Space News Update

— October 26, 2018 —

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1. Rocky? Habitable? Sizing up a Galaxy of Planets

The planets so far discovered across the Milky Way are a motley, teeming multitude: hot Jupiters, gas giants, small, rocky worlds and mysterious planets larger than Earth and smaller than Neptune. As we prepare to add many thousands more to the thousands found already, the search goes on for evidence of life – and for a world something like our own.

And as our space telescopes and other instruments grow ever more sensitive, we're beginning to zero in.

The discoveries so far inspire excitement and curiosity among scientists and the public. We've found rocky planets in Earth's size range, at the right distance from their parent stars to harbor liquid water. While these characteristics don't guarantee a habitable world – we can't quite tell yet if these planets really do possess atmospheres or oceans – they can help point us in the right direction.

Future space telescopes will be able to analyze the light from some of these planets, searching for water or a mixture of gases that resembles our own atmosphere. We will gain a better understanding of temperatures on the surface. As we continue checking off items on the habitability list, we'll draw closer and closer to finding a world bearing recognizable signs of life.

Among the most critical factors in the shaping and development of a habitable planet is the nature of its parent star. The star's mass, size and age determine the distance and extent of its "habitable zone" – the region around a star where the temperature potentially allows for liquid water to pool on a planet's surface.

Star-mapping the Galaxy

The European Space Agency's Gaia satellite, launched in 2013, is becoming one of history's greatest star mappers. It relies on a suite of high-precision instruments to measure star brightness, distance, and composition. The ambitious goal is to create a three-dimensional map of our Milky Way galaxy. The chart so far includes the positions of about 1.7 billion stars, with distances for about 1.3 billion.

That has prompted a reassessment of star sizes to learn whether some might be larger, smaller, dimmer or brighter than scientists had thought.

It turns out that many of the stars were found to be brighter – and larger – than previous surveys estimated. For the team managing the explosion of planet finds from NASA's Kepler space telescope, beginning in 2009, that also means a revision of sizes for the planets in orbit around them.

If a star is brighter than we thought, it's often larger than we thought as well. The planet in orbit around it, measured proportionally by the transit method, must also be larger.

That means some of the planets thought to be of a size and temperature similar to Earth's are really bigger – and usually, hotter.

"Gaia has improved distances and has improved assessments of how bright a star is, and how big a planet is," said Eric Mamajek, the deputy program chief scientist for NASA's Exoplanet Exploration Program. "The whole issue has always been, how well do we understand the star? This is just another chapter of that ongoing story."

The latest scientific data from the Gaia space probe also is prompting a reassessment of the most promising "habitable zone" planets found by observatories around the world, as well as space-based instruments like NASA's Kepler. As scientists iron out both observations and definitions of what we consider a potentially habitable world, better data is bringing us closer to finding such a planet and – maybe just as important – finding our own planet's place among them.

Of the 3,700 exoplanets – planets around other stars – confirmed by scientists so far, about 2,600 were found by the Kepler space telescope. Kepler hunts for the tiny eclipse, or dip in starlight, as a planet crosses the face of its star.

The most recent analysis of Kepler's discoveries shows that 20 to 50 percent of the stars in the sky are likely to have small, potentially rocky planets in their habitable zones. Our initial estimate of near Earth-sized, habitable-zone planets from the Kepler spacecraft as of June 19, 2017, was 30. Preliminary analysis of newer data, on both those exoplanets and their host stars, shows that the number is likely smaller – possibly between 2 and 12.

Much more data are needed, including a better understanding of how a planet's size relates to its composition.

"We're still trying to figure out how big a planet can be and still be rocky," said Jessie Dotson, an astrophysicist at NASA's Ames Research Center in California's Silicon Valley. She is also the project scientist for Kepler's current, extended mission, known as K2.

At first glance, the latest analysis might seem disappointing: fewer rocky, potentially habitable worlds among the thousands of exoplanets found so far. But that doesn't change one of the most astonishing conclusions after more than 20 years of observation: Planets in the habitable zone are common.

More and better data on these far distant planets means a more accurate demographic portrait of a universe of planets – and a more nuanced understanding of their composition, possible atmospheres and life-bearing potential.

