Space News Update

— September 8, 2017 —

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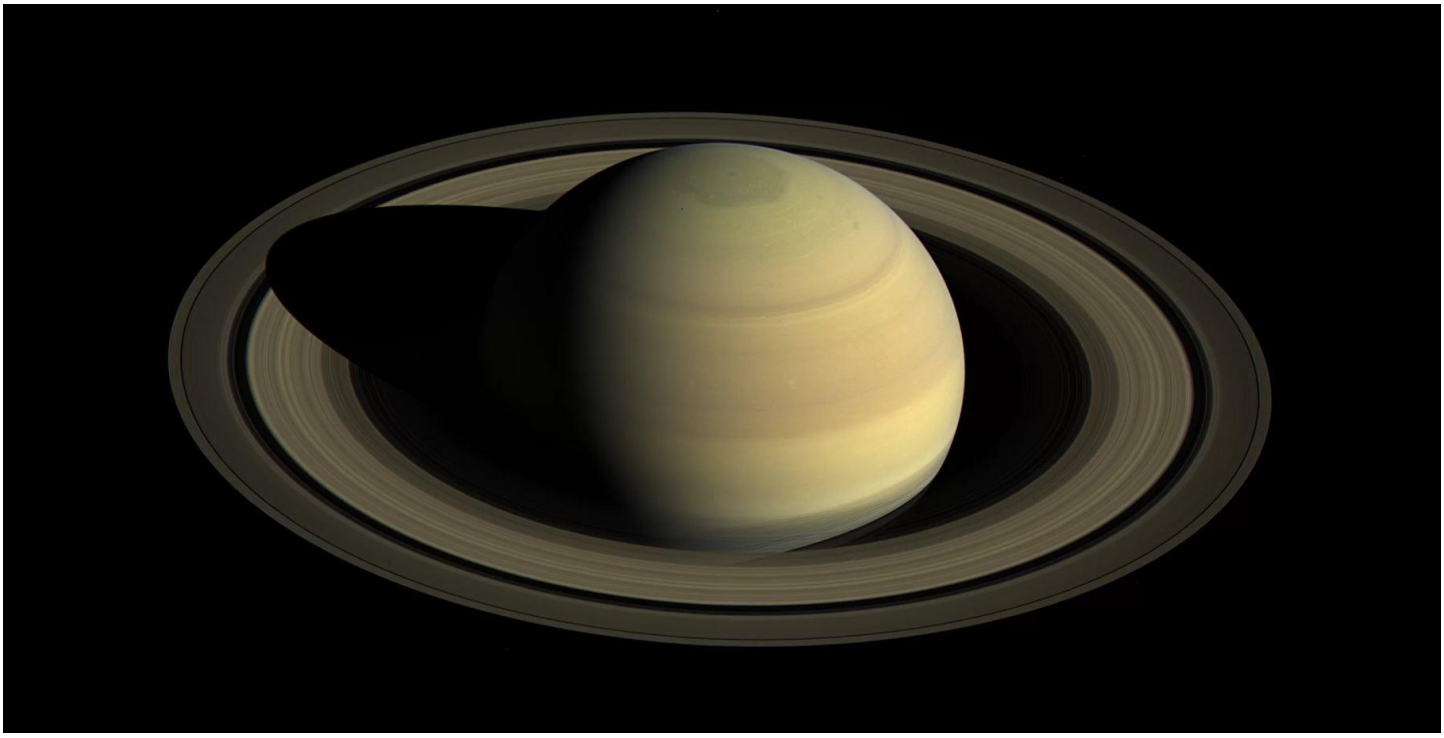
1. 1 Week Until Cassini's Fatal Saturn Dive: Here's How the Probe Will Spend Its Final Days



The one-week countdown has begun for the Cassini spacecraft's fatal dive into Saturn's atmosphere.

On Sept. 15, Cassini will dive straight into Saturn, collecting in-situ data from the planet's atmosphere and firing it back to Earth in the 1 to 2 minutes before breaking apart. The dive will bring a dramatic end to the probe's 13-year tenure in the Saturnian system, where it has unearthed many incredible and unexpected science discoveries.

This coming week is filled with activity for Cassini. Check out our complete coverage page for a full schedule of events and how to watch them.

On Saturday (Sept. 9), the probe will make the last of its 22 dives through Saturn's rings — a flight path that has produced some incredible views.

On Sept. 11, Cassini will make its last distant flyby of Saturn's largest moon, Titan. From a distance of 73,974 miles (119,049 kilometers), Titan's gravity will slow down Cassini. This will prove fatal for Cassini. On Sept. 15, instead of skimming the top of Saturn's atmosphere as it has done during its last few loops around the planet, the slower-moving Cassini will dip much deeper into the atmosphere. The probe may reach depths of up to 9,300 miles (15,000 kilometers) before breaking apart, according to mission scientists.

On Sept. 13 and 14, Cassini's cameras will take the probe's last images of the system.

On Sept. 15, starting at 4:37 a.m. EDT (0837 GMT), the "final plunge" will begin as the spacecraft gets into position to sample the atmosphere. Normally, there is at least an hours-long delay between when the probe collects data and transmits it back to Earth, but because Cassini will only be able to transmit for 1 to 2 minutes during the final plunge, the probe will send data within 2 to 3 seconds of collecting it, Cassini scientists have said. The spacecraft will transmit data back to Earth from eight of its 11 instruments, but it will not have

enough bandwidth to send images (which require larger data files), which is why the probe will take its final snapshots of the system on Sept. 14.

