

Space News Update – May 2019

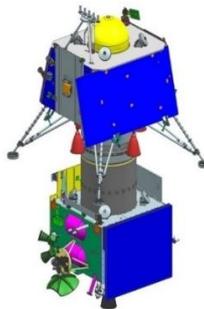
By Pat Williams

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

INDIA AIMS TO BE 1ST COUNTRY TO LAND ROVER ON MOON'S SOUTH POLE



India will become the first country to land a rover on the Moon's the south pole if the country's space agency "Indian Space Research Organisation (ISRO)" successfully achieves the feat during the country's second Moon mission "Chandrayaan-2" later this year. "This is a place where nobody has gone. All the ISRO missions till now to the Moon have landed near the Moon's equator. Chandrayaan-2, India's second lunar mission, has three modules namely Orbiter, Lander (Vikram) & Rover (Pragyan). The Orbiter and Lander modules will be interfaced mechanically and stacked together as an integrated module and accommodated inside the GSLV MK-III launch vehicle. The Rover is housed inside the Lander. After launch into earth bound orbit by GSLV MK-III, the integrated module will reach Moon orbit using Orbiter propulsion module. Subsequently, Lander will separate from the Orbiter and soft land at the predetermined site close to lunar South Pole. Further, the Rover will roll out for carrying out scientific experiments on the lunar surface. Instruments are also mounted on Lander and Orbiter for carrying out scientific experiments. All the modules are getting ready for Chandrayaan-2 launch during the window of July 09, to July 16, 2019, with an expected Moon landing on September 06, 2019.

[India aims to be 1st country to land rover on Moon's south pole](#) (06 May 2019)

JEFF BEZOS SAYS BLUE ORIGIN WILL LAND HUMANS ON MOON BY 2024



Blue Origin's Blue Moon lander. Photo courtesy of Blue Origin

Blue Origin announced Blue Moon, its large lunar lander capable of delivering multiple metric tons of payload to the lunar surface based on configuration and mission. The cargo variant revealed today can carry 3.6 metric tons to the surface. We have also designed a variant of the lander that can stretch to be capable of carrying a 6.5-metric-ton, human-rated ascent stage. Blue also announced it can meet the current Administration's goal of putting Americans on the Moon by 2024 with the Blue Moon lunar lander. (Blue Origin) [Jeff Bezos says Blue Origin will land humans on moon by 2024](#) (09 May 2019)

CHINA'S CHANG'E-4 PROBE RESUMES WORK FOR SIXTH LUNAR DAY

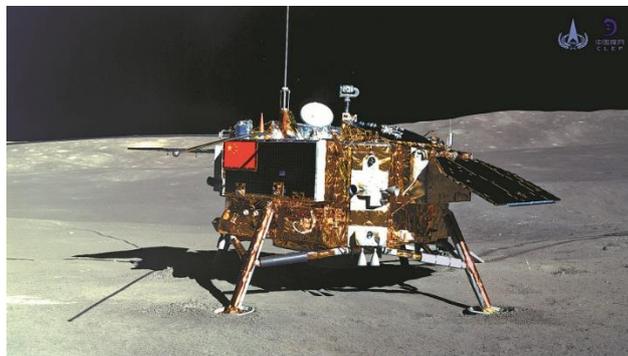
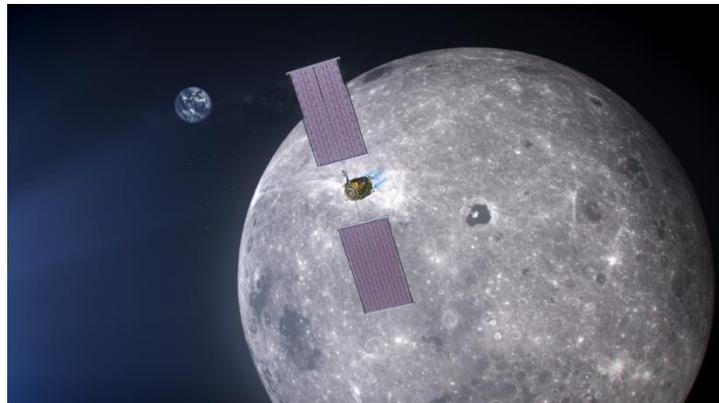


Photo taken by the rover Yutu 2 (Jade Rabbit-2) on Jan 11, 2019 shows the lander of the Chang'e 4 probe. [Photo/Xinhua/China National Space Administration]

