

Space News Update – June 2020

By Pat Williams

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

SKYRORA TEST LAUNCH FROM SHETLAND



Image Credit: Skyrora

Edinburgh-based Skyrora successfully launched its Skylark Nano rocket from remote land, the Fethaland Peninsula at North Roe on the Scottish island on Saturday, the 13th of June. Skyrora plans to launch from one of the three proposed spaceports in Scotland and commercially launching from Shetland in the future is a potential option for them. Reaching an altitude of six kilometres, this marked the third time the 2 metre projectile took to the skies. The launch was completed for educational purposes, collecting meteorological data, measuring wind profiles, analysing the vehicles trajectory and providing critical training in support of Skyrora’s future plans. All social distancing measures were met during the launch days. The launch signifies a vital step towards Skyrora’s ambitions to become the UK’s “go-to” satellite launch provider. We’re ecstatic and truly proud. This is a great success for

Skylark Nano, and the Skyrora team in general. Launching from Shetland is very important for us because it's a potential option for our Skyrora XL orbital commercial launch vehicle. To understand the local launch conditions learning more about the wind profiles in Shetland is critical. "Skylark Nano's third successive launch is testament to the engineers who have worked tirelessly to bring to life a reusable rocket that can provide valuable intelligence for the future of the UK space programme." "With this successful launch from Shetland we are further closing the gap to making the UK a rocket launching nation again. "We hope reaching space will inspire the whole nation and show the younger generation what the future of UK Space holds". Skylark Nano's first launch took place in Ross-shire in summer 2018, with the firm continuing to develop cutting-edge research and technology ahead of its first planned commercial orbital launches. Expanding their company across Scotland will allow them to leverage the highly skilled workforce available with their aim of creating 170 jobs by the end of 2023. Skyrora is developing launch vehicle technology that builds on previous rocket systems with the aim of reducing the cost of launches thanks to proven technology and advanced engineering methods. (Skyrora)

[Skyrora test launch from Shetland](#) (15 June 2020)

SOLAR ORBITER MAKES FIRST CLOSE APPROACH TO THE SUN

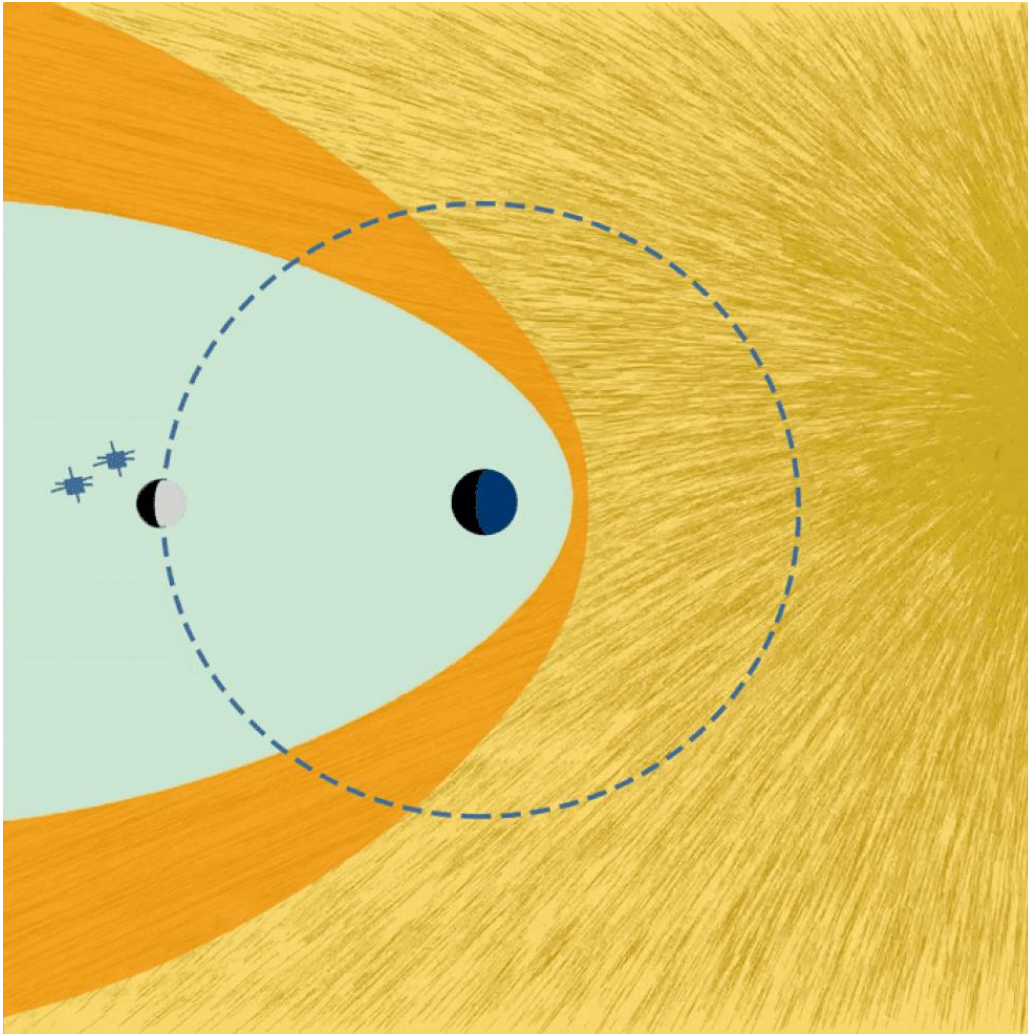


Image Credit: ESA

ESA's Sun-exploring mission Solar Orbiter has made its first close approach to the star on June 15, getting as close as 77 million kilometres to its surface, about half the distance between the Sun and Earth. In the week following this first perihelion, the point in the orbit closest to the Sun, the mission scientists will test the spacecraft's ten science instruments, including the six telescopes on-board, which will acquire close-up images of the Sun in unison for the first time. Since the spacecraft is currently 134 million kilometres from Earth, it will take about a week for all perihelion images to be downloaded via ESA's 35-m deep-space antenna in Malargüe, Argentina. The data from the in-situ instruments will become public later this year after a careful calibration of all individual sensors. The images, to be released in mid-July, will be the closest images of the Sun ever captured. (ESA)

