Space News Update

— June 26, 2018 —

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1. Webb Space Telescope To Target Jupiter's Great Red Spot

NASA's James Webb Space Telescope will use its unparalleled infrared capabilities to study Jupiter's Great Red Spot.

In so doing it will be shedding new light on the enigmatic storm and building upon data returned from NASA's Hubble Space Telescope and other observatories.

Jupiter's iconic storm is on the Webb telescope's list of targets chosen by guaranteed time observers, scientists who helped develop the incredibly complex telescope and among the first to use it to observe the universe. One of the telescope's science goals is to study planets, including the mysteries still held by the planets in our own solar system from Mars and beyond.

Leigh Fletcher, a senior research fellow in planetary science at the University of Leicester in the United Kingdom, is the lead scientist on the Webb telescope's observations of Jupiter's storm. His team is part of a larger effort to study several targets in our solar system with Webb, spearheaded by astronomer Heidi Hammel, the executive vice president of the Association of Universities for Research in Astronomy (AURA). NASA selected Hammel as an interdisciplinary scientist for Webb in 2002.

"Webb's infrared sensitivity provides a wonderful complement to Hubble visible-wavelength studies of the Great Red Spot," explained Hammel. "Hubble images have revealed striking changes in the size of the Great Red Spot over the mission's multi-decade-long lifetime."

Fletcher and his team plan to use Webb's mid-infrared instrument (MIRI) to create multispectral maps of the Great Red Spot and analyze its thermal, chemical and cloud structures. The scientists will be able to observe infrared wavelengths that could shed light on what causes the spot's iconic color, which is often attributed to

the sun's ultraviolet radiation interacting with nitrogen, sulfur and phosphorus-bearing chemicals that are lifted from Jupiter's deeper atmosphere by powerful atmospheric currents within the storm.

Fletcher explained that using MIRI to observe in the 5 to 7 micrometer range could be particularly revealing for the Great Red Spot, as no other mission has been able to observe Jupiter in that part of the electromagnetic spectrum, and observations in such wavelengths are not possible from Earth. Those wavelengths of light could allow the scientists to see unique chemical byproducts of the storm, which would give insight into its composition.

"We'll be looking for signatures of any chemical compounds that are unique to the [Great Red Spot]...which could be responsible for the red chromophores," said Fletcher. Chromophores are the parts of molecules responsible for their color. Fletcher added, "If we don't see any unexpected chemistry or aerosol signatures...then the mystery of that red color may remain unresolved."

Webb's observations may also help determine whether the Great Red Spot is generating heat and releasing it into Jupiter's upper atmosphere, a phenomenon that could explain the high temperatures in that region. Recent NASA-funded research showed that colliding gravity waves and sound waves, produced by the storm, could generate the observed heat, and Fletcher said Webb might be able to gather data to support this.

