Space News Update – August 2020

By Pat Williams

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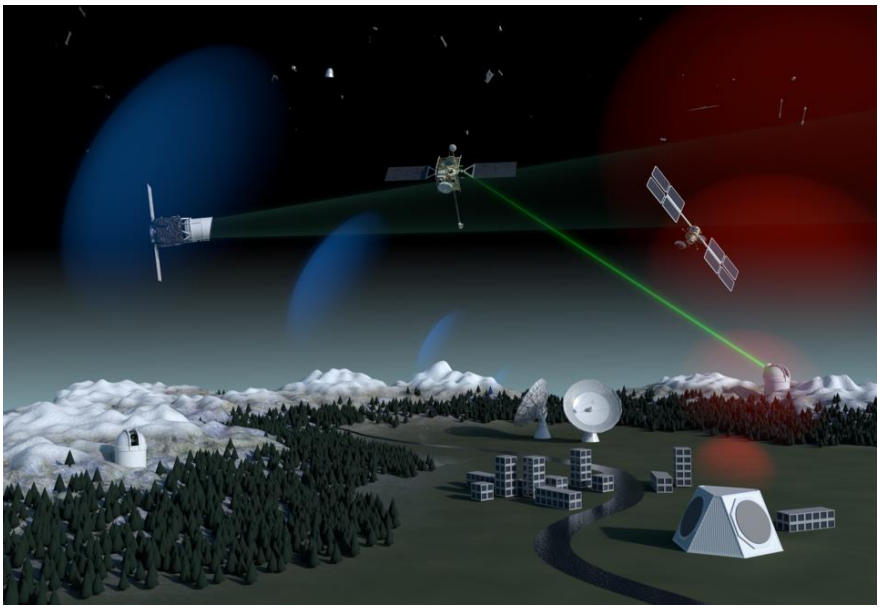
Disclaimer - I claim no authorship for the printed material; except where noted (PW).

FIRST LASER DETECTION OF SPACE DEBRIS IN DAYLIGHT



Credit: ESA

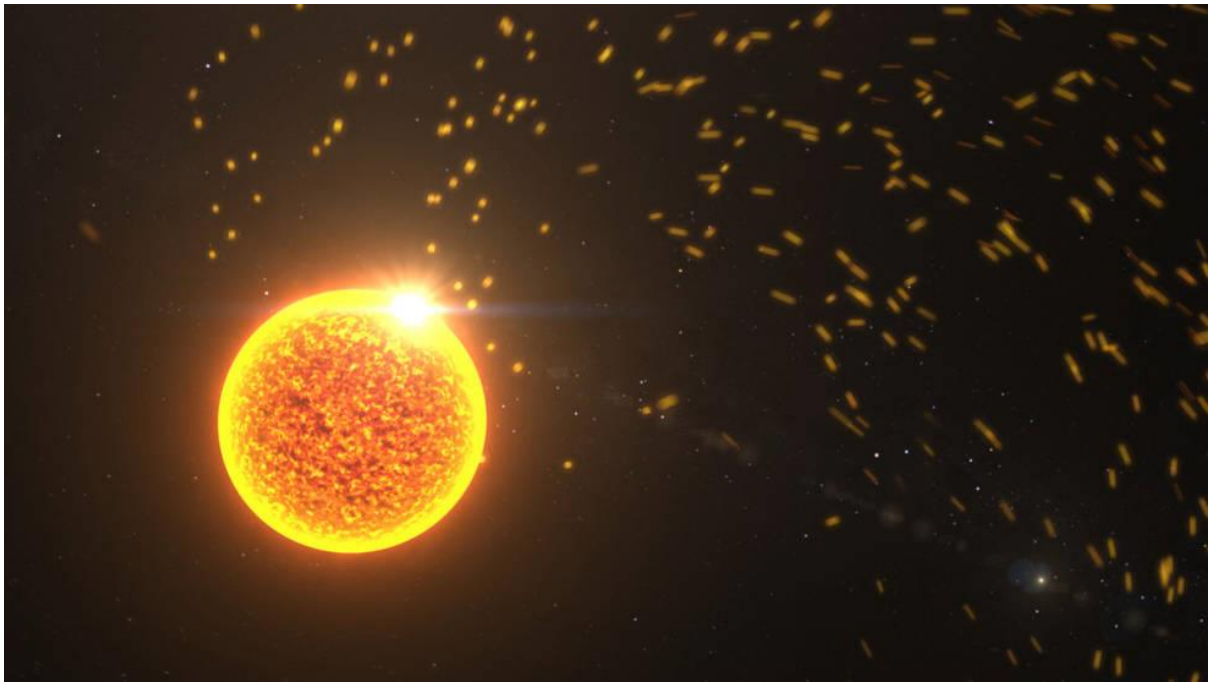
During the recent tests, 40 different debris objects (and stars approximately 10 times fainter than what can be seen by the naked eye) were observed using the new technique, standing out against a blue sky, for the first time observed in the middle of the day, something that would not have been possible before. Ultimately it means we will get to know the debris population better, allowing us to better protect Europe's space infrastructure. Further development of such technologies is a core objective of ESA's Space Safety programme, including establishing a network of space debris laser ranging stations. A new laser station next to ESA's well-known Optical Ground Station in the Canary Islands is awaiting deployment, which will serve as a 'test-bed' for laser ranging technologies, as well as developing networking concepts. (ESA)
First laser detection of space debris in daylight (4 August 2020)

