Space News Update

— August 18, 2017 —

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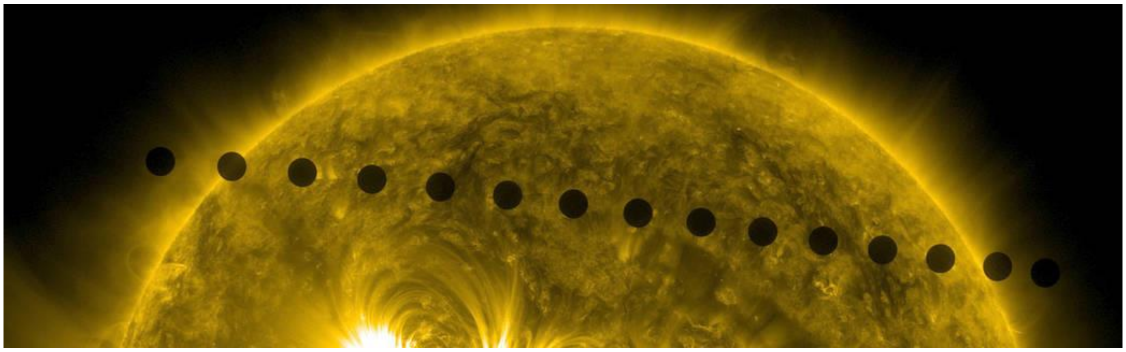
1. An Eclipse by Any Other Name: Doing Science with Transits and Occultations



An otherworldly atmosphere takes hold when a total solar eclipse blocks the Sun's light, yet the mechanics of the event are actually rather mundane. All you need is for one celestial body (in this case, the Moon) to block your view of a more distant object (here, the Sun). But different flavors of this phenomenon make some very sophisticated science possible. From the study of Pluto's atmosphere to the discovery of planets around other stars, NASA researchers are using eclipse-like events to learn more about the universe.

Shadow-Chasing SOFIA Explores Distant Worlds

On August 21, solar eclipse fans along the path of totality will enjoy a view of the Moon masking the entire disk of the Sun. Scientists use the term ***occultation*** for this situation, where the nearer object completely blocks the one behind. When the more distant body is a star, researchers can glean a wealth of information from the way the star's light passes near and around the object. They can tell, for instance, whether the object is surrounded by rings or if it has an atmosphere.

In 2015, NASA's Stratospheric Observatory for Infrared Astronomy, or SOFIA – an airborne observatory featuring a 2.5-meter infrared telescope mounted in a highly modified Boeing 747SP aircraft – used an occultation to learn more about Pluto. As the dwarf planet blotted out a distant star, it cast a dim, fast-moving shadow on the surface of the Earth, mostly across the middle of the Pacific Ocean. As the dark spot raced over the surface at 53,000 mph, SOFIA flew right through the middle of it, and had about 130 seconds to measure the light of the hidden star that seeped around the occulting object, Pluto, and scattered through its atmosphere. From this data, scientists learned about the structure, pressure and density of Pluto's atmosphere some three billion miles from Earth.

SOFIA's measurements were all the more valuable as they could be compared to the data from another mission, collected just two weeks later, when NASA'S New Horizons spacecraft flew by Pluto at a distance of a mere 7,750 miles. This allowed researchers to calibrate decades of existing Earth-based Pluto occultation data studying its atmosphere, enhancing their analyses of all those earlier observations.

Recently, in June, SOFIA studied another occultation, this time with a small, icy body that is likely a remnant from the earliest days of our solar neighborhood, called 2014 MU69. New Horizons plans to fly by MU69 to learn about the formation of our solar system. However, if it turns out MU69 is surrounded by rings or debris, the spacecraft's flyby would have to be adjusted to a safe distance.

"The MU69 occultation observations were much more challenging when compared to those done in support of the Pluto flyby in 2015, as MU69 is much smaller and we had more open questions about its location with respect to the background star, whose light it would block. It really brought occultation science to a whole new level of precision," said Kimberly Ennico Smith, SOFIA project scientist at NASA's Ames Research Center in Silicon Valley. "The researchers, instrument team and flight crew worked together to optimize our observing strategy."

