

# Space News Update

– August 17, 2018 –

## Contents

### In the News

#### Story 1:

Six Things About Opportunity's Recovery Efforts

#### Story 2:

Study of Material Surrounding Distant Stars Shows Earth's Ingredients  
Are Pretty Normal

#### Story 3:

First science with ALMA's Highest-frequency Capabilities

### Departments

#### The Night Sky

#### ISS Sighting Opportunities

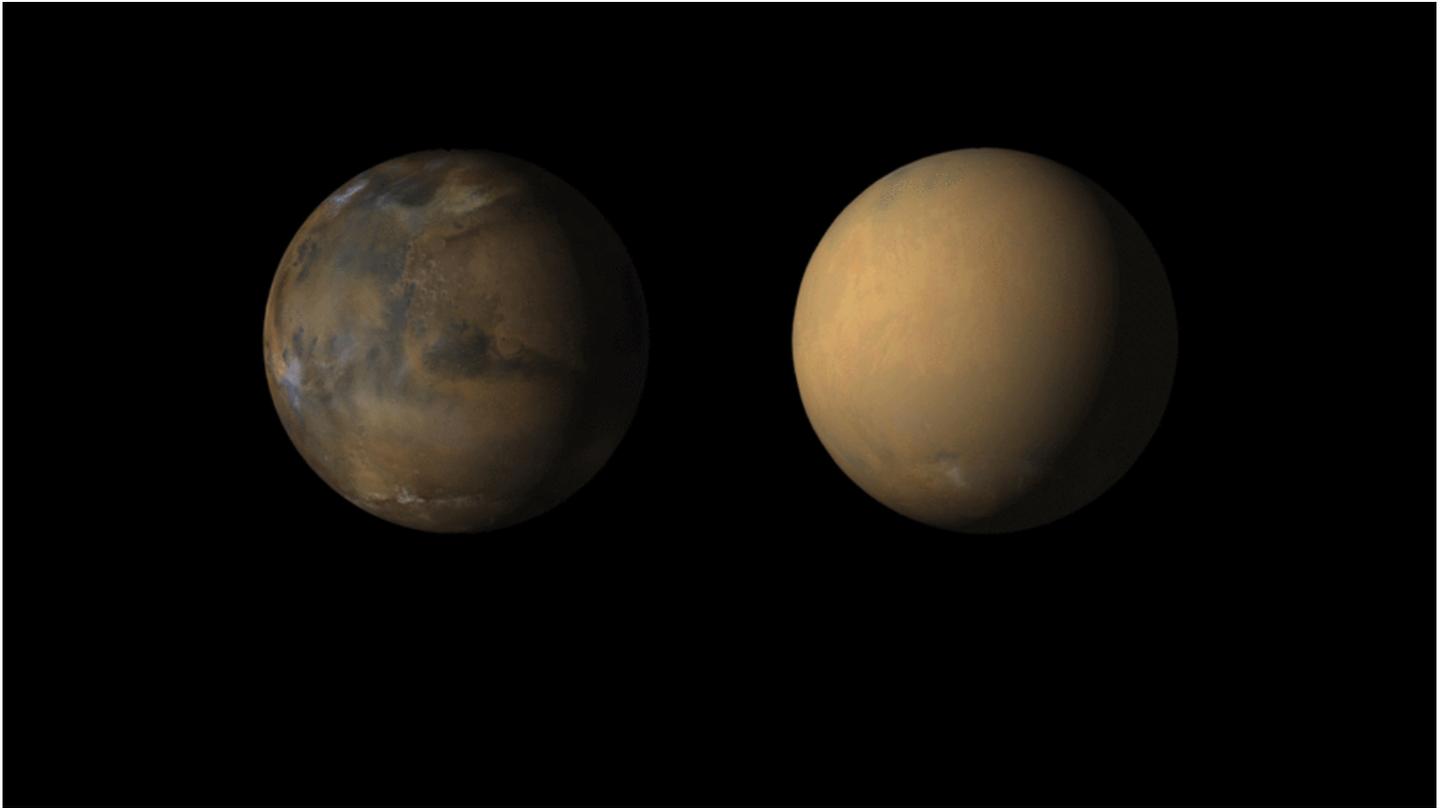
#### Space Calendar

#### NASA-TV Highlights

#### Food for Thought

#### Space Image of the Week

## 1. Six Things About Opportunity's Recovery Efforts



NASA's Opportunity rover has been silent since June 10, when a planet-encircling dust storm cut off solar power for the nearly-15-year-old rover. Now that scientists think the global dust storm is "decaying" -- meaning more dust is falling out of the atmosphere than is being raised back into it -- skies might soon clear enough for the solar-powered rover to recharge and attempt to "phone home."

