

Space News Update – February 2019

By Pat Williams

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

ORBEX UNVEILS PRIME ROCKET AT NEW FACILITY IN FORRES SCOTLAND



Orbex has publicly unveiled its Prime rocket for the first time at the opening of its new headquarters and rocket design facility in Forres in the Scottish Highlands. Designed to deliver small satellites into Earth's orbit, the rocket was unveiled at an opening ceremony attended by VIPs from the UK and European space community as well as local community stakeholders. The completed engineering prototype of the Stage 2 rocket (the stage that will transit into orbital flight after launch) is made from a specially-formulated lightweight carbon fibre and aluminium composite and includes the world's largest 3-D printed rocket engine. Orbex Prime is a completely re-thought and re-engineered two-stage rocket, designed by Orbex aerospace engineers with professional experience from organisations including NASA, ESA and Ariane, as well as other commercial spaceflight companies. Thanks to its novel architecture, Prime launchers are up to 30% lighter and 20% more efficient than any other vehicle in the small launcher category, packing more power per cubic litre than many heavy launchers. Seen for the first time, the 3-D printed rocket engine was uniquely manufactured in a single piece without joins in partnership with additive manufacturer SLM Solutions. Given the extreme temperature and pressure fluctuations involved in space flight, this gives

the engine an advantage over other rocket engines, which can suffer from weaknesses associated with joining and welding. It is also the first commercial rocket engine designed to work with biopropane, a clean-burning, renewable fuel source that cuts carbon emissions by 90% compared to fossil hydrocarbon fuels, supplied by Orbex's new exclusive BioLPG fuel partner Calor.

[Orbex Unveils Prime Rocket at New Facility in Forres Scotland](#) (7 February 2019)

SSC SEALS LAUNCH SITE PARTNERSHIP WITH ARIANEGROUP

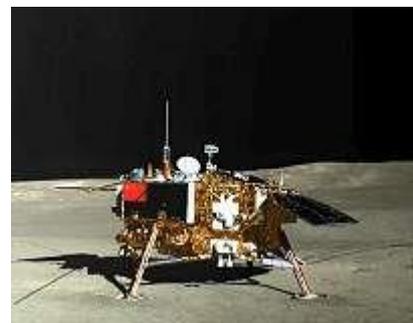


The Shetland Space Centre announces a major partnership with ArianeGroup. The joint venture, equally owned by Airbus and Safran and lead contractor for Europe's Ariane 5 and Ariane 6 launchers, will define a concept of operations and assess the range of missions for the SSC spaceport project in the frame of a three-month study. The spaceport will be designed from the ground up to be a commercial facility operated by SSC. During a visit ArianeGroup representatives acknowledged that Unst, Shetland's most northerly island, is a perfect location in Northern Europe" to establish a spaceport for launching small satellites and supporting associated services such as data-linking and storage. Frank Strang, CEO of Shetland Space Centre, said: "This is a huge step forward in further establishing a space economy in Shetland, and indeed Scotland. By accessing ArianeGroup's expertise and capabilities we will be able to accelerate our application ensuring that the UK will be able to launch small satellite launch vehicles by the end of 2020. (Shetland Space Centre)

[SSC seals launch site partnership with ArianeGroup](#) (31 January 2019)

Chang'e-4 finds moon's far side colder than expected during night

China's Chang'e-4 probe, having made the first-ever soft landing on moon's far side, found that the temperature of the lunar surface dropped to as low as minus 190 degrees centigrade, colder than expected. This is the first time Chinese scientists have received first-hand data about the temperatures on the surface of the moon during the lunar night. This is the first time Chinese scientists have received first-hand data about the temperatures on the surface of the



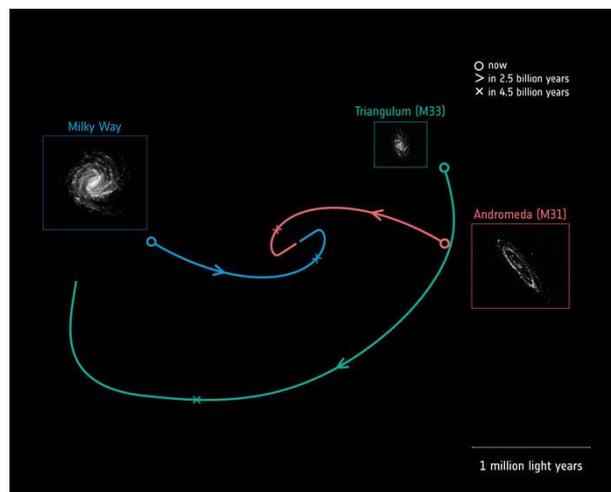
far side of the moon during the lunar night. As a result of the tidal locking effect, the moon's revolution cycle is the same as its rotation cycle, and the same side of the moon always faces

Earth. According to the measurements of Chang'e-4, the temperature of the shallow layer of the lunar soil on the far side of the moon is lower than the data obtained by the U.S. Apollo mission on the near side of the moon. That's probably due to the difference in lunar soil composition between the two sides of the moon. We still need more careful analysis. A lunar day equals 14 days on Earth, and a lunar night is the same length. The Chang'e-4 probe switched to dormant mode during the lunar night due to the lack of solar power.

Temperatures vary enormously between day and night on the moon. Previously, Chinese scientists had no data on exactly how cold it could be. The rover and the lander carried the radioisotope heat source, which helped keep the probe warm during the lunar night. The lander was also equipped with an isotope thermoelectric cell and dozens of temperature data collectors to measure the temperatures on the surface of the moon during the lunar night.

[Chang'e-4 finds moon's far side colder than expected during night](#) (01 February 2019)

GAIA CLOCKS NEW SPEEDS FOR MILKY WAY-ANDROMEDA COLLISION



Copyright Orbits: E. Patel, G. Besla (University of Arizona), R. van der Marel (STScI); Images: ESA (Milky Way); ESA/Gaia/DPAC (M31, M33)

It has taken 100 years and Gaia to finally measure the true, tiny, rotation rate of our nearest large galactic neighbour, M31. This will help us to understand more about the nature of galaxies. By combining existing observations with the new data release from Gaia, the researchers determined how Andromeda and Triangulum are each moving across the sky and calculated the orbital path for each galaxy both backwards and forwards in time for billions of years. As Andromeda's motion differs somewhat from previous estimates, the galaxy is likely to deliver more of a glancing blow to the Milky Way than a head-on collision. This will take place not in 3.9 billion years' time, but in 4.5 billion, some 600 million years later than anticipated. (ESA)

[Gaia clocks new speeds for Milky Way-Andromeda collision](#) (7 February 2019)