LUCY MISSION ONE STEP CLOSER TO EXPLORING THE TROJAN ASTEROIDS

Engineers install Lucy's oxygen propellant tank into the spacecraft structure in a high-bay clean room at Lockheed Martin.
Credits: Lockheed Martin Space

NASA's first mission to explore the Trojan asteroids is one step closer to launch. The Discovery Program's Lucy mission passed a critical milestone and is officially authorized to transition to its next phase. This major decision was made after a series of independent reviews of the status of the spacecraft, instruments, schedule and budget. The milestone, known as Key Decision Point-D (KDP-D), represents the official transition from the mission's development stage to delivery of components, testing, assembly and integration leading to launch. During this part of the mission's life cycle, known as Phase D, the spacecraft bus (the structure that will carry the science instruments) is completed, the instruments are integrated into the spacecraft and tested, and the spacecraft is shipped to NASA's Kennedy Space Center in Florida for integration with the launch vehicle. Lucy still has several years and a few billion miles to go before exploring the never-before-seen Trojan asteroids. All spacecraft assembly and testing will be completed by the end of July 2021, when the spacecraft will be shipped to Kennedy Space Center in Cape Canaveral, Florida in preparation for the launch window opening on October 16, 2021. After launch, Lucy will have a long cruise phase before it arrives at its first target. Lucy is flying out to the distance of Jupiter to make close fly-bys past a record-breaking number of asteroids, encountering the first of eight targets in April 2025 and the final binary pair of asteroids in March 2033. The next major milestone is the Mission Operation Review, scheduled in October 2020, which assesses the project's operational readiness and its progress towards launch. (NASA Goddard) Lucy mission one step closer to exploring the Trojan asteroids (28 August 2020)

NASA SELECTS PROPOSALS FOR NEW SPACE ENVIRONMENT MISSIONS



The Sun sends out a constant stream of particles and energy, which drives a complex space weather system near Earth and can affect spacecraft and astronauts. NASA has chosen five new mission concept studies for further development to study various aspects of this dynamic system. Credits: NASA

NASA has selected five proposals for concept studies of missions to help improve understanding of the dynamics of the Sun and the constantly changing space environment with which it interacts around Earth. The information will improve understanding about the universe as well as offer key information to help protect astronauts, satellites, and communications signals, such as GPS, in space. Each of these Medium-Class Explorer proposals will receive $1.25 million to conduct a nine-month mission concept study. Following the study period, NASA will choose up to two proposals to go forward to launch. Each potential mission has a separate launch opportunity and timeframe. NASA's heliophysics program explores the giant, interconnected system of energy, particles, and magnetic fields that fills interplanetary space, a system that constantly changes based on outflow from the Sun and its interaction with the space and atmosphere around Earth. Whether it's looking at the physics of our star, studying aurora, or observing how magnetic fields move through space, the heliophysics community seeks to explore the space system around us from a variety of vantage points.

The proposals selected for concept studies are:

Solar-Terrestrial Observer for the Response of the Magnetosphere (STORM)

HelioSwarm: The Nature of Turbulence in Space

PlasmaMulti-slit Solar Explorer (MUSE)

Auroral Reconstruction CubeSwarm (ARCS)

Solaris: Revealing the Mysteries of the Sun's Poles (NASA)

NASA selects proposals for new space environment missions (28 August 2020)

MAMMAL CELLS MAY NOT FIGHT SPACE GERMS

There are plans to search for signs of microorganisms on planets including on Mars. Credit: The University of Exeter)

