

Space News Update – March 2019

By Pat Williams

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

ASTRONAUTS ARRIVE SAFELY AT SPACE STATION



The official Expedition 59 crew portrait with (from left) astronauts David Saint-Jacques of the Canadian Space Agency and Anne McClain of NASA; cosmonauts Oleg Kononenko and Oleg Shkripochka of Roscosmos; and NASA astronauts Nick Hague and Christina Koch. Credit: NASA/Robert Markowitz

For more than 18 years, humans have lived and worked continuously aboard the station, advancing scientific knowledge and demonstrating new technologies, making research breakthroughs not possible on Earth that will enable long-duration human and robotic exploration into deep space, including the Moon and Mars. A global endeavour, 236 people from 18 countries have visited the unique microgravity laboratory that has hosted more than 2,500 investigations from researchers in 106 countries. Investigations conducted on the International Space Station impact the daily lives of people on Earth and prepare the way for

humans to venture farther into space.

Three crew members have arrived safely at the International Space Station, following a successful launch and docking of their Soyuz MS-12 spacecraft. The Soyuz spacecraft carried Nick Hague and Christina Koch of NASA and Alexey Ovchinin of the Russian space agency Roscosmos. They docked to the space station's Rassvet module after a four-orbit, six-hour journey. Their mission, Expedition 59, officially began at the time of docking. Their arrival restores the station's crew complement to six. They have joined Anne McClain of NASA, David Saint-Jacques of the Canadian Space Agency and Expedition 59 Commander Oleg Kononenko of Roscosmos. The crew members will spend more than six months conducting about 250 science investigations in fields such as biology, Earth science, human research, physical sciences, and technology development. Seventy-five of the investigations are new and have never been performed in space. Some of the investigations are sponsored by the U.S. National Laboratory on the space station, which Congress designated in 2005 to maximize its use for improving quality of life on Earth. (NASA)

[Astronauts arrive safely at space station](#) (15 March 2019)

NON-INVASIVE COLLECTION OF SALIVA HELPS MONITOR STRESS LEVELS IN REAL TIME



Paolo Nespoli performs the IN SITU experiment onboard the space station. Credits: NASA

Spitting is discouraged aboard the ISS, unless it helps monitor the health of crew members. However, while saliva samples can be useful for such monitoring, storing them for later analysis on Earth is expensive and cumbersome, and means any problems that are identified cannot be addressed in a timely manner. Increased stress is a common problem associated with spaceflight. The ISS Non-invasive Sample Investigation and results Transmission to ground with the Utmost easiness (IN SITU) investigation tested a portable device to conduct direct, real-time analysis of saliva samples on the space station. Investigators used the device to monitor stress levels among crew members by detecting the presence of the stress hormone cortisol. The IN SITU device uses disposable cartridges, and sample collections and analyses are simple to perform. Crew members collect saliva with a swab, inject the sample into the cartridge, and push buttons to initiate the analytical procedure. They then insert the cartridge into a reader to obtain results. The process poses no risk to the operator or the space station environment. Since this process relies on capillary forces, it is not affected by microgravity conditions. The device makes sensitive and specific quantitative measurement of biomarkers

possible by using fluid samples obtained non-invasively. Saliva is easily and non-invasively collected, especially in microgravity. It does not require cumbersome pre-analytical treatment procedures; in this case, it was analyzed as is. Moreover, it is a particularly interesting matrix for measuring cortisol, since data in the literature already demonstrate that salivary levels of cortisol well correlate with its blood levels. In addition to improving crew health monitoring on the space station, the device could be employed to monitor astronauts on long-duration missions to Mars, asteroids or other distant destinations. Simple modification of the cartridges would make it possible to analyse other biological fluids, such as blood, plasma and sweat. The potential advantages of this device are definitely worth salivating over.

[Non-invasive collection of saliva helps monitor stress levels in real time](#) (18 March 2019)

NASA MISSION REVEALS ASTEROID HAS BIG SURPRISES



This view of asteroid Bennu ejecting particles from its surface on January 19 was created by combining two images taken on board NASA's OSIRIS-REx spacecraft. Other image processing techniques were also applied, such as cropping and adjusting the brightness and contrast of each image. Credits: NASA/Goddard/University of Arizona/Lockheed Martin

A NASA spacecraft that will return a sample of a near-Earth asteroid named Bennu to Earth in 2023 made the first-ever close-up observations of particle plumes erupting from an asteroid's surface. Bennu also revealed itself to be more rugged than expected, challenging the mission team to alter its flight and sample collection plans, due to the rough terrain. Bennu is the target of NASA's Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer (OSIRIS-REx) mission, which began orbiting the asteroid on Dec. 31. Bennu, which is only slightly wider than the height of the Empire State Building, may contain unaltered material from the very beginning of our solar system. The team has directly observed a change in the spin rate of Bennu as a result of what is known as the Yarkovsky-O'Keefe-Radzievskii-Paddack (YORP) effect. The uneven heating and cooling of Bennu as it rotates in sunlight is causing the asteroid to increase its rotation speed. As a result, Bennu's rotation period is decreasing by about one second every 100 years. Separately, two of the spacecraft's instruments, the MapCam colour imager and the OSIRIS-REx Thermal Emission Spectrometer (OTES), have made detections of magnetite on Bennu's surface, which bolsters earlier findings indicating the interaction of rock with liquid water on Bennu's parent body. (NASA)

