Space News Update – July 2019

By Pat Williams

IN THIS EDITION:

- ISRO's GSLV launches Chandrayaan-2 spacecraft.
- Fuelling of NASA's Mars 2020 rover power system begins.
- First of two Van Allen probes spacecraft ceases operations.
- A new plan for keeping NASA's oldest explorers going.
- Astronauts less likely to faint on earth if they exercise in space.
- NASA selects 12 new lunar science, technology investigations.
- Guidelines for the long-term sustainability of outer space activities of the committee on peaceful uses of outer space adopted.
- Links to other space and astronomy news published in July 2019.

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

ISRO'S GSLV LAUNCHES CHANDRAYAAN-2 SPACECRAFT

Chandrayaan-2 spacecraft. Credit: ISRO

India's Geosynchronous Satellite Launch Vehicle GSLV MkIII-M1, successfully launched the 3840 kg Chandrayaan-2 spacecraft into an earth orbit. The spacecraft is now revolving round the earth with a perigee (nearest point to Earth) of 169.7 km and an apogee (farthest point to Earth) of 45,475 km. Today's flight marks the first operational flight of the GSLV Mk III. This is the beginning of the historical journey of India towards Moon and to land at a place near south pole to carry out scientific experiments to explore the unexplored. The mission life of the Orbiter is one year, and it will be placed in a 100X100 km lunar polar orbit. (ISRO)

ISRO's GSLV launches Chandrayaan-2 spacecraft (22 July 2019)

FUELLING OF NASA'S MARS 2020 ROVER POWER SYSTEM BEGINS

Power for Mars 2020: The electricity for NASA's Mars 2020 rover is provided by a power system called a Multi-Mission Radioisotope Thermoelectric Generator, or MMRTG. The MMRTG will be inserted into the aft end of the rover between the panels with gold tubing visible at the rear, which are called heat exchangers. Image Credit: NASA/JPL-Caltech.

NASA has given the go-ahead to begin fuelling the Mars 2020 rover's Multi-Mission Radioisotope Thermoelectric Generator, or MMRTG. The generator will power the rover and help keep it warm while exploring the Red Planet. Essentially a nuclear battery, an MMRTG can provide about 110 watts of electrical power to a spacecraft and its science instruments at the beginning of a mission. The excess heat from the generator can also serve to keep spacecraft systems warm in cold environments. In all, 27 past U.S. space missions have used radioisotope power, from the Viking missions on Mars to the Voyager spacecraft entering interplanetary space to, most recently, the Curiosity rover on Mars and the New Horizons spacecraft that sailed past Pluto. MMRTGs work by converting heat from the natural decay of radioisotope materials into electricity. The generators consist of two major elements: a heat source that contains plutonium-238 (Pu-238) and thermocouples that convert the plutonium's decay heat energy to electricity. The process of loading the heat source into the MMRTG, which the Department of Energy (DOE) manufactured, is timed to a mission's launch date. Mars 2020 will launch from Cape Canaveral Air Force Station in Florida in July 2020 and land at Jezero Crater on Feb. 18, 2021. It will be the first spacecraft in the history of planetary exploration with the ability to accurately retarget its point of touchdown during the landing sequence; technology that could prove essential to future crewed missions to the Moon and Mars. (JPL)
Fuelling of NASA's Mars 2020 Rover power system begins (24 July 2019)

FIRST OF TWO VAN ALLEN PROBES SPACECRAFT CEASES OPERATIONS

Van Allen Probe. Credit: NASA

As expected, following final de-orbit manoeuvres in February of this year, the spacecraft has used its remaining propellant to keep its solar panels pointed at the Sun and is now out of

fuel. Since it depends on the Sun to provide power to the instruments, and can no longer orient itself to acquire power, the spacecraft has been turned off. The spacecraft is in a stable, circular orbit around Earth and, in about 15 years, will re-enter the atmosphere and burn up safely. The de-orbit manoeuvres in February were designed to ensure this would happen and prevent the spacecraft from becoming "space junk" in orbit. The other Van Allen Probes spacecraft, spacecraft A, is expected to operate normally until early September. Originally slated for a two-year mission, the Van Allen Probes launched on Aug. 30, 2012, and have gathered unprecedented data on Earth's two radiation belts, named for scientist James Van Allen, for nearly seven years. The Van Allen Probes were the first spacecraft designed to operate and gather scientific data for many years within the belts, a region around our planet that most spacecraft and astronaut missions try to minimize time in to avoid the damaging radiation. Before the Van Allen Probes, the most recent radiation belt-focused mission was the Combined Release and Radiation Effects Satellite, or CRRES, mission that operated from July 1990 to October 1991. The mission has made several major discoveries about how the radiation belts operate, including data showing, for the first time, the existence of a third radiation belt. (NASA Goddard)
First of two Van Allen Probes spacecraft ceases operations (23 July 2019)

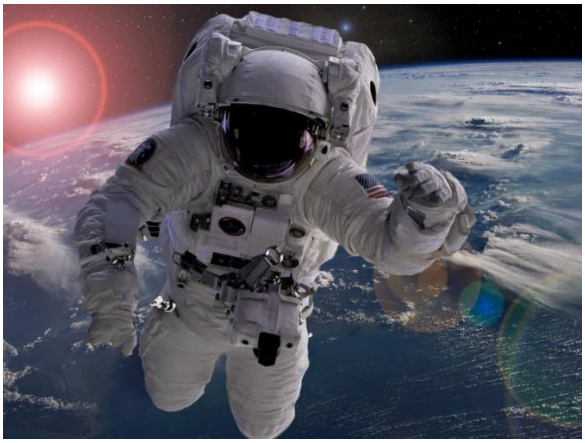
A NEW PLAN FOR KEEPING NASA'S OLDEST EXPLORERS GOING

This artist's concept depicts one of NASA's Voyager spacecraft, including the location of the cosmic ray subsystem (CRS) instrument. Both Voyagers launched with operating CRS instruments. Credits: NASA/JPL-Caltech

With careful planning and dashes of creativity, engineers have been able to keep NASA's Voyager 1 and 2 spacecraft flying for nearly 42 years, longer than any other spacecraft in history. To ensure that these vintage robots continue to return the best science data possible from the frontiers of space, mission engineers are implementing a new plan to manage them. And that involves making difficult choices, particularly about instruments and thrusters. One key issue is that both Voyagers, launched in 1977, have less and less power available over time to run their science instruments and the heaters that keep them warm in the coldness of deep space. Engineers have had to decide what parts get power and what parts have to be turned off on both spacecraft. But those decisions must be made sooner for Voyager 2 than Voyager 1 because Voyager 2 has one more science instrument collecting data and drawing power than its sibling.

