Space News Update

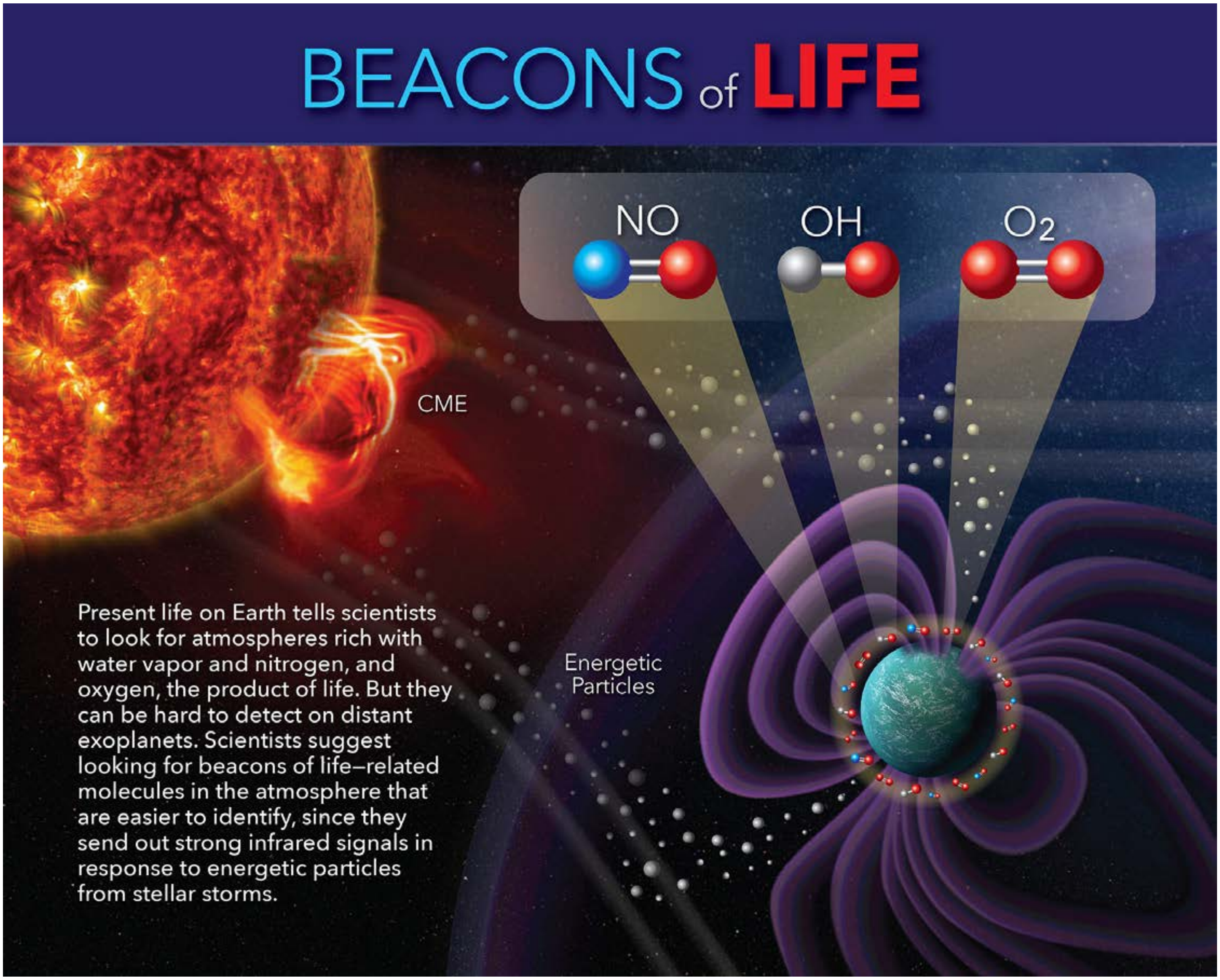
— November 3, 2017 —

Contents

In the News

Departments

1. Using Atmospheric Beacons to Search for Signs of Extra-Terrestrial Life



Despite the thousands of exoplanets that have been discovered by astronomers in recent years, determining whether or not any of them are habitable is a major challenge. Since we cannot study these planets directly, scientists are forced to look for indirect indications. These are known as biosignatures, which consist of the chemical byproducts we associate with organic life showing up in a planet's atmosphere.

A new study by a team of NASA scientists proposes a new method to search for potential signs of life beyond our Solar System. The key, they recommend, is to takes advantage of frequent stellar storms from cool, young dwarf stars. These storms hurl huge clouds of stellar material and radiation into space, interacting with exoplanet atmospheres and producing biosignatures that could be detected.

The study, titled "Atmospheric Beacons of Life from Exoplanets Around G and K Stars", recently appeared in *Nature Scientific Reports.* Led by Vladimir S. Airapetian, a senior astrophysicist with the Heliophysics Science Division (HSD) at the NASA Goddard Space Flight Center, the team included members from NASA's Langley Research Center, the Science Systems and Applications Incorporated(SSAI), and the American University.

