Space News Update – June 2018

By Pat Williams

IN THIS EDITION:

- **Hayabusa2 and Mascot arrive at asteroid Ryugu.**
- **ESA Council endorses transition from Ariane 5 to Ariane 6.**
- **Interstellar asteroid is really a comet.**
- **Juno solves 39-year old mystery of Jupiter lightning.**
- **Collisions of dead stars spray heavy elements throughout small galaxies.**
- **Wormhole echoes that may revolutionize astrophysics.**
- **Links to other space and astronomy news published in June 2018.**

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

HAYABUSA2 AND MASCOT ARRIVE AT ASTEROID RYUGU

(Courtesy of Akihiro Ikeshita)

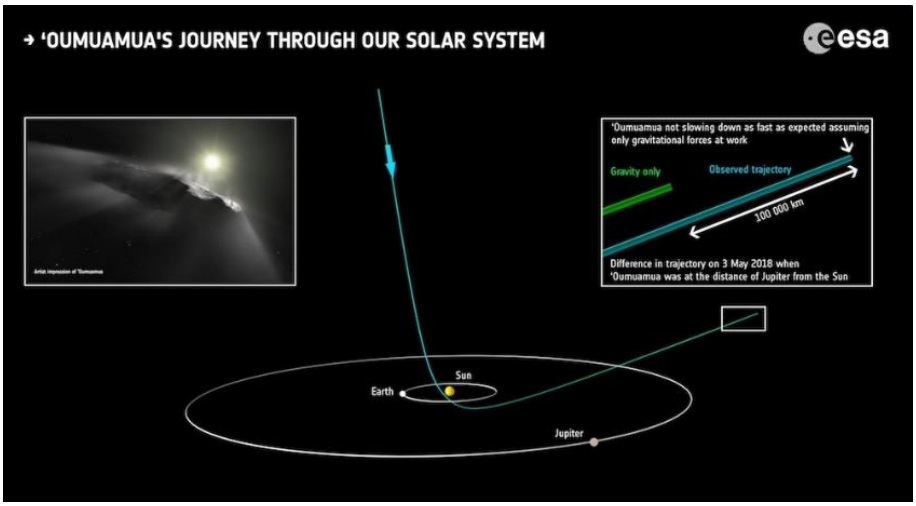
The Japanese Hayabusa2 space probe has reached the end of its 3.2-billion-kilometre journey with its passenger, the French-German MASCOT (Mobile Asteroid Surface Scout) lander. Launched in 2014, Hayabusa2 has completed three orbits of the Sun in four years, after which it began a few weeks ago its very slow approach to its destination. Since today, Hayabusa2 is now escorting Ryugu at a close distance of some 20 kilometres, collecting images and data from this celestial object that spins on itself in a little more than seven and a half hours. MASCOT is scheduled to land on the asteroid in early October. For the first time in the history of space, a lander is set to move about on the surface of an asteroid, making small 'hops' to sample Ryugu's soil at different points on the surface just a few metres apart. Scientists are seeking to investigate the properties and structure of near-Earth asteroids to gain new insights into how our solar system and planets formed, and possibly to devise solutions if an object of this type finds itself on a collision course with Earth. After 18 months studying the asteroid remotely and then collecting samples, Hayabusa2 will begin its return journey to Earth to bring back its precious cargo, arriving late in 2020. (CNES)
Intense sequence for CNES, DLR and JAXA - Hayabusa2 and Mascot arrive at asteroid Ryugu (27 June 2018)

ESA COUNCIL ENDORSES TRANSITION FROM ARIANE 5 TO ARIANE 6

Ariane 6 Credit: ESA

In view of the progress made in the Ariane 6 programme, participating states have decided on the completion of the development up to full operational capability and agreed to fund industrial incentives associated with the development of Ariane 6 and P120C solid rocket motor. Participating States also committed to start with the first step of the Ariane 6 and P120C Transition Programme. This programme supports the evolution from Europe's Ariane 5 to full operational capability of Ariane 6. Ariane 6 is Europe's new-generation launcher, designed to secure guaranteed access to space for Europe at an affordable price for European institutional users. It will operate in two configurations: Ariane 62 is fitted with two P120C strap-on boosters while Ariane 64 has four. Ariane 6's maiden flight is planned for mid-2020. P120C is the largest carbon-fibre solid propellant booster ever built in one segment at almost 13.5 m long and about 3.4 m in diameter. Two boosters will be used on Ariane 6's maiden flight in 2020. (ESA)
ESA Council decides on the completion of Ariane 6 and endorses start of transition from Ariane 5 to Ariane 6 (14 June 2018)

INTERSTELLAR ASTEROID IS REALLY A COMET



'Oumuamua's journey through our Solar System (courtesy: ESA; artist impression: ESA/Hubble, NASA, ESO, M. Kornmesser)

It was extremely surprising that `Oumuamua first appeared as an asteroid, given that we expect interstellar comets should be far more abundant. Results certainly lean towards it being a comet and not an asteroid. (ESA) Interstellar asteroid is really a comet (27 June 2018)

JUNO SOLVES 39-YEAR OLD MYSTERY OF JUPITER LIGHTNING

This artist's concept of lightning distribution in Jupiter's northern hemisphere incorporates a JunoCam image with artistic embellishments.

