

# Space News Update – December 2015

*By Pat Williams*

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

## AMERICAN, RUSSIAN AND BRITON JOIN INTERNATIONAL SPACE STATION CREW.



*In the Integration Facility at the Baikonur Cosmodrome in Kazakhstan, Expedition 46-47 crewmembers Tim Peake of the European Space Agency (left), Yuri Malenchenko of the Russian Federal Space Agency (Roscosmos, centre) and Tim Kopra of NASA (right) pose for photos in front of their Soyuz TMA-19M spacecraft during a crew fit check. The trio will launch Dec. 15 from Baikonur for a six-month mission on the International Space Station.*

*Image credit: NASA/Victor Zelentsov.*

### Next space station crew launch (7 December 2015)

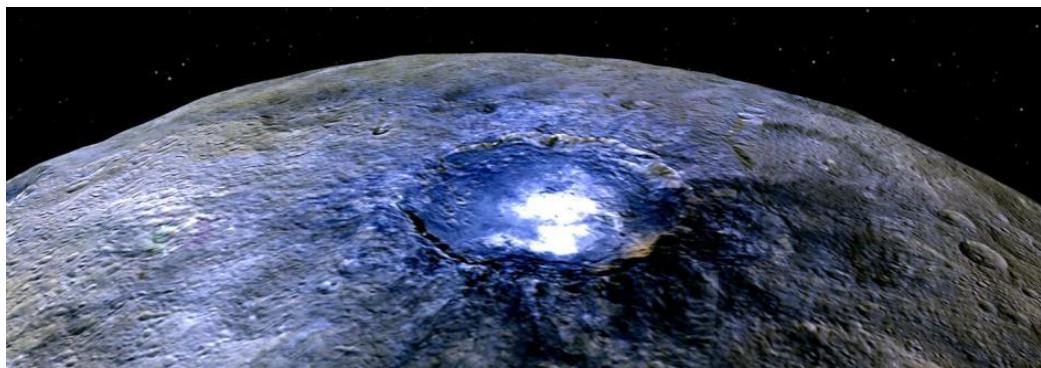
The next three crew members bound for the International Space Station are set to launch on Tuesday, Dec. 15.

### American, Russian and Briton join International Space Station crew (15 December 2015)

Hatches between the International Space Station and an arriving Soyuz spacecraft opened at 2:58 p.m. EST Tuesday, signalling the arrival of three new crew members, including NASA astronaut Tim Kopra.

*The link immediately above takes you to the ongoing blog of what has happened and details of the work that is currently being carried out on the ISS. (PW)*

## **DAWN MISSION TEAM REPORTS FIRST RESULTS FROM CERES**



*Occator Crater on Ceres (shown in false color) hosts several mysterious bright spots. Mission scientists have published their first hypothesis for what those spots might be and how they formed.*

*Image credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA*

The second paper published offers a clue about mysterious bright spots first imaged by Dawn during its approach. Ceres itself is very dark. It's one of the darkest asteroids visited, but these spots were much, much brighter than everything else on the surface. The analysis suggested that the spots are deposits of salt but it's not entirely clear yet how the deposits got there. One possibility is that an impact dredged up a briny mixture of salt and water ice from Ceres' subsurface. As the ice sublimated away, the salt deposits were left behind. This is a viable hypothesis but analysis of more spectroscopic data which Dawn is gathering right now is needed to find a definitive answer. Now that the spacecraft has reached its lowest orbit, it can gather much higher resolution images of surface features. Scientists will now be able to use an instrument in Dawn's payload that hasn't been used at Ceres yet — the neutron and gamma ray spectrometer.

[Dawn mission team reports first results from Ceres](#) (10 December 2015)