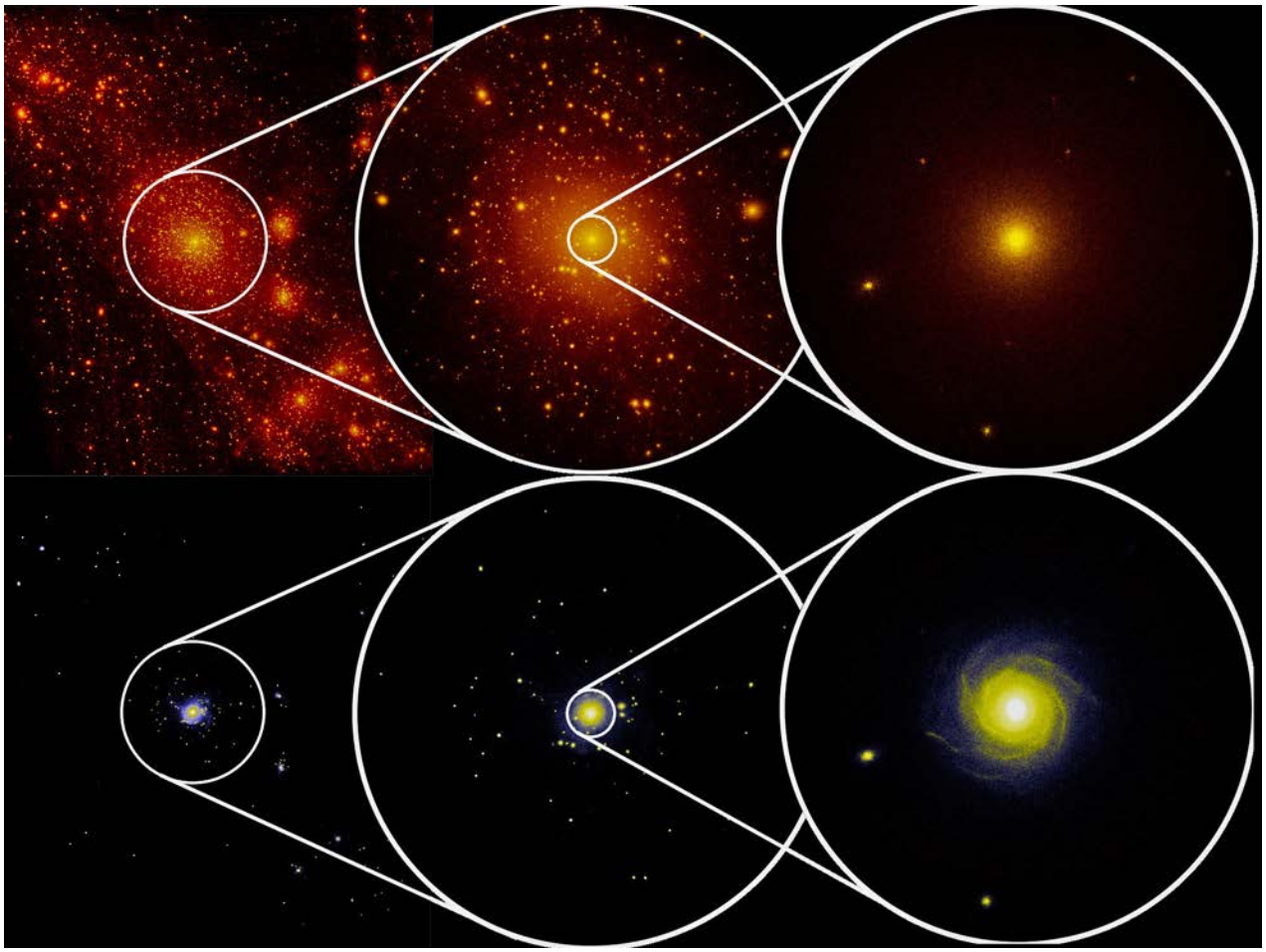
"Any waves produced by the vigorous convective activity within the storm must pass through the stratosphere before they reach the ionosphere and thermosphere," he explained. "So if they really do exist and are responsible for heating Jupiter's upper layers, hopefully we'll see evidence for their passage in our data."

Generations of astronomers have studied the Great Red Spot; the storm has been monitored since 1830, but it has possibly existed for more than 350 years. The reason for the storm's longevity largely remains a mystery, and Fletcher explained that the key to understanding the formation of storms on Jupiter is to witness their full life cycle -- growing, shrinking, and eventually dying. We did not see the Great Red Spot form, and it may not die anytime soon (though it has been shrinking, as documented by images from NASA's Hubble Space Telescope and other observatories), so scientists must rely on observing "smaller and fresher" storms on the planet to see how they begin and evolve, something that Webb may do in the future, said Fletcher.

"These particular observations will reveal the storm's vertical structure, which will be an important constraint for numerical simulations of Jovian [Jupiter] meteorology," he explained. "If those simulations can help explain what Webb observes in the infrared, then we'll be a step closer to understanding how these gigantic maelstroms live for so long."

Source: SpaceRef.com Return to Contents

2. A galactic test will clarify the existence of dark matter



Researchers at the University of Bonn and the University of California at Irvine used sophisticated computer simulations to devise a test that could answer a burning question in astrophysics: is there really dark matter? Or does Newton's gravitational law need to be modified? The new study, now published in the *Physical Review Letters*, shows that the answer is hidden in the motion of the stars within small satellite galaxies swirling around the Milky Way.

Using one of the fastest supercomputers in the world, the scientists have simulated the matter distribution of the so-called satellite "dwarf" galaxies. These are small galaxies that surround, for instance, the Milky Way or Andromeda.

The researchers focused on a relationship called "radial acceleration relation" (RAR). In disk galaxies, stars move in circular orbits around the galactic center. The acceleration that forces them to constantly change direction is caused by the attraction of matter in the galaxy. The RAR describes the relationship between this acceleration and the one caused by the visible matter only. It provides an insight into the structure of galaxies and their matter distribution.