Traditionally, researchers have searched for signs of oxygen and methane in exoplanet atmospheres, since these are well-known byproducts of organic processes. Over time, these gases accumulate, reaching amounts that could be detected using spectroscopy. However, this approach is time-consuming and requires that astronomers spend days trying to observe spectra from a distant planet.

But according to Airapetian and his colleagues, it is possible to search for cruder signatures on potentially habitable worlds. This approach would rely on existing technology and resources and would take considerably less time. As Airapetian explained in a NASA press release:

“We’re in search of molecules formed from fundamental prerequisites to life — specifically molecular nitrogen, which is 78 percent of our atmosphere. These are basic molecules that are biologically friendly and have strong infrared emitting power, increasing our chance of detecting them.”

Using life on Earth as a template, Airapetian and his team designed a new method to look or signs of water vapor, nitrogen and oxygen gas byproducts in exoplanets atmospheres. The real trick, however, is to take advantage of the kinds of extreme space weather events that occur with active dwarf stars. These events, which expose planetary atmospheres to bursts of radiation, cause chemical reactions that astronomers can pick on.

When it comes to stars like our Sun, a G-type yellow dwarf, such weather events are common when they are still young. However, other yellow and orange stars are known to remain active for billions of years, producing storms of energetic, charged particles. And M-type (red dwarf) stars, the most common type in the Universe, remain active throughout their long-lives, periodically subjecting their planets to mini-flares.

When these reach an exoplanet, they react with the atmosphere and cause the chemical dissociation of nitrogen (N^2) and oxygen (O^2) gas into single atoms, and water vapor into hydrogen and oxygen. The broken down nitrogen and oxygen atoms then cause a cascade of chemical reactions which produce hydroxyl (OH), more molecular oxygen (O), and nitric oxide (NO) – what scientists refer to as “atmospheric beacons”.

When starlight hits a planet’s atmosphere, these beacon molecules absorb the energy and emit infrared radiation. By examining the particular wavelengths of this radiation, scientists are able to determine what chemical elements are present. The signal strength of these elements is also an indication of atmospheric pressure. Taken together, these readings allow scientist’s to determine an atmosphere’s density and composition.

For decades, astronomers have also used a model to calculate how ozone (O^3) is formed in Earth’s atmosphere from oxygen that is exposed to solar radiation. Using this same model – and pairing it with space weather events that are expected from cool, active stars – Airapetian and his colleagues sought to calculate just how much nitric oxide and hydroxyl would form in an Earth-like atmosphere and how much ozone would be destroyed.

To accomplish this, they consulted data from NASA’s Thermosphere Ionosphere Mesosphere Energetics Dynamics (TIMED) mission, which has been studying the formation of beacons in Earth’s atmosphere for years. Specifically, they used data from its Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument, which allowed them to simulate how infrared observations of these beacons might appear in exoplanet atmospheres.

As Martin Mlynczak, the SABER associate principal investigator at NASA’s Langley Research Center and a co-author of the paper, indicated:

“Taking what we know about infrared radiation emitted by Earth’s atmosphere, the idea is to look at exoplanets and see what sort of signals we can detect. If we find exoplanet signals in nearly the same proportion as Earth’s, we could say that planet is a good candidate for hosting life.”

What they found was that the frequency of intense stellar storms was directly related to the strength of the heat signals coming from the atmospheric beacons. The more storms occur, the more beacon molecules are created, generating a signal strong enough to be observed from Earth with a space telescope, and based on just two hours of observation time.

They also found that this kind of method can weed out exoplanets that do not possess an Earth-like magnetic field, which naturally interact with charged particles from the Sun. The presence of such a field is what ensures that a planet's atmosphere is not stripped away, and is therefore essential to habitability. As Airapetian explained:

"A planet needs a magnetic field, which shields the atmosphere and protects the planet from stellar storms and radiation. If stellar winds aren't so extreme as to compress an exoplanet's magnetic field close to its surface, the magnetic field prevents atmospheric escape, so there are more particles in the atmosphere and a stronger resulting infrared signal."

This new model is significant for several reasons. On the one hand, it shows how research that has enabled detailed studies of Earth's atmosphere and how it interacts with space weather is now being put towards the study of exoplanets. It is also exciting because it could allow for new studies of exoplanet habitability around certain classes of stars – ranging from many types of yellow and orange stars to cool, red dwarf stars.

Red dwarfs are the most common type of star in the Universe, accounting for 70% of stars in spiral galaxies and 90% in elliptical galaxies. What's more, based on recent discoveries, astronomers estimate that red dwarf stars are very likely to have systems of rocky planets. The research team also anticipates that next-generation space instruments like the James Webb Space Telescope will increase the likelihood of finding habitable planets using this model.