RECORD-SETTING OPPORTUNITY ROVER MISSION ON MARS COMES TO END



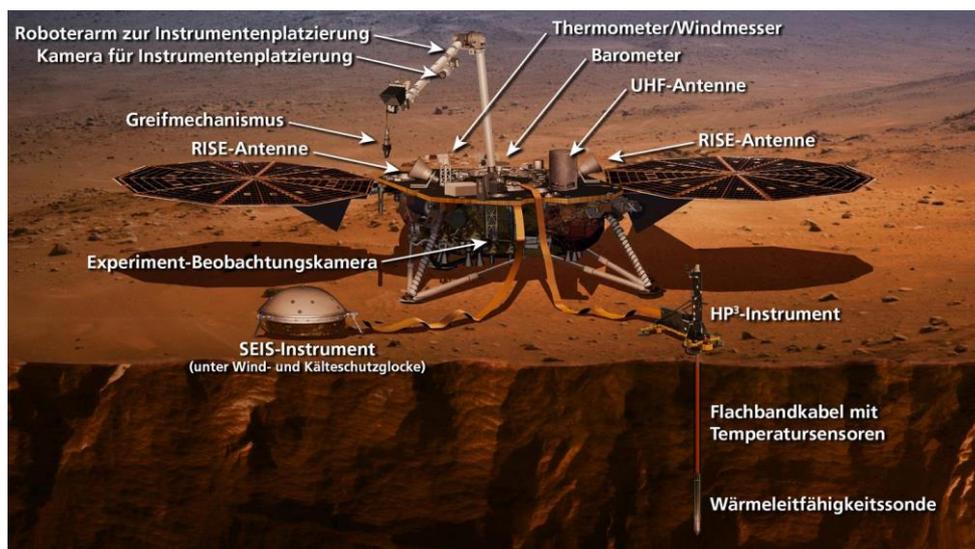
1. An artist's concept portrays a NASA Mars Exploration Rover on the surface of Mars. Two rovers were launched in 2003 and arrived at sites on Mars in January 2004. Each rover was built to have the mobility and toolkit for functioning as a robotic geologist. Image credit: NASA/JPL/Cornell University
 2. This infographic highlights NASA's twin robot geologists, the Mars Exploration Rovers (MER) Spirit and Opportunity. Credits: NASA/JPL-Caltech

One of the most successful and enduring feats of interplanetary exploration, NASA's Opportunity rover mission is at an end after almost 15 years exploring the surface of Mars and helping lay the groundwork for NASA's return to the Red Planet. The Opportunity rover stopped communicating with Earth when a severe Mars-wide dust storm blanketed its location in June 2018. After more than a thousand commands to restore contact, engineers in the Space Flight Operations Facility at NASA's Jet Propulsion Laboratory (JPL) made their last attempt to revive Opportunity, to no avail. The solar-powered rover's final communication was received June 10. (NASA)

Opportunity and Spirit showed that Mars had the wet and warm conditions in its ancient past that were potentially hospitable to life.

[Record-setting Opportunity rover mission on Mars comes to end](#) (13 February 2019)

INSIGHT MISSION – DLR 'MOLE' DEPLOYED ON SURFACE OF MARS



Artist's Concept of InSight Lander on Mars: InSight is the first mission dedicated to investigating the deep interior of Mars. The findings will advance understanding of how all rocky planets, including Earth, formed and evolved. Credit: DLR

'Mole' (HP³) was deployed on the Martian surface using the NASA InSight mission's robotic arm. In the coming weeks, the remote-controlled penetrometer is expected to make space history by becoming the first probe to reach a depth of up to five metres in the Martian subsurface. Its goal is to measure the temperature and thermal conductivity of the subsurface and thus determine the heat flow from the interior of Mars. The heat flow gives researchers indications about the thermal activity of the Red Planet. This can provide insights into the evolution of the Martian interior, whether it still has a hot liquid core, and what makes Earth so special in comparison. (DLR)

[InSight mission – DLR 'Mole' deployed on surface of Mars](#) (13 February 2019)

LINKS TO OTHER SPACE NEWS PUBLISHED IN FEBRUARY 2019

ASTROPHYSICS

[Novel experiment validates a widely speculated and important mechanism during the formation of stars and planets](#) (5 February 2019)

How have stars and planets developed from the clouds of dust and gas that once filled the cosmos? A novel experiment at the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) has demonstrated the validity of a widespread theory known as "magnetorotational instability," or MRI, that seeks to explain the formation of heavenly bodies. Direct measurement of the results found that when the spring-tethering was weak, analogous to the condition of the magnetic fields in accretion disks, behaviour of the angular momentum of the ball was consistent with MRI predictions of developments in a real accretion disk. The findings showed that the weakly tethered rotating ball gained angular momentum and shifted outward during the experiment. Since the angular momentum of a rotating body must be conserved, any gains in momentum must be matched by a loss of momentum in the inner section, allowing gravity to draw the disk into the object it has been orbiting. (Princeton Plasma Physics Laboratory)

BLACK HOLES

[Hiding black hole found](#) (28 February 2019)

A research team noticed HCN-0.009-0.044, a gas cloud moving strangely near the centre of the Galaxy 25,000 light-years away from Earth in the constellation Sagittarius. They used ALMA (Atacama Large Millimeter/submillimeter Array) to perform high resolution observations of the cloud and found that it is swirling around an invisible massive object. Detailed kinematic analyses revealed that an enormous mass, 30,000 times that of the Sun, was concentrated in a region much smaller than our Solar System. This and the lack of any observed object at that location strongly suggests an intermediate-mass black hole. By analysing other anomalous clouds, we hope to expose other quiet black holes. (ALMA)

COMETS

[Rosetta's comet sculpted by stress](#) (18 February 2019)

ESA's Rosetta mission has revealed that geological stress arising from the shape of Comet 67P/Churyumov–Gerasimenko has been a key process in sculpting the comet's surface and interior following its formation. Small, icy comets with two distinct lobes seem to be commonplace in the Solar System, with one possible mode of formation a slow collision of two primordial objects in the early stages of formation some 4.5 billion years ago. (ESA)

DARK MATTER

[Dark matter may be hitting the right note in small galaxies](#) (26 February 2019)

Astronomers have already found dark matter does not seem to clump together as much as computer simulations suggest. If gravity is the only force that drives dark matter, only pulling and never pushing, then dark matter should become very dense towards the centre of galaxies. However, especially in small faint galaxies called dwarf spheroidals, dark matter does not seem to become as dense as expected toward their centres. This puzzle could be solved if dark matter scatters with each other like billiard balls, allowing them to spread out more evenly after a collision. But one problem with this idea is that dark matter does seem to clump in bigger systems such as clusters of galaxies. What makes dark matter behave differently between dwarf spheroidals and clusters of galaxies? An international team of researchers has developed an explanation that could solve this riddle and reveal what dark matter is. If dark matter scatters with each other only at a low but very special speed, it can happen often in dwarf spheroidals where it is moving slowly, but it is rare in clusters of galaxies where it is moving fast. It needs to hit a resonance. When they come at a special speed, they “resonate” and stick with each other for a brief moment, and move out to different directions afterwards, causing them to scatter. This way, dark matter can spread out so that we can understand smooth profile in small galaxies. Resonance is a phenomenon that appears every day. To swirl wine in a glass to get it more oxygen so that it lets out more aroma and softens its taste, you need to find the right speed to circle the wine glass. Or you dial old analogue radios to the right frequency to tune into your favourite station. The team suspects this is precisely what dark matter is doing. (Kavli IPMU)

