Space News Update – September 2020

By Pat Williams

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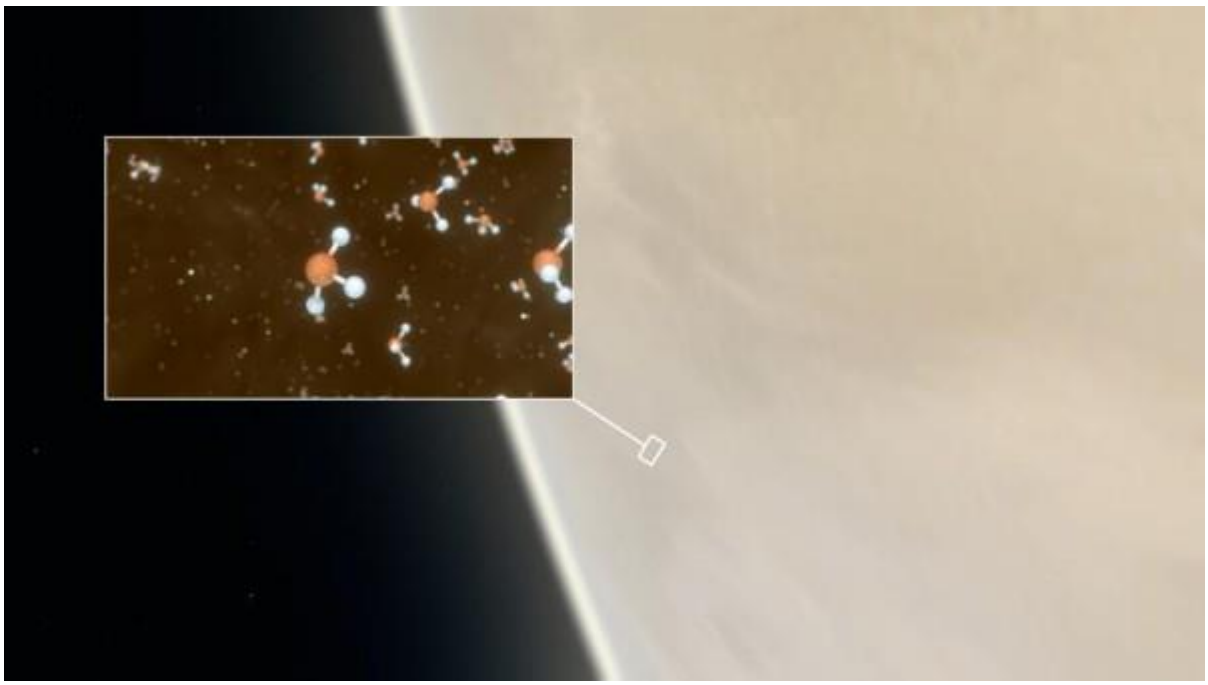
Disclaimer - I claim no authorship for the printed material; except where noted (PW).

HINTS OF LIFE ON VENUS

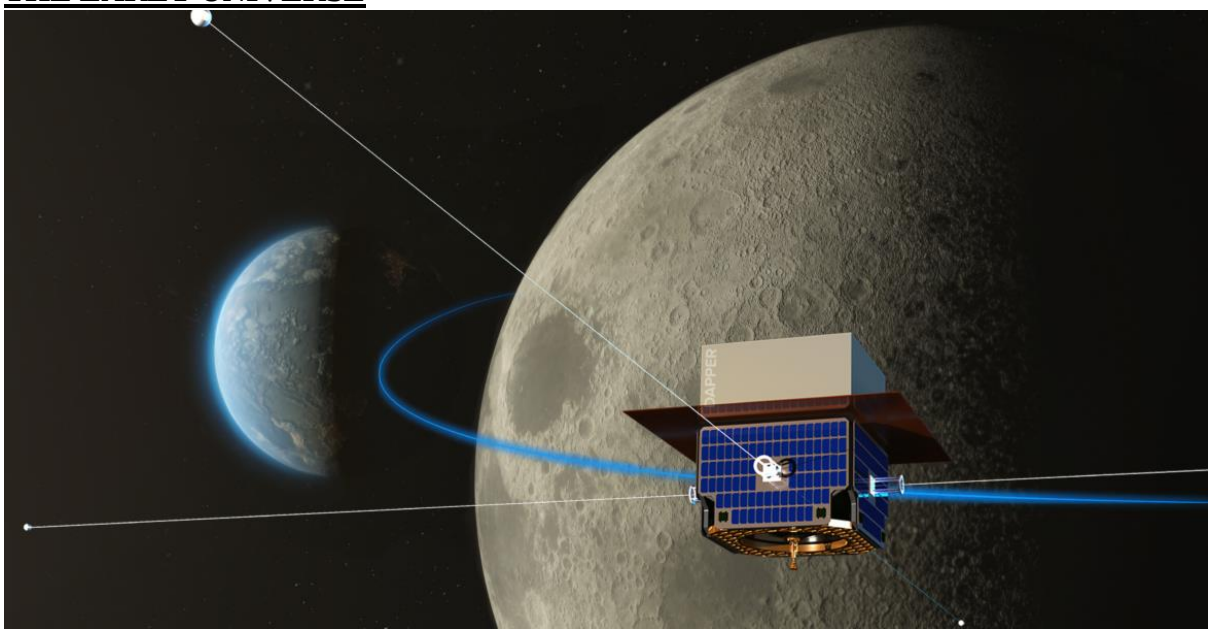


Artist's impression of Venus, with an inset showing a representation of the phosphine molecules detected in the high cloud decks. Credit: ESO / M. Kornmesser / L. Calçada & NASA / JPL / Caltech

An international team of astronomers, led by Professor Jane Greaves of Cardiff University, today announced the discovery of a rare molecule, phosphine, in the clouds of Venus. On Earth, this gas is only made industrially, or by microbes that thrive in oxygen-free environments. Astronomers have speculated for decades that high clouds on Venus could offer a home for microbes, floating free of the scorching surface, but still needing to tolerate very high acidity. The detection of phosphine molecules, which consist of hydrogen and phosphorus, could point to this extra-terrestrial 'aerial' life. The team first used the James

