Space News Update – September 2019

By Pat Williams

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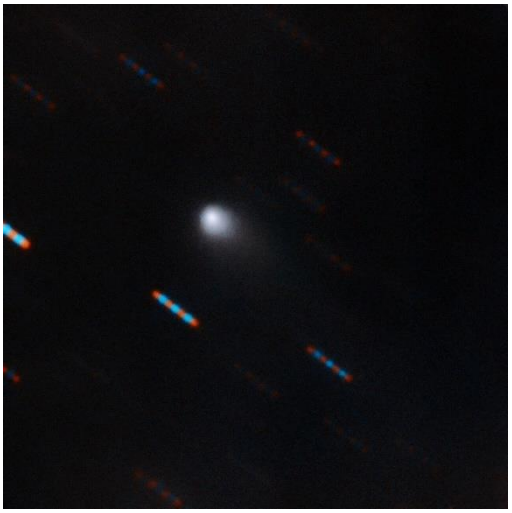
Disclaimer - I claim no authorship for the printed material; except where noted (PW).

NAMING OF NEW INTERSTELLAR VISITOR: 2I/BORISOV



The first-ever comet from beyond our Solar System, as imaged by the Gemini Observatory. The image of the newly discovered object, named 2I/Borisov, was obtained on the night of 9–10 September 2019 using the Gemini Multi-Object Spectrograph on the Gemini North Telescope on Hawaii's Mauna Kea. Credit: Gemini Observatory/NSF/AURA

A new object from interstellar space has been found within the Solar System, only the second such discovery of its kind. Astronomers are turning their telescopes towards the visitor, which offers a tantalising glimpse beyond our Solar System and raises some puzzling questions. The object has been given the name 2I/Borisov by the IAU. On 30 August 2019 the amateur astronomer Gennady Borisov, from MARGO observatory, Crimea, discovered an object with a comet-like appearance. The object has a condensed coma, and more recently a short tail has been observed. Mr. Borisov made this discovery with a 0.65-metre telescope he built himself. After a week of observations by amateur and professional astronomers all over the world, the IAU Minor Planet Centre was able to compute a preliminary orbit, which suggested this object was interstellar, only the second such object known to have passed through the Solar System. The orbit is now sufficiently well known, and the object is unambiguously interstellar in origin; it has received its final designation as the second interstellar object, 2I. In this case, the IAU has decided to follow the tradition of naming

cometary objects after their discoverers, so the object has been named 2I/Borisov. Of the thousands of comets discovered so far, none has an orbit as hyperbolic as that of 2I/Borisov. This conclusion is independently supported by the NASA JPL Solar System Dynamics Group. Coming just two years after the discovery of the first interstellar object 1I/'Oumuamua, this new finding suggests that such objects may be sufficiently numerous to provide a new way of investigating processes in planetary systems beyond our own. 2I/Borisov will make its closest approach to the Sun (reach its perihelion) on 7 December 2019, when it will be 2 astronomical units (AU) from the Sun and 2 AU from Earth. By December and January it is expected that it will be at its brightest in the southern sky. It will then begin its outbound journey, eventually leaving the Solar System forever. Astronomers are eagerly observing this object, which will be continuously observable for many months, a period longer than that of its predecessor, 1I/'Oumuamua. Astronomers are optimistic about their chances of studying this rare guest in detail. (IAU)
Naming of new interstellar visitor: 2I/Borisov (24 September 2019)

ASTRONAUTS ARRIVE SAFELY AT INTERNATIONAL SPACE STATION

The nine International Space Station residents pose for a portrait inside the Zvezda service module. At the bottom row from left are, station cosmonaut Alexey Ovchinin, astronauts Luca Parmitano and Nick Hague, visiting astronaut Hazzaa Ali Almansoori of the United Arab Emirates, astronaut Jessica Meir and cosmonaut Oleg Skripochka. At the top are, astronauts Christina Koch and Andrew Morgan with cosmonaut Alexander Skvortsov. Credits: NASA.

NASA astronaut Jessica Meir and two fellow crew members arrived Wednesday for their mission aboard the International Space Station, temporarily increasing the orbiting laboratory's population to nine people. The Soyuz MS-15 spacecraft was carrying Meir, Oleg Skripochka of the Russian space agency Roscosmos, and the first space traveller from the United Arab Emirates (UAE), Hazzaa Ali Almansoori from the Baikonur Cosmodrome in Kazakhstan. Their spacecraft docked to the station's Zvezda service module after a four-orbit, six-hour flight. After the hatches open, station commander Alexey Ovchinin of Roscosmos, along with NASA astronauts Christina Koch, Nick Hague, Andrew Morgan, ESA (European Space Agency) astronaut Luca Parmitano and cosmonaut Alexander Skvortsov, greeted the new residents. The eight days between the trio's arrival and the departure of Soyuz MS-12 spacecraft will see the largest crew aboard the station since September 2015, when nine crew members were aboard for seven days during Scott Kelly and Mikhail Kornienko's year-long mission. Meir and Skripochka will spend more than six months on the station. Almansoori's eight-day mission as a spaceflight participant under an intergovernmental contract between the UAE and Roscosmos will come to an end when he returns to Earth Thursday, Oct. 3 on

