

# Southwest Florida Astronomical Society, Inc. SWFAS



## The Eyepiece November 2020

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### A MESSAGE FROM THE PRESIDENT

The Covid situation has not improved. We will not be having star parties and will do a Zoom meeting for the November meeting.

Most public events have been cancelled or cut back so at this time, we don't have any events other than Solar Observing in Charlotte County Parks. There is a tentative set of dates for Big Cypress and a tentative date for the Rotary Park Star Party. Decisions on these events will be made closer to those dates.

Hopefully you got a chance to view the planets this year. Jupiter and Saturn are starting to slip away into the evening twilight. Mars is starting to shrink back in size and brightness.

While cleaning up the back room in the planetarium, I discovered a black 8" Orion Dobsonian was there that I don't have any information on. If you know about this scope, please contact me!

The December Officer Election Voter meeting is coming up. If you are interested in any of the officer positions, please contact me well before the December meeting so I can get information out well prior to the meeting. The meeting may be a Zoom Meeting again and I want to get feedback on the officers from all the members if we don't have a public meeting.

Please join our Zoom meeting Thursday. We have only had about a dozen members each time and would really like to see more members.

Brian

## **Star Party Schedule 2020**

**Sea Hawk Park** - No more Seahawk Park Star Parties for the time being.

We have scheduled some of the Seahawk Park nights to coincide with the moon being a crescent to 1<sup>st</sup> quarter stage to allow for lunar observing.

**Caloosahatchee Regional Park** - 12/12 -- This is tentative.

### **Big Cypress Preserve – Tentative**

December 12<sup>th</sup>, 2020, January 9<sup>th</sup> 2021, February 13<sup>th</sup>, 2021, March 13<sup>th</sup>, 2021

### **Ideas for Using Outreach Funds**

*SWFAS would like to hear from members for any suggestions for applying outreach funds.*

### **Members' Recommended Reading & News Links**

*Members are encouraged to submit to the editor links to recommended articles and books that might be of interest to Club members.*

#### **Uncle Rod's Astro Blog**

<https://uncle-rods.blogspot.com>

#### **Books**

Several, including The Case for Mars by Robert Zubrin, are almost a requirement. Another, Mission to Mars by Buzz Aldrin (*yeah, that guy*).

**Each Weekly Newsletter of S&T has a 60-second news section. The general link for S&T Astronomy News is <https://www.skyandtelescope.com/astronomy-news/>.**

Sky and Telescope has a new free introductory E-book "Stargazing: Getting Started" if you sign up with your email. <https://skyandtelescope.com>

**For NASA-JPL News see <https://www.jpl.nasa.gov/> .**

**For Astronomy Magazine & News, see <https://www.astronomy.com/news>**

Astronomy magazine has a free PDF download of "The Hitchhiker's Guide to the Planets", published September 19, 2019.

## In the Sky for November

Rise & set times of planets are in local time for Ft. Myers, FL, (26.6°N, 81.9°W).

**NOTE: Standard Time starts on November 1<sup>st</sup>.**

(<http://www.heavens-above.com>).

**Sunrise: 1<sup>st</sup> 6:36 am (106°ESE). Sunset: 5:45 pm (254°WSW)**

**Sunrise: 31<sup>st</sup> 6:58 am (114°ESE). Sunset: 5:34 pm (246°WSW)**

**September starts with 11 hours, 7 minutes of daylight and ends with 10 hours, 36 minutes.**

(<https://www.timeanddate.com>)

**Information is from above as well as Sky & Telescope and Astronomy Magazine and SkyMania.com.**

**Night sky simulations, such as on <https://www.timeanddate.com> (select Night Sky) are helpful for planning planetary observations relative to constellations and other night sky events (Beta).**

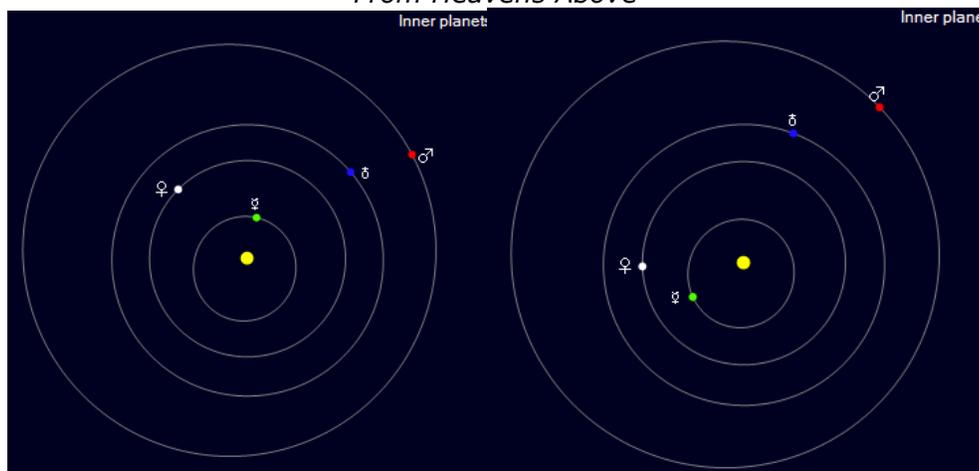
**Moon:** Last Quarter – 8<sup>th</sup>; Perigee – 14<sup>th</sup>; New – 15<sup>th</sup>; First Quarter – 22<sup>nd</sup>; Apogee – 27<sup>th</sup>; Full–30<sup>th</sup>. On the 1<sup>st</sup>, it sets at 7:23 a.m. (287°W), and rises at 6:38 p.m. (71°E). On the 30<sup>th</sup>, set time is 7:06 a.m. (294°WSW), and rise time is 5:56 p.m. (65°ENE).