The immune systems of mammals, including humans, might struggle to detect and respond to germs from other planets, new research suggests. Microorganisms (such as bacteria and viruses) could exist beyond Earth, and there are plans to search for signs of them on Mars and some of Saturn and Jupiter's moons. Such organisms might be based on different amino acids (key building blocks of all life) than lifeforms on Earth. Scientists from the universities of Aberdeen and Exeter tested how mammal immune cells responded to peptides (combinations of amino acids) containing two amino acids that are rare on Earth but are commonly found on meteorites. The immune response to these "alien" peptides was "less efficient" than the reaction to those common on Earth. The study, conducted in mice, whose immune cells function in a similar way to those of humans, suggests extra-terrestrial microorganisms could pose a threat to space missions, and on Earth if they were brought back. Some very unusual organic building blocks exist outside of the planet Earth, and these could be used to make up the cells of such alien microbes. Would our immune system be able to detect proteins made from these non-terrestrial building blocks if such organisms were discovered and were brought back to Earth and then accidently escaped? Researchers examined the reaction of T cells, which are key to immune responses, to peptides containing amino acids commonly found on meteorites: isovaline and α-aminoisobutyric acid. The response was less efficient, with activation levels of 15% and 61%, compared to 82% and 91% when exposed to peptides made entirely of amino acids that are common on Earth. Life on Earth relies on essential 22 amino acids. The researchers hypothesized that lifeforms that evolved in an environment of different amino acids might contain them in their structure. They chemically synthetized 'exo-peptides' containing amino acids that are rare on Earth and tested whether a mammal immune system could detect them. The investigation showed that these exo-peptides were still processed, and T cells were still activated, but these responses were less efficient than for 'ordinary' Earth peptides. They speculate that contact with extra-terrestrial microorganisms might pose an immunological risk for space missions aiming to retrieve organisms from exoplanets and moons. The discovery of liquid water at several locations in the solar system raises the possibility that microbial life may have evolved outside Earth and could therefore be accidently introduced into the Earth's ecosystem. (University of Exeter)
Mammal Cells May Not Fight Space Germs (23 July 2020)

NASA'S GREEN PROPELLANT INFUSION MISSION NEARS COMPLETION

An Aerojet Rocketdyne researcher examines a container of the Advanced Spacecraft Energetic Non-Toxic (ASCENT) monopropellant during preparation for flight testing. Credits: Aerojet

NASA just validated a new type of propellant, or fuel, for spacecraft of all sizes. Instead of toxic hydrazine, space missions can use a less toxic, "green" propellant and the compatible technologies designed to go along with it. In a little over a year since launch, NASA's Green Propellant Infusion Mission (GPIM) successfully proved a never-before-used propellant and propulsion system work as intended, demonstrating both are practical options for future missions. GPIM set out to test a monopropellant, a chemical propellant that can burn by itself without a separate oxidizer, called Advanced Spacecraft Energetic Non-Toxic (ASCENT). It is an alternative to the monopropellant hydrazine. This is the first time in 50 years NASA tested a new, high-performing monopropellant in space. It has the potential to supplement or even replace hydrazine, which spacecraft have used since the 1960s. GPIM's effective demonstration of the propellant paved the way for NASA's acceptance of ASCENT in new missions. The next NASA mission to use ASCENT will be Lunar Flashlight. The small spacecraft, which aims to provide clear-cut information about the presence of water deposits inside craters, will launch as a secondary payload on Artemis I, the first integrated flight test of NASA's Orion spacecraft and Space Launch System (SLS) rocket. Despite being pink in colour, ASCENT is considered "green" for its significantly reduced toxicity compared to hydrazine, which requires protective suits and rigorous propellant loading processing procedures. It is safer to store and use, requiring minimal personal protective equipment such as lab coats, goggles, and gloves. Besides being easier and less expensive to handle here on Earth, when loading a spacecraft with propellant, for example, ASCENT will allow spacecraft to travel farther or operate longer with less propellant in their tank, given its higher performance. (NASA)
NASA's Green Propellant Infusion Mission nears completion (20 August 2020)

LINKS TO OTHER SPACE NEWS PUBLISHED IN AUGUST 2020

ASTEROIDS

Space Dynamics Laboratory building smallsat radios for NASA Janus mission
(5 August 2020)
Making long-distance calls from deep space is technologically challenging even with large spacecraft, and from small satellites, it becomes exponentially challenging. The SDL-built Iris radios will provide communications for dual Lockheed Martin small spacecraft being built for NASA's deep space mission called Janus, to visit near-Earth asteroids. The Janus

mission is targeted for launch in August 2022 and will travel more than 10 million kilometres to meet up with the pair of binary asteroids designated 1991 VH and 1996 FG3.
(Space Dynamics Laboratory)