No one will know how the rover is doing until it speaks. But the team notes there's reason to be optimistic: They've performed several studies on the state of its batteries before the storm, and temperatures at its location. Because the batteries were in relatively good health before the storm, there's not likely to be too much degradation. And because dust storms tend to warm the environment -- and the 2018 storm happened as Opportunity's location on Mars entered summer -- the rover should have stayed warm enough to survive.

What will engineers at NASA's Jet Propulsion Laboratory in Pasadena, California, be looking for -- and what will those signs mean for recovery efforts?

### **A tau below 2**

Dust storms on Mars block sunlight from reaching the surface, raising the level of a measurement called "tau." The higher the tau, the less sunlight is available; the last tau measured by Opportunity was 10.8 on June 10. To compare, an average tau for its location on Mars is usually 0.5.

JPL engineers predict that Opportunity will need a tau of less than 2.0 before the solar-powered rover will be able to recharge its batteries. [A wide-angle camera](#) on NASA's Mars Reconnaissance Orbiter will watch for surface features to become visible as the skies clear. That will help scientists estimate the tau.

Updates on the dust storm and tau can be found [here](#).

## Two Ways to Listen for Opportunity

Several times a week, engineers use NASA's [Deep Space Network](#), which communicates between planetary probes and Earth, to attempt to talk with Opportunity. The massive DSN antennas ping the rover during scheduled "wake-up" times, and then search for signals sent from Opportunity in response.

In addition, JPL's radio science group uses special equipment on DSN antennas that can detect a wider range of frequencies. Each day, they record any radio signal from Mars over most of the rover's daylight hours, then search the recordings for Opportunity's "voice."

## Rover faults out

When Opportunity experiences a problem, it can go into so-called "fault modes" where it automatically takes action to maintain its health. Engineers are preparing for three key fault modes if they do hear back from Opportunity.

- Low-power fault: engineers assume the rover went into low-power fault shortly after it stopped communicating on June 10. This mode causes the rover to hibernate, assuming that it will wake up at a time when there's more sunlight to let it recharge.
- Clock fault: critical to operating while in hibernation is the rover's onboard clock. If the rover doesn't know what time it is, it doesn't know when it should be attempting to communicate. The rover can use environmental clues, like an increase in sunlight, to make assumptions about the time.
- Uploss fault: when the rover hasn't heard from Earth in a long time, it can go into "uploss" fault -- a warning that its communication equipment may not be functioning. When it experiences this, it begins to check the equipment and tries different ways to communicate with Earth.

## What happens if they hear back?

After the first time engineers hear from Opportunity, there could be a lag of several weeks before a second time. It's like a patient coming out of a coma: It takes time to fully recover. It may take several communication sessions before engineers have enough information to take action.

The first thing to do is learn more about the state of the rover. Opportunity's team will ask for a history of the rover's battery and solar cells and take its temperature. If the clock lost track of time, it will be reset. The rover would take pictures of itself to see whether dust might be caked on sensitive parts, and test actuators to see if dust slipped inside, affecting its joints.

Once they've gathered all this data, the team would take a poll about whether they're ready to attempt a full recovery.

## Not out of the woods

Even if engineers hear back from Opportunity, there's a real possibility the rover won't be the same.

The rover's batteries could have discharged so much power -- and stayed inactive so long -- that their capacity is reduced. If those batteries can't hold as much charge, it could affect the rover's continued operations. It could also mean that energy-draining behavior, like running its heaters during winter, could cause the batteries to brown out.

Dust isn't usually as much of a problem. Previous storms plastered dust on the camera lenses, but most of that was shed off over time. Any remaining dust can be calibrated out.

## Send Opportunity a postcard

Do you miss Opportunity as much as the rover's team? You can write a message sharing your thoughts [here](#).

Read more about Opportunity at:

<https://mars.nasa.gov/mer/highlights/>

Source: [NASA](#)

[Return to Contents](#)

## 2. Study of Material Surrounding Distant Stars Shows Earth's Ingredients Are Pretty Normal



The Earth's building blocks seem to be built from 'pretty normal' ingredients, according to researchers working with the world's most powerful telescopes.

Scientists have measured the compositions of 18 different planetary systems from up to 456 light years away and compared them to ours, and found that many elements are present in similar proportions to those found on Earth.

This is amongst the largest examinations to measure the general composition of materials in other planetary systems, and begins to allow scientists to draw more general conclusions on how they are forged, and what this might mean for finding Earth-like bodies elsewhere.

"Most of the building blocks we have looked at in other planetary systems have a composition broadly similar to that of the Earth", said researcher Dr Siyi Xu of the Gemini Observatory in Hawaii, who was presenting the work at the Goldschmidt conference in Boston.

The first planets orbiting other stars were only found in 1992 (this was orbiting a pulsar), since then scientists have been trying to understand whether some of these stars and planets are similar to our own solar system.