**Mercury** (starts in Virgo and moves to Libra this month). On the 1<sup>st</sup>, at +1.4 magnitude and 8.9" wide, it rises at 5:40 a.m. two hours before sunrise (Az, 100°ESE), then sets at 5:01 p.m. (260°WSW) at magnitude +1.2 and 8.8" wide. By the end of November, at a brightness of -0.7 and almost 5" wide, it rises before the Sun at 6:10 a.m. (111°E). About ½ hour before sunset, it sets at 4:51 p.m. (284.4°W).

**Venus** (pre-dawn to dawn, starts in Virgo, then moves to Libra this month) On the 1<sup>st</sup>, it rises at 4:05 a.m. at just over 90°E, and sets at 4:03 p.m. (269°W). Its brightness is at -4 to -3.9 for the month, and changes from about 11½" to 13" wide. On the 31<sup>st</sup>, it rises at 5:03 am (90°E) and sets at 5:03 pm (270° W).

**Mars** (all night, in Pisces all month) still presents a good show this month. The orbital relationship with the Earth is changing so that the Earth is moving ahead. They were closest on Oct. 6. Retrograde ends on the 15<sup>th</sup>. It is dimming during the month from a magnitude of about -2.1 and 19.88" wide to -1.1 and 14.58" wide. Mars is still north of the celestial equator. On the 1<sup>st</sup>, it rises at 4:33 p.m. (Az~85°E) and sets the next morning at 4:49 a.m. (Az~275°W). On the 30<sup>th</sup>, it rises at 4:36 p.m. (Az~ 96°E), and sets at 3:00 a.m. (Az~277°W). S&T's Mars Profiler tool, <https://is.gd/marsprofiler>, shows the viewable Martian face by date and time.

From Heavens Above



Nov 1<sup>st</sup>, Earth-Mars upper right. Nov 30<sup>th</sup>, Earth moving anticlockwise "ahead" of Mars

**Jupiter** (dusk to late night, South, in Sagittarius). It starts the month with a diameter of 36.9" and ends at almost 34.4". On the 1<sup>st</sup>, it rises at noon (11:59 a.m.) at 115° azimuth and sets that night at 10:23 p.m. at 245°. On the 30<sup>th</sup>, it rises just after 10:24 a.m. and sets that night at almost 8:52 p.m. Its brightness starts the month at -2.0 and increases slightly to -1.9 by month's end. Jupiter and Saturn will be about 5.1° apart at the beginning of November, and will close to about 2.3° apart by the 30<sup>th</sup>. They continue moving closer together until they are only 0.1° apart on December 21<sup>st</sup>. The two giants will move to Capricornus late next month to their first conjunction in 20 years. They are at their closest alignment in *hundreds* of years.

**Saturn** (dusk to late night, South, in Sagittarius). Saturn's brightness for the month is fairly constant at 0.6. Its disk size decreases from 16.3" 15.6" this month. On the 1<sup>st</sup> it rises at 12:19 p.m. and sets at 10:47 p.m. that night after Jupiter. On the 30<sup>th</sup>, it rises at 1:23 p.m. (114°, Az) and sets around 11:50 p.m. (246°). Saturn's rings are tilted about 22° around the 15<sup>th</sup> and span a little more than Jupiter's width, almost doubling Saturn's apparent size. On the 17<sup>th</sup> – 19<sup>th</sup> within an hour after sunset, Saturn, Jupiter are just above the crescent Moon from left to right looking SSW, just above Sagittarius. Saturn and Jupiter appear again within an hour after sunset, minus the Moon, in the last days of the month above

**Uranus:** (all night, in Aries) At the beginning of November, it rises just north of due East, Az ≈ 74.5°, at 5:37 p.m. (a little ahead of the Moon) and sets at 6:35 a.m. (286°WNW) on the 2<sup>nd</sup>. It appears only 3.75" wide and a 5.7 brightness this month. As the night progresses its visibility improves appearing between Mars and the Moon, and can be seen with binoculars. On the 30<sup>th</sup>, it rises at 3:37 p.m. at Az of 74.5°ENE and sets at 6:36 a.m. (285.6°WNW) on December 1. It has excellent visibility, "leading" the Moon in the sky and "following" Mars during night.

**Neptune:** (evening to early morning, in Aquarius) On the 1<sup>st</sup>, it rises at 3:11 p.m. just south of due East at 96.5° Az, and sets about 2:50 a.m. (264.1°WSW) on the 2<sup>nd</sup>. On the 30<sup>th</sup>, it rises at 1:16 p.m. and sets at 12:55 a.m., 264°Az, on December 1.

**International Space Station:** The ISS is visible on November 9 & 11 (predawn), 12-20 (predawn and evening). See this link for specific times and routes for the ISS: <http://www.heavens-above.com>

**Hubble Space Telescope:** will be visible on November 6-26 (predawn), and from the 27<sup>th</sup> – 30<sup>th</sup> it will make early evening dinnertime appearances. Brightness magnitudes range from +0.7 - +3.8. See this link for specific times and routes for the HST: <http://www.heavens-above.com>

**Comets and Asteroids:** See this link for specific times and routes for brightest observable comets and asteroids: <http://www.heavens-above.com>. Links to finder charts are also available. Comet 88P Howell, with a short period of 5.5 years, is in good viewing position every 11 years (it is alternately on the opposite side of the Sun). It will have a brightness of 8.6, a smidgeon (is smidgeon metric or English?) brighter than last month's 9.2. It has also moved from Scorpius to Sagittarius with an Alt, Az of 36.4°, 175° S. Some others are higher in the sky, but much dimmer. Consider C/2019 K7 Smith in Hercules at 81.9° altitude and 198°SSW, 67° from the Sun, but only a stealthy 15.9 brightness.