Juno's MWR detected 377 lightning discharges. They were recorded in the megahertz as well as gigahertz range, which is what you can find with terrestrial lightning emissions. While the revelation showed how Jupiter lightning is similar to Earth's, the new paper also notes that where these lightning bolts flash on each planet is actually quite different. There is a lot of activity near Jupiter's poles but none near the equator. This doesn't hold true for our planet. Why do lightning bolts congregate near the equator on Earth and near the poles on Jupiter? Follow the heat. Earth's derives the vast majority of its heat externally from solar radiation, courtesy of our Sun. Because our equator bears the brunt of this sunshine, warm moist air rises (through convection) more freely there, which fuels towering thunderstorms that produce lightning. Jupiter's orbit is five times farther from the Sun than Earth's orbit, which means that the giant planet receives 25 times less sunlight than Earth. But even though Jupiter's atmosphere derives the majority of its heat from within the planet itself, this doesn't render the Sun's rays irrelevant. They do provide some warmth, heating up Jupiter's equator more than the poles, just as they heat up Earth. Scientists believe that this heating at Jupiter's equator is just enough to create stability in the upper atmosphere, inhibiting the rise of warm air from within. The poles, which do not have this upper-level warmth and therefore no atmospheric stability, allow warm gases from Jupiter's interior to rise, driving convection and therefore creating the ingredients for lightning. (JPL)
Juno solves 39-year old mystery of Jupiter lightning (6 June 2018)

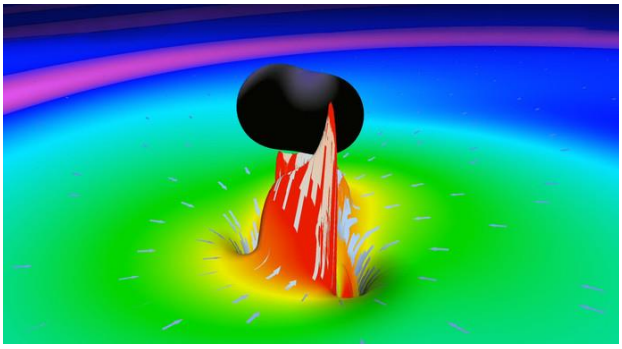
COLLISIONS OF DEAD STARS SPRAY HEAVY ELEMENTS THROUGHOUT SMALL GALAXIES

The Sculptor Dwarf galaxy, pictured here, is one of the smallest galaxies included in the new Caltech study. Credit: ESO

Caltech scientists have found, for the first time, that merging pairs of neutron stars, the burnt-out cores of stars that have explode, create the majority of heavy elements in small "dwarf" galaxies. Heavy elements, such as silver and gold, are key for planet formation and even life

itself. By studying these dwarf galaxies, the researchers hope to learn more about the primary sources of heavy elements for the whole universe. The origin of the majority of the heaviest elements of the periodic table, including 95 percent of all gold on Earth, has been debated for decades. It is now known that the heaviest elements are created when the nuclei of atoms in stars capture particles called neutrons. (Caltech)
Collisions of dead stars spray heavy elements throughout small galaxies (5 June 2018)

WORMHOLE ECHOES THAT MAY REVOLUTIONIZE ASTROPHYSICS



Instant of a simulation in which two black holes merge. The collision of two rotating wormholes would trigger a similar deformation of space-time, albeit leaving ´echoes´ in the signal. / Credit: LIGO LabCaltech (MIT)

Scientists have deduced the existence of black holes from a multitude of experiments, theoretical models and indirect observations, such as the recent detection, by the LIGO and Virgo observatories, of gravitational waves, which are supposed to originate from the collision of two of these dark gravitational monsters. But what if those ripples of space-time had not been produced by black holes, but by other exotic objects? A team of European physicists offer an alternative: wormholes, which can be traversed to appear in another universe. Madrid, Spain (SPX)
Wormhole Echoes That May Revolutionize Astrophysics (13 June 2018)

LINKS TO OTHER SPACE NEWS PUBLISHED IN JUNE 2018

ASTEROIDS

NEOWISE thermal data reveal surface properties of over 100 asteroids (1 June 2018)
The properties of the surface regolith show that small asteroids, as well as fast rotating asteroids, have little, if any, dust covering their surfaces. (Regolith is the term for the broken rocks and dust on the surface.) It could be difficult for fast-rotating asteroids to retain very fine regolith grains because their low gravity and high spin rates tend to fling small particles off their surfaces and into space. Also, it could be that fast-rotating asteroids do not experience large temperature changes because the sun's rays are more rapidly distributed across their surfaces. That would reduce or prevent the thermal cracking of an asteroid's surface material that could cause the generation of fine grains of regolith. Scientists also found that their detailed calculations for estimated sizes of the asteroids they studied were consistent with those of the same asteroids calculated by the NEOWISE team using simpler models. With the asteroids for which they were able to gather the most information from other sources, their calculations of their sizes were consistent with the radiometrically-

derived values performed by the NEOWISE team. The uncertainties were within 10 percent between the two sets of results. (JPL)

Earth's first mission to a binary asteroid, for planetary defence (25 June 2018)
Planning for humankind's first mission to a binary asteroid system has entered its next engineering phase. ESA's proposed Hera mission would also be Europe's contribution to an ambitious planetary defence experiment. Named for the Greek goddess of marriage, Hera would fly to the Didymos pair of Near-Earth asteroids: the 780 m-diameter mountain-sized main body is orbited by a 160 m moon, informally called 'Didymoon', about the same size as the Great Pyramid of Giza. By the time Hera reaches Didymos, in 2026, Didymoon will have achieved historic significance: the first object in the Solar System to have its orbit shifted by human effort in a measurable way. A NASA mission called the Double Asteroid Redirection Test, or DART, is due to collide with it in October 2022. The impact will lead to a change in the duration of Didymoon's orbit around the main body. Ground observatories all around the world will view the collision, but from a minimum distance of 11 million km away. (ESA)