Clerk Maxwell Telescope (JCMT) in Hawaii to detect the phosphine and then with 45 telescopes of the Atacama Large Millimeter/submillimeter Array (ALMA) in Chile. Both facilities observed Venus at a wavelength of about 1 millimetre, much longer than the human eye can see, only telescopes at high altitude can detect this wavelength effectively. Both observatories had seen the same thing, faint absorption at the right wavelength to be phosphine gas, where the molecules are backlit by the warmer clouds below. Professor Hideo Sagawa of Kyoto Sangyo University then used his models for the Venusian atmosphere to interpret the data, finding that phosphine is present but scarce, only about twenty molecules in every billion. The astronomers then ran calculations to see if the phosphine could come from natural processes on Venus. They caution that some information is lacking. The only other study of phosphorus on Venus came from one lander experiment, carried by the Soviet Vega 2 mission in 1985. Massachusetts Institute of Technology led the work on assessing natural ways to make phosphine. Some ideas included sunlight, minerals blown upwards from the surface, volcanoes, or lightning, but none of these could make anywhere near enough of it. Natural sources were found to make at most one ten thousandth of the amount of phosphine that the telescopes saw. To create the observed quantity of phosphine on Venus, terrestrial organisms would only need to work at about 10% of their maximum productivity. Any microbes on Venus will likely be very different to their Earth cousins though, to survive in hyper-acidic conditions. Earth bacteria can absorb phosphate minerals, add hydrogen, and ultimately expel phosphine gas. It costs them energy to do this, so why they do it is not clear. The phosphine could be just a waste product, but other scientists have suggested purposes like warding off rival bacteria. Finding phosphine on Venus was an unexpected bonus. The discovery raises many questions, such as how any organisms could survive. On Earth, some microbes can cope with up to about 5% of acid in their environment but the clouds of Venus are almost entirely made of acid. Other possible biosignatures in the Solar System may exist, like methane on Mars and water venting from the icy moons Europa and Enceladus. On Venus, it has been suggested that dark streaks where ultraviolet light is absorbed could come from colonies of microbes. The Akatsuki spacecraft, launched by the Japanese space agency JAXA, is currently mapping these dark streaks to understand more about this “unknown ultraviolet absorber”. The team believes their discovery is significant because they can rule out many alternative ways to make phosphine, but they acknowledge that confirming the presence of “life” needs a lot more work. Although the high clouds of Venus have temperatures up to a pleasant 30 degrees centigrade, they are incredibly acidic, around 90% sulphuric acid, posing major issues for microbes to survive there. Could microbes shield themselves inside droplets? The team are now eagerly awaiting more telescope time, for example to establish whether the phosphine is in a relatively temperate part of the clouds, and to look for other gases associated with life. New space missions could also travel to our neighbouring planet and sample the clouds in situ to further search for signs of life.
(Royal Astronomical Society)
Hints of life on Venus (14 September 2020)

NRAO JOINS SPACE MISSION TO THE FAR SIDE OF THE MOON TO EXPLORE THE EARLY UNIVERSE



Artist illustration of the Dark Ages Polarimetry Pathfinder (DAPPER), which will look for faint radio signals from the early universe while operating in a low lunar orbit. Its specialized radio receiver and high-frequency antenna are currently being developed by NRAO. Credit: NRAO/AUI/NSF, Sophia Dagnello

The National Radio Astronomy Observatory (NRAO) has joined a new NASA space mission to the far side of the Moon to investigate when the first stars began to form in the early universe. The universe was dark and foggy during its "dark ages," just 380 thousand years after the Big Bang. There were no light-producing structures yet like stars and galaxies, only large clouds of hydrogen gas. As the universe expanded and started to cool down, gravity drove the formation of the stars and black holes, which ended the dark ages and initiated the "cosmic dawn," tens of millions of years later. To learn more about that dark period of the cosmos and understand how and when the first stars began to form, astronomers are trying to catch energy produced by these hydrogen clouds in the form of radio waves, via the so-called 21-centimeter line. But picking up signals from the early universe is extremely challenging. They are mostly blocked by the Earth's atmosphere or drowned out by human-generated radio transmissions. That's why a team of scientists and engineers have decided to send a small spacecraft to lunar orbit and measure this signal while traversing the far side of the Moon, which is radio-quiet. The spacecraft, called the Dark Ages Polarimetry Pathfinder (DAPPER), will be designed to look for faint radio signals from the early universe while operating in a low lunar orbit. Its specialized radio receiver and high-frequency antenna are currently being developed by a team at the NRAO's Central Development Laboratory (CDL) in Charlottesville, Virginia. The project builds upon the work of Marian Pospieszalski who developed flight-ready low noise amplifiers at the CDL in the 1990s for the highly-successful Wilkinson Microwave Anisotropy Probe (WMAP), a spacecraft that gave the most precise figure yet for the age of the universe. (NRAO)

NRAO joins space mission to the far side of the Moon to explore the early universe
(22 September 2020)