That should put us on more solid ground for the coming torrent of exoplanet discoveries from TESS (the Transiting Exoplanet Survey Satellite), and future telescopes as well. It brings us one step closer in our search for a promising planet among a galaxy of stars.

"This is the exciting part of science," Dotson said. "So often, we're really portrayed as, 'Now we know this story.' But I have a theory: Scientists love it when we don't know something. It's the hunt that's so exciting."

Source: NASA Return to Contents

2. Ultra-close Stars Discovered Inside a Planetary Nebula

An international team of astronomers have discovered two stars in a binary pair that complete an orbit around each other in a little over three hours, residing in the planetary nebula M3-1.

Remarkably, the stars could drive a nova explosion, an entirely unexpected event based on our current understanding of binary star evolution. The team, led by David Jones of the Instituto Astrofisica de Canarias and the Universidad de La Laguna, report their findings in Monthly Notices of the Royal Astronomical Society: Letters.

Planetary nebulae are the glowing shells of gas and dust formed from the outer layers of stars like our own Sun, which they throw off during the final stages of their evolution. In many cases, interaction with a nearby companion star plays an important role in the ejection of this material and the formation of the elaborate structures seen in the resulting planetary nebulae.

The planetary nebula M3-1 is located in the constellation of Canis Major, at a distance of roughly 14,000 light years. M3-1 was a firm candidate to host a binary central star, as its structure with prominent jets and filaments is typical of these binary star interactions.

Using the telescopes of the European Southern Observatory (ESO) in Chile, Jones's team looked at M3-1 over a period of several years. In the process they discovered and studied the binary stars in the centre of the nebula.

"We knew M3-1 had to host a binary star, so we set about acquiring the observations required to prove this and to relate the properties of the nebula with the evolution of the star or stars that formed it" says Brent Miszalski, researcher at the Southern African Large Telescope, and co-author of the study.

The two stars are so close together that they cannot be resolved from the ground, so instead the presence of the second star is inferred from the variation of their observed combined brightness - most obviously by periodic eclipses of one star by the other which produce marked drops in the brightness.

"When we began the observations, it was immediately clear that the system was a binary" explains Henri Boffin, researcher at the European Southern Observatory in Germany. "We saw that the apparently single star at the centre of the nebula was rapidly changing in brightness, and we knew that this must be due to the presence of a companion star."

The team discovered that the central star of the planetary nebula M3-1 has one of the shortest orbital period binary central stars known to date, at just over three hours. The ESO observations also show that the two stars - most likely a white dwarf with a low-mass main sequence companion - are almost touching.

As a result, the pair are likely to undergo a so-called nova eruption, the result of the transfer of material from one star to the other. When this reaches a critical mass, a violent thermonuclear explosion takes place and the system temporarily increases in brightness by up to a million times.

"After the various observing campaigns in Chile, we had enough data to begin to understand the properties of the two stars - their masses, temperatures and radii" says Paulina Sowicka, a PhD student at the Nicolas Copernicus Astronomical Center in Poland. "It was a real surprise that the two stars were so close together and so large that they were almost touching one another. A nova explosion could take place in just a few thousand years from now."

Theory suggests that binary stars should be well separated after the formation of a planetary nebula. It should then take a long time before they begin to interact again and events such as novae become possible.

In 2007, astronomers observed a different nova explosion, known as Nova Vul 2007, inside another planetary nebula.