New mystery discovered regarding active asteroid Phaethon (29 June 2018)
Discovered in 1983, Phaethon has been shown to be the parent body of the Geminid meteor shower. Based on a new study of how near-Earth asteroid Phaethon reflects light at different angles, astronomers think that its surface may reflect less light than previously thought. This is an exciting mystery for the recently approved DESTINY$^+$ mission to investigate when it flies past Phaethon. The way an object reflects light depends not only on its albedo (the percentage of light it reflects) but also on the illumination angle. One effect that scientists are interested in is how the polarization changes when sunlight reflects off the surface of an asteroid. Scientifically, light is referred to as electromagnetic waves; the waves create changes in the electric and magnetic fields. The directions of these changes can either be random or aligned. When the electromagnetic effects of light are aligned, the light is said to be polarized. An international team used the 1.6-m Pirka Telescope at Nayoro Observatory in Hokkaido Japan to observe the near-Earth asteroid (3200) Phaethon. They studied the changes in the polarization of the light it reflected at many different illumination angles. The results show that at some angles, the light reflected from Phaethon is the most polarized light ever observed among small bodies in the Solar System.
(National Astronomical Observatory of Japan)

ASTROPHYSICS

VLT makes most precise test of Einstein's General Relativity outside Milky Way
(21 June 2018)
Astronomers using the MUSE instrument on ESO's Very Large Telescope in Chile, and the NASA/ESA Hubble Space Telescope, have made the most precise test yet of Einstein's general theory of relativity outside the Milky Way. The nearby galaxy ESO 325-G004 acts as a strong gravitational lens, distorting light from a distant galaxy behind it to create an Einstein ring around its centre. By comparing the mass of ESO 325-G004 with the curvature of space around it, the astronomers found that gravity on these astronomical length-scales behaves as predicted by general relativity. This rules out some alternative theories of gravity. (ESO)

BLACK HOLES

Astronomers see distant eruption as black hole destroys star (14 June 2018)
For the first time, astronomers have directly imaged the formation and expansion of a fast-moving jet of material ejected when the powerful gravity of a supermassive black hole ripped apart a star that wandered too close to the massive monster. The scientists tracked the event with radio and infrared telescopes, including the National Science Foundation's Very Long Baseline Array (VLBA) and NASA's Spitzer Space Telescope, in a pair of colliding galaxies called Arp 299. The galaxies are nearly 150 million light-years from Earth. At the core of one of the galaxies, a black hole 20 million times more massive than the Sun shredded a star more than twice the Sun's mass, setting off a chain of events that revealed important details of the violent encounter. The researchers also used observations of Arp 299 made by NASA's Hubble space telescope prior to and after the appearance of the eruption. Only a small number of such stellar deaths, called tidal disruption events, or TDEs, have been detected. Theorists have suggested that material pulled from the doomed star forms a rotating disk around the black hole, emitting intense X-rays and visible light, and also launches jets of material outward from the poles of the disk at nearly the speed of light.
(National Radio Astronomy Observatory)

Star shredded by rare breed of black hole (18 June 2018)
ESA's XMM-Newton observatory has discovered the best-ever candidate for a very rare and elusive type of cosmic phenomenon: a medium-weight black hole in the process of tearing apart and feasting on a nearby star. There are various types of black hole lurking throughout the Universe: massive stars create stellar-mass black holes when they die, while galaxies host supermassive black holes at their centres, with masses equivalent to millions or billions of Suns. Lying between these extremes is a more retiring member of the black hole family: intermediate-mass black holes. Thought to be seeds that will eventually grow to become supermassive, these black holes are especially elusive, and thus very few robust candidates have ever been found. Now, a team of researchers using data from ESA's XMM-Newton X-ray space observatory, as well as NASA's Chandra X-Ray Observatory and Swift X-Ray Telescope, has found a rare tell-tale sign of activity. They detected an enormous flare of radiation in the outskirts of a distant galaxy, thrown off as a star passed too close to a black hole and was subsequently devoured. (ESA)

DWARF PLANETS

Organics on Ceres may be more abundant than originally thought (13 June 2018)
A new analysis of data from NASA's Dawn mission suggests that organic matter may exist in surprisingly high concentrations on the dwarf planet's surface. (Brown University)

Dawn's engines complete firing, science continues (28 June 2018)
Mission controllers have turned off the industrious ion engines on NASA's Dawn spacecraft for the last time and do not expect to turn them back on again, if everything goes as planned for the rest of Dawn's mission in orbit around Ceres, the largest body in the main asteroid belt. Mission managers expect Dawn to continue gathering science data and transmitting it to Earth for another few months. (JPL)

EARTH

Thales Alenia Space takes major steps forward in production of SWOT (5 June 2018)
SWOT (Surface Water & Ocean Topography) is designed to study the topography of oceans and continental bodies of water; it performs a two-pronged mission, encompassing oceanography and hydrology. For oceanography, the satellite will take measurements of the ocean surface and ocean wave height. This data will be used to analyze and understand the impact of coastal water circulation on marine life, ecosystems, water quality, energy transfer, etc., resulting in more accurate models of the interactions between oceans and the atmosphere. The hydrology mission will observe continental surface water to evaluate changes in water storage in humid zones, lakes and reservoirs, as well as flow rates in rivers. SWOT will be able to carry out end-of-life maneuvers to ensure disintegration during reentry over the Pacific Ocean, far from any inhabited zone or shipping routes. (Thales Alenia Space)

First UZH Space Hub research flight campaign (13 June 2018)
The UZH Space Hub is holding its first research flight campaign from 11 to 13 June. An airbus performing parabolic flights will take off from the military airfield in Dübendorf. In addition, a zeppelin will be used to investigate how to discover plastic in water from above using special image sensors. This could help to detect plastic pollution in the world's seas. (University of Zurich)