EARTH

[NASA finds possible second impact crater under Greenland ice](#) (11 February 2019)

This follows the finding, announced in November 2018, of a 19-mile-wide crater beneath Hiawatha Glacier, the first meteorite impact crater ever discovered under Earth's ice sheets. Though the newly found impact sites in northwest Greenland are only 114 miles apart, at present they do not appear to have formed at the same time. If the second crater, which has a width of over 22 miles, is ultimately confirmed as the result of a meteorite impact, it will be the 22nd largest impact crater found on Earth. (NASA Goddard)

[Earth's atmosphere stretches out to the Moon – and beyond](#) (20 February 2019)

The outermost part of our planet's atmosphere extends well beyond the lunar orbit, almost

twice the distance to the Moon. A recent discovery based on observations by the ESA/NASA Solar and Heliospheric Observatory, SOHO, shows that the gaseous layer that wraps around Earth reaches up to 630 000 km away, or 50 times the diameter of our planet. The Moon flies through Earth's atmosphere. We were not aware of it until we dusted off observations made over two decades ago by the SOHO spacecraft. Where our atmosphere merges into outer space, there is a cloud of hydrogen atoms called the geocorona. One of the spacecraft instruments, SWAN, used its sensitive sensors to trace the hydrogen signature and precisely detect how far the very outskirts of the geocorona are. (ESA)

[Copernicus Sentinel-1 reveals shared plumbing led to Agung awakening](#) (22 February 2019)

When Mount Agung in Indonesia erupted in 2017, the search was on to find out why it had stirred. Thanks to information on ground deformation from the Copernicus Sentinel-1 mission, scientists now have more insight into the volcano's hidden secrets that caused it to reawaken. After lying dormant for more than 50 years, Mount Agung on the Indonesian holiday island of Bali rumbled back to life in November 2017, with smoke and ash causing airport closures and stranding thousands of visitors. The researchers noticed that both the earthquake activity and the ground deformation signal were five kilometres away from the summit, which means that magma must be moving sideways as well as vertically upwards. The study provides the first geophysical evidence that Agung and Batur volcanoes may have a connected plumbing system. (ESA)

EXOPLANETS

[Exiled planet linked to stellar flyby 3 million years ago](#) (28 February 2019)

Simulation of a binary star flyby of a young planetary system. UC Berkeley and Stanford astronomers suspect that such a flyby altered the orbit of a planet around the star HD 106906 so that it remained bound to the system in an oblique orbit similar to that of a proposed Planet Nine attached to our own solar system. (UC Berkeley)

FUTURE PLANNED MISSIONS

[NASA selects new mission to explore origins of universe](#) (13 February 2019)

NASA has selected a new space mission that will help astronomers understand both how our universe evolved and how common are the ingredients for life in our galaxy's planetary systems. The Spectro-Photometer for the History of the Universe, Epoch of Reionization and Ices Explorer (SPHEREx) mission is a planned two-year mission funded at \$242 million (not including launch costs) and targeted to launch in 2023. SPHEREx will survey the sky in optical as well as near-infrared light which, though not visible to the human eye, serves as a powerful tool for answering cosmic questions. Astronomers will use the mission to gather data on more than 300 million galaxies, as well as more than 100 million stars in our own Milky Way. The mission will deliver an unprecedented galactic map containing 'fingerprints' from the first moments in the universe's history. And have new clues to one of the greatest mysteries in science: What made the universe expand so quickly less than a nanosecond after the big bang?" (NASA)

[Five teams win NASA DALI awards to advance future lunar missions](#) (27 February 2019)

Submillimeter Solar Observation Lunar Volatiles Experiment (SSOLVE). Since 2008, when scientists first discovered water in Moon's thin atmosphere and later at its poles, Earth's only orbiting natural orb has become a decidedly more interesting place. SSOLVE is being designed to investigate the origin of this water.

Characterization of Regolith and Trace Economic Resources (CRATER)

CRATER Principal Investigator is working to develop an advanced laser-based mass spectrometer aimed at redefining scientists' understanding of the Moon's composition. CRATER would produce high-resolution spectra that would provide insights into how the Moon formed. It would also catalog non-native organic compounds and prospect for valuable metals, such as titanium, iron, chromium, and copper.

Bulk Elemental Composition Analyzer (BECA)

BECA is a lander instrument capable of determining the bulk elemental composition of material found on the Moon's surface as well as that located about eight inches (20 centimetres) beneath it. BECA would pulse neutrons into the regolith. When these neutrons interacted with an element's nucleus, the nucleus would become excited and emit gamma rays, which a spectrometer would detect to reveal the presence of elements, including hydrogen, oxygen, aluminium, silicon, titanium, and iron, among many others.

Potassium-Argon Laser Experiment (KArLE)

Determining the age of lunar rocks is the primary purpose of KArLE, a proposed lander or rover instrument conceived by Goddard scientist Barbara Cohen. Currently, radiometric dating can only be done on samples returned to Earth-based laboratories.

Lunar Environment Monitoring Station (LEMS)

LEMS is a compact, long-duration surface station that would monitor the exosphere, the thin atmosphere surrounding the Moon. It would also listen to the Moon's seismic activities to better understand the structure of the Moon's interior.

(NASA Goddard)

GALAXIES

[Anaemic galaxy reveals deficiencies in ultra-diffuse galaxy formation theory](#)

(26 February 2019)

A team of astronomers have studied in great detail a galaxy so faint and in such pristine condition it has acted as a time capsule, sealed shortly after the dawn of our universe only to be opened by the newest technology at W. M. Keck Observatory. Using the Keck Cosmic Web Imager (KCWI), the team discovered a bizarre, solitary ultra-diffuse galaxy (UDG). This transparent, ghost-like galaxy, named DGSAT I, contradicts the current theory on the formation of UDGs. All previously studied UDGs have been in galaxy clusters, which informed the basis for the theory that they were once "normal" galaxies, but with time have been blasted into a fluffy mess due to violent events within the cluster. There seemed to be a relatively tidy picture of the origins of galaxies, from spirals to ellipticals, and from giants to

dwarfs. The recent discovery of UDGs raised new questions about how complete this picture is. All of the UDGs that have been studied in detail so far were within galaxy clusters: dense regions of violent interaction where the galaxies' characteristics at birth have been scrambled up by a difficult adolescence. (W M Keck Observatory)

GRAVITATIONAL WAVES

[\(Re\)solving the jet/cocoon riddle of a gravitational wave event](#) (21 February 2019)

An international research team has combined radio telescopes from five continents to prove the existence of a narrow stream of material, a so-called jet, emerging from the only gravitational wave event involving two neutron stars observed so far. With its high sensitivity and excellent performance, the 100-m radio telescope in Effelsberg played an important role in the observations. This event is the first and only one of this type that has been observed so far, and it happened in a galaxy 130 million light years away from Earth, in the constellation of Hydra. The team determined that this jet contained as much energy as produced by all the stars in our Galaxy for one year. And all that energy was contained in a size smaller than one light year. (Max Planck Institute for Radio Astronomy)