[NASA mission reveals asteroid has big surprises](#) (19 March 2019)

PENTAGON SUBMITS SPACE FORCE PROPOSAL TO CONGRESS

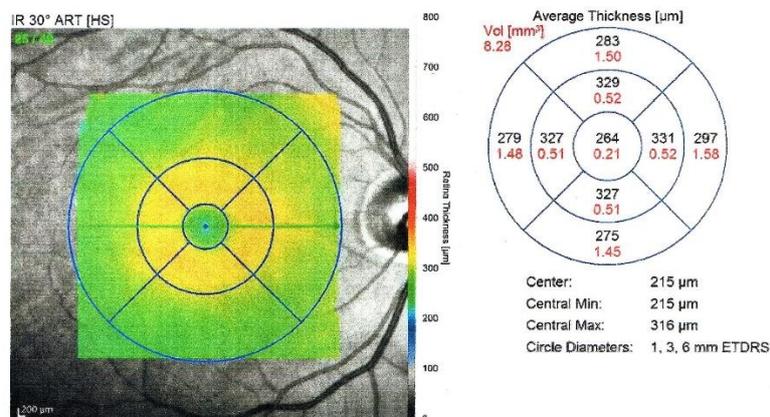


US President Donald Trump shows his signature on the Space Policy Directive-4 (SPD-4) Credit: The Pentagon.

The Pentagon has submitted a proposal to Congress that, if approved, would see the creation of a new "Space Force." The move comes at the request of President Donald Trump, who has insisted that a separate branch of military is needed to focus on protecting satellites and tackling vulnerabilities in space. This follows President Trump's bold vision for space and commits resources to deliver more capability faster, ensuring the United States can compete, deter, and, if needed, win in a complex domain. In its current form, the Space Force would be established as its own branch of the military but would fall under the Air Force, as the Navy oversees the Marine Corps. Not since the Air Force was stood up in 1947 has the Pentagon created a new military branch. Space Force would be the sixth, with the others being the Army, Navy, Marines and Coast Guard. But the creation of Space Force is by no means a done deal, as it must be vetted and approved by Congress. (Washington)

[Pentagon submits Space Force proposal to Congress](#) (1 March 2019)

ACUCELA TO DEVELOP A COMPACT OCT FOR NASA'S DEEP SPACE MISSIONS



Credit: Wikipedia

Approximately 63% of long-duration spaceflight crewmembers present with one or more signs of Spaceflight Associated Neuro-ocular Syndrome (SANS), including optic disc oedema, globe flattening, choroidal folds, cotton wool spots, and refractive shifts. *OCT has

become a mainstay of crew testing for SANS because it allows accurate measurement of retinal thickness and cross-sectional imagery of the retina and optic disc. This in combination with other tests provides the necessary data to diagnose, monitor, and eventually treat SANS. The commercially available off-the-shelf (COTS) OCT devices currently deployed to the International Space Station (ISS) are not suitable for Lunar, Martian and other expeditionary space travel. These commercial systems are complex, too large, not radiation hardened, and contain features that are not necessary for diagnosing and monitoring the anatomic effects of SANS, according to a company news release. By using a unique approach, Acucela are able to create a solid-state OCT yielding high resolution imagery. The final flight-ready device will allow NASA to replace current COTS OCT devices with smaller, lighter, easier to use, durable and radiation hardened instruments that are practical for use in smaller spacecrafts, while providing required image quality from astronauts during flight. (Acucela)

*Optical coherence tomography (OCT) is a **non**-invasive imaging test. OCT uses light waves to take cross-section pictures of your retina. With OCT, an ophthalmologist can see each of the retina's distinctive layers.

[Acucela to develop a compact OCT for NASA's deep space missions](#) (17 March 2019)

WEIGHING GALACTIC WIND PROVIDES CLUES TO EVOLUTION OF GALAXIES



The Central Magnetic Field of the Cigar Galaxy

Image Credit: NASA, SOFIA, E. Lopez-Rodriguez; NASA, Spitzer, J. Moustakas et al.

The Cigar Galaxy (M82) is famous for its extraordinary speed in making new stars, with stars being born 10 times faster than in the Milky Way. Now, data from the Stratospheric Observatory for Infrared Astronomy, SOFIA, have been used to study this galaxy in further detail, revealing how material that affects the evolution of galaxies may get into intergalactic space. Researchers found that the galactic wind flowing from the centre of the Cigar Galaxy (M82) is aligned along a magnetic field and transports a very large mass of gas and dust, the equivalent mass of 50 to 60 million Suns. The space between galaxies contains gas and dust, which are the seed materials for stars and galaxies. Now, we have a better understanding of how this matter escaped from inside galaxies over time. The magnetic field detected by SOFIA appears to follow the bipolar outflows generated by the intense nuclear starburst. Besides being a classic example of a starburst galaxy, which means it is forming an extraordinary number of new stars compared with most other galaxies, M82 also has strong winds blowing gas and dust into intergalactic space. Astronomers have long theorized that these winds would also drag the galaxy's magnetic field in the same direction, but despite numerous studies, there has been no observational proof of the concept. Researchers using the airborne observatory SOFIA found definitively that the wind from the Cigar Galaxy not

only transports a huge amount of gas and dust into the intergalactic medium, but also drags the magnetic field so it is perpendicular to the galactic disc. In fact, the wind drags the magnetic field more than 2,000 light-years across close to the width of the wind itself. One of the main objectives of this research was to evaluate how efficiently the galactic wind can drag along the magnetic field. We did not expect to find the magnetic field to be aligned with the wind over such a large area. These observations indicate that the powerful winds associated with the starburst phenomenon could be one of the mechanisms responsible for seeding material and injecting a magnetic field into the nearby intergalactic medium. If similar processes took place in the early universe, they would have affected the fundamental evolution of the first galaxies. (NASA)