Cassini will enter Saturn's atmosphere at 7:53 a.m. EDT (1153 GMT), and will initially fire its thrusters at 10 percent capacity "to maintain directional stability, enabling the spacecraft's high-gain antenna to remain pointed at Earth and allowing continued transmission of data," NASA officials said in a statement. During the next 60 seconds, the probe will then ramp up its thrusters to 100 percent capacity in an attempt to keep the spacecraft's antennas pointed at Earth.

When Cassini reaches an altitude of about 940 miles (1,510 kilometers) above Saturn's cloud tops, "communication from the spacecraft will cease, and Cassini's mission of exploration will have concluded," the statement said. "The spacecraft will break up like a meteor moments later."

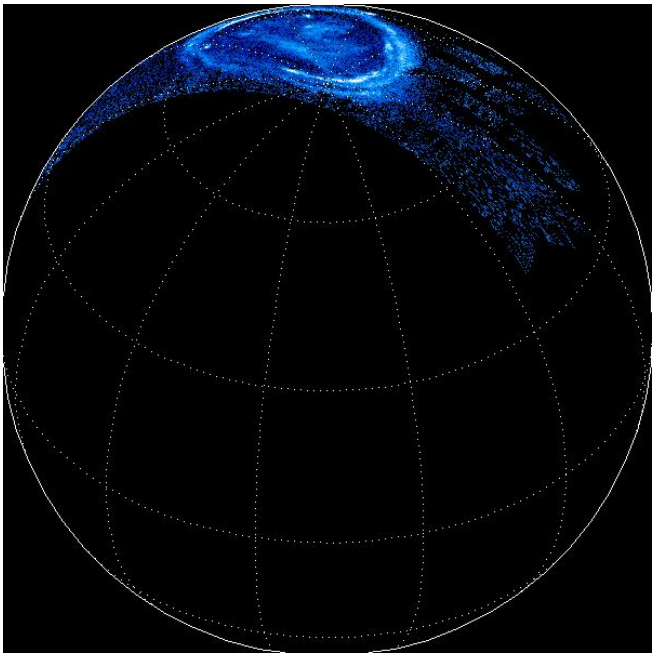
The probe's demise was planned by the Cassini team in anticipation of the spacecraft running out of fuel to steer itself around Saturn; because the mission will have to end anyway, the researchers decided to take the opportunity to get unique data from Saturn's atmosphere.

Cassini's destruction will serve another important purpose: protecting some of the planet's moons from Earth invaders. Saturn's moons Enceladus and Titan may possess environments that are fit to support life, and if Cassini is carrying bacteria or other miniature life-forms from Earth, planetary-protection scientists don't want those life-forms taking up residence on one of the moons. Just as invasive species on Earth can devastate native populations, an Earth-based life-form could overwhelm native life-forms on one of Saturn's moons. However unlikely such a scenario may be, its effects would be devastating. The proliferation of an Earth-based life-form on an alien moon could also make it harder for humans to identify alien life-forms in that location.

"The Cassini mission has been packed full of scientific firsts, and our unique planetary revelations will continue to the very end of the mission," said Linda Spilker, Cassini project scientist from NASA's Jet Propulsion Laboratory in Pasadena, California, said in a statement from the agency. "We'll be sending data in near real time as we rush headlong into the atmosphere — it's truly a first-of-its-kind event at Saturn."

Source: Space.com Return to Contents

2. Jupiter's Auroras Present a Powerful Mystery



Scientists on NASA's Juno mission have observed massive amounts of energy swirling over Jupiter's polar regions that contribute to the giant planet's powerful auroras - only not in ways the researchers expected.

Examining data collected by the ultraviolet spectrograph and energetic-particle detector instruments aboard the Jupiter-orbiting Juno spacecraft, a team led by Barry Mauk of the Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland, observed signatures of powerful electric potentials, aligned with Jupiter's magnetic field, that accelerate electrons toward the Jovian atmosphere at energies up to 400,000 electron volts. This is 10 to 30 times higher than the largest auroral potentials observed at Earth, where only several thousands of volts are typically needed to generate the most intense auroras -- known as discrete auroras -- the dazzling, twisting, snake-like northern and southern lights seen in places like Alaska and Canada, northern Europe, and many other northern and southern polar regions.

Jupiter has the most powerful auroras in the solar system, so the team was not surprised that electric potentials play a role in their generation. What's puzzling the researchers, Mauk said, is that despite the magnitudes of these potentials at Jupiter, they are observed only sometimes and are not the source of the most intense auroras, as they are at Earth.

"At Jupiter, the brightest auroras are caused by some kind of turbulent acceleration process that we do not understand very well," said Mauk, who leads the investigation team for the APL-built Jupiter Energetic Particle Detector Instrument (JEDI). "There are hints in our latest data indicating that as the power density of the auroral generation becomes stronger and stronger, the process becomes unstable and a new acceleration process takes over. But we'll have to keep looking at the data."

Scientists consider Jupiter to be a physics lab of sorts for worlds beyond our solar system, saying the ability of Jupiter to accelerate charged particles to immense energies has implications for how more distant astrophysical systems accelerate particles. But what they learn about the forces driving Jupiter's auroras and shaping its space weather environment also has practical implications in our own planetary backyard.