## **Zoom Meeting Info: (Thursday November 5<sup>th</sup>, 7:30pm)**

**(Please don't login or test the link before 7:15 pm on Thursday)**

*If you have not been emailed the link, contact Brian or Tom.*

Members who are familiar with Zoom may disregard instructions below.

### **For PC Users:**

You'll want to install the "Zoom" app. on your computer, if you don't already have it. This way when you click on the link at the time of the meeting, it will take you directly to our meeting.

Download for (free) Zoom Client for Meetings:

<https://zoom.us/client/latest/ZoomInstaller.exe>

### **For Apple Users:**

If you don't already have the "Zoom" app, you need to download it. After downloading, ignore all further instructions, and click to leave the app. (This app will automatically be used when you

double click the link to the meeting on Thursday)

**Here's the link to (free) Zoom in the App Store:**

<https://apps.apple.com/us/app/zoom-cloud-meetings/id546505307>

### **General Instructions to join the meeting:**

1. Click on the link above to join the meeting
2. Click on window that appears, "Join Zoom Meeting".
3. Then "Join Computer Audio"
4. On entering the meeting, audio is going to be "off" by default. Press down and hold your space bar to talk. Both Brian and the presenter will be unmuted by default. This is being done to cut down on background noise, as it seems to accumulate as our numbers increase.

**For more information on audio and video go to:**

<https://support.zoom.us/hc/en-us/articles/204484835-My-Audio-is-N>

Tom's Email: [kleinto@netscape.net](mailto:kleinto@netscape.net)

## Minutes for the Zoom Meeting on Oct 1<sup>st</sup>,2020

Meeting started at 7:37 pm. There were 15 members present.

There was a presentation about Cayo Costa Park's application for IDA Dark Sky Park Status. They requested that we provide a letter promoting it for the IDA. A motion to provide the letter from Mike McCauley, second by Tom Klein, motion passed.

Minutes approval motion for the September minutes by Tom Klein, second by Tom Segur, motion passed.

Treasurer's report for September 2020 read by John MacLean, motion by Mike McCauley to approve, second by Tom Klein, motion passed.

Ending balance for Treasurer's report was 2,666.99 for all accounts.

Business meeting ended at 8:07 pm. Ray Bratten showed some recent pictures/images and several other open discussion items were presented in the open forum.

Reported by Brian Risley

### Southwest Florida Astronomical Society, Inc. Event Schedule for 2020/2021

**This is tentative based on Covid-19 conditions**

<b>Date</b>	<b>Event</b>	<b>Location</b>	<b>Time/Note</b>
Nov 5 <sup>th</sup> , 2020	Monthly Meeting	ZOOM Online Meeting	7:30pm
Nov 7 <sup>th</sup> , 2020	Monthly Star Party	Seahawk Park	Cancelled
Nov 14 <sup>th</sup> , 2020	Monthly Star Party	Caloosahatchee Regional Park	Cancelled
Nov 28 <sup>th</sup> , 2020	Solar Observing	Gilchrist Park Punta Gorda	9:00 am - Noon
Dec 3 <sup>rd</sup> , 2020	Monthly Meeting	Calusa Nature Ctr Planetarium	7:30pm
Dec 12 <sup>th</sup> , 2020	Monthly Star Party	Caloosahatchee Regional Park	Dusk
Dec 26 <sup>th</sup> , 2020	Solar Observing	Ponce De Leon Park Punta Gorda	9:00 am - Noon
Jan 7 <sup>th</sup> , 2021	Monthly Meeting	Calusa Nature Ctr Planetarium	7:30pm
Jan 23 <sup>rd</sup> , 2021	Solar Observing	Bayshore Live Oak Park Port Charlotte	9:00 am - Noon
Feb 27 <sup>th</sup> , 2021	Solar Observing	Gilchrist Park Punta Gorda	9:00 am - Noon
Mar 27 <sup>th</sup> , 2021	Solar Observing	Ponce De Leon Park Punta Gorda	9:00 am - Noon
April 24 <sup>th</sup> , 2021	Solar Observing	Bayshore Live Oak Park Port Charlotte	9:00 am - Noon
May 22 <sup>nd</sup> , 2021	Solar Observing	Gilchrist Park Punta Gorda	9:00 am - Noon

***All observing events are Weather Permitting.***

***If it is cloudy or a chance of rain, we may not setup at all.***

***There may be no way to provide advance notice of cancellation.***

**Events may be cancelled several hours before scheduled time based on observed conditions and forecasts at that time and weather may change.**

**Monthly Star Parties:** These are held at either Seahawk Park in Cape Coral or at Caloosahatchee Regional Park (CRP) off SR78 7 miles east of SR31. Other than park fees noted, these are free and open to the public. Those wanting to learn how to use equipment can bring it to the monthly star parties or the monthly meetings. We are always glad to help people learn how to use their telescopes. It is also a great way to learn about different telescopes and try some out before making a purchase.