UPDATED on July 12, 2019: Voyager 2 successfully fired up its trajectory correction manoeuvre thrusters on July 8, 2019 and will be using them to control the pointing of the spacecraft for the foreseeable future. Voyager 2 last used those thrusters during its encounter with Neptune in 1989. The spacecraft's aging attitude control thrusters have been experiencing degradation that required them to fire an increasing and untenable number of pulses to keep the spacecraft's antenna pointed at Earth. Voyager 1 switched to its trajectory correction manoeuvre thrusters for the same reason in January 2018. (JPL)
A new plan for keeping NASA's oldest explorers going (8 July 2019)

ASTRONAUTS LESS LIKELY TO FAINT ON EARTH IF THEY EXERCISE IN SPACE



(iStock/Getty Images Plus)

Space-travel might look like fun, but it turns out there's a price to pay for all that floating around without gravity: Astronauts often pass out when they return. But a new study shows exercising in space and receiving IV fluid after landing appears to alleviate the problem, and researchers say their findings have the potential to help people who never leave terra firma. The technical term for the issue is orthostatic hypotension. That's a temporary drop in blood pressure that comes when a person stands up and blood rushes to the feet, away from the brain. The related dizziness or fainting can occur after lengthy bed rest, among people with certain health disorders or, in the case of astronauts, being in a low-gravity environment. The longer the time in a gravity-free environment, the greater the risk. The study included 12 astronauts, eight men and four women, who spent about six months in space. All did endurance and resistance exercise training for up to two hours a day during spaceflight to prevent cardiovascular, bone and muscle deconditioning. They also received a saline infusion upon landing. The astronauts' blood pressure was recorded with every heartbeat over each 24-hour period before, during and after their time in space. The astronauts' blood pressure was steady, and none experienced dizziness or fainting during routine activities 24 hours after landing. (American Heart Association)
Astronauts less likely to faint on Earth if they exercise in space (19 July 2019)

NASA SELECTS 12 NEW LUNAR SCIENCE, TECHNOLOGY INVESTIGATIONS

Commercial landers will carry NASA-provided science and technology payloads to the lunar surface, paving the way for NASA astronauts to land on the Moon by 2024. Credits: NASA

NASA has selected 12 new science and technology payloads that will help us study the Moon and explore more of its surface as part of the agency's Artemis lunar program. These investigations and demonstrations will help the agency send astronauts to the Moon by 2024 as a way to prepare to send humans to Mars for the first time.

The 12 selected investigations are:
•MoonRanger is a small, fast-moving rover that has the capability to drive beyond communications range with a lander and then return to it. This will enable investigations within a 0.6-mile (1 kilometre) range from the lander. MoonRanger will aim to continually map the terrain it traverses and transmit data for future system improvement.
•Heimdall is a flexible camera system for conducting lunar science on commercial vehicles. This innovation includes a single digital video recorder and four cameras: a wide-angle descent imager, a narrow-angle regolith imager, and two wide-angle panoramic imagers. This camera system is intended to model the properties of the Moon's regolith – the soil and other material that makes up the top later of the lunar surface – and characterize and map geologic features, as well characterize potential landing or trafficability hazards, among other goals.
•Lunar Demonstration of a Reconfigurable, Radiation Tolerant Computer System aims to demonstrate a radiation-tolerant computing technology. Due to the Moon's lack of atmosphere and magnetic field, radiation from the Sun will be a challenge for electronics. This investigation also will characterize the radiation effects on the lunar surface.
•RAC will determine how lunar regolith sticks to a range of materials exposed to the Moon's environment at different phases of flight. Components of this experiment are derived from a commercial payload facility called MISSE currently on the International Space Station.
•The Lunar Magnetotelluric Sounder is designed to characterize the structure and composition of the Moon's mantle by studying electric and magnetic fields. The investigation will make use of a flight-spare magnetometer, a device that measures magnetic fields, originally made for the MAVEN spacecraft, which is currently orbiting Mars.
•LuSEE will integrate flight-spare and repurposed hardware from the NASA Parker Solar Probe FIELDS experiment, the STEREO/Waves instrument, and the MAVEN mission to make comprehensive measurements of electromagnetic phenomena on the surface of the Moon.
•LEXI will capture images of the interaction of Earth's magnetosphere with the flow of charged particles from the Sun, called the solar wind.

•NGLR will serve as a target for lasers on Earth to precisely measure the Earth-Moon distance. They are designed to provide data that could be used to constrain various aspects of the lunar interior and address questions of fundamental physics.
•L-CIRiS is targeted to deploy a radiometer, a device that measures infrared wavelengths of light, to explore the Moon's surface composition, map its surface temperature distribution, and demonstrate the instrument's feasibility for future lunar resource utilization activities.
•LISTER is an instrument designed to measure heat flow from the interior of the Moon. The probe will attempt to drill 7 to 10 feet (2 to 3 meters) into the lunar regolith to investigate the Moon's thermal properties at different depths.
•PlanetVac is a technology for acquiring and transferring lunar regolith from the surface to other instruments that would analyse the material or put it in a container that another spacecraft could return to Earth.
•SAMPLR is another sample acquisition technology that will make use of a robotic arm that is a flight spare from the Mars Exploration Rover mission, which included the long-lived rovers Spirit and Opportunity.
NASA's lunar exploration plans are based on a two-phase approach: the first is focused on speed; landing astronauts on the Moon by 2024; while the second will establish a sustained human presence on the Moon by 2028. The agency will use what we learn on the Moon to prepare for the next giant leap, sending astronauts to Mars. (NASA)
NASA selects 12 new lunar science, technology investigations (1 July 2019)

GUIDELINES FOR THE LONG-TERM SUSTAINABILITY OF OUTER SPACE ACTIVITIES OF THE COMMITTEE ON PEACEFUL USES OF OUTER SPACE ADOPTED

Credit: United Nations Office for Outer Space Affairs.