The lander and the rover of the Chang'e-4 probe have resumed work for the sixth lunar day on the far side of the moon after "sleeping" during the extremely cold night. The lander woke and the rover, Yutu-2 (Jade Rabbit-2). The lander's neutron radiation detector and low-frequency radio detector will be restarted to conduct scientific tasks including particle radiation observation and low-frequency radio astronomical observation. The rover's panoramic camera, detection radar, infrared imaging spectrometer and neutral atom detector will be restarted during the sixth lunar day. China's Chang'e 4 probe, launched on Dec 8, 2018, made the first-ever soft landing on the Von Karman Crater in the South Pole-Aitken Basin on the far side of the moon on Jan. 3. A lunar day equals 14 days on Earth, and a lunar

night is the same length. The Chang'e 4 probe switched to a dormant mode during the lunar night due to the lack of solar power. As a result of the tidal locking effect, the moon's revolution cycle is the same as its rotation cycle, and the same side always faces Earth. The far side of the moon has unique features, and scientists expect Chang'e 4 to provide breakthrough findings. The scientific tasks of the Chang'e 4 mission include low-frequency radio astronomical observation, surveying the terrain and landforms, detecting the mineral composition and shallow lunar surface structure and measuring neutron radiation and neutral atoms. The Chang'e 4 mission embodies China's hope to combine human wisdom in space exploration with four payloads developed by the Netherlands, Germany, Sweden and Saudi Arabia. Beijing (XNA) (30 May 2019)

NASA AWARDS ARTEMIS CONTRACT FOR LUNAR GATEWAY POWER, PROPULSION



The power and propulsion element provides a communications relay capability for NASA's Gateway, enabling it to serve as a mobile command and service module for human and robotic expeditions to the lunar surface. Credits: NASA

Charged with returning to the Moon within five years, NASA's lunar exploration plans are based on a two-phase approach: the first is focused on speed, landing on the Moon by 2024, while the second will establish a sustained human presence on and around the Moon by 2028. We then will use what we learn on the Moon to prepare to send astronauts to Mars. The power and propulsion element is the foundation of Gateway and a fine example of how partnerships with U.S. companies can help expedite NASA's return to the Moon with the first woman and next man by 2024. It will be the key component upon which we will build the lunar Gateway outpost, the cornerstone of NASA's sustainable and reusable Artemis exploration architecture on and around the Moon. The power and propulsion element is a high-power, 50-kilowatt solar electric propulsion spacecraft, three times more powerful than current capabilities. As a mobile command and service module, the Gateway provides a communications relay for human and robotic expeditions to the lunar surface, starting at the Moon's South Pole. (NASA)

[NASA awards Artemis contract for lunar gateway power, propulsion](#) (24 May 2019)

FROM AIRPORT TO SPACEPORT AS UK TARGETS HORIZONTAL SPACEFLIGHT



Future spaceports can apply for a share of 2 million pounds to support plans for small satellite launch from aircraft and sub-orbital flight from the UK. Sites such as Newquay in Cornwall, Campbeltown and Glasgow Prestwick in Scotland, and Snowdonia in Wales are already developing their sub-orbital flight, satellite launch and spaceplane. The £2 million strategic development fund, opened by the UK Space Agency, will help sites like these accelerate their plans further. The UK space sector is thriving, and horizontal spaceflight is an exciting prospect which could provide services to our world-leading small satellite industry as well as international customers and space tourists. This new fund will help develop ambitious proposals to enable spaceplanes and aircraft capable of deploying satellites to operate from future UK spaceports, as part of the government’s modern industrial Strategy. The potential spaceports can now submit applications to enable research into the market opportunities offered by new and emerging horizontal spaceflight technologies. Grant recipients can then use this research to develop an individual business case for offering horizontal launch services from the UK in the early 2020s, better positioning themselves to engage with potential suppliers and investors. The UK’s spaceflight expertise means we are ready to thrive in the new space age, encouraging innovation and creating jobs. This fund provides a chance for UK spaceports to take the initiative and become global leaders in this field. As part of its £50 million spaceflight programme, in July 2018 Government announced support for the establishment of a vertical spaceport in Scotland. This additional funding opportunity will support the development of horizontal spaceports in the UK, further growing the market for both small satellite launch and sub-orbital flights. The UK Space Agency is helping prospective spaceports seize the commercial opportunities offered by the increasing demands for launch. We are working closely with the industry to ensure the UK becomes a global leader in providing access to space for small satellites and sub orbital vehicles.” Individual applicants will be able to apply for up to £500,000 of funding. The UK Space Agency is driving the growth of the space sector as part of the Government’s Industrial Strategy and continues to be a leading member of European Space Agency, which is independent of the EU. The UK is also playing a major role in space exploration and science, with a British built rover going to Mars in 2020. The demanding environment of space means that investments in the sector generate new knowledge and innovations that extend far beyond the space industry.

For example, satellites provide services that enable a wide range of economic activities, supporting industries worth £300 billion to the UK. Earlier this year, the UK Space Agency revealed that every £1 of public spending generates up to £4 in value for the recipients in the space industry, with additional benefits to the UK economy. (UK Gov).

