Space News Update

— September 4, 2018 —

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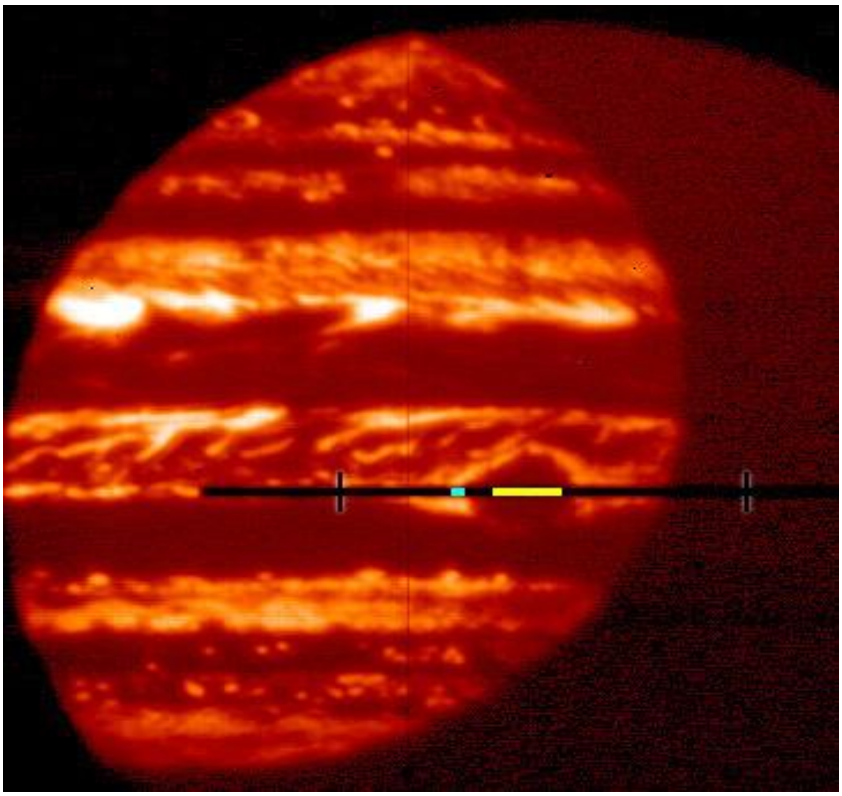
1. How a NASA Scientist Looks in the Depths of the Great Red Spot to Find Water on Jupiter



The Great Red Spot is the dark patch in the middle of this infrared image of Jupiter. It is dark due to the thick clouds that block thermal radiation. The yellow strip denotes the portion of the Great Red Spot used in astrophysicist Gordon L. Bjoraker's analysis. Credits: NASA's Goddard Space Flight Center/Gordon Bjoraker

For centuries, scientists have worked to understand the makeup of Jupiter. It's no wonder: this mysterious planet is the biggest one in our solar system by far, and chemically, the closest relative to the Sun. Understanding Jupiter is key to learning more about how our solar system formed, and even about how other solar systems develop.

But one critical question has bedeviled astronomers for generations: Is there water deep in Jupiter's atmosphere, and if so, how much?

Gordon L. Bjoraker, an astrophysicist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, reported in a recent paper in the Astronomical Journal that he and his team have brought the Jovian research community closer to the answer.

By looking from ground-based telescopes at wavelengths sensitive to thermal radiation leaking from the depths of Jupiter's persistent storm, the Great Red Spot, they detected the chemical signatures of water above the planet's deepest clouds. The pressure of the water, the researchers concluded, combined with their measurements of another oxygen-bearing gas, carbon monoxide, imply that Jupiter has 2 to 9 times more oxygen than the Sun. This finding supports theoretical and computer-simulation models that have predicted abundant water (H_2O) on Jupiter made of oxygen (O) tied up with molecular hydrogen (H_2).

This animation takes the viewer on a simulated flight into, and then out of, Jupiter's upper atmosphere at the location of the Great Red Spot. It was created by combining an image from the JunoCam imager on NASA's Juno spacecraft with a computer-generated animation. The perspective begins about 2,000 miles (3,000 kilometers) above the cloud tops of the planet's southern hemisphere. The bar at far left indicates altitude during the quick descent; a second gauge next to that depicts the dramatic increase in temperature that occurs as the perspective dives deeper down. The clouds turn crimson as the perspective passes through the Great Red Spot. Finally, the view ascends out of the spot.

The revelation was stirring given that the team's experiment could have easily failed. The Great Red Spot is full of dense clouds, which makes it hard for electromagnetic energy to escape and teach astronomers anything about the chemistry within.

"It turns out they're not so thick that they block our ability to see deeply," said Bjoraker. "That's been a pleasant surprise."

New spectroscopic technology and sheer curiosity gave the team a boost in peering deep inside Jupiter, which has an atmosphere thousands of miles deep, Bjoraker said: "We thought, well, let's just see what's out there."

The data Bjoraker and his team collected will supplement the information NASA's Juno spacecraft is gathering as it circles the planet from north to south once every 53 days.

Among other things, Juno is looking for water with its own infrared spectrometer and with a microwave radiometer that can probe deeper than anyone has seen — to 100 bars, or 100 times the atmospheric pressure at Earth's surface. (Altitude on Jupiter is measured in bars, which represent atmospheric pressure, since the planet does not have a surface, like Earth, from which to measure elevation.)

If Juno returns similar water findings, thereby backing Bjoraker's ground-based technique, it could open a new window into solving the water problem, said Goddard's Amy Simon, a planetary atmospheres expert.

"If it works, then maybe we can apply it elsewhere, like Saturn, Uranus or Neptune, where we don't have a Juno," she said.

Juno is the latest spacecraft tasked with finding water, likely in gas form, on this giant gaseous planet.

Water is a significant and abundant molecule in our solar system. It spawned life on Earth and now lubricates many of its most essential processes, including weather. It's a critical factor in Jupiter's turbulent weather, too, and in determining whether the planet has a core made of rock and ice.