EXOPLANETS

ALMA discovers trio of infant planets around newborn star (13 June 2018)
Astronomers have used Atacama Large Millimeter/submillimeter Array (ALMA) to uncover convincing evidence that three young planets are in orbit around the infant star HD 163296. Using a novel planet-finding technique, the astronomers identified three disturbances in the gas-filled disc around the young star: the most reliable evidence yet that newly formed planets are in orbit there. These are considered the first planets discovered by ALMA. (ALMA)

Hunting molecules to find new planets (19 June 2018)
Astronomers used archival images taken by the SINFONI instrument of the star *beta pictoris*, which is known to be orbited by a giant planet, *beta pictoris b*. Each pixel in these images contains the spectrum of light received by that pixel. The astronomers then compared the spectrum contained in the pixel with a spectrum corresponding to a given molecule, for example water vapour, to see if there is a correlation. If there is a correlation, it means that the molecule is present in the atmosphere of the planet. By applying this technique to *beta pictoris b*, Jens Hoeijmakers notices that the planet becomes perfectly visible when he looks for water (H2O) or carbon monoxide (CO). However, when he applies his technique to methane (CH4) and ammonia (NH3), the planet remains invisible, suggesting the absence of these molecules in the atmosphere of *beta pictoris b*. (University of Geneva)

ALMA discover exciting structures in a young protoplanetary disk that support planet formation (20 June 2018)
The protoplanetary disk around a young star MWC 758 is located at 500 light years from us. In 2012, a pair of near symmetric giant spiral arms was discovered in reflected light. In dust thermal and molecular gas line emission at millimeter wavelengths, a big inner hole and two major dust clumps have been found, too. Now with the new ALMA image, the previously known cavity of MWC 758 is shown to be off-centered from the star with its shape well

described by an ellipse with one focus on the star. Also, a millimeter dust emission feature corresponds nicely with one of the two spiral arms previously seen in reflected light. Both discoveries are the first among protoplanetary disks. (ALMA)

Nearly 80 exoplanet candidates identified in record time (20 June 2018)
Scientists at MIT and elsewhere have analyzed data from K2, the follow-up mission to NASA's Kepler Space Telescope, and have discovered a trove of possible exoplanets amid some 50,000 stars. (MIT)

NASA uses Earth as laboratory to study distant worlds (28 June 2018)
The study of exoplanets, planets that lie outside our solar system, could help scientists answer big questions about our place in the universe, and whether life exists beyond Earth. But, these distant worlds are extremely faint and difficult to image directly. A new study uses Earth as a stand-in for an exoplanet and shows that even with very little light, as little as one pixel, it is still possible to measure key characteristics of distant worlds. (JPL)

GRAVITATIONAL WAVES

Cosmic blast takes rest at last (31 May 2018)
In what scientists call a multi-messenger approach, observations across the electromagnetic spectrum are key to study in-depth this and similar sources of gravitational waves that will be discovered in future years by LIGO and Virgo. The two gravitational wave experiments will start their observations again, with improved sensitivity, at the beginning of 2019, while ESA's future mission, LISA, the Laser Interferometer Space Antenna, which will observe lower frequency gravitational waves from space, is planned for launch in 2034. (ESA)

GRAVITY

Parabolic flight campaign – three 'firsts' in partial gravity (5 June 2018)
Stumbling in partial gravity
For humans to be able to move around and interact with their environment, they require finely tuned muscle movements, to walk around or ensure a secure footing, for instance. Under partial gravity they must be able to effectively control their muscles via their neural pathways. If we are unable to do so, the risk of stumbling is dramatically increased. This applies to both humans on Earth and astronauts in space. However, partial gravity conditions appear to influence this neuromuscular control in challenging situations, increasing the astronaut's risk of stumbling. Researchers at the University of Freiburg are investigating why this is so. The results are intended to reduce the risk to astronaut safety during missions to other planets, thereby resolving a fundamental safety issue in human physiological space exploration.
The brain in space
Stress has a negative impact on human mental health and puts a strain on cognitive performance – both factors that are important for the success and safety of a long-term mission. This is because living under extreme conditions is highly stressful. Although these correlations have been known for some time, many questions regarding the causes of neurocognitive performance remain. The team at German Sport University Cologne wants to attempt to better understand the impact of stress on mental health. The aim is to develop adequate countermeasures that can contribute to an improvement in safety and the success of a long-term mission.

Plant growth in 3D and colour
For plants, experiencing gravity is important for the growth process. During the University of Freiburg experiment, scientists are using the FLUMIAS fluorescence microscope to study the dynamic changes in Arabidopsis thaliana (thale cress) cells caused by statoliths. The three different gravity levels primarily enable them to investigate the response at various thresholds. The cells are stained and observed live in high spatial and temporal resolution using the FLUMIAS microscope built by Airbus on behalf of the DLR Space Administration. A FLUMIAS 'sister' model featuring new technology will be used during the 'horizons' mission of the German ESA Astronaut, Alexander Gerst. (DLR)

Plants on a gravity rollercoaster (11 June 2018)
Plants are quicker to react and more sensitive than you might think. They can detect light changes in a fraction of a second and can bend towards light sources within minutes and they respond equally fast to gravity. For the first time last week, European scientists filmed roots growing in real-time on a plane that recreates different gravity levels. Guided by gravity on Earth, roots find their way down into the soil, but how do plants keep their 'feet' on the ground when in space? Altered gravity has a big impact on plant growth. We do not fully understand how their cells cope. (ESA)

INTERNATIONAL SPACE STATION

NASA astronaut, crewmates safely return to Earth from space station (3 June 2018)
Three members of the International Space Station Expedition 55 crew, including NASA astronaut Scott Tingle, returned to Earth Sunday after 168 days of living and working in low-Earth orbit. Tingle, astronaut Norishige Kanai of the Japan Aerospace Exploration Agency, and cosmonaut Anton Shkaplerov of the Russian space agency Roscosmos landed at 8:39 a.m. EDT (6:39 p.m. in Kazakhstan) southeast of the remote town of Dzhezkazgan in Kazakhstan. (NASA)