[From airport to spaceport as UK targets horizontal spaceflight](#) (23 May 2019)

RUSSIAN SPACE SECTOR PLAGUED BY ASTRONOMICAL CORRUPTION



Analysts say Roscosmos chief Dmitry Rogozin, a former deputy prime minister known for his anti-Western statements, is struggling to deal with the industry's problems (AFP Photo/YURI KOCHETKOV)

With millions of dollars missing and officials in prison or fleeing the country, Russia's space sector is at the heart of a staggering embezzlement scheme that has dampened ambitions of recovering its Soviet-era greatness. For years, Moscow has tried to fix the industry that was a source of immense pride in the USSR. While it has bounced back from its post-Soviet collapse and once again become a major world player, the Russian space sector has recently suffered a series of humiliating failures. And now, massive corruption scandals at state space agency Roscosmos have eclipsed its plans to launch new rockets and lunar stations. Corruption has particularly affected Russia's two most important space projects of the decade: GLONASS and the construction of the country's showpiece cosmodrome Vostochny, built to relieve Moscow's dependence on Baikonur in ex-Soviet Kazakhstan.

(Victoria Loguinova-Yakovleva)

[Russian space sector plagued by astronomical corruption](#) (28 May 2019)

LINKS TO OTHER SPACE NEWS PUBLISHED IN MAY 2019

ASTERIODS

[Hera's CubeSat to perform first radar probe of an asteroid](#) (1 May 2019)

Small enough to be an aircraft carry-on, the Juventas spacecraft nevertheless has big mission goals. Once in orbit around its target body, Juventas will unfurl an antenna larger than itself, to perform the very first subsurface radar survey of an asteroid. ESA's proposed Hera mission for planetary defence will explore the twin Didymos asteroids, but it will not go there alone: it will also serve as mothership for Europe's first two 'CubeSats' to travel into deep space. (ESA)

[ASU researchers find water in samples from asteroid Itokawa](#) (1 May 2019)

Itokawa is a peanut-shaped asteroid about 1,800 feet long and 700 to 1,000 feet wide. It circles the Sun every 18 months at an average distance of 1.3 times the Earth-Sun distance. Part of Itokawa's path brings it inside Earth's orbit and at farthest, it sweeps out a little beyond that of Mars. The NanoSIMS measurements revealed the samples were unexpectedly rich in water. They also suggest that even nominally dry asteroids such as Itokawa may in fact harbour more water than scientists have assumed. (Arizona State University)

COMETS AND EXOCOMETES

[Three exocomets discovered around the star Beta Pictoris](#) (21 May 2019)

Just about a year after the launch of the NASA mission TESS, the first three comets orbiting the nearby star Beta Pictoris outside our solar system were discovered in data from the space telescope. The main goal of TESS is to search for exoplanets - planets orbiting other stars. The recognition of signals from much smaller exocomets compared to planets requires the analysis of a precise light curve, which can now be obtained using the technical sophistication of the new space telescope. Sebastian Zieba discovered the signal of the exocomets when he investigated the TESS light curve of Beta Pictoris in March this year. The data showed a significant decrease in the intensity of the light of the observed star. These variations due to darkening by an object in the star's orbit can clearly be related to a comet. Three similar exocomet systems have recently been found around three other stars during data analysis by NASA's Kepler mission. The researchers suggest that exocomets are more likely to be found around young stars. (University of Innsbruck)

EARTH

[Swarm helps explain Earth's magnetic jerks](#) (1 May 2019)

Ground-based magnetic observatories are built on land. Information about these jerks has been incomplete as the ocean covers 70% of Earth's surface. Thanks to ESA's trio of Swarm satellites, which measure variations in Earth's magnetic field from space, scientists can now study the global structure of geomagnetic jerks. The researchers have been able to document the series of events that lead to jerks which, in the simulation, arise from hydromagnetic waves emitted within the core. As molten matter rises to reach the outer surface of the Earth's core, it produces powerful waves along the magnetic field lines near the core. This results in sharp changes in the flow of liquid beneath the magnetic field. The jerks originate in rising blobs of metal that form in the planet's core 25 years before the corresponding jerk takes place. These current findings are part of a longer-term project in which scientists hope to predict the evolution of the geomagnetic field over the coming decades. (ESA)

[NASA scientist receives patent for innovative technique for measuring space weather phenomena](#) (14 May 2019)

A NASA expert in space-weather phenomena has won a patent for an idea that, if fully implemented, would create the world's largest scientific instrument for detecting a condition that has caused power outages in the past. The team have installed scientific stations equipped with commercial fluxgate magnetometers and compact command-and-control computers beneath high-voltage power transmission lines operated by Dominion Virginia Power and American Electric Power in Ohio. The team is getting ready to install additional stations, equipped with second-generation equipment, beneath lines operated by the Southern