Jupiter is thought to be the first planet to have formed by siphoning the elements left over from the formation of the Sun as our star coalesced from an amorphous nebula into the fiery ball of gases we see today. A widely accepted theory until several decades ago was that Jupiter was identical in composition to the Sun; a ball of hydrogen with a hint of helium — all gas, no core.

But evidence is mounting that Jupiter has a core, possibly 10 times Earth's mass. Spacecraft that previously visited the planet found chemical evidence that it formed a core of rock and water ice before it mixed with gases from the solar nebula to make its atmosphere. The way Jupiter's gravity tugs on Juno also supports this theory. There's even lightning and thunder on the planet, phenomena fueled by moisture.

"The moons that orbit Jupiter are mostly water ice, so the whole neighborhood has plenty of water," said Bjoraker. "Why wouldn't the planet — which is this huge gravity well, where everything falls into it — be water rich, too?"

The water question has stumped planetary scientists; virtually every time evidence of H_2O materializes, something happens to put them off the scent. A favorite example among Jupiter experts is NASA's Galileo spacecraft, which dropped a probe into the atmosphere in 1995 that wound up in an unusually dry region. "It's like sending a probe to Earth, landing in the Mojave Desert, and concluding the Earth is dry," pointed out Bjoraker.

In their search for water, Bjoraker and his team used radiation data collected from the summit of Maunakea in Hawaii in 2017. They relied on the most sensitive infrared telescope on Earth at the W.M. Keck Observatory, and also on a new instrument that can detect a wider range of gases at the NASA Infrared Telescope Facility.

The idea was to analyze the light energy emitted through Jupiter's clouds in order to identify the altitudes of its cloud layers. This would help the scientists determine temperature and other conditions that influence the types of gases that can survive in those regions.

Planetary atmosphere experts expect that there are three cloud layers on Jupiter: a lower layer made of water ice and liquid water, a middle one made of ammonia and sulfur, and an upper layer made of ammonia.

To confirm this through ground-based observations, Bjoraker's team looked at wavelengths in the infrared range of light where most gases don't absorb heat, allowing chemical signatures to leak out. Specifically, they analyzed the absorption patterns of a form of methane gas. Because Jupiter is too warm for methane to freeze, its abundance should not change from one place to another on the planet.

"If you see that the strength of methane lines vary from inside to outside of the Great Red Spot, it's not because there's more methane here than there," said Bjoraker, "it's because there are thicker, deep clouds that are blocking the radiation in the Great Red Spot."

Bjoraker's team found evidence for the three cloud layers in the Great Red Spot, supporting earlier models. The deepest cloud layer is at 5 bars, the team concluded, right where the temperature reaches the freezing point for water, said Bjoraker, "so I say that we very likely found a water cloud." The location of the water cloud, plus the amount of carbon monoxide that the researchers identified on Jupiter, confirms that Jupiter is rich in oxygen and, thus, water.

Bjoraker's technique now needs to be tested on other parts of Jupiter to get a full picture of global water abundance, and his data squared with Juno's findings.

"Jupiter's water abundance will tell us a lot about how the giant planet formed, but only if we can figure out how much water there is in the entire planet," said Steven M. Levin, a Juno project scientist at NASA's Jet Propulsion Laboratory in Pasadena, California.

Source: NASA

Jupiter's Swirling Cloudscape

Intricate swirls in Jupiter's volatile northern hemisphere are captured in this color-enhanced image from NASA's Juno spacecraft. Bursts of bright-white "pop-up" clouds appear scattered throughout the scene, with some visibly casting shadows on the neighboring cloud layers beneath them. Juno scientists are using shadows to determine the distances between cloud layers in Jupiter's atmosphere, which provide clues to their composition and origin.

This image was taken at 10:27 p.m. PDT on May 23, 2018 (1:27 a.m. EDT on May 24) as the spacecraft performed its 13th close flyby of Jupiter. At the time, Juno was about 7,050 miles (11,350 kilometers) from the planet's cloud tops, above a northern latitude of approximately 49 degrees.

Citizen scientists Gerald Eichstädt and Seán Doran created this image using data from the spacecraft's JunoCam imager.

Source: NASA

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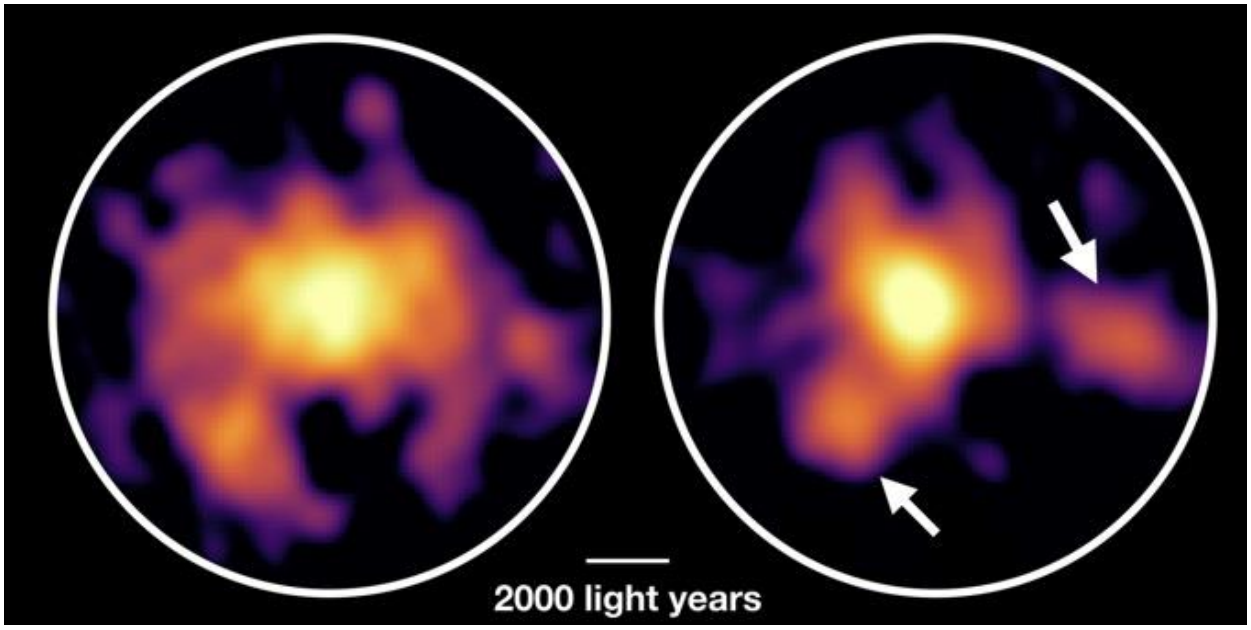
2. ALMA Reveals Dusty Anatomy of an Ancient Starburst Galaxy