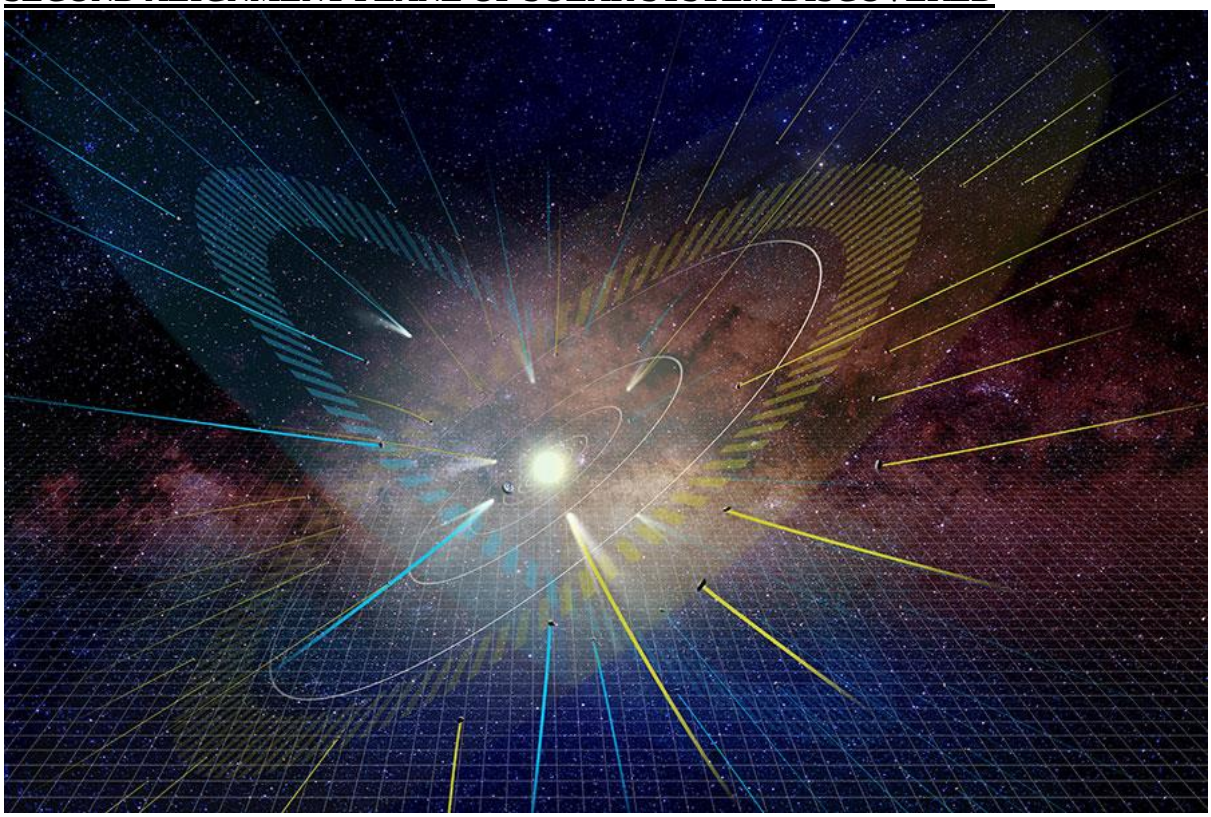
SPACEX TO LAUNCH FIRST COMMERCIAL CREW ROTATION MISSION TO INTERNATIONAL SPACE STATION

The SpaceX Crew-1 official crew portrait with (from left) NASA astronauts Shannon Walker, Victor Glover, Mike Hopkins, and JAXA (Japan Aerospace Exploration Agency) astronaut Soichi Noguchi. Credits: NASA

NASA and SpaceX are beginning a regular cadence of missions with astronauts launching on an American rocket from American soil to the International Space Station as part of NASA's Commercial Crew Program. NASA's SpaceX Crew-1 is the first crew rotation mission with four astronauts flying on a commercial spacecraft, and the first including an international partner. NASA astronauts Michael Hopkins, Victor Glover, Shannon Walker, and Soichi Noguchi of the Japan Aerospace Exploration Agency (JAXA) are set to launch to the space station on SpaceX's Crew Dragon spacecraft and Falcon 9 rocket. The Crew-1 astronauts named the spacecraft Resilience, highlighting the dedication the teams involved with the mission have displayed and to demonstrate that when we work together, there is no limit to what we can achieve. They named it in honour of their families, colleagues, and fellow citizens. Launch is targeted for Saturday, Oct. 31, from Launch Complex 39A at NASA's Kennedy Space Center in Florida. The crew is scheduled for a long duration stay aboard the orbiting laboratory, conducting science and maintenance. The four astronauts are set to return in spring 2021. (NASA)

SpaceX to launch first Commercial Crew rotation mission to International Space Station (29 September 2020)

SECOND ALIGNMENT PLANE OF SOLAR SYSTEM DISCOVERED



Artist's impression of the distribution of long-period comets. The converging lines represent the paths of the comets. The ecliptic plane is shown in yellow and the empty ecliptic is shown in blue. The background grid represents the plane of the Galactic disk. (Credit: NAOJ)

A study of comet motions indicates that the Solar System has a second alignment plane. Analytical investigation of the orbits of long-period comets shows that the aphelia of the comets, the point where they are farthest from the Sun, tend to fall close to either the well-known ecliptic plane where the planets reside or a newly discovered "empty ecliptic." This has important implications for models of how comets originally formed in the Solar System. In the Solar System, the planets and most other bodies move in roughly the same orbital plane, known as the ecliptic, but there are exceptions such as comets. Comets, especially long-period comets taking tens-of-thousands of years to complete each orbit, are not confined to the area near the ecliptic; they are seen coming and going in various directions. (NAOJ)
Second alignment plane of solar system discovered (29 September 2020)

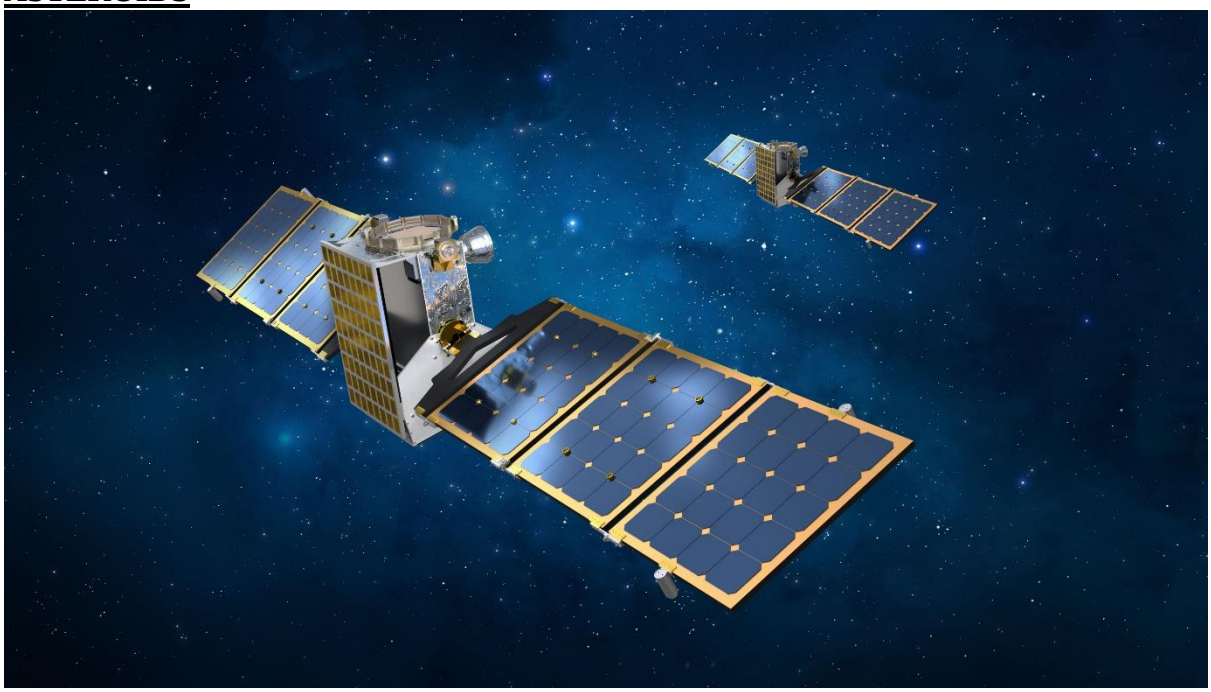
Testing Time for Pills in Space (22 September 2020)