In June 2019, the Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space were adopted. The Guidelines provide

guidance on the policy and regulatory framework for space activities; safety of space operations; international cooperation, capacity-building and awareness; and scientific and technical research and development. The Committee encourages States and international intergovernmental organizations to voluntarily take measures to ensure that the guidelines are implemented to the greatest extent feasible and practicable. The Committee should also serve as the principal forum for continued institutionalized dialogue on issues related to the implementation and review of the guidelines. (UNOOSA)
Guidelines for the long-term sustainability of outer space activities of the Committee on Peaceful Uses of Outer Space adopted (21 June 2019)

LINKS TO OTHER SPACE NEWS PUBLISHED IN JULY 2019

ASTEROIDS

Small fragments of carbon-rich asteroids are too fragile to survive entry into Earth's atmosphere (15 July 2019)
Ryugu and other asteroids of the common 'C-class' consist of more porous material than was previously thought. Small fragments of their material are therefore too fragile to survive entry into the atmosphere in the event of a collision with Earth. This has revealed the long-suspected cause of the deficit of this meteorite type in finds on Earth. Researchers at the German Aerospace Centre (DLR) have come to this conclusion in a scientific paper published in the journal Nature Astronomy. The results are based on high-resolution measurements of the surface temperature with the DLR radiometer MARA on board the German-French Mobile Asteroid Surface Scout (MASCOT) lander. On 3 October 2018, as part of the Japanese Hayabusa2 mission, MASCOT descended onto the almost one-kilometre-diameter asteroid Ryugu and sent spectacular images and physical measurements from the surface back to Earth. On the asteroid, they observed only larger fragments that are highly porous and probably very fragile. Earlier telescopic infrared light curves of such carbon-rich asteroids acquired from Earth had been interpreted by researchers studying their thermal properties as bodies covered in sand- to pebble-sized particles. (DLR)

ASTROPHYSICS

NASA awards launch services contract for ground-breaking astrophysics mission
(8 July 2019)
NASA has selected SpaceX of Hawthorne, California, to provide launch services for the agency's Imaging X-Ray Polarimetry Explorer (IXPE) mission, which will allow astronomers to discover, for the first time, the hidden details of some of the most exotic astronomical objects in our universe. IXPE measures polarized X-rays from objects, such as black holes and neutron stars to better understand these types of cosmic phenomena and extreme environments. The IXPE mission currently is targeted to launch in April 2021 on a Falcon 9 rocket from Launch Complex 39A in Florida. IXPE will fly three space telescopes with sensitive detectors capable of measuring the polarization of cosmic X-rays, allowing

scientists to answer fundamental questions about these turbulent environments where gravitational, electric and magnetic fields are at their limits. (NASA)

BLACK HOLES

Hubble uncovers black hole disk that shouldn't exist (11 July 2019)
As if black holes weren't mysterious enough, astronomers using NASA's Hubble Space Telescope have found an unexpected thin disk of material furiously whirling around a supermassive black hole at the heart of the magnificent spiral galaxy NGC 3147, located 130 million light-years away. The conundrum is that the disk shouldn't be there, based on current astronomical theories. However, the unexpected presence of a disk so close to a black hole offers a unique opportunity to test Albert Einstein's theories of relativity. General relativity describes gravity as the curvature of space and special relativity describes the relationship between time and space. The type of disk seen is a scaled-down quasar that they did not expect to exist. It's the same type of disk seen in objects that are 1,000 or even 100,000 times more luminous. The predictions of current models for gas dynamics in very faint active galaxies clearly failed. (NASA Goddard)

How black holes shape galaxies (24 July 2019)
In a new study, scientists analysed eight years of XMM-Newton observations of the black hole at the core of an active galaxy known as PG 1114+445, showing how ultrafast winds – outflows of gas emitted from the accretion disk very close to the black hole – interact with the interstellar matter in central parts of the galaxy. These outflows have been spotted before, but the new study clearly identifies, for the first time, three phases of their interaction with the host galaxy. (ESA)

DARK MATTER

Light dark matter is a thousand times less likely to bump into regular matter than previous astrophysical analyses allowed(11 July 2019)
The researchers found that in order to make everything fit together, dark matter particles with relatively low mass must interact at least a thousand times more weakly with normal matter than the previous limit. (SLAC)

Scientists piece together the largest U.S.-based dark matter experiment (16 July 2019)
Most of the remaining components needed to fully assemble an underground dark matter-search experiment called LUX-ZEPLIN (LZ) arrived at the project's South Dakota home during a rush of deliveries in June. When complete, LZ will be the largest, most sensitive U.S.-based experiment yet that is designed to directly detect dark matter particles. Scientists around the world have been trying for decades to solve the mystery of dark matter, which makes up about 85 percent of all matter in the universe though we have so far only detected it indirectly through observed gravitational effects. The bulk of the digital components for LZ's electronics system, which is designed to transmit and record signals from ever-slight particle interactions in LZ's core detector vessel, were among the new arrivals at the Sanford Underground Research Facility (SURF). SURF, the site of a former gold mine now dedicated

to a broad spectrum of scientific research, was also home to a predecessor search experiment called LUX. (Berkeley Lab)

EARTH

EntrySat - first CubeSat dedicated to studying atmospheric re-entry of orbital debris (1 July 2019)
First CubeSat capable of analysing re-entry of orbital debris. Keeping proliferation of orbital debris in check is increasingly focusing attention as it poses a real long-term threat to space activities. To this end, researchers are thus seeking to gain deeper insight into the processes at work when a satellite breaks up on re-entering Earth's atmosphere.
It is with this precise goal in mind that a team of researchers at ISAE-SUPAERO, supported by CNES and ONERA, has designed EntrySat. The CubeSat will use position, pressure, temperature and heat flux sensors to study re-entry of orbital debris. Alongside this prime mission, EntrySat will also enable a range of technology experiments to test communications with the ground and measure the atmosphere's characteristics. Launched aboard a Cygnus cargo vehicle to the International Space Station (ISS) by an Antares NG-11 vehicle on 17 April from NASA's Wallops Flight Facility, Virginia, the satellite will be released into orbit on 3 July. (CNES)

New method can spot failing infrastructure from space (9 July 2019)
We rely on bridges to connect us to other places, and we trust that they're safe. While many governments invest heavily in inspection and maintenance programs, the number of bridges that are coming to the end of their design lives or that have significant structural damage can outpace the resources available to repair them. But infrastructure managers may soon have a new way to identify the structures most at risk of failure. Scientists have developed a new technique for analysing satellite data that can reveal subtle structural changes that may indicate a bridge is deteriorating, changes so subtle that they are not visible to the naked eye. (JPL)

NASA maps surface changes from California quakes (9 July 2019)
Damage from two strong earthquakes that rattled Southern California on July 4 and July 5 - a magnitude 6.4 and a magnitude 7.1, respectively - can be seen from space. The epicentre of the quakes was near the city of Ridgecrest, about 150 miles (241 kilometres) northeast of Los Angeles. According to the U.S. Geological Survey, the 7.1 quake was one of the largest to hit the region in some 40 years. The Advanced Rapid Imaging and Analysis (ARIA) team at NASA's Jet Propulsion Laboratory in Pasadena, California, used synthetic aperture radar (SAR) data from the ALOS-2 satellite to produce a map showing surface displacement from the earthquakes. The post-quake imagery was acquired on July 8, 2019, and compared with April 8, 2018, data from the same region. (JPL)