Observations of a starburst galaxy using the Atacama Large Millimeter/submillimeter Array reveal unstable clouds thousands of light years apart that are thought to be sites of runway star formation. Image: ALMA (ESO/NAOJ/NRAO), Tadaki et al.

Astronomers peering into the heart of a starburst galaxy 12.4 billion light years away have confirmed the presence of highly unstable molecular clouds believed to be fueling runaway star formation. Because starburst galaxies are thought to be predecessors of the huge elliptical galaxies seen in the modern universe, the new observations may help fill in some of the blanks about how such galaxies form and evolve.

Using the Atacama Large Millimeter/submillimeter Array, or ALMA, a team led by Ken-ichi Tadaki, a postdoctoral researcher at the Japan Society for the Promotion of Science and the National Astronomical Observatory of Japan, studied a galaxy known as COSMOS-AzTEC-1, discovered with the James Clerk Maxwell Telescope in Hawaii.

"One of the best parts of ALMA observations is to see the far-away galaxies with unprecedented resolution," said Tadaki, lead author of the research paper published in the journal *Nature*. "We found that there are two distinct large clouds several thousand light-years away from the center. In most distant starburst galaxies, stars are actively formed in the center. So it is surprising to find off-center clouds."

Starburst galaxies form new suns 1,000 times faster than the rates observed in mature galaxies like the Milky Way. To understand how such monster galaxies can be so active, researchers must understand the environments in regions where such rapid star formation is taking place.

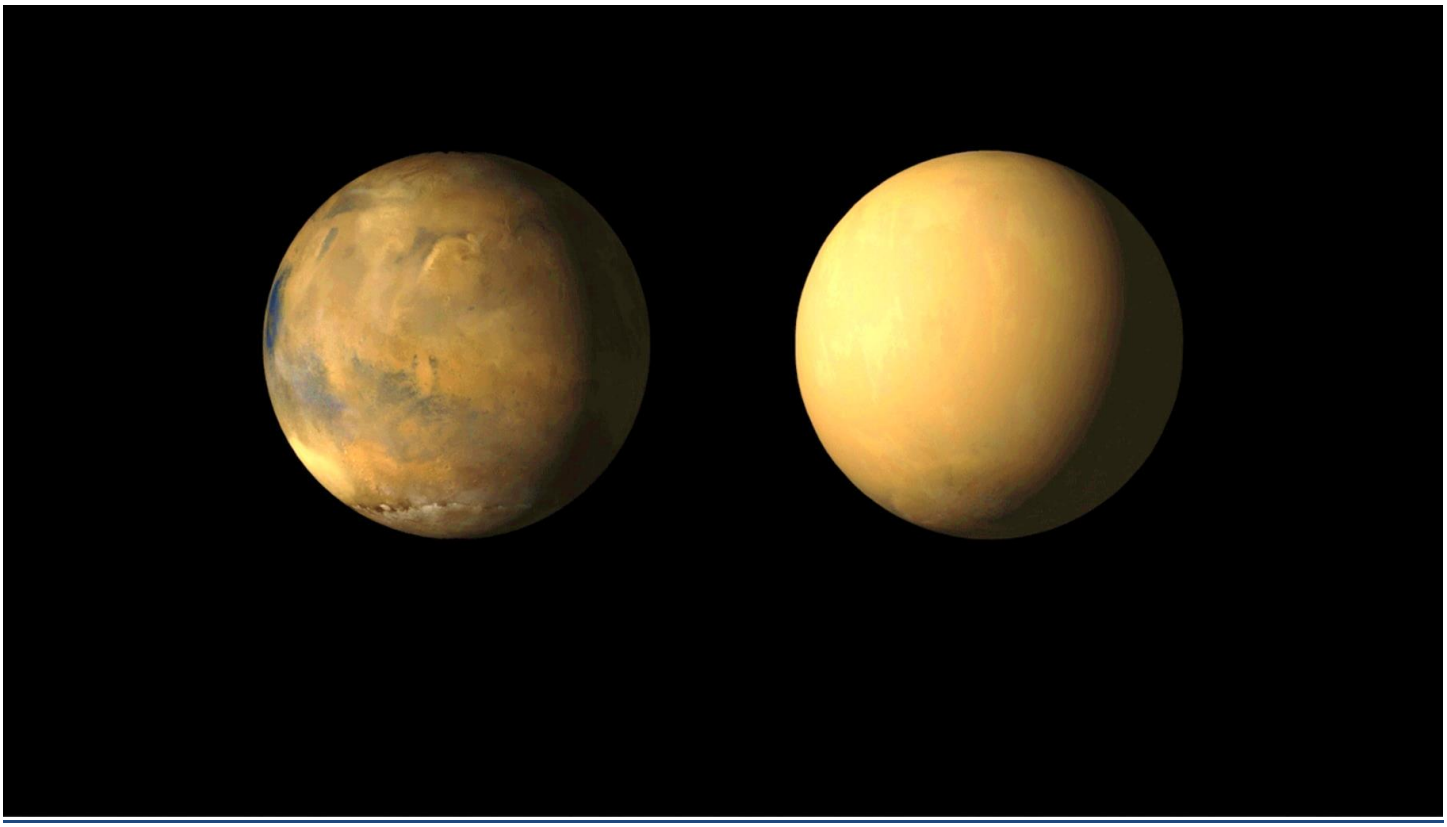
In "normal" galaxies, star formation is self-regulating, in a sense, balancing the inward pull of gravity in dense molecular clouds with the outward pressure generated by stellar ignition, supernova blasts and related phenomena. But in a starburst galaxy, the clouds are unstable, gravity dominates and runway star formation results.

