

[VLA makes first direct image of key feature of powerful radio galaxies](#) (2 April 2019)

Astronomers used the National Science Foundation's Karl G. Jansky Very Large Array (VLA) to make the first direct image of a dusty, doughnut-shaped feature surrounding the supermassive black hole at the core of one of the most powerful radio galaxies in the Universe, a feature first postulated by theorists nearly four decades ago as an essential part of such objects. (NRAO)

[Planck reveals link between active galaxies and their dark matter environment](#)

(17 April 2019)

Scientists have used the tiny distortions imprinted on the cosmic microwave background by the gravity of matter throughout the Universe, recorded by ESA's Planck satellite, to uncover the connection between the luminosity of quasars, the bright cores of active galaxies, and the mass of the much larger 'halos' of dark matter in which they sit. The result is an important confirmation for our understanding of how galaxies evolve across cosmic history. analysis hints that that the more luminous a quasar is, the more massive its halo of dark matter. This is compelling evidence that a correlation exists between the luminosity of a quasar, energy that is released in the immediate vicinity of a supermassive black hole, a region spanning perhaps a few light days, and the mass of the encompassing halo of dark matter and surrounding environment, which extends for tens of millions of light years around the quasar. (ESA)

INTERNATIONAL SPACE STATION

[Studying behaviour in space shows mice adapt to microgravity](#) (11 April 2019)

In this study, scientists examined video recordings of mice and compared their activity to that of mice that stayed on Earth. The total study duration included 37 days in microgravity, a long-duration mission on the scale of the rodent life span. The results showed that the spaceflight mice did all the things they normally would: feeding, grooming their fur, huddling together and interacting with other mice. The rodents quickly adapted to their new weightless circumstances, for example by anchoring themselves to the habitat walls with their hindlimbs or tails and stretching out their bodies. This pose was similar to mice on Earth standing up on their back legs to explore their environment. Throughout their time aboard the space station, the mice actively explored the entire habitat. At the end of the study, they weighed about the same as the Earth-based group and their coats were in excellent condition, both signs of good health. A unique behaviour was seen in some mice, starting about a week after launch. The study included groups of younger and older females, and the younger mice in space were more physically active than their counterparts on the ground. The younger group also began to show a new behaviour that the scientists describe as "race-tracking", running laps around the cage. This even evolved into a group activity. Scientists don't yet know the reasons for

this group circling behaviour. It could be that the physical exercise itself was rewarding for the mice, that the behaviour was a stress response, or that the motion provided stimulation to the body's balance system, which is mostly absent in microgravity. The researchers think stress is less likely to be the cause, the mice behaved normally otherwise and were in excellent health, but more research is needed to know for sure. For the moment, even knowing about the circling will be helpful for other studies of mouse physiology in space. For example, other scientists might now take into consideration increased blood flow from the rodents' extra activity. (NASA Ames)

[Northrop Grumman set to launch 11th cargo delivery mission to the International Space Station for NASA](#) (16 April 2019)

For the NG-11 mission, Northrop Grumman will showcase a number of new capabilities including late load operations and a solo, long duration post-space station departure mission for Cygnus. In addition, the Antares medium-class rocket is set to carry its largest cargo load to date, transporting approximately 7,600 pounds (3,450 kilograms) of vital supplies and scientific equipment aboard Cygnus. (Northrop Grumman)

[Northrop Grumman successfully launches 11th cargo delivery mission to the International Space Station for NASA](#) (17 April 2019)

Following the release of Cygnus, Antares performed another new capability, deploying secondary satellites for science, technology, engineering and mathematics outreach programs. This included the NASA-sponsored 3U CubeSat called Student Aerothermal Spectrometer Satellite of Illinois and Indiana CubeSat (SASSI2) and 60 ThinSats sponsored by Virginia Space Flight Authority. These satellites were built by approximately 400 students in grades 4-12, from 70 schools located in nine states. (Northrop Grumman)

[Cygnus spacecraft successfully completes rendezvous and berthing with International Space Station](#) (19 April 2019)

Northrop Grumman Corporation (NYSE: NOC) today announced that the "S.S. Roger Chaffee" Cygnus™ spacecraft successfully completed its rendezvous and berthing manoeuvres with the International Space Station earlier this morning. The mission marks the company's 11th successful berthing with the orbiting laboratory. (Northrop Grumman)