Orbiting Carbon Observatory-3 gets first data (12 July 2019)
NASA's Orbiting Carbon Observatory-3 (OCO-3), the agency's newest carbon dioxide-measuring mission to launch into space, has seen the light. From its perch on the International Space Station, OCO-3 captured its first glimpses of sunlight reflected by Earth's surface on June 25, 2019. Just weeks later, the OCO-3 team was able to make its first determinations of

carbon dioxide and solar-induced fluorescence, the "glow" that plants emit from photosynthesis, a process that includes the capture of carbon from the atmosphere. (NASA)

European Galileo satellite navigation system resumes Initial Services (19 July 2019)
The Initial Services provided by the European satellite navigation system – Galileo – have been successfully restored. Galileo was affected by a technical incident related to its ground infrastructure. This event led to a temporary interruption of the globally available Galileo navigation and timing services, with the exception of the Galileo Search and Rescue Service. The Search and Rescue Service, which is used to locate and assist people in emergency situations, for example, at sea or in remote, mountainous areas, was not affected and remained operational. The navigation service impact was caused by a malfunction of some equipment in the Galileo control centres, which generate the system time and calculate orbit predictions; these data are used to produce the navigation messages. The disruption affected various elements at the control centres in Fucino (Italy) and at the DLR site in Oberpfaffenhofen. (DLR)

Expanding our knowledge of Arctic Ocean bathymetry (24 July 2019)
The surface of the ocean is not flat. Because of gravitational pull, the height of the ocean surface mimics the rise and fall of the ocean floor. Areas of greater mass such as underwater mountains have a higher gravity and therefore attract more water creating a rise in the sea surface. Fine-tuning the relationship between bathymetry and gravity in the Arctic Ocean has enabled scientists to calculate sea-floor bathymetry from satellite gravity measurements. (ESA)

Airbus brings a SMILE to ESA (30 July 2019)
Airbus has been selected by the European Space Agency to build the European component of the SMILE satellite (Solar wind Magnetosphere Ionosphere Link Explorer). SMILE will be the first joint satellite mission between the European Space Agency (ESA) and the Chinese Academy of Sciences (CAS), following on from the success of the Double Star / Tan Ce mission which flew between 2003 and 2008. The objective of SMILE is to study and understand space weather. Specifically, it will look at the physics behind continuous interaction between particles in the solar wind and Earth's magnetosphere, the magnetic shield that protects the existence of life in our planet.(Airbus)

EXOPLANETS

Atmosphere of midsize planet revealed by Hubble, Spitzer (2 July 2019)
Fortuitously, the atmosphere of GJ 3470 b turned out to be mostly clear, with only thin hazes, enabling the scientists to probe deep into the atmosphere. They expected an atmosphere strongly enriched in heavier elements like oxygen and carbon which are forming abundant water vapor and methane gas, similar to what we see on Neptune. Instead, they found an atmosphere that is so poor in heavy elements that its composition resembles the hydrogen/helium-rich composition of the Sun. (JPL)

'Moon-forming' circumplanetary disk discovered in distant star system (11 July 2019)
Astronomers using the Atacama Large Millimeter/submillimeter Array (ALMA) have made

the first-ever observations of a circumplanetary disk, the planet-girding belt of dust and gas that astronomers strongly theorize controls the formation of planets and gives rise to an entire system of moons, like those found around Jupiter. This never-before-seen feature was discovered around one of the planets in PDS 70, a young star located approximately 370 light-years from Earth. Recently, astronomers confirmed the presence of two massive, Jupiter-like planets there. This earlier discovery was made with the European Southern Observatory's Very Large Telescope (VLT), which detected the warm glow naturally emitted by hydrogen gas accreting onto the planets. The new ALMA observations instead image the faint radio waves given off by the tiny (about one tenth of a millimetre across) particles of dust around the star. The ALMA data, combined with the earlier optical and infrared VLT observations, provide compelling evidence that a dusty disk capable of forming multiple moons surrounds the outermost known planet in the system. (NRAO)

Astronomers make first calculations of magnetic activity in 'hot Jupiter' exoplanets (22 July 2019)
The magnetic field strengths the team found range from 20 to 120 gauss. For comparison, Jupiter's magnetic field is 4.3 gauss and Earth's field strength is only half a gauss, although that is strong enough to orient compasses worldwide. (Arizona State University)

FAST RADIO BURSTS

Fast radio burst pinpointed to distant galaxy (2 July 2019)
Fast radio bursts (FRBs) are among the most enigmatic and powerful events in the cosmos. Around 80 of these events, intensely bright millisecond-long bursts of radio waves coming from beyond our galaxy, have been witnessed so far, but their causes remain unknown. In a rare feat, researchers at Caltech's Owens Valley Radio Observatory (OVRO) have now caught a new burst, called FRB 190523, and, together with the W. M. Keck Observatory in Hawaii, have pinpointed its origins to a galaxy 7.9 billion light-years away. Identifying the galaxies from which these radio bursts erupt is a critical step toward solving the mystery of what triggers them. (Caltech)

GALAXIES

Early days of the Milky Way revealed (22 July 2019)
Thirteen thousand million years ago stars began to form in two different stellar systems which then merged: one was a dwarf galaxy which we call Gaia-Enceladus, and the other was the main progenitor of our Galaxy, some four times more massive and with a larger proportion of metals. Some ten thousand million years ago there was a violent collision between the more massive system and Gaia-Enceladus. As a result some of its stars, and those of Gaia-Enceladus were set into chaotic motion, and eventually formed the halo of the present Milky Way. After that there were violent bursts of star formation until 6,000 million years ago, when the gas settled into the disc of the Galaxy and produced what we know as the "thin disc". (Instituto de Astrofísica de Canarias)

Astronomers map vast void in our cosmic neighbourhood (22 July 2019)
For 30 years, astronomers have been trying to identify why the motions of the Milky Way, our nearest large galaxy neighbour Andromeda, and their smaller neighbours deviate from the overall expansion of the Universe by over 600 km/s (1.3 million mph). The new study shows that roughly half of this motion is generated "locally" from the combination of a pull from the massive nearby Virgo Cluster and our participation in the expansion of the Local Void as it becomes ever emptier. (Institute for Astronomy, University of Hawaii)