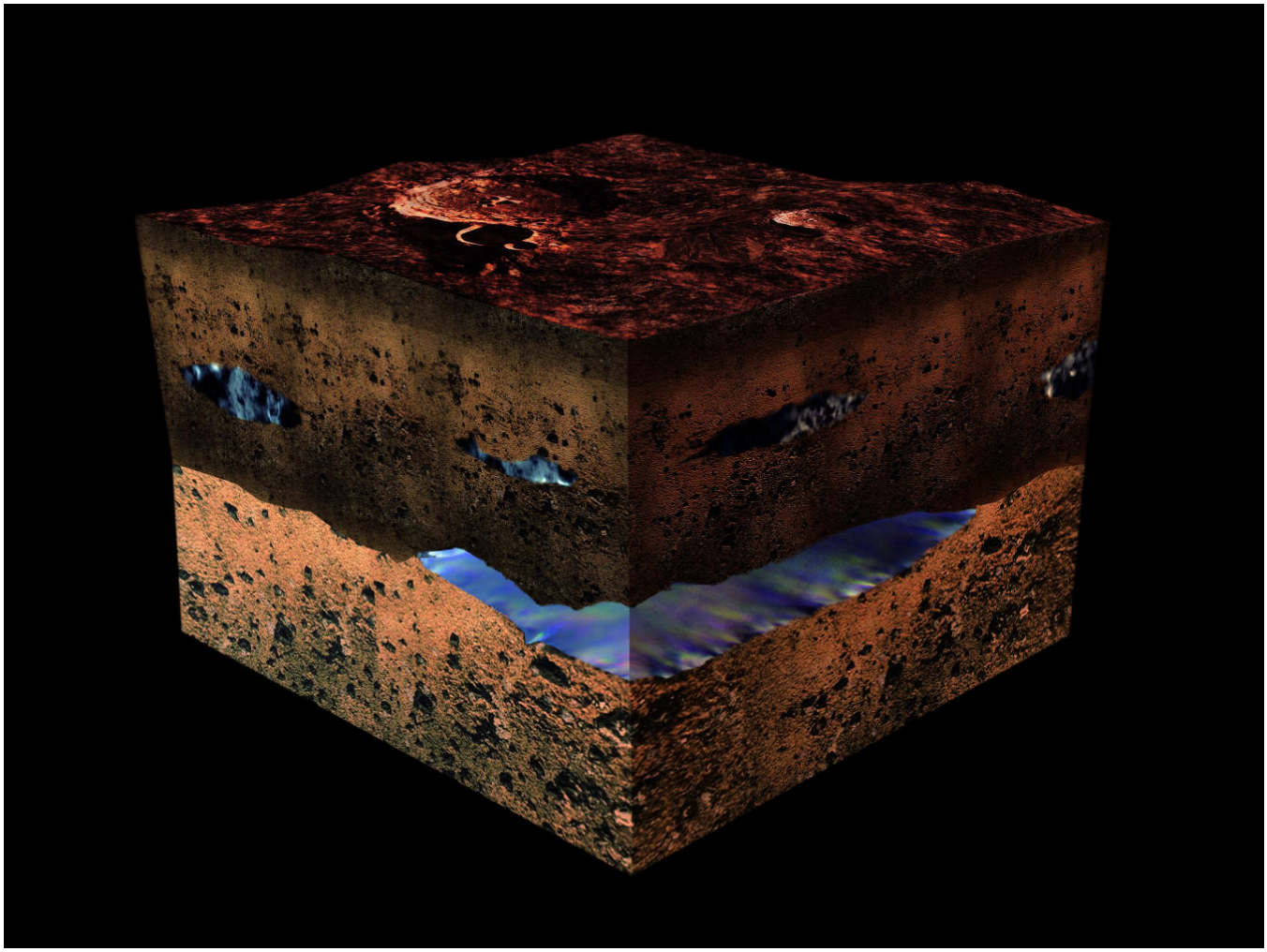
Jones comments: "The 2007 event was particularly difficult to explain. By the time the two stars are close enough for a nova, the material in the planetary nebula should have expanded and dissipated so much that it's no longer visible."

The new event adds to the conundrum, adds Jones: "In the central stars of M3-1, we've found another candidate for a similar nova eruption in the relatively near future."

The team now hope to carry out further study of the nebula and others like it, helping to shed light on the physical processes and origins of novae and supernovae, some of the most spectacular and violent phenomena in the Universe.

Source: Spaceref.com Return to Contents

3. There Might be Enough Oxygen Below the Surface of Mars to Support Life



The possibility that life could exist on Mars has captured the imagination of researchers, scientists and writers for over a century. Ever since Giovanni Schiaparelli (and later, Percival Lowell) spotted what they believed were “Martian Canals” in the 19th century, humans have dreamed of one day sending emissaries to the Red Planet in the hopes of finding a civilization and meeting the native Martians.