"The highest energies that we are observing within Jupiter's auroral regions are formidable. These energetic particles that create the auroras are part of the story in understanding Jupiter's radiation belts, which pose such a challenge to Juno and to upcoming spacecraft missions to Jupiter under development," said Mauk. "Engineering around the debilitating effects of radiation has always been a challenge to spacecraft engineers for missions at Earth and elsewhere in the solar system. What we learn here, and from spacecraft like NASA's Van Allen Probes and Magnetospheric Multiscale mission (MMS) that are exploring Earth's magnetosphere, will teach us a lot about space weather and protecting spacecraft and astronauts in harsh space environments. Comparing the processes at Jupiter and Earth is incredibly valuable in testing our ideas of how planetary physics works."

Mauk and colleagues present their findings in the Sept. 7 issue of the journal Nature.

Source: JPL

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3. Kennedy Space Center braces for Hurricane Irma

With an eye on fast-moving Hurricane Irma, SpaceX successfully launched a Falcon 9 rocket from the Kennedy Space Center Thursday while NASA and contractor personnel rushed to prepare the sprawling spaceport for extreme winds, torrential rain and a threatening storm surge.

Using historic pad 39A, SpaceX launched an Air Force X-37B spaceplane on time at 10 a.m. EDT (GMT-4), taking advantage of a relatively clear morning sky. Had the weather or some other problem prevented launch, the rocket and its Air Force payload would have been hauled back to a hangar to ride out the approaching storm.

Kennedy Space Center Director Bob Cabana said the NASA spaceport will be closed Friday through Monday except for a few essential work crews Friday and a "rideout" team of 130 to 140 people that will remain on site at the Launch Control Center through the weekend to monitor critical equipment and infrastructure.

"I'm concerned about the health and welfare of the Kennedy workforce," Cabana said in an interview with CBS News. "Getting everybody out of here tonight, and essential personnel tomorrow, allows the KSC team to make sure their homes and families are safe. So, big storm coming our way, and we're going to be ready for it."

Similar preparations were underway at the nearby Cape Canaveral Air Force Station.

Schools across Brevard County were closed Thursday until further notice and the state ordered mandatory evacuations of barrier islands along Florida's "Space Coast," including Merritt Island where the space center is located, effective Friday afternoon at 3 p.m.

The National Hurricane Center expects Hurricane Irma to sweep up Florida's east coast this weekend, passing directly over or close to the Kennedy Space Center overnight Saturday. The spaceport faced a similar threat last October from Hurricane Matthew, but the storm veered slightly east before reaching Cape Canaveral, and the dangerous eye passed by well offshore.

Even so, Matthew caused major damage at the spaceport, showing managers areas where improvements were needed.

"It certainly got us up to date on all our hurricane procedures," Cabana said. "We learned a few lessons from it that we've applied to make sure we're even better prepared for this one. … The latest weather brief that we've gotten shows it hasn't made up its mind yet, but it's coming our way, whether it goes right over or slightly to the east or west of us."

NASA's iconic Vehicle Assembly Building, the cavernous structure where Saturn 5 moon rockets and space shuttles were once assembled, was designed in the 1960s to withstand hurricane-force winds and Cabana said he believes it will weather Irma without any major problems.

Parked nearby is a new mobile launch platform being built to haul NASA's new Space Launch System rockets from the VAB to launch complex 39B where they eventually will be fired off on deep space voyages to the moon and beyond. The mobile launch tower is 40 feet square, 335 feet tall and weighs nearly seven million pounds.

"One of my biggest concerns this year is all the construction we have going on, specifically at the mobile launcher, installing all the systems in it," Cabana said. "There's a lot of loose equipment out there we had to make sure was secured. Folks got a good start on that yesterday, so we'll have everything secured (in time).

Out at pad 39B, workers rushed to finish on-going work installing a massive deflector in the "flame trench" where the SLS rocket's exhaust will be diverted to each side during the initial moments of flight.

"We've got that all secured," Cabana said. "The other major area that needed to be thoroughly secured was the Launch Environment Test Facility where we have some critical swing arms and umbilicals that are in test to be installed on the mobile launcher. That all was being worked on yesterday."

Pad 39B and 39A, now operated by SpaceX, are both just a few hundred yards from the Atlantic Ocean. Forecasters expect a five- to seven-foot storm surge that could cause problems for pad systems.

Critical systems at the space center have generator backup power and the rideout team will monitor them throughout the weekend. Monday afternoon, after tropical storm force winds subside, damage assessment teams will swing into action.

Cabana said one KSC office building that suffered roof leaks and water damage in the wake of Hurricane Matthew had only recently been repaired.