OSIRIS-REx is one rehearsal away from touching asteroid Bennu (6 August 2020)
NASA's first asteroid sampling spacecraft is making final preparations to grab a sample from asteroid Bennu's surface. Next week, the OSIRIS-REx mission will conduct a second rehearsal of its touchdown sequence, practicing the sample collection activities one last time before touching down on Bennu this fall. On Aug. 11, the mission will perform its "Matchpoint" rehearsal – the second practice run of the Touch-and-Go (TAG) sample collection event. The rehearsal will be similar to the Apr. 14 "Checkpoint" rehearsal, which practiced the first two manoeuvres of the descent, but this time the spacecraft will add a third manoeuvre, called the Matchpoint burn, and fly even closer to sample site Nightingale, reaching an altitude of approximately 131 ft (40 m), before backing away from the asteroid.
(NASA Goddard)

Successful second rehearsal puts OSIRIS-REx on a path to sample collection
(12 August 2020)
Four hours after departing its 0.6-mile (1-km) safe-home orbit, OSIRIS-REx performed the Checkpoint manoeuvre at an approximate altitude of 410 feet (125 meters) above Bennu's surface. From there, the spacecraft continued to descend for another eight minutes to perform the Matchpoint burn. After descending on this new trajectory for another three minutes, the spacecraft reached an altitude of approximately 131 ft (40 m), the closest the spacecraft has ever been to Bennu, and then performed a back-away burn to complete the rehearsal.
(NASA Goddard)

Hayabusa2 re-entry capsule approved to land in Australia (19 August 2020)
On August 10, 2020, JAXA was informed that the Authorisation of Return of Overseas-Launched Space Object (AROLSO) for the re-entry capsule from Hayabusa2 was issued by the Australian Government. The date of the issuance is August 6, 2020. The Hayabusa2 re-entry capsule will return to Earth in South Australia on December 6, 2020 (Japan Time and Australian Time). The landing site will be the Woomera Prohibited Area. The issuance of the AROLSO gave a major step forward for the capsule recovery. We will continue careful operation for return of Hayabusa2 and recovery of the capsule, and the operation status will be announced in a timely manner. (JAXA)

ASTROPHYSICS

Tracing the cosmic origin of complex organic molecules with their radiofrequency footprint
(25 August 2020)
By considering the special behaviour of acetonitrile, its amount in the low-density region around Sgr B2(M) can be accurately determined. Because acetonitrile is a representative COM in space, knowing its amount and distribution though space can help us probe further into the overall distribution of organic matter." Ultimately, this study may not only give us some clues about where the molecules that conform us came from, but also serve as data for the time when humans manage to venture outside the solar system.
(Tokyo University of Science)

DWARF PLANETS

Bright areas on Ceres come from salty water below (10 August 2020)
NASA's Dawn spacecraft gave scientists extraordinary close-up views of the dwarf planet Ceres, which lies in the main asteroid belt between Mars and Jupiter. By the time the mission ended in October 2018, the orbiter had dipped to less than 22 miles (35 kilometres) above the surface, revealing crisp details of the mysterious bright regions Ceres had become known for. Scientists had figured out that the bright areas were deposits made mostly of sodium carbonate, a compound of sodium, carbon, and oxygen. They likely came from liquid that percolated up to the surface and evaporated, leaving behind a highly reflective salt crust. But what they hadn't yet determined was where that liquid came from. By analysing data collected near the end of the mission, Dawn scientists have concluded that the liquid came from a deep reservoir of brine, or salt-enriched water. By studying Ceres' gravity, scientists learned more about the dwarf planet's internal structure and were able to determine that the brine reservoir is about 25 miles (40 kilometres) deep and hundreds of miles wide. Ceres doesn't benefit from internal heating generated by gravitational interactions with a large planet, as is the case for some of the icy moons of the outer solar system. But the new research, which focuses on Ceres' 57-mile-wide (92-kilometre-wide) Occator Crater, home to the most extensive bright areas, confirms that Ceres is a water-rich world like these other icy bodies. (JPL)