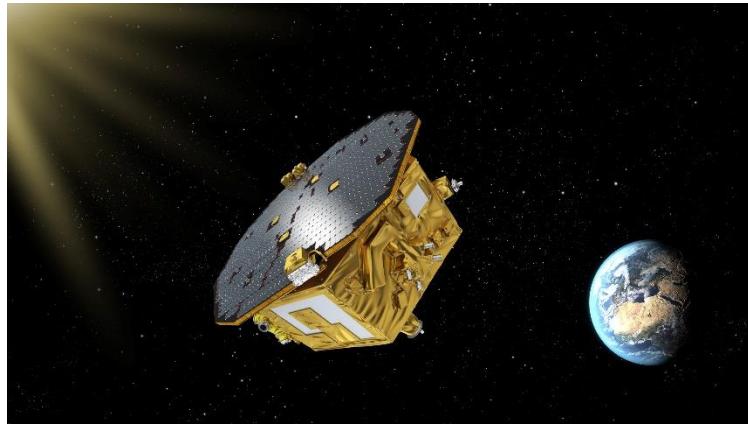


*This image of Ceres was taken in Dawn's low-altitude mapping orbit around a crater chain called Gerber Catena. (A 3-D view is also available.) Image credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA*

Dawn took these images of the southern hemisphere of Ceres on Dec. 10, at an approximate altitude of 240 miles (385 kilometers), which is its lowest-ever orbital altitude. Dawn will remain at this altitude for the rest of its mission, and indefinitely afterward. The resolution of the new images is about 120 feet (35 meters) per pixel. Among the striking views is a chain of craters called Gerber Catena, located just west of the large crater Urvara. Troughs are common on larger planetary bodies, caused by contraction, impact stresses and the loading of the crust by large mountains -- Olympus Mons on Mars is one example. The fracturing found all across Ceres' surface indicates that similar processes may have occurred there, despite its smaller size (the average diameter of Ceres is 584 miles, or 940 kilometers). Many of the troughs and grooves on Ceres were likely formed as a result of impacts, but some appear to be tectonic, reflecting internal stresses that broke the crust.

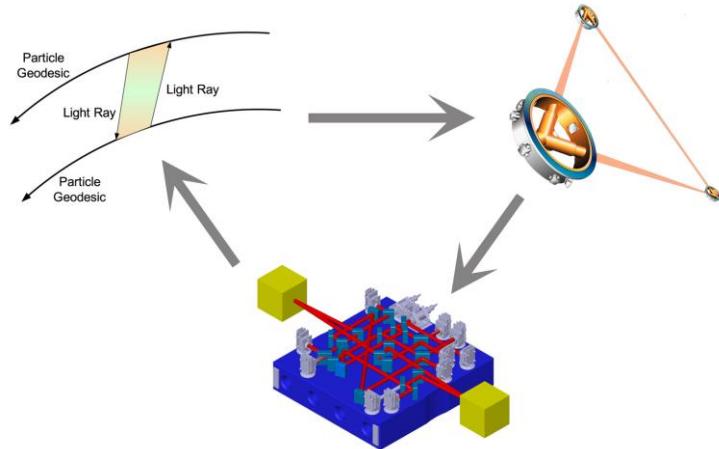
[Lowdown on Ceres: images from Dawn's closest orbit](#) (22 December 2015)

## LISA PATHFINDER TO PAVE THE WAY TO DETECTING GRAVITATIONAL WAVES.



*The LISA Pathfinder spacecraft, which launched on Dec. 3, 2015, from Kourou, French Guiana, will help pave the way for a mission to detect gravitational waves. Image credit: ESA*

[LISA Pathfinder carries advanced NASA thruster tech](#) (3 December 2015)



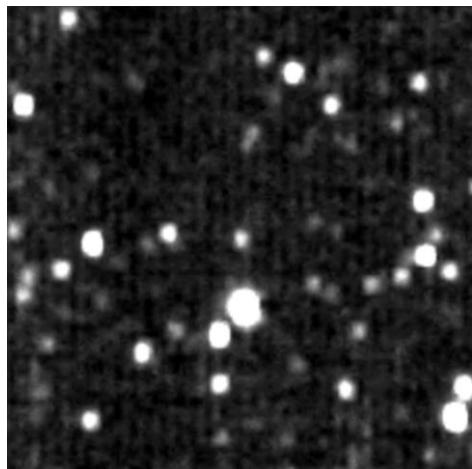
*LISA Pathfinder experiment concept. The top left image shows the classical Einstein thought experiment to measure spacetime curvature. This is the basis for all gravitational wave detectors, e.g. LISA (top right). LISA Pathfinder will not only pave the way for LISA, but will also demonstrate the main assumption of the thought experiment: that free particles follow geodesics. Courtesy: ESA*

ESA's LISA Pathfinder lifted off on 3<sup>rd</sup> December on a Vega rocket from Europe's spaceport in Kourou, French Guiana, on its way to demonstrate technology for observing gravitational waves from space. Arianespace marked another mission accomplished for science as its light-lift Vega vehicle successfully launched Europe's pioneering LISA Pathfinder technology demonstrator – which will study the ripples in space-time. Gravitational waves are ripples in the fabric of spacetime, predicted a century ago by Albert Einstein's General Theory of Relativity, published on 2 December 1915.