Professor Hessel Credit: The University of Adelaide

Pills are being sent into space to test how they cope with the rigours of one of the harshest environments known. The University of Adelaide is studying how exposure to microgravity and space radiation affects the stability of pharmaceutical tablet formulations. Two separate missions will send science payloads into orbit around Earth: the first will test how tablets cope with the environment inside the International Space Station (ISS) U.S. National Laboratory. The second mission scheduled for early 2021, will test how tablets cope outside the ISS. The microgravity and space radiation investigations, evaluating pharmaceutical stability, are the first science payloads to be sent by the University to the ISS. The investigation will be conducted inside and outside the ISS National Laboratory in two separately owned and operated research facilities. Space Tango and Alpha Space are combining their space flight expertise to send 60 tablets to the International Space Station. Materials used in the tablets being tested, which are packaged in blister packs as they would be available commercially, include Ibuprofen as a pharmaceutical active ingredient and vitamin C, and excipients which are found in abundance in the lunar surface such as silica, magnesium silicate (talcum) and calcium phosphate. These materials and others could be used for new pharmaceutical formulations which may benefit the stability and bioavailability of formulations on Earth as well as those for use in space. The tablets will be exposed to the microgravity and cosmic rays found in the harsh environment of space for six months before returning to Earth where they will test what effect the space environment has had on them. Radiation protection was incorporated into the design of the pills by using ingredients with heavy elements. By altering the ingredient-drug complexation the interaction between the ingredients and the drug they will be able to examine how these variations affect their stability. They only used ingredients from materials that are only available on the Moon, and in so doing they are making the first steps towards autonomous on-board pharmaceutical manufacturing. The first mission will be launched on Friday 2 October from NASA's Wallops Flight Facility in Virginia, USA and will reach the ISS on Monday 5 October. Space Tango's automated CubeLab hardware containing the tablets will be installed inside the ISS. (University of Adelaide)

Testing Time for Pills in Space (22 September 2020)

NEW SMALL SATELLITE MISSION TO RENDEZVOUS WITH BINARY ASTEROIDS



Janus-Illustration The twin-spacecraft Janus project will study the formation and evolutionary implications for small "rubble pile" binary asteroids. Credit: Lockheed Martin

The University of Colorado Boulder and Lockheed Martin (NYSE: LMT) will soon lead a new space mission to capture the first-ever closeup look at a mysterious class of solar system objects: binary asteroids. The twin-spacecraft Janus project will study the formation and evolutionary implications for small "rubble pile" binary asteroids. These bodies are pairs of asteroids that orbit around each other in space, much like the Earth and Moon. The Janus mission, named after the two-faced Roman God, will study these asteroid couplets in never-before-seen detail. It will be a moment for twos: In 2022, the Janus team will launch two identical spacecraft that will travel millions of miles to individually fly close to two pairs of binary asteroids. Their observations could open up a new window into how these diverse bodies evolve and even burst apart over time. Binary asteroids are one class of objects for which we don't have high-resolution scientific data. Everything we have on them is based on ground observations, which don't give as much detail as being up close. Janus' twin spacecraft are designed to be small and nimble, each one about the size of a carry-on suitcase. The mission will rendezvous with two binary pairs, named 1996 FG3 and 1991 VH, each showcasing a different kind of orbital pattern. The pair called 1991 VH, for example, has a "moon" that whips around a much bigger "primary" asteroid following a hard-to-predict pattern. The team will use a suite of cameras to track the dynamical motion in unprecedented detail. Among other goals, they hope to learn more about how binary asteroids move, both around each other and through space. The mission's twin spacecraft, each of which weigh just about 80 pounds, will travel farther than any small satellite to date. After blasting off in 2022, they'll first complete an orbit around the sun, before heading back toward Earth and sling-shotting their way far into space and beyond the orbit of Mars. (Lockheed Martin)
New small satellite mission to rendezvous with binary asteroids (10 September 2020)

LINKS TO OTHER SPACE NEWS PUBLISHED IN SEPTEMBER 2020

ASTEROIDS

Why is asteroid Bennu ejecting particles into space?(9 September 2020)
By tracking the journeys of hundreds of ejected particles, scientists were able to better understand what might be causing the particles to launch from the surface of Bennu. The particle sizes match what is expected for thermal fracturing (as the asteroid's surface is repeatedly heated and cooled while it rotates), but the locations of the ejection events also match the modelled impact locations of meteoroids (small rocks hitting the surface of Bennu as it orbits the Sun). It may even be a combination of these phenomena. But to come to a definitive answer, more observations are needed. (JPL)

Thales Alenia Space to provide key technology to HERA, ESA's planetary defence mission (15 September 2020)
Named after the Greek goddess of marriage, HERA, European contribution to AIDA international cooperation (Asteroid Impact & Deflection Assessment, the first planetary defence mission of humanity), aims to find out if we are capable of deflecting an asteroid and prevent it from hitting Earth. AIDA consists of two missions, NASA's Double Asteroid Redirection Test (DART), a kinetic impactor designed to deviate the orbit of the smaller of the two Didymos asteroids, and ESA's HERA inspector spacecraft, that will rendezvous the Didymos target asteroid about 4 years after the DART impact. HERA, scheduled for launch in 2024, will travel for the first time in history to explore a binary asteroid system. (Thales)