EXOPLANETS

ALMA captures stirred-up planet factory (4 August 2020)
Planet-forming environments can be much more complex and chaotic than previously expected. This is evidenced by a new image of the star RU Lup, made with the Atacama Large Millimeter/submillimeter Array (ALMA). Protoplanetary disks contain much more gas than dust. While dust is needed to accumulate the cores of planets, gas creates their atmospheres. In recent years, high resolution observations of dust structures have revolutionized our understanding of planet formation. However, a new image of the gas indicates that the current view of planet formation is still too simplistic and that it might be much more chaotic than previously inferred from the well-known images of neatly concentric ringed disks “The fact that we observed this spiral structure in the gas after a longer observation suggests that we have likely not seen the full diversity and complexity of planet-forming environments. We may have missed much of the gas structures in other disks.” The team suggest several scenarios that could possibly explain why the spiral arms appeared around RU Lup. Maybe the disk is collapsing under its own gravity, because it is so massive. Or maybe RU Lup is interacting with another star. Another possibility is that the disk is interacting with its environment, accreting interstellar material along the spiral arms. “None of these scenarios completely explain what we have observed.” “There might be unknown processes happening during planet formation that we have not yet accounted for in our models. We will only learn what they are if we find other disks out there that look like RU Lup.” (ALMA)

NASA’s planet hunter completes its primary mission (11 August 2020)
On July 4, NASA’s Transiting Exoplanet Survey Satellite (TESS) finished its primary mission, imaging about 75% of the starry sky as part of a two-year-long survey. In capturing this giant mosaic, TESS has found 66 new exoplanets, or worlds beyond our solar system, as well as nearly 2,100 candidates astronomers are working to confirm. (NASA Goddard)

GALAXIES

Hubble maps a giant halo around the Andromeda Galaxy (27 August 2020)
In a landmark study, scientists using NASA's Hubble Space Telescope have mapped the immense envelope of gas, called a halo, surrounding the Andromeda galaxy, our nearest large galactic neighbour. Scientists were surprised to find that this tenuous, nearly invisible halo of diffuse plasma extends 1.3 million light-years from the galaxy, about halfway to our Milky Way and as far as 2 million light-years in some directions. This means that Andromeda's halo is already bumping into the halo of our own galaxy. They also found that the halo has a layered structure, with two main nested and distinct shells of gas. This is the most comprehensive study of a halo surrounding a galaxy. (STScI)

INTERNATIONAL SPACE STATION

NASA astronauts safely splash down after first commercial crew flight to space station (2 August 2020)
Two NASA astronauts splashed down safely in the Gulf of Mexico Sunday for the first time in a commercially built and operated American crew spacecraft, returning from the International Space Station to complete a test flight that marks a new era in human spaceflight. Behnken and Hurley participated in a number of scientific experiments, spacewalks and public engagement events during their 62 days aboard station. Overall, the astronaut duo spent 64 days in orbit, completed 1,024 orbits around Earth and travelled 27,147,284 statute miles. (NASA)

JUPITER AND MOONS

Shallow lightning' and 'mushballs' reveal ammonia in Jupiter's atmosphere (5 August 2020)
New results from NASA's Juno mission at Jupiter suggest our solar system's largest planet is home to what's called "shallow lightning." An unexpected form of electrical discharge, shallow lightning originates from clouds containing an ammonia-water solution, whereas lightning on Earth originates from water clouds. Other new findings suggest the violent thunderstorms for which the gas giant is known may form slushy ammonia-rich hailstones Juno's science team calls "mushballs"; they theorize that mushballs essentially kidnap ammonia and water in the upper atmosphere and carry them into the depths of Jupiter's atmosphere. (JPL)

A 70-degree shift on Europa was the last event to fracture its surface (21 August 2020)
Europa's outer icy shell has completely reoriented itself in one of the last geologic events recorded on its young surface. Europa's poles are not where they used to be. Cracks in the surface of Jupiter's icy moon indicate its shell of ice rotated by 70 degrees sometime in the last several million years. In addition to supporting prior evidence for the existence of a subsurface ocean, it also means that the geologic history of Europa's surface must be re-examined. (USRA)

LAUNCH SERVICES

Rocket Lab increases Electron payload capacity, enabling interplanetary missions and reusability (4 August 2020)

Rocket Lab, a satellite manufacturer and the global leader in dedicated small satellite launch, has today announced a major performance increase to the Electron launch vehicle, boosting the company's payload lift capacity up to 300 kg (660 lbs). The increased payload mass capacity has primarily been made possible through advances in the battery technology that powers Rutherford's electric pumps. Since Rocket Lab's maiden launch in 2017, the Electron launch vehicle has boasted a payload lift capacity of 150 kg to 500 km to Sun- synchronous orbits (SSO), with a maximum lift capacity of 225 kg total to lower orbits. Thanks to the performance increase, Electron is now capable of lifting 200 kg to 500 km SSO and up to 300 kg to lower orbits. The performance improvements make it possible to launch more payload to low Earth orbit (LEO), lunar, and interplanetary destinations on expendable Electron missions, while offsetting the additional mass of recovery systems added to Electron for missions slated for recovery and re-flight. (Rocket Lab)