Company in Alabama. All participating stations include reference stations positioned up to two miles from the power lines. The project represents the first time NASA has used high-voltage power lines as a tool to map large-scale geomagnetically induced currents, or GICs, caused by severe space weather. During solar storms, violent changes occur in near-space, which then are sensed by the transmission lines, essentially making them antennae. (NASA Goddard)

[Tug-of-war drives magnetic north sprint](#) (15 May 2019)

As far as we know, Earth's magnetic north has always wandered, but it has recently gained new momentum and is making a dash towards Siberia at a pace not seen before. While this has some practical implications, scientists believe that this sprint is being caused by tussling magnetic blobs deep below our feet. Unlike our geographic North Pole, which is in a fixed location, magnetic north wanders. This has been known since it was first measured in 1831, and subsequently mapped drifting slowly from the Canadian Arctic towards Siberia. One of the practical consequences of this is that the World Magnetic Model must be updated periodically with the pole's current location. The model is vital for many navigation systems used by ships, Google maps and smartphones, for example. (ESA)

EXOPLANETS

[Rare-Earth metals in the atmosphere of a glowing-hot exoplanet](#) (9 May 2019)

KELT-9 b is the hottest exoplanet known to date. In the summer of 2018, a joint team of astronomers found signatures of gaseous iron and titanium in its atmosphere. Now these researchers have also been able to detect traces of vaporized sodium, magnesium, chromium, and the rare-Earth metals scandium and yttrium. (PlanetS) (University of Bern)

[Small, hardy planets most likely to survive death of their stars](#) (14 May 2019)

Small, hardy planets packed with dense elements have the best chance of avoiding being crushed and swallowed up when their host star dies, new research from the University of Warwick has found. Astrophysicists have modelled the chances of different planets being destroyed by tidal forces when their host stars become white dwarfs and have determined the most significant factors that decide whether they avoid destruction. Their 'survival guide' for exoplanets could help guide astronomers locate potential exoplanets around white dwarf stars, as a new generation of even more powerful telescopes is being developed to search for them. Most stars like our own Sun will run out of fuel eventually and shrink and become white dwarfs. Some orbiting bodies that aren't destroyed in the maelstrom caused when the star blasts away its outer layers will then be subjected to shifts in tidal forces as the star collapses and becomes super-dense. The gravitational forces exerted on any orbiting planets would be intense and would potentially drag them into new orbits, even pushing some further out in their solar systems. By modelling the effects of a white dwarf's change in gravity on orbiting rocky bodies, the researchers have determined the most likely factors that will cause a planet to move within the star's 'destruction radius'; the distance from the star where an object held together only by its own gravity will disintegrate due to tidal forces. Within the destruction radius a disc of debris from destroyed planets will form. Although a planet's survival is dependent on many factors, the models reveal that the more massive the planet, the more likely that it will be destroyed through tidal interactions. (University of Warwick)

[NASA astrobiology researchers identify features that could be used to detect life-friendly climates on other worlds](#) (22 May 2019)

Scientists may have found a way to tell if alien worlds have a climate that is suitable for life by analysing the light from these worlds for special signatures that are characteristic of a life-friendly environment. This technique could reveal the inner edge of a star's habitable zone, the region around a star where liquid water could exist on the surface of a rocky planet. (NASA)

[18 Earth-sized exoplanets discovered](#) (22 May 2019)

Scientists have discovered 18 Earth-sized planets beyond the solar system. The worlds are so small that previous surveys had overlooked them. One of them is one of the smallest known so far; another one could offer conditions friendly to life. The researchers re-analyzed a part of the data from NASA's Kepler Space Telescope with a new and more sensitive method that they developed. The team estimates that their new method has the potential of finding more than 100 additional exoplanets in the Kepler mission's entire data set. (Max Planck Institute for Solar System Research)

INTERNATIONAL SPACE STATION

[SpaceX Dragon heads to space station with NASA science, cargo](#) (4 May 2019)

Some of the scientific investigations Dragon is delivering to the space station:

- Measuring Atmospheric CO₂ from Space
- Putting Microalgae on the Menu
- Organs on Chips Advance Human Health Research
Scientists are using a new technology called tissue chips, which could help predict the effectiveness of potential medicines in humans. Fluid that mimics blood can be passed through the chip to simulate blood flow and can include drugs or toxins.
- Multi-Use Microgravity Experiment Platform

These are just a few of the hundreds of investigations that will help us learn how to keep astronauts healthy during long-duration space travel and demonstrate technologies for future human and robotic exploration beyond low-Earth orbit to the Moon and Mars. Space station research also provides opportunities for other U.S. government agencies, private industry, and academic and research institutions to conduct microgravity research that leads to new technologies, medical treatments, and products that improve life on Earth. (NASA)

JUPITER AND MOONS

[Juno finds changes in Jupiter's magnetic field](#) (20 May 2019)