[Weighing galactic wind provides clues to evolution of galaxies](#) (5 March 2019)

LINKS TO OTHER SPACE NEWS PUBLISHED IN MARCH 2019

ASTERIODS

[World's best telescopes target asteroids for ESA's Hera mission](#) (5 March 2019)

In the coming days the largest and most powerful telescopes in Europe and South America will be trained on a single spot in the sky, gathering details of twin asteroids to help guide the design of ESA's proposed Hera mission, headed for the Didymos pair in late 2023. (ESA)

[Asteroid Bennu, target of NASA's sample return mission, is rotating faster over time](#) (12 March 2019)

New research finds the asteroid's rotation is speeding up by about 1 second per century. In other words, Bennu's rotation period is getting shorter by about 1 second every 100 years. While the increase in rotation might not seem like much, over a long period of time it can translate into dramatic changes in the space rock. As the asteroid spins faster and faster over millions of years, it could lose pieces of itself or blow itself apart. Detecting the increase in rotation helps scientists understand the types of changes that could have happened on Bennu, like landslides or other long-term changes, that the OSIRIS-REx mission will look for. (AGU)

[ESA's Hera asteroid mission borrows eyes of NASA's Dawn](#) (15 March 2019)

The mission to the smallest asteroid ever explored will employ the same main camera as the mission to the largest asteroids of all. ESA's proposed Hera spacecraft to the Didymos asteroid pair has inherited its main imager from NASA's Dawn mission to the Vesta and Ceres asteroids. Hera is currently the subject of detailed design work, ahead of being presented to Europe's space ministers at the Space19+ Ministerial Council at the end of this year, for launch in late 2023. 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)

[Hubble watches spun-up asteroid coming apart](#) (28 March 2019)

A small asteroid has been caught in the process of spinning so fast it's throwing off material, according to new data from NASA's Hubble Space Telescope and other observatories.

Images from Hubble show two narrow, comet-like tails of dusty debris streaming from the asteroid (6478) Gault. Each tail represents an episode in which the asteroid gently shed its material, key evidence that Gault is beginning to come apart. (STScI)

ASTROPHYSICS

[CERN Approves Hunt for New Cosmic Particles at Large Hadron Collider](#) (6 Mar 2019)

The CERN research board has approved the Forward Search Experiment, giving a green light to the assembly, installation and use of an instrument that will look for new fundamental particles at the Large Hadron Collider in Geneva, Switzerland. (CERN)

[Waiting for neutrinos](#) (26 March 2019)

A supernova is born when the burnt-out stellar core collapses, releasing a shockwave, which speeds toward the outer layers of the star. Most of the energy released in a supernova is emitted as neutrinos, nearly massless subatomic particles that react rarely with ordinary matter. Scientists are building the international Deep Underground Neutrino Experiment (DUNE), hosted by Fermilab. Its 70,000-ton liquid-argon detector will be located almost a mile underground at Sanford Underground Research Facility in South Dakota, waiting for another burst of supernova neutrinos to arrive. The discovery would portend a new exploding star somewhere in the Milky Way. (Fermilab)

DARK MATTER

[Unusual galaxies defy dark matter theory](#) (27 March 2019)

After drawing both praise and scepticism, the team of astronomers who discovered NGC 1052-DF2, the very first known galaxy to contain little to no dark matter, are back with stronger evidence about its bizarre nature. Dark matter is a mysterious, invisible substance that typically dominates the makeup of galaxies; finding an object that's missing dark matter is unprecedented and came as a complete surprise. Now, the team has not one, but two, new studies supporting their initial observations, demonstrating that dark matter is in fact separable from galaxies. (WM Keck Observatory)

EXOPLANETS

[The case of the over-tilting exoplanets](#) (4 March 2019)

For almost a decade, astronomers have tried to explain why so many pairs of planets outside our solar system have an odd configuration; their orbits seem to have been pushed apart by a powerful unknown mechanism. Yale researchers say they've found a possible answer, and it implies that the planets' poles are majorly tilted. The finding could have a big impact on how researchers estimate the structure, climate, and habitability of exoplanets as they try to identify planets that are like Earth. (Yale University)

[Exoplanet under the looking glass](#) (27 March 2019)

For the first time, astronomers have succeeded in investigating an exoplanet using optical interferometry. The new method allowed astronomers to measure the position of the exoplanet HR 8799e with unprecedented accuracy. Also, the planet's spectrum was recorded as precisely as never before, paving the way for future searches for life on other planets. The

measurements, which were obtained with the participation of astronomers from the Max Planck Institutes for Astronomy and for Extraterrestrial Physics, were performed with the GRAVITY instrument at ESO's Paranal Observatory. (Max Planck Institute for Astronomy)

[Data flows from NASA's TESS Mission, leads to discovery of Saturn-sized planet](#)

(27 March 2019)