HUMAN SPACEFLIGHT

[Starship nematode](#) (20 February 2019)

An exciting collaboration will send nematodes (small round worms) into space to the International Space Station (ISS). The mission represents a look into the future where food crops will be grown in space. The goal is to develop environmentally friendly methods for space travel that are not harmful to humans. This will be the first biological control experiment in space. The nematode's send-off, funded by the ISS U.S. National Laboratory, hopes to launch to the orbiting platform as early as 2019. (USDA)

[Virgin Galactic makes space for second time in ten weeks with three on board](#)

(22 February 2019)

Virgin Galactic's first test passenger spent part of her flight Feb. 22 "spidermanning along the ceiling" as the VSS Unity spacecraft successfully soared to a peak altitude that some say brought the vessel into space itself. Astronaut trainer Beth Moses, along with pilots Dave Mackay and Michael "Sooch" Masucci, made it to an altitude of 89.9 kilometres, higher than Virgin Galactic's historic Dec. 13 flight that reached beyond the U.S. Air Force-defined boundary of space for the first time. Both flights are still below the Karman line of 62 miles (100 km) that the International Astronautical Federation defines as the start of space. (Virgin Galactic)

INTERNATIONAL SPACE STATION

[Departure of US cargo ship from International Space Station](#) (5 February 2019)

Three months after delivering several tons of supplies and science to the International Space Station, Northrop Grumman's Cygnus cargo craft will depart the complex on Feb. 8. Expedition 58 Flight Engineers Anne McClain of NASA and David Saint-Jacques of the

Canadian Space Agency will use the station's Canadarm2 robotic arm to release Cygnus after ground controllers unbolt the spacecraft from the Earth-facing port of the Unity module and manoeuvre it to the release position. Cygnus will depart the station with 5,500 pounds of trash and carry out an extended mission over about two weeks. The spacecraft will manoeuvre to a higher altitude where a CubeSat deployer will release two CubeSats into orbit through a service provided by industry partner NanoRacks to provide increased commercial access to space. Cygnus then will move to a lower orbit to deploy a third CubeSat, KickSat-2, which carries 100 tiny satellites called femtosatellites. The femtosatellites each include a power, sensor and communication system on a printed circuit board that measures 3.5 by 3.5 cm, with a thickness of a few millimetres and a mass of less than 3.5 ounces. Cygnus is scheduled to deorbit Feb. 25 and enter the Earth's atmosphere, burning up harmlessly over the Pacific Ocean. (NASA)

*With advances in nanotechnology, very small-scale satellites, known as **femtosatellites**, which weigh less than 100 grams (i.e., less than 0.22 lbs) have been developed over the last fifteen years. Most of these small satellites have been used with "mother" satellites that provide operating signals; however, more recent versions are operating independently.*

[Over 10 Litres of Water Leaked From Space Toilet at US Segment at ISS](#) (05 February 2019)
Moscow (Sputnik) Feb 05, 2019 - Over 10 litres of water leaked from the toilet at the US segment of the International Space Station (ISS) and had to be collected across the segment by the crew using towels, a source in the Russian space industry told Sputnik. "Our colleagues at the Tranquillity module had an incident on Friday. Astronauts separated the water supply line and the liquid leaked."

[Cygnus spacecraft successfully concludes mission to the International Space Station](#)
(25 February 2019)

During the mission, the "S.S. John Young" Cygnus met the needs of multiple customers throughout this flight to the International Space Station. The spacecraft removed more than 5,500 pounds (2,500 kilograms) of disposal cargo from the space station. After departure, the extended mission included the deployment of three CubeSats via the NanoRacks External Cygnus Deployer at two different altitudes and two CubeSats from the Slingshot CubeSat Deployer System. Slingshot, a new commercial customer for Cygnus, is a flexible platform that can fly hosted payloads and CubeSats. The spacecraft also operated a commercial powered payload for another new customer, UbiquitiLink, Inc. These innovative uses of Cygnus beyond the primary mission demonstrate expanded commercial opportunities enabled by partnerships built through the space station. (Northrop Grumman)

JUPITER AND MOONS

[Sodium, not heat, reveals volcanic activity on Jupiter's moon Io](#) (17 February 2019)

A large volcanic event was detected on Jupiter's moon Io using Jovian sodium nebula brightness variation. The volcanic event occurred sometime between mid-December 2017 and early January 2018. Gas from the event filled Jupiter's magnetosphere with excess material until early June. Io is the most volcanic body in the solar system, so its volcanism is the ultimate source of the material. Interestingly, this event, which was the longest recorded by this technique, was not independently reported by any other Io volcanic monitoring

technique, despite significant number of observations in support of NASA's Juno mission. The immediate goal of the research is to better understand how ionized material moves in a rapidly rotating planetary magnetosphere. Ultimately, this project will help us understand all magnetospheres better. The Earth's magnetosphere protects us from some of the harmful effects of living relatively close to a star. (Planetary Science Institute)

KUIPER BELT OBJECTS

[New Horizons research indicates small objects are surprisingly rare in the Kuiper Belt](#)

(28 February 2019)

Using New Horizons data from the NASA mission's 2015 flyby of the Pluto system, scientists have indirectly discovered a distinct and surprising lack of very small objects in the Kuiper Belt. The evidence for the paucity of small Kuiper Belt objects (KBOs) comes from New Horizons imaging that revealed a dearth of small craters on Pluto's largest satellite, Charon, indicating that impactors from 91 meters to 1.6 km in diameter must also be rare. (JHU APL)

LAUNCH SERVICES

[Shetland Space Centre and Goonhilly Earth Station form north-south UK partnership to co-develop new space capabilities](#) (5 February 2019)

Unst (Scotland) and Cornwall, UK - Shetland Space Centre (SSC) and Goonhilly Earth Station have joined forces to develop rocket launch and tracking business capabilities for the burgeoning new space launch sector. Projects include working together to support both Shetland's and Cornwall's aspirations for both vertical and horizontal UK space launches. The firms will jointly promote and deliver launch, monitoring and tracking capabilities from the two sites at the extremities of the UK. SSC is planning to construct a commercial rocket launch centre on the island of Unst and is developing a teleport and other space-related ground infrastructure, while Goonhilly will invest in and install a new highly capable tracking antenna on Unst. The two firms will also co-develop data centres in both Unst and Cornwall. (Goonhilly Earth Station)

MARS

[InSight's seismometer now has a cozy shelter on Mars](#) (4 February 2019)

For the past several weeks, NASA's InSight lander has been adjusting the seismometer it set on the Martian surface on Dec. 19. Now it's reached another milestone by placing a domed shield over the seismometer to help the instrument collect accurate data. The seismometer will give scientists their first look at the deep interior of the Red Planet, helping them understand how it and other rocky planets are formed. (JPL)