NASA's Juno mission to Jupiter made the first definitive detection beyond our world of an internal magnetic field that changes over time, a phenomenon called secular variation. Juno determined the gas giant's secular variation is most likely driven by the planet's deep atmospheric winds. (JPL)

MARS & MOONS

[Lockheed Martin completes critical testing milestone for NASA JPL's Mars 2020 rover heat shield](#) (2 May 2019)

Protecting against the extremes of space travel is critical to the success of any mission. Lockheed Martin has successfully completed the flight hardware structure of the heat shield, validating the physical integrity with a final static test after exposing it to flight-like thermal conditions. The heat shield is half of the large and sophisticated two-part aeroshell that Lockheed Martin is designing and building to encapsulate NASA Jet Propulsion Laboratory's Mars 2020 rover from the punishing heat and friction of entry through the Martian atmosphere. The Mars 2020 mission will be one of the most challenging entry, descent and landings ever attempted on the Red Planet. The heat shield aerodynamics serve as a "brake" to slow the spacecraft from about 12,000 mph (19,300 kph) so the structure needs to be flawless. As the tenth aeroshell system that Lockheed Martin has produced for NASA, this is one of the largest at 15 feet (4.5 meters) in diameter. (Lockheed Martin)

[ExoMars laboratory passes Red Planet simulation](#) (8 May 2019)

A key set of scientific instruments developed for the ExoMars rover Rosalind Franklin passed tests last month to ensure compatibility with the Martian environment. The rover's Analytical Laboratory Drawer (ALD) flight model completed its thermal and vacuum sessions. The ExoMars rover will be the first of its kind to both roam the Mars surface and to study it at depth. Rosalind Franklin will drill down to two metres into the surface to sample the soil, analyse its composition and search for evidence of past and perhaps even present life hidden underground. A miniature laboratory inside the rover will analyse the samples and send data and images back to Earth to the scientific community, eager to learn more about our neighbouring planet. (ESA)

[Why this Martian full moon looks like candy](#) (9 May 2019)

NASA's Mars Odyssey orbiter has caught the Martian moon Phobos during a full moon phase. Each colour in the new image represents a temperature range detected by Odyssey's infrared camera, which has been studying the Martian moon since September of 2017. Looking like a rainbow-colored jawbreaker, these latest observations could help scientists understand what materials make up Phobos, the larger of Mars' two moons. Odyssey is NASA's longest-lived Mars mission. Its heat-vision camera, the Thermal Emission Imaging System (THEMIS), can detect changes in surface temperature as Phobos circles Mars every seven hours. Different textures and minerals determine how much heat THEMIS detects. Now we're gathering data on what minerals are in it, including metals. Iron and nickel are two such metals. Depending on how abundant the metals are, and how they're mixed with other minerals, these data could help determine whether Phobos is a captured asteroid or a pile of Mars fragments, blasted into space by a giant impact long ago. (JPL)

[3D-printed Mars habitat team has breakthrough, finishes second in NASA challenge](#)

(16 May 2019)

The team's habitat design features a cylindrical base completed with a dome-style roof concept that requires the 3D-printing robotic arm to add layers of paste-like concrete that inch closer to the centre of the structure, resulting in a pointed roof that fully encloses the structure. (Penn State)

[Massive Martian ice discovery opens a window into Red Planet's history](#) (22 May 2019)

Newly discovered layers of ice buried a mile beneath Mars' north pole are the remnants of ancient polar ice sheets and could be one of the largest water reservoirs on the planet. The team made the discovery using measurements gathered by the Shallow Radar (SHARAD) on NASA's Mars Reconnaissance Orbiter (MRO). SHARAD emits radar waves that can penetrate up to a mile and a half beneath the surface of Mars. (University of Texas at Austin)

[Strange Martian mineral deposit likely sourced from volcanic explosions](#) (22 May 2019)

Ashfall from ancient volcanic explosions is the likely source of a strange mineral deposit near the landing site for NASA's next Mars rover, a new study finds. The research, published in the journal *Geology*, could help scientists assemble a timeline of volcanic activity and environmental conditions on early Mars. (Brown University)

[A European mission control for the Martian rover](#) (30 May 2019)

The ExoMars rover has a brand new control centre in one of Europe's largest Mars yards. The Rover Operations Control Centre (ROCC) was inaugurated in Turin, Italy, ahead of the rover's exploration adventure on the Red Planet in 2021. The control centre will be the operational hub that orchestrates the roaming of the European-built laboratory on wheels, named after Rosalind Franklin, upon arrival to the Martian surface on Kazachok, the Russian surface platform. This is the crucial place on Earth from where we will listen to the rover's instruments, see what she sees and send commands to direct the search for evidence of life on and under the surface. The ExoMars rover will be the first of its kind to both move across the Mars surface and to study it at depth with a drill able to collect samples from down to two metres into the surface. The epicentre of the action for directing Mars surface operations on Earth is at the ALTEC premises in Turin, Italy. From here, engineers and scientists will work shoulder to shoulder at mission control, right next to a very special Mars yard. (ESA)