Astronomers who study stars are providing a valuable assist to the planet-hunting astronomers pursuing the primary objective of NASA's new TESS Mission. In fact, asteroseismologists, stellar astronomers who study seismic waves (or "starquakes") in stars that appear as changes in brightness, often provide critical information for finding the properties of newly discovered planets. This teamwork enabled the discovery and characterization of the first planet identified by TESS for which the oscillations of its host star can be measured. The planet – TOI 197.01 (TOI is short for "TESS Object of Interest") – is described as a "hot Saturn" in a recently accepted scientific paper. That's because the planet is about the same size as Saturn and is also very close to its star, completing an orbit in just 14 days, and therefore, very hot. (Iowa State University)

GALAXIES

[What does the Milky Way Weigh? Hubble and Gaia investigate](#) (7 March 2019)

In a striking example of multi-mission astronomy, measurements from the NASA/ESA Hubble Space Telescope and the ESA Gaia mission have been combined to improve the estimate of the mass of our home galaxy the Milky Way: 1.5 trillion solar masses. (STScI)

HUMAN SPACEFLIGHT

[Floating ideas for an airlock near the Moon](#) (13 March 2019)

Assembly of a new habitable structure near the Moon, known as the Gateway, is scheduled to begin in 2023. The international project will allow humans to explore farther than ever before and it brings new opportunities for European design in space. In late 2018, ESA commissioned two consortia, one led by Airbus and the other by Thales Alenia Space, to undertake parallel studies into the design of a scientific airlock. Similarly, to the Japanese Experiment Module Kibo on the International Space Station, this airlock will allow scientific experiments to be transferred from the Gateway to and from outer space. The scientific airlock forms one part of a European module called ESPRIT, a module that will also enable refuelling and provide telecommunications with the Moon and Earth. Though it is still very early days for the ESPRIT development, ESA astronaut Jean-François Clervoy and ESA astronaut trainer Hervé Stevenin recently had the opportunity to get hands-on with one airlock concept in Marseille, France and see how this could work in space. (ESA)

[Returning astronauts to the Moon: Lockheed Martin finalizes full-scale cislunar habitat prototype](#) (14 March 2019)

For long-duration, deep space missions, astronauts will need a highly efficient and reconfigurable space, and Lockheed Martin is researching and designing ways to support those missions. Under a public-private partnership as a part of NASA's Next Space Technologies for Exploration Partnerships (NextSTEP) Phase II study contract, Lockheed Martin has completed the initial ground prototype for a cislunar habitat that would be

compatible with NASA's Gateway architecture. This habitat will help NASA study and assess the critical capabilities needed to build a sustainable presence around the Moon and support pioneering human exploration in deep space. The full-scale prototype, or Habitat Ground Test Article (HGTA), is built inside of a repurposed shuttle-era cargo container, called a Multi-Purpose Logistics Module (MPLM), at Kennedy Space Centre. Using rapid prototyping and modern design tools like virtual and augmented reality, the team customized the interior making full use of the entire volume of the module to accommodate a variety of tasks like science missions and personal needs of future astronauts. (Lockheed Martin)

INTERNATIONAL SPACE STATION

[Next Space Station crew launch](#) (7 March 2019)

Two American astronauts and a Russian cosmonaut are set to join the crew aboard the International Space Station on Thursday, March 14. The trio's arrival will return the orbiting laboratory's population to six, including three NASA astronauts. This launch will also mark the fourth Expedition crew with two female astronauts. (NASA)

[Can organisms survive on Mars, and can we identify them?](#) (26 March 2019)

During the BIOMEX experiment, which ran from 2014 to 2016, several hundred samples of organisms were exposed to the conditions found in space or on Mars while on board the International Space Station. The results of the experiment have now been evaluated and show that some organisms that exist on Earth can survive even under Martian conditions. DLR is developing sensors with which the metabolic products of microorganisms can be detected during future space missions. (DLR)

JUPITER AND MOONS

[Jupiter's unknown journey revealed](#) (22 March 2019)

The giant planet Jupiter was formed four times further from the sun than its current orbit and migrated inwards in the solar system over a period of 700 000 years. Researchers found proof of this incredible journey thanks to a group of asteroids close to Jupiter. (Lund University)

LAUNCHES & SERVICES

[NASA, SpaceX launch first flight test of space system designed for crew](#) (4 March 2019)

For the first time in history, a commercially built and operated American crew spacecraft and rocket, which launched from American soil, is on its way to the International Space Station. The SpaceX Crew Dragon spacecraft lifted off at 2:49 a.m. EST Saturday on the company's Falcon 9 rocket from Launch Complex 39A at NASA's Kennedy Space Centre in Florida. NASA and SpaceX will use data from Demo-1, along with planned upgrades and additional qualification testing, to further prepare for Demo-2, the crewed flight test that will carry NASA astronauts Bob Behnken and Doug Hurley to the International Space Station. NASA will validate the performance of SpaceX's systems before putting crew on board for the Demo-2 flight, currently targeted for July. (NASA)

LEGISLATION

[FAA rule would streamline commercial space launch and re-entry requirements](#)

(26 March 2019)

The Federal Aviation Administration (FAA) today posted a proposed rule (PDF) that would streamline federal commercial space transportation requirements for future launch, re-entry, and launch-site providers, and maintain safety during launches and re-entries. The proposed rule follows the National Space Council's 2018 'Space Policy Directive 2', which called on the Secretary of Transportation to review and revise the Department's commercial space launch and re-entry licensing regulations. It will expand national and international access to the economic, scientific, and educational benefits of traveling to space. "These rules will maintain safety, simplify the licensing process, enable innovation, and reduce costs to help our country remain a leader in commercial space launches," said U.S. Secretary of Transportation (FAA)