MSSS To provide science cameras for Janus asteroid mission (14 September 2020)
Malin Space Science Systems (MSSS) has been selected to provide the science payloads for the two Janus spacecraft. Last week, Janus was approved by NASA to proceed with final design of the mission hardware, including the MSSS cameras (called "JCam"). The two Janus spacecraft will be launched in August 2022 on the same Falcon Heavy rocket as NASA's Psyche spacecraft. They will fly by two small binary asteroids, 1991 VH and 1996 FG3, in March-April 2026. Each spacecraft will carry a JCam system built by MSSS. JCam consists of an ECAM M50 visible camera and an ECAM IR3 thermal infrared camera, with a DVR4 processing/storage unit with 16 GB of flash memory. It will obtain images of the asteroid targets and also be used for spacecraft navigation and pointing during the flybys. Each complete JCam system weighs less than 3.2 kg and has a maximum power draw of less than 14 watts. These combined visible and thermal infrared imaging capabilities will enable JCam to characterize the current morphology of 1991 VH and 1996 FG3 and to constrain their evolution. (Malin Space Science Systems)

Meteorites from Vesta found on asteroid Bennu (21 September 2020)
In an interplanetary faux pas, it appears some pieces of asteroid Vesta ended up on asteroid Bennu, according to observations from NASA's OSIRIS-REx spacecraft. The new result sheds light on the intricate orbital dance of asteroids and on the violent origin of Bennu, which is a "rubble pile" asteroid that coalesced from the fragments of a massive collision. Six boulders ranging in size from 5 to 14 feet (about 1.5 to 4.3 meters) were scattered across Bennu's southern hemisphere and near the equator. These boulders were much brighter than

the rest of Bennu and matched material from Vesta. The leading hypothesis is that Bennu inherited this material from its parent asteroid after a vestoid (a fragment from Vesta) struck the parent. Then, when the parent asteroid was catastrophically disrupted, a portion of its debris accumulated under its own gravity into Bennu, including some of the pyroxene from Vesta. (NASA Goddard)

OSIRIS-REx begins its countdown to TAG (24 September 2020)
A historic moment is on the horizon for the University of Arizona-led NASA OSIRIS-REx mission. In just a few weeks, the robotic OSIRIS-REx spacecraft will descend to asteroid Bennu's boulder-strewn surface, touch down for a few seconds and collect a sample of the asteroid's rocks and dust, marking the first time NASA has grabbed pieces of an asteroid, which will be returned to Earth for study. (NASA Goddard)

COMETS

SwRI instruments aboard Rosetta help detect unexpected ultraviolet aurora at a comet
(21 September 2020)
Finding auroras around 67P, which lacks a magnetic field, is surprising and fascinating. Initially, they thought the ultraviolet emissions at comet 67P were phenomena known as 'dayglow,' a process caused by solar photons interacting with cometary gas. They were amazed to discover that the UV emissions were aurora, driven not by photons, but by electrons in the solar wind that break apart water and other molecules in the coma and have been accelerated in the comet's nearby environment. The resulting excited atoms make this distinctive light. (SwRI)

DARK MATTER

Dark matter destruction ruled out as origin of extra radiation in galaxy centre
(14 September 2020)
The detection more than a decade ago by the Fermi Gamma-ray Space Telescope of an excess of high-energy radiation in the centre of the Milky Way convinced some physicists that they were seeing evidence of the annihilation of dark matter particles, but a team led by a researcher at the Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU) has ruled out that interpretation. In a paper published recently in the journal Physical Review D, the Kavli IPMU Project Researcher at other institutions report that, through an analysis of the Fermi data and an exhaustive series of modelling exercises, they were able to determine that the observed gamma rays could not have been produced by what are called weakly interacting massive particles (WIMPS), most popularly theorized as the stuff of dark matter. For 40 years or so, the leading candidate for dark matter among particle physicists was a thermal, weakly interacting and weak-scale particle, and this result for the first time rules out that candidate up to very high-mass particles. In many models, this particle ranges from 10 to 1,000 times the mass of a proton, with more massive particles being less attractive theoretically as a dark matter particle. Dark matter signals could be crowded out by other astrophysical phenomena in the Galactic Center, such as star formation, cosmic ray deflection off molecular gas and, most notably, neutron stars and millisecond pulsars, as sources of excess gamma rays detected by the Fermi space telescope. If you peer at the Galactic Center,

you see that the stars are distributed in a boxy way. There's a disk of stars, and right in the centre, there's a bulge that's about 10 degrees on the sky, and it's actually a very specific shape, sort of an asymmetric box and this shape leaves very little room for additional dark matter. Does this research does not rule out the existence of dark matter in the galaxy? The study constrains the kind of particle that dark matter could be. The multiple lines of evidence for dark matter in the galaxy are robust. There are a lot of alternative dark matter candidates out there. The search is going to be more like a fishing expedition where you don't already know where the fish are. (KAVLI IPMU)

EARTH

Plans underway for new polar ice and snow topography mission (21 September 2020)
Monitoring the cryosphere is essential to fully assess, predict and adapt to climate variability and change. Given the importance of this fragile component of the Earth system, today ESA has signed a contract to develop the Copernicus Polar Ice and Snow Topography Altimeter mission, known as CRISTAL. With a launch planned in 2027, the CRISTAL mission will carry, for the first time on a polar mission, a dual-frequency radar altimeter, and microwave radiometer, that will measure and monitor sea-ice thickness, overlying snow depth and ice-sheet elevations. The data will support maritime operations in the polar oceans and contribute to a better understanding of climate processes. CRISTAL will also support applications related to coastal and inland waters, as well as providing observations of ocean topography. (ESA)

EXOPLANETS

New observations show planet-forming disc torn apart by its three central stars
(3 September 2020)
A team of astronomers have identified the first direct evidence that groups of stars can tear apart their planet-forming disc, leaving it warped and with tilted rings. This new research suggests exotic planets, not unlike Tatooine in Star Wars, may form in inclined rings in bent discs around multiple stars. The results were made possible thanks to observations with the European Southern Observatory's Very Large Telescope (ESO's VLT) and the Atacama Large Millimeter/submillimeter Array (ALMA). (ESO)

Exoplanet observer reveals extreme alien world (28 September 2020)
ESA's new exoplanet mission, Cheops, has found a nearby planetary system to contain one of the hottest and most extreme extra-solar planets known to date: WASP-189 b. The finding, the very first from the mission, demonstrates Cheops' unique ability to shed light on the Universe around us by revealing the secrets of these alien worlds. (ESA)