"We have now simulated, for the first time, the RAR of dwarf galaxies on the assumption that dark matter exists," explains Prof. Dr. Cristiano Porciani of the Argelander Institute for Astronomy at the University of Bonn. "It turned out that they behave as scaled-down versions of larger galaxies." But what if there is no dark matter and instead gravity "works" differently than Newton thought? "In this case the RAR of dwarf galaxies depends strongly on the distance to their parent galaxy, while this does not happen if dark matter exists", explains the researcher Emilio Romano-Díaz.

This difference makes the satellites a powerful probe for testing whether dark matter really exists. The Gaia spacecraft, which was launched by the European Space Agency (ESA) in 2013, could already provide an answer. It was designed to study the stars in the Milky Way and its satellite galaxies in unprecedented detail and has collected a large amount of data.

However, it will probably take years to solve this riddle. "Individual measurements are not enough to test the small differences we have found in our simulations", explains doctoral student Enrico Garaldi. "But repeatedly taking a close look at the same stars improves the measurements every time. Sooner or later it should be possible to determine whether the dwarf galaxies behave like in a universe with dark matter - or not."

The cement that holds galaxies together

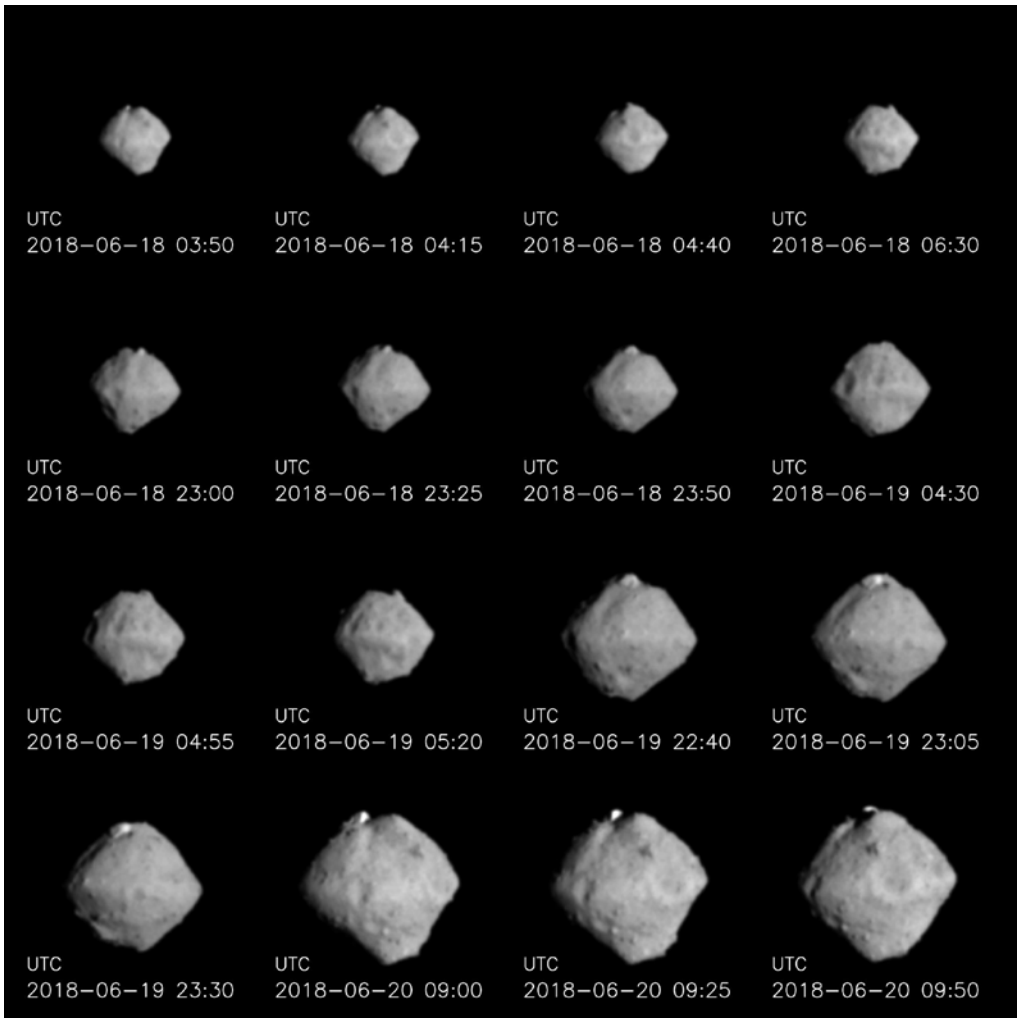
This question is one of the most pressing issues in cosmology today. The existence of dark matter was already suggested more than 80 years ago by the Swiss astronomer Fritz Zwicky. He realized that galaxies move so fast within galaxy clusters that they should actually drift apart. He therefore postulated the presence of invisible matter which, due to its mass, exerts sufficient gravity to keep galaxies on their observed orbits. In the 1970s, his US colleague Vera Rubin discovered a similar phenomenon in spiral galaxies like the Milky Way: they rotate so quickly that the centrifugal force should tear them apart if only visible matter was present.