Skyrora's Skylark Micro rocket launches from Iceland (18 August 2020)
Skyrora has successfully launched its two-stage, four-metre tall sub-orbital rocket, Skylark Micro from the company's mobile launch complex set up within a few days at Langanes Peninsula, Iceland. The rocket climbed to 26.86km in altitude before both stages were parachuted back down to sea. The launch is part of Skyrora's de-risking program leading up to the building and launching of its orbital vehicle, Skyrora XL, scheduled for 2023. The launch of Skylark Micro was to test onboard electronics and communications that will also be used in the larger Skylark-L and Skyrora XL launch vehicles. Before launch, the team undertook a number of weather procedures to learn more about the mid and upper-level wind speeds and altitudes. In addition, the mobile launch complex allowed the team to collect a large amount of data of telemetry, GPS tracking, and weather conditions during the flight to which they are currently analysing. The test also allowed the Skyrora crew to practice launch procedures and marine recovery operations. Despite the ongoing heroic efforts of the Langanes Search and Rescue and Skyrora Recovery teams, Skyrora has unfortunately been unsuccessful in their efforts of locating the Skylark Micro booster and sustainer stages. However, they are still continuing search operations for the next few days as well as learning how to improve future recovery operations. Creating another test of our suborbital mobile launch complex in a different location demonstrates the immense speed and flexibility of Skyrora for launching its test rockets. Until this year, Iceland had no permit procedure to allow rockets to be launched from the country. However, after Skyrora travelled to Iceland in January to meet the relevant government officials and see the launch site, the Icelandic authorities agreed upon and implemented a framework to allow Skyrora to launch its Skylark Micro. The successful launch was closely organised with Space Iceland, only founded in 2019. With their help and within a few months, Skyrora got the operational logistics and governmental documents in place before the launch took place. (Skyrora)

MARS

Researchers use InSight for deep Mars measurements (5 August 2020)
Using data from NASA's InSight Lander on Mars, Rice University seismologists have made the first direct measurements of three subsurface boundaries from the crust to the core of the red planet. The first boundary measured is the divide between Mars' crust and mantle almost 22 miles (35 kilometres) beneath the lander. The second is a transition zone within the mantle where magnesium iron silicates undergo a geochemical change. Above the zone, the elements form a mineral called olivine, and beneath it, heat and pressure compress them into a new mineral called wadsleyite. Known as the olivine-wadsleyite transition, this zone was found 690-727 miles (1,110-1,170 kilometres) beneath InSight. The temperature at the olivine-

wadsleyite transition is an important key to building thermal models of Mars. From the depth of the transition, we can easily calculate the pressure, and with that, we can derive the temperature. The third boundary measured is the border between Mars' mantle and its iron-rich core, which they found about 945-994 miles (1,520-1,600 kilometres) beneath the lander. Better understanding this boundary can provide information about the planet's development from both a chemical and thermal point of view. (Rice University)

MAVEN observes Martian night sky pulsing in ultraviolet light (6 August 2020)
The MAVEN team was surprised to find that the atmosphere pulsed exactly three times per night, and only during Mars' spring and fall. The new data also revealed unexpected waves and spirals over the winter poles, while also confirming the Mars Express spacecraft results that this nightglow was brightest over the winter polar regions. MAVEN's images offer our first global insights into atmospheric motions in Mars' middle atmosphere, a critical region where air currents carry gases between the lowest and highest layers. The brightenings occur where vertical winds carry gases down to regions of higher density, speeding up the chemical reactions that create nitric oxide and power the ultraviolet glow. Ultraviolet light is invisible to the human eye but detectable by specialized instruments. (Sierra Nevada Corporation)

METEORS and METEORITES

Iron-rich meteorites retain record of core crystallization in solar system's oldest planetary objects (3 August 2020)
Work led by Carnegie's Peng Ni and Anat Shahar uncovers new details about our Solar System's oldest planetary objects, which broke apart in long-ago collisions to form iron-rich meteorites. Their findings reveal that the distinct chemical signatures of these meteorites can be explained by the process of core crystallization in their parent bodies, deepening our understanding of the geochemistry occurring in the Solar System's youth. Iron meteorites were thought to be the remnants of the cores of their ancient, broken-apart parent bodies. A history of how their layers differentiated is recorded in their chemical makeup, if we can read it. There are four stable isotopes of iron. (Each element contains a unique number of protons, but its isotopes have varying numbers of neutrons.) This means that each iron isotope has a slightly different mass than the others. As a result, some isotopes are preferred by certain chemical reactions, which, in turn, affects the proportion of that isotope in the reaction's end products. The traces of this favouritism can be found in rock samples and can help elucidate the processes that forged these meteorite parent bodies. (Carnegie Institution for Science)