MARS

[DLR's HP3 experiment starts hammering into the Martian soil](#) (1 March 2019)

On 28 February 2019, the German Aerospace Centre 'Mole' fully automatically hammered its way into the Martian subsurface for the first time. In a first step, it penetrated to a depth between 18 and 50 centimetres into the Martian soil with 4000 hammer blows over a period of four hours. "On its way into the depths, the mole seems to have hit a stone, tilted about 15 degrees and pushed it aside or passed it. The Mole then worked its way up against another stone at an advanced depth until the planned four-hour operating time of the first sequence expired. Tests on Earth showed that the rod-shaped penetrometer can push smaller stones to the side, which is very time-consuming. (DLR)

[Clues to Martian Life Found in Chilean Desert](#) (01 March 2019)

A robotic rover deployed in the most Mars-like environment on Earth, the Atacama Desert in Chile, has successfully recovered subsurface soil samples during a trial mission to find signs of life. The samples contained unusual and highly specialized microbes that were distributed in patches, which researchers linked to the limited water availability, scarce nutrients and chemistry of the soil. (EurekAlert)

[Mars 'Mole' takes a break](#) (5 March 2019)

As part of NASA's InSight mission, the German Aerospace Centre developed a penetrometer designed to dig three to five metres below the surface of Mars and measure the heat emanating from the planet's interior. After the Mars 'Mole' began hammering into the ground on Thursday 28 February, the probe, which is part of DLR's HP3 (Heat and Physical Properties Package) instrument, came about three-quarters of the way out of its housing structure before stopping. Data also suggests that the 'Mole' is at a 15-degree tilt. The team therefore decided to pause the hammering for about two weeks to allow the situation to be analysed more closely and jointly come up with strategies for overcoming the obstacle. The researchers suspect that the Mole has hit a rock or some gravel. The team had hoped that there would be relatively few rocks beneath the soil, as images of the landing site show only a few on the surface near the landing module. In principle, the Mars Mole has been designed to push smaller stones aside and proved capable of such a feat in tests conducted before it was launched for Mars. (DLR)

[A NASA spacecraft may have explored the edges of an early Mars sea in 1997](#)

(14 March 2019)

Nearly half a century ago the Mariner 9 spacecraft returned images of some of the largest channels in the Solar System. Orbital observations of the gigantic channels suggested they were formed approximately 3.4 billion years ago by cataclysmic floods, much larger than any known to have occurred on Earth. The prospect that abundant flowing water once sculptured the Martian landscape ignited renewed interest in the possibility that life may have once thrived on the planet. To test the Martian mega-flood hypothesis, NASA deployed its first Martian rover; the Sojourner, on board the 1997 Mars Pathfinder spacecraft that journeyed to the red planet. NASA spent a total of \$280 million on the mission, including the launch vehicle and mission operations. The terrain within the rover's visual range includes potential fluvial features suggestive of regionally extensive flooding. However, those features suggest floods that were at least 10 times shallower than those estimated using images obtained from orbit. Hence, the mission was not able to exclude still disputed alternative views sustaining that debris or lavas flows could have in fact dominated the channels' formational history without significant water discharges. (Planetary Science Institute)

[ExoMars landing platform arrives in Europe with a name](#) (20 March 2019)

The platform destined to land on the Red Planet as part of the next ExoMars mission has arrived in Europe for final assembly and testing and been given the name of 'Kazachok'. The ExoMars programme is a joint endeavour between ESA and Roscosmos and comprises two missions. The Trace Gas Orbiter is already circling Mars examining the planet's atmosphere, while the second mission, comprising a surface science platform and a rover, is foreseen for launch in 2020. Last month, the rover was named 'Rosalind Franklin' after the prominent scientist behind the discovery of the structure of DNA. Now the surface platform also has a name. Kazachok literally means little Cossack, and it is a lively folk dance. Once on the Martian surface, Rosalind the rover will drive off the Kazachok platform to perform scientific investigations. Kazachok will remain stationary to investigate the climate, atmosphere, radiation and possible presence of subsurface water in the landing site. (ESA)

[InSight mission – diagnostic run for the 'Mole' on Mars](#) (21 March 2019)

DLR will command the Mars 'Mole' to begin a short new round of hammering at the end of March. The seismometer and the camera will closely monitor the movement of the Mole. The researchers want to analyse in more detail the situation of the self-hammering probe, which has shown no further progress since it reached a depth of approximately 30 centimetres at the beginning of March. Different ideas for releasing the Mole require a more detailed analysis of the situation and at least a few more weeks to test different strategies on Earth. (DLR)

[Asteroids, hydrogen make great recipe for life on Mars](#) (25 March 2019)

A new study reveals asteroid impacts on ancient Mars could have produced key ingredients for life if the Martian atmosphere was rich in hydrogen. An early hydrogen-rich atmosphere on Mars could also explain how the planet remained habitable after its atmosphere thinned. The study used data from NASA's Curiosity rover on Mars and was conducted by researchers on Curiosity's Sample Analysis at Mars (SAM) instrument team and international colleagues. These key ingredients are nitrites (NO₂) and nitrates (NO₃), fixed forms of nitrogen that are important for the establishment and sustainability of life as we know it. Curiosity discovered them in soil and rock samples it took as it traversed within Gale Crater, the site of ancient lakes and groundwater systems on Mars. (JPL)