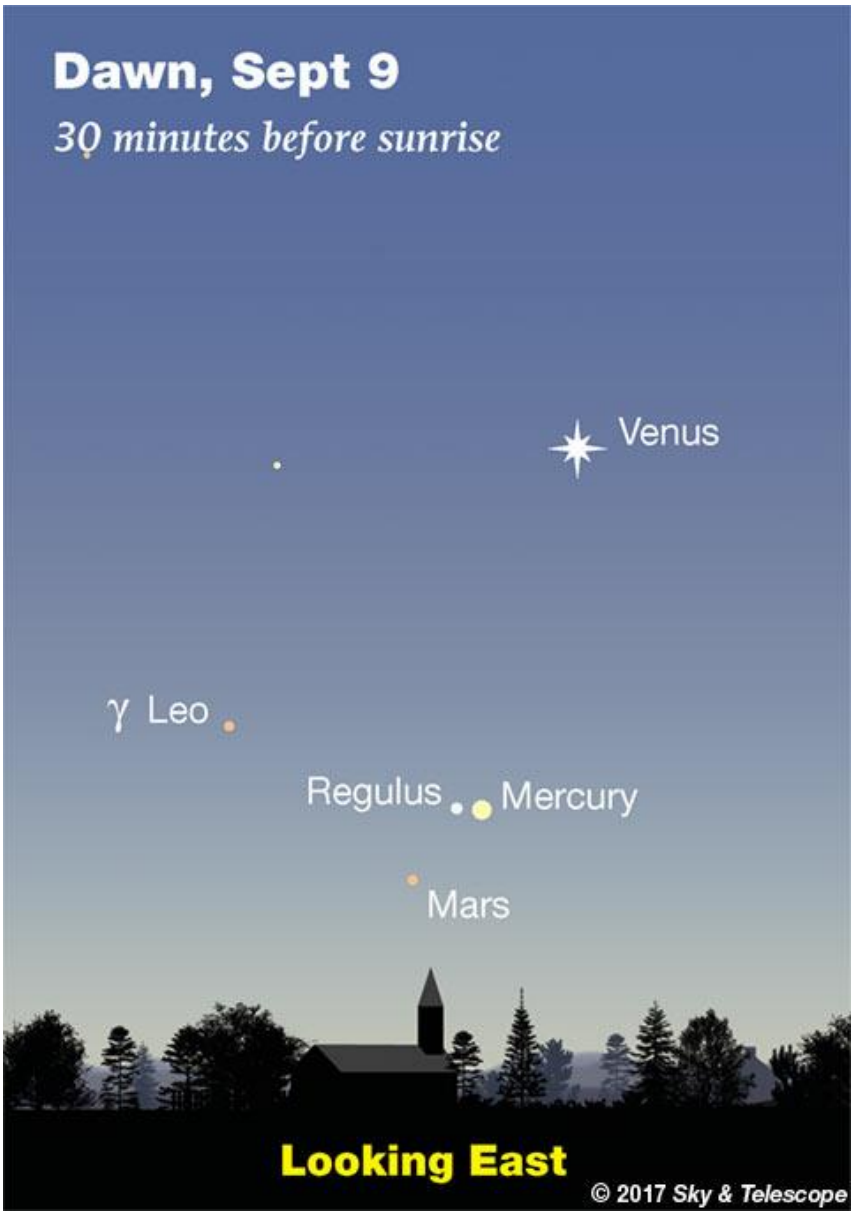
"Hopefully, we won't have any more roof leaks," he said. "Everybody just got back into their offices here about a month and a half ago. I'd sure hate to see that happen again. Hopefully, the repairs to the roof will withstand Irma."

Source: Spaceflight Now Return to Contents

The Night Sky

Friday, September 8

• *A dawn challenge:* Very low in the east as dawn brightens on Saturday morning September 9th, Mercury, now a respectable magnitude 0, glows 1° to the right of Regulus, magnitude 1.3, under bright Venus as shown here. Mars, fainter at magnitude 1.8, is about 3° farther lower left. Bring binoculars.



Saturday, September 9

• The changes deep in the eastern dawn continue. On Sunday morning the 10th, Mercury glows 1° or less to the *lower* right of Regulus, while Mars remains below.

Sunday, September 10

• As dusk turns to night, Arcturus twinkles due west. It's getting lower every week. Off to its right in the northwest, the Big Dipper is turning more and more level.

Monday, September 11

• Tomorrow morning the 12th, the last-quarter Moon approaches Aldebaran and then occults it for much of North America: before or during dawn in the West, and after sunrise in a (hopefully) blue sky farther east. The star disappears on the Moon's bright limb (as shown here) and reappears from behind the dark limb. See the September *Sky & Telescope*, page 50. Map and timetables.

Tuesday, September 12

• The Great Square of Pegasus is high in the east after dark, balancing on one corner. From the Square's left corner extends a big line of three 2nd-magnitude stars running to the lower left. They mark the head, backbone and leg of the constellation Andromeda. (The line of three includes the Square's corner.) Upper left from the end of this line, you'll find W-shaped Cassiopeia tilting up.

Source: Sky & Telescope

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ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Fri Sep 8, 4:43 AM	2 min	21°	21° above NNW	10° above NNE
Sat Sep 9, 3:53 AM	< 1 min	12°	12° above NE	12° above NE
Sat Sep 9, 5:26 AM	2 min	12°	10° above NNW	10° above N
Sun Sep 10, 4:35 AM	2 min	14°	14° above NNW	10° above NNE
Sun Sep 10, 6:12 AM	1 min	10°	10° above N	10° above NNE
Mon Sep 11, 5:19 AM	1 min	10°	10° above NNW	10° above N
Tue Sep 12, 4:28 AM	1 min	11°	11° above N	10° above NNE
Tue Sep 12, 6:04 AM	3 min	12°	10° above NNW	11° above NNE

Sighting information for other cities can be found at NASA's Satellite Sighting Information

NASA-TV Highlights

(all times Eastern Daylight Time)