[Vega launches LISA Pathfinder space probe](#)

[LISA Pathfinder en route to gravitational wave demonstration](#) (3 December 2015)

## NEW HORIZONS' CAMERA CAPTURES A WANDERING KUIPER BELT OBJECT.



*Image credit: NASA/JHUAPL/SwRI*

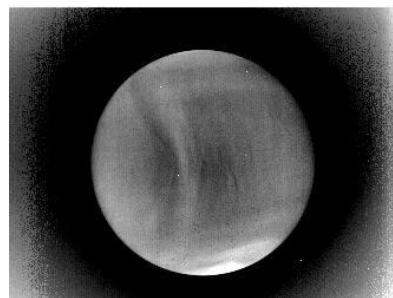
NASA's New Horizons spacecraft recently took the closest images ever of a distant Kuiper Belt object – demonstrating its ability to observe numerous such bodies over the next several years if NASA approves an extended mission into the Kuiper Belt.

In this still taken from a short animation, consisting of four frames taken by the spacecraft's Long Range Reconnaissance Imager (LORRI) on Nov. 2, and spaced an hour apart, one can see this 90-mile (150-kilometer)-wide ancient body, officially called 1994 JR1, moving against a background of stars. When these images were made, 1994 JR1 was 3.3 billion miles (5.3 billion miles) from the sun, but only 170 million miles (280 million kilometers) away from New Horizons. This sets a record, by a factor of at least 15, for the closest-ever picture of a small body in the Kuiper Belt, the solar system's "third zone" beyond the inner, rocky planets and outer, icy gas giants.

Mission scientists plan to use images like these to study many more ancient Kuiper Belt objects from New Horizons if an extended mission is approved. New Horizons flew through the Pluto system on July 14, making the first close-up observations of Pluto and its family of five moons. The spacecraft is on course for a close flyby of another Kuiper Belt object, 2014 MU69, on Jan. 1, 2019.

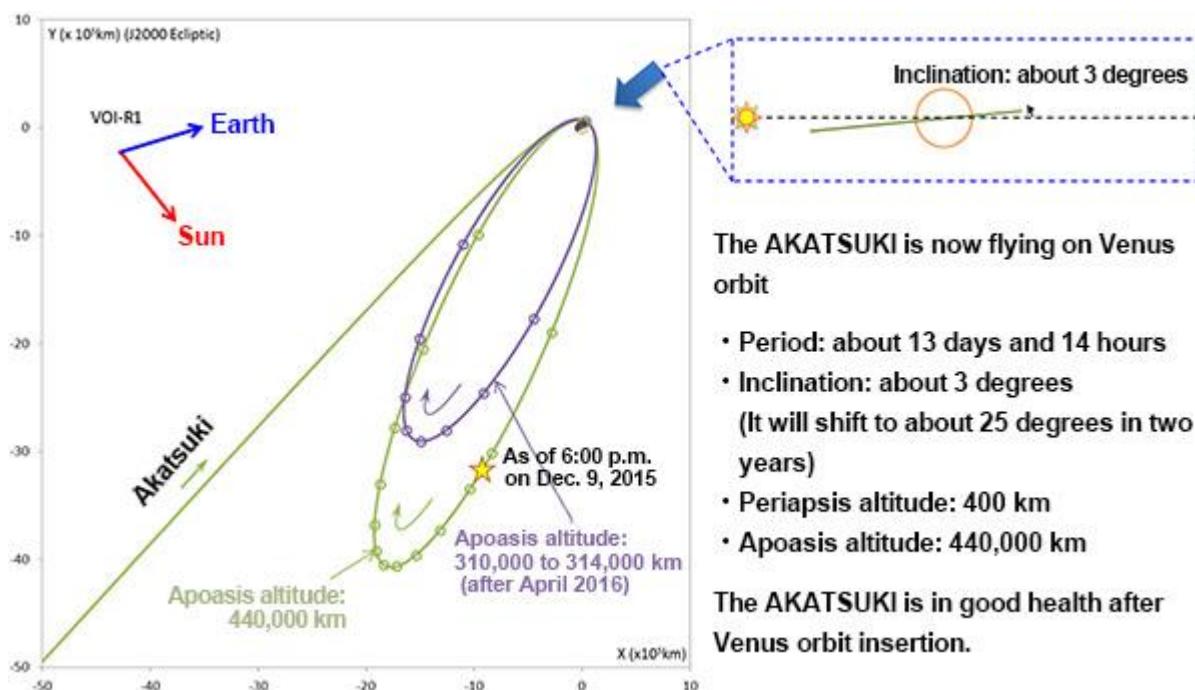
[New Horizons' camera captures a wandering Kuiper Belt object](#) (4 December 2015)