MOON

Blue Origin-led National Team delivers Lunar Lander engineering mock-up to NASA
(20 August 2020)
The Blue Origin-led Human Landing System (HLS) National Team delivered an engineering mock-up of a crew lander vehicle that could take American astronauts to the Moon. The lander is set up in the Space Vehicle Mock-up Facility (SVMF). The full-scale engineering mock-up showcases two elements of the National Team's multi-element architecture, the Ascent Element (AE) and Descent Element (DE). Standing at more than 40 feet, it is the Blue Origin National Team's update to Apollo's Lunar Module (LM) and will be used to validate the National Team's approaches for getting crew, equipment, supplies, and samples off and on the vehicle. The team will collaborate with NASA organizations including JSC's Astronaut Office to perform engineering and crew operations tests with astronauts aiming to

fly the final system within several years. (Blue Origin)

SpaceX to launch Masten lunar mission in 2022 (26 August 2020)
Masten's first mission to the Moon, MM1 is a collaboration with NASA's Commercial Lunar Payload Services (CLPS) Project Office. The Masten XL-1 lunar lander is scheduled to touch down on the lunar south pole in 2022, carrying a suite of NASA-sponsored scientific instruments and various payloads from commercial space customers. SpaceX was founded upon the goal of extending humanity's reach beyond Earth. (Masten Space Systems)

SOLAR SYSTEM

Uncovering our solar system's shape (5 August 2020)
All the planets of our solar system are encased in a magnetic bubble, carved out in space by the Sun's constantly outflowing material, the solar wind. Outside this bubble is the interstellar medium, the ionized gas and magnetic field that fills the space between stellar systems in our galaxy. One question scientists have tried to answer for years is on the shape of this bubble, which travels through space as our Sun orbits the centre of our galaxy. Traditionally, scientists have thought of the heliosphere as a comet shape, with a rounded leading edge, called the nose, and a long tail trailing behind. Research provides an alternative shape that lacks this long tail: the deflated croissant. Considering the solar wind's components separately, combined with Opher's earlier work using the solar magnetic field as a dominant force in shaping the heliosphere, created a deflated croissant shape, with two jets curling away from the central bulbous part of the heliosphere, and notably lacking the long tail predicted by many scientists. (NASA Goddard)

STARS AND STAR CLUSTERS

Pulsing stars distribute key ingredient for life (3 August 2020)
As Carl Sagan famously said, "We're made of star stuff." How do stars distribute their essential "stuff" for life into space? NASA's telescope on an airplane, SOFIA, is finding some answers by watching pulsating stars as they expand and contract, almost like beating hearts. The Stratospheric Observatory for Infrared Astronomy, SOFIA, examined several types of pulsating stars in our Milky Way galaxy, watching as some spewed carbon, a key ingredient of life as we know it, into interstellar space. Carbon is created deep inside stars through the process of helium fusion. As stars evolve, this carbon can get dredged up to the surface. But it must be forced into space for it to be available as a building block of life. SOFIA found that some Mira stars, late-stage red giants with especially powerful pulsations, can drive strong stellar winds that eject carbon-rich gas and dust out into interstellar space. On the other hand, stars with much weaker pulsations called semiregular stars, can't push the wind out as effectively. The Mira stars are therefore responsible for distributing large amounts of carbon into the universe. (NASA)

A direct view of star/disk interactions (28 August 2020)
A team from the Institute for Astrophysics of the University of Cologne has for the first time directly observed the columns of matter that build up newborn stars. This was observed in the young star TW Hydrae system located approximately 163 light years from Earth. This result was obtained with the Very Large Telescope Interferometer (VLTI) and its GRAVITY

instrument of the European Southern Observatory (ESO) in Chile. The article ‘A measure of the size of the magnetospheric accretion region in TW Hydrae’ has been published in a recent issue of Nature. (University of Cologne)