The New Horizons team will continue to pore through the new data for additional clues about 2014 MU69 to better understand its shape, size and the environment around the object. It will be the most distant object ever explored by a spacecraft—more than a billion miles beyond Pluto.

Tiny, Telltale Transits Show Kepler Where Exoplanets Orbit

Sometimes the partners in an eclipse-like dance do not yield the full-coverage effect of the upcoming solar eclipse or the MU69 occultation. In an event called a ***transit***, the nearer object blocks very little of a star that lies beyond. Instead, you may see a small dark spot crossing the stellar face, as in the 2012 transit of Venus across the Sun.

If both objects are very far away – in other solar systems – our telescopes can't yet make out the smaller partner. What some instruments, such as NASA's Kepler space telescope, *can* see is the minuscule dimming of the star that occurs when an orbiting planet blocks a fraction of its light. Using this method, Kepler has, to date, discovered more than 4,500 potential exoplanets orbiting other stars. Of these, nearly 2,500 have been confirmed as bona fide exoplanets.

With measurements made during a transit, scientists can calculate the size of the exoplanet and its distance from its star. When multiple transits are observed, the orbital period, or year, of an exoplanet also can be calculated. These characteristics are important factors in determining if an exoplanet resides in the just-right "Goldilocks" or habitable zone of their star, where liquid water might exist on the surface.

"Astronomers are adept at leveraging the improbable and ephemeral coincidences of nature and using them to learn something remarkable," said Natalie Batalha, the Kepler mission project scientist, at Ames. "Catching shadows, Kepler opened our eyes to the terrestrial-size planets that populate the galaxy."

An "Artificial Eclipse" to Bring Exoplanets into Focus

Several upcoming NASA missions will use the transit method to continue the hunt for exoplanets, including TESS and WFIRST. The next major step in exoplanet research may be to capture direct images of the exoplanets themselves. It's an exciting, challenging prospect, given that the planets are billions of times fainter than the stars they orbit.

Today, NASA researchers are developing a sophisticated tool that will let us see these distant planets by intentionally blocking the light of their star. "During a solar eclipse, many solar system planets become visible, which are otherwise lost in the glare of the Sun," said Ruslan Belikov, who co-leads, along with Eduardo Bendek, the Exoplanet Technologies research group at Ames. "In the same way, by 'eclipsing' the light from another star, a telescope can see planets that are otherwise lost in the glare of that star."

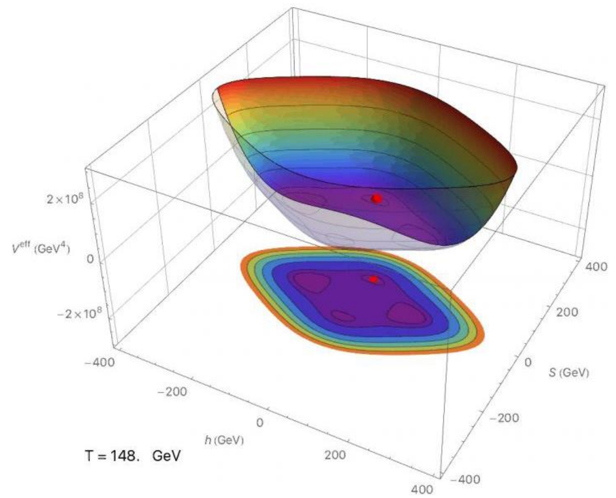
The lab's technology, called a coronagraph, essentially creates an artificial eclipse inside a telescope.

"By coupling the coronagraph, which occults the star, with an instrument for analyzing the light reflected from the exoplanets' atmosphere, NASA's next generation of space telescopes will be able to explore these worlds and assess if they can harbor life," said Bendek.

Whether an occultation briefly blots out a star entirely, or a transit causes its light to fade by a minuscule degree, these cousins to the eclipse are helping NASA answer certain questions, and also ask many more that will form the basis of exciting future investigations. On August 21, remember that an eclipse by any other name yields science just as sweet.

Source: NASA Return to Contents

2. New Theory on the Origin of Dark Matter



Only a small part of the universe consists of visible matter. By far the largest part is invisible and consists of dark matter and dark energy.