Today, most physicists are convinced that dark matter makes up about 80 percent of the mass in the universe. Since it does not interact with light, it is invisible to telescopes. Yet, assuming its existence provides an excellent fit to a number of other observations - such as the distribution of background radiation, an afterglow of the Big Bang. Dark matter also provides a good explanation for the arrangement and formation rate of galaxies in the universe. However, despite numerous experimental efforts, there is no direct proof that dark matter exists. This led astronomers to the hypothesis that the gravitational force itself might behave differently than previously thought. According to the theory called MOND (MOdified Newtonian Dynamics), the attraction between two masses obeys Newton's laws only up to a certain point. At very small accelerations, such as those prevailing in galaxies, gravity becomes considerably stronger. Therefore, galaxies do not tear apart due to their rotational speed and the MOND theory can dispense with the mysterious star putty.

The new study opens up the possibility for astronomers to test these two hypotheses in an unprecedented regime.

Source: EurekAlert Return to Contents

3. A Japanese Probe Is Closing in on an Asteroid 180 Million Miles from Earth



Japan's Hayabusa2 spacecraft is closing in on its asteroid target ahead of a planned rendezvous just a few days from now.

The Japan Aerospace Exploration Agency (JAXA) released several new images that Hayabusa2 snapped recently of the asteroid Ryugu, whose shape has now become clear.

"From a distance, Ryugu initially appeared round, then gradually turned into a square before becoming a beautiful shape similar to fluorite (known as the 'firefly stone' in Japanese)," Hayabusa2 project manager Yuichi Tsuda wrote today (June 25) in a description of the newest photos, which the probe took Saturday and Sunday (June 23 and 24), from as close as 25 miles (40 kilometers).

"Now, craters are visible, rocks are visible and the geographical features are seen to vary from place to place," Tsuda added. "This form of Ryugu is scientifically surprising and also poses a few engineering challenges."

Several earlier images, taken from 62 miles to 124 miles (100 to 200 km) away, reveal topography suggesting that the 3,000-foot-wide (900 meters) asteroid has probably had a complex evolutionary history, JAXA officials said. Scientists say asteroids in Ryugu's size range might be fragments of a larger parent body.

"As we approached Ryugu and were able to distinguish individual features in the asteroid's topology, it became clear that Ryugu has a land of rich terrain," mission principal investigator Seiji Sugita said in a different

statementpublished Friday (June 21). "Numerous clusters of rock roll on the surface. Among these, a large rocky mass (about 150 meters [490 feet] across) stands out on the upper part of Ryugu due to its brighter color (higher reflectivity). The belt-shaped ring of peaks that surround the equator are also slightly brighter than their surroundings.

"This color difference," Sugita added, "may reflect a difference in material composition and the size of the particles that form the rock. We can also see many sunken regions that look like craters. These depressions may have been made in collisions with other celestial bodies. A structure that looks like a grove is also visible."

JAXA has released a number of Hayabusa2's Ryugu photos in recent days. For example, another set showed that the asteroid rotates perpendicular to its orbit every 7.5 hours. Ryugu also appears to be similar in shape to asteroid Bennu, the target of NASA's OSIRIS-REx asteroid-sampling mission, and asteroid 2008 EV5, the target of the proposed European MarcoPolo-R mission that ultimately was not selected for launch.

Hayabusa2 left Earth in 2014 and is scheduled to arrive at Ryugu — which is about 180 million miles (290 million km) from Earth at the moment — Wednesday (June 27) or thereabouts.