## VENUS CLIMATE ORBITER AKATSUKI INSERTED INTO VENUS' ORBIT.



*By Longwave IR camera (LIR) at around 2:19 p.m. on Dec. 7 (Japan Standard Time) at the Venus altitude of about 72,000 km. Image credit: JAXA*

## Orbit pattern diagram



**The AKATSUKI is now flying on Venus orbit**

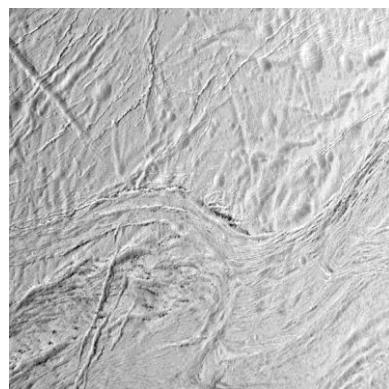
- Period: about 13 days and 14 hours
- Inclination: about 3 degrees  
(It will shift to about 25 degrees in two years)
- Periapsis altitude: 400 km
- Apoapsis altitude: 440,000 km

**The AKATSUKI is in good health after Venus orbit insertion.**

As a result of measuring and calculating the AKATSUKI's orbit after its thrust ejection, the orbiter is now flying on the elliptical orbit at the apoapsis altitude and is flying in the same direction as that of Venus's rotation. JAXA will deploy the three scientific mission instruments namely the  $2\mu\text{m}$  camera (IR2), the Lightning and Airglow Camera (LAC) and the Ultra-Stable oscillator (USO) and check their functions. They will then perform initial observations with the above three instruments along with the three other instruments whose function has already been confirmed, the Ultraviolet Imager (UVI), the Longwave IR camera (LIR), and the  $1\mu\text{m}$  camera (IR1) for about three months. At the same time, JAXA will also gradually adjust the orbit for shifting its elliptical orbit to the period of about nine days. The regular operation is scheduled to start in April, 2016.

[Venus Climate Orbiter Akatsuki inserted into Venus' orbit \(9 December 2015\)](#)

## CASSINI COMPLETES FINAL CLOSE ENCELADUS FLYBY.

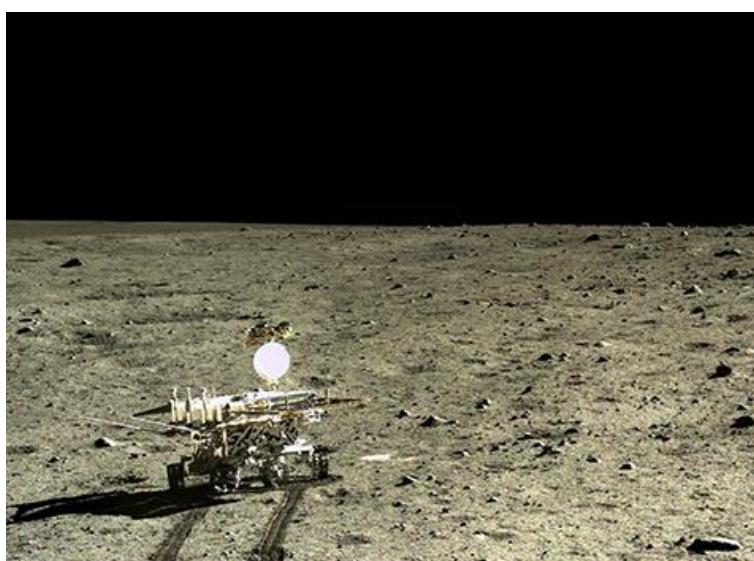


NASA's Cassini spacecraft captured this view featuring the nearly parallel furrows and ridges of the feature named Samarkand Sulci. *Image credit: NASA/JPL-Caltech/Space Science Institute*