- **2 p.m., 4 p.m., Friday, September 8 -** Video File of the ISS Expedition 53-54 Crew's Pre-Launch Media Day Activities at the Baikonur Cosmodrome in Kazakhstan (Misurkin, Vande Hei, Acaba) (all channels)
- **5 p.m., 9 p.m., Friday, September 8 -** Replay of SpaceCast Weekly (all channels)
- **8 p.m., Friday, September 8 -** Replay of the 2017 Women in STEM Forum - The Role of Men in Sustaining Women in STEM – Introduction by NASA Acting Administrator Robert Lightfoot – HQ (NTV-1) (NTV-1 (Public))
- **8 a.m., 4 p.m., Saturday, September 9 -** Replay of "Voyager 40th Anniversary" - Panel Discussion from NASA's Jet Propulsion Laboratory (all channels)
- **9 a.m., 5 p.m., Saturday, September 9 -** Replay of "Voyager - 40th Anniversary" from the Smithsonian's National Air and Space Museum and the Jet Propulsion Laboratory (all channels)
- **2 p.m., 6 p.m., 10 p.m., Saturday, September 9 -** Replay of SpaceCast Weekly (all channels)
- **9 a.m., Sunday, September 10 -** Video File of the ISS Expedition 53-54/ Soyuz MS-06 Rollout to the Launch Pad and Pad Interviews at the Baikonur Cosmodrome in Kazakhstan (recorded on Sept. 10) (all channels)
- **2 p.m., 6 p.m., 9 p.m., Sunday, September 10 -** Replay of SpaceCast Weekly (all channels)
- **4 p.m., Sunday, September 10 -** Replay of "Voyager 40th Anniversary" - Panel Discussion from NASA's Jet Propulsion Laboratory (all channels)
- **5 p.m., Sunday, September 10 -** Replay of "Voyager - 40th Anniversary" from the Smithsonian's National Air and Space Museum and the Jet Propulsion Laboratory (all channels)

- **11 a.m., 2 p.m., 5 p.m., 9 p.m., 11 p.m., Monday, September 11 -** ISS Expedition 52 Post-Flight News Conference (NASA Flight Engineers Peggy Whitson and Jack Fischer) (all channels)
- **4 p.m., 6 p.m., 10 p.m., Monday, September 11 -** Replay of the Russian State Commission Meeting and Final ISS Expedition 53-54 Pre-Launch Crew News Conference in Baikonur, Kazakhstan (Misurkin, Vande Hei, Acaba) (all channels)
- **4 p.m., Tuesday, September 12 -** ISS Expedition 53-54/Soyuz MS-06 Launch Coverage (Misurkin, Vande Hei, Acaba; includes video B-roll of the crew's launch day pre-launch activities at 4:30 p.m. ET; launch scheduled at 5:17 p.m. ET) (Starts at 4:15 p.m.) (all channels)
- **7 p.m., Tuesday, September 12 -** Video File of ISS Expedition 53-54/Soyuz MS-06 (Misurkin, Vande Hei, Acaba) Pre-Launch and Launch Video and Post-Launch Interviews (all channels)
- **10 p.m., Tuesday, September 12 -** ISS Expedition 53-54/Soyuz MS-06 Docking to the ISS Coverage (Misurkin, Vande Hei, Acaba; docking scheduled at 10:57 p.m. ET) (Starts at 10:15 p.m.) (all channels)

Watch NASA TV on the Net by going to the NASA website. Return to Contents

Space Calendar

- Sep 08 -  [Sep 01] 50th Anniversary (1967), Surveyor 5 Launch (Moon Lander)
- Sep 08 - Comet 73P-AQ/Schwassmann-Wachmann Closest Approach To Earth (1.138 AU)
- Sep 08 - Comet 14P/Wolf At Opposition (1.864 AU)
- Sep 08 - Asteroid 727 Nipponia Closest Approach To Earth (1.429 AU)