"It is difficult to examine these remote bodies directly. Because of the huge distances involved, their nearby star tends to drown out any electromagnetic signal, such as light or radio waves" said Siyi Xu. "So we needed to look at other methods".

Because of this, the team decided to look at how the planetary building blocks affect signals from white dwarf stars. These are stars which have burnt off most of their hydrogen and helium, and shrunk to be very small and dense - it is anticipated that our Sun will become a white dwarf in around 5 billion years.

Dr Xu continued, "White dwarfs' atmospheres are composed of either hydrogen or helium, which give out a pretty clear and clean spectroscopic signal. However, as the star cools, it begins to pull in material from the planets, asteroids, comets and so on which had been orbiting it, with some forming a dust disk, a little like the rings of Saturn. As this material approaches the star, it changes how we see the star. This change is measurable because it influences the star's spectroscopic signal, and allows us to identify the type and even the quantity of material surrounding the white dwarf. These measurements can be extremely sensitive, allowing bodies as small as an asteroid to be detected".

The team took measurements using spectrographs on the Keck telescope in Hawaii, the world's largest optical and infrared telescope, and on the Hubble Space Telescope.

Siyi Xu continued, "In this study, we have focused on the sample of white dwarfs with dust disks. We have been able to measure calcium, magnesium, and silicon content in most of these stars, and a few more elements in some stars. We may also have found water in one of the systems, but we have not yet quantified it: it's likely that there will be a lot of water in some of these worlds. For example, we've previously identified one star system, 170 light years away in the constellation Boötes, which was rich in carbon, nitrogen and water, giving a composition similar to that of Halley's Comet. In general though, their composition looks very similar to bulk Earth.

This would mean that the chemical elements, the building blocks of earth are common in other planetary systems. From what we can see, in terms of the presence and proportion of these elements, we're normal, pretty normal. And that means that we can probably expect to find Earth-like planets elsewhere in our Galaxy".

Dr Xu continued "This work is still on-going and the recent data release from the Gaia satellite, which so far has characterized 1.7 billion stars, has revolutionized the field. This means we will understand the white dwarfs a lot better. We hope to determine the chemical compositions of extrasolar planetary material to a much higher precision"

Professor Sara Seager, Professor of Planetary Science at Massachusetts Institute of Technology, is also the deputy science director of the recently-launched TESS (Transiting Exoplanet Survey Satellite) mission, which will search for exoplanets. She said:

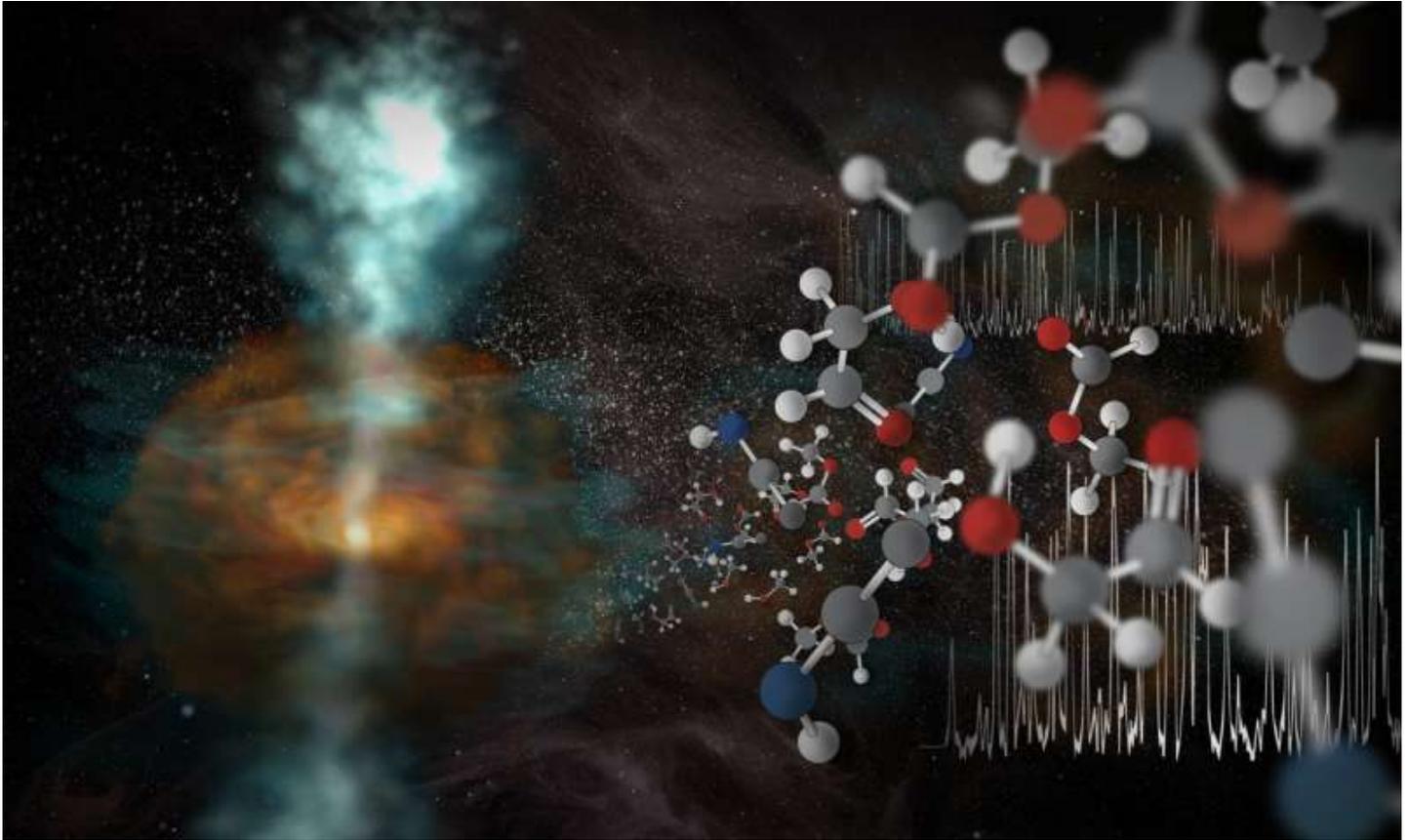
"It's astonishing to me that the best way to study exoplanet interiors is by planets ripped apart and absorbed by their white dwarf host star. It is great to see progress in this research area and to have solid evidence that planets with Earth-like compositions are common--fueling our confidence that an Earth-like planet around a very nearby normal star is out there waiting to be found".