the Soyuz MS-12 spacecraft, along with Hague and Ovchinin, who are completing more than 200 days in space. The Expedition 61 crew will spend more than six months conducting about 250 science investigations in fields such as biology, Earth science, human research, physical sciences, and technology development. Work on the unique microgravity laboratory advances scientific knowledge and demonstrates new technologies, making research breakthroughs that will enable long-duration human and robotic exploration of the Moon and Mars. (NASA)
Astronauts arrive safely at International Space Station (25 September 2019)

JAPANESE CARGO SHIP TO LAUNCH TO SPACE STATION

The Japan Aerospace Exploration Agency's (JAXA) unpiloted H-II Transport Vehicle-6 (HTV-6) makes its final approach to the International Space Station Dec. 13, 2016. Credits: NASA

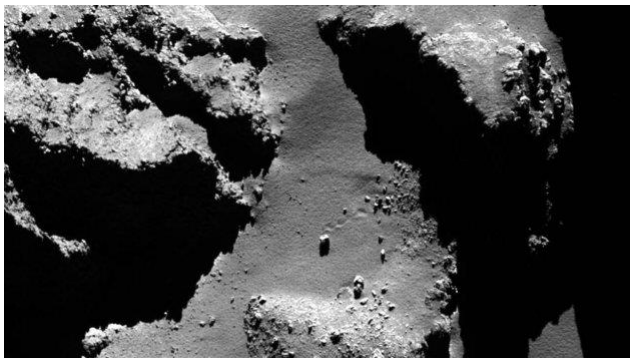
A Japanese cargo spacecraft loaded with more than four tons of supplies, spare parts, and experiment hardware is scheduled to launch from the Tanegashima Space Centre in southern Japan to the International Space Station. The Japan Aerospace Exploration Agency (JAXA) unpiloted H-II Transport Vehicle-8 (HTV-8) originally was scheduled to launch Sept. 10, but the launch was postponed because of a fire at the mobile launch pad exit hole during the countdown operation. Launch provider Mitsubishi Heavy Industries identified the root cause for the fire and set the new launch date after corrective measures were put in place. Following a successful launch Sept. 24, the spacecraft will arrive at the station Saturday, Sept. 28. Expedition 60 Flight Engineer Christina Koch of NASA, backed up by her NASA crewmate Andrew Morgan, will operate the station's Canadarm2 robotic arm from the station's cupola to capture the 12-ton spacecraft as it approaches from below. Robotics flight controllers will then take over the operation of the arm to install HTV-8 to the Earth-facing port of the Harmony module where it will spend a month attached to the orbiting laboratory. Flight Engineer Luca Parmitano of ESA (European Space Agency) will monitor HTV-8 systems during its approach to the station. Named Kounotori, meaning "white stork" in Japanese, the craft will deliver six new lithium-ion batteries and corresponding adapter plates that will replace aging nickel-hydrogen batteries for two power channels on the station's far port truss segment. The batteries will be installed through a series of robotics and spacewalks the station's crew members will conduct later this year. Additional experiments on board HTV-8 include an upgrade to the Cell Biology Experiment Facility (CBEF-L), a small-sized satellite optical communication system (SOLISS), and a payload for testing the effects of gravity on powder and granular material (Hourglass). (NASA)
Japanese cargo ship to launch to space station (21 September 2019)

ASTROBOTIC AND SPACEBIT TO BRING THE FIRST UK COMMERCIAL PAYLOAD TO THE MOON

The Peregrine Lander. Image Credit: Astrobotic.

Spacebit proudly announces at The UK Space Conference 2019 their signing of a joint agreement with Astrobotic to begin commercial and scientific lunar exploration with the first mission in 2021 on the Peregrine lunar lander. Astrobotic's Peregrine lunar lander will be launched on a Vulcan Centaur rocket from Space Launch Complex-41 at Cape Canaveral Air Force Station in Florida. The launch will carry the first lunar lander from American soil since Apollo. This agreement comes after Spacebit examined the field of commercial lunar delivery providers and determined Astrobotic to be the world's leading provider with one of the most technically mature lunar lander programs. With this announcement, Spacebit joins Astrobotic's existing manifest of 16-signed contracts toward Peregrine Mission One. This mission will result in the first payload from the UK to reach the Moon surface and mark the beginning of a new era in commercial space exploration for Britain. Astrobotic is very excited to bring Spacebit's first payload to the Moon. Spacebit has pioneered a captivating new way of working on the lunar surface. More details being released soon. (Spacebit)
Astrobotic and Spacebit to bring the first UK commercial payload to the Moon
(24 September 2019)

COMET'S COLLAPSING CLIFFS AND BOUNCING BOULDERS



Bouncing boulder on Comet 67P/C-G Image Credit: ESA.