Tadaki's team estimates COSMOS-AzTEC-1 will completely consume its supply of star-forming gas in just 100 million years or so, 10 times faster than the rate observed in other star-forming galaxies. The researchers do not yet know why the gas is so unstable. It could be due to an earlier merger with another galaxy, but no such evidence has been found.

"At this moment, we have no evidence of merger in this galaxy," Tadaki said. "By observing other similar galaxies with ALMA, we want to unveil the relation between galaxy mergers and monster galaxies."

Source: Astronomy Now Return to Contents

3. Martian Skies Clearing over Opportunity Rover



The view from May shows Valles Marineris chasms (left), Meridiani center, an autumn dust storm in Acidalia (top) and the early spring south polar cap (bottom). The view from July shows the same regions, but most of the surface was obscured by the planet-encircling dust cloud and haze.A planet-encircling dust storm on Mars, which was first detected May 30 and halted operations for the Opportunity rover, continues to abate. Image credit: NASA/JPL-Caltech/MSSS

With clearing skies over Opportunity's resting spot in Mars' Perseverance Valley, engineers at NASA's Jet Propulsion Laboratory in Pasadena, California, believe the nearly 15-year-old, solar-powered rover will soon receive enough sunlight to automatically initiate recovery procedures -- if the rover is able to do so. To prepare, the Opportunity mission team has developed a two-step plan to provide the highest probability of successfully communicating with the rover and bringing it back online.

"The Sun is breaking through the haze over Perseverance Valley, and soon there will be enough sunlight present that Opportunity should be able to recharge its batteries," said John Callas, Opportunity project manager at JPL. "When the tau level [a measure of the amount of particulate matter in the Martian sky] dips below 1.5, we will begin a period of actively attempting to communicate with the rover by sending it commands via the antennas of NASA's Deep Space Network. Assuming that we hear back from Opportunity, we will begin the process of discerning its status and bringing it back online."

The rover's last communication with Earth was received June 10, and Opportunity's current health is unknown. Opportunity engineers are relying on the expertise of Mars scientists analyzing data from the Mars Color Imager (MARCI) aboard NASA's Mars Reconnaissance Orbiter (MRO) to estimate the tau near the rover's position.

"The dust haze produced by the Martian global dust storm of 2018 is one of the most extensive on record, but all indications are it is finally coming to a close," said MRO Project Scientist Rich Zurek at JPL. "MARCI images

of the Opportunity site have shown no active dust storms for some time within 3,000 kilometers [about 1,900 miles] of the rover site."

With skies clearing, mission managers are hopeful the rover will attempt to call home, but they are also prepared for an extended period of silence. "If we do not hear back after 45 days, the team will be forced to conclude that the Sun-blocking dust and the Martian cold have conspired to cause some type of fault from which the rover will more than likely not recover," said Callas. "At that point our active phase of reaching out to Opportunity will be at an end. However, in the unlikely chance that there is a large amount of dust sitting on the solar arrays that is blocking the Sun's energy, we will continue passive listening efforts for several months."

The additional several months for passive listening are an allowance for the possibility that a Red Planet dust devil could come along and literally dust off Opportunity's solar arrays. Such "cleaning events" were first discovered by Mars rover teams in 2004 when, on several occasions, battery power levels aboard both Spirit and Opportunity increased by several percent during a single Martian night, when the logical expectation was that they would continue to decrease. These cleaning dust devils have even been imaged by both rovers on the surface and spacecraft in orbit

The chances are small that dust accumulation would be the root cause of Opportunity's lack of communication. Nonetheless, each day during the passive phase, JPL's Radio Science group will scour the signal records taken by a very sensitive broadband receiver of radio frequencies emanating from Mars, looking for a sign that the rover is trying to reach out.

Even if the team hears back from Opportunity during either phase, there is no assurance the rover will be operational. The impact of this latest storm on Opportunity's systems is unknown but could have resulted in reduced energy production, diminished battery performance, or other unforeseen damage that could make it difficult for the rover to fully return online.

While the situation in Perseverance Valley is critical, the rover team is cautiously optimistic, knowing that Opportunity has overcome significant challenges during its 14-plus years on Mars. The rover lost use of its front steering -- its left-front in June of 2017, and right front in 2005. Its 256-megabyte flash memory is no longer functioning. The team also knows that everything about the rover is well beyond its warranty period -- both Opportunity and its twin rover, Spirit, were constructed for 90-day missions (Spirit lasted 20 times longer and Opportunity is going on 60 times). The rovers were designed to travel about 1,000 yards, and Opportunity has logged more than 28 miles. Through thick and thin, the team has seen their rover soldier on. Now, Opportunity engineers and scientists of Opportunity are planning, and hoping, that this latest dilemma is just another bump in their Martian road.

"In a situation like this you hope for the best but plan for all eventualities," said Callas. "We are pulling for our tenacious rover to pull her feet from the fire one more time. And if she does, we will be there to hear her."

Updates on the dust storm and tau can be found here.

JPL, a division of Caltech in Pasadena, built Opportunity and manages the mission for NASA's Science Mission Directorate, Washington.

Source: NASA Return to Contents

The Night Sky

Tuesday, September 4

• As dawn brightens tomorrow morning, use binoculars or a wide-field telescope to spot Regulus twinkling about 1.6° below brighter Mercury. Look very low above the east-northeast horizon, as shown here.