Professor Seager was not involved in this research, this is an independent comment.

Source: [Spaceref.com](http://Spaceref.com)

[Return to Contents](#)

### 3. First science with ALMA's Highest-frequency Capabilities



The ALMA telescope in Chile has transformed how we see the universe, showing us otherwise invisible parts of the cosmos. This array of incredibly precise antennas studies a comparatively high-frequency sliver of radio light: waves that range from a few tenths of a millimeter to several millimeters in length. Recently, scientists pushed ALMA to its limits, harnessing the array's highest-frequency (shortest wavelength) capabilities, which peer into a part of the electromagnetic spectrum that straddles the line between infrared light and radio waves.

"High-frequency radio observations like these are normally not possible from the ground," said Brett McGuire, a chemist at the National Radio Astronomy Observatory in Charlottesville, Virginia, and lead author on a paper appearing in the *Astrophysical Journal Letters*. "They require the extreme precision and sensitivity of ALMA, along with some of the driest and most stable [atmospheric conditions](#) that can be found on Earth."

Under ideal atmospheric conditions, which occurred on the evening of 5 April 2018, astronomers trained ALMA's highest-frequency, submillimeter vision on a curious region of the Cat's Paw Nebula (also known as NGC 6334I), a star-forming complex located about 4,300 light-years from Earth in the direction of the southern constellation Scorpius.

Previous ALMA observations of this region at lower frequencies uncovered turbulent star formation, a highly dynamic environment, and a wealth of molecules inside the nebula.

To observe at higher frequencies, the ALMA antennas are designed to accommodate a series of "bands"—numbered 1 to 10—that each study a particular sliver of the spectrum. The Band 10 receivers observe at the highest frequency (shortest wavelengths) of any of the ALMA instruments, covering wavelengths from 0.3 to 0.4 millimeters (787 to 950 gigahertz), which is also considered to be long-wavelength infrared light.

These first-of-their-kind ALMA observations with Band 10 produced two exciting results.

### **Jets of Steam from Protostar**

One of ALMA's first Band 10 results was also one of the most challenging, the direct observation of jets of water vapor streaming away from one of the massive protostars in the region. ALMA was able to detect the submillimeter-wavelength light naturally emitted by [heavy water](#) (water molecules made up of oxygen, hydrogen and deuterium atoms, which are hydrogen atoms with a proton and a neutron in their nucleus).

"Normally, we wouldn't be able to directly see this particular signal at all from the ground," said Crystal Brogan, an astronomer at the NRAO and co-author on the paper. "Earth's atmosphere, even at remarkably arid places, still contains enough water vapor to completely overwhelm this signal from any cosmic source. During exceptionally pristine conditions in the high Atacama Desert, however, ALMA can in fact detect that signal. This is something no other telescope on Earth can achieve."