As William Danchi, a Goddard senior astrophysicist and co-author on the study, said:

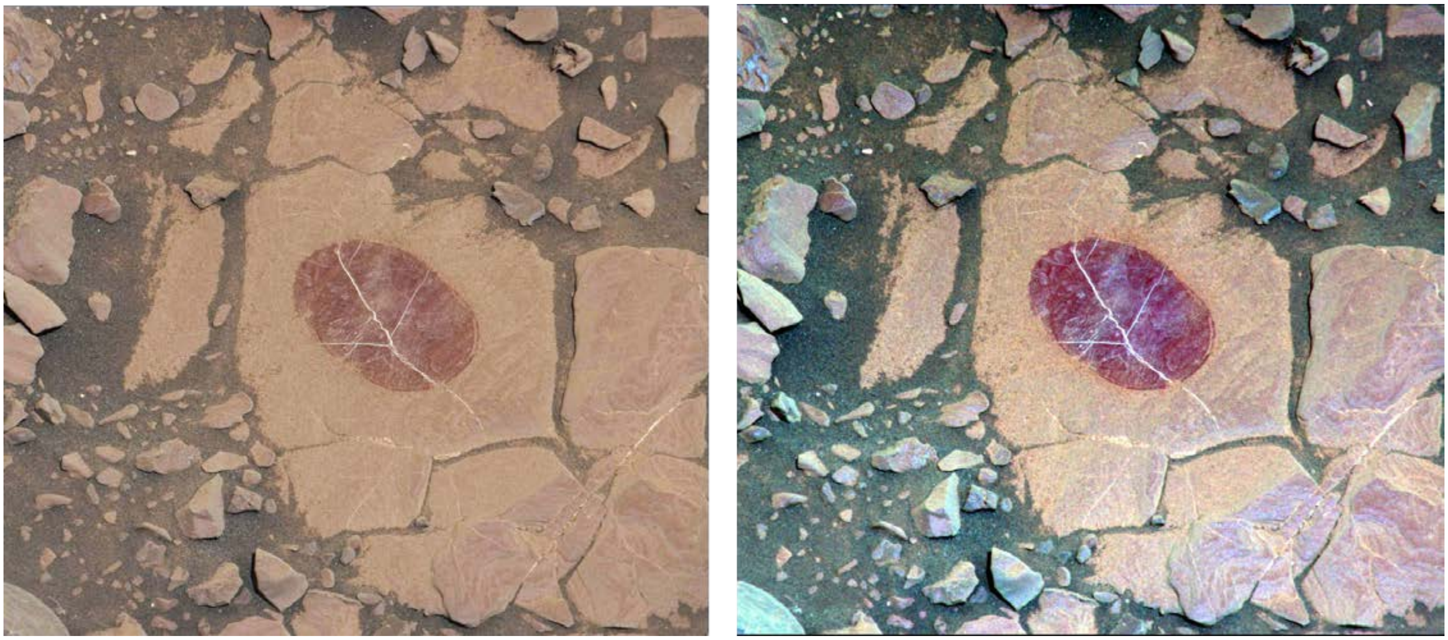
"New insights on the potential for life on exoplanets depend critically on interdisciplinary research in which data, models and techniques are utilized from NASA Goddard's four science divisions: heliophysics, astrophysics, planetary and Earth sciences. This mixture produces unique and powerful new pathways for exoplanet research."

Until such time that we are able to study exoplanets directly, any development that makes biosignatures more discernible and easier to detect is incredibly valuable. In the coming years, Project Blue and Breakthrough Starshot are hoping to conduct the first direct studies of the Alpha Centauri system. But in the meantime, improved models that allow us to survey countless other stars for potentially habitable exoplanets are golden!

Not only will they vastly improve our understanding of just how common such planets are, they might just point us in the direction of one or more Earth 2.0s!

Source: Universe Today Return to Contents

2. Martian Ridge Brings Out Rover's Color Talents



The Mastcam on Curiosity took this image (left) of a rock surface that had been brushed with the rover's Dust Removal Tool. The false-color image (right) demonstrates how use of special filters available on the Mastcam can reveal the presence of certain minerals in target rocks.

Color-discerning capabilities that NASA's Curiosity rover has been using on Mars since 2012 are proving particularly helpful on a mountainside ridge the rover is now climbing.

These capabilities go beyond the thousands of full-color images Curiosity takes every year: The rover can look at Mars with special filters helpful for identifying some minerals, and also with a spectrometer that sorts light into thousands of wavelengths, extending beyond visible-light colors into infrared and ultraviolet. These observations aid decisions about where to drive and investigations of chosen targets.

One of these methods for discerning targets' colors uses the Mast Camera (Mastcam); the other uses the Chemistry and Camera instrument (ChemCam).

Each of the Mastcam's two eyes -- one telephoto and one wider angle -- has several science filters that can be changed from one image to the next to assess how brightly a rock reflects light of specific colors. By design, some of the filters are for diagnostic wavelengths that certain minerals absorb, rather than reflect. Hematite, one iron-oxide mineral detectable with Mastcam's science filters, is a mineral of prime interest as the rover examines "Vera Rubin Ridge."

"We're in an area where this capability of Curiosity has a chance to shine," said Abigail Fraeman of NASA's Jet Propulsion Laboratory, Pasadena, California, who leads planning for the mission's investigation of Vera Rubin Ridge.