**Seahawk Park** is in North Cape Coral off Wilmington Blvd. (Nelson Rd or Chiquita Blvd are the nearest cross streets.) There is a brown sign in the center median at the entrance to the park. (GPS may not get you to the park, as some of the local roads have been closed.) You will make a big J hook before getting to the parking area. Seahawk Park is managed by the *Cape Coral R/Seahawks* Club for Radio Controlled Planes and they have priority. They are usually done by sunset but may be there before sunrise. Park in the lot and transport your equipment to the concrete staging area before the runway. This park is handicap capable as there is level concrete leading from parking to the staging area.

**CRP** has a gate that closes at dusk, you can check the county's website for current gate closing times and the status of the park's Northside entrance as that is where we observe from. (They may close the area if there are issues with the trails.) There is a parking fee of \$1/hr or \$5/day at CRP. Park in the main Northside parking lot. We sometimes setup down the dirt road that goes to the east. That area is grassy and may not be level, so one should walk on the dirt road as much as possible and watch their step.

**Big Cypress:** The Big Cypress Welcome Center is located off US41 3 miles east of SR29 about 25 miles east of Naples. Big Cypress has earned a Dark Sky Park designation. They hold observing events down the road that extends south of the Welcome Center during the winter months. This is a real dark sky site. Their observing events are free. The site is open all the time and is a fee free area. They ask that you keep the road clear.

**Solar Events:** We have daytime solar events where one can safely look at the Sun. Things such as sunspots and prominences may be visible. These are free unless tied to another event that may have an entrance fee. There are seasonal monthly events held at different parks around Charlotte County as well as at other major public events in SW FLA.

**Rotary Park Star Party:** This is a free public star party held at Rotary Park at the south end of Pelican Blvd in South Cape Coral. Park to the west of the main building and walk to where we are setup to the east of the main building.

**Moore Observatory, FSW Punta Gorda Campus:** The campus is located off Airport Rd just east of I-75. Go to the right around the lake and park. The observatory is located down the path along the lake. Besides the telescope in the observatory, additional scopes may be setup around the observatory. This is a free event.

**Star Party Etiquette:** Bright white flashlights are not welcome. We use red flashlights to preserve our night vision. At the parks, please use just your parking lights if possible. As there may be cords and tripod legs that are hard to see in the dark, we ask that all children be well behaved and cautious around the telescopes. If you need help in moving around in the dark, just ask. Someone will be happy to guide you with a red light. If you have a telescope and need help with it, just ask. Someone will be glad to show you how to use it.

**Golden Rules to Telescope Observing:** Move your eye to the telescope, don't try to move the telescope to your eye! Ladders/chairs are there for your support, the telescopes do not provide support and should not be touched.

Website: [www.theeyepiece.org](http://www.theeyepiece.org) Check us out on Facebook, too.