Scientists analysing the treasure trove of images taken by ESA's Rosetta mission have turned up more evidence for curious bouncing boulders and dramatic cliff collapses. Rosetta operated at Comet 67P/Churyumov-Gerasimenko between August 2014 and September 2016, collecting data on the comet's dust, gas and plasma environment, its surface characteristics and its interior structure. As part of the analysis of some 76 000 high-resolution images captured with its OSIRIS camera, scientists have been looking for surface changes. They are

interested in comparing the period of the comet's closest approach to the Sun, known as perihelion, with that after this most active phase, to better understand the processes that drive surface evolution. Loose debris is seen all over the comet, but sometimes boulders have been caught in the act of being ejected into space or rolling across the surface. A new example of a bouncing boulder was recently identified in the smooth neck region that connects the comet's two lobes, an area that underwent a lot of noticeable large-scale surface changes over the course of the mission. There, a boulder about 10 m-wide has apparently fallen from the nearby cliff, and bounced several times across the surface without breaking, leaving 'footprints' in the loosely consolidated surface material. (ESA)
Comet's collapsing cliffs and bouncing boulders (18 September 2019)

LINKS TO OTHER SPACE NEWS PUBLISHED IN SEPTEMBER 2019

ASTEROIDS

Iron magma could explain Psyche's density puzzle (23 September 2019)
The metallic asteroid Psyche has mystified scientists because it is less dense than it should be. Now, a new theory by researchers including scientists at the University of Arizona, could explain Psyche's low density and metallic surface. Psyche, the largest known metallic asteroid in the solar system, is in the asteroid belt between Mars and Jupiter. Psyche appears to be composed largely of iron and nickel, rather than rocky rubble, like most asteroids, yet its density is estimated to be only about half that of an iron meteorite. Metal-rich asteroids are thought to have formed when primordial planetesimals collided, stripping away much of the outer material and leaving behind the inner metallic cores, which then cooled and solidified from the outside in. During this cooling process, an alloy of residual melted pockets of iron, nickel and lighter elements like sulphur, might have flowed to the surface through fluid-filled cracks called dikes, coating a topmost, rocky layer. These processes are collectively referred to as "ferrovolcanism". This is a very new idea as of 2019. It's a kind of volcanism where the magma is liquid metal instead of liquid rock.
(University of Arizona)

BLACK HOLES

Scientists detect tones in the ringing of a newborn black hole for the first time
(12 September 2019)
If Albert Einstein's theory of general relativity holds true, then a black hole, born from the cosmically quaking collisions of two massive black holes, should itself "ring" in the aftermath, producing gravitational waves much like a struck bell reverberates sound waves. Einstein predicted that the pitch and decay of these gravitational waves should be a direct signature of the newly formed black hole's mass and spin. Now, physicists from MIT and elsewhere have studied the ringing of an infant black hole, and found that the pattern of this ringing does, in fact, predict the black hole's mass and spin; more evidence that Einstein was right all along. (MIT)

Black hole at the centre of our galaxy appears to be getting hungrier (11 September 2019)

The new findings are based on observations of the black hole, which is called Sagittarius A*, or Sgr A* during four nights in April and May at the Keck Observatory. The brightness surrounding the black hole always varies somewhat, but the scientists were stunned by the extreme variations in brightness during that timeframe, including their observations on May 13. The first image I seen that night, the black hole was so bright it was initially mistaken for the star S0-2, because of its unusual brightness. It quickly became clear the source had to be the black hole. One hypothesis about the increased activity is that when a star called S0-2 made its closest approach to the black hole during the summer 2018, it launched a large quantity of gas that reached the black hole this year. Another possibility involves a bizarre object known as G2, which is most likely a pair of binary stars, which made its closest approach to the black hole in 2014 . It's possible the black hole could have stripped off the outer layer of G2 which could help explain the increased brightness just outside the black hole. Another possibility is that the brightening corresponds to the demise of large asteroids that have been drawn in to the black hole. (UCLA)