INTERNATIONAL SPACE STATION

Space nematodes: a giant leap for interplanetary agriculture (22 September 2020)
In a successful return-to-space mission, research study results indicate that beneficial insect-killing nematodes (small round worms) can be used in the future for natural control of insect

pests when humans are growing crops in space. The research objective was to study entomopathogenic (insect-killing) nematodes (EPNs) foraging and infection dynamics in space onboard the International Space Station (ISS) between December 2019 and January 2020. (USDA-ARS)

LAUNCH SERVICES

NASA awards launch services contract for IMAP mission (25 September 2020)
NASA has selected Space Exploration Technologies (SpaceX) of Hawthorne, California, to provide launch services for the agency's Interstellar Mapping and Acceleration Probe (IMAP) mission, which includes four secondary payloads. IMAP will help researchers better understand the boundary of the heliosphere, a magnetic barrier surrounding our solar system. This region is where the constant flow of particles from our Sun, called the solar wind, collides with winds from other stars. This collision limits the amount of harmful cosmic radiation entering the heliosphere. IMAP will collect and map neutral particles that make it through, as well as investigate the fundamental processes of how particles are accelerated in space, from its vantage point orbiting the Sun at the Lagrange 1 point directly between the Sun and Earth. The IMAP mission is targeted to launch in October 2024 on a Falcon 9 Full Thrust rocket from Launch Complex 40 at Cape Canaveral Air Force Station in Florida. (NASA)

MARS

General Atomics delivers Nuclear Thermal Propulsion concept to NASA (9 September 2020)
General Atomics Electromagnetic Systems (GA-EMS) announced today that it has delivered a design concept of a Nuclear Thermal Propulsion (NTP) reactor to power future astronaut missions to Mars for a NASA-funded study. The study, managed by Analytical Mechanics Associates (AMA), explored a design space defined by key performance parameters as well as figures of merit. The GA-EMS design exceeded the key performance parameters and optimized the NTP reactor for manufacturability, the highest ranked figure of merit. (General Atomics)

NASA's new Mars rover will use X-rays to hunt fossils (22 September 2020)
NASA's Mars 2020 Perseverance rover has a challenging road ahead: After having to make it through the harrowing entry, descent, and landing phase of the mission on Feb. 18, 2021, it will begin searching for traces of microscopic life from billions of years back. That's why it's packing PIXL, a precision X-ray device powered by artificial intelligence (AI). Short for Planetary Instrument for X-ray Lithochemistry, PIXL is a lunchbox-size instrument located on the end of Perseverance's 7-foot-long (2-meter-long) robotic arm. The rover's most important samples will be collected by a coring drill on the end of the arm, then stashed in metal tubes that Perseverance will deposit on the surface for return to Earth by a future mission. (JPL)

First tests for landing the Martian Moons eXploration Rover (30 September 2020)
The Japan Aerospace Exploration Agency (JAXA) Martian Moons eXploration (MMX) mission will have a German-French rover on board when it is launched in 2024. The rover

will land on the Martian moon Phobos and explore its surface for approximately three months. Initial landing tests are currently underway at the German Aerospace Centre in Bremen. Using a first preliminary development model, the engineers are determining how robust the design of the approximately 25-kilogram rover must be to withstand an impact on the moon's surface after a free fall of about 40 to 100 metres. (DLR)

MOON

NASA conducts SLS booster test for future Artemis missions (2 September 2020)
The SLS boosters are the largest, most powerful boosters ever built for flight. The flight support booster used in the test is the same size and has the same power as the flight version of a five-segment solid rocket booster used for NASA's Artemis missions. The Artemis I boosters are currently being prepared for launch at NASA's Kennedy Space Center in Florida. This flight support booster test is the first motor firing NASA and Northrop Grumman have completed since qualifying the booster design for the Space Launch System rocket. Full-scale booster tests are rare, so NASA tries to test multiple objectives at one time so they are highly confident that any changes we make to the boosters will still enable them to perform as expected on launch day. NASA is working to land the first woman and next man on the Moon by 2024. 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 as part of America's broader Moon to Mars exploration approach. Experience gained at the Moon will enable humanity's next giant leap: sending humans to Mars. SLS is the only rocket that can send Orion, astronauts and supplies to the Moon in a single mission. (NASA)

Astrobotic successfully completes Peregrine Lunar Lander Structural Model testing
(3 September 2020)
Astrobotic's Peregrine Mission One program has successfully passed structural qualification testing, marking a major development milestone toward its maiden voyage and lunar landing in 2021. These tests qualify the integrity of the Peregrine lander's structure and its ability to survive launch while carrying payloads from 16 customers. (Astrobotic)

National Team completes System Requirements Review to define its integrated human landing system design (14 September 2020)
A complex undertaking like human lunar landings requires paying attention to thousands of details and thinking through every likely contingency. The National Team is working to directly apply the lessons from the Apollo experience to make America's next crewed lunar landing successful and the precursor to sustained human activity on the Moon. The Blue Origin-led National Team is developing an integrated landing system for the NASA Artemis Human Landing System Program managed at NASA's Marshall Space Flight Center to return Americans to the lunar surface; this time to stay. (Blue Origin)

Preparations for next moonwalk simulations underway (23 September 2020)
NASA engineers are laying the foundation for the moonwalks the first woman and next man will conduct when they land on the lunar South Pole in 2024 as part of the Artemis program. At the agency's Johnson Space Center in Houston, teams are testing the tools and developing

training approaches for lunar surface operations. As part of a test series occurring in the Neutral Buoyancy Lab (NBL) at Johnson, astronauts in a demonstration version of the exploration spacesuit and engineers in “hard hat” dive equipment are simulating several different tasks crew could do on the surface of the Moon. The tests are focused on evaluating Johnson’s facilities for Artemis spacewalk testing, development, and crew training. Astronauts are practicing a variety of tasks, including picking up samples of lunar regolith, examining a lunar lander, and planting an American flag. There are many fundamentals that the teams have to consider and work through, such as how crew might get up and down a ladder safely, how to swing a hammer safely, and how to conduct successful moonwalks in different lighting conditions than the Apollo-era moonwalks. The tests will inform future mission planning, including how many spacewalks to conduct during a mission, how long they’ll be, and how far away from a lander the crew will travel. “We can evaluate tools in a lab or the rock yard, but you can learn so much when you put a pressurized spacesuit on and have to work within the limitations of its mobility,” Welsh said. “These NBL runs are so valuable for understanding the human performance component and ensuring our astronauts are as safe as possible.” In addition to testing in the NBL, teams also are using different analogue environments to simulate lunar conditions. Tests are occurring at Johnson’s rock yard, a large, outdoor test area which simulates general features of the lunar surface terrain. (NASA)