Very little is known about dark energy, but there are many theories and experiments on the existence of dark matter designed to find these as yet unknown particles. Scientists at Johannes Gutenberg University Mainz (JGU) in Germany have now come up with a new theory on how dark matter may have been formed shortly after the origin of the universe. This new model proposes an alternative to the WIMP paradigm that is the subject of various experiments in current research.

Dark matter is present throughout the universe, forming galaxies and the largest known structures in the cosmos. It makes up around 23 percent of our universe, whereas the particles visible to us that make up the stars, planets, and even life on Earth represent only about four percent of it. The current assumption is that dark matter is a cosmological relic that has essentially remained stable since its creation. "We have called this assumption into question, showing that at the beginning of the universe dark matter may have been unstable," explained Dr. Michael Baker from the Theoretical High Energy Physics (THEP) group at the JGU Institute of Physics. This instability also indicates the existence of a new mechanism that explains the observed quantity of dark matter in the cosmos.

The stability of dark matter is usually explained by a symmetry principle. However, in their paper, Dr. Michael Baker and Prof. Joachim Kopp demonstrate that the universe may have gone through a phase during which this symmetry was broken. This would mean that it is possible for the hypothetical dark matter particle to decay. During the electroweak phase transition, the symmetry that stabilizes dark matter would have been re-established, enabling it to continue to exist in the universe to the present day.

With their new theory, Baker and Kopp have introduced a new principle into the debate about the nature of dark matter that offers an alternative to the widely accepted WIMP theory. Up to now, WIMPs, or weakly interacting massive particles, have been regarded as the most likely components of dark matter, and experiments involving heavily shielded underground detectors have been carried out to look for them. "The absence of any convincing signals caused us to start looking for alternatives to the WIMP paradigm," said Kopp.

The two physicists claim that the new mechanism they propose may be connected with the apparent imbalance between matter and antimatter in the cosmos and could leave an imprint which would be detected in future experiments on gravitational waves. In their paper published in the scientific journal Physical Review Letters, Baker and Kopp also indicate the prospects of finding proof of their new principle at CERN's LHC particle accelerator and other experimental facilities.

Source: Spaceref.com

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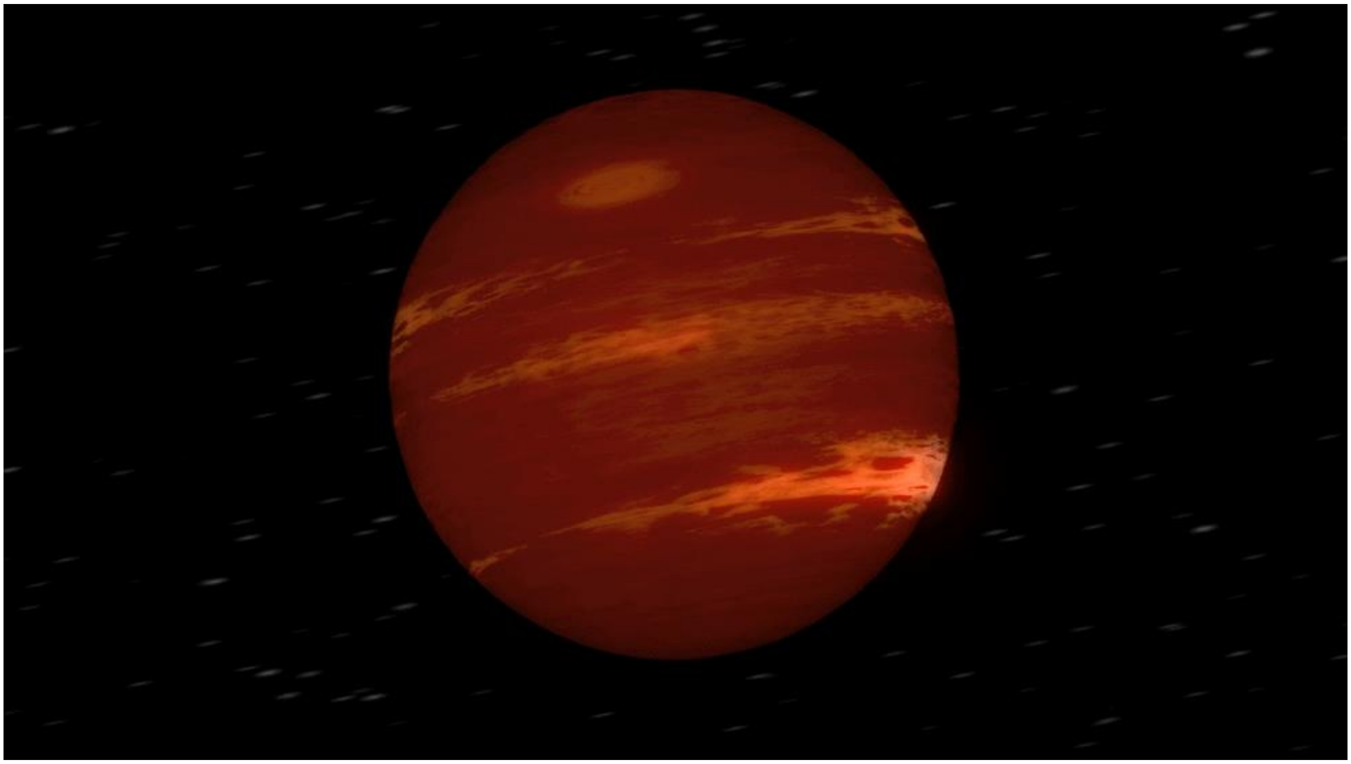
3. Scientists Improve Brown Dwarf Weather Forecasts