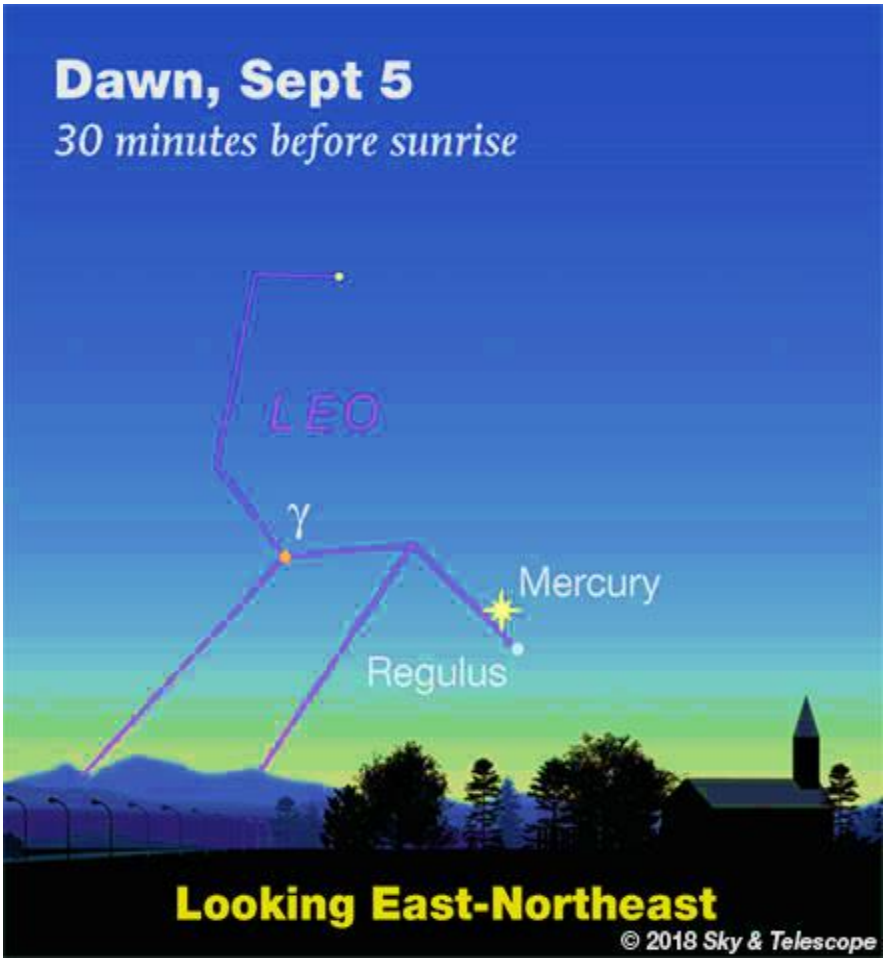
Then on Thursday morning the 6th they'll appear even closer, with Regulus 1.2° to Mercury's right.

Wednesday, September 5

• 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 scooping to the right.

Thursday, September 6

• With the evening sky moonless, this is a great week for observing the Milky Way under a dark sky. When Deneb crosses your zenith (around 10 or 11 p.m. now), the Milky Way does too — running straight up from the southwest horizon and straight down to the northeast horizon.



Find Regulus just below Mercury on the morning of the 5th, then and closer to Mercury's right on the 6th

Friday, September 7

• With summer waning away, Scorpius lies down in the south-southwest as soon as night arrives. Its brightest star, orange Antares, appears about midway between Jupiter and Saturn. Jupiter shines well off to Antares's right, in Libra, and Saturn is well off to Antares's upper left, in Sagittarius.

Saturday, September 8

• The wide W pattern of Cassiopeia is tilting up in the northeast after dark. Look below the W's bottom segment, by a little farther than the segment's length, for an enhanced spot of the Milky Way's glow if you have a dark enough sky. Binoculars will show this to be the Perseus Double Cluster — even through a fair amount of light pollution.

Source: Sky and Telescope

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ISS Sighting Opportunities (from Denver)

Date	Visible	Max Height	Appears	Disappears
Wed Sep 5, 5:18 AM	3 min	14°	10° above NW	10° above NNE
Thu Sep 6, 4:28 AM	2 min	17°	17° above N	10° above NNE
Thu Sep 6, 6:05 AM	< 1 min	10°	10° above N	10° above N
Fri Sep 7, 5:12 AM	2 min	11°	10° above NNW	10° above N
Sat Sep 8, 4:21 AM	1 min	12°	12° above N	10° above NNE
Sat Sep 8, 5:58 AM	2 min	11°	10° above N	10° above NNE

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

NASA-TV Highlights (all times Eastern Time Zone)

September 4, Tuesday

- 9:10 a.m. – Space Station In-Flight Event for the European Space Agency with the DLR "Time Capsule" Event in Berlin, Germany and ESA astronaut Alexander Gerst (Public Channel with interpretation; Media Channel in native language)

September 6, Thursday

- 5:35 a.m. – Space Station In-Flight Event for the European Space Agency at the Federal Chancellery in Berlin involving German Chancellor Angela Merkel and ESA astronaut Alexander Gerst
- 2 p.m. - Space Station Expedition 58-59 Crew News Conference (All Channels)

September 7, Friday

- 6:40 a.m. – Live interviews from Goddard Space Flight Center on the upcoming launch of the ICESat-2 mission (Media Channel)
- 2:00 p.m. Science Chat – Dawn: Mission to Small Worlds (All Channels)

Watch NASA TV online by going to the NASA website.