[ExoMars orbiter prepares for Rosalind Franklin](#) (30 May 2019)

On 15 June, the ESA-Roscosmos ExoMars Trace Gas Orbiter (TGO) will follow a different path. An 'Inclination Change Manoeuvre' will put the spacecraft in an altered orbit, enabling it to pick up crucial status signals from the ExoMars rover, Rosalind Franklin, due to land on the Red Planet in 2021. After completing a complex series of manoeuvres during 2017, ExoMars TGO is now orbiting the Red Planet every two hours, collecting scientific data from NASA's surface-bound rover and lander, and relaying it back to Earth. At the same time, the orbiter is gathering its own data on the planet's atmosphere, water abundance and alien surface. (ESA)

MOON

[Blue Origin is going to the Moon](#) (9 May 2019)

Blue Moon can deliver payloads to the lunar surface, host payloads and even deploy payloads during its journey to the Moon. Its technology builds on Blue Origin's experience with New Shepard with respect to LH2/LOX propulsion, precision guidance, vertical landing and landing gear systems. The Blue Moon lander provides kilowatts of power to payloads using its fuel cells, allowing for long mission durations and the ability to last through the lunar night. The Blue Moon lander can deliver large infrastructure payloads with high accuracy to pre-position systems for future missions. The larger variant of Blue Moon has been designed

to land an ascent vehicle that will allow us to return Americans to the Moon by 2024.
(Blue Origin)

[Shrinking Moon may be generating moonquakes](#) (13 May 2019)

The Moon is shrinking as its interior cools, getting more than about 150 feet (50 meters) skinnier over the last several hundred million years. Just as a grape wrinkles as it shrinks down to a raisin, the Moon gets wrinkles as it shrinks. Unlike the flexible skin on a grape, the Moon's surface crust is brittle, so it breaks as the Moon shrinks, forming "thrust faults" where one section of crust is pushed up over a neighbouring part. Analysis gives the first evidence that these faults are still active and likely producing moonquakes today as the Moon continues to gradually cool and shrink. Some of these quakes can be strong, around five on the Richter scale. (NASA Goddard)

[MIT, Blue Origin to cooperate on sending research experiment to the moon](#) (10 May 2019)

MIT and Blue Origin have signed a memorandum outlining plans to pursue mutual interests in space exploration. MIT will develop one or more payload experiments to be launched aboard Blue Origin's Blue Moon, a flexible lander delivering a wide variety of small, medium, and large payloads to the lunar surface. MIT Apollo Professor of Astronautics and former NASA Deputy Director Dava Newman, who developed the agreement with Blue Origin, says that over the coming months, MIT researchers will invite input from the MIT community to help determine the nature of the flight opportunity experiment. "Some potential areas include smart habitats, rovers, life support and autonomous systems, human-machine interaction, science of the moon, lunar poles, sample return, and future astronaut performance and suit technologies. (MIT)

[Astrobotic signs lunar payload agreement with Canadensys Aerospace](#) (20 May 2019)

NASA recently awarded Astrobotic two contracts that could help move the Pittsburgh-based company closer to making its first lunar landing. The contracts are for developing technologies for the company's Peregrine lander but could possibly make lunar landings easier and more accessible to others in the future. The first contract is a \$10 million "Tipping Point" award from NASA's Space Technology and Mission Directorate for the development of a terrain relative navigation (TRN) sensor for precise lunar landings. TRN is being designed to allow the spacecraft to land with unprecedented levels of accuracy at some of the most challenging landing sites on the Moon. These include areas of promising scientific exploration and compelling economic opportunity, such as lunar skylights and the permanently-shadowed ice-rich poles of the Moon. (Astrobotic)

[Formation of the Moon brought water to Earth](#) (22 May 2019)

The Earth is unique in our solar system: It is the only terrestrial planet with a large amount of water and a relatively large moon, which stabilizes the Earth's axis. Both were essential for Earth to develop life. Planetologists at the University of Münster have now been able to show, for the first time, that water came to Earth with the formation of the Moon some 4.4 billion years ago. The Moon was formed when Earth was hit by a body about the size of Mars, also called Theia. Until now, scientists had assumed that Theia originated in the inner solar system near the Earth. However, researchers from Münster can now show that Theia comes from the outer solar system, and it delivered large quantities of water to Earth. The Earth formed in the 'dry' inner solar system, and so it is somewhat surprising that there is

water on Earth. To put it simply, without the Moon there probably would be no life on Earth. (University of Münster)

[Maxar selected to build, fly first element of NASA's Lunar Gateway](#) (23 May 2019)