[Solar Orbiter makes first close approach to the Sun](#) (15 June 2020)

NASA SPACECRAFT HELPS IDENTIFY SOLAR RADIATION PATTERNS THAT EXPOSE THE MOON



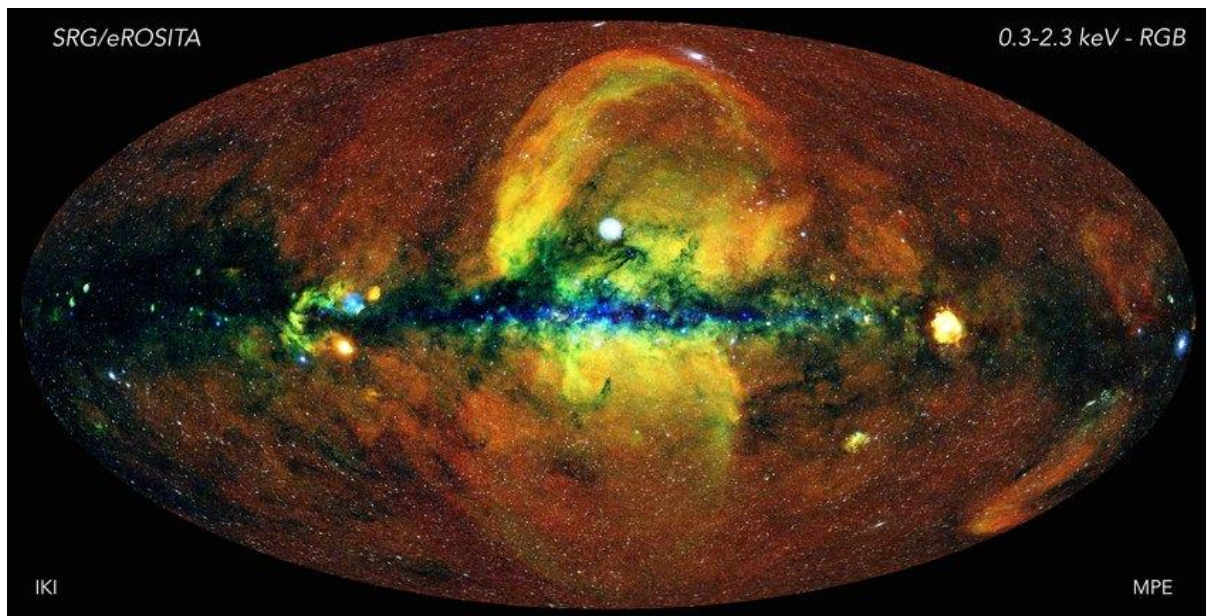
Credit: NASA

https://www.nasa.gov/sites/default/files/thumbnails/image/moonsock_final_985.gif

Which way the wind blows in space has new importance for astronaut safety at the Moon. Using data from several NASA missions, scientists discovered that wind created by high-speed particles from the Sun can cause the tail of Earth's protective magnetic bubble to flap like a windsock in a strong breeze. This movement can pull the tail so far out of line that it exposes the Moon to potentially damaging charged particles at times it was previously thought to be protected. The finding, which reveals a new challenge of predicting when solar activity exposes the Moon, will help scientists and engineers prepare for future lunar missions. Our Sun provides life-giving light, but it also spews out high-speed particles – the solar wind, in which some very high energy particle bursts can be damaging to satellites and humans in space. While Earth is safe inside its magnetic bubble, the magnetosphere, the Moon continually passes into and out of the stretched-out tail of this protective bubble as it orbits the planet. During the 25% of the time the Moon spends behind Earth, in the full Moon phase, it is inside the magnetosphere and thought to be protected. But this new research, published in the *Journal of Geophysical Research: Space Physics*, shows that's not always the case. (NASA Goddard)

[NASA spacecraft helps identify solar radiation patterns that expose the Moon](#) (30 June 2020)

OUR DEEPEST VIEW OF THE X-RAY SKY



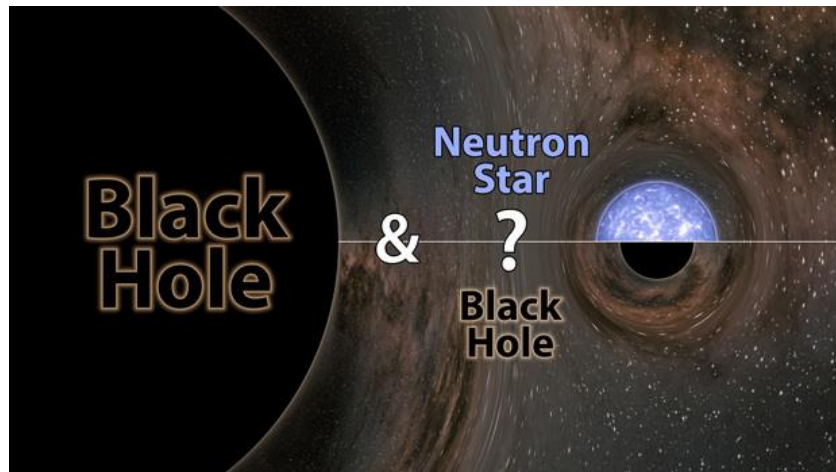
Credit: Jeremy Sanders, Hermann Brunner and the eSASS team (MPE); Eugene Churazov, Marat Gilfanov (on behalf of IKI)