This ridge on lower Mount Sharp became a planned destination for Curiosity before the rover landed five years ago. Spectrometer observations from orbit revealed hematite here. Most hematite forms in the presence of water, and the mission focuses on clues about wet environments in Mars' ancient past. It found evidence during the first year after landing that some ancient Martian environments offered conditions favorable for life. As the mission continues, it is studying how those conditions varied and changed.

Curiosity's ChemCam is best known for zapping rocks with a laser to identify chemical elements in them, but it also can examine targets near and far without use of the laser. It does this by measuring sunlight reflected by the targets in thousands of wavelengths. Some patterns in this spectral data can identify hematite or other minerals.

"The colors of the rocks on the ridge are more interesting and more variable than what we saw earlier in Curiosity's traverse," said science team member Jeffrey Johnson of the Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland. He uses both Mastcam and ChemCam data for analyzing rocks.

Hematite occurs at sufficiently small grain sizes in rocks found at this part of Mars to preferentially absorb some wavelengths of green light. This gives it a purplish tint in standard color images from Curiosity, due to more reflection of redder and bluer light than reflection of the green wavelengths. The additional color-discerning capabilities of Mastcam and ChemCam show hematite even more clearly.

Johnson said, "We're using these multi-spectral and hyper-spectral capabilities for examining rocks right in front of the rover and also for reconnaissance -- looking ahead to help with choosing where to drive for closer inspection."

For example, a false-color Sept. 12 panorama combining Mastcam images taken through three special filters provided a map of where hematite could be seen in a region a few days' drive away. The hematite is most apparent in zones around fractured bedrock. The team drove Curiosity to a site in that scene to check the possible link between fracture zones and hematite. Investigation with Mastcam, ChemCam and other tools, including a camera and brush on the rover's arm, revealed that hematite is also in bedrock farther from the fractures once an obscuring layer of tan dust is brushed away. The dust doesn't coat the fractured rock as thoroughly.

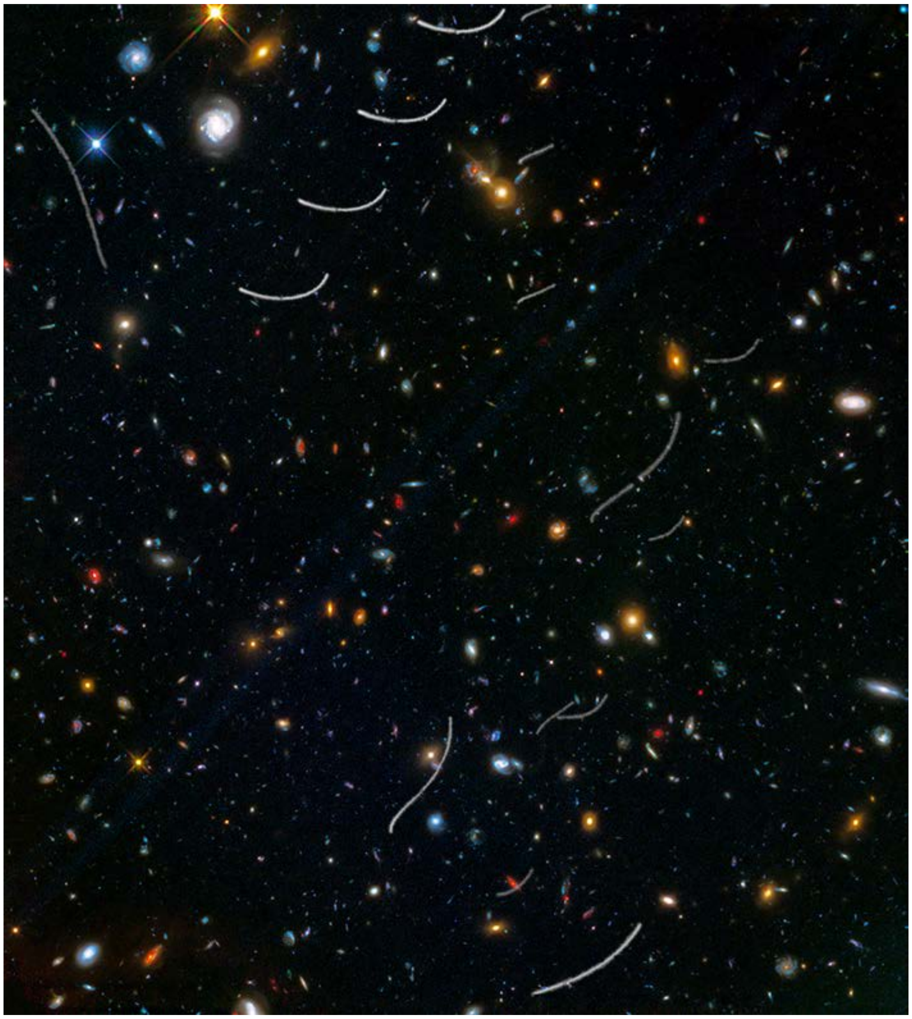
That finding suggests that dust and fractures cause the hematite to appear more patchy than it actually is. If the hematite is broadly distributed, its origin likely was early, rather than in a later period of fluids moving through fractures in the rock.