[Beyond Mars, the Mini MarCO spacecraft fall silent](#) (5 February 2019)

Before the pair of briefcase-sized spacecraft known collectively as MarCO launched last year, their success was measured by survival: If they were able to operate in deep space at all, they would be pushing the limits of experimental technology. Now well past Mars, the daring

twins seem to have reached their limit. MarCO, short for Mars Cube One, was the first interplanetary mission to use a class of mini-spacecraft called CubeSats. The MarCOs - nicknamed EVE and WALL-E served as communications relays during InSight's landing, beaming back data at each stage of its descent to the Martian surface in near-real time, along with InSight's first image. WALL-E sent back stunning images of Mars as well, while EVE performed some simple radio science. WALL-E was last heard from on Dec. 29; EVE, on Jan. 4. Based on trajectory calculations, WALL-E is currently more than 1 million miles (1.6 million kilometres) past Mars; EVE is farther, almost 2 million miles (3.2 million kilometres) past Mars. Even if they're never revived, the team considers MarCO a spectacular success. (JPL)

[MAVEN spacecraft shrinking its Mars orbit to prepare for Mars 2020 rover](#)

(11 February 2019)

NASA's 4-year-old atmosphere-sniffing Mars Atmosphere and Volatile Evolution (MAVEN) mission is embarking on a new campaign today to tighten its orbit around Mars. The operation will reduce the highest point of the MAVEN spacecraft's elliptical orbit from 3,850 to 2,800 miles (6,200 to 4,500 kilometres) above the surface and prepare it to take on additional responsibility as a data-relay satellite for NASA's Mars 2020 rover, which launches next year. (NASA Goddard)

[InSight prepares to take Mars' temperature](#) (13 February 2019)

The probe is designed to measure heat coming from the inside of Mars. Changes on the surface, both from the seasons and the day-night cycle, could add 'noise' to the data. That's why they want to get it below ground. The mole will stop every 19 inches (50 centimetres) to take a thermal conductivity measurement of the soil. Because hammering creates friction and releases heat, the mole is first allowed to cool down for a good two days. Then it will be heated up by about 50 degrees Fahrenheit (28 degrees Celsius) over 24 hours. Temperature sensors within the mole measure how rapidly this happens, which tells scientists the conductivity of the soil. Between the careful burrowing action, the pauses and the time required for the science team to send commands to the instrument, more than a month will go by before the mole reaches its maximum depth. If the mole extends as far as it can go, the team will need only a few months of data to figure out Mars' internal temperature. If the mole encounters a large rock before reaching at least 10 feet (3 meters) down, the team will need a full Martian year (two Earth years) to filter noise out of their data. This is one reason the team carefully selected a landing site with few rocks and why it spent weeks choosing where to place the instrument. (JPL)

[First evidence of planet-wide groundwater system on Mars](#) (28 February 2019)

Mars Express has revealed the first geological evidence of a system of ancient interconnected lakes that once lay deep beneath the Red Planet's surface, five of which may contain minerals crucial to life. (ESA)

MOON

[First 3D printed part is going to the Moon](#) (11 February 2019)

A 3D engine mount from RUAG Space will be the first 3D printed part on the moon. The

lunar lander of the private Israeli company SpaceIL is scheduled for launch on 18 February. The spacecraft will use a 3D printed aluminium structure developed by RUAG Space for its main engine. The 3D part will support landing and lift off of the spacecraft on the moon. RUAG Space is a pioneer in offering 3D Printing solutions to space. Since 2014 RUAG Space has developed space components based on Additive Manufacturing (3D Printing) technology. (RUAG Space)

[Spaceflight to launch first privately funded lunar lander](#) (11 February 2019)

A Ground-breaking Mission. While rideshare missions are becoming more and more routine, Spaceflight's first GTO mission stands apart for several reasons. The spacecraft are headed to two different orbits. Once the Falcon 9 reaches GTO, it will separate SpaceIL's lunar lander with a custom separation system. Beresheet will orbit Earth, gradually increasing its apogee until it can manoeuvre to be captured by the Moon's gravity. It will travel to the Moon's surface under its own power, a voyage taking nearly two months. Following Beresheet's deployment, the AFRL spacecraft, built by Blue Canyon Technologies, will remain attached to the telecommunications satellite as they continue their journey to Geostationary Orbit (GEO). Before the telecommunications satellite reaches its final GEO position, it will separate the S5 spacecraft which will then turn on and start its mission. SpaceIL's four-legged lunar spacecraft, which was competing in the Google Lunar XPrize, will be the smallest spacecraft to land on the Moon, at only 1,322 pounds, or 600 kilograms. Once it has completed its mission, Beresheet will represent Israel's first spacecraft and the world's first privately funded spacecraft to reach the Moon. Its mission is to transmit photos and video of its new home and conduct scientific measurements. Upon the mission's completion, it will remain as a lunar time capsule commemorating this historic accomplishment. (Spaceflight)

[Israel's first Moon mission will conduct scientific measurements](#) (13 February 2019)

After an enterprise lasting nearly a decade, the Israeli unmanned moon mission "Beresheet" (Genesis) will soon take off from Earth, bound for the Moon's rocky surface. Prof. Oded Aharonson will be watching closely as the craft approaches the Moon and initiates the scientific part of the mission, which will start well before touch-down on the Moon's surface. The cost of planning and building the spacecraft was 100 million dollars, most of it contributed by private donors. If the Beresheet craft touches down successfully on the Moon, it will make Israel only the fourth country to land on the Moon, after the US, the former Soviet Union and China. The spacecraft will be launched on a Falcon 9 rocket made by SpaceX, from Cape Canaveral, Florida, and, after multiple orbits around the Earth, will arrive at its destination two months later. Although the landing will be a historic achievement for Israel, the project is an independent initiative started by the three founders of SpaceIL, who had two main objectives in mind: firstly, to land the first Israeli space vehicle on the Moon and secondly, to inspire a new generation of students to study science and technology. (Weizmann Institute of Science)

[Project Pextex: materials for lunar spacesuits](#) (15 February 2019)

Pextex is a two-year project to identify materials and textiles that could be used for future lunar mission space suits. The project aims to develop solutions that could be based on existing space suit materials, but also identify novel types of textiles with self-healing functions or repulsing lunar dust and smart textiles for example. The identification and test of

such materials could serve the development of future European space suits for spacewalks on the Moon and is in line with ESA's exploration strategy to return to the Moon in the coming decades, including proposed missions such as Heracles. Future missions will aim to establish a permanent presence on the Moon and new space suits need to be made that can be used for longer and more frequently than in previous mission to the Moon. (ESA)

[NASA is aboard first private Moon landing attempt](#) (21 February 2019)