Over the course of 182 days, the eROSITA X-ray telescope onboard SRG has completed its first full sweep of the sky. This new map of the hot, energetic universe contains more than one million objects, roughly doubling the number of known X-ray sources discovered over the 60-year history of X-ray astronomy. Most of the new sources are active galactic nuclei at cosmological distances, marking the growth of gigantic black holes over cosmic time. Clusters of galaxies in the new map will be used to track the growth of cosmic structures and constrain cosmological parameters. Closer to home, stars with hot coronae, binaries and supernova remnants dot our Galaxy, and we now have a complete map of the hot baryons in the Milky Way, something that can only be achieved with the 360-degree view provided by the eROSITA survey. The all-sky image reveals in exquisite detail the structure of the hot gas in the Milky Way itself, and the circum-galactic medium, which surrounds it, whose properties are key to understanding the formation history of our Galaxy. The eROSITA X-ray map also reveals stars with strong, magnetically active hot coronae, X-ray binary stars containing neutron stars, black holes or white dwarves, and spectacular supernova remnants in our own and other nearby galaxies such as the Magellanic clouds.

(Max Planck Institute for Extraterrestrial Physics)

[Our deepest view of the X-ray sky](#) (19 June 2020)

LIGO-VIRGO FINDS MYSTERY OBJECT IN "MASS GAP"



In August of 2019, the LIGO-Virgo gravitational-wave network witnessed the merger of a black hole with 23 times the mass of our sun and a mystery object 2.6 times the mass of the sun. Scientists do not know if the mystery object was a neutron star or black hole, but either way it set a record as being either the heaviest known neutron star or the lightest known black hole.
Image credit: LIGO/Caltech/MIT/R. Hurt (IPAC)

When the most massive stars die, they collapse under their own gravity and leave behind black holes; when stars that are a bit less massive die, they explode in a supernova and leave behind dense, dead remnants of stars called neutron stars. For decades, astronomers have been puzzled by a gap that lies between neutron stars and black holes: the heaviest known neutron star is no more than 2.5 times the mass of our sun, or 2.5 solar masses, and the lightest known black hole is about 5 solar masses. The question remained: does anything lie in this so-called mass gap? Now, in a new study from the National Science Foundation's Laser Interferometer Gravitational-Wave Observatory (LIGO) and the Virgo detector in Europe, scientists have announced the discovery of an object of 2.6 solar masses, placing it firmly in the mass gap. The object was found on August 14, 2019, as it merged with a black hole of 23 solar masses, generating a splash of gravitational waves detected back on Earth by LIGO and Virgo. "We don't know if this object is the heaviest known neutron star, or the lightest known black hole, but either way it breaks a record." (Caltech)

[LIGO-Virgo finds mystery object in "mass gap"](#) (23 June 2020)

THALES ALENIA SPACE WILL PROVIDE TWO KEY PRESSURIZED ELEMENTS FOR AXIOM COMMERCIAL SPACE STATION



© Axiom Space

In January, NASA selected Axiom's proposal to attach its space station modules to the International Space Station (ISS) starting from the second half of 2024, ultimately creating a new 'Axiom Segment' which will expand the usable and habitable volume of the ISS. When the ISS reaches its retirement date, the Axiom complex will detach and operate as a free-flying commercial space station. The Axiom Segment will be attached to the ISS Node 2 built by Thales Alenia Space. (Thales)

[Thales Alenia Space will provide two key pressurized elements for Axiom commercial space station](#) (24 June 2020)

LINKS TO OTHER SPACE NEWS PUBLISHED IN JUNE 2020

ASTEROIDS

[OSIRIS-REx discovers sunlight can crack rocks on asteroid Bennu](#) (9 June 2020)

Asteroids don't just sit there doing nothing as they orbit the Sun. They get bombarded by meteoroids, blasted by space radiation, and now, for the first time, scientists are seeing evidence that even a little sunshine can wear them down. Daytime highs on Bennu can reach almost 127 degrees Celsius and night-time lows plummet to about minus 73 degrees Celsius. Rocks on asteroid Bennu appear to be cracking as sunlight heats them up during the day and they cool down at night, according to images from NASA's OSIRIS-REx (Origins Spectral Interpretation Resource Identification Security - Regolith Explorer) spacecraft. It is the first time evidence for this process, called thermal fracturing, has been definitively observed on an object without an atmosphere. It is one piece of a puzzle that tells us what the surface used to be like, and what it will be like millions of years from now. (NASA Goddard)

ASTROPHYSICS

[Confirming Einstein's most fortunate thought](#) (10 June 2020)

An international research team determined with extremely high precision that gravity causes neutron stars and white dwarf stars to fall with equal accelerations. They did this by precisely tracking the motion of pulsar PSR J0337+1715, a neutron star that is a member of an unusual triple star system. Their findings, achieved by a new rigorous method and a combination of radio telescope data with latest insight from gravitational wave detectors, provide the strongest test ever of one of the most fundamental predictions of general relativity: that gravity attracts all objects with the same acceleration, without regard for their composition, density or the strength of their own gravitational field.

(Max Planck Institute for Radio Astronomy)

[MESSENGER shows how a spacecraft could end neutron lifetime stalemate](#) (11 June 2020)

MESSENGER provided data to estimate neutron lifetime. Cosmic rays striking Venus' atmosphere eject neutrons that gradually fly into space. As neutrons move to higher altitudes, more time passes, and more neutrons radioactively decay. MESSENGER counted the number of neutrons at various altitudes, allowing scientists to compare neutron numbers across altitudes. Using models, researchers could then estimate the neutron lifetime.