As stars begin to form out of massive clouds of dust and gas, the material surrounding the star falls onto the mass at the center. A portion of this material, however, is propelled away from the growing protostar as a pair of jets, which carry away gas and molecules, including water.

The heavy water the researchers observed is flowing away from either a single protostar or a small cluster of protostars. These jets are oriented differently from what appear to be much larger and potentially more-mature jets emanating from the same region. The astronomers speculate that the heavy-water jets seen by ALMA are relatively recent features just beginning to move out into the surrounding nebula.

These observations also show that in the regions where this water is slamming into the surrounding gas, low-frequency water masers—naturally occurring microwave versions of lasers—flare up. The masers were detected in complementary observations by the National Science Foundation's Very Large Array.

### **ALMA Observes Molecules Galore**

In addition to making striking images of objects in space, ALMA is also a supremely sensitive cosmic chemical sensor. As molecules tumble and vibrate in space, they naturally emit light at specific wavelengths, which appear as spikes and dips on a spectrum. All of ALMA's receiver bands can detect these unique spectral fingerprints, but those lines at the highest frequencies offer unique insight into lighter, important chemicals, like heavy water. They also provide the ability to see signals from complex, warm molecules, which have weaker spectral lines at lower frequencies.

Using Band 10, the researchers were able to observe a region of the spectrum that is extraordinarily rich in molecular fingerprints, including glycoaldehyde, the simplest sugar-related molecule.

When compared to previous best-in-the-world observations of the same source with the European Space Agency's Herschel Space Observatory, the ALMA observations detected more than ten times as many spectral lines.

"We detected a wealth of complex organic molecules surrounding this massive star-forming region," said McGuire. "These results have been received with excitement by the astronomical community and show once again how ALMA will reshape our understanding of the universe."

ALMA is able to take advantage of these rare windows of opportunity when the atmospheric conditions are "just right" by using dynamic scheduling. That means, the telescope operators and astronomers carefully monitor the weather and conduct those planned observations that best fit the prevailing conditions.

"There certainly are quite a few conditions that have to be met to conduct a successful observation using Band 10," concluded Brogan. "But these new ALMA results demonstrate just how important these observations can be."

"To remain at the forefront of discovery, observatories must continuously innovate to drive the leading edge of what astronomy can accomplish," said Joe Pesce, the program director for the National Radio Astronomy Observatory at NSF. "That is a core element of NSF's NRAO, and its ALMA telescope, and this discovery pushes the limit of what is possible through ground-based astronomy."

This research is presented in a paper titled "First results of an ALMA band 10 spectral line survey of NGC 6334I: Detections of glycolaldehyde (HC(O)CH<sub>2</sub>OH) and a new compact bipolar outflow in HDO and CS," by B. McGuire et al. in the *Astrophysical Journal Letters*.

**Explore further:** [First light for band 5 at ALMA](#)

**More information:** First results of an ALMA band 10 spectral line survey of NGC 6334I: Detections of glycolaldehyde (HC(O)CH<sub>2</sub>OH) and a new compact bipolar outflow in HDO and CS, *Astrophysical Journal Letters* (2018). DOI: [10.3847/2041-8213/aad7bb](https://doi.org/10.3847/2041-8213/aad7bb) , <https://arxiv.org/abs/1808.05438>

**Journal reference:** [Astrophysical Journal Letters](#)

Source: [Phys.org](#)

[Return to Contents](#)