## Members' Photos

By John Maclean



By Chuck Pavlik

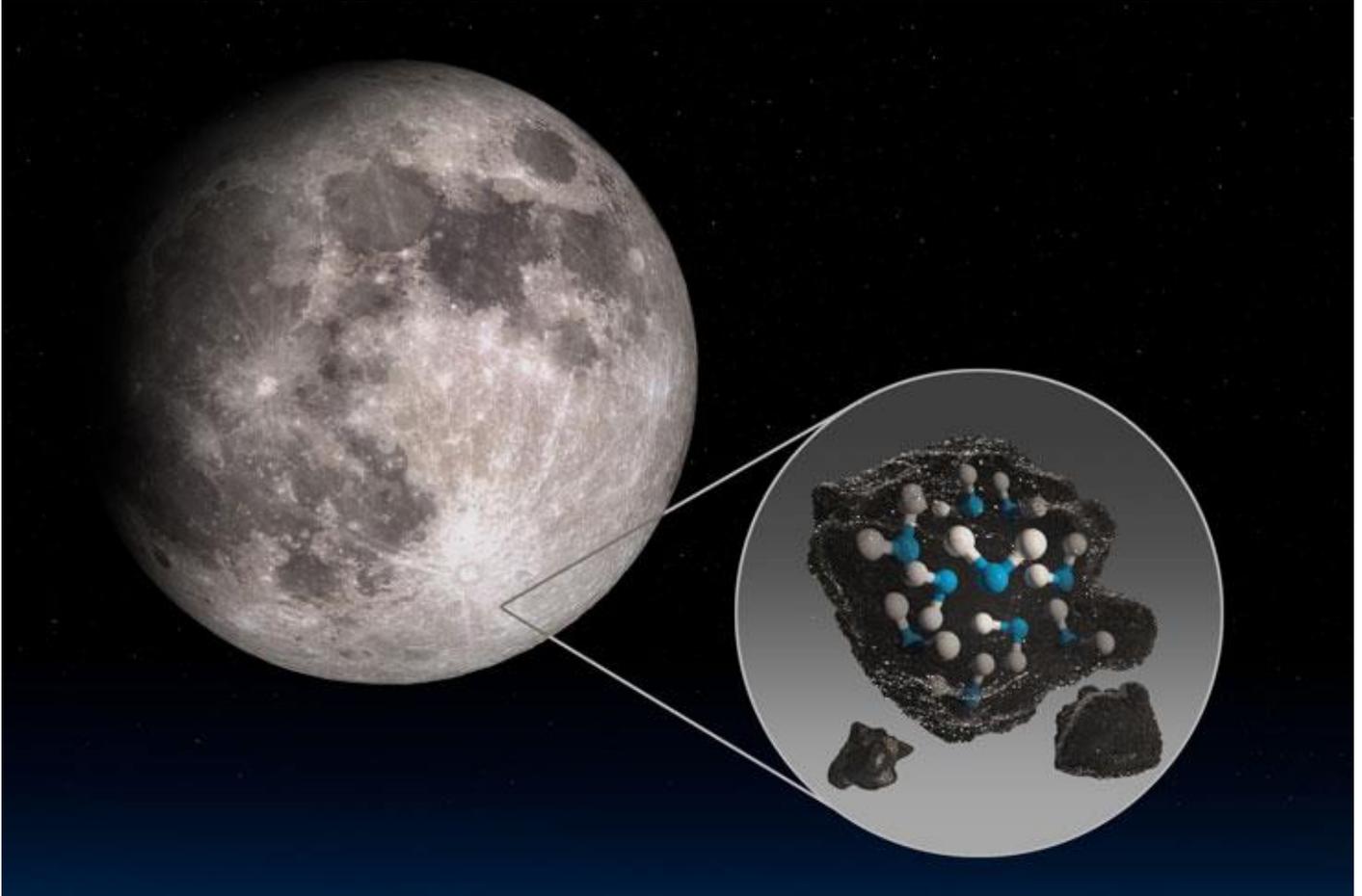


Helix Nebula In Hydrogen Alpha and O3

## Water on the Moon Isn't Just at the Poles

By: Jeff Hecht, *Sky & Telescope Weekly* October 26, 2020 3

*Water exists even on the sunlit Moon, a new study shows — trapped in glass beads but still extractable for lunar exploration.*



***This illustration highlights the Moon's Clavius Crater with an illustration depicting water trapped in the lunar soil there. NASA***

Permanently dark craters are no longer the only places to find water on the Moon. NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA) has found evidence of water molecules near in the Moon's sunlit Southern Highlands.

A separate analysis of lunar topography found that areas as small as a centimeter across — but adding up to 8,000 square kilometers (3,000 square miles) — could act as *cold traps* where water ice collects.

Both discoveries appearing today in [Nature Astronomy](#) give new insight into water distribution on the lunar surface. But they also require follow-up study to assess their implications for future exploration of the Moon.

## Water Molecules on the Moon

Spacecraft observations have revealed the presence of water ice in permanently shadowed craters at the lunar poles, where temperatures stand below the 110 K (-262°F) vacuum sublimation point of water ice.

Other studies have also found that the spectral fingerprints of hydrogen at near-infrared wavelengths of 2.8 to 3 microns are widespread on the sunlit part of the Moon. However, while those features can come from water, they can also come from hydrogen-oxygen bonds in minerals containing hydroxyl (OH) groups. So they are not proof of water molecules. Sunlit regions are exposed to harsh ultraviolet radiation that breaks up water molecules but does not split hydroxyl groups.

Seeking to resolve that ambiguity, Casey Honniball (now at NASA Goddard Space Flight Center) and colleagues searched for spectral features present only in molecular water and identified an emission band at 6 microns. Finding an instrument to make the observations was much harder, as our atmosphere is completely opaque at that wavelength. No spacecraft could perform spectroscopic imaging of the Moon at that wavelength either.

Honniball's only option was FORCAST, the faint-object infrared camera on SOFIA, the 2.5-meter telescope that flies aboard a modified 747 above 99% of the atmosphere's water vapor. SOFIA had never before observed the Moon.

She had only 20 minutes of observing time on a nine-hour flight in 2018, but she was able to observe two regions: one near 60°S (including Clavius Crater), where high hydrogen levels had previously been measured, and one at lower northern latitudes in Mare Serenitatis, the Sea of Serenity, where hydrogen levels were low. In [Nature Astronomy](#), her group reports that the higher-latitude, high-hydrogen site has water molecule at concentrations 100 to 400 parts per million higher than what was found in the more equatorial site.



**Clavius Crater on the Moon,  
NASA / Moon Trek / USGS /  
LRO**

How did water molecules withstand destruction by the harsh ultraviolet light? Honniball's team compared spectra of the Clavius site with those of meteorites and of basalts from mid-ocean ridges on Earth. The researchers suggest that perhaps water is trapped in impact glasses formed after micrometeorites smash onto the lunar surface. The impact energy vaporizes both the impactor and some of the rock it's impacting; that vapor cools quickly to form glass. She thinks already-present hydroxyl groups combine to form water molecules that are then trapped in the glass, which protects them from incident ultraviolet light.

"They clearly detect molecular H<sub>2</sub>O on the sunlit lunar surface for the first time," says planetary scientist Paul Hayne (University of Colorado). (Hayne was not involved in the SOFIA observations but published a separate analysis of cold traps in the same issue of *Nature Astronomy*). The presence of water molecules is important because they can be extracted from mineral grains much more readily than hydroxyl groups can.

These results also are good news for SOFIA, which [NASA proposed cancelling](#) in February because of its high operating costs. At \$82 million a year, SOFIA's costs are second only to the Hubble Space Telescope. Congress later restored SOFIA to the budget.

### **Micro Cold Traps**

In a separate study that appears in the same issue of [Nature Astronomy](#), Hayne and colleagues reported the existence of large numbers of permanently shadowed cold traps as small as one centimeter on the lunar surface.