GRAVITATIONAL WAVES

Fastest eclipsing binary, a valuable target for gravitational wave studies (24 July 2019)
Observations made with a new instrument developed for use at the 2.1-meter (84-inch) telescope at the National Science Foundation's Kitt Peak National Observatory have led to the discovery of the fastest eclipsing white dwarf binary yet known. Clocking in with an orbital period of only 6.91 minutes, the rapidly orbiting stars are expected to be one of the strongest sources of gravitational waves detectable with LISA, the future space-based gravitational wave detector. After expanding into a red giant at the end of its life, a star like the Sun will eventually evolve into a dense white dwarf, an object with a mass like that of the Sun squashed down to a size comparable to Earth. Similarly, as binary stars evolve, they can engulf their companion in the red giant phase and spiral close together, eventually leaving behind a close white dwarf binary. White dwarf binaries with very tight orbits are expected to be strong sources of gravitational wave radiation. Although anticipated to be relatively common, such systems have proven elusive, with only a few identified to date. (NOAO)

HUMAN SPACEFLIGHT

Virgin Galactic and Social Capital Hedosophia announce merger (9 July 2019)
Virgin Galactic and Social Capital Hedosophia Announce Merger to Create the World's First and Only Publicly Traded Commercial Human Spaceflight Company. (Virgin Galactic)

INTERNATIONAL SPACE STATION

RUBI – Full steam ahead for the ISS (2 July 2019)
The next supply mission (CRS-18) to be launched from Cape Canaveral, Florida, will transport a special 'steam engine' to the International Space Station (ISS). RUBI (Reference mUltiscale Boiling Investigation), a fluid science experiment developed and built by Airbus for the European Space Agency (ESA), addresses the fundamentals of the boiling of fluids. ESA astronaut Luca Parmitano is set to install RUBI in the Columbus module of the ISS during his five-month 'Beyond' mission (from July to December 2019). The fluid experiment will then be operated and controlled by the Belgian User Support and Operation Centre (B-USOC) in Brussels. (Airbus)

Spaceflight to launch multiple spacecraft from International Space Station via Cygnus (10 July 2019)
The Cygnus vehicle is already docked at the ISS, following its launch on April 17, 2019 and

landing on April 19, 2019. During the weeks following the arrival of the Dragon capsule in late July which will carry the rideshare customers' spacecraft, the ISS crew will transfer the cargo from the Dragon to the ISS, where they will place the SEOPS SlingShot Deployer with the installed satellites into the SlingShot hardware attached to the Cygnus hatch bulkhead. After the ISS side-hatch is closed and the space between the ISS and Cygnus spacecraft depressurized, the ISS robotic arm will unberth the Cygnus from the ISS. Cygnus will then manoeuvre itself to a higher orbit (450-500 km altitude, 51.6-degree inclination) to deploy the satellites and conduct more tests. (Spaceflight)

SpaceX's Cargo Dragon to deliver new space station docking adapter for commercial crew spacecraft (12 July 2019)
A new International Docking Adapter, called IDA-3, is scheduled to arrive at the International Space Station this July aboard SpaceX's 18th cargo resupply mission to the microgravity laboratory. When installed on the space station, the one-of-a-kind outpost will have two common ports enabling expanded opportunities for visiting vehicles, including new spacecraft designed to carry humans for NASA's Commercial Crew Program.
(NASA Kennedy)

NASA astronaut Andrew Morgan, crewmates arrive at space station on 50th anniversary of Moon landing (20 July 2019)
Fifty years to the day that astronauts Neil Armstrong and Buzz Aldrin stepped on the Moon in a giant leap for humanity, NASA astronaut Andrew Morgan and two fellow crew members arrived Saturday for their mission aboard the International Space Station, where humans have lived and worked continuously for more than 18 years. The Expedition 60 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)

SpaceX Dragon en route to Space Station with NASA science, cargo (25 July 2019)
A SpaceX Dragon cargo spacecraft is on its way to deliver the second commercial crew docking port and about 5,000 pounds of science investigations and supplies for the International Space Station. The spacecraft launched on a Falcon 9 rocket from Space Launch Complex 40 at Cape Canaveral Air Force Station and is scheduled to arrive at the orbiting laboratory Saturday, July 27. Dragon will join three other spacecraft currently at the space station. (NASA)

NanoRacks flies science mission for first Emirati astronaut, commercial, educational customers on SpaceX ISS launch (29 July 2019)
The 18th cargo resupply mission to the International Space Station from SpaceX delivered a historic mission for NanoRacks. NanoRacks, the leading provider of commercial access to low-Earth orbit, transported the materials for the science experiments that will be conducted by the first Emirati astronaut upon his arrival to the International Space Station (ISS) in late September 2019. NanoRacks also launched the first-ever microgravity experiment from Young Living, the world-leader in essential oils, amongst other educational research. In April

2019, NanoRacks announced an agreement with the Mohammed bin Rashid Space Centre (MBRSC) to empower and encourage youth in the United Arab Emirates (UAE) to take an interest in space science. In coordination with NanoRacks, MBRSC launched the 'Science in Space' competition, an initiative under the umbrella of the UAE Astronaut Program, where schools were able to apply to participate in conducting scientific experiments to study the impact of microgravity. (NanoRacks)

LAUNCH SERVICES

Successful Orion Crew Capsule abort test (2 July 2019)
NASA successfully demonstrated the Orion spacecraft's launch abort system can outrun a speeding rocket and pull astronauts to safety during an emergency during launch. The test is another milestone in the agency's preparation for Artemis missions to the Moon that will lead to astronaut missions to Mars. (NASA)

MANNED SPACE

Virgin Orbit completes key drop test ahead of orbital test flight (10 July 2019)
Virgin Orbit, Sir Richard Branson's small satellite launch company, announced that it has successfully completed a key drop test of its LauncherOne vehicle, the last major step in the development program of the company's novel launch service. In the run-up to its first space shot, Virgin Orbit has completed a steady progression of test flights with its "flying launch pad" Cosmic Girl and LauncherOne vehicle, and today's achievement marks the beginning of the company's transition to its orbital test flight launch campaign. (Virgin Orbit)

MARS

InSight uncovers the 'Mole' (1 July 2019)
Behold the "mole": The heat-sensing spike that NASA's InSight lander deployed on the Martian surface is now visible. Last week, the spacecraft's robotic arm successfully removed the support structure of the mole, which has been unable to dig, and placed it to the side. Getting the structure out of the way gives the mission team a view of the mole — and maybe a way to help it dig. (JPL)