While the *Mariner* and *Viking* programs of the 1960s and 70s shattered the notion of a Martian civilization, multiple lines of evidence have since emerged that indicate how life could have once existed on Mars. Thanks to a new study, which indicates that Mars may have enough oxygen gas locked away beneath its surface to support aerobic organisms, the theory that life could *still* exist there has been given another boost.

The study, which recently appeared in the journal *Nature Geoscience*, was led by Vlada Stamenkovic, an Earth & planetary scientist and a theoretical physicist from NASA’s Jet Propulsion Laboratory. He was joined by multiple members of the JPL and the Division of Geological and Planetary Sciences at the California Institute of Technology (Caltech).

To put it simply, the possible role that oxygen gas could have played on Mars has historically been given little attention. This is due to the fact that oxygen makes up a very tiny percentage of Mars’ atmosphere, which is primarily composed of carbon dioxide and methane. However, geochemical evidence from Martian meteorites and manganese-rich rocks on its surface have shown a high degree of oxidation.

This could have been the result of water existing on Mars in the past, which would indicate that oxygen did play a role in the chemical weathering of the Martian crust. To explore this possibility, Stamenkovi and his team considered two pieces of evidence collected by the *Curiosity* rover. The first was chemical evidence from Curiosity's Chemistry and Mineralogy (CheMin) instrument, which confirmed the high-levels of oxidation in samples of Martian rock.

Second, they consulted evidence obtained by the *Mars Express'* Mars Advanced Radar for Subsurface and Ionosphere Sounding (MARSIS) instrument, which indicated the presence of water beneath Mars' southern polar region. Using this data, the team began to calculate how much oxygen could exist in subsurface briny deposits, and whether or not this would be enough to sustain aerobic organisms.

They began by developing a comprehensive thermodynamic framework to calculate the solubility of O^2 in liquid brines (salt water and other soluble minerals) under Martian conditions. For these calculations, they assumed that the supply of O^2 was Mars'atmosphere, which would be able to make contact with surface and subsurface environments – and hence, transferable.

Next, they combined this solubility framework to a Mars general circulation model (GCM) to determine the annual rate at which O^2 would dissolve in brines – making allowances for local pressure and temperature conditions on Mars today. This allowed them to immediately spot which regions were most likely to sustain high levels of O^2 solubility.

Lastly, they calculated historical and future changes in Mars' obliquity to determine how the distribution of aerobic environments evolved over the past 20 million years, and how they might change in the next 10 million. From this, they found that even in the worst case scenarios, there was enough oxygen in Martian rocks and subsurface reservoirs to support aerobic microbial organisms. As Stamenkovic told Universe Today:

"Our result is that oxygen can be dissolved in various brines under modern Mars conditions at concentrations that are much greater than aerobic microbes need for breathing. We cannot make yet statements related to the potential of groundwater, but our results might imply the existence of cool brines acting on rocks forming manganese oxides, which have been observed with MSL."

From their calculations, they found that most of the subsurface environments on Mars exceeded the oxygen levels required for aerobic respiration (~10^?6 mol m^?3) by up to 6 orders of magnitude. This is commensurate with oxygen levels in Earth's oceans today, and higher than what existed on Earth before the Great Oxygenation Event roughly 2.35 billion years ago (10^?13–10^?6 mol m^?3).

These findings indicate that life could still exist in underground salt water deposits and offer an explanation for the formation of highly-oxidized rocks. "MSL's Curiosity rover has detected manganese oxides that typically only form when rocks interact with highly oxidized rocks," said Stamenkovic. "So our results could explain these findings if cool brines were present and oxygen concentrations were similar or greater than today while the rocks were altered."

They also concluded that there could be multiple locations around the polar regions where much higher concentrations of O^2 existed, which would be sufficient to support the existence of more complex multi-cellular organisms like sponges. Meanwhile, environments with intermediate solubilities would likely occur in lower-lying areas closer to the equator that have higher surface pressures – such as Hellas and Amazonis Planitia, and Arabia and Tempe Terra.