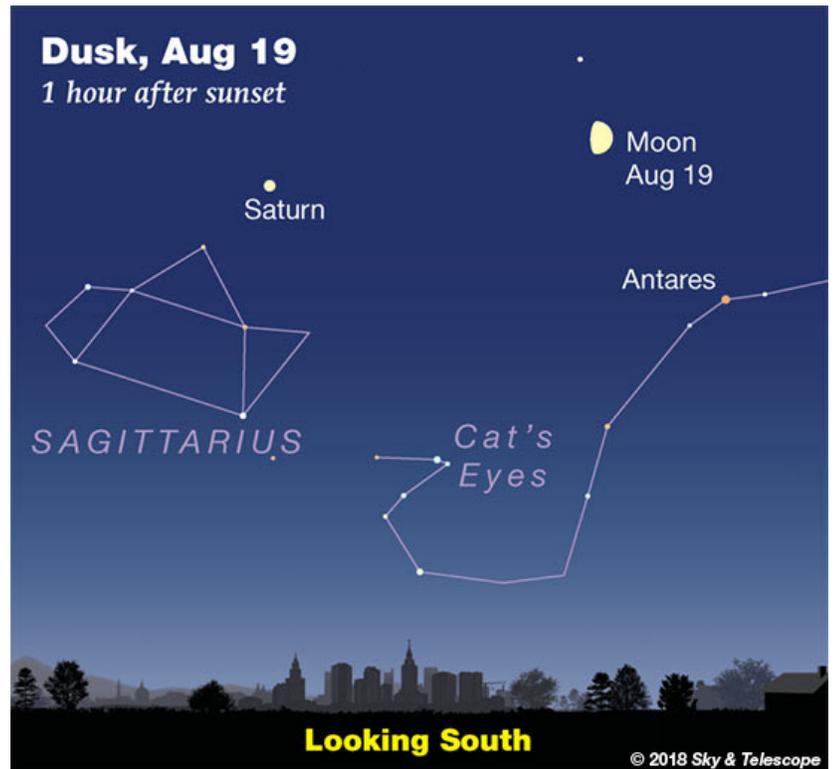
# The Night Sky

## Friday, August 17

- Once again, four bright planets remain in view as twilight fades all week. From right to left, they're Venus very low in the west-southwest, Jupiter in the southwest (upper left of Venus), Saturn in the south about as high as Jupiter, and bright Mars lower in the southeast. Best view: about 40 minutes after sunset.

- *This* evening the first-quarter Moon poses to the upper left of Jupiter. Antares is three times as far to the Moon's lower left.

- A mere  $0.6^\circ$  below Jupiter (about the width of a chopstick at arm's length) is 3rd-magnitude Alpha Librae, a wide double star for binoculars. Its fainter component, 4 arcminutes to the right of the bright one, is magnitude 5.1. That's only a little brighter than Jupiter's moons — which good binoculars will also show, lined up just to the big planet's left and right. Jupiter remains close to Alpha Librae all week.



## Saturday, August 18

- Lined up nearly vertically below the Moon this evening are the stars marking the head of Scorpius. Lower left of the Moon is brighter Antares, one of the brightest orange-red supergiant stars in the sky.

## Sunday, August 19

- Now Antares is lower right of the Moon at nightfall, and Saturn glows to the Moon's left, as shown here.

## Monday, August 20

- Saturn is the "star" left of the Moon this evening, as shown below right.

Source: [Sky & Telescope](#)

[Return to Contents](#)

## **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)

No special programming

Watch NASA TV on the Net by going to the [NASA website](#).

[Return to Contents](#)

# Space Calendar

- Aug 17 - [Venus](#) At Its Greatest Eastern [Elongation](#) (46 Degrees)
- Aug 17 - [Comet C/2017 U2 \(Fuls\)](#) [Closest Approach To Earth](#) (6.096 AU)
- Aug 17 - [Aten Asteroid 2016 JJ17](#) Near-Earth Flyby (0.065 AU)
- Aug 17 - **NEW** [Aug 10] [Apollo Asteroid 2018 PL8](#) Near-Earth Flyby (0.066 AU)
- Aug 17 - [Apollo Asteroid 4341 Poseidon](#) [Closest Approach To Earth](#) (1.912 AU)
- Aug 17 - [Lunar and Planetary Laboratory Conference](#), Tucson, Arizona
- Aug 17 - [Gene Kranz's](#) 85th Birthday (1933)
- Aug 18 - [Comet 37P/Forbes](#) [Closest Approach To Earth](#) (0.975 AU)
- Aug 18 - [Comet 137P/Shoemaker-Levy](#) [At Opposition](#) (1.204 AU)
- Aug 18 - [Comet 76P/West-Kohoutek-Ikemura](#) [Closest Approach To Earth](#) (2.824 AU)
- Aug 18 - **NEW** [Aug 15] [Aten Asteroid 2018 PK20](#) Near-Earth Flyby (0.020 AU)
- Aug 18 - **NEW** [Aug 17] [Apollo Asteroid 2018 PO22](#) Near-Earth Flyby (0.023 AU)
- Aug 18 - **NEW** [Aug 12] [Apollo Asteroid 2018 PL10](#) Near-Earth Flyby (0.050 AU)
- Aug 18 - [Asteroid 5335 Damocles](#) (Burnt Out Comet) [At Opposition](#) (19.188 AU)
- Aug 18 - 150th Anniversary (1868), [Jules Janssen's](#) Discovery of [Helium](#)
- Aug 19 - [Comet P/2010 U2 \(Hill\)](#) [Closest Approach To Earth](#) (2.580 AU)
- Aug 19 - [Apollo Asteroid 5786 Talos](#) [Closest Approach To Earth](#) (0.766 AU)
- Aug 19 - [Asteroid 7536 Fahrenheit](#) [Closest Approach To Earth](#) (1.466 AU)
- Aug 19 - [Leonid Kulik's](#) 135th Birthday (1883)
- Aug 20 - [Comet 48P/Johnson](#) [Closest Approach To Earth](#) (1.014 AU)
- Aug 20 - [Comet 78P/Gehrels](#) [At Opposition](#) (1.660 AU)
- Aug 20 - [Comet P/2006 F1 \(Kowalski\)](#) [Closest Approach To Earth](#) (3.140 AU)
- Aug 20 - [Aten Asteroid 2017 FR63](#) Near-Earth Flyby (0.099 AU)
- Aug 20 - [Asteroid 9770 Discovery](#) [Closest Approach To Earth](#) (1.441 AU)