NanoRacks completes Barrios Protein Crystal Growth operations on Space Station
(4 June 2018)
The Barrios PCG investigation, in the first of three phases, tested the feasibility of the use of 96-well crystallization plates on orbit, as well as the protein crystal growth yielded from these plates. The investigation uses commercial off-the-shelf (COTS) microplates, and specifically tested the ability to pipette small amounts of fluids (about 10 microliters) into the plate in microgravity. This first phase involved mixing a blue dye with four solutions of varying viscosities. Ricky Arnold also tested two different methods of mixing the solutions after they were already placed in the wells. Pipetting, while a common technique in protein crystal labs on the ground, is still a new process in microgravity. (NanoRacks)

Astronauts safely in orbit following launch to International Space Station (6 June 2018)
Feustel, Arnold and Artemyev are scheduled to remain aboard the station until October, while Auñón-Chancellor, Gerst and Prokopyev are slated to return to Earth in December.
This crew continues the long-term increase in crew size on the U.S. segment from three to four, allowing NASA to maximize time dedicated to research on the space station. Highlights of upcoming investigations include a new facility to study ultra-cold quantum gases, the first commercial European facility to conduct microgravity research, and a system that uses surface forces to accomplish liquid-liquid separation. For more than 17 years, humans have lived and worked continuously aboard the station, advancing scientific knowledge and demonstrating new technologies, making research breakthroughs not possible on Earth that

will enable long-duration human and robotic exploration into deep space. A global endeavor, more than 230 people from 18 countries have visited the unique microgravity laboratory that has hosted more than 2,400 research investigations from researchers in more than 103 countries. (NASA)

New NASA research, hardware heading to space station on 15th SpaceX resupply mission (29 June 2019)
Research materials flying inside Dragon's pressurized cargo area include a cellular biology investigation (Micro-12) to understand how microgravity affects the growth, gene expression and ability of a model bacterium to transfer electrons through its cell membrane along the bacterial nanowires it produces. Such bacteria could be used in microbial fuel cells to make electricity from waste organic material. An Earth science instrument called the ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) will provide a new space-based measurement of how plants respond to changes in water availability. This data can help society better manage agricultural water use. An observational pilot study with the Crew Interactive MObile companioN (CIMON) aims to provide first insights into the effects of crew support from an artificial intelligence (AI) in terms of efficiency and acceptance during long-term missions in space. (NASA)

JUPITER AND MOONS

NASA re-plans Juno's Jupiter mission (6 June 2018)
NASA has approved an update to Juno's science operations until July 2021. This provides for an additional 41 months in orbit around Jupiter and will enable Juno to achieve its primary science objectives. Juno is in 53-day orbits rather than 14-day orbits as initially planned because of a concern about valves on the spacecraft's fuel system. This longer orbit means that it will take more time to collect the needed science data. (JPL)

KUIPER BELT

New Horizons wakes for Kuiper Belt flyby (5 June 2018)
NASA's New Horizons spacecraft is back "awake" and being prepared for the farthest planetary encounter in history, a New Year's Day 2019 flyby of the Kuiper Belt object nicknamed Ultima Thule. New Horizons has been speeding deeper into this distant region, observing other Kuiper Belt objects and measuring the properties of the heliosphere while heading toward the flyby of Ultima Thule, about a billion miles (1.6 billion kilometers) beyond Pluto. (Johns Hopkins University Applied Physics Laboratory)

MARS

NASA CubeSats steer toward Mars (1 June 2018)
NASA has achieved a first for the class of tiny spacecraft known as CubeSats, which are opening new access to space. Over the past week, two CubeSats called MarCO-A and MarCO-B have been firing their propulsion systems to guide themselves toward Mars. This process, called a trajectory correction maneuver, allows a spacecraft to refine its path to Mars following launch. Both CubeSats successfully completed this maneuver; NASA's InSight spacecraft just completed the same process on May 22. (JPL)

Mars Curiosity's labs are back in action (4 June 2018)

On May 20, a technique called "feed extended drilling" allowed Curiosity to drill its first rock sample since October 2016; on May 31, an additional technique called "feed extended sample transfer" successfully trickled rock powder into the rover for processing by its mineralogy laboratory. Delivery to its chemistry laboratory will follow in the week ahead. (JPL)

NASA finds ancient organic material, mysterious methane on Mars (7 June 2018)
NASA's Curiosity rover has found new evidence preserved in rocks on Mars that suggests the planet could have supported ancient life, as well as new evidence in the Martian atmosphere that relates to the search for current life on the Red Planet. While not necessarily evidence of life itself, these findings are a good sign for future missions exploring the planet's surface and subsurface.
Scientists describe the discovery of seasonal variations in methane in the Martian atmosphere over the course of nearly three Mars years, which is almost six Earth years. This variation was detected by Curiosity's Sample Analysis at Mars (SAM) instrument suite. (NASA)

Opportunity hunkers down during dust storm (13 June 2018)
NASA engineers attempted to contact the Opportunity rover today but did not hear back from the nearly 15-year old rover. The team is now operating under the assumption that the charge in Opportunity's batteries has dipped below 24 volts and the rover has entered low power fault mode, a condition where all subsystems, except a mission clock, are turned off. Pasadena CA (JPL)