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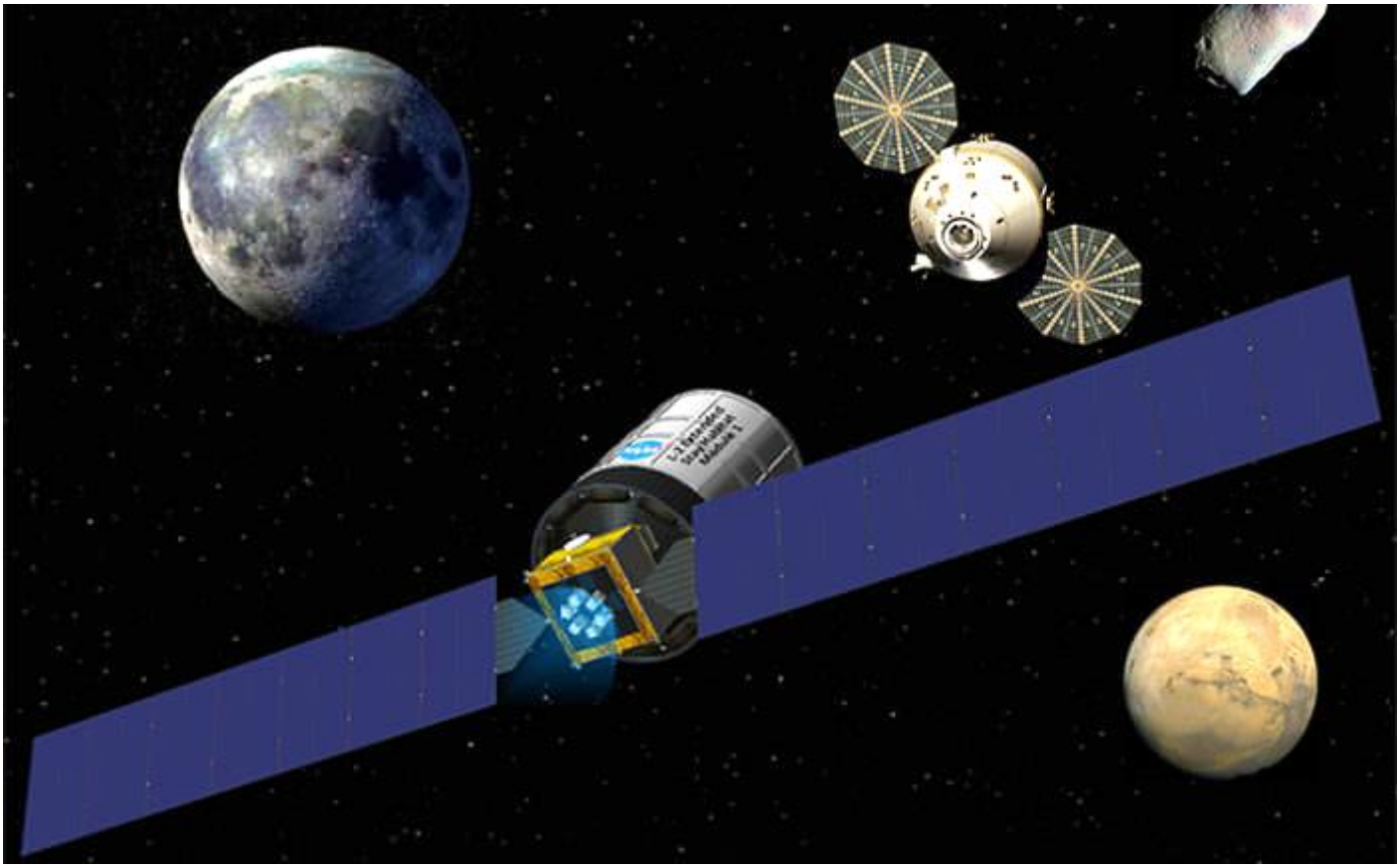
Space Calendar

- Sep 04 - Comet 73P-S/Schwassmann-Wachmann Closest Approach To Earth (0.893 AU)
- Sep 04 - Comet 65P/Gunn At Opposition (2.305 AU)
- Sep 04 - Asteroid 11055 Honduras Closest Approach To Earth (1.128 AU)
- Sep 04 - Asteroid 149244 Kriegh Closest Approach To Earth (1.194 AU)
- Sep 04 - Asteroid 4305 Clapton Closest Approach To Earth (2.105 AU)
- Sep 04-06 - Asteroids and Comets - Inside Out Workshop (ACIO18), Tampere, Finland
- Sep 04-06 - Young European Radio Astronomers Conference (YERAC), Dwingeloo, The Netherlands
- Sep 04-06 - 4th International Conference: Scientific and Technological Experiments on Automatic Space Vehicles and Small Satellites (SPEXP), Samara, Russia
- Sep 04-07 - Conference: From First Stars to Life - Science with the Origins Space Telescope, Oxford, United Kingdom
- Sep 04-09 - Northern Prairie Star Party, Black Nugget Lake, Canada
- Sep 05 - Comet 137P/Shoemaker-Levy Closest Approach To Earth (1.168 AU)
- Sep 05 - Comet P/2013 A2 (Scotti) At Opposition (4.169 AU)
- Sep 05 - Asteroid Aten Asteroid 2100 Ra-Shalom Closest Approach To Earth (0.895 AU)
- Sep 05 - Asteroid 1996 Adams Closest Approach To Earth (1.215 AU)
- Sep 05 - Asteroid 4559 Strauss Closest Approach To Earth (1.731 AU)
- Sep 05 - Asteroid 10552 Stockholm Closest Approach To Earth (2.503 AU)
- Sep 05 - Apollo Asteroid 7092 Cadmus Closest Approach To Earth (3.291 AU)
- Sep 05 - Exoplanet Science Strategy: Public Briefing and Webcast
- Sep 05-06 - Space VLBI Workshop, Noordwijk, The Netherlands
- Sep 05-06 - Workshop on Advances Packaging and Components (APAC 2018), Noordwijk, The Netherlands
- Sep 05-07 - Workshop: Physics of Comets after the Rosetta Mission - Unresolved Problems, Stara Lesna, Slovakia
- Sep 06 - Comet C/2018 EF9 (Lemmon) Closest Approach To Earth (1.578 AU)
- Sep 06 - Comet 223P/Skiff At Opposition (1.622 AU)
- Sep 06 - Comet 78P/Gehrels Closest Approach To Earth (1.625 AU)
- Sep 06 - Asteroid 117329 Spencer Closest Approach To Earth (1.821 AU)
- Sep 06 - Comet C/2017 U7 Closest Approach To Earth (6.077 AU)
- Sep 06 - Lecture: NASA@60 - The Role of the Robots, Pasadena, California
- Sep 06 - Lecture: Curiosity and our Evolving View of the Red Planet, Houston, Texas
- Sep 06 - Lecture: The Bucket Brigade Comes To Town!, London, United Kingdom
- Sep 06-09 - Spruce Woods Star Party, Spruce Woods Provincial Park, Canada
- Sep 07 - Neptune At Opposition
- Sep 07 - Apollo Asteroid 2008 PW4 Near-Earth Flyby (0.075 AU)
- Sep 07 - Amor Asteroid 2007 RZ8 Near-Earth Flyby (0.096 AU)
- Sep 07 - Aten Asteroid 5381 Sekmet Closest Approach To Earth (0.993 AU)
- Sep 07 - Asteroid 274020 Skywalker Closest Approach To Earth (1.486 AU)
- Sep 07 - Apollo Asteroid 5731 Zeus Closest Approach To Earth (2.436 AU)
- Sep 07 - Kuiper Belt Object 145452 (2005 RN43) At Opposition (39.617 AU)
- Sep 06 - Lecture: NASA@60 - The Role of the Robots, Pasadena, California