Landing the Mars 2020 Rover (1 July 2019)
The Mars 2020 mission is facing the most challenging landing yet on the Red Planet. It will touch down on Feb. 18, 2021, in Jezero Crater, a 28-mile-wide (45-kilometer-wide) expanse full of steep cliffs, boulder fields and other things that could boobytrap the landing. A new technology called Terrain Relative Navigation (TRN) will allow the spacecraft to avoid hazards autonomously. It's the closest thing to having an astronaut piloting the spacecraft, and the technology will benefit future robotic and human exploration of Mars. (JPL)

MOON

Astrobotic to deliver autonomous Moon rover (1 July 2019)
Astrobotic was selected today by NASA's Lunar Surface and Instrumentation and

Technology Payload (LSITP) program to develop an autonomous lunar rover with its partner, Carnegie Mellon University. The 13 kilogram autonomous rover known as MoonRanger, is being developed to provide high fidelity 3D maps of the Moon's surface in areas such as polar regions and lunar pits. It will demonstrate transformational high-speed, long-range, communication-denied autonomous lunar exploration. (Astrobotic)

Third European service module for Orion to ferry astronauts on Moon landing (17 July 2019)
NASA and ESA have a long term plan for Europe to deliver the European Service Modules for Orion. With NASA's announcement to bring humans back to the lunar surface before the end of 2024, it was also decided that the third ESA-provided European Service Module will contribute to this mission. The Artemis-3 mission is slated to launch on NASA's Space Launch System in 2024 and will send up to four astronauts on board Orion to a lunar orbit where the spacecraft will dock at the planned Gateway. From there, two of the astronauts will board a lander to ride down to south pole of the Moon. ESA has already supplied the first European Service Module that is being connected to Orion's Crew Module this month. The second module is being built in Bremen, Germany, for shipment next year to USA. (ESA)

Angelic halo orbit chosen for humankind's first lunar outpost (18 July 2019)
Mission planners at NASA and ESA's Operations Centre (ESOC) have spent months debating the pros and cons of different orbits and have now decided on the path of the lunar Gateway. Like the International Space Station, the Gateway will be a permanent and changeable human outpost. Instead of circling our planet however, it will orbit the Moon, acting as a base for astronauts and robots exploring the lunar surface. Like a mountain refuge, it will also provide shelter and a place to stock up on supplies for astronauts en route to more distant destinations, as well as providing a place to relay communications and a laboratory for scientific research. Instead of orbiting around the Moon in a low lunar orbit like Apollo, the Gateway will follow a highly 'eccentric' path. At is closest, it will pass 3000 km from the lunar surface and at its furthest, 70 000 km. The orbit will rotate together with the moon, and as seen from the Earth will appear a little like a lunar halo. (ESA)

Inside dark, polar Moon craters, water not as invincible as expected (23 July 2019)
The Moon's south pole region is home to some of the most extreme environments in the solar system: it's unimaginably cold, massively cratered, and has areas that are either constantly bathed in sunlight or in darkness. This is precisely why NASA wants to send astronauts there in 2024 as part of its Artemis program. The most enticing feature of this southernmost region is the craters, some of which never see the light of day reach their floors. The reason for this is the low angle of sunlight striking the surface at the poles. To a person standing at the lunar south pole, the Sun would appear on the horizon, illuminating the surface sideways, and, thus, skimming primarily the rims of some craters while leaving their deep interiors in shadow. As a result of the permanent darkness, NASA's Lunar Reconnaissance Orbiter (LRO) has measured the coldest temperatures in the solar system inside these craters, which have become known as perfect environments for preserving material like water for eons. Or so we thought. It turns out that despite temperature that dips to -388 degrees Fahrenheit (-233 Celsius) and can presumably keep frost locked in soil virtually forever, water is slowly escaping the topmost, super thin layer (thinner than the width of a red blood cell) of the Moon's surface. People think of some areas in these polar craters as trapping water and that's

it. But there are solar wind particles and meteoroids hitting the surface, and they can drive reactions that typically occur at warmer surface temperatures. That's something that's not been emphasized. (NASA Goddard)

SATELLITES

Space weather causes years of radiation damage to satellites using electric propulsion (1 July 2019)
The study concludes that after a radiation storm, maximum solar cell output power could be reduced by up to 8% by the time satellites reach their target destination using electric orbit raising. This is equivalent to the level of damage that would be expected after spending around 15 years at geostationary orbit. During a radiation storm, charged particles released by the Sun become trapped within Earth's magnetic field, forming the Van Allen radiation belts which encircle Earth, and collisions with these charged particles causes damage to the solar cells. This degradation is up to 8% of output power in a worst-case scenario, but even in a quiet environment, the study predicts a 1-3% reduction in output.
(Royal Astronomical Society)

Maintaining large-scale satellite constellations using logistics approach (11 July 2019)
Today, large-scale communication satellite constellations, also known as megaconstellations, have been more and more popular. OneWeb launched the first batch of satellites of an initial 650-satellite constellation in February 2019, and SpaceX also launched the first batch of its 12,000-satellite constellation in May 2019. On July 8, Amazon also filed an application with the FCC for its planned satellite constellation with 3,236 satellites. These satellite constellations are expected to be a game changer by realizing the worldwide satellite Internet service. However, the unprecedently large scale of these megaconstellations also brings numerous challenges, some of which are hidden and not well-explored. Researchers at the University of Illinois at Urbana-Champaign identified a critical hidden challenge about replacing the broken satellites in megaconstellations and proposed a unique solution with inventory control methods. ~~(University of Illinois at Urbana-Champaign)~~

LightSail 2 spacecraft successfully demonstrates flight by light (31 July 2019)
Years of computer simulations. Countless ground tests. They've all led up to now. The Planetary Society's crowdfunded LightSail 2 spacecraft is successfully raising its orbit solely on the power of sunlight. Since unfurling the spacecraft's silver solar sail last week, mission managers have been optimizing the way the spacecraft orients itself during solar sailing. After a few tweaks, LightSail 2 began raising its orbit around the Earth. In the past 4 days, the spacecraft has raised its orbital high point, or apogee, by about 2 kilometres. The mission team has confirmed the apogee increase can only be attributed to solar sailing, meaning LightSail 2 has successfully completed its primary goal of demonstrating flight by light for CubeSats. (Planetary Society)