[What the devil is leaving these trails on Mars?](#) (28 March 2019)

The Chalcoporos Rupes region is located in the southern Martian highlands approximately 1000 kilometres west of the Hellas impact basin. The region is characterised by a heavy dust blanket and the activity of Martian winds. Here, narrow, dark lines that have been created by 'dust devils', small whirlwinds, are striking. From these, the wind directions in this region can be derived. (DLR)

[Rivers raged on Mars late into its history](#) (27 March 2019)

The rivers show strong flow up to the last geological minute before the wet climate dries up. You would expect them to wane gradually over time, but that's not what we see. The rivers get shorter, hundreds of kilometres rather than thousands, but discharge is still strong. The wettest day of the year is still very wet. It's possible the climate had a sort of "on/off" switch which tipped back and forth between dry and wet cycles. (University of Chicago)

[NASA's Mars helicopter completes flight tests](#) (28 March 2019)

In late January 2019, all the pieces making up the flight model (actual vehicle going to the Red Planet) of NASA's Mars Helicopter were put to the test. Weighing in at no more than 4 pounds (1.8 kilograms), the helicopter is a technology demonstration project currently going through the rigorous verification process certifying it for Mars. The majority of the testing the flight model is going through had to do with demonstrating how it can operate on Mars, including how it performs at Mars-like temperatures. Can the helicopter survive and function in cold temperatures, including nights with temperatures as low as minus 90 degrees Celsius? All this testing is geared towards February 2021, when the helicopter will reach the surface of the Red Planet, firmly nestled under the belly of the Mars 2020 rover. A few months later, it will be deployed and test flights (up to 90 seconds long) will begin, the first from the surface of another world. (JPL)

[New evidence of deep groundwater on Mars](#) (28 March 2019)

In mid-2018, researchers detected the presence of a deep-water lake on Mars under its south polar ice caps. Now, researchers at the USC Arid Climate and Water Research Centre (AWARE) have published a study that suggests deep groundwater could still be active on Mars and could originate surface streams in some near-equatorial areas on Mars. The researchers at USC have determined that groundwater likely exists in a broader geographical area than just the poles of Mars and that there is an active system, as deep as 750 meters, from which groundwater comes to the surface through cracks in the specific craters they analyzed. (University of Southern California)

MILKY WAY

[Giant 'chimneys' vent X-rays from Milky Way's core](#) (20 March 2019)

By surveying the centre of our Galaxy, ESA's XMM-Newton has discovered two colossal 'chimneys' funnelling material from the vicinity of the Milky Way's supermassive black hole into two huge cosmic bubbles. The giant bubbles were discovered in 2010 by NASA's Fermi Gamma-ray Space Telescope: one stretches above the plane of the Milky Way galaxy and the other below, forming a shape akin to a colossal hourglass that spans about 50 000 light years, around half the diameter of the entire Galaxy. They can be thought of as giant 'burps' of material from the central regions of our Milky Way, where its central black hole, known as Sagittarius A*, resides. Now, XMM-Newton has discovered two channels of hot, X-ray

emitting material streaming outwards from Sagittarius A*, finally linking the immediate surroundings of the black hole and the bubbles together. Scientists think that these act as a set of exhaust pipes through which energy and mass are transported from our Galaxy's heart out to the base of the bubbles, replenishing them with new material. This finding clarifies how the activity occurring at the core of our home Galaxy, both present and past, is connected to the existence of larger structures around it. (ESA)

MOON

[Israel's first spacecraft to moon sends selfie](#) (5 March 2019)

An Israeli spacecraft on its maiden mission to the moon has sent its first selfie back to Earth. The image showing part of the Beresheet spacecraft with Earth in the background was beamed to mission control in Yehud, Israel, 37,600 kilometres (23,360 miles) away. The partners, NGO SpaceIL and state-owned Israel Aerospace Industries, launched the unmanned Beresheet, Hebrew for Genesis, from Cape Canaveral in Florida on February 22. The 585-kilogram (1,290-pound) craft took off atop a Falcon 9 rocket from the private US-based SpaceX company of entrepreneur Elon Musk. The trip is scheduled to last seven weeks, with the Beresheet due to touch down on April 11. Jerusalem (AFP)

[Moon shot: Toyota, Japan space agency plan lunar mission](#) (6 March 2019)

Toyota is teaming up with Japan's space agency on a planned mission to the Moon, with the Japanese auto giant expected to develop a lunar rover. It will be the car manufacturer's first full-fledged entry into space exploration, after the company jointly developed a small robot sent to the International Space Station. To make the lunar rover, we have been asked to consider the following parameters:

- The vehicle must be able to travel on the moon's surface for up to 6 weeks
- The interior must be designed to allow the astronauts to remove their space suits and live
- The space inside needs to be able to provide just under about 13 m³ of living space
- The exterior should be slightly larger than "the size of two minibuses"

[LAMP instrument sheds light on lunar water movement](#) (8 March 2019)