Dim objects called brown dwarfs, less massive than the Sun but more massive than Jupiter, have powerful winds and clouds -- specifically, hot patchy clouds made of iron droplets and silicate dust. Scientists recently realized these giant clouds can move and thicken or thin surprisingly rapidly, in less than an Earth day, but did not understand why.

Now, researchers have a new model for explaining how clouds move and change shape in brown dwarfs, using insights from NASA's Spitzer Space Telescope. Giant waves cause large-scale movement of particles in brown dwarfs' atmospheres, changing the thickness of the silicate clouds, researchers report in the journal Science. The study also suggests these clouds are organized in bands confined to different latitudes, traveling with different speeds in different bands.

"This is the first time we have seen atmospheric bands and waves in brown dwarfs," said lead author Daniel Apai, associate professor of astronomy and planetary sciences at the University of Arizona in Tucson.

Just as in Earth’s ocean, different types of waves can form in planetary atmospheres. For example, in Earth’s atmosphere, very long waves mix cold air from the polar regions to mid-latitudes, which often lead clouds to form or dissipate.

The distribution and motions of the clouds on brown dwarfs in this study are more similar to those seen on Jupiter, Saturn, Uranus and Neptune. Neptune has cloud structures that follow banded paths too, but its clouds are made of ice. Observations of Neptune from NASA's Kepler spacecraft, operating in its K2 mission, were important in this comparison between the planet and brown dwarfs.

"The atmospheric winds of brown dwarfs seem to be more like Jupiter’s familiar regular pattern of belts and zones than the chaotic atmospheric boiling seen on the Sun and many other stars," said study co-author Mark Marley at NASA's Ames Research Center in California's Silicon Valley.

Brown dwarfs can be thought of as failed stars because they are too small to fuse chemical elements in their cores. They can also be thought of as "super planets" because they are more massive than Jupiter, yet have roughly the same diameter. Like gas giant planets, brown dwarfs are mostly made of hydrogen and helium, but they are often found apart from any planetary systems. In a 2014 study using Spitzer, scientists found that brown dwarfs commonly have atmospheric storms.

Due to their similarity to giant exoplanets, brown dwarfs are windows into planetary systems beyond our own. It is easier to study brown dwarfs than planets because they often do not have a bright host star that obscures them.

"It is likely the banded structure and large atmospheric waves we found in brown dwarfs will also be common in giant exoplanets," Apai said.

Using Spitzer, scientists monitored brightness changes in six brown dwarfs over more than a year, observing each of them rotate 32 times. As a brown dwarf rotates, its clouds move in and out of the hemisphere seen by the telescope, causing changes in the brightness of the brown dwarf. Scientists then analyzed these brightness variations to explore how silicate clouds are distributed in the brown dwarfs.