SATURN AND MOONS

Cassini explores ring-like formations around Titan's lakes (17 July 2019)
Using observations from the international Cassini spacecraft, scientists have explored the

ring-like mounds that wrap around some of the pools found at the poles of Saturn's largest moon, Titan. The study reveals more about how these features formed. The new study suggests two possible mechanisms in which such ramparts may be created: either a process involving a subsurface that is saturated with groundwater, given the differences in elevation between the empty lake floors and the filled lakes, or one in which the basin of and crust surrounding a lake first harden and then deflate, leading the lake to percolate down into the subsurface, and leaving a region of the lake basin protruding above the surrounding terrain to form a rampart. (ESA)

STARS AND STAR CLUSTERS

Gaia's biggest operation since launch and commissioning (15 July 2019)
On Tuesday 16 July, teams at ESA's mission control will perform an 'orbit change manoeuvre' on the Gaia space observatory – the biggest operation since the spacecraft was launched in 2013. Placing Gaia at L2 has ensured the star-catcher's stability, because to this day it has never passed into Earth's shadow. This has kept the spacecraft undisturbed by any change in temperature or varying infra-red radiation that would result from an Earth eclipse. Although at the end of its planned lifetime, Gaia still has fuel in the tank and a lot more science to do, and so its mission continues. However, its eclipse-dodging path will not. In August and November of this year, without measures to change its orbit, the billion-star hunter will become partially shrouded by Earth's shadow. These two eclipses would prevent sufficient sunlight from reaching Gaia's solar panels that the observatory would shut down. As well as affecting its stability and power, such shade would cause a thermal disturbance, affecting the spacecraft's scientific data acquisition for weeks. To keep Gaia safe from these shady possibilities, operators at ESA's mission control are planning the 'Whitehead eclipse avoidance manoeuvre'. (ESA)

Production sites of stars are rare (24 July 2019)
Astronomers using the Nobeyama Radio Observatory (NRO) 45-m telescope found that high-density gas, the material for stars, accounts for only 3% of the total mass of gas distributed in the Milky Way. This result provides key information for understanding the unexpectedly low production rate of stars. Stars are born in gas clouds. The high-density gas pockets form in the extended, low-density gas clouds, and stars form in the very dense gas cores which evolve within the high-density gas. However, observations of distant galaxies detected 1000 times fewer stars than the production value expected from the total amount of low-density gas. To interpret the discrepancy, observations which detect both the high-density and low-density gas with high-spatial resolution and wide area coverage were needed. However, such observations are difficult, because the high-density gas structures are dozens of times smaller than the low-density gas structures. The Milky Way survey project "FUGIN" conducted using the NRO 45-m telescope and the multi-beam receiver FOREST overcame these difficulties. NAOJ team analyzed the big data obtained in the FUGIN project and measured the accurate masses of the low-density and high-density gas for a large span of 20,000 light-years along the Milky Way. They revealed for the first time that the high-density gas accounts for only 3% of the total gas. These results imply the production rate of high-density gas in the low-density gas clouds is small, creating only a small number of opportunities to

form stars. The researcher team will continue working on the FUGIN data to investigate the cause of inefficient formation of the high-density gas. (NAOJ)

SUN

Terminators' on the Sun trigger plasma tsunamis and the start of new solar cycles
(24 July 2019)
In a pair of new papers, scientists paint a picture of how solar cycles suddenly die, potentially causing tsunamis of plasma to race through the Sun's interior and trigger the birth of the next sunspot cycle only a few short weeks later. The new findings provide insight into the mysterious timing of sunspot cycles, which are marked by the waxing and waning of sunspot activity on the solar surface. While scientists have long known that these cycles last approximately 11 years, predicting when one cycle ends and the next begins has been challenging to pin down with any accuracy. The new research could change that. In one of the studies, which relies on nearly 140 years of solar observations from the ground and space, the scientists are able to identify "terminator" events that clearly mark the end of a sunspot cycle. With an understanding of what to look for in the run up to these terminators, the authors predict that the current solar cycle (Solar Cycle 24) will end in the first half of 2020, kicking off the growth of Solar Cycle 25 very shortly after.
(University Corporation for Atmospheric Research)

TECHNOLOGY

Jumping space robot 'flies' like a spacecraft (4 July 2019)
Astronauts on the Moon found themselves hopping around, rather than simply walking. Switzerland's SpaceBok planetary exploration robot has followed their example, launching all four legs off the ground during tests at ESA's technical heart. Instead of static walking, where at least three legs stay on the ground at all times, dynamic walking allows for gaits with full flight phases during which all legs stay off the ground. Animals make use of dynamic gaits due to their efficiency, but until recently, the computational power and algorithms required for control made it challenging to realise them on robots. For the lower gravity environments of the Moon, Mars or asteroids, jumping off the ground like this turns out to be a very efficient way to get around. (ESA)

SLS rocket testing ensures astronaut safety, mission success (9 July 2019)
SLS, the agency's first rocket built to send humans to deep space since the Saturn V, will have the power to take astronauts forward to the Moon and ultimately to Mars. Testing the new, increasingly complex pieces of hardware for the first flight of SLS and NASA's Orion spacecraft is critical to the success not only of the first mission but to future missions, especially for the core stage that is used on all configurations of the rocket. (NASA)

Ball Aerospace successfully commissions small satellite, begins on-orbit testing of green fuel
(5 July 2019)
Ball designed and built the small satellite, which contains NASA's first opportunity to demonstrate the practical capabilities of a "green" propellant and propulsion system in orbit, an alternative to conventional chemical propulsion systems. The propellant, called AF-

M315E, is a Hydroxyl Ammonium Nitrate fuel and oxidizer monopropellant developed by the Air Force Research Laboratory. (Ball Aerospace)

For climbing robots, the sky's the limit (10 July 2019)
Robots can drive on the plains and craters of Mars, but what if we could explore cliffs, polar caps and other hard-to-reach places on the Red Planet and beyond? Designed by engineers at NASA's Jet Propulsion Laboratory in Pasadena, California, a four-limbed robot named LEMUR (Limbed Excursion Mechanical Utility Robot) can scale rock walls, gripping with hundreds of tiny fishhooks in each of its 16 fingers and using artificial intelligence (AI) to find its way around obstacles. In its last field test in Death Valley, California, in early 2019, LEMUR chose a route up a cliff while scanning the rock for ancient fossils from the sea that once filled the area. (JPL)