(Johns Hopkins Applied Physics Laboratory)

[X-ray scattering enables closer scrutiny of the interior of planets and stars](#) (24 June 2020)

By using a new measuring method, the so-called X-ray Thomson scattering, an international team of researchers was able to prove that the high pressure inside planets like Neptune or Uranus dissolves hydrocarbons into its individual parts and converts the released carbon atoms into diamond structures. Thanks to the new measuring method, such conditions, which experts call warm, dense matter and which do not occur naturally on Earth, can be examined more closely. (Helmholtz Zentrum Dresden Rossendorf)

EARTH

[PICASSO, ESA's CubeSat to sift secrets from sunrise](#) (19 June 2020)

There is always a sunrise and sunset happening somewhere on our planet. Soon a new Belgium-led CubeSat flying aboard Europe's Vega launcher will be keeping watch. The miniature PICASSO mission will use the filtering of sunlight by Earth's atmosphere to check the health of our protective ozone layer. (ESA)

[Xplore awarded mission analysis by NOAA to study Lagrange point solar observation and space weather monitoring](#) (17 June 2020)

Since 1978, the L1 Lagrange point, the neutral gravity point between the Earth and Sun, has been continuously orbited by multiple solar observatories from NASA and ESA. Light from the Sun reaches L1 five seconds earlier than the Earth. The constant stream of particles from the sun (the solar wind) reach L1 about an hour before reaching Earth, providing significant advanced warning of any disruptive space weather event. (Xplore)

[TRACERS heliophysics mission transitions from concept study to preliminary flight design](#) (22 June 2020)

NASA has approved the Tandem Reconnection and Cusp Electrodynamics Reconnaissance Satellites (TRACERS) mission to proceed to Phase B, which marks the transition from concept study to preliminary flight design. The satellites, led by the University of Iowa (UI) and managed by Southwest Research Institute, are set to launch in late 2023. In addition to providing mission management and science services to UI, SwRI is developing the Analyzer for Cusp Ions (ACI) instrument, which will study how the magnetic fields of the Sun and the Earth interact through novel measurements in the polar cusps. The cusp provides easy access to the Earth's boundary with interplanetary space allowing a unique perspective on how magnetic fields all around Earth interact with those from the Sun. In a process known as magnetic reconnection, the field lines explosively reconfigure, accelerating particles to velocities reaching a significant fraction of the speed of light. Magnetic reconnection is responsible for explosive solar events, such as solar flares and coronal mass ejections, and drives disturbances in Earth's space environment. Such disturbances produce spectacular auroras, while the high-energy electromagnetic radiation they send toward Earth can also shut down electrical power grids and disrupt satellite-based communication and navigation systems. (SwRI)

EXOPLANETS

[TESS delivers new insights into an ultrahot world](#) (30 June 2020)

KELT-9 b is a gas giant world about 1.8 times bigger than Jupiter, with 2.9 times its mass. Tidal forces have locked its rotation, so the same side always faces its star. The planet swings

around its star in just 36 hours on an orbit that carries it almost directly above both of the star's poles. KELT-9 b receives 44,000 times more energy from its star than Earth does from the Sun. This makes the planet's dayside temperature around 7,800 degrees Fahrenheit (4,300 C), hotter than the surfaces of some stars. This intense heating also causes the planet's atmosphere to stream away into space. Its host star is an oddity, too. It's about twice the size of the Sun and averages about 56 percent hotter. But it spins 38 times faster than the Sun, completing a full rotation in just 16 hours. Its rapid spin distorts the star's shape, flattening it at the poles and widening its midsection. This causes the star's poles to heat up and brighten while its equatorial region cools and dims, a phenomenon called gravity darkening. The result is a temperature difference across the star's surface of almost 1,500 F (800 C). With each orbit, KELT-9 b twice experiences the full range of stellar temperatures, producing what amounts to a peculiar seasonal sequence. The planet experiences "summer" when it swings over each hot pole and "winter" when it passes over the star's cooler midsection. So KELT-9 b experiences two summers and two winters every year, with each season about nine hours. (NASA Goddard)

GALAXIES

[Patterns formed by spiral galaxies show that the universe may have a defined structure, and that the early universe could have been spinning](#) (1 June 2020)

An analysis of more than 200,000 spiral galaxies has revealed unexpected links between spin directions of galaxies, and the structure formed by these links might suggest that the early universe could have been spinning, according to a Kansas State University study. The findings are significant because the observations conflict with some previous assumptions about the large-scale structure of the universe. Since the time of Edwin Hubble, astronomers have believed that the universe is inflating with no particular direction and that the galaxies in it are distributed with no particular cosmological structure. But Shamir's recent observations of geometrical patterns of more than 200,000 spiral galaxies suggest that the universe could have a defined structure and that the early universe could have been spinning. Patterns in the distribution of these galaxies suggest that spiral galaxies in different parts of the universe, separated by both space and time, are related through the directions toward which they spin, according to the study. The geometrical pattern exhibited by the distribution of the spiral galaxies is clear but can only be observed when analysing a very large number of astronomical objects. A spiral galaxy is a unique astronomical object because its visual appearance depends on the observer's perspective. For instance, a spiral galaxy that spins clockwise when observed from Earth, would seem to spin counter-clockwise when the observer is located in the opposite side of that galaxy. If the universe is isotropic and has no particular structure, as previous astronomers have predicted, the number of galaxies that spin clockwise would be roughly equal to the number of galaxies that spin counter-clockwise. Shamir used data from modern telescopes to show that this is not the case. When comparing the number of galaxies with different spin directions, the number of galaxies that spin clockwise is not equal to the number of galaxies that spin counter-clockwise. The difference is small, just over 2%, but with the high number of galaxies, there is a probability of less than 1 to 4 billion to have such asymmetry by chance. The patterns span over more than 4 billion light-years, but the asymmetry in that range is not uniform. The study found that the asymmetry gets higher when the galaxies are more distant from Earth, which shows that the early universe was more consistent and less chaotic than the current universe. But the patterns do not just show that the universe is not symmetric, but also that the asymmetry changes in