Maxar Technologies (NYSE:MAXR) (TSX:MAXR), a global technology innovator powering the new space economy, today announced it has been selected by NASA to build and perform a spaceflight demonstration of the lunar Gateway's power and propulsion element spacecraft. Blue Origin and Draper will join the Maxar-led team in designing, building and operating the spacecraft through the demonstration period. The power and propulsion element is a key component to NASA's overall plans to land American astronauts on the surface of the Moon by 2024 and will be the first segment of the Gateway tested in space. (Maxar)

[NASA selects first commercial Moon landing services for Artemis program](#) (31 May 2019)

NASA has selected three commercial Moon landing service providers that will deliver science and technology payloads under Commercial Lunar Payload Services (CLPS) as part of the Artemis program. Each commercial lander will carry NASA-provided payloads that will conduct science investigations and demonstrate advanced technologies on the lunar surface, paving the way for NASA astronauts to land on the lunar surface by 2024. (NASA)

NEPTUNE

[Neptune's moon Triton fosters rare icy union](#) (22 May 2019)

Astronomers using the Gemini Observatory explore Neptune's largest moon Triton and observe, for the first time beyond the lab, an extraordinary union between carbon monoxide and nitrogen ices. The discovery offers insights into how this volatile mixture can transport material across the moon's surface via geysers, trigger seasonal atmospheric changes, and provide a context for conditions on other distant, icy worlds. (Gemini Observatory)

[The 'Forbidden' Planet has been found in the 'Neptunian Desert'](#) (29 May 2019)

A Neptunian planet has been found in what should be a 'Neptunian Desert' by telescopes run by the University of Warwick in an international collaboration of astronomers. NGTS-4b is 20% smaller than Neptune, about 3 times the size of Earth, and has been nicknamed the 'Forbidden' planet by researchers. Discovered using the state-of-the-art Next-Generation Transit Survey (NGTS) observing facility, designed to search for transiting planets on bright stars, but NGTS-4b is so small other ground surveys wouldn't have spotted it. It's hotter than Mercury at 1,000 degrees Celsius. (University of Warwick)

PLUTO

[Gas insulation could be protecting an ocean inside Pluto](#) (21 May 2019)

The researchers conducted computer simulations covering a timescale of 4.6 billion years, when the solar system began to form. The simulations showed the thermal and structural evolution of Pluto's interior and the time required for a subsurface ocean to freeze and for the icy shell covering it to become uniformly thick. They simulated two scenarios: one where an

insulating layer of gas hydrates existed between the ocean and the icy shell, and one where it did not. The simulations showed that, without a gas hydrate insulating layer, the subsurface sea would have frozen completely hundreds of millions of years ago; but with one, it hardly freezes at all. Also, it takes about one million years for a uniformly thick ice crust to completely form over the ocean, but with a gas hydrate insulating layer, it takes more than one billion years. (Hokkaido University)

STARS AND STAR CLUSTERS

[Blue supergiant stars open doors to concert in space](#) (6 May 2019)

Blue supergiants are the rock-and-roll stars of the universe. They are massive stars that live fast and die young. This makes them rare and difficult to study, even with modern telescopes. Before space telescopes, few blue supergiants had been observed, so our knowledge of these stars was limited. Using the latest NASA space telescope data, an international team led by KU Leuven has now discovered that almost all blue supergiants shimmer and ripple in brightness due to the presence of waves on their surface. The waves originate in the deep interior of the stars and allow us to study these stars using asteroseismology, a similar technique to how seismologists use earthquakes to study the Earth's interior. (KU Leuven)

[Explosions of universe's first stars spewed powerful jets](#) (8 May 2019)

Researchers at MIT have observed evidence that the first stars in the universe exploded as asymmetric supernova, strong enough to scatter heavy elements such as zinc across the early universe. These elements ultimately served as seeds for the second generation of stars, some of which can still be observed today. (MIT)

[Star formation burst in the Milky Way 2-3 billion years ago](#) (8 May 2019)

Researchers have found, analysing data from the Gaia satellite, that a star formation burst occurred in the Milky Way about two to three thousand million years ago. In this process, more than 50 % of the stars that created the galactic disc may have been born. The results come from the combination of the distances, colours and magnitude of the stars that were measured by Gaia with models that predict their distribution in our Galaxy. Just like a flame fades when there is no gas in the cylinder, the rhythm of the stellar formation in the Milky Way, fuelled by the gas that was deposited, should decrease slowly and in a continuous way until all the existing gas is used up. The results of the study show that, although this was the process that took place over the first 4,000 million years of the disc formation, a star formation burst, or "stellar baby boom" inverted this trend. The merging with a satellite galaxy of the Milky Way, which is rich in gas, could have added new fuel and reactivated the process of stellar formation. This mechanism would explain the distribution of distances, ages and masses that are estimated from the data taken from the European Space Agency Gaia satellite. The time scale of this star formation burst together with the great amount of stellar mass involved in the process, thousands of millions of solar mass, suggests the disc of our Galaxy did not have a steady and paused evolution but it may have suffered an external perturbation that began about five billion years ago. We have been able to find this out due to having precise distances for more than three million stars in the solar environment. Thanks to this data we could discover the mechanisms that controlled the evolution more than 8-10 billion years ago in the disc of our Galaxy. (University of Barcelona)