[Orbital Sidekick and Corning release high-fidelity hyperspectral images from space](#) (26 April 2019)

Orbital Sidekick and Corning Incorporated have released the first images from the International Space Station (ISS) demonstrating hyperspectral imaging capabilities. Launched in June and placed into operation in December last year, Orbital Sidekick's International Space Station Hyperspectral Earth Imaging System Trial (ISS-HEIST) platform utilizes a Corning hyperspectral sensor that takes incoming light reflected off surfaces and divides it into colour bands not visible to the human eye; light from the high ultraviolet to the near-infrared portion of the spectrum. More capable than cameras currently in place on traditional imaging satellites, hyperspectral sensing technology has applications for commercial Earth exploration in a variety of areas, from oil and gas to agriculture. (Corning)

[Photobioreactor: oxygen and a source of nutrition for astronauts](#) (25 April 2019)

Airbus is bringing another experimental system to the International Space Station (ISS) in the form of the photobioreactor (PBR). The PBR, developed by the University of Stuttgart and built by Airbus on behalf of the German Aerospace Centre is designed to convert part of the CO₂ extracted by the 'LSR' Life Support Rack on board the ISS into oxygen and biomass,

which could help to save valuable resources during future long-term missions into space. (Airbus)

[OCO-3 ready to extend NASA's study of carbon](#) (29 April 2019)

When the Orbiting Carbon Observatory 3, OCO-3, heads to the International Space Station, it will bring a new view to studies of Earth's carbon cycle. From its perch on the space station, OCO-3 will observe near-global measurements of carbon dioxide on land and sea, from just after sunrise to just before sunset. That makes it far more versatile and powerful than its predecessor, OCO-2. OCO-2 revisits areas on Earth at roughly the same time of day due to its sun-synchronous orbit. OCO-3 will expand the time period of that coverage and observe the presence of carbon dioxide at varying times of day. Since the space station orbits Earth every 90 minutes, OCO-3 will complete 16 passes a day. (JPL)

JUPITER AND MOONS

[Review board gives JUICE the all clear](#) (3 April 2019)

ESA's Jupiter ICy moons Explorer, JUICE, has been given the green light for full development after its critical design review was successfully concluded on 4 March. This major milestone marks the beginning of the qualification and production phase, taking this flagship mission one key step closer to starting its long journey to Jupiter in 2022. After launch JUICE will embark on a 7.5-year cruise toward Jupiter, entering orbit around the giant planet in 2029 to study its environment and three of its icy moons: Ganymede, Europa and Callisto. (ESA)

[Jupiter's atmosphere heats up under solar wind](#) (8 April 2019)

New Earth-based telescope observations show that auroras at Jupiter's poles are heating the planet's atmosphere to a greater depth than previously thought and that it is a rapid response to the solar wind. The solar wind impact at Jupiter is an extreme example of space weather. We're seeing the solar wind having an effect deeper than is normally seen. Auroras at Earth's poles (known as the aurora borealis at the North Pole and aurora australis at the South Pole) occur when the energetic particles blown out from the Sun (the solar wind) interact with and heat up the gases in the upper atmosphere. The same thing happens at Jupiter, but the new observations show the heating goes two or three times deeper down into its atmosphere than on Earth, into the lower level of Jupiter's upper atmosphere, or stratosphere. Within a day of the solar wind hitting Jupiter, the chemistry in its atmosphere changed and its temperature rose. (JPL)

LAUNCH SERVICES

[NASA investigation uncovers cause of two science mission launch failures](#) (30 April 2019)

NASA Launch Services Program (LSP) investigators have determined the technical root cause for the Taurus XL launch failures of NASA's Orbiting Carbon Observatory (OCO) and Glory missions in 2009 and 2011, respectively: faulty materials provided by aluminium manufacturer, Sapa Profiles, Inc. (SPI). LSP's technical investigation led to the involvement of NASA's Office of the Inspector General and the U.S. Department of Justice (DOJ). DOJ's efforts, recently made public, resulted in the resolution of criminal charges and alleged civil claims against SPI, and its agreement to pay \$46 million to the U.S. government and other commercial customers. This relates to a 19-year scheme that included falsifying thousands of certifications for aluminium extrusions to hundreds of customers. (NASA)

MARS

[Mars Express matches methane spike measured by Curiosity](#) (1 April 2019)

A reanalysis of data collected by ESA's Mars Express during the first 20 months of NASA's Curiosity mission found one case of correlated methane detection, the first time an in-situ measurement has been independently confirmed from orbit. Reports of methane in the Martian atmosphere have been intensely debated, with Mars Express contributing one of the first measurements from orbit in 2004, shortly after its arrival at the Red Planet.