From all this, what begins to emerge is a picture of how life on Mars could have migrated underground, rather than simply disappearing. As the atmosphere was slowly stripped away and the surface cooled, water began to freeze and travel into the ground and subsurface caches, where enough oxygen was present to support aerobic organisms independent of photosynthesis.

While this possibility could lead to new opportunities in the search for life on Mars, it could be very difficult (and inadvisable) to go looking for it. For starters, previous missions have avoided areas on Mars with water concentrations for fear of contaminating them with Earth bacteria. Hence why upcoming missions like NASA's *Mars 2020* rover will be focused on collecting surface soil samples to look for evidence of past life.

Second, while this study presents the possibility that life could exist in subsurface caches on Mars, it does not conclusively prove that life still exists on the Red Planet. But as Stamenkovic indicated, it does open doors for exciting new research, and could fundamentally change the way we look at Mars:

"This implies that we still have so much to learn about the potential for life on Mars, not just past but also present. So many questions remain open, but this work also gives hope to explore the potential for extant life on Mars today – with a focus on aerobic respiration, something very unexpected."

One of the biggest implications of this study is the way it shows how Mars could have evolved life under different conditions than those of Earth. Instead of anaerobic organisms arising in a noxious environment and using photosynthesis to produce oxygen (making the atmosphere suitable for aerobic organisms), Mars could have sourced oxygen through rocks and water to sustain aerobic organisms in a cold environment away from the Sun.

This study could also have implications in the search for life beyond Earth. While subterranean microbes on cold, desiccated exoplanets might not seem like the ideal definition of "habitable" to us, it does create a potential opportunity to search for life as we do *not* know it. After all, finding life beyond Earth will be groundbreaking, no matter what form it takes.

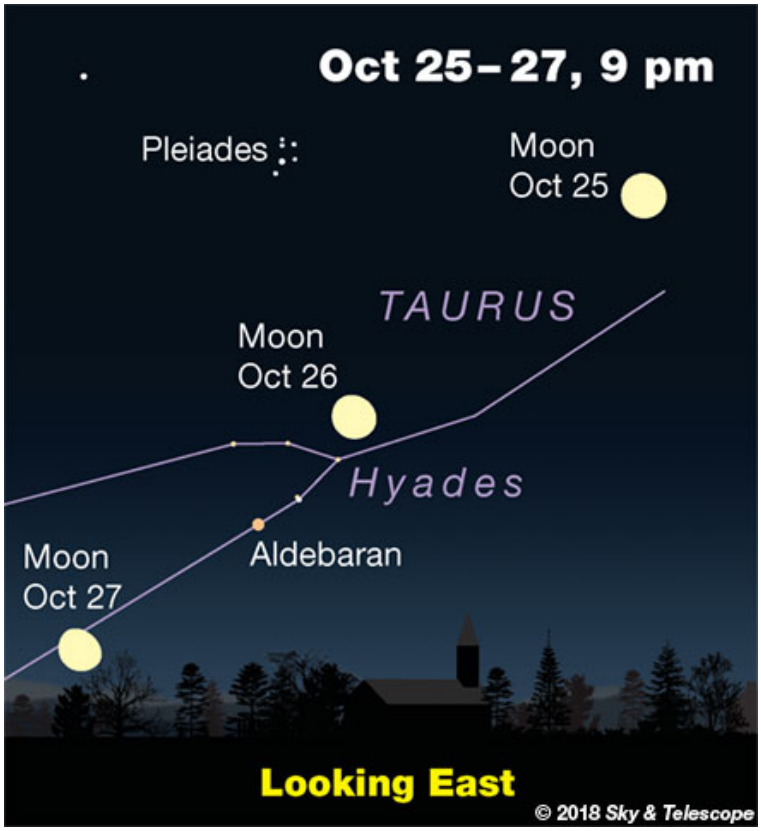
Further Reading: Popular Mechanics, Nature Geoscience

Source: Universe Today Return to Contents

The Night Sky

Friday, October 26

• The waning gibbous Moon is well up in the east by late evening, with the Pleiades above it and Aldebaran closer to its lower left as shown here (for North America).