Using the Southwest Research Institute-led Lyman Alpha Mapping Project (LAMP) aboard NASA's Lunar Reconnaissance Orbiter (LRO), scientists have observed water molecules moving around the dayside of the Moon. A paper published in Geophysical Research Letters describes how LAMP measurements of the sparse layer of molecules temporarily stuck to the surface helped characterize lunar hydration changes over the course of a day. (SwRI)

[Where's the water? Two resource-hunting tools for the Moon's surface](#) (11 March 2019)

Sensing the amount of hydrogen is the job of the Neutron Spectrometer System, or NSS. It can measure the total volume present, up to three feet below the surface. NSS works by measuring changes in the number and energy of particles called neutrons that are always coming from the Moon. When these tiny particles strike something that's about their size, like a hydrogen atom, they lose a lot of their energy. That's a change that NSS can detect and use to infer the presence of hydrogen. The second tool can't see underground. Instead, the superpower of the Near-Infrared Volatiles Spectrometer System, or NIRVSS (pronounced "nervous"), is the ability to tell the nature of the hydrogen it encounters. It could belong to water molecules or to hydroxyl or just exist as hydrogen atoms – any of which could be a useful resource, for tasks such as making fuel for space exploration. (NASA Ames)

[Gateway to the Moon](#) (12 March 2019)

The International Space Station partners have endorsed plans to continue the development of the Gateway, an outpost around the Moon that will act as a base to support both robots and astronauts exploring the lunar surface. The Multilateral Coordination Board, which oversees the management of the Space Station, stressed its common hope for the Gateway to open up a cost-effective and a sustainable path to the Moon and beyond, and inspire the next generation as a future success of international cooperation in science and technology.

[Untouched Apollo Moon rocks to be studied at NASA Ames](#) (13 March 2019)

The unopened sample was collected by the Apollo 17 mission, the last to put human boots on the lunar surface and the only to have a geologist onboard. Much like the samples of ice we use to see changes in Earth's climate over long periods of time, this core sample from the Moon contains material spanning millions to billions of years. Almost fifty years after Apollo, the current generation of scientists will now be able to use modern technologies on these samples to unravel even more about the history of the Moon. (NASA Ames)

NEPTUNE

[Hubble tracks the lifecycle of giant storms on Neptune](#) (25 March 2-19)

Neptunian storms are different from the cyclones we see on Earth or Jupiter. So are the wind patterns that propel them. Similar to the rails that keep errant bowling balls from bounding into the gutters, thin bands of wind currents on Jupiter keep the Great Red Spot on a set path. On Neptune, wind currents operate in much wider bands around the planet, allowing storms like the Great Dark Spot to slowly drift across latitudes. The storms typically hover between westward equatorial wind jets and eastward-blowing currents in the higher latitudes before strong winds pull them apart. (NASA Goddard)

PULSARS

[Fermi satellite clocks 'cannonball' pulsar speeding through space](#) (19 March 2019)

Astronomers found a pulsar hurtling through space at nearly 2.5 million miles an hour, so fast it could travel the distance between Earth and the Moon in just 6 minutes. The discovery was made using NASA's Fermi Gamma-ray Space Telescope and the National Science Foundation's Karl G. Jansky Very Large Array (VLA). Pulsars are superdense, rapidly spinning neutron stars left behind when a massive star explodes. This one, dubbed PSR J0002+6216 (J0002 for short), sports a radio-emitting tail pointing directly toward the expanding debris of a recent supernova explosion. (NASA Goddard)

SATURN AND MOONS

[Cassini finds Saturn's rings coat tiny moons](#) (28 March 2019)

New findings have emerged about five tiny moons nestled in and near Saturn's rings. The closest-ever flybys by NASA's Cassini spacecraft reveal that the surfaces of these unusual moons are covered with material from the planet's rings and from icy particles blasting out of

Saturn's larger moon Enceladus. The work paints a picture of the competing processes shaping these mini-moons. (JPL)

SOLAR SYSTEM

[What scientists found after sifting through dust in the solar system](#) (12 March 2019)

Just as dust gathers in corners and along bookshelves in our homes, dust piles up in space too. But when the dust settles in the solar system, it's often in rings. Several dust rings circle the Sun. The rings trace the orbits of planets, whose gravity tugs dust into place around the Sun, as it drifts by on its way to the centre of the solar system. The dust consists of crushed-up remains from the formation of the solar system, some 4.6 billion years ago, rubble from asteroid collisions or crumbs from blazing comets. Dust is dispersed throughout the entire solar system, but it collects at grainy rings overlying the orbits of Earth and Venus, rings that can be seen with telescopes on Earth. By studying this dust, what it's made of, where it comes from, and how it moves through space, scientists seek clues to understanding the birth of planets and the composition of all that we see in the solar system. Two recent studies report new discoveries of dust rings in the inner solar system. One study uses NASA data to outline evidence for a dust ring around the Sun at Mercury's orbit. A second study from NASA identifies the likely source of the dust ring at Venus' orbit: a group of never-before-detected asteroids co-orbiting with the planet. (NASA Goddard)

STARS AND STAR CLUSTERS

[Stars exploding as supernovae lose their mass to companion stars during their lives](#)

(7 March 2019)

A massive star evolving and becoming a red supergiant, and finally exploding as a supernova. A binary companion may strip the star's hydrogen away (producing supernova type IIb/Ib), and for a more massive star the stellar wind expels the remaining helium layer (producing supernova type Ic). (University of Turku)

[Researchers confirm massive hyper-runaway star ejected from the Milky Way disk](#)