different parts of the universe, and the differences exhibit a unique pattern of multipoles. If the universe has an axis, it is not a simple single axis like a merry-go-round. It is a complex alignment of multiple axes that also have a certain drift. The concept of cosmological multipoles is not new. Previous space-based observatories, such as the Cosmic Background Explorer, or COBE, satellite; the Wilkinson Microwave Anisotropy Probe, or WMAP mission; and the Planck observatory showed that the cosmic microwave background, which is electromagnetic radiation from the very early universe, also exhibits multiple poles. But the measurement of the cosmic microwave background is sensitive to foreground contamination such as the obstruction of the Milky Way and cannot show how these poles changed over time. The asymmetry between spin directions of spiral galaxies is a measurement that is not sensitive to obstruction. What can obstruct galaxies spinning in one direction in a certain field will necessarily also obstruct galaxies spinning in the opposite way. There is no error or contamination that could exhibit itself through such unique, complex and consistent patterns. We have two different sky surveys showing the exact same patterns, even when the galaxies are completely different. There is no error that can lead to that. This is the universe that we live in. This is our home. (Kansas State University)

HUMAN SPACEFLIGHT

[Virgin Galactic signs Space Act agreement with NASA for private orbital spaceflight to the International Space Station \(ISS\)](#)(22 June 2020)

Virgin Galactic Holdings, a vertically integrated aerospace company, announced today the signing of a Space Act Agreement with NASA's Johnson Space Center to encourage commercial participation in orbital human spaceflight to the International Space Station while enabling the development of a robust economy in Low Earth Orbit. Under the agreement, Virgin Galactic will develop a new private orbital astronaut readiness program. This program will include identifying candidates interested in purchasing private astronaut missions to the ISS, the procurement of transportation to the ISS, on-orbit resources, and ground resources. Supporting and coordinating the use of ISS resources will be an important point of integration required for each private astronaut mission. The next generation of space traveller is interested in a variety of space experiences. Building on its commercial spaceflight training experience, Virgin Galactic believes it can provide an unparalleled, personalized customer experience for orbital space travel. NASA is seeing greater demand for use of the ISS for scientific and technological research and development, commercial activity, and international collaboration. Private astronaut experiences could range from private citizen expeditions to government-enabled scientific research missions. As part of this partnership, NASA will leverage Virgin Galactic's commercial expertise and industry knowledge. Virgin Galactic will also contribute end-to-end program management and integrated astronaut training packages for private passengers, tailored to meet the needs for a commercial orbital space flight experience. The partnership also serves as a pathfinder for the ISS National Laboratory by demonstrating additional involvement by the commercial sector in human spaceflight and may lead to commercial participants conducting research and other commercial activities aboard the ISS. Virgin Galactic has already developed a customized Future Astronaut Readiness program for its customers flying out of Spaceport America in New Mexico. Virgin Galactic's existing space experiences could play an important role in the training for orbital travel, allowing passengers to become familiar with the environment in space, such as G-forces and zero-G. Spaceport America, Virgin Galactic's home base, will be utilized for some elements of the training program. (Virgin Galactic)

[NASA developing a plan to fly personnel on suborbital spacecraft](#) (23 June 2020)

For the first time in the agency's history, NASA has initiated a new effort to enable NASA personnel to fly on future commercial suborbital spaceflights. NASA's Flight Opportunities program has successfully worked with emerging commercial suborbital transportation systems to fly research payloads to space for short periods of microgravity time. In addition, the Flight Opportunities program recently released a call that allows those non-NASA researchers to propose accompanying their payloads in suborbital space. (NASA)

[NASA extends deep space atomic clock mission](#) (24 June 2020)

In less than a year of operations, the mission has passed its primary goal to become one of the most stable clocks to ever fly in space; it is now at least 10 times more stable than atomic clocks flown on GPS satellites. In order to keep testing the system, NASA has extended the mission through August 2021. The team will use the additional mission time to continue to improve the clock's stability, with a goal of becoming 50 times more stable than GPS atomic clocks. (JPL)

[RSC Energia and Space Adventures sign contract to launch space tourists](#) (25 June 2020)

RSC Energia and Space Adventures Inc. (USA) have signed a contract to launch a short mission in 2023 with two spaceflight participants aboard a Soyuz MS spacecraft to the Russian segment of the International Space Station (ISS). During the mission, one of the spaceflight participants is expected to go on a spacewalk from the ISS Russian segment together with a professional Russian cosmonaut. (Roscosmos)

[Virgin Galactic's SpaceShipTwo completes second flight from Spaceport America](#)

(25 June 2020)

Virgin Galactic announced the successful completion of the second SpaceShipTwo test flight from Spaceport America. This flight follows the completion of the first test flight from the Company's commercial headquarters in New Mexico on May 1, 2020 and marks another important milestone as the team progresses toward the launch of Virgin Galactic's commercial service. This glide flight, flown at higher speeds, allowed the team to continue to evaluate systems and vehicle performance in advance of future rocket-powered space flights from the Company's new operating base in New Mexico. Flying VSS Unity in glide configuration at higher speeds enables certain vehicle systems to operate close to the environment seen during phases of rocket boost on a spaceflight. The spaceship achieved a glide speed of Mach 0.85 after being released from the mothership VMS Eve at an altitude of 51,000 ft. Unity completed multiple test-points before touching back down smoothly for a runway landing at Spaceport America. (Virgin Galactic)

INTERNATIONAL SPACE STATION

[Dream Chaser spaceplane pressure test article arrives at Kennedy Space Center](#)

(11 June 2020)

NASA selected Dream Chaser to provide cargo delivery, return and disposal service for the International Space Station under the CRS-2 contract. Under the contract, Dream Chaser will provide a minimum of six cargo missions to and from the space station, carrying critical supplies like food, water and science experiments, and return to Earth with a landing at