• The Ghost of Summer Suns. Halloween is approaching, and this means that Arcturus, the star sparkling low in the west-northwest in twilight, has taken on its role as "the Ghost of Summer Suns." What does that mean? For several days around October 25th every year, Arcturus occupies a special place above your local landscape. It closely marks the spot *where the Sun stood at the same time,* by the clock, during hot June and July — in broad daylight, of course! So, as Halloween approaches every year, you can see Arcturus as the forlorn, chilly ghost of the departed summer Sun.

Saturday, October 27

• A small telescope will show Saturn's largest moon, Titan, about four ring-lengths to Saturn's west this evening.

• The dog-bone-shaped asteroid 216 Kleopatra, with its two tiny moons, should occult an 11th-magnitude star in Canis Minor during Sunday's early-morning hours along a path from central Alberta through upstate New York and Long Island. Details, map, finder charts.

Sunday, October 28

• This is the time of year when the dim Little Dipper extends straight left from Polaris right after dark. If your sky is light polluted, the only stars of it you'll see are Polaris (its handle-end) and the end of its bowl: Kochab and Pherkad, the "Guardians of the Pole." They're left of Polaris by about a fist and a half at arm's length.

Check again around 2 a.m., and they'll be straight below Polaris.

Monday, October 29

• Draw a line from Altair, the brightest star very high in the southwest after dark, to the right through Vega, very high in the west and even brighter. Continue the line half as far onward and you hit the Lozenge: the pointy-nosed head of Draco, the Dragon.

Its brightest star is orange Eltanin, the tip of the Dragon's nose, always pointing toward Vega.

Source: Sky & Telescope

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ISS Sighting Opportunities

For Denver: No sighting opportunities

Date	Visible	Max Height	Appears	Disappears
Sat Oct 27, 5:56 AM	3 min	33°	14° above SSW	29° above ESE
Sun Oct 28, 5:06 AM	1 min	17°	17° above SE	15° above ESE
Sun Oct 28, 6:39 AM	6 min	46°	10° above WSW	11° above NE

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

NASA-TV Highlights

(all times Eastern Daylight Time)

Friday, October 26

6 p.m., 10 p.m. Replay of SpaceCast Weekly (all channels)

Saturday, October 27

8 a.m., 4 p.m., 8 p.m., 10 p.m., Replay of NASA Administrator Participates in a Washington Post Discussion: The New Space Age (all channels)

9 a.m., 5 p.m., 9 p.m., Replay of SpaceCast Weekly (all channels)

Sunday, October 28

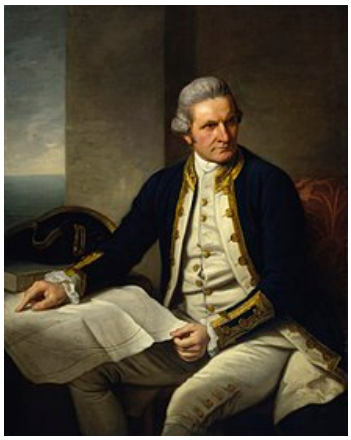
7 a.m., 1 p.m., 6 p.m., 10 p.m., Replay of SpaceCast Weekly (all channels)

11 a.m., 2 p.m., 7 p.m., 11 p.m., Replay of NASA Administrator Participates in a Washington Post Discussion: The New Space Age (all channels)