[Matter around a young star helps astronomers explore our stellar history](#) (10 May 2019)

Astronomers map the substance aluminium monoxide (AlO) in a cloud around a distant young star - Origin Source I. The finding clarifies some important details about how our solar system, and ultimately how we, came to be. The cloud's limited distribution suggests AlO gas rapidly condenses to solid grains, which hints at what an early stage of our solar evolution looked like. With the Atacama Large Millimeter/submillimeter Array (ALMA), we found the emission lines, a chemical fingerprint, for AlO in outflows from the circumstellar disk (gas and dust surrounding a star) of the massive young star candidate Orion Source I. It's not exactly like our sun, but it's a good start. ALMA was the ideal tool as it offered extremely high resolution and sensitivity to reveal the distribution of AlO around the star. No other instrument can presently make such observations. Thanks to ALMA, we discovered the distribution of AlO around a young star for the first time. The distribution of AlO is limited to the hot region of the outflow from the disk. This implies that AlO rapidly condenses as solid grains, like CAIs in our solar system. This data allows us to place tighter constraints on hypotheses that describe our own stellar evolution. But there's still much work to do. The team now plans to explore gas and solid molecules around other stars to gather data useful to further refine solar system models. (University of Tokyo)

[Stellar waltz with dramatic ending](#) (21 May 2019)

Astronomers at the University of Bonn and their colleagues from Moscow have identified an unusual celestial object. It is most likely the product of the fusion of two stars that died a long time ago. After billions of years circling around each other these so-called white dwarfs merged and rose from the dead. The extremely rare merger product was discovered by scientists from the University of Moscow. On images made by the Wide-field Infrared Survey Explorer (WISE) satellite they found a gas nebula with a bright star in its centre. Surprisingly, the nebula emitted almost exclusively infrared radiation and no visible light. The spectrum of the radiation emitted by the nebula and its central star was analyzed. They were able to show that the enigmatic celestial object contained neither hydrogen nor helium, a characteristic typical for the interiors of white dwarfs. When merged their total mass was enough to fuse heavier elements than hydrogen or helium. There are probably not even half a dozen such objects in the Milky Way. (University of Bonn)

TECHNOLOGY

[Orion flight test article attached to Launch Abort System for Ascent Abort-2](#) (23 May 2019)

The 46,000-pound flight test article that will be used for a test of Orion's Launch Abort System (LAS) was lifted and mated to its transportation pallet inside the Launch Abort System Facility at NASA's Kennedy Space Centre in Florida on May 18, 2019. The flight test article includes the Orion test article, a separation ring created for this test, and the LAS. This operation marks the completion of the flight test article integration and checkout operations necessary for NASA's Ascent Abort-2 (AA-2) flight test scheduled for July. (NASA Kennedy)

TELESCOPES

[Northrop Grumman finishes environmental test on NASA's Webb Telescope](#) (30 May 2019)
NASA's James Webb Space Telescope Spacecraft Element (SCE) successfully completed its last environmental test, thermal vacuum testing, at Northrop Grumman Corporation (NYSE: NOC) in Redondo Beach. Thermal vacuum testing exposes Webb's SCE to the extreme hot and cold temperatures it will experience in space. To test these extreme temperature ranges, the chamber uses liquid nitrogen shrouds and heater panels to expose the SCE to cold temperatures as low as -300 degrees Fahrenheit and hot temperatures as high as 220 degrees Fahrenheit. Real-time data collection via flight sensors on the SCE allow engineers to monitor Webb's electrical/unit functionality and ensures the structure will withstand the rigors of its cold journey to and operation at the second Lagrange point. Webb's SCE completed its two prior environmental tests (acoustic and sine vibration). After thermal vacuum testing, the SCE will return to Northrop Grumman's clean room to begin post-environmental testing, including deployments. Later this year, the Webb telescope will become a fully integrated observatory for the first time through integration of the SCE to the Optical Telescope Element/Integrated Science Instrument Module. The James Webb Space Telescope will be the world's premier space science observatory of the next decade. Webb will solve mysteries in our solar system, look to distant worlds around other stars, and probe the mysterious structures and the origins of our universe. Webb is an international program led by NASA with its partners, the European Space Agency and the Canadian Space Agency. (Northrop Grumman)

Pat Williams May 2019