- Sep 08 - Asteroid 3594 Scotti Closest Approach To Earth (1.597 AU)
- Sep 08 - Asteroid 270553 Loureed Closest Approach To Earth (1.739 AU)
- Sep 08 - Asteroid 296907 Alexander Closest Approach To Earth (1.919 AU)
- Sep 08 - 25th Anniversary (1992), Geotail, Moon Flyby
- Sep 08 - Arthur Wahl's 100th Birthday (1917)
- Sep 08 - Hans Fichtner's 100th Birthday (1917)
- Sep 09 - Cassini, Distant Flyby of Daphnis, Atlas & Prometheus
- Sep 09 - Comet 73P-AR/Schwassmann-Wachmann Closest Approach To Earth (1.150 AU)
- Sep 09 - Comet 73P-AG/Schwassmann-Wachmann Closest Approach To Earth (1.152 AU)
- Sep 09 - Comet C/2014 B1 (Schwartz) Perihelion (9.558 AU)
- Sep 09 - Asteroid 6925 Susumu Occults HIP 21673 (5.1 Magnitude Star)
- Sep 09 - Asteroid 904 Rockefellia Occults HIP 30602 (6.4 Magnitude Star)
- Sep 09 - Apollo Asteroid 2015 FO124 Near-Earth Flyby (0.070 AU)
- Sep 09 - Asteroid 19383 Rolling Stones Closest Approach To Earth (0.963 AU)
- Sep 09 - Asteroid 876 Scott Closest Approach To Earth (1.674 AU)
- Sep 09 - Asteroid 1604 Tombaugh Closest Approach To Earth (1.718 AU)
- Sep 09 - 35th Anniversary (1982), Conestoga I Launch (1st Private Rocket)
- Sep 09 - 125th Anniversary (1892), Edward Barnard's Discovery of Jupiter Moon Amalthea
- Sep 09 - John Poynting's 165th Birthday (1852)
- Sep 09 - 210th Anniversary (1807), Parisi's Discovery of The Great Comet of 1807
- Sep 09-14 - Workshop on Particle Physics and Cosmology TOOLS, Corfu, Greece
- Sep 10 - Comet 73P-AP/Schwassmann-Wachmann Closest Approach To Earth (0.730 AU)
- Sep 10 - Comet P/2013 EW90 (Tenagra) At Opposition (3.829 AU)
- Sep 10 - Amor Asteroid 2017 OP68 Near-Earth Flyby (0.051 AU)
- Sep 10 - Asteroid 21619 Johnhopkins Closest Approach To Earth (1.388 AU)
- Sep 10 - Asteroid 3124 Kansas Closest Approach To Earth (1.531 AU)
- Sep 10 - Asteroid 8629 Chucklorre Closest Approach To Earth (1.629 AU)
- Sep 10 - Asteroid 3728 IRAS Closest Approach To Earth (1.693 AU)
- Sep 10 - Asteroid 8103 Fermi Closest Approach To Earth (1.985 AU)
- Sep 10 - Arthur Compton's 125th Birthday (1892)
- Sep 10 - James Keeler's 160th Birthday (1857)
- Sep 11 -  [Sep 04] 20th Anniversary (1997), Mars Global Surveyor, Mars Orbit Insertion
- Sep 11 -  [Sep 07] Amazonas 5 Proton-M/Briz-M Launch
- Sep 11 - Cassini, Distant Flyby of Titan
- Sep 11 - Aten Asteroid 2017 QK18 Near-Earth Flyby (0.038 AU)
- Sep 11 - Apollo Asteroid 2014 RC Near-Earth Flyby (0.039 AU)
- Sep 11 -  [Sep 03] Amor Asteroid 2017 QM35 Near-Earth Flyby (0.084 AU)
- Sep 11 - Asteroid 7225 Huntress Closest Approach To Earth (1.622 AU)
- Sep 11 - Asteroid 2653 Principia Closest Approach To Earth (1.623 AU)
- Sep 11 - Robert Crippen's 80th Birthday (1937)
- Sep 11 - James Jeans' 140th Birthday (1877)
- Sep 12 -  [Sep 05] Soyuz MS-6 Soyuz-FG Launch (International Space Station 52S)
- Sep 12 -  [Sep 05] 25th Anniversary (1992), 1st African-American Woman in Space (Mae Jemison)
- Sep 12 - Mercury At Its Greatest Western Elongation (18 Degrees)