Other touchdown operations are planned in February 2019 and in April or May 2019. Additionally, Hayabusa2 will generate a crater with an impactor in March or April 2019, and do a second rover deployment in July. (Eventually, the mothership will deploy a total of three rovers and a lander onto Ryugu's surface.)

Hayabusa2 will also spiral down to collect samples from the fresh crater. If all goes according to plan, these samples will come down to Earth in a special return capsule near the end of 2020.

Such operations will be complicated somewhat by Ryugu's distinctive shape, as Tsuda mentioned in his reference to "engineering challenges."

That shape "means we expect the direction of the gravitational force on the wide areas of the asteroid surface to not point directly down," Tsuda said. "We therefore need a detailed investigation of these properties to formulate our future operation plans."

Hayabusa2 is following in the footsteps of the original Hayabusa mission, which made history in 2010 when it returned small pieces of the asteroid Itokawa to Earth.

Source: Space.com Return to Contents

The Night Sky

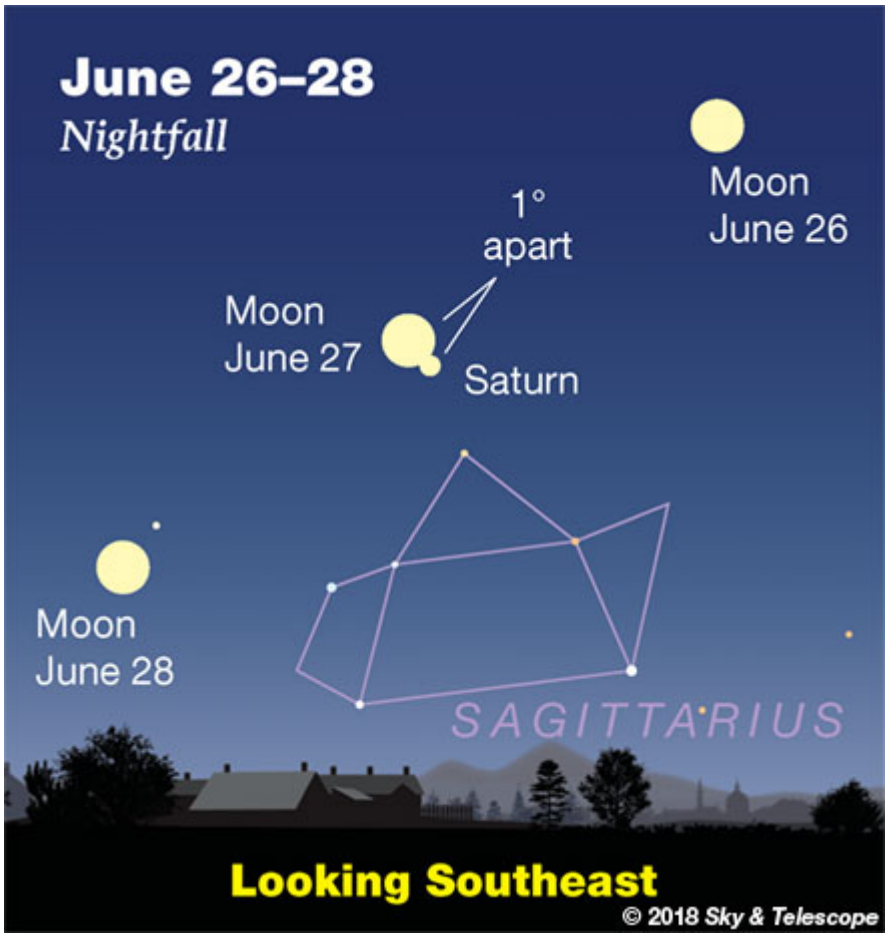
Tuesday, June 26

• Now you'll find the nearly full Moon more or less between Antares to its right and Saturn to its lower left.

Wednesday, June 27

• Full Moon (exact at 11:53 p.m. Eastern Daylight Time). The Moon shines only a degree or two from Saturn this evening for North America. Companions they may seem to be, but Saturn is currently 3,400 times farther away. And it's 35 times wider in true diameter.

• Appearing so close to an exactly full Moon, Saturn of course must be very close to opposition! And indeed it is. Saturn was at opposition earlier today, around 9 a.m. Eastern Daylight Time.



Thursday, June 28

• This evening Saturn leads the moon up and across the sky — glowing to its upper right at dusk, then more directly to the Moon's right later in the night.