Researchers had been expecting these brown dwarfs to have elliptical storms resembling Jupiter's Great Red Spot, caused by high-pressure zones. The Great Red Spot has been present in Jupiter for hundreds of years and changes very slowly: Such "spots" could not explain the rapid changes in brightness that scientists saw while observing these brown dwarfs. The brightness levels of the brown dwarfs varied markedly just over the course of an Earth day.

To make sense of the ups and downs of brightness, scientists had to rethink their assumptions about what was going on in the brown dwarf atmospheres. The best model to explain the variations involves large waves, propagating through the atmosphere with different periods. These waves would make the cloud structures rotate with different speeds in different bands.

University of Arizona researcher Theodora Karalidi used a supercomputer and a new computer algorithm to create maps of how clouds travel on these brown dwarfs.

"When the peaks of the two waves are offset, over the course of the day there are two points of maximum brightness," Karalidi said. "When the waves are in sync, you get one large peak, making the brown dwarf twice as bright as with a single wave."

The results explain the puzzling behavior and brightness changes that researchers previously saw. The next step is to try to better understand what causes the waves that drive cloud behavior.

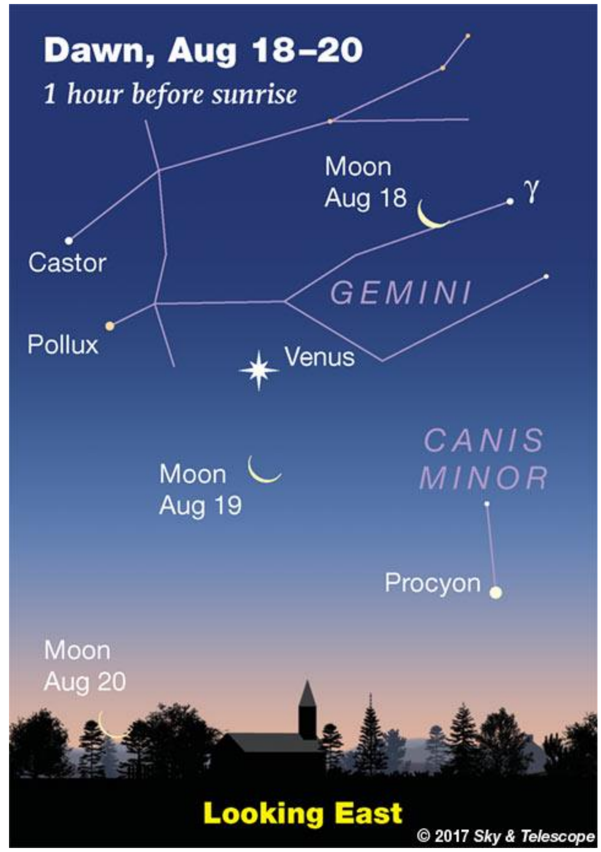
JPL manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington. Science operations are conducted at the Spitzer Science Center at Caltech in Pasadena, California. Spacecraft operations are based at Lockheed Martin Space Systems Company, Littleton, Colorado. Data are archived at the Infrared Science Archive housed at the Infrared Processing and Analysis Center at Caltech. Caltech manages JPL for NASA. For more information about Spitzer, visit http://spitzer.caltech.edu and https://www.nasa.gov/spitzer.

Source: NASA Return to Contents

The Night Sky

Friday, August 18

• As dawn begins to break on Saturday morning the 19th, look for the waning Moon hanging under Venus low in the east, as shown here. Find Pollux and Castor, *much* fainter, to Venus's left or upper left.



Saturday, August 19

• August is prime Milky Way time, and the dark night is now moonless. After dark the Milky Way runs from Sagittarius in the south, up and left across Aquila and through the big Summer Triangle very high in the east, and on down through Cassiopeia to Perseus rising low in the north-northeast.

