

Space News Update – May 2016

By Pat Williams

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

JUNO SPACECRAFT CROSSES JUPITER/SUN GRAVITATIONAL BOUNDARY



This artist's rendering shows NASA's Juno spacecraft making one of its close passes over Jupiter. Image credit: NASA/JPL-Caltech

Since its launch five years ago, there have been three forces tugging at NASA's Juno spacecraft as it speeds through the solar system. The Sun, Earth and Jupiter have all been influential -- a gravitational trifecta of sorts. At times, Earth was close enough to be the frontrunner. More recently, the Sun has had the most clout when it comes to Juno's trajectory. Today, it can be reported that Jupiter is now in the gravitational driver's seat, and the basketball court-sized spacecraft is not looking back. Juno was launched on Aug. 5, 2011. On July 4 of this year, it will perform a Jupiter orbit insertion manoeuvre -- a 35-minute burn of its main engine, which will impart a mean change in velocity of 1,212 mph (542 meters per second) on the spacecraft. Once in orbit, the spacecraft will circle the Jovian world 37 times, skimming to within 3,100 miles (5,000 kilometers) above the planet's cloud tops. During the flybys, Juno will probe beneath the obscuring cloud cover of Jupiter and study its auroras to learn more about the planet's origins, structure, atmosphere and magnetosphere.

[Juno spacecraft crosses Jupiter/Sun gravitational boundary](#) (27 May 2016)

EUROPA'S OCEAN MAY HAVE AN EARTHLIKE CHEMICAL BALANCE



This enhanced-colour view from NASA's Galileo spacecraft shows an intricate pattern of linear fractures on the icy surface of Jupiter's moon Europa. Image Credit: NASA/JPL-Caltech/ SETI Institute.

A new NASA study modelling conditions in the ocean of Jupiter's moon Europa suggests that the necessary balance of chemical energy for life could exist there, even if the moon lacks volcanic hydrothermal activity. On both Europa and Earth oxygen production is about 10 times higher than hydrogen production. The work draws attention to the ways that Europa's rocky interior may be much more complex and possibly earthlike than people typically think. The cycling of oxygen and hydrogen in Europa's ocean will be a major driver for Europa's ocean chemistry and any life there, just as it is on Earth. Ultimately, the scientists want to also understand the cycling of life's other major elements in the ocean: carbon, nitrogen, phosphorus and sulphur.

As part of their study, the researchers calculated how much hydrogen could potentially be produced in Europa's ocean as seawater reacts with rock, in a process called serpentinization. In this process, water percolates into spaces between mineral grains and reacts with the rock to form new minerals, releasing hydrogen in the process. The researchers considered how cracks in Europa's seafloor likely open up over time, as the moon's rocky interior continues to cool following its formation billions of years ago. New cracks expose fresh rock to seawater, where more hydrogen-producing reactions can take place.

In Earth's oceanic crust, such fractures are believed to penetrate to a depth of 3 to 4 miles (5 to 6 kilometers). On present-day Europa, the researchers expect water could reach as deep as 15 miles (25 kilometers) into the rocky interior, driving these key chemical reactions throughout a deeper fraction of Europa's seafloor.

The other half of Europa's chemical-energy-for-life equation would be provided by oxidants -- oxygen and other compounds that could react with the hydrogen -- being cycled into the European ocean from the icy surface above. Europa is bathed in radiation from Jupiter, which splits apart water ice molecules to create these materials. Scientists have inferred that Europa's surface is being cycled back into its interior, which could carry oxidants into the ocean.