NASA encounters the perfect storm for science (13 June 2018)
One of the thickest dust storms ever observed on Mars has been spreading for the past week and a half. The storm has caused NASA's Opportunity rover to suspend science operations, but offers a window for four other spacecraft to learn from the swirling dust. NASA has three orbiters circling the Red Planet, each equipped with special cameras and other atmospheric instruments. Additionally, NASA's Curiosity rover has begun to see an increase in dust at its location in Gale Crater. Each spacecraft offers a unique look at how dust storms form and behave; knowledge that will be essential for future robotic and human missions. (JPL)

Explosive volcanoes spawned mysterious Martian rock formation (18 June 2018)
Explosive volcanic eruptions that shot jets of hot ash, rock and gas skyward are the likely source of a mysterious Martian rock formation, a new study finds. The Medusae Fossae Formation is a massive, unusual deposit of soft rock near Mars's equator, with undulating hills and abrupt mesas. Scientists first observed the Medusae Fossae with NASA's Mariner spacecraft in the 1960s but were perplexed as to how it formed. Now, new research suggests the formation was deposited during explosive volcanic eruptions on the Red Planet more than 3 billion years ago. The formation is about one-fifth as large as the continental United States and 100 times more massive than the largest explosive volcanic deposit on Earth, making it the largest known explosive volcanic deposit in the solar system, according to the study's authors. (American Geophysical Union)

Meteorite 'Black Beauty' expands window for when life might have existed on Mars (27 June 2018)
The Mars meteorite Black Beauty has literally brought crisp news to Earth. Crust formation is an important step in the development of terrestrial planets, and what makes Black Beauty special and expensive is that it contains small pieces of the crust from Mars. More precisely, Black Beauty contains the rare mineral zircon, in which researchers have found a high concentration of hafnium. Zircon is a very robust mineral that is ideally suited to provide

absolute ages. In this context, the zircons can be used to establish a temporal framework to understand the formation history of the Martian crust. Zircon also acts as a small time capsule as it preserves information about the environment where and when it was created. In this case, a time capsule with hafnium that originates from the earliest crust of Mars, which was present approximately 100 million years before the oldest zircon of Black Beauty was created. Thus, Mars got an early start compared to Earth, whose solid crust wasn't formed until much later. (Natural History Museum of Denmark)

MOON

New NASA position to focus on exploration of Moon, Mars and worlds beyond
(13 June 2018)
NASA's Science Mission Directorate (SMD) is taking a giant leap focusing the agency's exploration of the Moon, Mars and our Solar System. Effective immediately, Steve Clarke is SMD's Deputy Associate Administrator for Exploration. He will serve as the agency's interface between the NASA mission directorates, the scientific community, and other external stakeholders in developing a strategy. Washington DC (SPX)

Long suspected theory about the Moon holds water (13 June 2018)
A team of Japanese scientists has discovered a mineral known as moganite in a lunar meteorite found in a hot desert in northwest Africa. This is significant because moganite is a mineral that requires water to form, reinforcing the belief that water exists on the Moon. Moganite is a crystal of silicon dioxide and is similar to quartz. It forms on Earth as a precipitate when alkaline water including SiO_2 is evaporated under high pressure conditions. The existence of moganite strongly implies that there is water activity on the Moon. (Tohoku University)

SATURN AND MOONS

Surprising magnetic reconnection spotted on Saturn's dayside (5 June 2018)
In data obtained by the Cassini probe at Saturn in 2008, a team of scientists recently found, for the first time, evidence of magnetic reconnection occurring on the planet's Sun-facing side, well within the magnetopause boundary, in the so-called magnetodisc, the flattened distribution of plasma that surrounds Saturn and rotates along with it. Reconnection in the night-side magnetodisc had been seen before, but the new phenomenon was seen in the dayside magnetodisc, which was completely unexpected. (ESA)

Complex organics bubble from the depths of ocean-world Enceladus (27 June 2018)
Data from the international Cassini spacecraft have revealed complex organic molecules originating from Saturn's icy moon Enceladus, strengthening the idea that this ocean-world hosts conditions suitable for life. (ESA)

SOLAR SYSTEM

Experiments at Berkeley Lab help trace interstellar dust back to solar system's formation
(11 June 2018)
Observations suggest that exotic grains represent surviving pre-solar interstellar dust that formed the very building blocks of planets and stars. If we have at our fingertips the starting materials of planet formation from 4.6 billion years ago, that is thrilling and makes possible a

deeper understanding of the processes that formed and have since altered them. (Berkeley Lab)

SPACE WEATHER

ESA's unexpected fleet of space weather monitors (28 June 2018)
A team of researchers has recently investigated a resourceful new method of monitoring space weather. They analysed data from spacecraft magnetometers typically used for attitude control, so-called "platform magnetometers", to see if these devices could also be used to investigate the impact of solar storms on the magnetic field around Earth. They concluded that platform magnetometers can provide excellent insight into space weather. Their contribution to monitoring this phenomenon can be significantly increased by initiating coordination between different groups and developing new data processing techniques, both of which are relatively low cost compared to developing dedicated instruments and missions. Traditionally platform magnetometer data is only sent to Earth so that engineers can check that a spacecraft is working properly. The next step is to make this data accessible to more people. (ESA)

STARS AND STAR CLUSTERS

ALMA and VLT find too many massive stars in starburst galaxies, near and far (4 June 2018)
Astronomers using ALMA and the VLT have discovered that both starburst galaxies in the early Universe and a star-forming region in a nearby galaxy contain a much higher proportion of massive stars than is found in more peaceful galaxies. These findings challenge current ideas about how galaxies evolved, changing our understanding of cosmic star-formation history and the build-up of chemical elements. (European Southern Observatory)