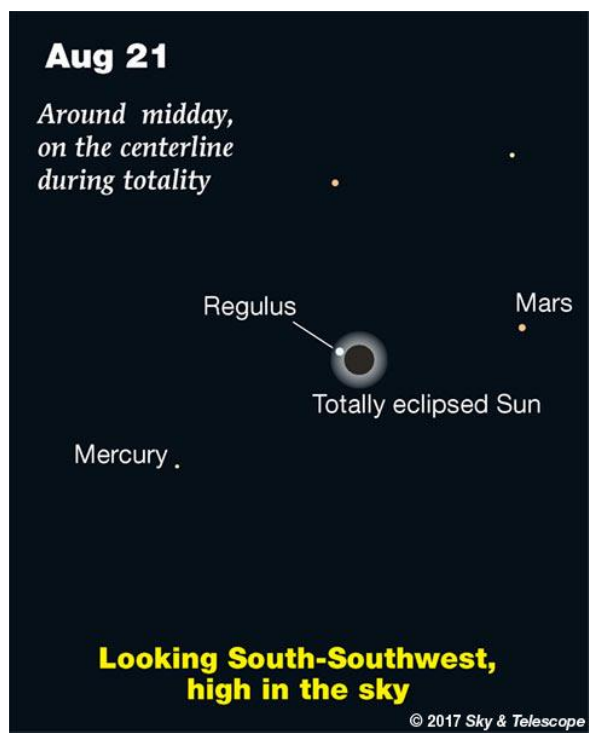
Sunday, August 20

• With the Moon obviously out of the night sky getting ready for tomorrow's command performance, this would be a fine evening to look far away from the Sun into the Cygnus Milky Way, high overhead. Hunt out the telescopic deep-sky sights there that Sue French highlights in the August Sky & Telescope, page 54, with finder charts, photo, and eyepiece sketches.

Monday, August 21

• In case you didn't hear, there's an eclipse of the Sun today. Not in the path of totality? You'll get a partial eclipse from anywhere in North or Central America, the Caribbean, and northern South America. Here are all our eclipse topics, including how to take photographs. Shortcut to NASA's clickable map to get your local timetable.

• If a solar eclipse is happening, you know it's new Moon today.



Source: Sky & Telescope

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ISS Sighting Opportunities

For Denver:

No sighting opportunities

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

NASA-TV Highlights

(all times Eastern Daylight Time)

Friday, August 18

11 a.m., SpaceCast Weekly (all channels)

12 p.m., College of Charleston News Conference on 2017 Solar Eclipse (NTV-3 (Media))

2 p.m., Replay of the College of Charleston News Conference on 2017 Solar Eclipse (all channels)

3 p.m., Smithsonian's National Air & Space Museum Presents - "What's New in Aerospace?" – Eclipsepalooza (NTV-1 (Public))

4 p.m., NASA Television Special – How to Safely Watch a Solar Eclipse (NTV-1 (Public))

5 p.m., Replay of - "What's New in Aerospace?" – Eclipsepalooza (NTV-1 (Public))

6 p.m., Replay of the College of Charleston News Conference on 2017 Solar Eclipse (all channels)

7 p.m., NASA Television Special – How to Safely Watch a Solar Eclipse (NTV-1 (Public))

8 p.m., Replay of - "What's New in Aerospace?" – Eclipsepalooza (NTV-1 (Public))

9 p.m., Replay of the College of Charleston News Conference on 2017 Solar Eclipse (all channels)

Monday, August 21

11:30 a.m., NASA Television Coverage of the 2017 Total Solar Eclipse – Unproduced/Raw Media Feed (starts at 11:45 a.m.) (NTV-3 (Media))

12 p.m., NASA Television Coverage of the 2017 Total Solar Eclipse Pre-Show -- from the College of Charleston (NTV-1 (Public))

1 p.m., "Through the Eyes of NASA" -- NASA Television Coverage of the 2017 Total Solar Eclipse -- from the College of Charleston (NTV-1 (Public))