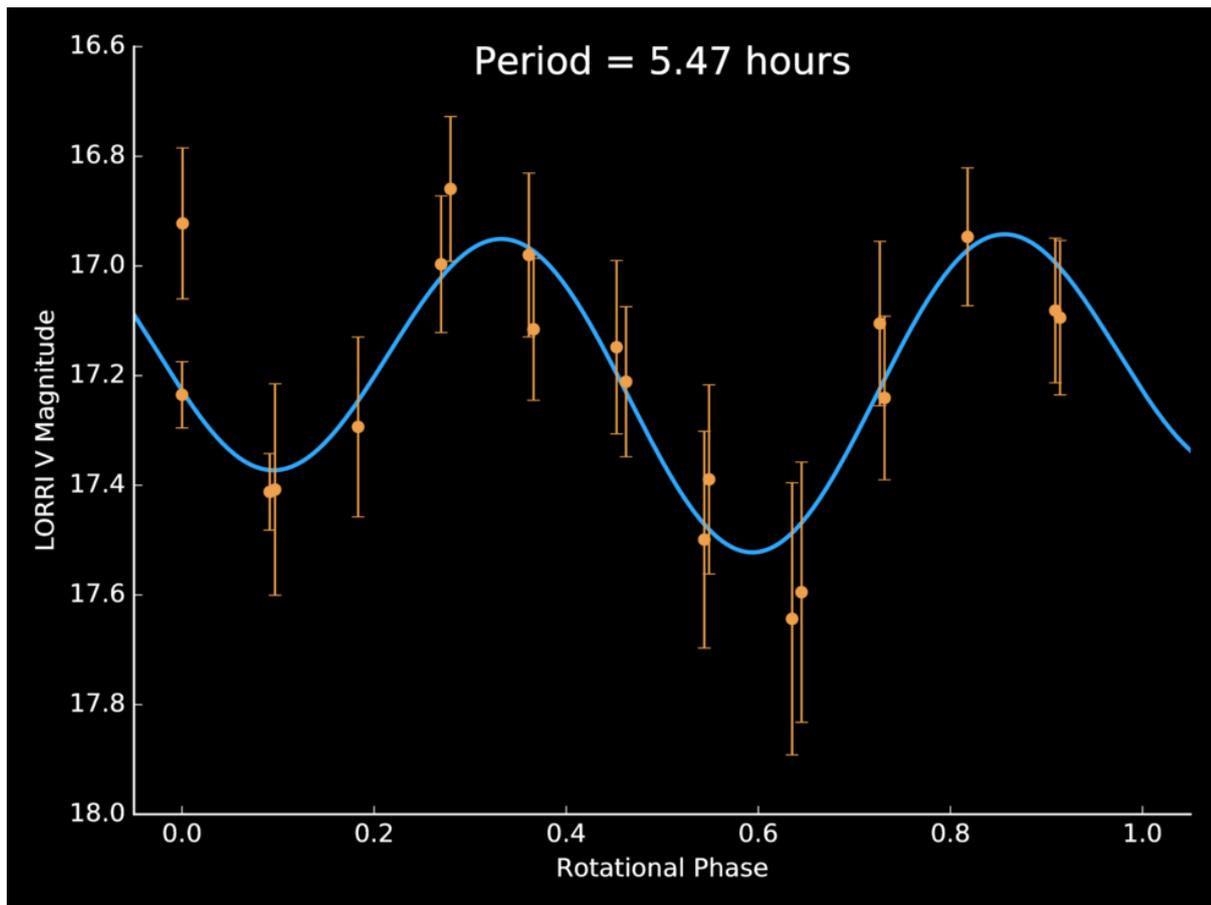
Europa's rocky, neighbouring Jovian moon, Io, is the most volcanically active body in the solar system, due to heat produced by the stretching and squeezing effects of Jupiter's gravity as it orbits the planet. Scientists have long considered it possible that Europa might also have volcanic activity, as well as hydrothermal vents, where mineral-laden hot water would emerge from the sea floor.

According to Vance, researchers previously speculated that volcanism is paramount for creating a habitable environment in Europa's ocean. If such activity is not occurring in its rocky interior, the thinking goes, the large flux of oxidants from the surface would make the ocean too acidic, and toxic, for life. "But actually, if the rock is cold, it's easier to fracture. This allows for a huge amount of hydrogen to be produced by serpentinization that would balance the oxidants in a ratio comparable to that in Earth's oceans," he said.

NASA is currently formulating a mission to explore Europa and investigate in depth whether the icy moon might be habitable.