"As we approached the ridge and now as we're climbing it, we've been trying to tie what was detected from orbit to what we can learn on the ground," said Curiosity science team member Danika Wellington of Arizona State University, Tempe. "It's still very much a work in progress. The extent to which iron-bearing minerals here are oxidized relates to the history of interactions between water and rock."

Source: SpaceRef.com

Return to Contents

3. Hubble Sees Nearby Asteroids Photobombing Distant Galaxies



Like rude relatives who jump in front of your vacation snapshots of landscapes, some of our solar system's asteroids have photobombed deep images of the universe taken by NASA's Hubble Space Telescope. These asteroids reside, on average, only about 160 million miles from Earth — right around the corner in astronomical terms. Yet they've horned their way into this picture of thousands of galaxies scattered across space and time at inconceivably farther distances.

This Hubble photo of a random patch of sky is part of a survey called Frontier Fields. The colorful image contains thousands of galaxies, including massive yellowish ellipticals and majestic blue spirals. Much smaller, fragmentary blue galaxies are sprinkled throughout the field. The reddest objects are most likely the farthest galaxies, whose light has been stretched into the red part of the spectrum by the expansion of space.

Intruding across the picture are asteroid trails that appear as curved or S-shaped streaks. Rather than leaving one long trail, the asteroids appear in multiple Hubble exposures that have been combined into one image. Of the 20 total asteroid sightings for this field, seven are unique objects. Of these seven asteroids, only two were earlier identified. The others were too faint to be seen previously.

The trails look curved due to an observational effect called parallax. As Hubble orbits around Earth, an asteroid will appear to move along an arc with respect to the vastly more distant background stars and galaxies.

This parallax effect is somewhat similar to the effect you see from a moving car, in which trees by the side of the road appear to be passing by much more rapidly than background objects at much larger distances. The motion of Earth around the Sun, and the motion of the asteroids along their orbits, are other contributing factors to the apparent skewing of asteroid paths.

All the asteroids were found manually, the majority by "blinking" consecutive exposures to capture apparent asteroid motion. Astronomers found a unique asteroid for every 10 to 20 hours of exposure time.

The Frontier Fields program is a collaboration among NASA's Great Observatories and other telescopes to study six massive galaxy clusters and their effects. Using a different camera, pointing in a slightly different direction, Hubble photographed six so-called "parallel fields" at the same time it photographed the massive galaxy clusters. This maximized Hubble's observational efficiency in doing deep space exposures. These parallel fields are similar in depth to the famous Hubble Deep Field, and include galaxies about four-billion times fainter than can be seen by the human eye.

This picture is of the parallel field for the galaxy cluster Abell 370. It was assembled from images taken in visible and infrared light. The field's position on the sky is near the ecliptic, the plane of our solar system. This is the zone in which most asteroids reside, which is why Hubble astronomers saw so many crossings. Hubble deep-sky observations taken along a line-of-sight near the plane of our solar system commonly record asteroid trails.

Source: NASA Return to Contents

The Night Sky

Friday, November 3

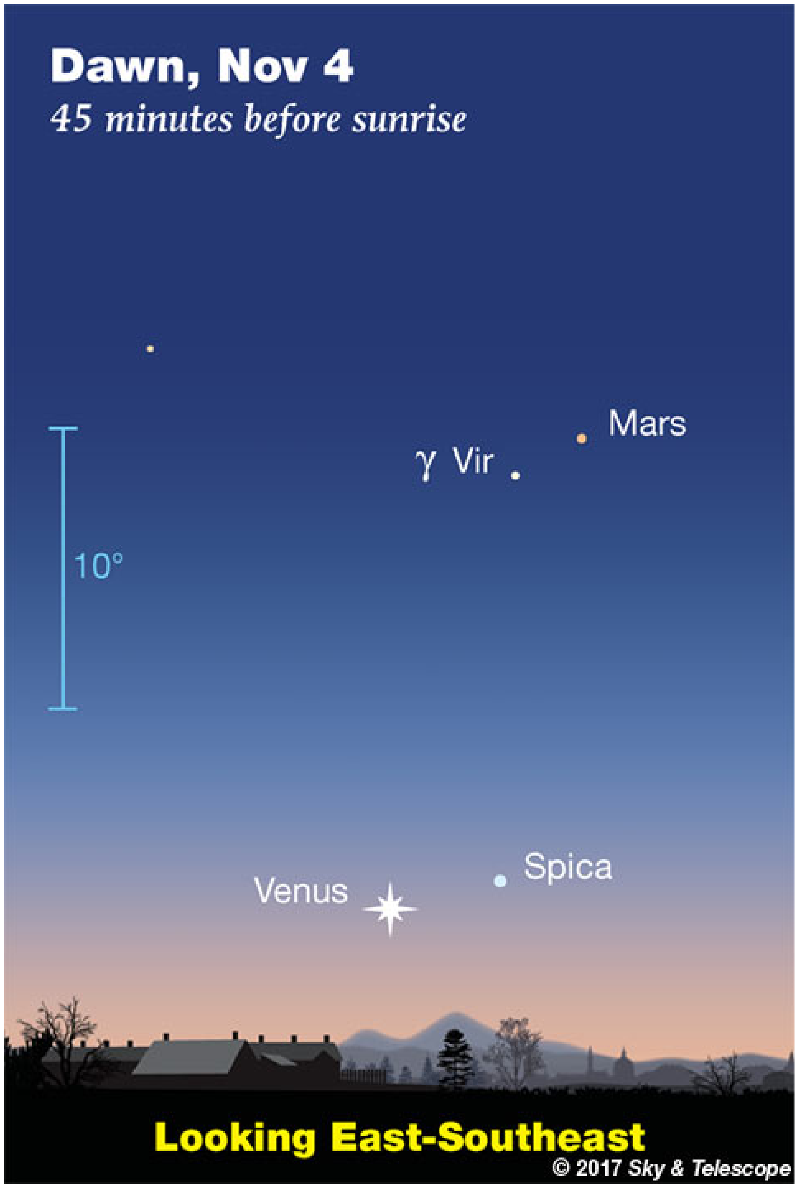
• Full Moon tonight (exactly full at 1:23 a.m.). The full Moon of November always rides very high across the sky in the middle of the night — almost as high as the full Moon of December.