SUN

NASA sounding rocket finds helium structures in Sun’s atmosphere(7 August 2020)
To measure the amount of atmospheric helium and hydrogen, NASA’s Helium Resonance Scattering in the Corona and Heliosphere, or HERSCHEL, sounding rocket took images of the solar corona. HERSCHEL’s observations showed that helium wasn’t evenly distributed around the corona. The equatorial region had almost no helium while the areas at mid latitudes had the most. Comparing with images from ESA/NASA’s Solar and Heliospheric Observatory (SOHO), the scientists were able to show the abundance at the mid latitudes overlaps with where Sun’s magnetic field lines open out into the solar system. This shows that the ratio of helium to hydrogen is strongly connected with the magnetic field and the speed of the solar wind in the corona. The equatorial regions, which had low helium abundance measurements, matched measurements from the solar wind near Earth. This points to the solar atmosphere being more dynamic than scientists thought. The HERSCHEL sounding rocket investigation adds to a body of work seeking to understand the origin of the slow component of the solar wind. HERSCHEL remotely investigates the elemental composition of the region where the solar wind is accelerated, which can be analyzed in tandem with in situ measurements of the inner solar system, such as those of the Parker Solar Probe. While the heat of the Sun is enough to power the lightest element, ionized hydrogen protons, to escape the Sun as a supersonic wind, other physics must help power the acceleration of heavier elements such as helium. Thus, understanding elemental abundance in the Sun’s atmosphere, provides additional information as we attempt to learn the full story of how the solar wind is accelerated. In the future, scientists plan to take more observations to explain the difference in abundances. Two new instruments, Metis and EUI on board ESA/NASA’s Solar Orbiter, are able to make similar global abundance measurements and will to help provide new information about the helium ratio in the corona. (NASA Goddard)

First physics-based method for predicting large solar flares (18 August 2020)
The new method of flare prediction, called the kappa scheme, is based on the theory of "double-arc instability," that is a magnetohydrodynamic (MHD) instability triggered by magnetic reconnection. The researchers assumed that a small-scale reconnection of magnetic field lines can form a double-arc (m-shape) magnetic field and trigger the onset of a solar flare. The kappa scheme can predict how a small magnetic reconnection triggers a large flare and how a large solar flare can occur. The predictive model was tested on about 200 active regions during solar cycle 24 from 2008 to 2019 using data obtained by NASA's Solar Dynamics Observatory (SDO) satellite. It was demonstrated that with few exceptions, the kappa-scheme predicts most imminent solar flares, as well as the precise location they will emerge from. The researchers also discovered that a new parameter, the "magnetic twist flux density" close to a magnetic polarity inversion line on the solar surface, determines when and where solar flares probably occur and how large they are likely to be. While it takes a lot more work to implement the scheme in real-time operational forecasting, this study shows

that the physics-based approach may open a new direction for flare prediction research. (Nagoya University)

TECHNOLOGY

New ground station brings laser communications closer to reality (20 August 2020)
Optical communications, transmitting data using infrared lasers, has the potential to help NASA return more data to Earth than ever. The benefits of this technology to exploration and Earth science missions are huge. In support of a mission to demonstrate this technology, NASA recently completed installing its newest optical ground station in Haleakala, Hawaii. The state-of-the-art ground station, called Optical Ground Station 2 (OGS-2), is the second of two optical ground stations to be built that will collect data transmitted to Earth by NASA's Laser Communications Relay Demonstration (LCRD). Launching in early 2021, this trailblazing mission will be the linchpin in NASA's first operational optical communications relay system. While other NASA efforts have used optical communications, this will be NASA's first relay system using optical entirely, giving NASA the opportunity to test this method of communications and learn valuable lessons from its implementation. Relay satellites create critical communications links between science and exploration missions and Earth, enabling these missions to transmit important data to scientists and mission managers back home. While optical communications provides missions with many advantages, it can be disrupted by atmospheric interference such as clouds. OGS-2 was chosen to be located in Hawaii because of its clear skies, but bad weather can still happen. On a cloudy day, LCRD would have to wait before transmitting data. In order to avoid delays, services may be transferred to another ground station developed by NASA's Jet Propulsion Laboratory; OGS-1, located in Table Mountain, California. To monitor cloud coverage and determine if OGS-1 is needed, commercial partner Northrop Grumman provided an atmospheric monitoring station that observes weather conditions at the site. This monitoring station runs nearly autonomously 24 hours a day, seven days a week. (NASA Goddard)

New RF filters deliver total spectrum control and utmost reliability for demanding space applications (20 August 2020)
Cobham Advanced Electronic Solutions (CAES), a leading provider of mission critical electronic solutions, announced today that it has bolstered its RF Filter portfolio with the addition of new microwave and millimeterwave filter assemblies specifically designed for space applications. Combining CAES' 40+ years space heritage with its proven manufacturing processes and high performance filter design expertise, these new assemblies surpass reliability standards and support harsh environment requirements of the space industry. Cobham Advanced Electronic Solutions high performance RF Filter capability is characterized by high power handling, narrow and broad bandwidths, connectorized and surface mount packaging in frequency ranges up to 50 gigahertz and enables total spectrum control, further ensuring mission assurance. (Cobham)