A private Moon lander is packed in the fairing atop a SpaceX Falcon 9 rocket at Cape Canaveral Air Force Station in Florida. It took eight years to get there, plus significant dedication by a small group of scientists and engineers building Israel's first machine to leave Earth's orbit. Now, the highly anticipated moment is here: a shot at the first private Moon landing, and NASA is contributing to the experiment. An Israeli spacecraft from SpaceIL is scheduled to launch Thursday, Feb. 21 and is aiming to touch down on Mare Serenitatis two months later. NASA installed a small laser retroreflector aboard the lander to test its potential as a navigation tool. The agency also provided images of the Moon's surface to help the engineers identify a landing site for the mission. NASA will also use its deep space telecommunications network to transmit images and science data home to SpaceIL and its partners. SpaceIL will provide NASA scientific data from the spacecraft's magnetometer as part of the collaboration. (NASA Goddard)

[NASA selects experiments for possible lunar flights in 2019](#) (21 February 2019)

The selected payloads include a variety of scientific instruments:

- The Linear Energy Transfer Spectrometer will measure the lunar surface radiation environment.
- Three resource prospecting instruments have been selected to fly:
The Near-Infrared Volatile Spectrometer System is an imaging spectrometer that will measure surface composition. The Neutron Spectrometer System and Advanced Neutron Measurements at the Lunar Surface are neutron spectrometers that will measure hydrogen abundance.
- The Ion-Trap Mass Spectrometer for Lunar Surface Volatiles instrument is an ion-trap mass spectrometer that will measure volatile contents in the surface and lunar exosphere.
- A magnetometer will measure the surface magnetic field.
- The Low-frequency Radio Observations from the Near Side Lunar Surface instrument, a radio science instrument, will measure the photoelectron sheath density near the surface.
- Three instruments will acquire critical information during entry, descent and landing on the lunar surface, which will inform the design of future landers including the next human lunar lander.
- The Stereo Cameras for Lunar Plume-Surface Studies will image the interaction between the lander engine plume as it hits the lunar surface.
- The Surface and Exosphere Alterations by Landers payload will monitor how the landing affects the lunar exosphere.

- The Navigation Doppler Lidar for Precise Velocity and Range Sensing payload will make precise velocity and ranging measurements during the descent that will help develop precision landing capabilities for future landers.

There also are two technology demonstrations selected to fly.

- The Solar Cell Demonstration Platform for Enabling Long-Term Lunar Surface Power will demonstrate advanced solar arrays for longer mission duration.
- The Lunar Node 1 Navigation Demonstrator will demonstrate a navigational beacon to assist with geolocation for lunar orbiting spacecraft and landers. (NASA)

[Astrobotic team selected by ESA to study delivery of lunar resources mission](#)

(26 February 2019)

A team led by Airbus has been competitively selected by ESA to study the delivery of a payload package on Astrobotic's Peregrine lunar lander around 2025. The study will analyse Europe's first mission to demonstrate in-situ resource utilisation on the Moon. Astrobotic is in charge of showing how the Peregrine lander's international payload delivery service is best suited to carry this ground-breaking European space resources mission to the Moon. The study team also includes Goonhilly Earth Station Limited of the United Kingdom. (Astrobotic)

NEPTUNE

[Tiny Neptune moon may have broken from larger moon](#) (20 February 2019)

The tiny moon, named Hippocamp, is unusually close to a much larger Neptunian moon called Proteus. Normally, a moon like Proteus should have gravitationally swept aside or swallowed the smaller moon while clearing out its orbital path. So why does the tiny moon exist? Hippocamp is likely a chipped-off piece of the larger moon that resulted from a collision with a comet billions of years ago. The diminutive moon, only 34 kilometres across, is 1/1000th the mass of Proteus which 418 kilometres across. We realized was that you wouldn't expect to find such a tiny moon right next to Neptune's biggest inner moon. In the distant past, given the slow migration outward of the larger moon, Proteus was once where Hippocamp is now. This scenario is supported by Voyager 2 images from 1989 that show a large impact crater on Proteus, almost large enough to have shattered the moon. With Hubble, now we know that a little piece of Proteus got left behind and we see it today as Hippocamp." The orbits of the two moons are now 12,070 kilometres apart. (STScI)

ROCKETS

[New test facility for Ariane 6 upper stage](#) (26 February 2019)

Operations inside the test stand are monitored from a central control room located away from the test stand. After final preparations, a countdown marks the start of the test, simulating an actual rocket launch. The tests will include the Vinci engine firing, non-propulsive ballistic phases, tank pressurisation to increase performance, Vinci reignitions, exhaust nozzle manoeuvres, ending with passivation where all remaining internal energy is removed. Tests will last up to 18 hours and could be repeated on a weekly basis. (ESA)

SATELLITES

[AI challenged to pinpoint state of drifting satellites](#) (1 February 2019)

ESA and Stanford University are challenging global AI specialists to train software to judge the position and orientation of a drifting satellite with a single glance. Such a skill could be used in the future for servicing or salvaging spacecraft. (ESA)

[Kite-blown Antarctic explorers make most southerly Galileo positioning fix](#)

(4 February 2019)

A kite-blown science expedition to the interior of Antarctica has made the most southerly positioning fixes yet made with Europe's Galileo satellite navigation system. Their measurements not only confirm Galileo performance at extremely high latitudes, but also offer knowledge of space weather events overhead. They offer insights into the ionosphere – the electrically active upper layer of Earth's atmosphere – above the southern continent, and the performance of Galileo software to correct ionospheric interference. (ESA)

[Orbex's maiden launch to demonstrate first end to end UK launch capability with UK rocket, UK satellite and UK launch](#) (7 February 2019)

Orbex has announced that it is partnering with UK-based Surrey Satellite Technology Ltd. (SSTL) to carry an experimental payload on its maiden flight from Scotland in 2021. The first launch of the Orbex Prime rocket will represent a first for the UK space industry, showcasing the UK's end to end satellite launch capability, combining a UK rocket, a UK satellite and a UK launch site. This follows the announcement in July 2018 of the proposed UK Vertical Launch spaceport in Sutherland in the Scottish Highlands. At that time, the UK Space Agency announced that Orbex had been chosen to launch orbital vehicles from the site as part of the main consortium. (Orbex)

[Nanosatellite to serve the Internet of Things tested for space](#) (11 February 2019)

Dutch space company Hiber is building an orbital constellation of CubeSats, small modular satellites based around 10 cm units, to provide global low-cost connectivity for the 'Internet of Things', tracking and harnessing data from modem-linked objects such as haulage vehicles, power cables, pipelines or sensors for precision agriculture. Evaluation of a test nanosatellite took place in ESA's metal-walled Hybrid European Radio Frequency and Antenna Test Zone (Hertz) at the Agency's technical centre in the Netherlands, shut off from all external influences for radio testing. Hertz's hybrid nature makes it unique: the facility can assess radio signals from antennas either on a local 'near-field' basis or as if the signal has crossed thousands of kilometres of space, allowing it to serve all kinds of satellites and antenna systems. (ESA)

[Arianespace to launch satellite deployment solution from Open Cosmos](#) (12 February 2019)