NASA's Cassini spacecraft has begun transmitting data and images from the mission's final close flyby of Saturn's active moon Enceladus. Cassini passed Enceladus at a distance of 3,106 miles (4,999 kilometers) on Saturday, Dec. 19, at 9:49 a.m. PST (12:49 p.m. EST). Cassini will continue to monitor activity on Enceladus from a distance, through the end of its mission in Sept. 2017. Future encounters will be much farther away -- at closest, more than four times farther than this latest encounter. This was the 22nd Enceladus encounter of Cassini's mission. The spacecraft's discovery of geologic activity there, not long after arriving at Saturn, prompted changes to the mission's flight plan to maximize the number and quality of flybys of the icy moon. Does this tiny ocean world harbour life? After revealing Enceladus' surprising geologic activity in 2005, Cassini made a series of discoveries about the material gushing from warm fractures near its south pole. Scientists announced strong evidence for a regional subsurface sea in 2014, revising their understanding in 2015 to confirm that the moon hosts a global ocean beneath its icy crust.

[Cassini completes final close Enceladus flyby](#) (21 December 2015)

#### **CHINESE ROVER ANALYSES MOON ROCKS: FIRST NEW 'GROUND TRUTH' IN 40 YEARS.**



*The Chinese lunar rover, Yutu, photographed by its lander Chang'e-3, after the lander touched down in Mare Imbrium, a giant impact basin that had been filled by successive lava flows. Image credit: CNSA/CLEP*

In 2013, Chang'e-3, an unmanned lunar mission, touched down on the northern part of the Imbrium basin, one of the most prominent of the lava-filled impact basins visible from Earth. The basalts at the Chang'e-3 landing site also turned out to be unlike any returned by the Apollo and Luna sample return missions. The Moon, thought to have been created by the collision of a Mars-sized body with the Earth, began as a molten or partially molten body that separated as it cooled into a crust, mantle and core but the buildup of heat from the decay of radioactive elements in the interior then re-melted parts of the mantle, which began to erupt onto the surface some 500 million years after the Moon's formation, pooling in impact craters and basins to form the maria, most of which are on the side of the Moon facing the Earth. The basalts returned by the Apollo and Luna missions had either a high titanium content or low to very low titanium; intermediate values were missing. Measurements made by an alpha-particle X-ray spectrometer and a near-infrared hyperspectral imager aboard the Yutu rover indicated that the basalts at the Chang'e-3 landing site are intermediate in titanium, as well as rich in iron. Titanium is especially useful in mapping and understanding volcanism on the Moon because it varies so much in concentration, from less than 1 weight percent  $TiO_2$  to over 15 percent. This variation reflects significant differences in the mantle source regions that derive from the time when the early magma ocean first solidified.

[Chinese rover analyses Moon rocks: first new 'ground truth' in 40 years](#)  
(22 December 2015)

## **LINKS TO OTHER SPACE AND ASTRONOMY NEWS PUBLISHED IN DECEMBER 2015**

### **ASTEROIDS**

#### [ESA station tracks Earth flyby mission](#) (3 December 2015)

An ESA deep-space ground station will lend a helping ear as Japan's Hayabusa-2 asteroid mission visits Earth on Thursday.

### **ASTROPHYSICS**

#### [MMS delivers promising initial results](#) (18 December 2015)

Just under four months into the science phase of the mission, NASA's Magnetospheric Multiscale, or MMS, is delivering promising early results on a process called magnetic reconnection — a kind of magnetic explosion that's related to everything from the northern lights to solar flares.

#### [Mysterious radio signals from space are much better test of General Relativity](#) (30 December 2015)

A new way to test one of the basic principles underlying Einstein's theory of General Relativity using brief blasts of rare radio signals from space called Fast Radio Bursts is ten times, to one-hundred times better than previous testing methods that used gamma-ray bursts, according to a paper just published in the journal Physical Review Letters.