Friday, June 29

• The waning gibbous Moon rises in the east-southeast in late twilight. An hour later, watch for Mars to clear the horizon about a fist at arm's length to the Moon's lower right (for North America).

Source: Sky & Telescope

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ISS Sighting Opportunities

For Denver:

There are no sightings in Denver through Friday, June 29th.

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

NASA-TV Highlights

(all times Eastern Daylight Time)

June 27, Wednesday
10:30 a.m. - Smithsonian Air and Space Museum Presents, "STEM in 30," featuring an 11:05 a.m. conversation with astronaut Serena Aunon-Chancellor on the International Space Station (All Channels)

June 28, Thursday
11 a.m. – SpaceX CRS-15 What's On Board Briefing (All Channels)
12:45 p.m. – SpaceX CRS-15 Pre-launch News Conference (All Channels)
1:40 p.m. – Space Station Educational Event with the Armstrong Flight Research Center in Edwards, California, and astronauts Serena Aunon-Chancellor of NASA and Alexander Gerst of the European Space Agency (All Channels)

June 29, Friday
5:15 a.m. – Coverage of the Launch of the SpaceX CRS-15 Mission to the International Space Station (Launch scheduled at 5:42 a.m. EDT) – Kennedy space Center (All Channels)
8 a.m. – SpaceX CRS-15 Post-Launch News Conference – Kennedy Space Center (All Channels)

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

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Space Calendar

- Jun 26 - Comet P/2009 Q4 (Boattini) At Opposition (3.910 AU)
- Jun 26 - Apollo Asteroid 2007 UD6 Near-Earth Flyby (0.074 AU)
- Jun 26 - Asteroid 12002 Suess Closest Approach To Earth (1.764 AU)
- Jun 26 - Asteroid 3866 Langley Closest Approach To Earth (1.929 AU)
- Jun 26 - 40th Anniversary (1978), SEASAT 1 Launch
- Jun 27 - HOT [Jun 20] Hayabusa 2 Arrives at Asteroid Ryugu
- Jun 27 - Saturn At Opposition
- Jun 27 - Moon Occults Asteroid 4 Vesta
- Jun 27 - Comet 96P/Machholz At Opposition (2.491 AU)
- Jun 27 - Comet 211P/Hill At Opposition (3.500 AU)
- Jun 27 - NEW [Jun 21] Amor Asteroid 2018 MX4 Near-Earth Flyby (0.014 AU)
- Jun 27 - Atira Asteroid 2015 ME131 Closest Approach To Earth (1.088 AU)
- Jun 27 - Asteroid 3000 Leonardo Closest Approach To Earth (1.382 AU)
- Jun 27 - Asteroid 79896 Billhaley Closest Approach To Earth (1.850 AU)
- Jun 28 - Comet C/2017 S6 (Catalina) Closest Approach To Earth (1.304 AU)
- Jun 28 - Comet 182P/LONEOS At Opposition (2.892 AU)
- Jun 28 - Apollo Asteroid 2018 LN2 Near-Earth Flyby (0.027 AU)
- Jun 28 - NEW [Jun 26] Aten Asteroid 2018 MH7 Near-Earth Flyby (0.029 AU)
- Jun 28 - Asteroid 797 Montana Closest Approach To Earth (1.406 AU)
- Jun 28 - Amor Asteroid 7088 Ishtar Closest Approach To Earth (1.738 AU)
- Jun 29 - HOT [Jun 24] CRS-15/ ECOSTRESS/ MISSE-FF 2/ Biarri-Squad 1-3 Falcon 9 Launch (International Space Station)
- Jun 29 - Comet 82P/Gehrels Perihelion (3.634 AU)
- Jun 29 - Asteroid 3727 Maxwell Occults HIP 5346 (5.5 Magnitude Star)
- Jun 29 - Apollo Asteroid 2018 LR3 Near-Earth Flyby (0.016 AU)
- Jun 29 - Apollo Asteroid 10563 Izhdubar Closest Approach To Earth (0.738 AU)
- Jun 29 - Asteroid 4238 Audrey Closest Approach To Earth (1.387 AU)
- Jun 29 - George Hale's 150th Birthday (1868)
- Jun 29 - Angelo Secchi's 200th Birthday (1818)
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Source: JPL Space Calendar