Kennedy's Launch and Landing Facility, managed by Space Florida. The pressure test article was used to validate that Dream Chaser can withstand the demands associated with repeated launches and returns from space. SNC designed the Dream Chaser spacecraft to be reusable for as many as 15 missions. The pressure article specifically verified the composite and bonded structure of the spacecraft. The test article will remain at Kennedy while SNC engineers use it to develop and verify refurbishment operations that will be used on Dream Chaser between flights. (NASA Kennedy)

[Airbus and ESA sign agreement to continue ISS operations](#) (25 June 2020)

The European Space Agency (ESA) has signed an annual renewal contract with Airbus on continuing the operation and use of European components on the International Space Station (ISS). The contract is worth around €16 million. For astronauts conducting research on the ISS, it is essential that all systems function reliably. An international team led by ESA is responsible for smooth operation of the life-support systems, power supply, flight control systems, laboratory equipment and experimental payloads in the European Columbus module. The agreement between ESA and Airbus is valid until the end of 2020 and includes the following work packages:

Support during operations, e.g. preparing and conducting experiments, as well as providing engineering support.

Preparing ISS missions, including the integration of ISS payloads.

Maintaining, repairing and developing systems.

Maintaining and developing software. (Airbus)

MARS

[ExoMars spots unique green glow at the Red Planet](#) (15 June 2020)

The observations at Mars agree with previous theoretical models but not with the actual glowing spotted around Earth, where the visible emission is far weaker. This suggests we have more to learn about how oxygen atoms behave, which is hugely important for our understanding of atomic and quantum physics. This understanding is key to characterising planetary atmospheres and related phenomena such as auroras. By deciphering the structure and behaviour of this green glowing layer of Mars' atmosphere, scientists can gain insight into an altitude range that has remained largely unexplored and monitor how it changes as the Sun's activity varies and Mars travels along its orbit around our star. (ESA)

MOON

[Northrop Grumman awarded NASA contract to provide first crew module for Artemis program Gateway](#) (5 June 2020)

Northrop Grumman Corporation (NYSE: NOC) has been awarded a contract by NASA to execute the preliminary design and development of the Habitation and Logistics Outpost (HALO). It is to be deployed in lunar orbit as the first crew module of the NASA Gateway, a space station orbiting the moon providing vital support for long-term human exploration of the lunar surface and deep space. Building off Cygnus' heritage pressurized cargo module, Northrop Grumman added command and control capabilities, including environmental control and life support systems, which, when coupled with NASA's Orion spacecraft capabilities, can sustain up to four astronauts for up to 30 days as they embark on, and return from, expeditions to the lunar surface. (Northrop Grumman)

[First global map of rockfalls on the Moon](#) (8 June 2020)

The map of the lunar surface between 80 degrees northern and southern latitude that shows 136,610 rockfalls with diameters of more than two and a half meters. For the first time, this map enables them to systematically analyse the occurrence and causes of rockfalls on another celestial body. Previously, scientists had assumed that lunar quakes in particular were responsible for the displacement of boulders. The new global map of rockfalls indicates that impacts from asteroids may play a much more important role. They are apparently directly or indirectly responsible for more than 80 percent of all observed rockfalls.

(Max Planck Institute for Solar System Research)

[Astrobotic awarded contract to deliver NASA Moon rover](#) (11 June 2020)

Astrobotic's Griffin lunar lander to carry the NASA VIPER mission to the south pole of the Moon in 2023, as a precursor to a human landing. The Griffin lunar lander is Astrobotic's medium capacity lander product line and is capable of delivering up to 500 kg of mass to the lunar surface. Griffin uses many of the same subsystems and approaches employed by the Peregrine lander, which will fly two years before VIPER. Both lander product lines put a heavy emphasis on safe and reliable delivery of customer payloads to the Moon. When VIPER disembarks from Griffin's ramps onto the Moon, it will survey the surface and subsurface for water ice, which could be used for breathable air and rocket propellant by future deep space explorers. VIPER's mapping of lunar water ice could be the first step toward utilizing resources in the space environment rather than carting them all from Earth to enable more affordable and sustainable space exploration. (Astrobotic)

[Northrop Grumman rocket boosters arrive at Kennedy Space Center for NASA's Artemis I mission](#) (15 June 2020)

Northrop Grumman Corporation announced that the segments for the two rocket boosters that will be used to help launch NASA's first Space Launch System (SLS) rocket for the Artemis I mission have arrived at Kennedy Space Center in Florida. The booster segments will be the first elements of the SLS rocket to be stacked on the mobile launcher in preparation for the launch of Artemis I, and the completed boosters will provide more than 75 percent of the initial thrust for launch. (Northrop Grumman)

[NASA completes Artemis Space Launch System structural testing campaign](#) (25 June 2020)

Engineers completed almost 200 tests on the Space Launch System (SLS) rocket by breaking the liquid oxygen tank test article. This test was the last in a 3-year structural campaign to ensure the rocket's structure was designed to endure the rigors of spaceflight. The tests were essential for safely sending astronauts to space on the Artemis missions the Moon. First, engineers used computer modelling to design the rocket's major structures to specific factors of safety. Then, they anchored those models with testing to see if the model's predictions are correct. More than 20 SLS structural tests showed that the liquid oxygen tank would survive the forces predicted to occur during launch and flight. The June 24 test pushed the tank beyond its limits to see how much force it would take to break the tank's structure. This image shows water gushing out of the tank as it failed. The resulted circumferential buckling of the structure occurred within 2% of the predicted failure value. The test results will provide rocket designers with valuable information for making the SLS tanks lighter and for informing the designs of other government and commercial rockets. (NASA)

[NASA plans for more SLS rocket boosters to launch Artemis Moon missions](#) (29 June 2020)