[Europa's ocean may have an Earthlike chemical balance](#) (17 May 2016)

NEW HORIZONS COLLECTS FIRST SCIENCE ON A POST-PLUTO OBJECT



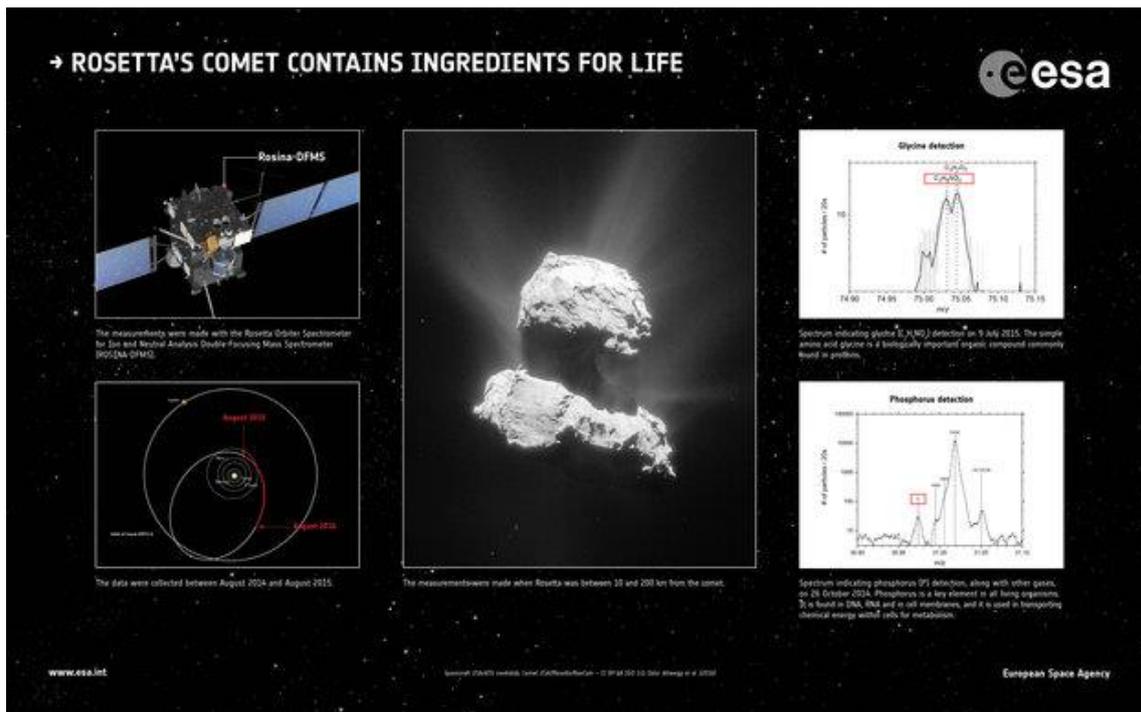
New

Horizons scientists used light curve data – the variations in the brightness of light reflected from the object's surface – to determine JR1's rotation period of 5.4 hours. Credits: NASA/JHUAPL/SwRI

Warming up for a possible extended mission as it speeds through deep space, NASA's New Horizons spacecraft has now twice observed 1994 JR1, a 90-mile (145-kilometer) wide Kuiper Belt object (KBO) orbiting more than 5 billion kilometers from the sun. From the closer vantage point of April 2016 observations, the team determined the object's rotation period, observing the changes in light reflected from JR1's surface to determine that it rotates once every 5.4 hours (or a JR1 day). That's relatively fast for a KBO.

[New Horizons collects first science on a post-Pluto object](#) (18 May 2016)

ROSETTA'S COMET CONTAINS INGREDIENTS FOR LIFE



Credit: ESA

Ingredients regarded as crucial for the origin of life on Earth have been discovered at the comet that ESA's Rosetta spacecraft has been probing for almost two years. They include the amino acid glycine, which is commonly found in proteins, and phosphorus, a key component of DNA and cell membranes. Scientists have long debated the important possibility that water and organic molecules were brought by asteroids and comets to the young Earth after it cooled following its formation, providing some of the key building blocks for the emergence of life. While some comets and asteroids are already known to have water with a composition like that of Earth's oceans, Rosetta found a significant difference at its comet – fuelling the debate on their role in the origin of Earth's water. But new results reveal that comets nevertheless had the potential to deliver ingredients critical to establish life as we know it.