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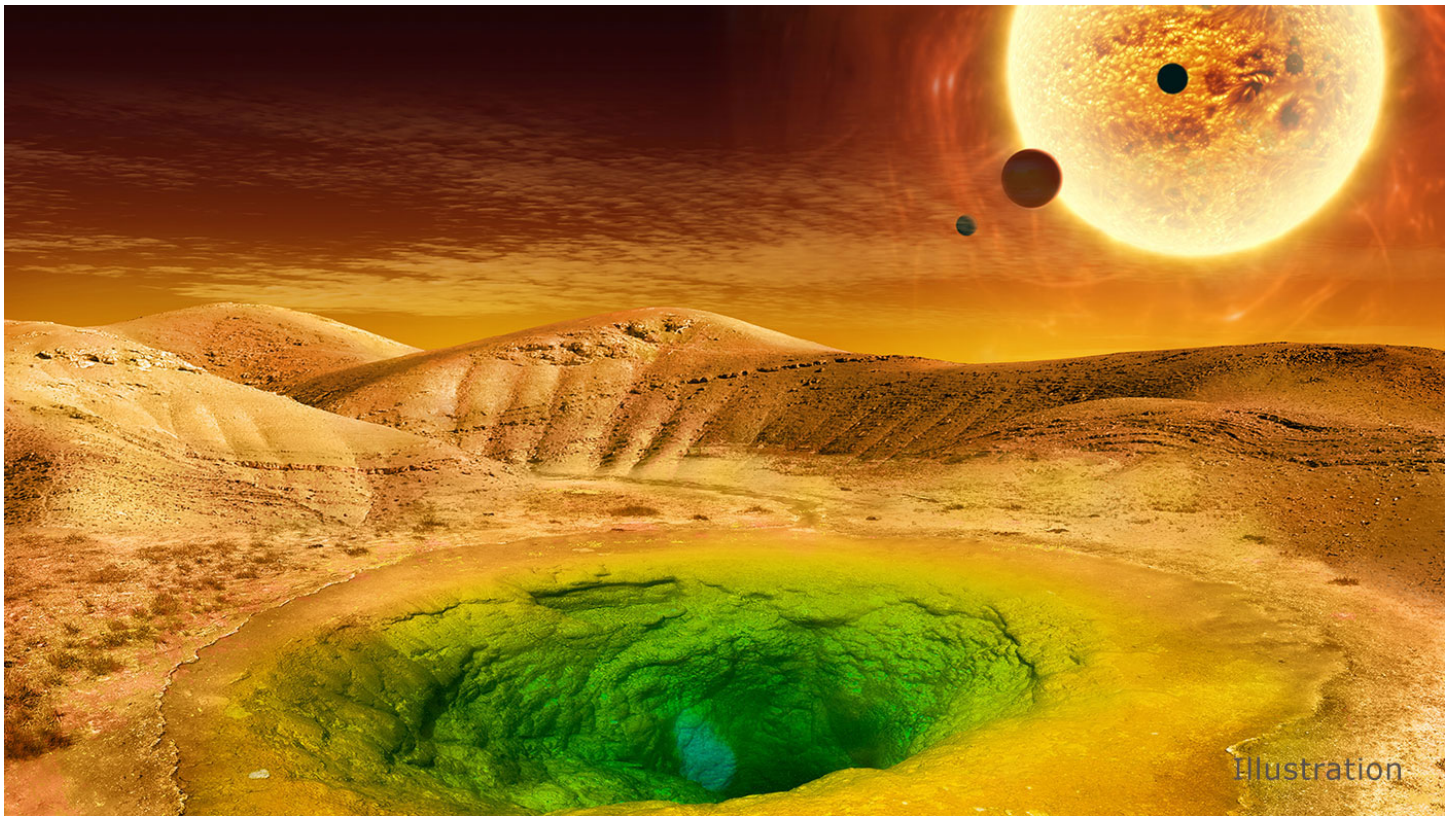
Food for Thought

NASA Asks: Will We Know Life When We See It?



In the last decade, we have discovered thousands of planets outside our solar system and have learned that rocky, temperate worlds are numerous in our galaxy. The next step will involve asking even bigger questions. Could some of these planets host life? And if so, will we be able to recognize life elsewhere if we see it?

A group of leading researchers in astronomy, biology and geology has come together under NASA's Nexus for Exoplanet System Science, or NExSS, to take stock of our knowledge in the search for life on distant planets and to lay the groundwork for moving the related sciences forward.