The researchers analyzed more than 5,000 images taken by NASA's Lunar Reconnaissance Orbiter to identify the distribution of shadows where sunlight was striking the surface at steep angles. They then calculated how many of these regions would remain dark and cold enough to retain ice even if heated by adjacent sunlit areas.



***Sunlight catches the rim of Shackleton Crater near the moon's south pole.***  
**NASA / GSFC / Arizona State University**

“There are tens of billions of these micro cold traps from 1 cm to 1 m, which are widely distributed from 80° latitude to the poles,” Hayne told *Sky & Telescope*. Accounting for these smaller cold traps increases the total known area of cold traps about 20%, to about 40,000 square kilometers or 0.15% of the lunar surface.

Both studies raise further questions. So far, SOFIA has surveyed only two small areas for water. Honniball has two more hours of observations scheduled and has requested 72 additional hours to learn how water is distributed across the Moon’s sunlit surface.

Meanwhile, Hayne, who is principal investigator for the Lunar Compact Infrared Imaging System (L-CIRiS) due to fly on NASA's polar lander in 2022, will use the instrument’s panoramic images of the landing site to measure the size, abundance and temperatures of micro-cold traps. Further study should answer important questions about how water and other volatiles migrate within the inner solar system and across the lunar surface.

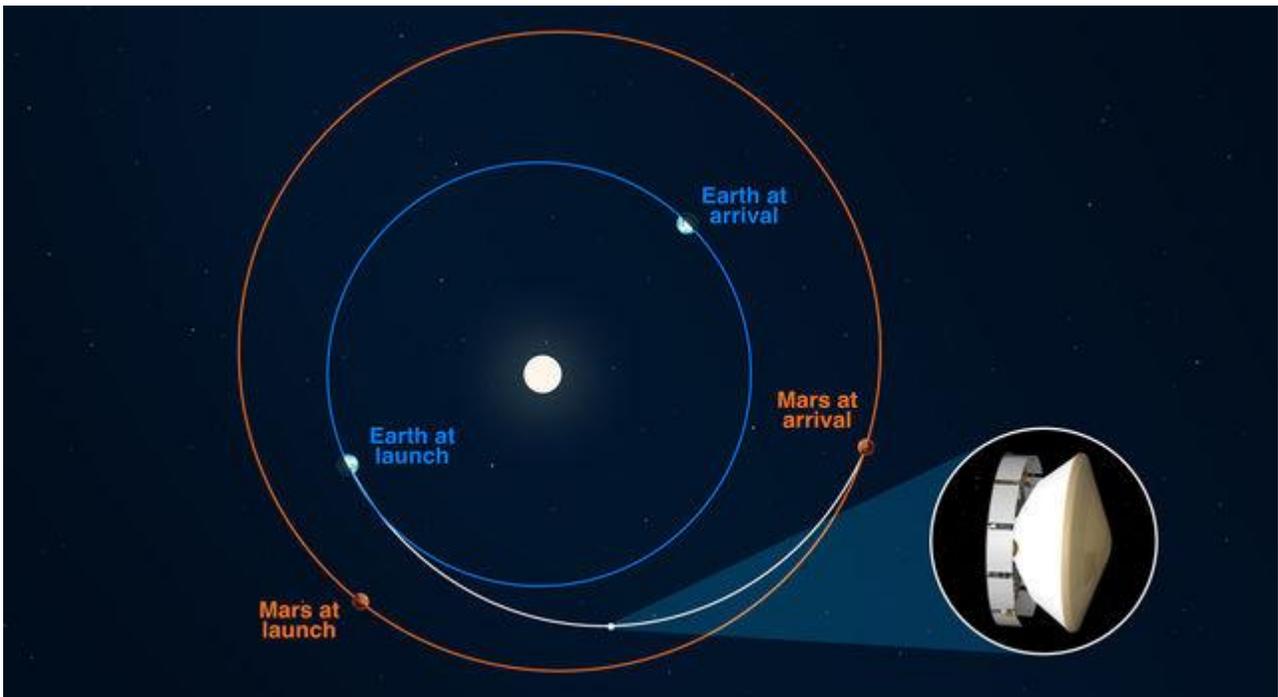
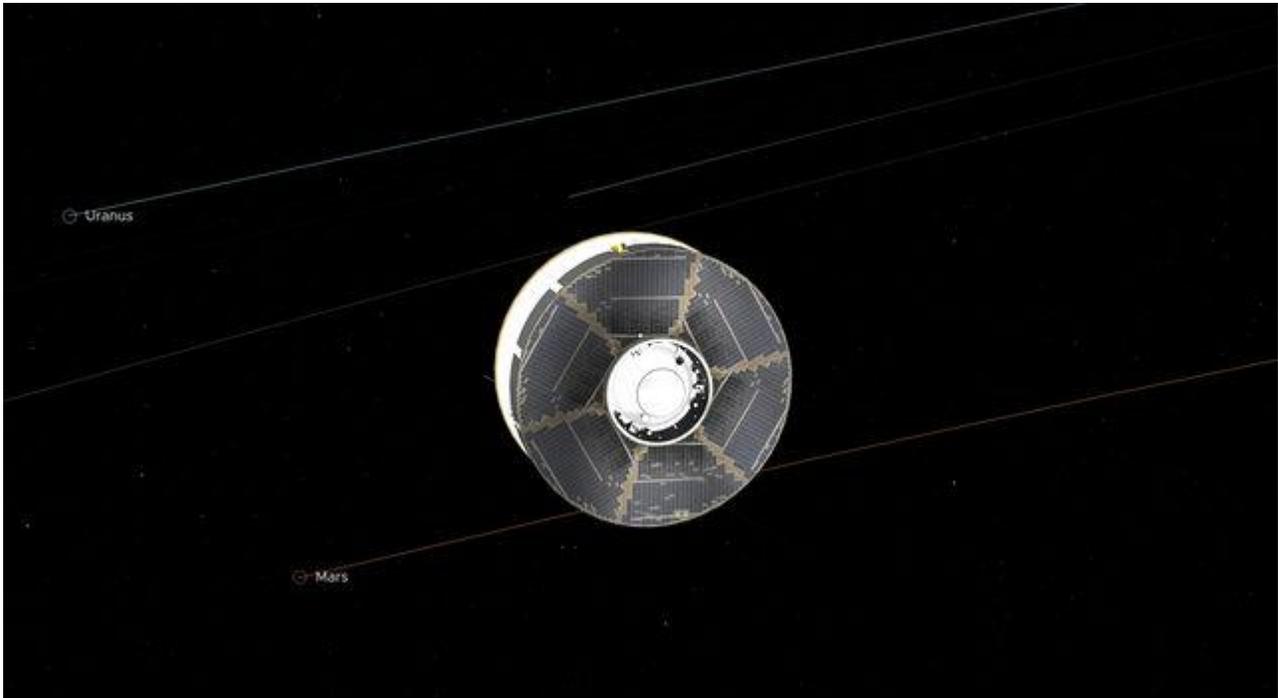
# NASA's Perseverance Rover Is Midway to Mars