[Rosetta's comet contains ingredients for life](#) (27 May 2016)

MINXSS CUBESAT DEPLOYED FROM ISS TO STUDY SUN'S SOFT X-RAYS



Astronaut Tim Peake on board the International Space Station captured this image of a CubeSat deployment on May 16, 2016. The bottom-most CubeSat is the NASA-funded MinXSS CubeSat, which observes soft X-rays from the sun -- such X-rays can disturb the ionosphere and thereby hamper radio and GPS signals. Credits: ESA/NASA

On May 16, 2016, the bread loaf-sized Miniature X-Ray Solar Spectrometer, or MinXSS, CubeSat deployed from an airlock on the International Space Station to begin its journey into space. The NASA-funded MinXSS studies emissions from the sun that can affect our communications systems.

MinXSS will operate for up to 12 months. The CubeSat observes soft X-rays from the sun, which can disrupt Earth's upper atmosphere and hamper radio and GPS signals traveling through the region. The intensity of the soft x-ray emissions emitted from the sun is continuously changing over a large range – with peak emission levels occurring during large eruptions on the sun called solar flares.

MinXSS data will also help us understand the physics behind solar flares. The soft X-rays carry information about the temperature, density and chemical composition of material in the sun's atmosphere, allowing scientists to trace how events like flares and other processes heat the surrounding material in the sun's atmosphere – which are still being debated among solar scientists.

CubeSats are a new, low-cost tool for space science missions. Instead of the traditional space science missions that carry a significant number of custom-built, state-of-the-art instruments, CubeSats are designed to take narrowly targeted scientific observations, with only a few instruments, often built from off-the-shelf components. For example, MinXSS uses a commercially purchased X-ray spectrometer for a detector and an extendable tape measure as a radio antenna. The MinXSS development program was funded by the NASA Science Mission Directorate CubeSat Initiative Program and implemented by the University of Colorado Boulder under the leadership of Principal Investigator Tom Woods.

MinXSS was launched via the NASA CubeSat Launch Initiative program on Dec. 6, 2015, aboard Orbital ATK's Cygnus spacecraft through NASA's Commercial Resupply Services contract. Since its inception in 2010, the CSLI has selected more than 120 CubeSats for launch and deployed 43 small satellites as part of the agency's Launch Services Program's [Educational Launch of Nanosatellite](#) Missions. [MinXSS CubeSat deployed from ISS to study Sun's soft x-rays](#) (16 May 2016)

VAN ALLEN PROBES REVEAL LONG-TERM BEHAVIOUR OF EARTH'S RING CURRENT



During periods when there are no geomagnetic storms impacting the area around Earth, high energy protons (with energy of hundreds of thousands of electronvolts, or keV; shown here in orange) carry a substantial electrical current that encircles the planet (also known as "the ring current"). Credit: Johns Hopkins APL

During periods when geomagnetic storms affect Earth, new low-energy protons (with energy of tens of thousands of electronvolts, or keV; shown here in magenta) enter the near-Earth region, enhancing the pre-existing ring current (orange). Credit: Johns Hopkins APL

New findings based on a year's worth of observations from NASA's Van Allen Probes have revealed that the ring current – an electrical current carried by energetic ions that encircles our planet – behaves in a much different way than previously understood.

The ring current lies at a distance of approximately 6,200 to 37,000 miles (10,000 to 60,000 km) from Earth. The ring current was hypothesized in the early 20th century to explain observed global decreases in the

Earth's surface magnetic field, which can be measured by ground magnetometers. The Van Allen Probes, launched in 2012, offer scientists the first chance in recent history to continuously monitor the ring current with instruments that can observe ions with an extremely wide range of energies. The RBSPICE instrument has captured detailed data of all types of these energetic ions for several years. After looking at one year of continuous ion data it became clear that there is a substantial, persistent ring current around the Earth even during non-storm times, which is carried by high-energy protons. During geomagnetic storms, the enhancement of the ring current is due to new, low-energy protons entering the near-Earth region. [Van Allen Probes reveal long-term behaviour of Earth's ring current](#) (19 May 2016)

LINKS TO OTHER SPACE AND ASTRONOMY NEWS PUBLISHED IN MAY 2016

ASTEROIDS

[Asteroid Sample Return Spacecraft Progressing Toward a September Launch](#) (23 March 2016)

NASA's asteroid sampling spacecraft, OSIRIS-REx, took an across-country journey of about 1,600 miles before it launches on its 509-million-mile journey to the asteroid Bennu.