### **BLACK HOLES**

#### [Event Horizon Telescope reveals magnetic fields at Milky Way's central black hole](#)

(3 December 2015)

Most people think of black holes as giant vacuum cleaners sucking in everything that gets too close.

#### [Black holes could grow as large as 50 billion suns](#) (18 December 2015)

Black holes at the heart of galaxies could swell to 50 billion times the mass of the sun before losing the discs of gas they rely on to sustain themselves, according to research at the University of Leicester.

### **DARK MATTER**

#### [New results from experimental facility deepen understanding of dark matter](#) (29 December 2015)

The Large Underground Xenon (LUX) dark matter experiment, which operates nearly a mile underground at the Sanford Underground Research Facility (SURF) in the Black Hills of South Dakota, has already proven itself to be the most sensitive dark matter detector in the world.

### **EARTH**

#### [Plunging into the ionosphere: satellite's last days improve orbital decay predictions](#)

(15 December 2015)

Scientists are learning more about how the upper atmosphere and ionosphere affect space satellites as well as communications and navigation here on Earth, thanks to new data from a U.S. Air Force satellite that recently completed a more than seven-year mission.

#### [Auroral mystery solved: Sudden bursts caused by swirling charged particles](#) (21 December 2015)

Auroras are dimly present throughout the night in polar regions, but sometimes these lights explode in brightness.

### **EXOPLANETS**

#### [Exiled exoplanet likely kicked out of star's neighbourhood](#) (1 December 2015)

A planet discovered last year sitting at an unusually large distance from its star – 16 times farther than Pluto is from the sun – may have been kicked out of its birthplace close to the star in a process similar to what may have happened early in our own solar system's history.

### [Coupling up may make life possible on other planets](#) (1 December 2015)

Life on other planets? A recent study by UNLV astrophysicist Jason Steffen is shedding new light on this persistently challenging question.

### [Half of Kepler's giant exoplanet candidates are false positives](#) (2 December 2015)

An international team led by Alexandre Santerne from Instituto de Astrofísica e Ciências do Espaço (IA), made a 5-year radial velocity campaign of Kepler's giant exoplanet candidates, using the SOPHIE spectrograph (Observatory of Haute-Provence, France), and found that 52,3% were actually eclipsing binaries, while 2,3% were brown dwarfs.

### [What kinds of stars form rocky planets?](#) (3 December 2015)

As astronomers continue to find more and more planets around stars beyond our own Sun, they are trying to discover patterns and features that indicate what types of planets are likely to form around different kinds of stars.

### [Space telescopes solve missing water mystery in comprehensive survey of exoplanets](#)

(14 December 2015)

A survey of 10 hot, Jupiter-sized exoplanets conducted with NASA's Hubble and Spitzer space telescopes has led a team to solve a long-standing mystery — why some of these worlds seem to have less water than expected.

### [Giant planets carving paths around four young stars](#) (16 December 2015)

Astronomers using the Atacama Large Millimeter/submillimeter Array (ALMA) have found the clearest evidence yet that giant planets have recently formed around four young stars

### [Nearby star hosts a potentially habitable planet](#) (17 December 2015)

UNSW Australia astronomers have discovered the closest potentially habitable planet found outside our solar system so far, orbiting a star just 14 light years away.

### [Forbidden substances may influence properties of super-Earths](#) (24 December 2015)

Using mathematical models, scientists have "looked" into the interior of super-Earths and discovered that they may contain compounds that are forbidden by the rules of classical chemistry – and the presence of newly predicted substances may increase the heat transfer rate and strengthen the magnetic field on these planets.

## **GALAXIES AND GALAXY CLUSTERS**

### [ALMA spots monstrous baby galaxies cradled in dark matter](#) (4 December 2015)

Astronomers discovered a nest of monstrous baby galaxies 11.5 billion light-years away using the Atacama Large Millimeter/submillimeter Array (ALMA).

### [Observations provide crucial third dimension in probe of Universe's dark side](#) (15 December 2015)

ESO telescopes have provided an international team of astronomers with the gift of the third dimension in a plus-sized hunt for the largest gravitationally bound structures in the Universe — galaxy clusters.