Three black holes on collision course (25 September 2019)
Chandra X-ray Observatory and other NASA space telescopes, captured the unusual system. This is the strongest evidence yet found for such a triple system of actively feeding supermassive black holes. The system is known as SDSS J084905.51+111447.2 (SDSS J0849+1114 for short) and is located a billion light years from Earth. To uncover this rare black hole trifecta, researchers needed to combine data from telescopes both on the ground and in space. First, the Sloan Digital Sky Survey (SDSS) telescope, which scans large swaths of the sky in optical light from New Mexico, imaged SDSS J0849+1114. With the help of citizen scientists participating in a project called Galaxy Zoo, it was then tagged as a system of colliding galaxies. Then, data from NASA's Wide-field Infrared Survey Explorer (WISE) mission revealed that the system was glowing intensely in infrared light during a phase in the galaxy merger when more than one of the black holes is expected to be feeding rapidly. To follow up on these clues, astronomers then turned to Chandra and the Large Binocular Telescope (LBT) in Arizona. The Chandra data revealed X-ray sources, a tell-tale sign of material being consumed by the black holes, at the bright centres of each galaxy in the merger, exactly where scientists expect supermassive black holes to reside. Chandra and NASA's Nuclear Spectroscopic Telescope Array (NuSTAR) satellite also found evidence for large amounts of gas and dust around one of the black holes, typical for a merging black hole system. Meanwhile, optical light data from SDSS and LBT showed characteristic spectral signatures of material being consumed by the three supermassive black holes. Optical spectra contain a wealth of information about a galaxy. They are commonly used to identify actively accreting supermassive black holes and can reflect the impact they have on the galaxies they inhabit. One reason it is difficult to find a triplet of supermassive black holes is that they are likely to be shrouded in gas and dust, blocking much of their light. The infrared images from WISE, the infrared spectra from LBT and the X-ray images from Chandra bypass this issue, because infrared and X-ray light pierce clouds of gas much more easily than optical light. (Chandra X-ray Observatory)

TESS mission spots its first star-shredding black hole (26 September 2019)
For the first time, NASA's planet-hunting Transiting Exoplanet Survey Satellite (TESS) watched a black hole tear apart a star in a cataclysmic phenomenon called a tidal disruption event. Follow-up observations by NASA's Neil Gehrels Swift Observatory and other

facilities have produced the most detailed look yet at the early moments of one of these star-destroying occurrences. TESS data let us see exactly when this destructive event, named ASASSN-19bt, started to get brighter, which we've never been able to do before. Because we identified the tidal disruption quickly with the ground-based All-Sky Automated Survey for Supernovae (ASAS-SN), we were able to trigger multiwavelength follow-up observations in the first few days. The early data will be incredibly helpful for modelling the physics of these outbursts. (NASA Goddard)

EARTH

KASI space mission will be launched on Soyuz-2 in 2021 (17 September 2019)
Four KASI 6U Cubesats will be launched on Soyuz-2.1a as part of the rideshare mission scheduled for 2021 in two 12U deployers from the Baikonur Cosmodrome. A new and very challenging space mission was initiated by KASI since 2017. KASI designed the innovative concept of multi-satellites mission, named as the Small scale magNetospheric and Ionospheric Plasma Experiments (SNIPE). The SNIPE mission consists of four 6U nanosatellites (~12kg), which will be launched into a polar orbit at an altitude of 600 km. Four satellites will be deployed in orbit, and the distances between each satellite will be controlled from 100 m to 1,000 km by a formation-flying algorithm. The science targets of the SNIPE mission are fine-scale morphology of high-energy electron precipitation, background plasma density/temperature, field-aligned currents, and electromagnetic waves. Hence, the mission will observe micro-scale structures of the following geophysical phenomena: high-latitude irregularities such as polar-cap patches, field-aligned currents in the auroral oval, Electro-Magnetic Ion Cyclotron (EMIC) waves, hundreds keV electron precipitations such as electron microbursts, subauroral plasma density trough, low-latitude plasma irregularities such as ionospheric plasma blobs and bubbles. (Roscosmos)

EXOPLANETS

A planet that should not exist (26 September 2019)
Astronomers detected a giant planet orbiting a small star. The planet has much more mass than theoretical models predict. While this surprising discovery was made by a Spanish-German team at an observatory in southern Spain, researchers at the University of Bern studied how the mysterious exoplanet might have formed. The red dwarf GJ 3512 is located 30 light-years from us. Although the star is only about a tenth of the mass of the Sun, it possesses a giant planet, an unexpected observation. Around such stars there should only be planets the size of the Earth or somewhat more massive Super-Earths. PlanetS: "GJ 3512b, however, is a giant planet with a mass about half as big as the one of Jupiter, and thus at least one order of magnitude more massive than the planets predicted by theoretical models for such small stars. The consortium built a new instrument, which was installed at the Calar Alto Observatory at 2100 m altitude in southern Spain. Observations with this infrared spectrograph showed that the small star regularly moved towards and away from us, a phenomenon triggered by a companion who had to be particularly massive in this case. Because this discovery was so unexpected, the consortium contacted, among others, the Bern research group of Mordasini, one of the world's leading experts in the theory of planet

formation, to discuss plausible formation scenarios for the giant exoplanet. The paper with all contributions has now been published in the journal Science. (University of Bern)