Saturday, November 4

• Look lower left of the bright Moon this evening for Aldebaran. Above Aldebaran are the Pleiades, perhaps not so easy to spot in the moonlight. Binoculars help.

The bright star much farther to the left is Capella.

• Standard time returns at 2 a.m. Sunday morning for most of North America. Clocks fall back an hour.



Sunday, November 5

• The waning gibbous Moon occults Aldebaran early this evening for much of North America, and later in the night for northern Europe. The star disappears on the Moon's bright limb and reappears from behind the Moon's very thin dark sector — so for the disappearance you'll need a telescope, and for the reappearance, at least binoculars. See the November *Sky & Telescope*, page 51. Map and timetables.

Monday, November 6

• Around 8 p.m. this week, the Great Square of Pegasus stands in its level position very high toward the south. (It's straight overhead if you're as far south as Miami.) Its right (western) side points very far down toward Fomalhaut. Its eastern side points down less directly toward Beta Ceti, less far down.

Tuesday, November 7

• Algol should be at its minimum brightness, magnitude 3.4 instead of its usual 2.3, for a couple hours centered on 10:56 p.m. Eastern Standard Time.

Source: Sky & Telescope

Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Fri Nov 3, 6:22 AM	3 min	21°	20° above NW	10° above NNE
Sat Nov 4, 5:33 AM	1 min	17°	17° above NNE	10° above NE
Sat Nov 4, 7:07 AM	2 min	11°	10° above NNW	10° above N
Sun Nov 5, 5:15 AM	2 min	14°	14° above NNW	10° above NNE
Mon Nov 6, 4:25 AM	< 1 min	10°	10° above NNE	10° above NNE
Mon Nov 6, 6:00 AM	< 1 min	10°	10° above N	10° above N

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

NASA-TV Highlights
(all times Eastern Daylight Time)

11:30 a.m., Friday, November 3 - The Smithsonian National Air and Space Museum Presents – "What's New in Aerospace?" Astronaut Presentation with Jack "2fish" Fischer (NTV-1 (Public))

9 a.m., Monday, November 6 - ISS Expedition 53 In-Flight Event for ESA with Italian Prime Minister Paolo Gentiloni and Flight Engineer Paolo Nespoli of the European Space Agency (starts at 9:10 a.m.) (all channels)