The molecule attracts such attention because on Earth methane is generated by living organisms, as well as geological processes. Because it can be destroyed quickly by atmospheric processes, any detection of the molecule in the Martian atmosphere means it must have been released relatively recently – even if the methane itself was produced millions or billions of years ago and lay trapped in underground reservoirs until now. (ESA)

[ExoMars carrier module prepares for final pre-launch testing](#) (5 April 2019)

The module, along with electrical ground support equipment, that will carry the ExoMars rover and surface science platform from Earth to Mars has arrived in Italy for final integration preparations. The mission is the second in the joint ESA-Roscosmos ExoMars programme that is exploring the possibility of whether life has ever existed on Mars. (ESA)

[First results from the ExoMars Trace Gas Orbiter](#) (10 April 2019)

New evidence of the impact of the recent planet-encompassing dust storm on water in the atmosphere, and a surprising lack of methane, are among the scientific highlights of the ExoMars Trace Gas Orbiter's first year in orbit. (ESA)

[Tests for the InSight 'Mole'](#) (11 April 2019)

A blue box, a cubic metre of Mars-like sand, a rock, a fully-functional model of the Mars 'Mole' and a seismometer – these are the main components with which DLR is simulating the current situation on Mars. After its first hammering operation on 28 February 2019, the DLR Heat and Physical Properties Package (HP³), the Mars Mole, was only able to drive itself about 30 centimetres into the Martian subsurface. DLR planetary researchers and engineers are now analysing how this could have happened and looking into what measures could be taken to remedy the situation. When the NASA InSight lander arrived on the Martian surface, everything looked even better than expected. Although the lander's camera showed numerous rocks some distance away, the immediate surroundings were free of rocks and debris. The reason why the 'Mole' hammered its way quickly into the ground after being placed on the surface of Mars and was then unable to continue its progress is now being diagnosed remotely. (DLR)

[Curiosity tastes first sample in 'Clay-Bearing Unit'](#) (11 April 2019)

Scientists working with NASA's Curiosity Mars rover have been excited to explore a region called "the clay-bearing unit" since before the spacecraft launched. Now, the rover has finally tasted its first sample from this part of Mount Sharp. Curiosity drilled a piece of bedrock nicknamed "Aberlady" on Saturday, April 6 (the 2,370th Martian day, or sol, of the mission), and delivered the sample to its internal mineralogy lab. (JPL)

MERCURY

[BepiColombo is ready for its long cruise](#) (5 April 2019)

Following a series of tests conducted in space over the past five months, the ESA-JAXA BepiColombo mission has successfully completed its near-Earth commissioning phase and is now ready for the operations that will take place during the cruise and, eventually, for its scientific investigations at Mercury. BepiColombo started its seven-year long journey to the Solar System's innermost planet on 20 October 2018, lifting off on an Ariane 5 rocket from Europe's spaceport in Kourou, French Guiana. (ESA)

[Mercury's spin and gravity reveals the planet's inner solid core](#) (17 April 2019)

The team put data from MESSENGER into a sophisticated computer program that allowed them to adjust parameters and figure out what the interior composition of Mercury must be like to match the way it spins and the way the spacecraft accelerated around it. The results showed that for the best match, Mercury must have a large, solid inner core. They estimated that the solid, iron core is about 1,260 miles (about 2,000 kilometres) wide and makes up about half of Mercury's entire core (about 2,440 miles, or nearly 4,000 kilometres, wide). In contrast, Earth's solid core is about 1,500 miles (2,400 kilometres) across, taking up a little more than a third of this planet's entire core. (NASA Goddard)

MISCELLANEOUS

[ESA and DLR in joint study to support deep space missions](#) (2 April 2019)