NASA has taken the next steps toward building Space Launch System (SLS) solid rocket boosters to support as many as six additional flights, for a total of up to nine Artemis missions. The agency is continuing to work with Northrop Grumman of Brigham City, Utah, the current lead contractor for the solid rocket boosters that will launch the first three Artemis missions, including the mission that will land the first woman and next man on the Moon in 2024. The twin solid rocket boosters, which are mounted on the side of the SLS core stage, will produce more than 75% percent of the thrust for each SLS launch. The boosters were based on the design of the space shuttle solid rocket boosters but include a fifth segment to produce the extra power needed to send the larger SLS rocket to space. The SLS rocket, Orion spacecraft, Gateway and Human Landing System are part of NASA's backbone for deep space exploration. The Artemis program is the next step in human space exploration. It's part of America's broader Moon to Mars exploration approach, in which astronauts will explore the Moon and experience gained there to enable humanity's next giant leap, sending humans to Mars. (NASA)

PULSARS

[XMM-Newton spies youngest baby pulsar ever discovered](#) (17 June 2020)

An observation campaign led by ESA's XMM-Newton space observatory reveals the youngest pulsar ever seen, the remnant of a once-massive star, that is also a 'magnetar', sporting a magnetic field some 70 quadrillion times stronger than that of Earth. A multi-instrument campaign led by XMM-Newton has now captured an outburst emanating from the youngest baby pulsar ever spotted: Swift J1818.0-1607, which was originally discovered by NASA's Swift Observatory in March. And there is more. Not only is this pulsar the youngest of the 3000 known in our Milky Way galaxy, but it also belongs to a very rare category of pulsars: magnetars, the cosmic objects with the strongest magnetic fields ever measured in the Universe. Swift J1818.0-1607 lies around 15,000 light-years away, within the Milky Way. Spotting something so young, just after it formed in the Universe, is extremely exciting. People on Earth would have been able to see the supernova explosion that formed this baby magnetar around 240 years ago, right in the middle of the American and French revolutions. The magnetar has yet more claims to fame. It is one of the fastest-spinning such objects known, whirling around once every 1.36 seconds despite containing the mass of two Suns within a stellar remnant measuring just 25 kilometres across. Immediately after the discovery, the astronomers looked at this object in further detail using XMM-Newton, NASA's Swift and NuSTAR X-ray satellites, and the Sardinia Radio Telescope in Italy. Unlike most magnetars, which are only observable in X-rays, the observations revealed that Swift J1818.0-1607 is one of the very few to also show pulsed emission in radio waves. The fact that it can be seen in both radio waves and X-rays offers an important clue in an ongoing scientific debate on the nature of a specific type of stellar remnant: pulsars. An especially magnetised type of pulsar, magnetars are generally thought to be uncommon in the Universe, astronomers have only detected around 30, and are assumed to be distinct from other types of pulsar that show up strongly in radio emission. But X-ray researchers have long suspected that magnetars may be far more common than this view suggests. This new finding supports the idea that, rather than being exotic, they may instead form a substantial fraction of the pulsars found in the Milky Way. Astronomers have also discovered many magnetars in the past decade, doubling the known population. It's likely that magnetars are just good at flying under the radar when they're dormant and are only discovered when they 'wake up' as

demonstrated by this baby magnetar, which was far less luminous before the outburst that led to its discovery. Additionally, there may not be as wide a diversity of pulsars as initially thought. The distinctive phenomena shown by magnetars may also occur in other types of pulsar, just as Swift J1818.0–1607 exhibits characteristics radio emission not usually attributed to magnetars. While interesting in their own right, magnetars are relevant on a far wider scale: they might play a key role in driving a whole host of transient events we see in the Universe. Such events are thought to be somehow connected to magnetars either during their birth, or in the very early stages of their lives, making this discovery especially exciting. Examples of transient events include gamma-ray bursts, super-luminous supernova explosions, and the mysterious fast radio bursts. These energetic events are potentially linked to the formation and existence of young, strongly magnetised objects – like Swift J1818.0–1607. To infer this magnetar’s age, the researchers needed high-resolution long-term measurements of both the rate at which it is spinning, and of how this spin is changing over time. XMM-Newton’s European Photon Imaging Camera, EPIC, observed Swift J1818.0–1607 just three days after it was discovered, enabling the researchers to extract an accurate picture of its X-ray emission, and characterise its rotation and spectral properties in detail. This kind of research is hugely important in understanding more about the stellar content of the Milky Way and revealing the intricacies of phenomena occurring throughout the wider Universe. (ESA)

SATELLITES

[Preparations resume for Vega’s upcoming mission with 53 small satellite passengers](#)

(1 June 2020)

The launch campaign has resumed for Arianespace’s next mission, which will be the proof-of-concept flight with the Vega launcher’s “ride-share” configuration known as the Small Spacecraft Mission Service (SSMS). Scheduled for the middle of this month from the Spaceport in French Guiana, it will loft 53 micro- and nanosatellites for the benefit of 21 customers, deploying these payloads into Sun-Synchronous orbit. For the mission, designated Flight VV16 in Arianespace’s launcher family numbering system, Vega will carry seven microsatellites weighing from 15 kg. to 150 kg., along with 46 smaller CubeSats. These spacecraft are to serve various applications, including Earth observation, telecommunications, science, technology and education. (Arianespace)

SATURN AND MOONS

[Saturn’s moon Titan drifting away faster than previously thought](#) (8 June 2020)

Just as our own Moon floats away from Earth a tiny bit more each year, other moons are doing the same with their host planets. As a moon orbits, its gravity pulls on the planet, causing a temporary bulge in the planet as it passes. Over time, the energy created by the bulging and subsiding transfers from the planet to the moon, nudging it farther and farther out. Our Moon drifts 1.5 inches (3.8 centimetres) from Earth each year. Scientists thought they knew the rate at which the giant moon Titan is moving away from Saturn, but they recently made a surprising discovery: Using data from NASA’s Cassini spacecraft, they found Titan drifting a hundred times faster than previously understood, about 4 inches (11 centimetres) per year. The findings may help address an age-old question. While scientists know that Saturn formed 4.6 billion years ago in the early days of the solar system, there’s more uncertainty about when the planet’s rings and its system of more than 80 moons formed.