ASTROPHYSICS

[Magnetospheric Multiscale \(MMS\) mission puts magnetic reconnection under the microscope](#) (12 May 2016)

A team led by Southwest Research Institute (SwRI) has made the first direct detection of the source of magnetic reconnection.

BLACK HOLES

[Intense wind found in the neighbourhood of a black hole](#) (9 May 2016)

An international team of astrophysicists, including Professor Phil Charles from the University of Southampton, have detected an intense wind from one of the closest known black holes to the Earth.

[How giant black holes formed so quickly](#) (24 May 2016)

Using data from NASA's Great Observatories, astronomers have found the best evidence yet for cosmic seeds in the early universe that should grow into supermassive black holes.

[Supermassive black holes in 'red geyser' galaxies cause galactic warming](#) (25 May 2016)

An international team of scientists, including the University of Kentucky's Renbin Yan, have uncovered a new class of galaxies, called "red geysers," with supermassive black hole winds so hot and energetic that stars can't form.

COMET

[First evidence of icy comets orbiting a sun-like star](#) (19 May 2016)

Astronomers have found the first evidence of comets around a star similar to the sun, providing an opportunity to study what our solar system was like as a 'baby'.

DWARF PLANETS

[2007 OR10: largest unnamed world in the solar system](#) (11 May 2016)

Dwarf planets tend to be a mysterious bunch. With the exception of Ceres, which resides in the main asteroid belt between Mars and Jupiter, all members of this class of minor planets in our solar system lurk in the depths beyond Neptune.

EARTH

[Sun glitter reveals coastal waves](#) (19 May 2016)

Sentinel-2A is demonstrating how it can be used to help forecast ocean waves around our coasts: sunlight reflected from the water surface reveals complex waves as they encounter the coastline and seafloor off the tip of Dorre Island, Western Australia.

[14 Galileo satellites now in orbit](#) (24 May 2016)

Named for the astronomer who pinpointed Earth's true position in the Solar System, the Galileo satellite navigation system that will help Europe find its way in the 21st century now has 14 satellites in orbit after today's double launch.

[New NASA instrument brings coasts and coral into focus](#) (31 May 2016)

A coastal scene with deep blue seas and a coral reef is beautiful to look at, but if you try to record the scene with a camera or a scientific instrument, the results are almost always disappointing.

EXOPLANETS

[Kepler mission announces largest collection of planets ever discovered](#) (10 May 2016)

NASA's Kepler mission has verified 1,284 new planets – the single largest finding of planets to date.

[Footprints of baby planets in a gas disk](#) (25 May 2016)

A new analysis of the ALMA data for a young star HL Tauri provides yet more firm evidence of baby planets around the star.

[Giant planet around very young star](#) (26 May 2016)

In contradiction to the long-standing idea that larger planets take longer to form, U.S. astronomers today announced the discovery of a giant planet in close orbit around a star so young that it still retains a disk of circumstellar gas and dust.

GALAXIES

[Second strongest shock wave found in merging galaxy clusters](#) (4 May 2016).

The discovery by a physics doctoral student at The University of Alabama in Huntsville (UAH) of the second-strongest merger shock in clusters of galaxies ever observed has generated excitement that is opening doors to further scientific exploration.

[Bright dusty galaxies are hiding secret companions](#) (6 May 2016)

A new University of Sussex study has cleared the air on what lies behind hot dust visible in the distant universe.

[Astronomers use new imaging software to detect double 'peanut shell' galaxy](#) (6 May 2016) Astronomers at Swinburne University of Technology, Melbourne, have discovered an unusually shaped structure in two nearby disc galaxies.