Source: JPL Space Calendar Return to Contents

Food for Thought

Aerojet Rocketdyne Tests Out its New Advanced Ion Engine System



Aerojet Rocketdyne artists concept for solar electric propulsion system for deep space missions. Credit: Aerojet Rocketdyne

When it comes to the next generation of space exploration, a number of key technologies are being investigated. In addition to spacecraft and launchers that will be able to send astronauts farther into the Solar System, NASA and other space agencies are also looking into new means of propulsion. Compared to conventional rockets, the goal is to create systems that offer reliable thrust while ensuring fuel-efficiency.

To this end, NASA has paired with Aerojet Rocketdyne, a California-based rocket and missile propulsion manufacturer, to develop a Solar Electric Propulsion (SEP) Hall Effect thruster. Known as the Advanced Electric Propulsion System (AEPS), the company recently completed a successful early systems integration test on this thruster, which will enable deep space exploration missions as well as commercial space endeavors.

The test took place at NASA's Glenn Research Center and focused on the discharge supply unit (DSU) and the power processing unit (PPU), which were combined with a NASA-development thruster and then tested in a thermal vacuum chamber. The test proved that the system could covert power efficiently, turning solar energy into thrust while producing minimal waste heat.

As Eileen Drake, the CEO and president of Aerojet Rocketdyne, said in a recent company press release:

""Our AEPS discharge supply unit performed exceptionally, yielding significant conversion efficiency improvements important for future demanding missions. These results are a testament to the Aerojet Rocketdyne team's focus and dedication to advancing the state of the art in this critical in-space technology area."

Much like conventional Hall Effect thrusters, SEP relies on an electrical field to ionize and accelerate a propellant (in most cases, a noble gas like xenon). In the case of SEP, the necessary electricity is generated by photovoltaic cells (aka. solar panels). An immediate benefit of this kind of system is that it can offer thrust comparable to a conventional chemical propulsion system, but using one-tenth the propellant.

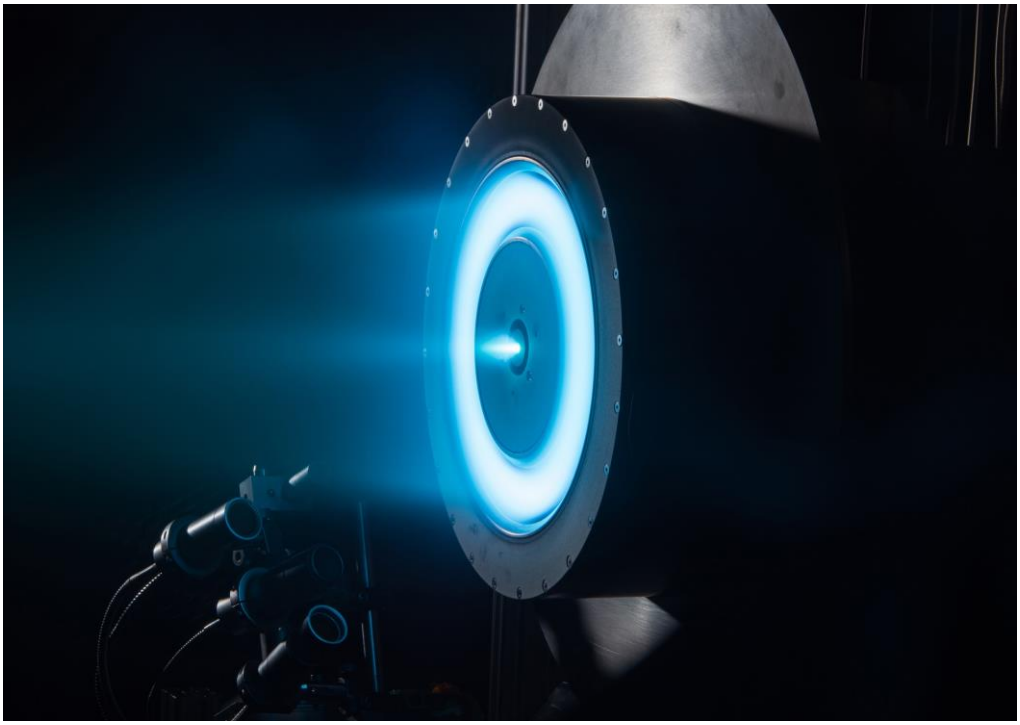
Using a 10 kW SEP thruster system and 425 kg (937 lbs) of xenon propellant, the *Dawn* spacecraft was able to reach a maximum speed of 41,260 km/h (mph). This most recent test involved a 13-kilowatt system, and Aerodyne plans to scale that up in the coming years. For example, a 50-kW SEP thruster system is planned for use on NASA's proposed Lunar Orbital Platform-Gateway (LOP-G) – formerly known as the Deep Space Gateway.