GRAVITATIONAL WAVES

Afterglow sheds light on the nature, origin of neutron star collisions (10 September 2019)
The final chapter of the historic detection of the powerful merger of two neutron stars in 2017 officially has been written. After the extremely bright burst finally faded to black, an international team led by Northwestern University painstakingly constructed its afterglow, the last bit of the famed event's life cycle. Not only is the resulting image the deepest picture of the neutron star collision's afterglow to date, it also reveals secrets about the origins of the merger, the jet it created and the nature of shorter gamma ray bursts.
(Northwestern University)

MARS

SENER Aeroespacial delivers the flight model of the Umbilical Release Mechanism for ExoMars 2020 (18 September 2019)
The ExoMars mission (Exobiology on Mars) is a joint venture of the European Space Agency (ESA) and the Russian Roscosmos. The goal of the mission is to look for traces of life on Mars and better preparation for future manned missions on this planet. Regarding the umbilical cord for Exomars, engineers from SENER Aeroespacial have been working on this equipment since 2015. The company was responsible for the whole project, from the concept stage, through manufacturing and tests to the delivery of flight models, which in 2021 are to land on Mars. When entering the atmosphere of Mars, the Rover, named after Rosalind Franklin, will be inside the lander. After reaching the surface, the lander will unfold the solar panels and start charging the Rover battery. During the flight from Earth to Mars, as well as during the start-up of the robot, the power supply and signals will be transmitted through the connection created by SENER Aeroespacial. After charging, the rover will lift on the wheels, and then the "umbilical cord" will detach itself to allow the vehicle to go to the surface of Mars and start testing. The system consists of two devices, the primary and the redundant one. The trip to Mars itself is a challenge because of the extreme conditions of the interplanetary space, characterized by high radiation and temperatures of down to -135 degrees Celsius. The mechanism will also be exposed to the heavy conditions of taking off from Earth and landing on Mars, as well as on the pollination and atmospheric conditions of the planet. (SENER)

MISCELLANEOUS

NASA satellite spots a mystery that's gone in a flash (4 September 2019)
Pops of bright blue and green in the Fireworks galaxy (NGC 6946) show the locations of extremely bright sources of X-ray light captured by NASA's NuSTAR space observatory. Generated by some of the most energetic processes in the universe, these X-ray sources are rare compared to the many visible light sources in the background image. A new study, published in the Astrophysical Journal, offers some possible explanations for the surprise appearance of the green source near the centre of the galaxy, which came into view and disappeared in a matter of weeks. (JPL)

Vega Flight VV15: Findings of the Independent Inquiry Commission's investigations
(5 September 2019)
The Vega launcher lifted off as scheduled on July 10, 2019. At precisely 130s 850ms after lift-off and shortly after ignition of the second stage (Zefiro 23) an anomaly occurred on the launcher, leading to the premature end of the mission. The Commission identified as the most likely cause of the anomaly a thermo-structural failure in the forward dome area of the Z23 motor. Other possible causes such as inadvertent activation of the Z23 neutralization system have been found unlikely. Furthermore, after specific investigations, the Independent Inquiry Commission did not find any evidence of a malicious act.
The Commission has proposed:
An exhaustive verification plan of its findings based on analyses and tests,
A set of corrective actions on all subsystems, processes and equipment concerned.
This action plan shall enable a resumption of Vega launches under all requisite conditions of reliability by the first quarter of 2020. (Arianespace)

MOON

NASA science experiments to be delivered to Moon by commercial landers
(5 September 2019)
After sitting in a vacuum chamber for 15 years, a gas-sniffing instrument will finally get its chance to fly. The device, a neutral mass spectrometer dubbed SEAL, is one of four instruments from NASA's Goddard Space Flight Centre in Greenbelt, Maryland that will fly on the first set of private landers, through NASA's Commercial Lunar Payload Services provider program, scheduled to begin delivering science instruments to the Moon starting in the early 2020s. These instruments, which are part of a suite of instruments chosen by NASA, will power the first NASA science experiments to be conducted from the surface of the Moon since the Apollo era. Using advanced technologies to gather information about the amount of water in the Moon's tenuous atmosphere and on its surface, to measure magnetic fields, and to determine the frequency of radio signals that can reach the Moon, these instruments will help scientists better understand the Moon as NASA works to send humans there through its Artemis program. (NASA Goddard)