An existing deep-space dish antenna at the DLR Weilheim site, near Munich, may offer an almost-readymade solution to the problem of providing sufficient ground station capacity to support ESA's current and future deep-space exploration missions. Now and in the next few years, ESA is sending some of the most advanced spacecraft ever flown to exotic locations like Mars, Mercury and Jupiter, and these missions all have one thing in common: they need plenty of ground station capacity to download their masses of science data and to enable mission controllers to send up commands. (ESA)

MOON

[URI researcher calculates temperature inside moon to help reveal its inner structure](#) (1 April 2019)

Little is known about the inner structure of the Moon, but a major step forward was made by a University of Rhode Island scientist who conducted experiments that enabled her to determine the temperature at the boundary of the Moon's core and mantle. She found the temperature to be between 1,130 and 1,470 degrees Celsius, which is at the high end of an 800 degree range that previous scientists had determined. (University of Rhode Island)

[Meteoroid strikes eject precious water from Moon](#) (15 April 2019)

Scientists have discovered that water is being released from the moon during meteor showers. When a speck of comet debris strikes the moon it vaporizes on impact, creating a shock wave in the lunar soil. For a sufficiently large impactor, this shock wave can breach the soil's dry upper layer and release water molecules from the hydrated layer below. The LADEE spacecraft detects these water molecules as they enter the tenuous lunar atmosphere. This discovery provides a potential resource for future exploration, and it improves our understanding the moon's geologic past and its continued evolution. (JPL)

[German Orbital Systems and Scanway aim for a joint Moon mission](#) (28 April 2019)

German Orbital System and Scanway, a NewSpace company from Wroclaw, Poland, have signed a Letter of Intent in the framework of the European SpaceTech Transfer Forum in Warsaw to work towards a joint CubeSat mission into the orbit of the moon. (German Orbital Systems)

QUASARS

[Astronomers find quasars are not nailed to the sky](#) (24 April 2019)

The apparent positions of quasars change with the radiation frequency used to observe them. Researchers predicted this effect about 40 years ago based on the theory of synchrotron radiation and observed it soon afterwards. What could be the reason behind this phenomenon? Scientists checked the apparent AGN positions for potential correlations with some of the variable quasar parameters, such as their brightness or magnetic fields. It turned out that the apparent coordinates of an active galactic nucleus are directly associated with the particle density in the jet: the higher the brightness, the more pronounced the perceived position shift. This could complement theoretical quasar models by indicating the role of nuclear flares injecting higher-density plasma into the outflow. There is a practical dimension to this analysis as well. New precise data on the apparent shifts of quasar positions will enable a correction of astrometry techniques, leading to the most accurate navigation systems that ever existed in human history. (MIT) Moscow

SATELLITES

[ESA's 'Cubesat central' for smaller missions into space](#) (2 April 2019)

ESA has set up a dedicated unit to work on the standardised nanosatellites called 'CubeSats', teaming up with European companies to develop low-cost technology-testing missions. Missions in preparation include a double CubeSat to test rendezvous and docking techniques, and one to explore near-Earth asteroids. (ESA)

SATURN AND MOONS

[Cassini reveals surprises with Titan's lakes](#) (15 April 2019)

On its final flyby of Saturn's largest moon in 2017, NASA's Cassini spacecraft gathered radar data revealing that the small liquid lakes in Titan's northern hemisphere are surprisingly deep, perched atop hills and filled with methane. The new findings are the first confirmation of just how deep some of Titan's lakes are (more than 300 feet, or 100 meters) and of their composition. They provide new information about the way liquid methane rains on, evaporates from and seeps into Titan - the only planetary body in our solar system, other than Earth, known to have stable liquid on its surface. (JPL)

[What deep learning reveals about Saturn's storms](#) (29 April 2019)

A "deep learning" approach to detecting storms on Saturn is set to transform our understanding of planetary atmospheres, according to University College London and University of Arizona researchers. The new technique, called PlanetNet, identifies and maps the components and features in turbulent regions of Saturn's atmosphere, giving insights into the processes that drive them. The results clearly show the vast regions affected by storms and that dark storm clouds contain material swept up from the lower atmosphere by strong vertical winds. PlanetNet was trained and tested using infrared data from the Visible and Infrared Mapping Spectrometer instrument on Cassini. PlanetNet enables us to analyse much

bigger volumes of data, and this gives insights into the large-scale dynamics of Saturn. The results reveal atmospheric features that were previously undetected. Previous analysis of the dataset indicated a rare detection of ammonia in Saturn's atmosphere, in the form of an S-shaped cloud. The map produced through PlanetNet shows that this feature is a prominent part of a much larger upwelling of ammonia ice clouds around a central dark storm. PlanetNet identifies similar upwelling around another small storm, suggesting such features are quite common. The map also shows pronounced differences between the centre of storms and the surrounding areas, indicating that the eye gives a clear view into the warmer, deep atmosphere. (University of Arizona)