This space station, which will be built in orbit around the Moon, will facilitate future missions to the lunar surface, as well as serving as a launching point for the first crewed missions to Mars, and deeper into the Solar System. As Drake indicated:

"By staying on the cutting edge of propulsion technology, we have positioned ourselves for a major role not only in getting back to the Moon, but also in any future initiative to send people to Mars. AEPS is the vanguard for the next generation of deep space exploration and we're thrilled to be at the mast."

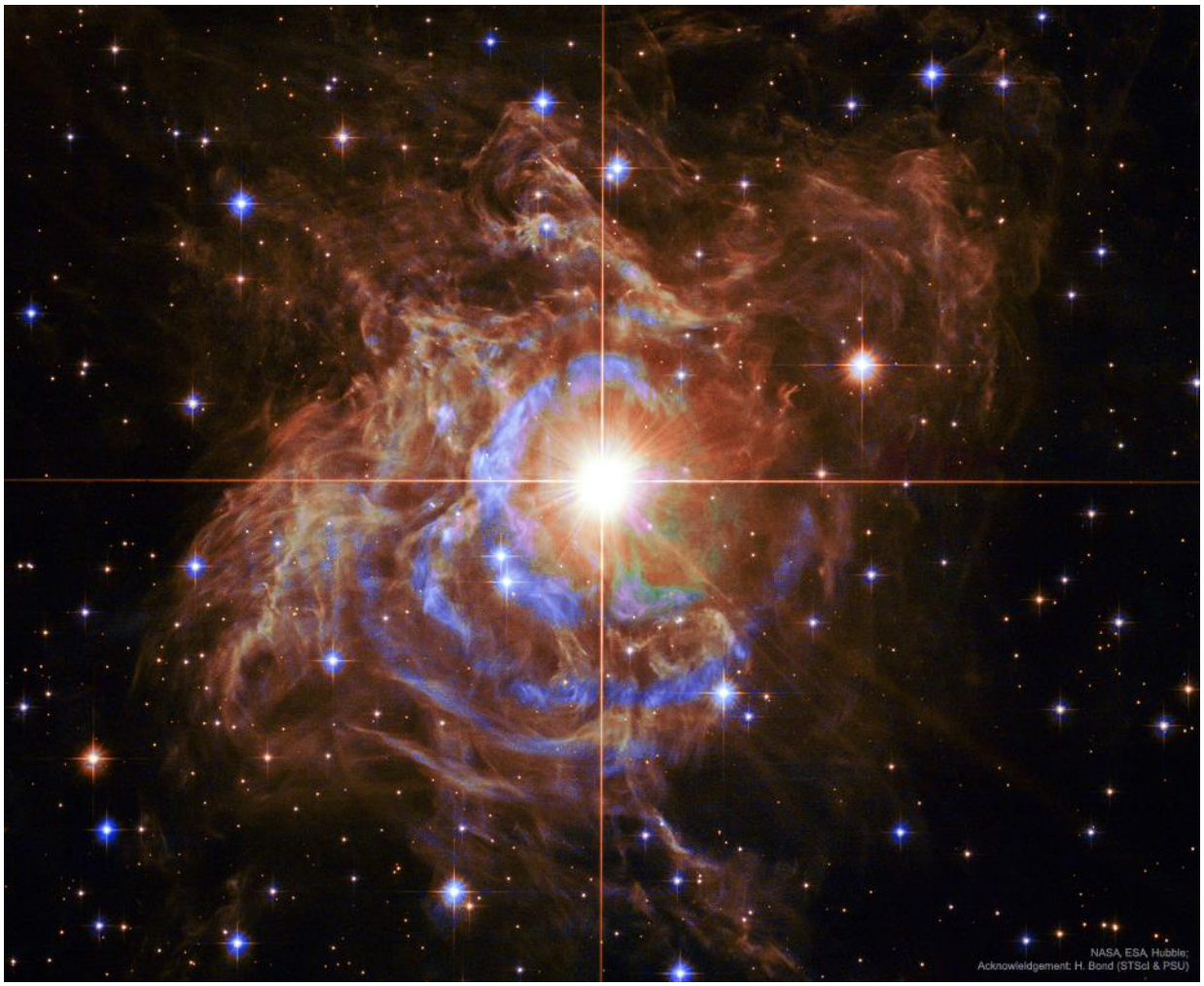
With this latest test complete, the team will now move onto the design finalization and verification phase, which will be followed by the critical design review (CDR) – where the thruster's design will be finalized and cleared for production. If all goes as planned, the 50-kW version of this system will serve as the Power and Propulsion Element (PPE) on the Lunar Orbital Platform-Gateway (LOP-G).

In addition to developing next-generation SEP technology for NASA, Aerodyne is also responsible for the propulsion systems that power the Mars Atmosphere and Volatile EvolutioN (MAVEN) mission, the Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer (OSIRIS-REx) mission, and the recently-launched Parker Solar Probe.



Source: Universe Today Return to Contents

Space Image of the Week



Nearby Cepheid Variable RS Pup

Image Credit: NASA, ESA, Hubble Heritage Team; Acknowledgement: Howard Bond (STScI & Penn State U.)

Explanation: In the center is one of the most important stars on the sky. This is partly because, by coincidence, it is surrounded by a dazzling reflection nebula. Pulsating RS Puppis, the brightest star in the image center, is some ten times more massive than our Sun and on average 15,000 times more luminous. In fact, RS Pup is a Cepheid type variable star, a class of stars whose brightness is used to estimate distances to nearby galaxies as one of the first steps in establishing the cosmic distance scale.

As RS Pup pulsates over a period of about 40 days, its regular changes in brightness are also seen along the nebula delayed in time, effectively a light echo. Using measurements of the time delay and angular size of the nebula, the known speed of light allows astronomers to geometrically determine the distance to RS Pup to be 6,500 light-years, with a remarkably small error of plus or minus 90 light-years.

An impressive achievement for stellar astronomy, the echo-measured distance also more accurately establishes the true brightness of RS Pup, and by extension other Cepheid stars, improving the knowledge of distances to galaxies beyond the Milky Way. The featured image was taken by the Hubble Space Telescope.

Source: NASA APOD

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