German instrument on the Chinese Chang'e-4 lunar lander measures cosmic radiation
(25 September 2020)
The Chang'e-4 lunar lander touched down on the far side of the Moon on 3 January 2019, with a German instrument for measuring space radiation on board. Since then, the Lunar Lander Neutron and Dosimetry (LND) instrument has been measuring temporally resolved cosmic radiation for the first time. Earlier devices could only record the entire 'mission dose'. Their investigations have involved more precise radiation measurements on the Moon. Space radiation poses a significant risk to the health of humans. The Apollo astronauts carried radiation measuring devices, referred to as dosimeters, on their bodies. But these only determined the radiation exposure over the course of the entire mission. With the LND instrument it is possible to measure the various characteristics of the radiation field over time intervals of one, 10 or 60 minutes. This enables researchers to calculate the 'equivalent dose', which is important for estimating biological effects. The radiation exposure measured is a good indication of the radiation inside a spacesuit. The measurements give an equivalent dose rate, the biologically weighted radiation dose per unit of time of around 60 microsieverts per hour. For comparison, during a long-haul flight from Frankfurt to New York, the dose rate is five to 10 times lower than this. On Earth's surface, it is some 200 times lower. In other words, a long-term stay on the Moon will expose astronauts' bodies to high doses of radiation. Human bodies are simply not made to be exposed to space radiation. On longer missions to the Moon, astronauts will have to protect themselves from it by covering their habitat with a thick layer of lunar rock, for example. This could reduce the risk of cancer and other illnesses caused by long periods of time spent on the Moon. The instrument developed in Kiel conducts measurements throughout the lunar day, but like all other scientific devices on the lander, remains switched off throughout the extremely cold, approximately two-week lunar night, to save power. The instrument and lander were designed to conduct their measurements for at least one year, a target they have already surpassed. The data from the LND and the lander are transmitted to Earth via the relay satellite Queqiao ('Magpie Bridge'),

which is located above the far side of the Moon. The radiation data are also relevant for future interplanetary missions. Since the Moon has neither a protective magnetic field nor an atmosphere, the radiation field on the Moon's surface is similar to that in interplanetary space. With that in mind, the LND measurements are also used to develop computer models to calculate the expected radiation exposure, refine our models and thus contribute towards work on radiation protection for astronauts on future missions. It is vital that the detector also allows conclusions to be drawn about the composition of the radiation field, such as how many neutrons and high energy-charged particles are present. (DLR)

ArianeGroup to deliver key propulsion system components for the Orion spacecraft for the Artemis III Moon mission (28 September 2020)
The first service module has been delivered to NASA and the second is currently being assembled and tested at the ArianeGroup site in Bremen, Germany. Integration of the third service module will be starting shortly in Bremen. The European Service Module that will propel the astronauts to the Moon has a propulsion sub-system comprising 33 engines. In addition to the main engines built in the U.S., it includes 24 attitude control motors with a thrust of 200N, built by ArianeGroup in Lampoldshausen, Germany. For NASA's Artemis program, the third ESM will be powering the astronauts into lunar orbit on board the Orion crew module, which will land on the Moon and return to Earth in 2024, carrying the first woman to set foot on the Moon. Before this, two flights will take place, with the first scheduled for 2021. This is the first time that NASA has used a European-built critical component to provide propulsion and electrical power for one of its spacecraft. (ArianeGroup)

PLANETARY NEBULA

Astronomers solve mystery of how planetary nebulae are shaped (17 September 2020)
Following extensive observations of stellar winds around cool evolved stars scientists have figured out how planetary nebulae get their mesmerizing shapes. The findings contradict common consensus, and show that not only are stellar winds aspherical, but they also share similarities with planetary nebulae. Since the complexity of stellar winds was not accounted for in the past, any previous estimate of the mass-loss rate of old stars could be wrong by up to a factor of 10. Some are disk-like, while others are shaped like eyes, spiral structures, and even arcs. Astronomers quickly realized that the shapes weren't formed randomly, and that companions, low-mass stars and heavy planets, in the vicinity of the AGB stars were influencing the shapes and patterns. All of our observations can be explained by the fact that the stars have a companion. In about five billion years, the Sun will become more luminous. Its radius will expand to a length that is comparable to the current distance between the Sun and Earth, and it will enter the AGB phase. Jupiter or even Saturn, because they have such a big mass are going to influence whether the Sun spends its last millennia at the heart of a spiral, a butterfly or any of the other entrancing shapes we see in planetary nebulae today. Current simulations predict that Jupiter and Saturn will create a weak spiral structure in the wind of the Sun once it is an AGB star. (Center for Astrophysics Harvard & Smithsonian)

SATURN AND MOONS

Infrared eyes on Enceladus: hints of fresh ice in northern hemisphere (18 September 2020)
New composite images made from NASA's Cassini spacecraft are the most detailed global infrared views ever produced of Saturn's moon Enceladus. And data used to build those images provides strong evidence that the northern hemisphere of the moon has been resurfaced with ice from its interior. (JPL)

SPACE

With DUST-2 launch, NASA's sounding rocket program is back on the range
(4 September 2020)
NASA is preparing for the first launch of a sounding rocket since the coronavirus pandemic began in the United States. The DUST-2 mission, which is short for the Determining Unknown yet Significant Traits-2, will carry a miniature laboratory into space, simulating how tiny grains of space dust, the raw materials of stars, planets and solar systems, form and grow. The launch window opens at the White Sands Missile Range in New Mexico on September 8, 2020. (NASA Goddard)

SUB ORBITAL SPACE

Testing super foods for space and more on Blue Origin suborbital flight (23 September 2020)
It's no surprise to most of us that regularly eating fresh produce is a great way to support a healthy diet. Fresh fruits and vegetables benefit astronauts on the International Space Station, too, and soon the Moon and beyond. Scientists are investigating sustainable ways to grow highly nutritious foods in microgravity, to give space explorers a readily available supply of daily greens. The microgravity LilyPond growth chamber uses capillary action to provide a stable water surface on which duckweed (and potentially other veggies, like microgreens) can grow. LED panels provide an efficient light source, and a salad spinner-like sieve helps separate the water from the plants when ready to harvest. On an upcoming flight Space Lab Technologies will test their microgravity LilyPond, a hydroponic chamber for growing edible aquatic plants in space. Along with several other technologies selected for testing, LilyPond will launch on Blue Origin's next New Shepard mission. The payloads will fly to space and experience several minutes of microgravity before returning to Earth, giving researchers valuable data about how their technologies perform. (NASA Armstrong)