[New test by deepest galaxy map finds Einstein's theory stands true](#) (10 May 2016)

By using the Fiber Multi-Object Spectrograph (FMOS) on the Subaru Telescope, an international team led by Japanese researchers has made a 3D map of 3000 galaxies 13 billion light years from Earth.

[Small blue galaxy could shed new light on Big Bang](#) (12 May 2016)

A faint blue galaxy about 30 million light-years from Earth and located in the constellation Leo Minor could shed new light on conditions at the birth of the universe.

INTERNATIONAL SPACE STATION

[Dragon departure from International Space Station](#) (5 May 2016)

After delivering almost 7,000 pounds of cargo to the International Space Station, including the Bigelow

Expandable Activity Module (BEAM), the SpaceX Dragon cargo spacecraft is set to leave the orbital laboratory with valuable science research and return to Earth on Wednesday, May 11.

[Critical NASA science returns to Earth aboard SpaceX Dragon spacecraft](#) (11 May 2016)

A SpaceX Dragon cargo spacecraft splashed down in the Pacific Ocean at 2:51 p.m. EDT Wednesday, May 11, about 261 miles southwest of Long Beach, California, with more than 3,700 pounds of NASA cargo, science and technology demonstration samples from the International Space Station.

JAMES WEBB SPACE TELESCOPE

[Science instruments of James Webb Space Telescope installed](#) (24 May 2016)

With surgical precision, two dozen engineers and technicians successfully installed the package of science instruments of the James Webb Space Telescope into the telescope structure.

JUPITER AND MOONS

[Squeezing out mountains, mathematically, on Jupiter's moon Io](#) (17 May 2016)

Mountains aren't the first thing that hit you when you look at images of Jupiter's innermost moon, Io.

MARS

[Second ExoMars mission moves to next launch opportunity in 2020](#) (2 May 2016)

On 14 March 2016, the Roscosmos State Corporation and the European Space Agency (ESA) launched the jointly-developed ExoMars 2016 interplanetary mission, comprising the Trace Gas Orbiter (TGO) and the Schiaparelli lander, on a Proton rocket from Baikonur, thus marking the first phase in the European-Russian ExoMars cooperation programme.

[Although boiling, water does shape Martian terrain](#) (2 May 2016)

At present, liquid water on Mars only exists in small quantities as a boiling liquid, and only during the warmest time of day in summer.

<https://news.cnrs.fr/articles/leaving-a-mark-on-mars>

[Clues about volcanoes under ice on ancient Mars](#) (3 May 2016)

Volcanoes erupted beneath an ice sheet on Mars billions of years ago, far from any ice sheet on the Red Planet today, new evidence from NASA's Mars Reconnaissance Orbiter suggests.

[Flying observatory detects atomic oxygen in Martian atmosphere](#) (6 May 2016)

An instrument onboard the Stratospheric Observatory for Infrared Astronomy (SOFIA) detected atomic oxygen in the atmosphere of Mars for the first time since the last observation 40 years ago.

[Second cycle of Martian seasons completing for Curiosity rover](#) (11 May 2016)

NASA's Curiosity Mars rover today completes its second Martian year since landing inside Gale Crater nearly four Earth years ago, which means it has recorded environmental patterns through two full cycles of Martian seasons.

[Ancient tsunami evidence on Mars reveals life potential](#) (19 May 2016)

The geologic shape of what were once shorelines through Mars' northern plains convinces scientists that two large meteorites – hitting the planet millions of years apart – triggered a pair of mega-tsunamis.

[Are mystery Mars plumes caused by space weather?](#) (23 May 2016)

Mysterious high-rise clouds seen appearing suddenly in the Martian atmosphere on a handful of occasions may be linked to space weather, say Mars Express scientists.

[Radar finds ice age record in Mars' polar cap](#) (26 May 2016)

Scientists using radar data from NASA's Mars Reconnaissance Orbiter (MRO) have found a record of the most recent Martian ice age recorded in the planet's north polar ice cap.