JPL-News Weekly, October 27, 2020

<https://www.jpl.nasa.gov/news>

See the source online for videos and links.

Sometimes half measures can be a good thing - especially on a journey this long. The agency's latest rover only has about 146 million miles left to reach its destination.



***This illustration of the Mars 2020 spacecraft in interplanetary space was generated using imagery from NASA's Eyes on the Solar System. The image is from the mission's midway point between Earth and Mars. Image credit: NASA/JPL-Caltech***

NASA's Mars 2020 Perseverance rover mission has logged a lot of flight miles since being lofted skyward on July 30 - 146.3 million miles (235.4 million kilometers) to be exact. Turns out that is exactly the same distance it has to go before the spacecraft hits the Red Planet's atmosphere like a 11,900 mph (19,000 kph) freight train on Feb. 18, 2021.

"At 1:40 p.m. Pacific Time today, our spacecraft will have just as many miles in its metaphorical rearview mirror as it will out its metaphorical windshield," said Julie Kangas, a navigator working on the Perseverance rover mission at NASA's Jet Propulsion Laboratory in Southern California. "While I don't think there will be cake, especially since most of us are working from home, it's still a pretty neat milestone. Next stop, Jezero Crater."<sup>1</sup>

The Sun's gravitational influence plays a significant role in shaping not just spacecraft trajectories to Mars (as well as to everywhere else in the solar system), but also the relative movement of the two planets. So Perseverance's route to the Red Planet follows a curved trajectory<sup>2</sup> rather than an arrow-straight path.

NASA's Mars 2020 Perseverance rover has logged 146.3 million (235.4 million kilometers) of space miles - exactly half of what will be covered before reaching the Red Planet. View the full interactive experience at Eyes on the Solar System<sup>3</sup>.

"Although we're halfway into the distance we need to travel to Mars, the rover is not halfway between the two worlds," Kangas explained. "In straight-line distance, Earth is 26.6 million miles [42.7 million kilometers] behind Perseverance and Mars is 17.9 million miles [28.8 million kilometers] in front."

At the current distance, it takes 2 minutes, 22 seconds for a transmission to travel from mission controllers at JPL via the Deep Space Network<sup>4</sup> to the spacecraft. By time of landing, Perseverance will have covered 292.5 million miles (470.8 million kilometers), and Mars will be about 130 million miles (209 million kilometers) away from Earth; at that point, a transmission will take about 11.5 minutes to reach the spacecraft.

## **Work Continues En Route**

The mission team continues to check out spacecraft systems big and small during interplanetary cruise. Perseverance's RIMFAX<sup>5</sup> and MOXIE<sup>6</sup> instruments were tested and determined to be in good shape on Oct. 15. MEDA<sup>7</sup> got a thumbs up on Oct. 19. There was even a line item to check the condition of the X-ray tube in the PIXL<sup>8</sup> instrument on Oct. 16, which also went as planned.

"If it is part of our spacecraft and electricity runs through it, we want to confirm it is still working properly following launch," said Keith Comeaux, deputy chief engineer for the Mars 2020 Perseverance rover mission. "Between these checkouts - along with charging the rover's and Mars Helicopter's batteries<sup>9</sup>, uploading files and sequences for surface operations, and planning for and executing trajectory correction maneuvers - our plate is full right up to landing."

## **More About the Mission**

A key objective of Perseverance's mission on Mars is astrobiology<sup>10</sup>, including the search for signs of ancient microbial life. The rover will characterize the planet's geology and past climate, pave the way for human exploration of the Red Planet, and be the first mission to collect and cache Martian rock and regolith (broken rock and dust).

Subsequent missions, currently under consideration by NASA in cooperation with ESA (European Space Agency), would send spacecraft to Mars to collect these cached samples from the surface and return them to Earth for in-depth analysis.

The Mars 2020 mission is part of a larger program that includes missions to the Moon as a way to prepare for human exploration of the Red Planet. Charged with returning astronauts to the Moon by 2024, NASA will establish a sustained human presence on and around the Moon by 2028 through NASA's Artemis lunar exploration plans<sup>11</sup>.