NASA funds CubeSat pathfinder mission to unique lunar orbit (13 September 2019)
NASA has awarded a $13.7 million contract to Advanced Space of Boulder, Colorado, to develop and operate a CubeSat mission to the same lunar orbit targeted for Gateway – an orbiting outpost astronauts will visit before descending to the surface of the Moon in a landing system as part of NASA's Artemis program. The Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment (CAPSTONE) is expected to be the first spacecraft to operate in a near rectilinear halo orbit around the Moon. In this unique orbit, the CubeSat will rotate together with the Moon as it orbits Earth and will pass as close as 1,000 miles and as far as 43,500 miles from the lunar surface. (NASA)

Terma returns to the moon together with Argotec (17 September 2019)
Terma has been selected to supply the spacecraft control system for the ArgoMoon cubesat. 20 years ago Terma delivered the Spacecraft Mission Control System for SMART-1, ESA's first mission to the moon. It was launched in September 2003, and the mission ended when the spacecraft was deliberately crashed into the lunar surface in September 2006. Now Terma

is returning to the moon. We have been selected to supply the spacecraft control system for the ArgoMoon cubesat. The mission is coordinated by the Italian Space Agency, ASI and was selected by the National Aeronautics and Space Administration, NASA to be part of Artemis-1, which will launch a total of 13 cubesats. The launch, due in 2020, will be the first to use the new American Space Launch System (SLS) which is to be used for future exploration missions. ArgoMoon will be the first European nanosatellite to operate in deep space. (Terma)

NASA joins last of five sections for Space Launch System rocket stage (19 September 2019)
NASA finished assembling and joining the main structural components for the largest rocket stage the agency has built since the Saturn V that sent Apollo astronauts to the Moon. Engineers at the agency's Michoud Assembly Facility in New Orleans connected the last of the five sections of the Space Launch System (SLS) rocket core stage on Sept. 19. The stage will produce 2 million pounds of thrust to send Artemis I, the first flight of SLS and NASA's Orion spacecraft to the Moon. (NASA)

NASA commits to long-term Artemis missions with Orion production contract
(23 September 2019)
NASA is setting in motion the Orion spacecraft production line to support as many as 12 Artemis missions, including the mission that will carry the first woman and next man to the Moon by 2024. (NASA)

PULSARS

Pulsar emission map thanks to Einstein (5 September 2019)
Pulsars in binary systems are affected by relativistic effects, causing the spin axes of each pulsar to change their direction with time. A research team led by Gregory Desvignes from the Max Planck Institute for Radio Astronomy in Bonn, Germany, has used radio observations of the source PSR J1906+0746 to reconstruct the polarised emission over the pulsar's magnetic pole and to predict the disappearance of the detectable emission by 2028. Observations of this system confirm the validity of a 50-year old model that relates the pulsar's radiation to its geometry. The researchers are also able to precisely measure the rate of change in spin direction and find an excellent agreement with the predictions of Einstein's general theory of relativity. (Max Planck Institute for Radio Astronomy)

SATURN AND MOONS

New models suggest Titan lakes are explosion craters (9 September 2019)
Using radar data from NASA's Cassini spacecraft, recently published research presents a new scenario to explain why some methane-filled lakes on Saturn's moon Titan are surrounded by steep rims that reach hundreds of feet high. The models suggests that explosions of warming nitrogen created basins in the moon's crust. Titan is the only planetary body in our solar system other than Earth known to have stable liquid on its surface. But instead of water raining down from clouds and filling lakes and seas as on Earth, on Titan it's methane and ethane, hydrocarbons that we think of as gases but that behave as liquids in Titan's frigid climate. Most existing models that lay out the origin of Titan's lakes show liquid methane dissolving the moon's bedrock of ice and solid organic compounds, carving reservoirs that fill with the liquid. This may be the origin of a type of lake on Titan that has sharp boundaries.