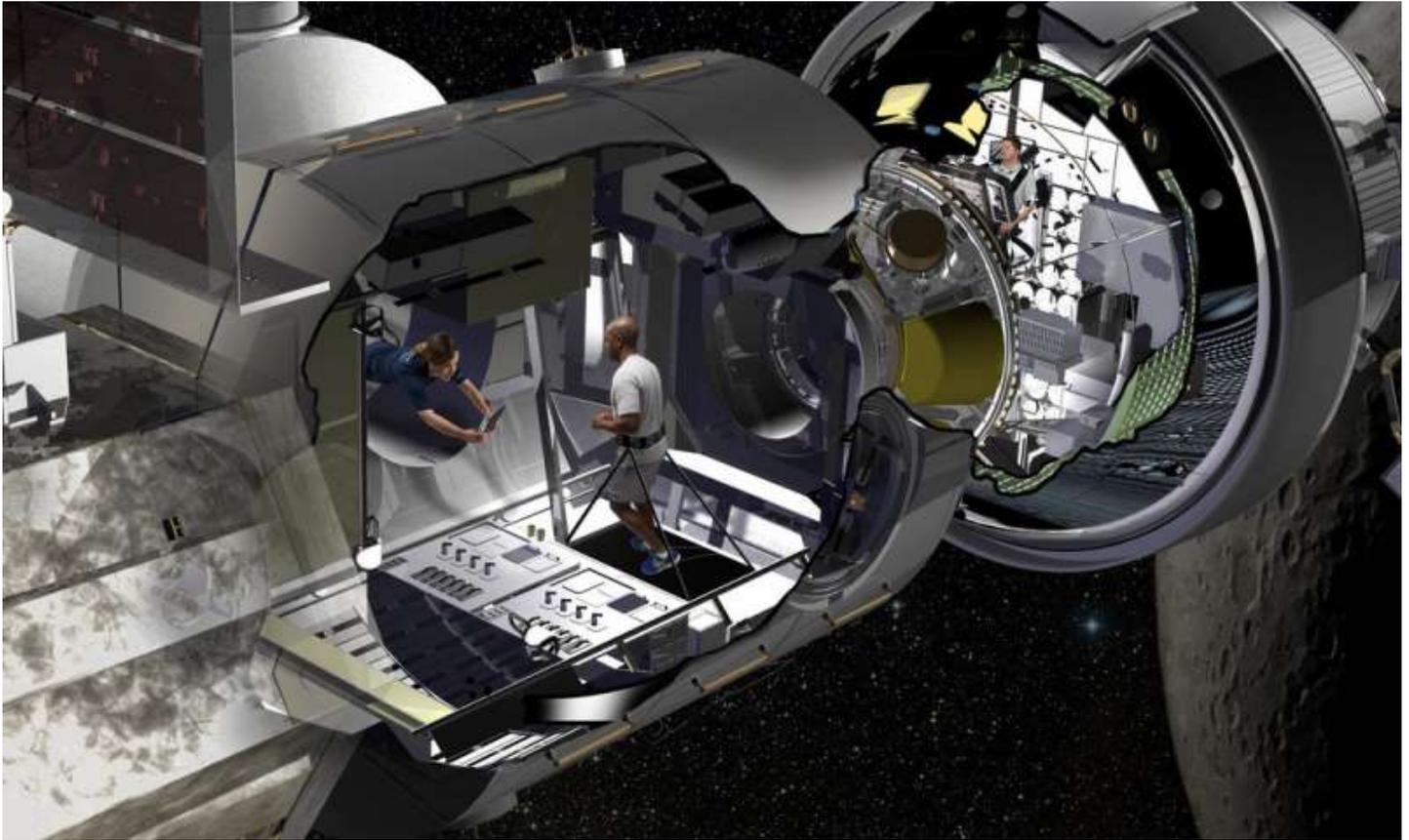
*Leonid Kulik*

Source: [JPL Space Calendar](#)

[Return to Contents](#)

## Food for Thought

### Lockheed Martin Gives First Look into Where Astronauts May Live on Missions to Deep Space



A massive cylindrical habitat may one day house up to four astronauts as they make the trek to deep space.

Lockheed Martin gave a first look at what one of these habitats might look like Thursday at the Kennedy Space Center, where the aerospace giant is under contract with NASA to build a prototype of the living quarters.