NASA funds demo of 3D-printed spacecraft parts made, assembled in orbit (12 July 2019)
NASA has awarded a $73.7 million contract to Made In Space, Inc. of Mountain View, California, to demonstrate the ability of a small spacecraft, called Archinaut One, to manufacture and assemble spacecraft components in low-Earth orbit. The in-space robotic manufacturing and assembly technologies could be important for America's Moon to Mars exploration approach. The contract is the start of the second phase of a partnership established through NASA's Tipping Point solicitation. The public-private partnership combines NASA resources with an industry contribution of at least 25% of the program costs, shepherding the development of critical space technologies while also saving the agency, and American taxpayers, money. Archinaut One is expected to launch on a Rocket Lab Electron rocket from New Zealand no earlier than 2022. Once it's positioned in low-Earth orbit, the spacecraft will 3D-print two beams that extend 32 feet (10 meters) out from each side of the spacecraft. As manufacturing progresses, each beam will unfurl two solar arrays that generate as much as five times more power than traditional solar panels on spacecraft of similar size. (NASA)

Northrop Grumman to demonstrate robotic manufacturing in space (16 July 2019)
The objective of Archinaut's flight demonstration mission is to construct two 10 meter solar arrays, on orbit, to power a small satellite. The Archinaut system will be integrated into an ESPA class satellite bus and launched into space. Once on orbit, Archinaut will employ its extended structure additive manufacturing capabilities and advanced robotics to manufacture and assemble the satellite's power generation system. The Archinaut-created solar array will yield nearly five times the power currently available to ESPA-class satellites.
(Northrop Grumman)

Ariane 6 Vulcain engine: successful qualification testing (18 July 2019)
Completion of the Vulcain 2.1 engine qualification tests is a major step forward in the development of Ariane 6. Following the qualification of the Vinci engine last year, all the Ariane 6 liquid propulsion engines have now completed their qualification firing tests. The last step in the qualification of the Ariane 6 engines will be that of the solid fuel side booster. Its third and final firing will take place in French Guiana at the beginning of 2020.
(ArianeGroup)

Olis Robotics and Tethers Unlimited launch development of new remotely operated "smart" robots for space stations (22 July 2019)
Two space tech companies that are headquartered in the Seattle area, Olis Robotics and Tethers Unlimited, are joining forces to create a new kind of remote-controlled robotic system that could be used on the International Space Station or other off-Earth outposts. (Olis Robotics)

NASA's new lightweight X-ray mirrors ready for try-outs in space (29 July 2019)
Recent testing has shown that super-thin, lightweight X-ray mirrors made of a material commonly used to make computer chips can meet the stringent imaging requirements of next-generation X-ray observatories. As a result, the X-ray mirror technology being developed at NASA's Goddard Space Flight Centre has been baselined for the Design Reference Mission of the conceptual Lynx X-ray Observatory, one of four potential missions that scientists have vetted as worthy pursuits under the 2020 Decadal Survey for Astrophysics. (NASA Goddard)

NASA announces US industry partnerships to advance Moon, Mars technology
(30 July 2019)
As NASA prepares to land humans on the Moon by 2024 with the Artemis program, commercial companies are developing new technologies, working toward space ventures of their own, and looking to NASA for assistance. NASA has selected 13 U.S. companies for 19 partnerships to mature industry-developed space technologies and help maintain American leadership in space. NASA centres will partner with the companies, which range from small businesses with fewer than a dozen employees to large aerospace organizations, to provide expertise, facilities, hardware and software at no cost. The partnerships will advance the commercial space sector and help bring new capabilities to market that could benefit future NASA missions.

- Advanced Communications, Navigation and Avionics
- Advanced Materials
- Entry, Descent and Landing
- In-Space Manufacturing and Assembly
- Power
- Propulsion
- Other Exploration Technologies
  (NASA)

TELESCOPES

SCISYS selected as partner for ESO's Extremely Large Telescope programme (1 July 2019)
With a 39-metre main mirror ESO's Extremely Large Telescope (ELT) will be the largest optical/near-infrared telescope on earth. The company will provide the Data Display Tool, allowing the visualisation of data received by detector systems and other applications during astronomical observations or engineering activities in pseudo real-time. With the DDT SCISYS delivers a subsystem for the ELT's ICT (Instrument Control System) Framework to help revealing previously unknown areas of the universe. (SCISYS)

STScI to design science operations for new panoramic space telescope (2 July 2019)
NASA has awarded a contract to the Space Telescope Science Institute (STScI) in Baltimore, Maryland, for the Science Operations Centre (SOC) of the Wide Field Infrared Survey Telescope (WFIRST) mission. WFIRST is a NASA observatory designed to settle essential questions in a wide-range of science areas, including dark energy and dark matter, and planets outside our solar system. WFIRST was ranked as the highest scientific priority for a large space astrophysics mission in the Decadal Survey conducted by the National Research Council in 2010. The launch of WFIRST is planned for the mid-2020s. To be located one million miles beyond Earth, WFIRST's prime mission will last for five years. (NASA)

Spectrum X-Gamma rockets into space with X-ray vision (15 July 2019)
The Russian State Space Corporation Roscosmos launched the world's newest set of X-ray eyes to the cosmos, designed for exploring fundamental questions about the universe's past, present and future. On board is a very sensitive set of mirrors made by NASA for finding black holes. Its destination is a special gravitational "parking spot" called the second Lagrangian point, about 930,000 miles (1.5 million kilometres) from Earth. The mission is known as SRG because of its German name, Spektrum-Roentgen-Gamma. The SRG is an international high-energy astrophysics observatory. NASA team members will play an important role in data processing and making scientific data available to collaborators for analysis. The observatory is designed to scan the whole sky every six months over a four-year period and collect X-ray signals from countless celestial objects and phenomena. Astronomers will use these data to map the observable X-ray universe in more detail than ever before. The enhanced all-sky survey will answer questions about cosmic mysteries such as dark matter and dark energy, the physics of black holes, and the evolution of the universe as we know it. (NASA Marshall)

UNIVERSE

New method may resolve difficulty in measuring universe's expansion (8 July 2019)
Astronomers using National Science Foundation (NSF) radio telescopes have demonstrated how a combination of gravitational-wave and radio observations, along with theoretical modelling, can turn the mergers of pairs of neutron stars into a "cosmic ruler" capable of measuring the expansion of the Universe and resolving an outstanding question over its rate. (NRAO)

New Hubble Constant measurement adds to mystery of universe's expansion rate
(16 July 2019)
The team announced a new measurement of the Hubble constant using a kind of star known as a red giant. Their new observations, made using Hubble, indicate that the expansion rate for the nearby universe is just under 70 kilometres per second per megaparsec (km/sec/Mpc). One parsec is equivalent to 3.26 light-years distance. This measurement is slightly smaller than the value of 74 km/sec/Mpc recently reported by the Hubble SH0ES (Supernovae H0 for the Equation of State) team using Cepheid variables, which are stars that pulse at regular intervals that correspond to their peak brightness. (STScI)

Pat Williams July 2019