On Earth, bodies of water that formed similarly, by dissolving surrounding limestone, are known as karstic lakes. The new, alternative models for some of the smaller lakes (tens of miles across) turns that theory upside down: It proposes pockets of liquid nitrogen in Titan's crust warmed, turning into explosive gas that blew out craters, which then filled with liquid methane. The new theory explains why some of the smaller lakes near Titan's north pole, like Winnipeg Lacus, appear in radar imaging to have very steep rims that tower above sea level, rims difficult to explain with the karstic model. (JPL)

SPACE

ESA spacecraft dodges large constellation (3 September 2019)
For the first time, ESA has performed a 'collision avoidance manoeuvre' to protect one of its spacecraft from colliding with a satellite in a large constellation. On Monday morning, the Agency's Aeolus Earth observation satellite fired its thrusters, moving it off a potential collision course with a SpaceX satellite in the Starlink constellation. Constellations are fleets of hundreds up to thousands of spacecraft working together in orbit. They are expected to become a defining part of Earth's space environment in the next few years. As the number of satellites in space dramatically increases, close approaches between two operated spacecraft will occur more frequently. Compared with such 'conjunctions' with space debris non-functional objects including dead satellites and fragments from past collisions these require coordination efforts, to avoid conflicting actions. Today, the avoidance process between two operational satellites is largely manual and ad hoc and will no longer be practical as the number of alerts rises with the increase in spaceflight. (ESA)

Space training, simulation and development facility opens in Colorado Springs
(17 September 2019)
Pulsar Guardian is a new, state-of-the art facility built by Lockheed Martin in Colorado Springs that lets the Air Force and others simulate, test and train in a multi-domain environment that reflects today's complex space environment. For the first time, warfighters can bring in any tool, from any company to simulate, test and train in a realistic synthetic space environment without disrupting real missions. Pulsar Guardian reflects a new way for space operators to evaluate new systems, changes to existing ones, or train on the platforms they use every day. Multi-Domain Operations require new, agile spaces that the military can use to integrate, synchronize and simulate battle conditions without interrupting present-day operations. Pulsar Guardian can simulate what an Air-Space-Integration looks like by showing how an unmanned aircraft or fighter jet could interface directly with a satellite and get the right data at the right time to act. Cyber-attacks and mitigations can be tested in a sandboxed, collaborative environment. (Lockheed Martin)

Virgin Galactic announces major milestone in manufacture of next spaceship
(17 September 2019)
Virgin Galactic announced today that it has mated the fuselage and cabin of its next spaceship to the completed wing assembly. In addition, the two tail booms have been mated to the spaceship's rear feather flap assembly. The completion of these two milestones brings assembly of the next SpaceShipTwo, planned to enter service after VSS Unity, a major step forward. (Virgin Galactic)

SLS Core Stage Pathfinder arrives at Kennedy(30 September 2019)
NASA's Pegasus Barge arrived at the agency's Kennedy Space Centre in Florida on Sept. 27, carrying the 212-foot-long core stage pathfinder for the Space Launch System (SLS) rocket. Weighing in at 228,000 pounds, the pathfinder is a full-scale mock-up of the rocket's core stage and will be used to validate ground support equipment and demonstrate it can be integrated with Kennedy facilities. NASA's Pegasus Barge made its way along the intercoastal waterway to its destination at the Kennedy Space Centre Launch Complex 39 turn basin wharf on Sept. 27, to make its first delivery to Kennedy in support of the agency's Artemis missions. After arriving at the Launch Complex 39 turn basin wharf, a docking area initially used during the Space Shuttle Program that has been modified to accommodate SLS hardware deliveries, the pathfinder was moved into the Vehicle Assembly Building (VAB) on Sept. 30, where it will remain for testing for about one month. (NASA Kennedy)

STARS AND STAR CLUSTERS

Most massive neutron star ever detected, almost too massive to exist (16 September 2019)
The researchers, members of the NANOGrav Physics Frontiers Centre, discovered that a rapidly rotating millisecond pulsar, called J0740+6620, is the most massive neutron star ever measured, packing 2.17 times the mass of our Sun into a sphere only 30 kilometres across. This measurement approaches the limits of how massive and compact a single object can become without crushing itself down into a black hole. Recent work involving gravitational waves observed from colliding neutron stars by LIGO suggests that 2.17 solar masses might be very near that limit. (Green Bank Observatory)

Tabby's Star: exomoon's slow annihilation could explain the dimming of the most mysterious star in the universe (16 September 2019)
The Columbia team suggests that Tabby's Star abducted an exomoon from a, now long-gone, nearby planet and pulled it into orbit around itself, where it has been getting torn apart by stronger stellar radiation than existed in its former orbit. Chunks of the exomoon's dusty outer layers of ice, gas, and carbonaceous rock have been able to withstand the radiation blow-out pressure that ejects smaller-grain dust clouds, and the volatile, large-grain material has inherited the exomoon's new orbit around Tabby's Star, where it forms a disk that persistently blocks the star's light. The opaqueness of the disk can change slowly, as smaller-grain clouds pass through and larger particles stuck in orbit move from the disk toward Tabby's Star, eventually getting so hot that they melt and fall onto the star's surface. Ultimately, after millions of years, the exomoon orbiting Tabby's Star will completely evaporate. (Columbia University)