### [New spin on star-forming galaxies](#) (15 December 2015)

Australian researchers have discovered why some galaxies are "clumpy" rather than spiral in shape—and it appears low spin is to blame.

## **GAMMA-RAY BURST**

### [Fermi satellite kicks off a blazar-detecting bonanza](#) (15 December 2015)

A long time ago in a galaxy half the universe away, a flood of high-energy gamma rays began its journey to Earth.

## INTERNATIONAL SPACE STATION

[Cygnus spacecraft launched on cargo delivery mission to ISS](#) (6 December 2015)



*Orbital ATK successfully launched its Cygnus spacecraft today aboard a United Launch Alliance (ULA) Atlas V launch vehicle with approximately 7,700 pounds (3,500 kilograms) of cargo for the crew aboard the International Space Station (ISS), beginning the company's fourth operational cargo resupply mission for NASA.*

*Image Credit: Orbital ATK*

Launch Aboard ULA Atlas V Rocket Is First of Four Cygnus Cargo Missions Scheduled for NASA Over the Next Year.

[Orbital ATK's Cygnus spacecraft berths with International Space Station](#) (9 December 2015)

Orbital ATK today announced that the "S.S. Deke Slayton II" Cygnus spacecraft successfully completed its rendezvous and berthing procedures with the International Space Station (ISS) earlier this morning.

[Astronauts complete space station mission, safely return to Earth](#)

(11 December 2015) The three Expedition 45 crew members returned to Earth Friday after a 141-day mission aboard the International Space Station, landing in Kazakhstan at approximately 8:12 a.m. EST (7:12 p.m. Kazakhstan time). While on station, the crew members participated in Earth observations and conducted research in the areas of physical, biological and molecular science to advance knowledge and demonstrate new technologies. Such investigations enable research breakthroughs and drive technology innovations that provide benefits on Earth, and will enable long-duration human and robotic exploration missions into deep space.

## MARS

[Study finds evidence for more recent clay formation on Mars](#) (14 December 2015)

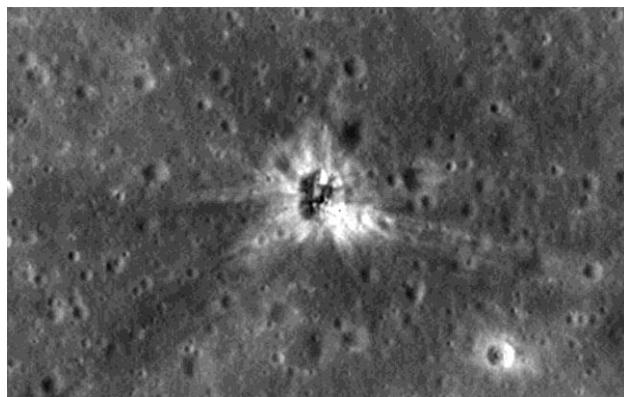
Recent orbital and rover missions to Mars have turned up ample evidence of clays and other hydrated minerals formed when rocks are altered by the presence of water.

[NASA suspends 2016 launch of InSight mission to Mars](#) (22 December 2015)

After thorough examination, NASA managers have decided to suspend the planned March 2016 launch of the Interior Exploration using Seismic Investigations Geodesy and Heat Transport (InSight) mission.

## MOON

[LRO finds Apollo 16 booster rocket impact site](#) (3 December 2015)



After decades of uncertainty, the Apollo 16 S-IVB impact site on the lunar surface has been identified.

*Image credit: NASA/Goddard/Arizona State University*

[LADEE shows the force of meteoroid strikes on lunar exosphere](#) (17 December 2015)

NASA scientists have released new findings about the moon's tenuous exosphere – the thin layer of gas surrounding the moon that's one 25-trillionth the density of Earth's atmosphere.

## PLUTO

[New Horizons returns the first of its very best images of Pluto](#) (4 December 2015)

NASA's New Horizons spacecraft has sent back the first few of a series of the sharpest views of Pluto it obtained during its July flyby – and this image sequence forms the best close-ups of Pluto that humans may see for decades.

## SATURN AND MOONS

[Cassini mission provides insight into Saturn](#) (30 November 2015)

Scientists have found the first direct evidence for explosive releases of energy in Saturn's magnetic bubble using data from the Cassini spacecraft, a joint mission between NASA, the European Space Agency, and the Italian Space Agency.