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

Space Calendar

- Nov 03 - [Oct 30] 60th Anniversary (1957), Sputnik 2 Launch (Laika Dog)
- Nov 03 - Taurids Meteor Shower Peak
- Nov 03 - Comet 73P-BO/Schwassmann-Wachmann At Opposition (1.954 AU)
- Nov 03 - Comet 73P-BN/Schwassmann-Wachmann At Opposition (1.961 AU)
- Nov 03 - Comet 73P-BK/Schwassmann-Wachmann At Opposition (1.979 AU)
- Nov 03 - Comet 73P-J/Schwassmann-Wachmann At Opposition (1.990 AU)
- Nov 03 - [Nov 01] Aten Asteroid 2017 UL44 Near-Earth Flyby (0.034 AU)
- Nov 03 - Aten Asteroid 2009 UZ87 Near-Earth Flyby (0.070 AU)
- Nov 03 - Apollo Asteroid 2015 WA2 Near-Earth Flyby (0.093 AU)
- Nov 03 - Asteroid 1655 Comas Sola Closest Approach To Earth (1.248 AU)
- Nov 03 - Asteroid 31664 Randiiwessen Closest Approach To Earth (1.713 AU)
- Nov 03 - Asteroid 3524 Schulz Closest Approach To Earth (1.723 AU)
- Nov 03 - Apollo Asteroid 4486 Mithra Closest Approach To Earth (2.285 AU)
- Nov 03 - Asteroid 5515 Naderi Closest Approach To Earth (2.289 AU)
- Nov 03 - Kuiper Belt Object 120348 (2004 TY364) At Opposition (38.116 AU)
- Nov 04 - Comet 73P-AB/Schwassmann-Wachmann At Opposition (2.027 AU)
- Nov 04 - Comet 73P-BJ/Schwassmann-Wachmann At Opposition (2.038 AU)
- Nov 04 - Comet 139P/Vaisala-Oterma Closest Approach To Earth (2.427 AU)
- Nov 04 - Comet 139P/Vaisala-Oterma At Opposition (2.427 AU)
- Nov 04 - Comet 73P-BA/Schwassmann-Wachmann Closest Approach To Earth (2.794 AU)
- Nov 04 - Comet 337P/WISE At Opposition (2.798 AU)
- Nov 04 - Comet 73P-BH/Schwassmann-Wachmann Closest Approach To Earth (2.801 AU)
- Nov 04 - Comet 73P-BI/Schwassmann-Wachmann Closest Approach To Earth (2.802 AU)
- Nov 04 - Comet 73P-BM/Schwassmann-Wachmann Closest Approach To Earth (2.802 AU)
- Nov 04 - Comet 73P-BP/Schwassmann-Wachmann Closest Approach To Earth (2.803 AU)
- Nov 04 - Comet 31P/Schwassmann-Wachmann At Opposition (3.104 AU)
- Nov 04 - Comet C/2015 T5 (Sheppard-Tholen) At Opposition (8.828 AU)
- Nov 04 - Aten Asteroid 365424 (2010 KX7) Near-Earth Flyby (0.096 AU)
- Nov 04 - Asteroid 22824 von Neumann Closest Approach To Earth (1.062 AU)
- Nov 04 - Asteroid 3192 A'Hearn Closest Approach To Earth (1.472 AU)
- Nov 04 - Asteroid 3430 Bradfield Closest Approach To Earth (1.713 AU)
- Nov 04 - Asteroid 3975 Verdi Closest Approach To Earth (1.803 AU)
- Nov 04 - Asteroid 4768 Hartley Closest Approach To Earth (1.804 AU)
- Nov 05 - Daylight Saving - Set Clock Back 1 Hour (United States)
- Nov 05 - [Oct 30] Comet P/2017 S8 (PANSTARRS) Closest Approach To Earth (0.903 AU)
- Nov 05 - Comet 73P-BE/Schwassmann-Wachmann Closest Approach To Earth (2.812 AU)
- Nov 05 - Comet P/2009 L2 (Yang-Gao) At Opposition (4.200 AU)
- Nov 05 - Comet C/2014 E1 (Larson) At Opposition (4.292 AU)
- Nov 05 - [Oct 31] Apollo Asteroid 2017 UJ43 Near-Earth Flyby (0.012 AU)
- Nov 05 - [Oct 29] Apollo Asteroid 2017 US7 Near-Earth Flyby (0.018 AU)
- Nov 05 - [Oct 31] Apollo Asteroid 2017 UX42 Near-Earth Flyby (0.027 AU)
- Nov 05 - [Oct 29] Apollo Asteroid 2017 UJ7 Near-Earth Flyby (0.043 AU)
- Nov 05 - [Oct 28] Apollo Asteroid 2017 UE5 Near-Earth Flyby (0.052 AU)
- Nov 05 - [Oct 29] Apollo Asteroid 2017 UT7 Near-Earth Flyby (0.074 AU)
- Nov 05 - Asteroid 1065 Amundsenia Closest Approach To Earth (1.197 AU)
- Nov 05 - Plutino 144897 (2004 UX10) At Opposition (38.267 AU)
- Nov 05 - Kuiper Belt Object 2014 UZ224 At Opposition (90.200 AU)
- Nov 05 - 10th Anniversary (2007), Chang'e 1, Moon Orbit Insertion

- Nov 05 - 15th Anniversary (2002), Galileo, Amalthea 34 Flyby
- Nov 05 - John Alcock's 125th Birthday (1893)
- Nov 06 - Moon Occults Aldebaran
- Nov 06 - Comet 73P-AM/Schwassmann-Wachmann At Opposition (2.101 AU)
- Nov 06 - NEW [Oct 29] Apollo Asteroid 2013 BD74 Near-Earth Flyby (0.027 AU)
- Nov 06 - NEW [Nov 01] Apollo Asteroid 2017 UM44 Near-Earth Flyby (0.052 AU)
- Nov 06 - Apollo Asteroid 2004 GD Near-Earth Flyby (0.057 AU)
- Nov 06 - Apollo Asteroid 1865 Cerberus Closest Approach To Earth (0.397 AU)
- Nov 06 - Asteroid 8621 Jimparsons Closest Approach To Earth (2.224 AU)
- Nov 06 - Neptune Trojan 2006 RJ103 At Opposition (29.260 AU)
- Nov 06 - Kuiper Belt Object 84522 (2002 TC302) At Opposition (43.645 AU)
- Nov 06 - 20th Anniverary (1997), Galileo, Europa 11 Flyby
- Nov 06 - Kuiper Belt Object 55637 (2002 UX25) At Opposition (39.624 AU)

Source: JPL Space Calendar Return to Contents

Food for Thought

Oceans on Jupiter? Gas Giants Might Start Out As 'Steam Worlds'

Jupiter may not always have been a big ball of hydrogen and helium.