JPL, which is managed for NASA by Caltech in Pasadena, California, built and manages operations of the Perseverance and Curiosity rovers.

For more about Perseverance:

[mars.nasa.gov/mars2020/](https://mars.nasa.gov/mars2020/) [nasa.gov/perseverance](https://nasa.gov/perseverance)

For more information about NASA's Mars missions, go to:

<https://www.nasa.gov/mars>

## News Media Contact

DC Agle

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<sup>1</sup> **"NASA's Mars 2020 Will Hunt for Microscopic Fossils"**, <https://mars.nasa.gov/news/8549/nasas-mars-2020-will-hunt-for-microscopic-fossils/?site=insight>

<sup>2</sup> Basics of Space Flight <https://solarsystem.nasa.gov/basics/chapter4-1/>

<sup>3</sup> <https://eyes.nasa.gov/apps/orrery/#/home>

<sup>4</sup> <https://eyes.nasa.gov/dsn/dsn.html>

<sup>5</sup> RIMFAX, Radar Imager for Mars' Subsurface Experiment,  
<https://mars.nasa.gov/mars2020/spacecraft/instruments/rimfax/>

<sup>6</sup> MOXIE, Mars Oxygen In-Situ Resource Utilization Experiment,  
<https://mars.nasa.gov/mars2020/spacecraft/instruments/moxie/>

<sup>7</sup> MEDA, Mars Environmental Dynamics Analyzer,  
<https://mars.nasa.gov/mars2020/spacecraft/instruments/meda/>

<sup>8</sup> PIXL, Planetary Instrument for X-ray Lithochemistry,  
<https://mars.nasa.gov/mars2020/spacecraft/instruments/pixl/>

<sup>9</sup> NASA's Ingenuity Mars Helicopter Recharges Its Batteries in Flight,  
<https://mars.nasa.gov/news/8736/nasas-ingenuity-mars-helicopter-recharges-its-batteries-in-flight/>

<sup>10</sup> <https://astrobiology.nasa.gov/>

<sup>11</sup> Artemis Program, <https://www.nasa.gov/specials/artemis/>

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### **The International Space Station: 20 Continuously Crewed Years of Operation**

David Prosper

Did you know that humans have been living in the International Space Station, uninterrupted, for twenty years? Ever since the first crew members docked with the International Space Station (ISS) in November 2000, more than 240 people have visited this outpost, representing 19 countries working together. They have been busy building, upgrading, and maintaining the space station - while simultaneously engaging in cutting-edge scientific research.

The first modules that would later make up the ISS were launched into orbit in 1998: the Russian Zarya launched via a Proton-K rocket, and the US-built Unity module launched about a week and a half later by the Space Shuttle Endeavour. Subsequent missions added vital elements and modules to the Space Station before it was ready to be inhabited. And at last, on November 2, 2000, Expedition-1 brought the first three permanent crew members to the station in a Russian Soyuz capsule: NASA astronaut William M. Shepherd and Russian cosmonauts Sergei Krikalev and Yuri Gidzenk. Since then, an entire generation has been born into a world where humans continually live and work in space! The pressurized space inside this modern engineering marvel is roughly equal to the volume of a Boeing 747, and is sometimes briefly shared by up to 13 individuals, though the average number of crew members is 6. The unique microgravity environment of the ISS means that long-term studies can be performed on the space station that can't be performed anywhere on Earth in many fields including space medicine, fluid dynamics, biology, meteorology and environmental monitoring, particle physics, and astrophysics. Of course, one of the biggest and longest experiments on board is research into the effects of microgravity on the human body itself, absolutely vital knowledge for future crewed exploration into deep space.

Stargazers have also enjoyed the presence of the ISS as it graces our skies with bright passes overhead. This space station is the largest object humans have yet put into orbit at 357 feet long, almost the length of an American football field (if end zones are included). The large solar arrays - 240 feet wide - reflect quite a bit of sunlight, at times making the ISS brighter than Venus to observers on the ground! Its morning and evening passes can be a treat for stargazers and can even be observed from brightly-lit cities. People all over the world can spot the ISS, and with an orbit only 90 minutes long, sometimes you can spot the station multiple times a night. You can find the next ISS pass near you and receive alerts at sites like NASA's Spot the Station website ([spotthestation.nasa.gov](https://spotthestation.nasa.gov)) and stargazing and satellite tracking apps.

Hundreds of astronauts from all over the world have crewed the International Space Station over the last two decades, and their work has inspired countless people to look up and ponder humanity's presence and future in space. You can find out more about the International Space Station and how living and working on board this amazing outpost has helped prepare us to return to the Moon - and beyond! - at [nasa.gov](https://www.nasa.gov)..



***The ISS photobombs the Sun in this amazing image taken during the eclipse of August 21, 2017 from Banner, Wyoming. Photo credit: NASA/Joel Kowsky More info: [bit.ly/eclipseiss](https://bit.ly/eclipseiss)***



***A complete view of the ISS as of October 4, 2018, taken from the Soyuz capsule of the departing crew of Expedition 56 from their Soyuz capsule. This structure was built by materials launched into orbit by 37 United States Space Shuttle missions and 5 Russian Proton and Soyuz rockets, and assembled and maintained by 230 spacewalks, with more to come! Credit: NASA/Roscosmos More info: [bit.ly/issbasics](https://bit.ly/issbasics)***

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