[How water escapes from Saturn](#) (3 December 2015)

A University of Montana professor who studies astrophysics has discovered how water ions escape from Saturn's environment. His findings recently were published in the journal Nature Physics.

## STARS AND STAR CLUSTERS

[Curious "inkblot" star outed for trolling the astronomers](#) (4 December 2015)

New images of an intriguing red giant star, known as CW Leo, have turned the usual astronomy

narrative on its head, with scrutiny focussed not only on the stars but also on the astronomers who study them.

[Mystery of 'born again' stars solved](#) (7 December 2015)

University of Texas astronomer Natalie Gosnell has used Hubble Space Telescope to better understand why some stars aren't evolving as predicted.

[Jupiter-like storm on small star](#) (10 December 2015)

Astronomers have discovered what appears to be a tiny star with a giant, cloudy storm, using data from NASA's Spitzer and Kepler space telescopes.

[Twisted magnetic fields give new insights on star formation](#) (21 December 2015)

Using new images that show unprecedented detail, scientists have found that material rotating around a very young protostar probably has dragged in and twisted magnetic fields from the larger area surrounding the star.

## SUPERNOVA

[Titan helps researchers explore explosive star scenarios](#) (8 December 2015)

Exploding stars may seem like an unlikely yardstick for measuring the vast distances of space, but astronomers have been mapping the universe for decades using these stellar eruptions, called supernovas, with surprising accuracy.

[Hubble captures first-ever predicted exploding star](#) (16 December 2015)

The NASA/ESA Hubble Space Telescope has captured the image of the first-ever predicted supernova explosion.

## SUN

[The sun could release flares 1000x greater than previously recorded](#) (2 December 2015)

The Sun demonstrates the potential to superflare, new research into stellar flaring suggests.

[VLA yields new insights on solar flares](#) (3 December 2015)

Astronomers have made a significant step toward confirming a proposed explanation for how solar flares accelerate charged particles to speeds nearly that of light.

[Saving STEREO-B](#) (11 December 2015)

On Oct. 1, 2014, NASA mission operations lost communication with one of the two spacecraft of the Solar and Terrestrial Relations Observatory, or STEREO, mission, just as the spacecraft was about to orbit around the other side of the sun.

[Previously unknown mechanism halts solar eruptions before they blast into space](#)

(23 December 2015)

Among the most feared events in space physics are solar eruptions, massive explosions that hurl millions of tons of plasma gas and radiation into space.

## TECHNOLOGY

[XCOR engineers announce major breakthrough in engine technology](#) (14 December 2015)

XCOR Director of Engineering and acting CTO Michael Valant announced today that his team has reached an important milestone in the development of the reusable 5K18 Lynx main propulsion rocket engine.

[Go for the burn: how to melt a satellite](#) (15 December 2015)

Imagine being confronted with half a tonne or more of metal and composite structures, electronics boxes and solar panels – an unwanted satellite. And then being handed a blowtorch and told to melt it into vapour.

[2D zero-g testing for space robotics](#) (21 December 2015)

A robotic arm reaches out to grapple a drifting satellite but its grip slips, pushing the space junk out into the void.

[U.S. demonstrates production of fuel for missions to the solar system and beyond](#)

(22 December 2015)

The first U.S. production in nearly 30 years of a specialized fuel to power future deep space missions has been completed by researchers at the Department of Energy's Oak Ridge National Laboratory (ORNL) in Tennessee.

## UNIVERSE

[Cosmic filaments exposed near huge clusters](#) (2 December 2015)

ESA's XMM-Newton X-ray observatory has revealed three massive filaments of hot gas flowing towards a cluster of galaxies, uncovering a portion of the cosmic skeleton that pervades the entire Universe.

[A new technique to gauge the distant universe](#) (3 December 2015)

Scientists have developed a technique to use quasars – powerful sources driven by supermassive black holes at the centre of galaxies – to study the Universe's history and composition.

[Origin of heavy elements in the universe](#) (8 December 2015)

In a letter published in the prestigious journal Nature Physics, a team of scientists from The Hebrew University of Jerusalem suggests a solution to the Galactic radioactive plutonium puzzle.

*Pat Williams. December 2015*