"We're moving from theorizing about life elsewhere in our galaxy to a robust science that will eventually give us the answer we seek to that profound question: Are we alone?" said Martin Still, an exoplanet scientist at NASA Headquarters, Washington.

In a set of five review papers published last week in the scientific journal Astrobiology, NExSS scientists took an inventory of the most promising signs of life, called biosignatures. The paper authors include four scientists from NASA's Jet Propulsion Laboratory in Pasadena, California. They considered how to interpret the presence of biosignatures, should we detect them on distant worlds. A primary concern is ensuring the science is strong enough to distinguish a living world from a barren planet masquerading as one.

The assessment comes as a new generation of space and ground-based telescopes are in development. NASA's James Webb Space Telescope will characterize the atmospheres of some of the first small, rocky planets. There are plans for other observatories -- such as the Giant Magellan Telescope and the Extremely Large Telescope, both in Chile -- to carry sophisticated instruments capable of detecting the first biosignatures on faraway worlds.

Through their work with NExSS, scientists aim to identify the instruments needed to detect potential life for future NASA flagship missions. The detection of atmospheric signatures of a few potentially habitable planets may possibly come before 2030, although determining whether the planets are truly habitable or have life will require more in-depth study.

Since we won't be able to visit distant planets and collect samples anytime soon, the light that a telescope observes will be all we have in the search for life outside our solar system. Telescopes can examine the light reflecting off a distant world to show us the kinds of gases in the atmosphere and their "seasonal" variations, as well as colors like green that could indicate life.

These kinds of biosignatures can all be seen on our fertile Earth from space, but the new worlds we examine will differ significantly. For example, many of the promising planets we have found are around cooler stars, which emit light in the infrared spectrum, unlike our sun's high emissions of visible-light.

"What does a living planet look like?" said Mary Parenteau, an astrobiologist and microbiologist at NASA's Ames Research Center in Silicon Valley and a co-author. "We have to be open to the possibility that life may arise in many contexts in a galaxy with so many diverse worlds -- perhaps with purple-colored life instead of the familiar green-dominated life forms on Earth, for example. That's why we are considering a broad range of biosignatures."

The scientists assert that oxygen -- the gas produced by photosynthetic organisms on Earth -- remains the most promising biosignature of life elsewhere, but it is not foolproof. Abiotic processes on a planet could also generate oxygen. Conversely, a planet lacking detectable levels of oxygen could still be alive - which was exactly the case of Earth before the global accumulation of oxygen in the atmosphere.

"On early Earth, we wouldn't be able to see oxygen, despite abundant life," said Victoria Meadows, an astronomer at the University of Washington in Seattle and lead author of one of the papers. "Oxygen teaches us that seeing, or not seeing, a single biosignature is insufficient evidence for or against life -- overall context matters."

Rather than measuring a single characteristic, the NExSS scientists argue that we should be looking at a suite of traits. A planet must show itself capable of supporting life through its features, and those of its parent star.

The NExSS scientists will create a framework that can quantify how likely it is that a planet has life, based on all the available evidence. With the observation of many planets, scientists may begin to more broadly classify the "living worlds" that show common characteristics of life, versus the "non-living worlds."

"We won't have a 'yes' or 'no' answer to finding life elsewhere," said Shawn Domagal-Goldman, an astrobiologist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, and a co-author. "What we will have is a high level of confidence that a planet appears alive for reasons that can only be explained by the presence of life."

Source: JPL Return to Contents

Space Image of the Week

Dark Nebulas across Taurus
Image Processing & Copyright: Oliver Czernetz - **Data:** Digitized Sky Survey (POSS-II)

Explanation: Sometimes even the dark dust of interstellar space has a serene beauty. One such place occurs toward the constellation of Taurus. The filaments featured here can be found on the sky between the Pleiades star cluster and the California Nebula. This dust is not known not for its bright glow but for its absorption and opaqueness. Several bright stars are visible with their blue light seen reflecting off the brown dust.
Other stars appear unusually red as their light barely peaks through a column of dark dust, with red the color that remains after the blue is scattered away. Yet other stars are behind dust pillars so thick they are not visible here. Although appearing serene, the scene is actually an ongoing loop of tumult and rebirth. This is because massive enough knots of gas and dust will gravitationally collapse to form new stars -- stars that both create new dust in their atmospheres and destroy old dust with their energetic light and winds.=

Source: APOD

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