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

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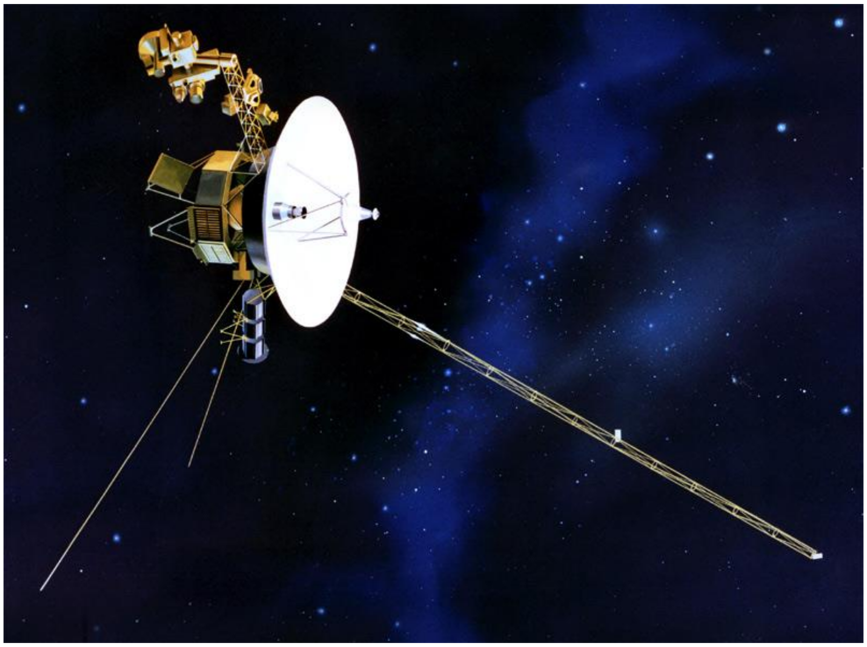
Space Calendar

- Aug 18 - UPDATED [Aug 17] TDRS M Atlas 5 Launch
- Aug 18 - Comet P/2010 P4 (WISE) Perihelion (1.861 AU)
- Aug 18 - Comet 164P/Christensen Closest Approach To Earth (2.026 AU)
- Aug 18 - Apollo Asteroid 2012 BD14 Near-Earth Flyby (0.067 AU)
- Aug 18 - Atira Asteroid 2015 ME131 Closest Approach To Earth (0.424 AU)
- Aug 18 - Asteroid 13208 Fraschetti Closest Approach To Earth (0.964 AU)
- Aug 18 - Lunar and Planetary Laboratory Conference, Tucson, Arizona
- Aug 19 - UPDATED [Aug 17] Michibiki 3 (QZS-3) H-2A Launch
- Aug 19 - Comet P/2012 T1 (PANSTARRS) Closest Approach To Earth (1.707 AU)
- Aug 19 - Comet 30P/Reinmuth Perihelion (1.877 AU)
- Aug 19 - Asteroid 3654 AAS Closest Approach To Earth (0.980 AU)
- Aug 19 - Asteroid 1132 Hollandia Closest Approach To Earth (1.014 AU)
- Aug 19 - Galaxy Forum Kansas 2017, Hutchinson, Kansas
- Aug 20 - Cassini, Distant Flyby of Pandora, Pan & Daphnis
- Aug 20 - Asteroid 3852 Glennford Closest Approach To Earth (1.707 AU)
- Aug 20 - Asteroid 48575 Hawaii Closest Approach To Earth (2.299 AU)
- Aug 20 - Asteroid 249516 Aretha Closest Approach To Earth (2.325 AU)
- Aug 20 - 40th Anniversary (1977), Voyager 2 Launch
- Aug 21 - HOT [Aug 14] Total Solar Eclipse (Visible from United States)
- Aug 21 - Comet C/2015 VL62 Closest Approach To Earth (1.742 AU)
- Aug 21 - Comet C/2015 VL62 At Opposition (1.742 AU)
- Aug 21 - Asteroid 1850 Kohoutek Closest Approach To Earth (1.135 AU)
- Aug 21 - Asteroid 1814 Bach Closest Approach To Earth (1.337 AU)
- Aug 21 - Asteroid 2865 Laurel Closest Approach To Earth (1.496 AU)
- Aug 21 - Asteroid 15332 CERN Closest Approach To Earth (1.565 AU)
- Aug 21 - Asteroid 6639 Marchis Closest Approach To Earth (1.840 AU)
- Aug 21 - Asteroid 78577 JPL Closest Approach To Earth (2.003 AU)
- Aug 21 - 45th Anniversary (1972), Copernicus Launch