Lockheed is one of six contractors—the others are Boeing, Sierra Nevada Corp.'s Space Systems, Orbital ATK, NanoRacks and Bigelow Aerospace—that NASA awarded a combined \$65 million to build a habitat prototype by the end of the year. The agency will then review the proposals to reach a better understanding of the systems and interfaces that need to be in place to facilitate living in [deep space](#).

Lockheed's design uses the Donatello Multi-Purpose Logistics Module, a refurbished module dating back to the space shuttle era that was once destined to transfer cargo to the International Space Station. But Donatello was never sent into space, and the module has now instead been transformed into Lockheed's prototype.

At about 15 feet wide and nearly 22 feet long, the cylindrical capsule is roughly the size of a small bus. But it'll be a tight fit if four astronauts reside in it for 30 to 60 days, as Bethesda, Md.-based Lockheed envisions.

The capsule is designed to house racks for science, life support systems, sleep stations, exercise machines and robotic work stations, said Bill Pratt, the program's manager.

"You think of it as an RV in deep space," he said during a tour of the prototype. "When you're in an RV, your table becomes your bed and things are always moving around, so you have to be really efficient with the space. That's a lot of what we are testing here."

The team used augmented reality headsets, which overlay real hardware with simulations, to visualize the layout of the capsule—saving time and helping Lockheed catch errors early on.

Another cost-saving measure: the reuse of Donatello.

"We want to get to the moon and to Mars as quickly as possible, and we feel like we actually have a lot of stuff that we can use to do that," Pratt said, adding that repurposing materials has become a big theme at Lockheed.

The habitat is part of the larger mission to take crews to the moon and Mars. The final version of the capsule will attach to the planned Deep Space Gateway, a space port that will orbit the moon and act as a jumping-off point for [deep space exploration](#) missions.

Astronauts would launch on the deep-space designed, still-in-progress Orion spacecraft—with the help of the Space Launch System, which NASA bills as the "most powerful rocket" it's ever built. The Gateway would be considerably smaller than the 450-ton International Space Station. At 75 tons, the spaceport would include the habitat, an airlock, a propulsion module, a docking port and a power bus.

Production is moving forward on Orion, which is expected to make an uncrewed mission (Exploration Mission-1) to orbit the moon by 2020. Exploration Mission-2 is scheduled to take a crew into lunar orbit in mid-2022.

At the Kennedy Space Center, the heat shields are now in place on Orion. The spacecraft has been in development on and off since 2004.

The long development time is due largely to the demands of a deep-space spacecraft and the punishing conditions the spacecraft will face when it takes the 1,000-day trip to Mars. For instance, NASA requires that the Orion crew module have zero weld defects, whereas the Apollo mission specifications had an allowable number of defects per inch.

"This is the infrastructure for sustained [human space exploration](#) and so you have to account for every scenario that could come up, that's why the requirements are so stringent," said Lisa Callahan, vice president and general manager of Lockheed Martin's commercial civil [space](#) division.

Lockheed now has its eyes on the finish line. Next month, the European Space Agency will deliver the European Service Module that will sit below the crew module on Orion, kicking off the final stretch of development before the spacecraft is integrated into the Space Launch System, said Mike Hawes, vice president and program manager for Orion at Lockheed Martin.

"It's all burned into our brains that we have 404 days of activity ... before we hand over to the Kennedy ground (operations) team," Hawes said.

**Explore further:** [Lockheed Martin powers up next Orion spacecraft for first time](#)

Source: [Phys.org](#)

[Return to Contents](#)

## Space Image of the Week



### Parker vs Perseid

**Explanation** The brief flash of a bright Perseid meteor streaks across the upper right in this composited series of exposures made early Sunday morning near the peak of the annual Perseid meteor shower. [Set up about two miles](#) from Space Launch Complex 37 at Cape Canaveral Air Force Station, the photographer also captured the four minute long trail of a Delta IV Heavy rocket carrying the [Parker Solar Probe](#) into the dark morning sky. Perseid meteors aren't slow. [The grains of dust](#) from periodic comet Swift-Tuttle vaporize as they plow through Earth's upper atmosphere at about 60 kilometers per *second* (133,000 mph). [On its way](#) to seven gravity-assist flybys of Venus over its seven year mission, the Parker Solar Probe's closest approach to the Sun will steadily decrease, finally reaching a distance of 6.1 million kilometers (3.8 million miles). That's about 1/8 the distance between Mercury and the Sun, and within the [solar corona](#), the Sun's tenuous outer atmosphere. By then it will be traveling roughly 190 kilometers per *second* (430,000 mph) with respect to the Sun, a record for fastest spacecraft from planet Earth.

**Image Credit & Copyright:** [Derek Demeter](#) ([Emil Buehler Planetarium](#))

Source: [APOD](#)

[Return to Contents](#)