Launched from the Guiana Space Centre in French Guiana using a Soyuz rocket, the CubeSat deployment platform is a key to the commercial offering from Open Cosmos. The first mission comprises an array of CubeSats with a total capacity of 12 units (12U). It will weigh about 30 kg. at lift-off, and the CubeSats will be injected into Sun-synchronous orbit at an altitude over 500 km. The first Open Cosmos payload will be an auxiliary passenger on the COSMO-SkyMed Second Generation (CSG 1) satellite mission, along with the CHEOPS

satellite for the European Space Agency ESA as well as the ANGELS and EyeSat's French CNES space agency missions. Launch is scheduled for the last quarter of 2019. (Arianespace)

SPACE

[RemoveDEBRIS: success for harpoon experiment](#) (15 February 2019)

The success of the harpoon firing marks the third successful experiment for the RemoveDEBRIS project which has already demonstrated a net capture experiment and trialled its state-of-the-art LiDAR based vision navigation system to identify a target cubesat. The RemoveDEBRIS satellite platform was designed and manufactured by SSTL to house two target cubesats and four debris removal technologies - a net, a harpoon, vision-based navigation using cameras and LiDAR, and a de-orbit dragsail. The spacecraft is operated in orbit by SSTL's engineers from Guildford. The RemoveDEBRIS team is now preparing for the final experiment, which is set to take place in March and sees RemoveDEBRIS inflate a sail that will drag the satellite into Earth's atmosphere where it will be destroyed. (SSTL)

[NASA selects mission to study space weather from Space Station](#) (25 February 2019)

NASA has selected a new mission that will help scientists understand and, ultimately, forecast the vast space weather system around our planet. Space weather is important because it can have profound impacts, affecting technology and astronauts in space, disrupting radio communications and, at its most severe, overwhelming power grids. The new experiment will, for the first time, obtain global observations of an important driver of space weather in a dynamic region of Earth's upper atmosphere that can cause interference with radio and GPS communications. The Atmospheric Waves Experiment (AWE) mission will cost \$42 million and is planned to launch in August 2022, attached to the exterior of the Earth-orbiting International Space Station. From its space station perch, AWE will focus on colourful bands of light in Earth's atmosphere, called airglow, to determine what combination of forces drive space weather in the upper atmosphere. (NASA)

STARS AND STAR CLUSTERS

[Retreating snow line reveals organic molecules around young star](#) (4 February 2019)

Thanks to ALMA's sharp vision and the enlarged snow line due to the flare-up of the star V883 Ori, the astronomers obtained the spatial distribution of methanol and acetaldehyde. The distribution of these molecules has a ring-like structure with a radius of 60 au, which is twice the size of Neptune's orbit. The researchers assume that inside of this ring the molecules are invisible because they are obscured by thick dusty material and are invisible outside of this radius because they are frozen in ice. Since rocky and icy planets are made from solid material, the chemical composition of solids in disks is of special importance. An outburst is a unique chance to investigate fresh sublimates, and thus the composition of solids. V883 Ori is a young star located at 1300 light-years away from the Earth. This star is experiencing a so-called FU Orionis type outburst, a sudden increase of luminosity due to a bursting torrent of material flowing from the disk to the star. These outbursts last only on the order of 100 years, therefore the chance to observe a burst is rather rare. However, since young stars with a wide range of ages experience FU Ori bursts, astronomers expect to be

able to trace the chemical composition of ice throughout the evolution of young stars.
(ALMA)

[Liberal sprinkling of salt discovered around a young star](#) (7 February 2019)

A team of astronomers and chemists using the Atacama Large Millimeter/submillimeter Array (ALMA) has detected the chemical fingerprints of sodium chloride (NaCl) and other similar salty compounds emanating from the dusty disk surrounding Orion Source I, a massive, young star in a dusty cloud behind the Orion Nebula. (ALMA)

[Tidal tails – the beginning of the end of an open star cluster](#) (15 February 2019)

From the simple assumption that a star cluster has a nearly constant mass-loss rate on its orbit about the Galactic Centre, its tidal tails are often expected to have a more or less homogenous and smooth structure. Substructure in the tidal tails is usually only expected in time-variable tidal fields when the mass-loss rate varies with time. In a recent paper, researchers analytically predicted and numerically proved the formation of substructure in tidal tails even within a constant tidal field. This effect is due to an epicyclic motion of stars evaporating from the cluster instead of the more common approximation of linear motion along the tails. Like a standing wave this motion leads to statistical over-densities if it is performed by a stream of stars (Heidelberg University)

[Citizen scientist finds ancient white dwarf star encircled by puzzling rings](#)

(19 February 2019)

A volunteer working with the NASA-led Backyard Worlds: Planet 9 project has found the oldest and coldest known white dwarf, an Earth-sized remnant of a Sun-like star that has died, ringed by dust and debris. Astronomers suspect this could be the first known white dwarf with multiple dust rings. The star, LSPM J0207+3331 or J0207 for short, is forcing researchers to reconsider models of planetary systems and could help us learn about the distant future of our solar system. (NASA Goddard)

[ALMA differentiates two birth cries from a single star](#) (26 February 2019)

Astronomers have unveiled the enigmatic origins of two different gas streams from a baby star. Using ALMA, they found that the slow outflow and the highspeed jet from a protostar have misaligned axes and that the former started to be ejected earlier than the latter. The origins of these two flows have been a mystery, but these observations provide tell-tale signs that these two streams were launched from different parts of the disk around the protostar.
(ALMA)

[Silicon carbide 'stardust' in meteorites leads to understanding of erupting stars](#)

(28 February 2019)

The microscopic grains of silicon carbide, a thousand times smaller than the average width of a human hair, were part of the construction materials that built the sun and planetary system. Born in nova outbursts, which are repeated cataclysmic eruptions by certain types of white dwarf stars, the silicon carbide grains are found today embedded in primitive meteorites. Silicon carbide is one of the most resistant bits found in meteorites. Unlike other elements, these stardust grains have survived unchanged from before the solar system was born.
(Arizona State University)

SUN

[Researchers find evidence for a new fundamental constant of the Sun](#) (7 February 2019)

After examining data gathered over a 10-year period, the team from Northumbria's Department of Mathematics, Physics and Electrical Engineering found that magnetic waves in the Sun's corona, its outermost layer of atmosphere, react to sound waves escaping from the inside of the Sun. These magnetic waves, known as Alfvénic waves, play a crucial role in transporting energy around the Sun and the solar system. The waves were previously thought to originate at the Sun's surface, where boiling hydrogen reaches temperatures of 6,000 degrees and churns the Sun's magnetic field. However, the researchers have found evidence that the magnetic waves also react or are excited higher in the atmosphere by sound waves leaking out from the inside of the Sun. The team discovered that the sound waves leave a distinctive marker on the magnetic waves. The presence of this marker means that the Sun's entire corona is shaking in a collective manner in response to the sound waves. This is causing it to vibrate over a very clear range of frequencies. This newly-discovered marker is found throughout the corona and was consistently present over the 10-year time-span examined. This suggests that it is a fundamental constant of the Sun and could potentially be a fundamental constant of other stars. The findings could therefore have significant implications for our current ideas about how magnetic energy is transferred and used in stellar atmospheres. (Northumbria University)