Chandra scouts nearest star system for possible hazards (6 June 2018)
In humanity's search for life outside our Solar System, one of the best places scientists have considered is Alpha Centauri, a system containing the three nearest stars beyond our Sun. A new study that has involved monitoring of Alpha Centauri for more than a decade by NASA's Chandra X-ray Observatory provides encouraging news about one key aspect of planetary habitability. It indicates that any planets orbiting the two brightest stars in the Alpha Cen system are likely not being pummeled by large amounts of X-ray radiation from their host stars. X-rays and related Space Weather effects are bad for unprotected life, directly through high radiation doses and indirectly through stripping away planetary atmospheres (a fate thought to have been suffered by Mars in our own Solar System). (NASA)

More mystery objects detected near Milky Way's supermassive black hole (6 June 2018)
Astronomers have discovered several bizarre objects at the Galactic Center that are concealing their true identity behind a smoke screen of dust; they look like gas clouds but behave like stars. These compact dusty stellar objects move extremely fast and close to our Galaxy's supermassive black hole. These objects that have very distinct movement and characteristics that place them in the G-object class, or dusty stellar objects. Astronomers first discovered G-objects at the Milky Way's monster black hole more than a decade ago; G1 was first seen in 2004, and G2 was discovered in 2012. Both were thought to be gas clouds until they made their closest approach to the supermassive black hole. G1 and G2 somehow managed to survive the black hole's gravitational pull, which can shred gas clouds apart. If these objects are binary star systems that have been driven to merge through their interaction

with the central supermassive black hole, this may provide us with insight into a process which may be responsible for the recently discovered stellar mass black hole mergers that have been detected through gravitational waves. (W M Keck Observatory)

Diamond dust shimmering around distant stars (11 June 2018)
For decades, astronomers have puzzled over the exact source of a peculiar type of faint microwave light emanating from a number of regions across the Milky Way. Known as anomalous microwave emission (AME), this light comes from energy released by rapidly spinning nanoparticles, bits of matter so small that they defy detection by ordinary microscopes. (The period on an average printed page is approximately 500,000 nanometers across.) (Green Bank Observatory)

Old star clusters could have been the birthplace of supermassive stars (21 June 2018)
A team of international astrophysicists may have found a solution to a problem that has perplexed scientists for more than 50 years. Since the 1960s, it has been known that most stars in these clusters contain different chemical elements than all other stars in the Milky Way. These could not have been produced in the stars themselves because the required temperatures are about 10 times higher than the temperatures of the stars themselves. The Surrey scientists argue that a supermassive star, with a mass that is tens of thousands times the mass of the Sun, formed at the same time as the globular clusters. At that time globular clusters were filled with dense gas out of which the stars were forming. As the stars collect more and more gas, they get so close to each other that they could physically collide and form a supermassive star in a runaway collision process. The supermassive star was hot enough to produce all the observed elements and "pollute" the other stars in the cluster with the peculiar elements we observe today. (University of Surrey)

Scientists reverse-engineer formation of star clusters (26 June 2018)
Many had previously argued that clusters of different sizes and ages had formed differently, but the new research shows they all form the same way. The simulations show that the outcome depends on the initial reservoir of gas, that will, after turbulence, gravity and feedback have done their work, create clusters of stars of various sizes over the course of a few million years. This is the first convincing route to modelling the formation of star clusters. It applies across all mass scales, little clusters and big ones, and it should work at any time in the universe's history, in any galaxy. (McMaster University)

SUN AND HELIOSPHERE

NASA selects mission to study solar wind boundary of outer solar system (1 June 2018)
NASA has selected a science mission planned for launch in 2024 that will sample, analyze, and map particles streaming to Earth from the edges of interstellar space. The Interstellar Mapping and Acceleration Probe (IMAP) mission will help researchers better understand the boundary of the heliosphere, a sort of magnetic bubble surrounding and protecting our solar system. This region is where the constant flow of particles from our Sun, called the solar wind, collides with material from the rest of the galaxy. This collision limits the amount of harmful cosmic radiation entering the heliosphere. IMAP will collect and analyze particles that make it through. (NASA)

NASA's Hi-C launches to study Sun's corona (4 June 2018)
NASA and its partners launched a rocket-borne camera to the edge of space. The clarity of images returned is unprecedented and their analysis will provide scientists around the world

with clues to one of the biggest questions in heliophysics - why the Sun's atmosphere, or corona, is so much hotter than its surface. Understanding how the Sun works is important to everyday things we do on Earth. Solar flares and eruptions can disrupt radio, GPS communications and satellites that disseminate cell phone signals. By studying how the Sun releases these bursts of energy, we hope to be able to better anticipate them and, in the future, design technology better equipped to withstand these disruptions. (NASA Marshall)

As solar wind blows, our heliosphere balloons (6 June 2018)
What happens when the solar wind suddenly starts to blow significantly harder? According to two recent studies, the boundaries of our entire solar system balloon outward and an analysis of particles rebounding off of its edges will reveal its new shape. In late 2014, NASA spacecraft detected a substantial change in the solar wind. For the first time in nearly a decade, the solar wind pressure, a combined measure of its speed and density, had increased by approximately 50 percent and remained that way for several years thereafter. Two years later, the Interstellar Boundary Explorer, or IBEX, spacecraft detected the first sign of the aftermath. Solar wind particles from the 2014 pressure increase had reached the edge of the heliosphere, neutralized themselves, and shot all the way back to Earth. Our heliosphere today is bigger than it was just a few years ago. (NASA Goddard)

SUPERNOVA

Astronomers observe the magnetic field of the remains of supernova 1987A (29 June 2018)
For the first time, astronomers have directly observed the magnetism in one of astronomy's most studied objects: the remains of Supernova 1987A (SN 1987A), a dying star that appeared in our skies over thirty years ago. In addition to being an impressive observational achievement, the detection provides insight into the early stages of the evolution of supernova remnants and the cosmic magnetism within them. The magnetism detected is around 50,000 times weaker than a fridge magnet and they have been able to measure this from around 1.6 million trillion kilometres. This is the earliest possible detection of the magnetic field formed after the explosion of a massive star. (Dunlap Institute for Astronomy and Astrophysics)

TECHNOLOGY

First engine assembled for DARPA and Boeing reusable experimental spaceplane
(4 June 2018)
The reusable Phantom Express spaceplane will take off vertically and land horizontally. The vehicle will be equipped with an expendable second stage capable of placing up to 3,000 pounds (1,361 kg) of payload into low Earth orbit. (Aerojet Rocketdyne) The AR-22 engine is capable of generating about 375,000 pounds (170,097 kg) of thrust and was designed to fly 55 missions with service every 10 missions. This reusability feature makes the AR-22 ideally suited for Phantom Express.