[Researchers find ice feature on Saturn's giant moon](#) (29 April 2019)

The major ice feature researchers found was completely unexpected. It consists of a linear ice corridor that wraps around 40 percent of Titan's circumference. The icy corridor is puzzling, because it doesn't correlate with any surface features nor measurements of the subsurface. Given that the study and past work indicate that Titan is currently not volcanically active, the trace of the corridor is likely a vestige of the past. They detected this feature on steep slopes, but not on all slopes. This suggests that the icy corridor is currently eroding, potentially unveiling presence of ice and organic strata. (University of Arizona)

SOLAR SYSTEM

[Ashes of a dying star hold clues about Solar System's birth](#) (29 April 2019)

Tucked inside a chondritic meteorite collected in Antarctica, the tiny speck represents actual stardust, most likely hurled into space by an exploding star before our own sun existed. Although such grains are believed to provide important raw materials contributing to the mix from which the sun and our planets formed, they rarely survive the turmoil that goes with the birth of a solar system. As actual dust from stars, such pre-solar grains give us insight into the building blocks from which our solar system formed. They also provide us with a direct snapshot of the conditions in a star at the time when this grain was formed. Dubbed LAP-149, the dust grain represents the only known assemblage of graphite and silicate grains that can be traced to a specific type of stellar explosion called a nova. Remarkably, it survived the journey through interstellar space and travelled to the region that would become our solar system some 4.5 billion years ago, perhaps earlier, where it became embedded in a primitive meteorite. The research team analyzed the microbe-sized dust grain down to the atomic level. The tiny messenger from outer space turned out to be truly alien, highly enriched in a carbon isotope called ^{13}C . (University of Arizona)

SPACE

[ExoAnalytic Solutions and NorthStar Earth & Space join forces to combat growing space debris threat, protect satellites in orbit](#) (1 April 2019)

The NorthStar Satellite Constellation will image Earth and its near space orbit continuously, with refresh rates that enable coverage unprecedented in human history. Optical sensors will monitor and protect high-value space assets from catastrophic collisions with space debris. NorthStar is the first commercial system to combine Hyperspectral and Infrared sensors to observe Earth, using reflected sunlight to image and obtain a wealth of information about any object on the planet. (NorthStar Earth & Space)

[New model accurately predicts harmful space weather](#) (9 April 2019)

A new, first-of-its-kind space weather model reliably predicts space storms of high-energy particles that are harmful to many satellites and spacecraft orbiting in the Earth's outer

radiation belt. A paper recently published in the journal *Space Weather* details how the model can accurately give a one-day warning prior to a space storm of ultra-high-speed electrons, often referred to as “killer” electrons because of the damage they can do to spacecraft such as navigation, communications, and weather monitoring satellites. This is the first time researchers have successfully predicted those killer electrons across the whole outer belt region. (Los Alamos National Laboratory)

STARS AND STAR CLUSTERS

[A new signal for a neutron star collision discovered](#) (16 April 2019)

A bright burst of X-rays has been discovered by NASA’s Chandra X-ray Observatory in a galaxy 6.6 billion light years from Earth. This event likely signalled the merger of two neutron stars and could give astronomers fresh insight into how neutron stars, dense stellar objects packed mainly with neutrons, are built. When two neutron stars merge, they produce jets of high energy particles and radiation fired in opposite directions. If the jet is pointed along the line of sight to the Earth, a flash, or burst, of gamma rays can be detected. If the jet is not pointed in our direction, a different signal is needed to identify the merger. The detection of gravitational waves, ripples in spacetime, is one such signal. Now, with the observation of a bright flare of X-rays, astronomers have found another signal, and discovered that two neutron stars likely merged to form a new, heavier and fast-spinning neutron star with an extraordinarily strong magnetic field. Chandra observed the source, dubbed XT2, as it suddenly appeared and then faded away after about seven hours. The source is located in the Chandra Deep Field-South, the deepest X-ray image ever taken that contains almost 12 weeks of Chandra observing time, taken at various intervals over several years. The source appeared on March 22, 2015 and was discovered later in analysis of archival data. (NASA)