Voyager spacecraft

Source: JPL Space Calendar

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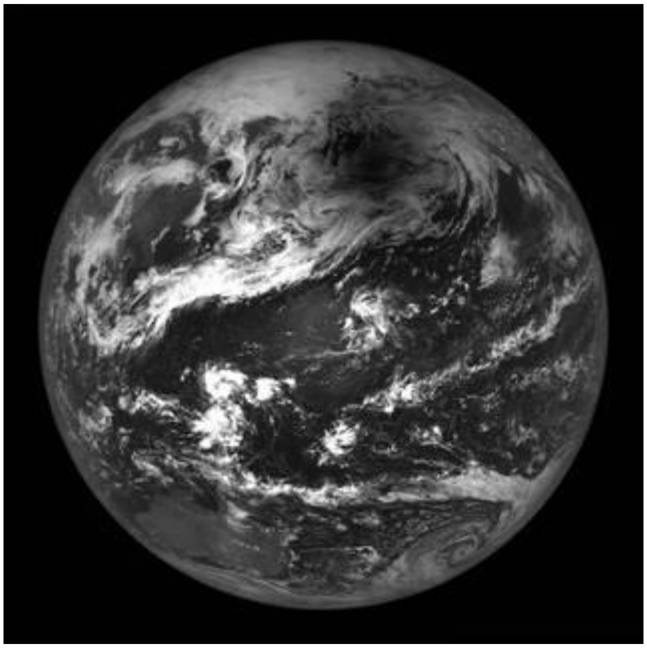
Food for Thought

NASA's LRO Team Wants You to Wave at the Moon



NASA's Lunar Reconnaissance Orbiter (LRO) team invites the public to wave at the Moon on Aug. 21 as LRO turns its camera toward Earth.

The LRO Camera, which has captured gorgeous views of the lunar landscape and documented geologic activity still occurring today, will turn toward Earth during the solar eclipse on Aug. 21 at approximately 2:25 p.m. EDT (11:25 a.m. PDT) to capture an image of the Moon's shadow on Earth. "I'm really excited about this campaign because it is something so many people can be a part of," said Andrea Jones, LRO public engagement lead at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "So much attention has been focused on the lucky folks who will get to experience eclipse totality, but everyone in an entire hemisphere of the Earth can wave at the Moon as LRO takes our picture!"

During the eclipse the Moon will be far enough from Earth that the resolution of the images are 2.5 miles per pixel. While the LRO Camera won't be able to see people or buildings, it will be able to see the continents, clouds and large surface features. "While people should not expect to see themselves in the images, this campaign is a great way to personalize the eclipse experience," said Noah Petro, LRO deputy project scientist at Goddard.

A note of caution: the only time it's safe to look at the Sun without eye protection is if you're in the 70-mile-wide path of totality and only during the minutes of totality. Do not look directly at the Sun at any other time without certified eclipse glasses. For more information on eclipse eye safety: https://eclipse2017.nasa.gov/safety.

The LRO Camera has imaged a solar eclipse previously. To see an example of the type of image captured, go to: http://www.lroc.asu.edu/posts/513.

Launched on June 18, 2009, LRO has collected a treasure trove of data with its seven powerful instruments, making an invaluable contribution to our knowledge about the Moon. LRO is managed by NASA's Goddard Space Flight Center in Greenbelt, Maryland, for the Science Mission Directorate at NASA Headquarters in Washington, D.C.

For more information on LRO, visit: www.nasa.gov/lro.

Source: NASA

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Space Image of the Week

Perseids over the Pyrénées

Explanation: This mountain and night skyscape stretches across the French Pyrenees National Park on August 12, near the peak of the annual Perseid meteor shower. The multi-exposure panoramic view was composed from the Col d'Aubisque, a mountain pass, about an hour before the bright gibbous moon rose. Centered is a misty valley and lights from the region's Gourette ski station toward the south. Taken over the following hour, frames capturing some of the night's long brightperseid meteors were aligned against the backdrop of stars and Milky Way.

Image Credit & Copyright**:** Jean-Francois Graffand

Source: APOD

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