Sample return technology successfully tested on Xodiac rocket (13 June 2018)
Honeybee Robotics flight tested its pneumatic sampler collection system, PlanetVac, on Masten Space Systems' Xodiac rocket on May 24, launching from Mojave, California, and landing to collect a sample of more than 320 grams of top soil from the surface of the desert floor. The opportunity to test a technology on Earth before it is destined for another planet allows researchers and mission planners to have confidence that once the technology arrives to its space destination it will work. PlanetVac is a surface soil collection system for a sample return mission. The configuration tested would replace a foot pad of a planetary lander

spacecraft. The goal is to bring back a sample of surface soil from a celestial body. (NASA Armstrong)

Teledyne to supply infrared detectors to NASA's WFIRST astronomy mission (15 June 2018)
NASA's current plans call for WFIRST to perform an extraordinarily broad set of scientific investigations: studying the newly-discovered phenomenon of dark energy, measuring the history of cosmic acceleration, completing the exoplanet census begun by NASA's Kepler Space Telescope and demonstrating technology for direct imaging and characterization of exoplanets. Teledyne Technologies Incorporated announced that NASA has awarded a contract for the Short Wave Infra-Red (SWIR) Sensor Chip Assembly (SCA) for the Wide Field Infrared Survey Telescope (WFIRST) Project at the NASA/Goddard Space Flight Center in Greenbelt, Maryland. (Teledyne Technologies)

Foam and cork insulation protects deep space rocket from fire and ice (20 June 2018)
Extreme temperatures, ranging from minus 423 degrees Fahrenheit to more than 200 degrees Fahrenheit, call for novel thermal protection systems on NASA's new heavy-lift rocket, the Space Launch System (SLS). NASA is advancing state-of-the-art technology for thermal protection with more environmentally friendly materials and 3D printed molds for smaller parts. With the power and precision needed for sending humans to deep space, SLS will launch astronauts in NASA's Orion spacecraft to distant destinations such as the Moon and Mars. Spray-on foam insulation, along with other traditional insulation materials such as cork, will provide thermal protection for every rocket part, large and small. The insulation is flexible enough to move with the rocket but rigid enough to take the aerodynamic pressures as SLS accelerates from 0 to 17,400 miles per hour and soars to more than 100 miles above Earth in just 8 minutes. The cryogenic fuel made up of liquid hydrogen and liquid oxygen, that powers the rocket has to stay extremely cold to remain liquid. Hydrogen has to remain at minus 423 degrees Fahrenheit and oxygen at minus 298 degrees Fahrenheit. If temperatures rise too high, the fuel would become a gas. (NASA)

European industry gears up for Vega-C debut in 2019 (21 June 2018)
With just one year before Vega-C lifts off from Europe's Spaceport in French Guiana, preparations for Europe's next launcher are gaining momentum. Vega-C will increase performance from Vega's current 1.5 t to about 2.2 t hauled to its reference 700 km polar orbit, with no increase in launch costs. P120C solid-propellant motor. Thrust in the first phase of flight comes from new solid-fuel first and second stage motors, P120C and Zefiro-40 respectively. P120C's upcoming first hot static-firing test at Europe's Spaceport will prove the design, new materials, techniques, tools and components. P120C is 13.5 m long and 3.4 m in diameter, the largest solid-propellant motor ever built in one segment. Two or four will also be used for Ariane 6. (ESA)

NASA tests solar sail for CubeSat that will study near-earth asteroids (29 June 2018)
NASA's Near-Earth Asteroid Scout, a small satellite designed to study asteroids close to Earth, performed a successful deployment test June 28 of the solar sail that will launch on Exploration Mission-1 (EM-1). The test was performed in an indoor clean room at the NeXolve facility in Huntsville, Alabama. NEA Scout is a six-unit CubeSat that relies on an innovative solar sail for propulsion. It is one of 13 secondary science payloads NASA selected to fly on EM-1. (NASA)

TELESCOPES

AGC supplies the coater for mirrors of the world's largest telescope (21 June 2018)
AGC Glass Europe has been awarded a contract by the European Southern Observatory (ESO) to supply the magnetron sputtering coating plant aimed at producing the mirror for the world's largest optical telescope, the Extremely Large Telescope (ELT). This telescope manufactured by ESO will be installed at Cerro Armazones (3,046 m) in the Atacama Desert (Chilean Andes). It will be equipped with a gigantic 39-meter segmented primary mirror to collect the light from the cosmos and allow astronomers discover unexplored galaxies, study exoplanets and investigate other objects and phenomena across the universe. The plant will perform the initial coating and subsequent re-coating with a protected silver layer stack on the mirror segments. These coating operations are required by the harsh climate conditions such as sandstorms that are liable to affect the silver layers of the primary mirror. AGC will do the design, manufacture, on-site assembly and commissioning of the mirror segment coating plant at the ELT (AGC Plasma Technology Solutions)

Pat Williams June 2018