A new study suggests that, in their youth, Jupiter and other gas-giant planets may have been "steam worlds" — warm ocean planets a bit bigger than Earth, with water-vapor atmospheres.

John Chambers, a researcher at the Carnegie Institution of Washington in Washington, D.C., proposes that some protoplanets may grow into steam worlds from their modest beginnings as accretions of rock and ice pebbles.

As the accreting bodies come together and the protoplanet grows, increasing pressure liquefies the ices, and oceans form. Without any air present, water and any other liquids sublimate, creating an atmosphere dominated by water vapor, the idea goes. Even a relatively small protoplanet of between 0.08 and 0.16 Earth masses can be quite warm — from 32 to 704 degrees Fahrenheit (0 to 347 degrees Celsius), Chambers said.

"I calculated the structure of atmospheres in this case, and worked out when conditions are right for rapid inflow of gas to form a giant planet," Chambers told Space.com. "The answer is, this happens when a planet is a few Earth masses, which is somewhat lower than the conventional value of 10 Earth masses."

In his model, Chambers started with a planet that orbits a sun-like star about three times farther away than Earth circles the sun. The makeup of the initial protoplanet is half ice and half rock. The pebbles accrete into a small protoplanet, whose atmosphere is very thin and made up of sublimating ices. Once the protoplanet hits 0.084 Earth masses, there's enough atmospheric pressure for ice to melt, and the object becomes a small ocean world. As more ice and rock accrete, the protoplanet gets bigger and starts to accumulate hydrogen and helium.

Since there's a lot of water in the atmosphere, the planet gets warmer. (Water is a powerful greenhouse gas.) As the protoplanet gains mass, the atmospheric pressure also keeps rising, allowing the atmosphere to absorb more water vapor. Eventually the pressure gets so high that the water is no longer an ocean of liquid but a "supercritical fluid" mixed with hydrogen and helium, with no clear boundary between the atmosphere and the surface.

Once about two to five Earth masses of rock and ice come together, a runaway process starts, and the protoplanet picks up more gas from the disk around its host star quickly. That's what allows a gas giant to grow, according to the new study.

Most models of planet formation assume that planetesimals — the bits that accrete to form planets — are roughly kilometer-size bodies. Pebble accretion, on the other hand, assumes that the accreting objects are, as the name implies, the size of pebbles.

Michiel Lambrechts, a researcher at Lund University in Sweden who was not involved in Chambers' study, said the scheme is a logical one.

"It's all about some physics that is very plausible," Lambrechts said.

Whether this scenario applies to Jupiter is not known, though there is some data from NASA's Jupiter-orbiting Juno mission that seems to show a core that's more diffuse than scientists initially thought. One implication is that, if Chambers and others are correct about the pebble-accretion model, one would expect to find that Jupiter's core harbors only a few Earth masses, Lambrechts said.

Planetary scientists generally think that gas giants must pick up most of their mass in just a few million years, because the solar wind from a newborn star blows away most of the gas in its protoplanetary disk quickly.

That fast timeline can cause problems for some planet-formation models. But it suits the pebble-accretion idea just fine, Chambers said.

"At a certain point, it's about how you avoid accreting quickly," he said.

Chambers said the next step is to look at more exoplanet data.

"I'm still working through the implications of this, but the next step is to feed this result into more general models for planet formation," he said. "The idea is to compare the outcome of these models with the observed population of extrasolar planets to pin down other unknown factors in planet formation."

The study has been accepted for publication in The Astrophysical Journal. You can read a copy of it for free at on the online preprint server arXiv.org.

Source: Space.com Return to Contents

Space Image of the Week

Thor's Helmet Emission Nebula
Image Credit & Copyright: Adam Block, Mt. Lemmon SkyCenter, U. Arizona

Explanation: This helmet-shaped cosmic cloud with wing-like appendages is popularly called Thor's Helmet. Heroically sized even for a Norse god, Thor's Helmet spans about 30 light-years across. In fact, the helmet is more like an interstellar bubble, blown as a fast wind -- from the bright star near the center of the bubble's blue-hued region -- sweeps through a surrounding molecular cloud. This star, a Wolf-Rayet star, is a massive and extremely hot giant star thought to be in a brief, pre-supernova stage of evolution. Cataloged as NGC 2359, the emission nebula is located about 12,000 light-years away toward the constellation of the Big Dog (Canis Major). The sharp image, made using broadband and narrowband filters, captures striking details of the nebula's filamentary gas and dust structures. The blue color originates from strong emission from oxygen atoms in the nebula.

Source: APOD

Return to Contents