SUN

Sandia experiments at temperature of sun offer solutions to solar model problems
(10 September 2019)
Experimenting at 4.1 million degrees Fahrenheit, physicists at Sandia National Laboratories' Z machine have found that an astronomical model, used for 40 years to predict the sun's behaviour as well as the life and death of stars, underestimates the energy blockage caused by free-floating iron atoms, a major player in those processes. The blockage effect, called

opacity, is an element's natural resistance to energy passing through it, like an opaque window's resistance to the passage of light. By observing real-world discrepancies between theory and experiments at Z, we were able to identify weaknesses in opacity figures inserted into solar models. The good news is that Sandia's experimental opacity measurements can help bloodlessly resolve a major discrepancy in how the widely used Standard Solar Model uses the composition of the sun to predict the behaviour of stars.
(Sandia National Laboratories)

TECHNOLOGY

JAXA and Ricoh jointly develop a compact spherical camera for use in outer space (28 August 2019)
The Japan Aerospace Exploration Agency (JAXA) and Ricoh Company, Ltd. (Ricoh), today announced that they have jointly developed a spherical camera that can be used in outer space (outside the spacecraft) to capture 360-degree spherical images in a single shot.
This camera will be used as to monitor the operation of the biaxial gimbal of the SOLISS (Small Optical Link for International Space Station)*1. It will be carried aboard the H-II Transfer Vehicle (HTV8) "KOUNOTORI-8", the cargo transporter to the International Space Station (ISS), which is scheduled for launch on September 11th, 2019. It will shoot spherical pictures and videos from the Exposed Facility of the Japanese Experiment Module (JEM) "Kibo" and send them to ground stations. This camera was developed from a consumer product and is the world's smallest 360-degree camera that can be used in outer space. In addition, it is the first time that this 360-degree camera based on a consumer product from Japanese company will take spherical images in outer space. (JAXA)

Relativity Space signs launch services agreement for multiple launches with Momentus on Terran 1, world's first 3D printed rocket (11 September 2019)
Relativity Space, the startup developing manufacturing technologies for entirely 3D printed rockets and space equipment, has signed its latest paying customer, the orbital transportation startup, Momentus. Relativity's Terran 1 rocket will carry Momentus' small and medium-sized satellite payloads on its rocket and Momentus will then move those satellites into geosynchronous orbit using its own in-space shuttle technology. The deal between Momentus and Relativity covers the first Terran 1 launch scheduled for 2021, with the option for five additional Relativity launches, according to a statement from the company. (Relativity Space)

TELESCOPES

eROSITA telescope first image (2 September 2019)
On August 27, 2019, the eROSITA telescope received the first X-Ray image from one of the seven modules of the German telescope installed on the Spektr-RG orbital observatory. The image of the extragalactic sky about one square degree in area shows dozens of X-Ray sources, mainly active galactic cores and quasars. The image is shown in the energy range 0.5-2 keV with the exposure duration about 2000 seconds. The Spektr-RG space observatory was injected into orbit by the Proton-M carrier rocket with the DM-03 booster on July 13, 2019. The observatory includes two unique X-Ray mirror telescopes ART-XC and eROSITA working on oblique incidence principle. The Russian ART-XC telescope has been watching the Milky Way galaxy centre. Now the spacecraft is 1,614 million kilometres away from Earth continuing its journey towards the L2 Sun – Earth system libration point with the arrival to the working orbit expected in the end of October 2019. (Roscosmos)

MeerKAT discovers giant radio bubbles at centre of Milky Way (11 September 2019)
An international team of astronomers using South Africa's MeerKAT radio telescope has discovered enormous balloon-like structures that tower hundreds of light-years above and below the centre of our galaxy. The impressive result is the first to come from observations using MeerKAT's full 64-dish array and reveals structures that have never been seen in such detail before. Operated by the South African Radio Astronomy Observatory (SARAO), MeerKAT is the world's biggest radio telescope and one of two SKA precursor instruments in South Africa. Despite only recently entering full survey operations, the telescope is already displaying its scientific prowess and providing new insights into activity at the centre of the Milky Way. The bubbles were caused by a phenomenally energetic burst that erupted near the Milky Way's supermassive black hole a few million years ago. Until now, they have been hidden by the glare of extremely bright radio emission from the centre of the galaxy. (SARAO)

Leading UK space organisations collaborate to develop self-aligning deployable space telescope (24 September 2019)
Three leading UK Space organisations, Surrey Satellite Technology Ltd (SSTL), the University of Oxford and the Surrey Space Centre (SSC), have been awarded National Space Technology Programme (NSTP) funding to develop a novel self-aligning deployable space telescope, designed for sub 1 metre ground sample imaging requirements in a small launch volume spacecraft. (SSTL)

Pat Williams September 2019