- Sep 12 - Moon Occults Aldebaran
- Sep 12 - Comet 73P-P/Schwassmann-Wachmann Closest Approach To Earth (1.198 AU)
- Sep 12 - Comet 14P/Wolf Closest Approach To Earth (1.862 AU)
- Sep 12 - Comet 240P/NEAT At Opposition (1.923 AU)
- Sep 12 - Comet 49P/Arend-Rigaux Closest Approach To Earth (2.216 AU)
- Sep 12 - Comet 59P/Kearns-Kwee At Opposition (2.505 AU)
- Sep 12 - 25th Anniversary (1992), STS-47 Launch (Space Shuttle Endeavour, Spacelab-J)
- Sep 12 - 55th Anniversary (1962), John F. Kennedy's Moon Speech
- Sep 12 - Robert Farquhar's 85th Birthday (1932)

Source: JPL Space Calendar Return to Contents

Food for Thought

Are we being watched? Tens of other worlds could spot the Earth

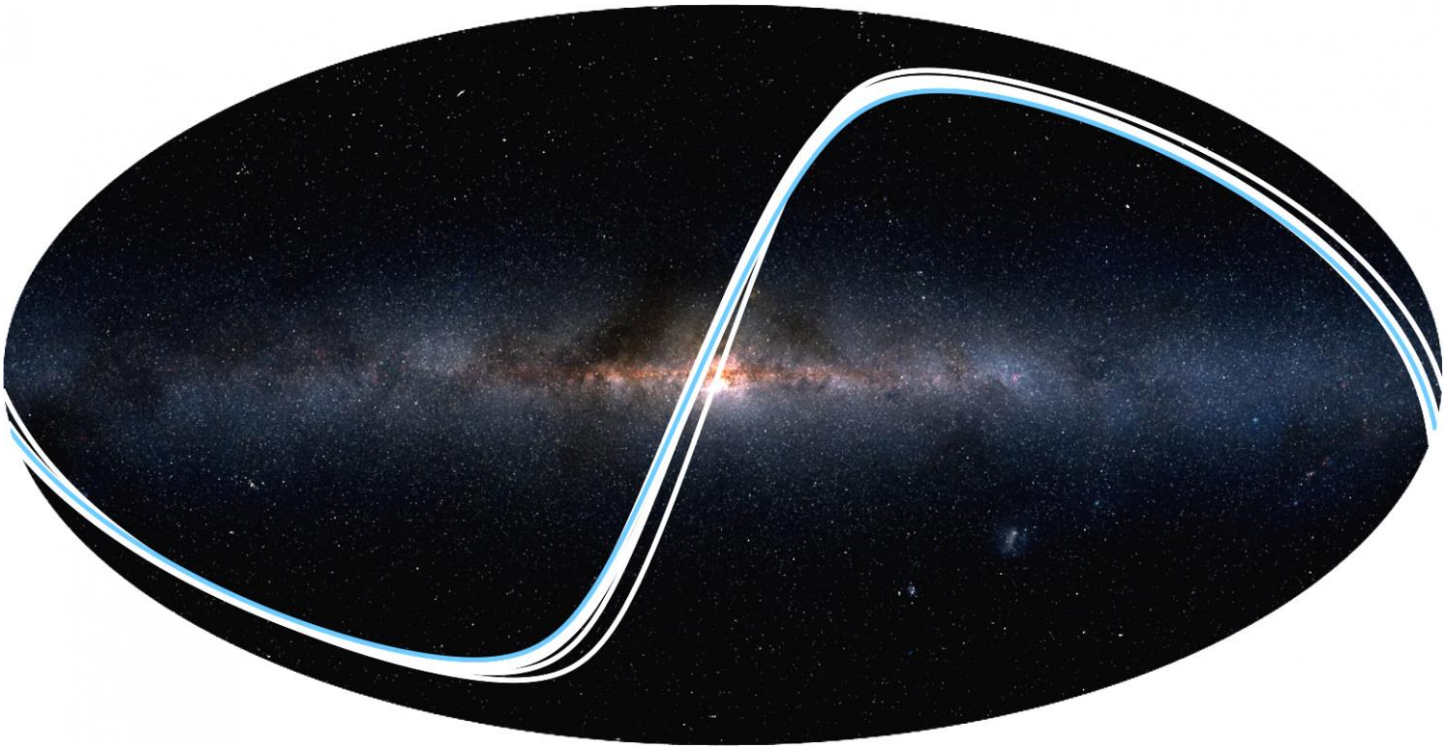


Image showing where transits of our Solar System planets can be observed. Each line represents where one of the planets could be seen to transit, with the blue line representing Earth; an observer located here could detect us. Credit: 2MASS / A. Mellinger / R. Wells

A group of scientists from Queen's University Belfast and the Max Planck Institute for solar system Research in Germany have turned exoplanet-hunting on its head, in a study that instead looks at how an alien observer might be able to detect Earth using our own methods. They find that at least nine exoplanets are ideally placed to observe transits of Earth, in a new work published in the journal *Monthly Notices of the Royal Astronomical Society*.

Thanks to facilities and missions such as SuperWASP and Kepler, we have now discovered thousands of planets orbiting stars other than our sun, worlds known as 'exoplanets'. The vast majority of these are found when the planets cross in front of their host stars in what are known as 'transits', which allow astronomers to see light from the host star dim slightly at regular intervals every time the planet passes between us and the distant star.

In the new study, the authors reverse this concept and ask, "How would an alien observer see the solar system?" They identified parts of the distant sky from where various planets in our solar system could be seen to pass in front of the sun – so-called 'transit zones'—concluding that the terrestrial planets (Mercury, Venus, Earth, and Mars) are actually much more likely to be spotted than the more distant 'Jovian' planets (Jupiter, Saturn, Uranus, and Neptune), despite their much larger size.

"Larger planets would naturally block out more light as they pass in front of their star", commented lead author Robert Wells, a PhD student at Queen's University Belfast. "However the more important factor is actually how close the planet is to its parent star – since the terrestrial planets are much closer to the sun than the gas giants, they'll be more likely to be seen in transit."

To look for worlds where civilisations would have the best chance of spotting our solar system, the astronomers looked for parts of the sky from which more than one planet could be seen crossing the face of the sun. They found that three planets at most could be observed from anywhere outside of the solar system, and that not all combinations of three planets are possible.

Katja Poppenhaeger, a co-author of the study, adds, "We estimate that a randomly positioned observer would have roughly a 1 in 40 chance of observing at least one planet. The probability of detecting at least two planets would be about ten times lower, and to detect three would be a further ten times smaller than this."