SUPERNOVA/NOVA

[SOFIA finds dust survives obliteration in Supernova 1987A](#) (8 February 2019)

Dust particles form as dying red giant stars throw off material and become part of interstellar clouds of various sizes, densities and temperatures. This cosmic dust is then destroyed by supernova blast waves, which propagate through space at more than 6,000 miles per second (10,000 km/sec)! The explosion also produces a blast wave that destroys almost everything in its path, including dust in the surrounding interstellar medium, the space between the stars. Current theories predict when a supernova blast sweeps through a region of space, much of the dust would be destroyed, so there should be little dust left. Observations with SOFIA, however, tell a different, mysterious story revealing more than 10 times the dust expected. This suggests that dust is much more abundant in the wake of a blast wave than theories estimate. (NASA)

[First evidence discovered of a gigantic remnant around an exploding star](#) (15 February 2019)

An astrophysicist has helped discover evidence of a gigantic remnant surrounding an exploding star, a shell of material so huge, it must have been erupting on a regular basis for millions of years. When a white dwarf, the core of a dead star, is in a close orbit with another star, it pulls gas from the other star. The gas becomes heated and compressed, eventually exploding to create a nova. This explosion causes the star to brighten by a millionfold and eject material at thousands of miles per second. The ejected material forms a remnant or shell surrounding the nova. A team of astrophysicists have been studying a nova in the nearby Andromeda galaxy known as M31N 2008-12a. What makes the nova unusual is that it erupts every year far more frequently than any other known nova system. A more typical pattern is about every 10 years. The team believe M31N 2008-12a has been erupting regularly for

millions of years. These frequent eruptions over time have resulted in a “super remnant” surrounding the nova measuring almost 400 light years across. Using Hubble Space Telescope imaging along with ground-based telescopes, the team worked to determine the chemical composition of the super-remnant and confirm its association with M31N 2008-12a. These findings open the door to the possibility that this nova and remnant are linked to something more crucial to the universe. Type Ia supernovae are among the most powerful and luminous objects in the universe and are believed to occur when a white dwarf exceeds its maximum allowable mass. At that point, the entire white dwarf is blown apart instead of experiencing explosions on the surface as other novae do. These are relatively rare and unseen in our own galaxy since the early 1600s. Theoretical models show that novae experiencing frequent explosions surrounded by large remnants must harbour massive white dwarfs that are nearing their limit. This means M31N 2008-12a is behaving precisely the way astronomers believe a nova does before it potentially explodes as a supernova. The discovery of additional large remnants around other novae will help identify systems undergoing repeated eruptions and help astronomers determine how many type Ia supernovae are formed; how frequently they occur; and their potential association with novae like M31N 2008-12a. Type Ia supernovae are a critical part of understanding how the entire universe expands and grows. (San Diego State University)

[Old stars live longer than we thought](#) (25 February 2019)

The study shows that these stars lose mass at a much slower rate than previously thought. The stellar wind is not stronger than usual, but it is affected by a companion star which had not been noticed until now, a second star orbiting around the red giant. The fact that this process is slower than expected has a major impact on our understanding of how stars end their lives. As a consequence of this discovery we find that the most massive giant stars need a longer time to expel their chemically rich interiors into their environment, which affects the enrichment of the interstellar medium, and therefore the chemical evolution of galaxies. (Instituto de Astrofísica de Canarias)

TECHNOLOGY

[Airbus and Hisdesat successfully processed the first TerraSAR-X / PAZ radar interferogram](#) (12 February 2019)

Interferometry is one of the most technically demanding applications. Interferograms are typically used to derive the topographic elevation and deformation of the Earth’s surface and are created using at least two different images acquired at different dates. (Airbus)

[Tinier and less power-hungry quantum atomic clock push toward intelligent IoT](#) (19 February 2019)

As current telecommunication technologies continue to evolve, the speed and sheer amount of data required by users worldwide increase accordingly. One promising method for satisfying this ever-growing demand is by deploying a constellation of nano- or micro-scale satellites that circle the planet in low earth orbit. However, such a swarm of satellites requires extremely precise synchronization to a global time standard, for which a very precise atomic clock on board each unit is necessary. (Tokyo Tech)

[NASA set to demonstrate X-ray communications in space](#) (19 February 2019)

A new experimental type of deep space communications technology is scheduled to be demonstrated on the International Space Station this spring. Currently, NASA relies on radio waves to send information between spacecraft and Earth. Emerging laser communications technology offers higher data rates that let spacecraft transmit more data at a time. This demonstration involves X-ray communications, or XCOM, which offers even more advantages. X-rays have much shorter wavelengths than both infrared and radio. This means that, in principle, XCOM can send more data for the same amount of transmission power. The X-rays can broadcast in tighter beams, thus using less energy when communicating over vast distances. (NASA Goddard)

[ESA tests new 3D-printed design for future rocket engines using storable propellants](#)

(21 February 2019)

The recent hot firing of a full-scale rocket thrust chamber assembly takes us a step closer to proving 3D-printing for an engine design destined for rocket upper stages, in-orbit transportation applications (kick-stages and space-tugs), microlaunchers, and exploration spacecraft such as a lunar lander and ascent stage on the Moon. Manufactured entirely by 3D-printing, this thrust chamber is designed for 'storable propellants', called such because they can be stored as liquids at room temperature. Rocket engines that are powered this way are easy to ignite reliably and repeatedly on missions lasting many months. This Combustion Chamber demonstrator, with a reference thrust of 2.5kN, was hot-fired for 560 seconds at the DLR German Aerospace Centre's Lampoldshausen testing facility in Germany. (ESA)

TELESCOPES

[SKA's infrastructure consortia complete their detailed design work for the SKA sites](#)

(25 February 2019)

The two engineering consortia tasked with designing all the essential infrastructure for the SKA sites in Australia and South Africa have formally concluded their work, bringing to a close nearly five years of collaboration both within and between the consortia. (SKA)

URANUS

[Hubble reveals dynamic atmospheres of Uranus and Neptune](#) (7 February 2019)

Since Hubble's launch in 1990, astronomers have used it to amass an album of outer planet images. Yearly monitoring of these giant worlds is now allowing astronomers to study long-term seasonal changes, as well as capture transitory weather patterns. The telescope's new snapshot of Uranus shows that the ice giant is not a planetary wallflower. A vast bright polar cap across the north pole dominates the image. The cap, which may form due to seasonal changes in atmospheric flow, has become much more prominent than in previous observations dating back to the Voyager 2 flyby, when the planet, in the throes of winter, looked bland. During its routine yearly monitoring of the weather on our solar system's outer planets, NASA's Hubble Space Telescope has uncovered a new mysterious dark storm on Neptune (right) and provided a fresh look at a long-lived storm circling around the north polar region on Uranus. (STScI)

Pat Williams February 2019