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

Space Calendar

- Oct 26 - Comet P/2008 CL94 (Lemmon) At Opposition (4.977 AU)
- Oct 26 - Asteroid 4 Vesta Occults 2UCAC 21415058 (11.6 Magnitude Star)
- Oct 26 - Amor Asteroid 2018 TQ2 Near-Earth Flyby (0.056 AU)
- Oct 26 - NEW [Oct 24] Amor Asteroid 2018 UX1 Near-Earth Flyby (0.099 AU)
- Oct 26 - Asteroid 3831 Pettengill Closest Approach To Earth (1.183 AU)
- Oct 26 - James Cook's 290th Birthday (1728)
- Oct 27 - Comet C/2018 B1 (Lemmon) Closest Approach To Earth (4.431 AU)
- Oct 27 - Asteroid 54521 Aladdin Closest Approach To Earth (2.603 AU)
- Oct 27 - Kuiper Belt Object 55636 (2002 TX300) At Opposition (41.690 AU)
- Oct 27 - Martian Greenhouse Talk + Tour at Villanova University, Villanova, Pennsylvania
- Oct 27 - 45th Anniversary (1973), Canon City Meteorite Fall (Hit Garage)
- Oct 28 - European Summer Time Ends - Set Clock Back 1 Hour (European Union)
- Oct 28 - Comet 64P/Swift-Gehrels Closest Approach To Earth (0.445 AU)
- Oct 28 - Comet 73P-T/Schwassmann-Wachmann At Opposition (1.725 AU)
- Oct 28 - Comet P/2008 CL94 (Lemmon) Closest Approach To Earth (4.976 AU)
- Oct 28 - Apollo Asteroid 2018 RJ7 Near-Earth Flyby (0.086 AU)
- Oct 28 - Asteroid 3581 Alvarez Closest Approach To Earth (1.294 AU)
- Oct 28 - Asteroid 35734 Dilithium Closest Approach To Earth (1.612 AU)
- Oct 28 - Asteroid 9969 Braille Closest Approach To Earth (2.226 AU)
- Oct 28 - Centaur Object 20461 Dioretsa At Opposition (29.433 AU)
- Oct 28 - 165th Anniversary (1853), Bright Daytime Fireball near Beeston, United Kingdom
- Oct 29 - Chinese-French Oceanography Satellite (CFOSAT) CZ-2C Launch
- Oct 29 - GOSAT 2/ KhalifaSat/ Diwata 2b/ PROITERES 2 H-2A Launch
- Oct 29 - Comet 71P/Clark Closest Approach To Earth (2.759 AU)
- Oct 29 - Comet C/2017 F1 (Lemmon) Closest Approach To Earth (4.433 AU)
- Oct 29 - Asteroid 3 Juno Occults TYC 4725-00589-1 (10.4 Magnitude Star)
- Oct 29 - Aten Asteroid 475534 (2006 TS7) Near-Earth Flyby (0.019 AU)
- Oct 29 - Apollo Asteroid 2018 TS2 Near-Earth Flyby (0.055 AU)
- Oct 29 - Aten Asteroid 302169 (2001 TD45) Near-Earth Flyby (0.099 AU)
- Oct 29 - Aten Asteroid 3753 Cruithne Closest Approach To Earth (0.542 AU)
- Oct 29 - Asteroid 284996 Rosaparks Closest Approach To Earth (2.520 AU)
- Oct 29 - Neptune Trojan 2001 QR322 At Opposition (29.133 AU)
- Oct 29 - 20th Anniversary (1998), STS-95 Launch (Space Shuttle Discovery (SPACEHAB, John Glenn)
- Oct 29 - 80th Anniversary (1938), Orson Welles' Broadcast of the "War of the Worlds"



James Cook

Source: JPL Space Calendar

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Food for Thought

50 Years Ago, Apollo 8 Preparations at L-8 Weeks



As Apollo 7 completed its highly successful engineering test mission, preparations intensified for the next flight, Apollo 8, the first to use the Saturn V rocket to send astronauts into space in December 1968. With two months to go before their historic launch, the Apollo 8 crew busied themselves with egress training both at the launch pad and at sea, as well as spending time in mission simulators. Preparations for the following two missions, Apollo 9 and 10, were also well underway. Apollo 9 was planned as the first crewed flight of the Lunar Module (LM) in Earth orbit in February 1969 and Apollo 10 most likely as a lunar orbit flight three months later. With the Apollo Program now flying astronauts in space and preparations and training underway for several missions, the goal of landing a man on the Moon before the end of the decade seemed within reach.

October 23, 1968, was a busy day at the Kennedy Space Center (KSC). The Apollo 7 crew arrived back at KSC one day after returning to Earth from their highly-successful 11-day mission to thoroughly test the Apollo spacecraft in Earth orbit. Wearing their pressure suits, Apollo 8 astronauts participated in emergency egress training and practiced slide wire evacuation techniques at Launch Complex 39A, where engineers were testing the Saturn V rocket and Apollo spacecraft since the rollout October 9. The prime crew of Frank Borman, James A. Lovell, and William A. Anders, as well as the backup crew of Neil A. Armstrong, Edwin E. “Buzz” Aldrin, and Fred W. Haise, took part in the egress training. For the slide wire evacuation training, the astronauts only practiced the final portion including dismounting, and not the full test from the 350-foot level of the launch tower.