SUN

Global helium abundance measurements in solar corona (18 September 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.
(Naval Research Laboratory)

TECHNOLOGY

Large-scale 3D printing of rocket engines (11 September 2020)
As part of the Artemis program, NASA is returning astronauts to the Moon where we will prepare for human exploration of Mars. Additive manufacturing, or 3D printing, experts from NASA, industry, and academia are pioneering methods to print the rocket parts that could power those journeys. NASA's Rapid Analysis and Manufacturing Propulsion Technology project, or RAMPT, is advancing development of an additive manufacturing technique to 3D print rocket engine parts using metal powder and lasers. The method, called blown powder directed energy deposition, could bring down costs and lead times for producing large, complex engine components like nozzles and combustion chambers. Prior developments in additive manufacturing did not have the large-scale capabilities this emerging technology provides. (NASA Marshall)

NASA technology enables precision landing without a pilot (17 September 2020)
Some of the most interesting places to study in our solar system are found in the most inhospitable environments – but landing on any planetary body is already a risky proposition. With NASA planning robotic and crewed missions to new locations on the Moon and Mars, avoiding landing on the steep slope of a crater or in a boulder field is critical to helping ensure a safe touch down for surface exploration of other worlds. In order to improve landing safety, NASA is developing and testing a suite of precise landing and hazard-avoidance technologies. A combination of laser sensors, a camera, a high-speed computer, and sophisticated algorithms will give spacecraft the artificial eyes and analytical capability to find a designated landing area, identify potential hazards, and adjust course to the safest touchdown site. The technologies developed under the Safe and Precise Landing – Integrated Capabilities Evolution (SPLICE) project within the Space Technology Mission Directorate's Game Changing Development program will eventually make it possible for spacecraft to avoid boulders, craters, and more within landing areas half the size of a football field already targeted as relatively safe. (NASA)

Opterus awarded NASA contract to develop large retractable blanket solar array
(29 September 2020)
The National Aeronautics and Space Administration (NASA) awarded Opterus Research and Development, Inc. a ground-breaking project that will pave the way for very large lunar surface solar arrays. Technologies developed in the program will also serve as pathfinders for NASA's ambitious Moon to Mars program, which puts a premium on the need for reliable, reusable, retractable equipment that can be packaged and deployed multiple times. The six-month contract, which was awarded through NASA's Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) program, will begin development of a patent pending large-diameter Collapsible Tubular Mast (CTM). The mast will use High Strain Composite (HSC) materials that reduce mechanical system part count by

an order of magnitude. The CTM Opterus is developing will handle much greater buckling, torsional, and bending loads than any existing HSC deployable mast developed to date. (Opterus)

TELESCOPES

Primary mirror for NASA's Roman Space Telescope completed (3 September 2020)
The primary mirror, in concert with other optics, will send light to Roman's two science instruments, the Wide Field Instrument and Coronagraph Instrument. The first is essentially a giant 300-megapixel camera that provides the same sharp resolution as Hubble across nearly 100 times the field of view. Using this instrument, scientists will be able to map the structure and distribution of invisible dark matter, study planetary systems around other stars, and explore how the universe evolved to its present state. The coronagraph demonstrates technology that blocks out the glare of stars and allows astronomers to directly image planets in orbit around them. If the coronagraph technology performs as anticipated, it will see planets that are almost a billion times fainter than their host star and enable detailed studies of giant planets around other suns. Roman will observe from a vantage point about 930,000 miles (1.5 million km) away from Earth in the direction opposite the Sun. Roman's barrel-like shape will help block out unwanted light from the Sun, Earth, and Moon, and the spacecraft's distant location will help keep the instruments cool, ensuring that it will be able to detect faint infrared signals. (NASA Goddard)

SKA completes final reviews ahead of construction (15 September 2020)
External reviews are good practice and an important ingredient to the management of large construction projects like SKA. They provide reassurance to the project team that they are on a good track with their project, that their assumptions and projections are sound and that no critical issues have been overlooked. It's also always interesting to see how similar the problems are that we encounter in our projects. Adopting solutions that have been successful elsewhere can be important for the success of big projects. Overall, more than 250 formal observations and questions were raised and addressed resulting in 40 recommendations, all of which were accepted by SKAO and are being implemented. (SKA Organisation)

Trelleborg to provide sealing solutions to the world's largest optical telescope
(28 September 2020)
Trelleborg's marine and infrastructure operation has been specified by contractor, Cimolai S.p.A, to supply bespoke high-performance inflatable and compression seals to the largest optical / near-infrared telescope in the world. The Extremely Large Telescope (ELT), located on top of Cerro Armazones, sits at an altitude of over 3,000 metres in the Atacama Desert of northern Chile. Upon completion in 2025, the ELT, which is owned and will be operated by the European Southern Observatory (ESO), will gather 15 times more light than today's largest optical telescopes. Boasting a 39-meter primary mirror, ESO's ELT will also feature ground-breaking adaptive optics technology, that will help correct the distortions in the Earth's atmosphere, making the images sharper than those taken from space. Showcasing the craftsmanship of its engineers, Trelleborg will manufacture and supply highly-durable, handmade inflatable and compression seals, that will keep the ELT's classic dome-shaped

enclosure pressurized, airtight from water, heat and dust, and ensure there is no UV exposure within the enclosure. (Trelleborg)

URANUS

Observations with the Herschel Space Observatory reveal the composition of the largest Uranian moons (14 September 2020)
More than 230 years ago astronomer William Herschel discovered the planet Uranus and two of its moons. Using the Herschel Space Observatory, a group of astronomers now has succeeded in determining physical properties of the five main moons of Uranus. The measured infrared radiation, which is generated by the Sun heating their surfaces, suggests that these moons resemble dwarf planets like Pluto. The team developed a new analysis technique that extracted the faint signals from the moons next to Uranus, which is more than a thousand times brighter. (Max Planck Institute for Astronomy)

Pat Williams September 2020