(12 March 2019)

A fast-moving star may have been ejected from the Milky Way's stellar disk by a cluster of young stars, according to researchers who say the star did not originate from the middle of the galaxy, as previously believed by astronomers. This discovery dramatically changes our view on the origin of fast-moving stars. The fact that the trajectory of this massive fast-moving star originates in the disk rather than at the Galactic centre indicates that the very extreme environments needed to eject fast-moving stars can arise in places other than around supermassive black holes. (University of Michigan)

[Spiralling giants: witnessing the birth of a massive binary star system](#) (18 March 2019)

This is an exciting finding because we have long been perplexed by the question of whether stars form into binaries during the initial collapse of the star-forming cloud or whether they are created during later stages. Our observations clearly show that the division into binary stars takes place early on, while they are still in their infancy. (ALMA)

SUN

[ESA gives go-ahead for Smile mission with China](#) (5 March 2019)

The Solar wind Magnetosphere Ionosphere Link Explorer, Smile, has been given the green light for implementation by ESA's Science Programme Committee. The announcement clears the way for full development of this new mission to explore the Sun-Earth connection, which will be conducted in collaboration with China. Smile is expected to revolutionise scientists' understanding of the physical processes taking place during the continuous interaction between particles in the solar wind and Earth's magnetic shield, the magnetosphere. (ESA)

[ESA's space weather mission to be protected against stormy Sun](#) (5 March 2019)

ESA is planning Earth's first dedicated space weather observatory to warn of potentially harmful turbulence in our parent star. Like a referee at a sports game, the Lagrange spacecraft will be able to observe both the Sun and Earth as well as the space in between but will itself be in the space weather line of fire. Our goal is an optimised design that endures the radiation storms associated with space weather events in an efficient but effective way. (ESA)

[Discovering bonus science with NASA's Magnetospheric Multiscale spacecraft](#)

(7 March 2019)

The data MMS gathered in this campaign will be some of the most accurate measurements of turbulence in the solar wind ever made. The research will also complement the work being done by NASA's Parker Solar Probe, which flies through the Sun's atmosphere studying the origins of the solar wind. While Parker Solar Probe measures the initial turbulence in the solar wind, MMS measured the aftermath when it reaches Earth. (NASA Goddard)

TECHNOLOGY

[First MOONS camera delivered and mounted](#) (1 March 2019)

MOONS, the Multi-Object Optical and Near-infrared Spectrograph. The Kavli Institute for Cosmology, Cambridge is heavily involved, together with the Cavendish Laboratory and the Institute of Astronomy, in the development of MOONS, the next generation near-IR multi-object spectrograph for ESO's Very Large Telescope in Chile. These cameras use an innovative optical design, including a lens nested into a larger aspherical lens. The camera will be aligned and tested at cryogenic temperatures (-140 C) and tested for resilience to simulated earthquake conditions. MOONS will provide spectra of over a million galaxies in a spectral range and with a sensitivity that will enable us to constrain the cosmic evolution of the key physical properties of galaxies, also as a function of environment.

(Kavli Institute for Cosmology, Cambridge)

[ESA greenlight for UK's air-breathing rocket engine](#) (14 March 2019)

The development programme of the world's first air-breathing rocket engine has taken an additional significant step forward, which will lead to major testing milestones being undertaken within the next 18 months. It confirms the test version of this revolutionary new class of engine is ready for implementation. (ESA)

[ANU research set to shake-up space missions](#) (14 March 2019)

A new study from The Australian National University (ANU) has found a number of 2D materials can not only withstand being sent into space, but potentially thrive in the harsh conditions. It could influence the type of materials used to build everything from satellite

electronics to solar cells and batteries, making future space missions more accessible, and cheaper to launch. (Australian National University)

[Dream Chaser spacecraft passes another NASA milestone](#) (21 March 2019)

Sierra Nevada Corporation's (SNC) Dream Chaser spacecraft passed NASA's Integrated Review Milestone 5 (IR5), a key status check on SNC's performance of a variety of ground and flight operations. IR5 demonstrates that the Dream Chaser team is on track to operate the space vehicle in advance of the first mission to the International Space Station under the Commercial Resupply Services Contract 2 (CRS-2). Owned and operated by SNC, the Dream Chaser spacecraft is a reusable, multi-mission space utility vehicle. It is capable of transportation services to and from low-Earth orbit and is the only commercial, lifting-body vehicle capable of a runway landing. The Dream Chaser Cargo System was selected by NASA to provide cargo delivery and disposal services to the International Space Station under the Commercial Resupply Services 2 (CRS-2) contract. All Dream Chaser CRS-2 cargo missions are planned to land at Kennedy Space Centre's Shuttle Landing Facility. (Sierra Nevada Corporation)

TELESCOPES

[UK becomes home to the HQ of the new international organisation behind the World's biggest ever radio telescope](#) (12 March 2019)

At a treaty signing in Rome today the UK has formally become the home of the new international organisation behind what will soon be the World's biggest ever radio telescope – the Square Kilometre Array (SKA). The UK is one of the seven founding countries involved in the SKA Project creating the intergovernmental organisation that will oversee the delivery of the SKA. Once operational the SKA will improve our understanding of the evolution of the Universe and help us to map hundreds of millions of galaxies. The treaty signing also establishes the siting of the international nerve centre of this project at Jodrell Bank in the UK. (STFC)

Pat Williams March 2019