[Explosion on Jupiter-sized star ten times more powerful than ever seen on our Sun](#)

(17 April 2019)

A stellar flare ten times more powerful than anything seen on our sun has burst from an ultracool star almost the same size as Jupiter. The star is the coolest and smallest to give off a rare white-light superflare, and by some definitions could be too small to be considered a star. (University of Warwick)

[Making good use of bad weather: Finding metal-poor stars through the clouds](#)

(17 April 2019)

The Gemini telescopes helped identify low-metallicity stars by gathering medium-resolution spectroscopic GMOS data for 666 bright stars under poor weather conditions. These data provide a unique opportunity to explore the chemical evolution of the Milky Way and look at the enrichment of star-forming gas clouds in the early Universe. Low-metallicity stars (stars with less than 1% of the elements heavier than Hydrogen and Helium that the Sun contains) are the Rosetta Stones of stellar astrophysics. (Gemini Observatory)

[Omega Centauri’s lost stars](#) (22 April 2019)

A team of researchers from the Strasbourg Astronomical Observatory, Bologna Observatory and the University of Stockholm has identified a stream of stars that was torn off the globular cluster Omega Centauri. Searching through the 1.7 billion stars observed by the ESA Gaia mission, they have identified 309 stars that suggest that this globular cluster may actually be the remnant of a dwarf galaxy that is being torn apart by the gravitational forces of our Galaxy. (Canada-France-Hawaii Telescope)

TECHNOLOGY

[3-D printed RL10C-X prototype rocket engine soars through initial round of testing](#)

(8 April 2019)

Aerojet Rocketdyne has successfully completed initial testing of a nearly flight-weight and production-ready configuration of its next generation RL10C-X upper-stage rocket engine that contains major components produced with the company's industry-leading 3-D printing technology. The successful series of tests confirmed that the 3-D printed components performed as expected when integrated into a complete, full-scale engine system. They have made steady progress incorporating game-changing 3-D printing technology into their production engine programs to make them more affordable. By producing these components with 3-D printing, they expect to reduce lead time by 35-50%, and overall engine cost by 25-35%. (Aerojet Rocketdyne)

[NASA's new flying robots](#) (17 April 2019)

Astrobee is a free-flying robot system that will provide a research platform for the orbiting laboratory. The system includes three robots, named Honey, Queen and Bumble, as well as a docking station for recharging. The first two robots are planned to launch to the station on April 17 aboard Northrop Grumman's 11th Commercial Resupply Services mission from NASA's Wallops Flight Facility in Virginia. The main purpose of the Astrobee platform is to provide a zero-gravity testbed for guest scientists to try out new robotic technologies in space. Astrobee will prove out robotic capabilities that will enable and enhance human exploration. Performing such experiments in zero gravity will ultimately help develop new hardware and software for future space missions. Astrobee has a highly modular hardware and software design that makes it possible for the robot to do a wide range of tasks or experiments, even things that have not yet been imagined. Each robot has three payload bays, attachment points for which station crew can easily install new hardware modules. Software modules can be installed while the robots are connected to Astrobee's docking station, located in the Kibo module of the space station. Astrobee's software was released by NASA as open-source to encourage development and testing of new algorithms and features. (NASA Ames)

[NASA, Blue Origin agreement signals rocketing growth of commercial space](#) (17 April 2019)

Officials from NASA and the private space company Blue Origin have signed an agreement that grants the company use of a historic test stand as the agency focuses on returning to the Moon and on to Mars, and America's commercial space industry continues to grow. Under a Commercial Space Launch Act agreement, Blue Origin will upgrade and refurbish Test Stand 4670, at NASA's Marshall Space Flight Centre in Huntsville, Alabama, to support testing of their BE-3U and BE-4 rocket engines. The BE-4 engine was selected to power United Launch Alliance's new Vulcan rocket and Blue Origin's New Glenn launch vehicle, both being developed to serve the expanding civil, commercial and national security space markets. (NASA)

Pat Williams April 2019