PLUTO

[Pluto's interaction with the solar wind is unique](#) (4 May 2016)

Pluto behaves less like a comet than expected and somewhat more like a planet like Mars or Venus in the way it interacts with the solar wind, a continuous stream of charged particles from the sun.

[Icy Hydra](#) (6 May 2016)

NASA's New Horizons spacecraft has sent home the first compositional data about Pluto's four small satellites.

[First stellar occultations shed additional light on Pluto's atmosphere](#) (18 May 2016)

Scientists on NASA's New Horizons team say the spacecraft succeeded in observing the first occultations of Pluto's atmosphere by ultraviolet stars, an important goal of the mission's Pluto encounter.

SATURN AND MOONS

[Enceladus jets: surprises in starlight](#) (6 May 2016)

During a recent stargazing session, NASA's Cassini spacecraft watched a bright star pass behind the plume of gas and dust that spews from Saturn's icy moon Enceladus.

STARS AND STAR CLUSTERS

[Three potentially habitable worlds found around nearby ultra-cool dwarf star](#) (2 May 2016)

Astronomers using the TRAPPIST telescope at ESO's La Silla Observatory have discovered three planets orbiting an ultra-cool dwarf star just 40 light-years from Earth.

[Star with different internal driving force than the sun](#) (4 May 2016)

A star like the Sun has an internal driving in the form of a magnetic field that can be seen on the surface as sunspots.

[Silicate stardust traces histories of dust in the galaxy](#) (6 May 2016)

NASA scientists are revealing the histories of dust particles from dying stars that roved the Galaxy for millions of years before the sun and planets formed.

[Did star formation regulation change as the universe evolve?](#) (11 May 2016)

An international team led by scientists at the Subaru Telescope and Eidgenössische Technische Hochschule (ETH) Zürich in Switzerland used the W. M. Keck Observatory to study the role of star formation rates in metal contents of distant galaxies.

[Star has four mini-Neptunes orbiting in lock step](#) (11 May 2016)

A four-planet system observed several years ago by the Kepler spacecraft is actually a rarity: Its planets, all miniature Neptunes nestled close to the star, are orbiting in a unique resonance that has been locked in for billions of years.

[Other suns got the right spin](#) (17 May 2016)

Astrophysicists from the Leibniz Institute for Astrophysics Potsdam (AIP) and the Johns Hopkins University in Baltimore have for the first time measured the rotation periods of stars in a cluster nearly as old as the Sun and found them to be similar.

[Stellar cannibalism transforms star into brown dwarf](#) (18 May 2016)

Astronomers have detected a sub-stellar object that used to be a star, after being consumed by its white dwarf companion.

SUPERNOVA

[Supernova reserve fuel tank clue to big parents](#) (19 May 2016)

Some supernovae have a reserve tank of radioactive fuel that cuts in and powers their explosions for three times longer than astronomers had previously thought.

TECHNOLOGY

[NASA invests in next stage of visionary technology development](#) (13 May 2016)

NASA has selected eight technology proposals for investment that have the potential to transform future aerospace missions, introduce new capabilities, and significantly improve current approaches to building and operating aerospace systems.

[Clyde Space 'catapults' to more success](#) (16 May 2016)

Clyde Space, Scotland's leading-edge space technology company, is to provide the satellites for a new pilot programme offering quick, regular and more affordable access to space.

[Ariane 6 is taking shape](#) (18 May 2016)

Demonstrating that Ariane 6 is forging ahead for a 2020 debut the engine that will power the upper stage of Europe's next-generation launcher completed its first test last week.

[Eu:CROPIS – greenhouses for the Moon and Mars](#) (24 May 2016) Space missions are a bit like a marathon with checkpoints – only once the first model of a satellite has been successfully tested will construction commence on the actual flight model.

UNIVERSE

[Establishing an early-universe observatory in Chile](#) (12 May 2016)

\$38.4 million has been given by the Simon's Foundation to establish a new astronomy facility in Chile's Atacama Desert, adding new telescopes and new detectors to existing instruments in order to boost ongoing studies of the evolution of the universe, from its earliest moments to today. The Heising-Simons Foundation is providing an additional \$1.7 million to support the project.

Pat Williams. May 2016