Titan is currently 759,000 miles (1.2 million kilometres) from Saturn. The revised rate of its drift suggests that the moon started out much closer to Saturn, which would mean the whole system expanded more quickly than previously believed. (JPL)

[Evidence for volcanic craters on Saturn's moon Titan](#) (15 June 2020)

Volcano-like features seen in polar regions of Saturn's moon Titan by NASA's Cassini spacecraft could be evidence of explosive eruptions that may continue today. Morphological features such as nested collapses, elevated ramparts, halos, and islands indicate that some of the abundant small depressions in the north polar region of Titan are volcanic collapse craters. A few similar depressions occur near the south pole of Titan. The close association of the proposed volcanic craters with polar lakes is consistent with a volcanic origin through explosive eruptions followed by collapse, as either maars or calderas. The apparent freshness of some craters may mean that volcanism has been relatively recently active on Titan or even continues today. There is also evidence for internal heat, manifest at the surface as cryovolcanoes, made from melting the water ice crust into liquid water that erupts onto Titan's surface. These features are roughly round, with raised rims, and they sometimes overlap each other. They are consistent with the shapes of other volcanic landforms on Earth and Mars formed by explosion, excavation and collapse. That these features are at the polar regions, near the lakes of methane, may indicate methane, nitrogen or some other volatile may power them. The features appear relatively fresh, meaning they could still be forming today. (Planetary Science Institute)

STARS AND STAR CLUSTERS

[Hot stars are plagued by giant magnetic spots](#) (1 June 2020)

Astronomers using European Southern Observatory (ESO) telescopes have discovered giant spots on the surface of extremely hot stars hidden in stellar clusters. Not only are these stars plagued by magnetic spots, some also experience superflare events, explosions of energy several million times more energetic than similar eruptions on the Sun. The findings may help astronomers better understand these puzzling stars and open doors to resolving other elusive mysteries of stellar astronomy. (ESO)

TECHNOLOGY

[ESA moves ahead on low-cost reusable rocket engine](#) (4 June 2020)

ESA's Prometheus is the precursor of ultra-low-cost rocket propulsion that is flexible enough to fit a fleet of new launch vehicles for any mission and will be potentially reusable. Prometheus is now seen as key in the effort to prepare competitive future European access to space. This Prometheus precursor runs on liquid oxygen-methane which brings high efficiency, allows standardisation and operational simplicity. Methane propellant is also widely available and easy to handle. (ESA)

[METIS instrument passes design milestone](#) (5 June 2020)

A new ground-breaking instrument for astronomy research has passed a major design milestone at the European Southern Observatory's (ESO)'s headquarters in Garching, Germany. Scientists and engineers at the Science and Technology Facilities Council's (STFC)'s UK Astronomy Technology Centre (UK ATC) in Edinburgh are responsible for a key component of this powerful imager and spectrograph. The Mid-infrared ELT Imager and Spectrograph, or METIS for short will bring astronomers one step closer to being able to

study the life cycle of stars, from infant stars and planet-forming discs to older stars near the end of their lifetime in our Solar System and in distant active galaxies. The team at UK ATC are leading on a component within METIS called the LM-band high resolution Spectrometer (the LMS). The LMS will enable astronomers to study weather and climate in the atmospheres of nearby extra-solar gas giants. These are planets like our own neighbours Jupiter and Saturn but orbiting stars beyond our solar system. METIS will take full advantage of the ELTs 39-metre primary mirror and advanced adaptive-optics systems. The study of exoplanets (planets beyond our solar system) is one of the most dynamic and exciting fields of astronomy for both scientists and the public and one in which METIS is expected to make large contributions. METIS has the potential to directly detect terrestrial exoplanets around the nearest stars and, even, investigate their atmospheric composition. "It will be really exciting to have an instrument which is powerful enough to observe the same targets as the space borne James Webb Space Telescope, or Webb for short, but with much higher spectral and spatial resolutions. With the UK ATC heavily involved in both projects it really is an exciting time for astronomy in Scotland," concludes Professor Glasse. (UK STC Edinburgh)

[GS Yuasa exceeds 4,000,000 Watt-hours of Li-ion energy storage in space](#) (10 June 2020)

GS Yuasa Lithium Power announced today that GS Yuasa Technology's "LSE" lithium ion (Li-ion) cells have exceeded 4.0 MWh of energy storage on orbit. This milestone is marked by the launch of HTV-9 and delivery of the final set of Li-ion replacement batteries for the International Space Station. (GS Yuasa)

TELESCOPES

[Preparations complete in Western Australia for construction of world's largest telescope](#) (10 June 2020)

Following seven years of design and prototyping work, the Curtin University node of the International Centre for Radio Astronomy Research (ICRAR) has completed its preparations for the construction of the Square Kilometre Array (SKA) in Western Australia, which will begin next year. 130,000 individual radio antennas, along with associated electronics, will be built and spread over thousands of square kilometres at CSIRO's Murchison Radio-astronomy Observatory (MRO), approximately 800 km north of Perth. This will work in tandem with an array of 197 dishes located in the Karoo in South Africa, north of Cape Town. To be built by a global collaboration of 14 countries, the SKA will be one of the world's largest science facilities, exploring the entire history and evolution of the Universe, and uncovering advances in fundamental physics. The search for the first stars 13 billion years ago, the discovery of missing matter in the Universe, and galaxy surveys of unprecedented scale feature among fundamental advances from the precursor telescopes, ready to be taken to the next level with the SKA. (ICRAR)

Pat Williams June 2020