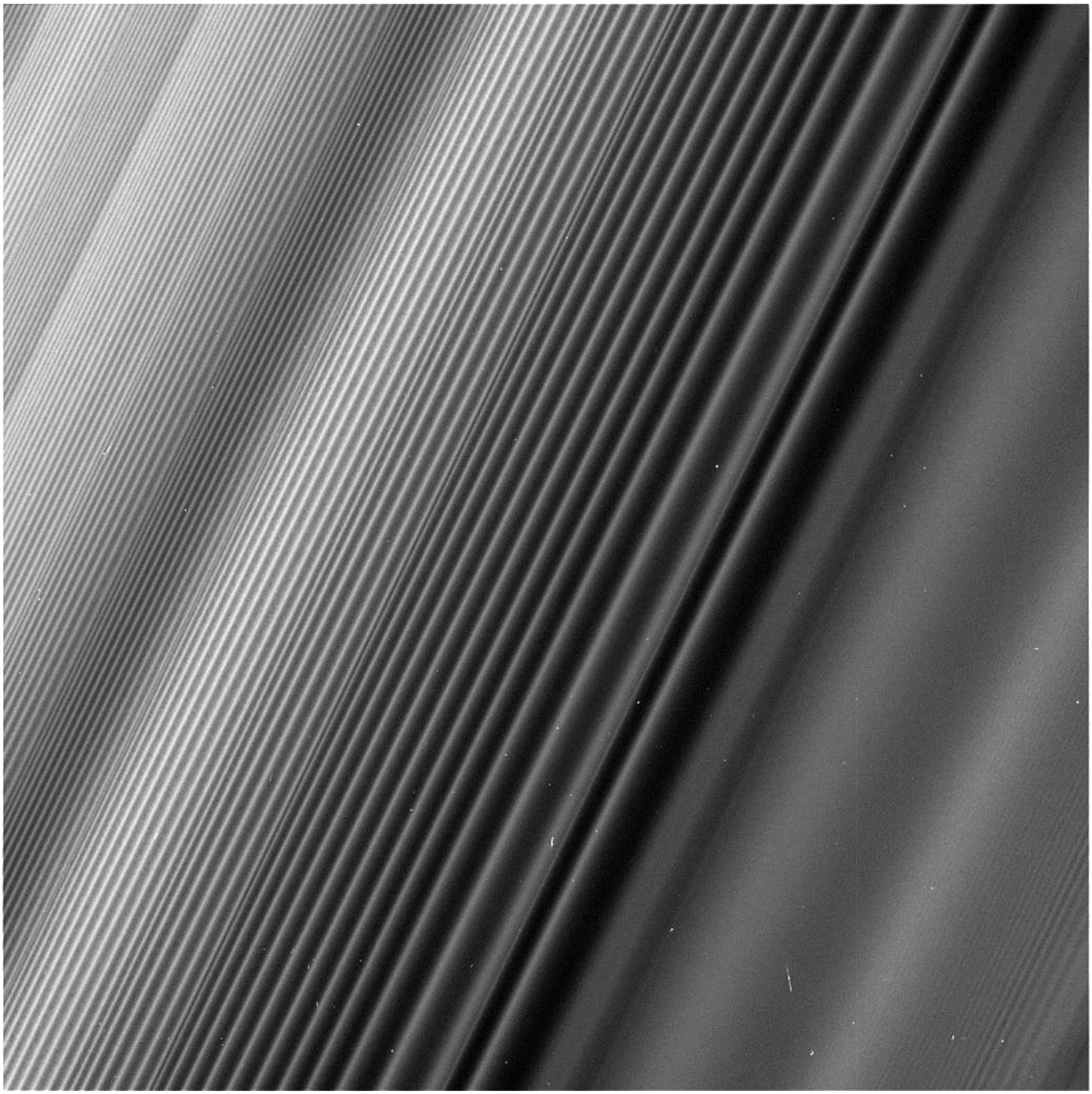
Of the thousands of known exoplanets, the team identified sixty-eight worlds where observers would see one or more of the planets in our solar system transit the sun. Nine of these planets are ideally placed to observe transits of Earth, although none of the worlds are deemed to be habitable.

In addition, the team estimate that there should be approximately ten (currently undiscovered) worlds which are favourably located to detect the Earth and are capable of sustaining life as we know it. To date however, no habitable planets have been discovered from which a civilisation could detect the Earth with our current level of technology.

The ongoing K2 mission of NASA's Kepler spacecraft is to continue to hunt for exoplanets in different regions of the sky for a few months at a time. These regions are centred close to the plane of Earth's orbit, which means that there are many target stars located in the transit zones of the solar system planets. The team's plans for future work include targeting these transit zones to search for exoplanets, hopefully finding some which could be habitable.

Source: Phys.org Return to Contents

Space Image of the Week



Staggering Structure

This view from NASA's Cassini spacecraft shows a wave structure in Saturn's rings known as the Janus 2:1 spiral density wave. Resulting from the same process that creates spiral galaxies, spiral density waves in Saturn’s rings are much more tightly wound. In this case, every second wave crest is actually the same spiral arm which has encircled the entire planet multiple times.

This is the only major density wave visible in Saturn's B ring. Most of the B ring is characterized by structures that dominate the areas where density waves might otherwise occur, but this innermost portion of the B ring is different.

The radius from Saturn at which the wave originates (toward lower-right in this image) is 59,796 miles (96,233 kilometers) from the planet. At this location, ring particles orbit Saturn twice for every time the moon Janus orbits once, creating an orbital resonance. The wave propagates outward from the resonance (and away from Saturn), toward upper-left in this view. For reasons researchers do not entirely understand, damping of waves by larger ring structures is very weak at this location, so this wave is seen ringing for hundreds of bright wave crests, unlike density waves in Saturn's A ring.

The image gives the illusion that the ring plane is tilted away from the camera toward upper-left, but this is not the case. Because of the mechanics of how this kind of wave propagates, the wavelength decreases with distance from the resonance. Thus, the upper-left of the image is just as close to the camera as the lower-right, while the wavelength of the density wave is simply shorter.

This wave is remarkable because Janus, the moon that generates it, is in a strange orbital configuration. Janus and Epimetheus (see PIA12602) share practically the same orbit and trade places every four years. Every time one of those orbit swaps takes place, the ring at this location responds, spawning a new crest in the wave. The distance between any pair of crests corresponds to four years' worth of the wave propagating downstream from the resonance, which means the wave seen here encodes many decades' worth of the orbital history of Janus and Epimetheus. According to this interpretation, the part of the wave at the very upper-left of this image corresponds to the positions of Janus and Epimetheus around the time of the Voyager flybys in 1980 and 1981, which is the time at which Janus and Epimetheus were first proven to be two distinct objects (they were first observed in 1966).

Epimetheus also generates waves at this location, but they are swamped by the waves from Janus, since Janus is the larger of the two moons.

This image was taken on June 4, 2017, with the Cassini spacecraft narrow-angle camera. The image was acquired on the sunlit side of the rings from a distance of 47,000 miles (76,000 kilometers) away from the area pictured. The image scale is 1,730 feet (530 meters) per pixel. The phase angle, or sun-ring-spacecraft angle, is 90 degrees.

Image Credit: NASA/JPL-Caltech/Space Science Institute

Source: NASA Return to Contents