Two days later, Borman, Lovell, and Anders were in the Gulf of Mexico near Galveston, Texas, conducting water egress training using a boilerplate Apollo spacecraft. The Motor Vessel M/V *Retriever* supported the activity, with sailors lowering the mockup Command Module (CM) with the crew inside into the water in a nose-down position. Flotation bags inflated to right the spacecraft to a nose-up position. The astronauts then exited the capsule onto life rafts and recovery personnel hoisted them aboard a helicopter. The next day, Armstrong, Aldrin, and Haise repeated the test.

Senior NASA managers were still evaluating the actual flight objectives for Apollo 8. On October 28, Associate Administrator for Manned Space Flight George E. Mueller and Apollo Program Director Samuel C. Phillips announced that in addition to the baseline Earth orbit mission using a Saturn V, NASA was assessing three alternative possibilities – an Earth orbital flight deeper into space, a circumlunar fly-by, and a lunar orbit mission. A decision to be announced in mid-November would follow a detailed analysis of the recently completed Apollo 7 mission, certification of changes made to the Saturn V following the Pogo problems encountered during Apollo 6, completion of flight computer programs for deep space and lunar missions, and rehearsal through computer simulations of the Mission Control ground systems. Thomas O. Paine, NASA Acting Administrator added, “The final decision on whether to send Apollo 8 around the moon will

be made after a thorough assessment of the total risks involved and the total gains to be realized in this next step toward a manned lunar landing."

Preparations for Apollo 9 included training for the first Extravehicular Activity (EVA) or spacewalk of the Apollo program. According to the mission plan, while the LM and CM were docked crewmembers in both spacecraft were to open their hatches. One astronaut would transfer via EVA from the LM to the CM using handrails for guidance and enter the CM in a test of an emergency rescue capability. The training took place aboard a KC-135 aircraft from Patrick Air Force Base in Florida. By flying repeated parabolic trajectories, the aircraft could simulate 20-30 seconds of weightlessness at a time, during which the astronauts wearing space suits practiced entering and exiting a mockup of the CM. Backup crewmembers Richard F. Gordon and Alan L. Bean completed the training on October 9 followed by David R. Scott and Russell L. Schweickart of the prime crew the next day.

Grumman Aircraft Engineering Corporation in Bethpage, New York, manufacturer of the LM, delivered the one for Apollo 9 to KSC in June 1968 where engineers were thoroughly checking out its systems. North American Rockwell in Downey, California, manufacturer of the Command and Service Modules, delivered them to KSC in early October. At the end that month, technicians in the Manned Spacecraft and Operations Building (MSOB) conducted a docking test of the Apollo 9 LM and CM to verify the interfaces between the two vehicles. Elsewhere at KSC, in the Vehicle Assembly Building workers stacked the three stages of the Saturn V rocket for Apollo 9 during the first week of October.

In preparation for Apollo 10, Grumman delivered the LM for that mission to KSC. The descent stage arrived October 11 followed by the ascent stage five days later. Technicians in the MSOB mated the two stages and installed the assembled vehicle into a vacuum chamber on November 2 to begin a series of tests.

Source: NASA Return to Contents

Space Image of the Week

Light Pillars over Whitefish Bay

Explanation What's happening in the sky? Unusual lights appeared last week to hover above Whitefish Bay on the eastern edge of Lake Superior between the USA and Canada. Unsure of the cause, the Michigan-based astrophotographer switched camera lenses -- from fisheye to telephoto -- and soon realized he was seeing light pillars: vertical lines of light over a ground source that reflect from falling ice crystals. As the ground temperature was above freezing, the flat crystals likely melted as they approached the ground, creating a lower end to the vertical light pillars. The red ground lights originated from wind turbines on Ile Parisienne, a Canadian Island visible across the bay.

Image Credit & Copyright: Vincent Brady

Source: APOD

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