Space News Update

— January 12, 2018 —

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1. SpaceX delays commercial crew test flights to latter half of 2018

SpaceX has delayed its two commercial crew test flights by four months, according to a new NASA schedule released Jan. 11, raising questions about whether it or Boeing will be able to send astronauts to the International Space Station by the end of the year as previously planned.

The updated schedule, which NASA said represents “the most recent publicly releasable dates” for the two companies, lists an uncrewed test flight of SpaceX’s Crew Dragon spacecraft in August 2018, followed by a crewed test flight in December. The previous schedule released by NASA, in October 2017, stated those flights would take place in April and August 2018, respectively.

SpaceX spokesperson Eva Behrend, in a statement to SpaceNews, did not discuss the reasons for the delay. “SpaceX continues to target 2018 for the first demonstration missions with and without crew under NASA’s Commercial Crew Program,” she said.

Behrend instead focused on the progress the company has made in the development of its Crew Dragon vehicle. “In 2017, significant progress was made towards the production, qualification and launch of Crew Dragon — one of the safest and most advanced human spaceflight systems ever built — and we are set to meet the additional milestones needed to launch our demonstration missions this year.”

In a Jan. 4 release, NASA outlined some of the milestones ahead for SpaceX before those test flights. They include “continued, rigorous qualification testing” of both the Merlin engines used on the Falcon 9 as well as the Dragon’s SuperDraco thrusters, tests of the Dragon’s parachutes, post-splashdown recovery tests, and testing of the pressure suits that will be worn by astronauts flying on the Dragon.

At the time of the release, NASA had not disclosed the latest delays, but the list of milestones suggested delays were likely. For example, NASA said that a second round of Dragon parachute system validation tests “will be completed by mid-2018,” which under the previous schedule would have been after the uncrewed test flight.

The Boeing schedule released by NASA is unchanged from the previous version, with an uncrewed test flight of its CST-100 Starliner scheduled for August 2018 and a crewed test flight in November. However, in an interview in September 2017, Chris Ferguson, director of Starliner crew and mission systems at Boeing, suggested the crewed test flight could be delayed until early 2019.

At that time, Ferguson said Boeing's goal was to name the crew of that crewed test flight — one NASA astronaut and one Boeing test pilot — about 12 months before launch, but wanted to wait until the schedule was more certain before doing so. The company has yet to announce that crew.

The Jan. 4 NASA release also listed a number of major upcoming milestones for Boeing's vehicle, including spacecraft construction and testing, pressure suit tests, abort engine and thruster tests and continued parachute tests.

NASA continues to rely on Russian Soyuz spacecraft to transport astronauts to and from the ISS, but had hoped to shift those duties to commercial vehicles by the end of this year. In October, NASA exercised an option in a contract with Boeing for three additional Soyuz seats on missions in the first half of 2019, which Boeing had obtained as part of a settlement with RSC Energia. The additional seats mean NASA does not have to rely on commercial crew vehicles for ISS crew transport until the second half of 2019.

"We're still thinking about ways to buy additional margin if we have to. There's a whole spectrum of options that we are considering," said Kirk Shireman, ISS program manager, at a Dec. 11 press conference at the Kennedy Space Center. He did not elaborate on those options.

"We are going to look for options until he first rotation flight, because that's our job, to be prepared for contingencies," he added, "but I think we are absolutely progressing and look forward to demo flights in 2018."

The status of the NASA commercial crew program will be the subject of a Jan. 17 hearing by the House Science Committee's space subcommittee, which the committee announced Jan. 10. Boeing and SpaceX executives are scheduled to testify, along with officials from NASA, the Government Accountability Office and NASA's Aerospace Safety Advisory Panel.

Source: Space News

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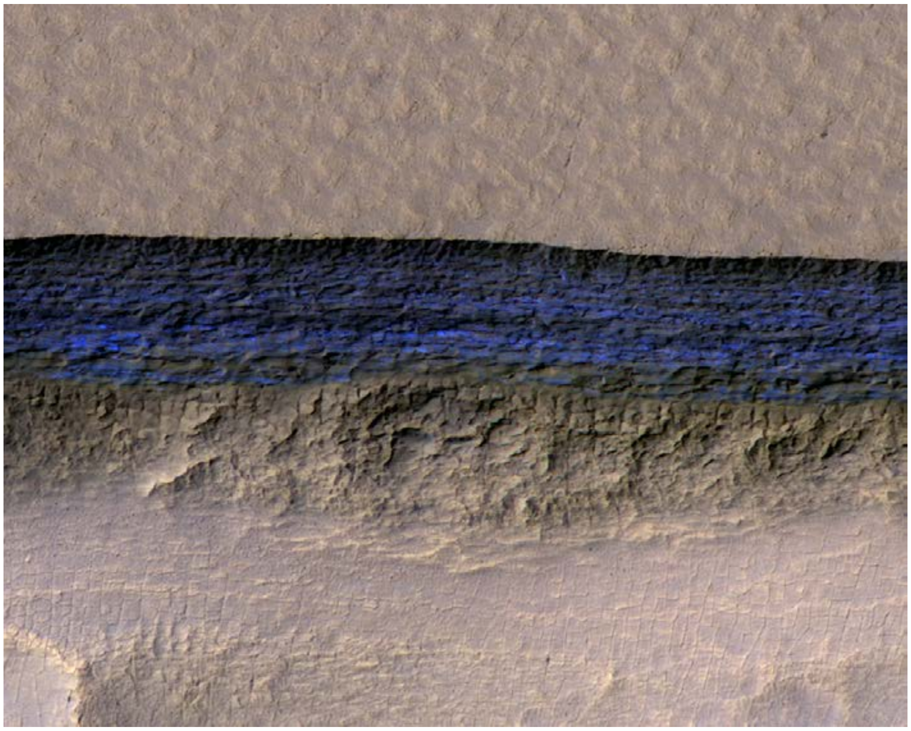
2. Steep Slopes on Mars Reveal Structure of Buried Ice



Researchers using NASA's Mars Reconnaissance Orbiter (MRO) have found eight sites where thick deposits of ice beneath Mars' surface are exposed in faces of eroding slopes.

These eight scarps, with slopes as steep as 55 degrees, reveal new information about the internal layered structure of previously detected underground ice sheets in Mars' middle latitudes.

The ice was likely deposited as snow long ago. The deposits are exposed in cross section as relatively pure water ice, capped by a layer one to two yards (or meters) thick of ice-cemented rock and dust. They hold clues about Mars' climate history. They also may make frozen water more accessible than previously thought to future robotic or human exploration missions.

Researchers who located and studied the scarp sites with the High Resolution Imaging Science Experiment (HiRISE) camera on MRO reported the findings today in the journal Science. The sites are in both northern and southern hemispheres of Mars, at latitudes from about 55 to 58 degrees, equivalent on Earth to Scotland or the tip of South America.

"There is shallow ground ice under roughly a third of the Martian surface, which records the recent history of Mars," said the study's lead author, Colin Dundas of the U.S. Geological Survey's Astrogeology Science Center in Flagstaff, Arizona. "What we've seen here are cross-sections through the ice that give us a 3-D view with more detail than ever before."

Windows into underground ice

The scarps directly expose bright glimpses into vast underground ice previously detected with spectrometers on NASA's Mars Odyssey (MRO) orbiter, with ground-penetrating radar instruments on MRO and on the European Space Agency's Mars Express orbiter, and with observations of fresh impact craters that uncover subsurface ice. NASA sent the Phoenix lander to Mars in response to the Odyssey findings; in 2008, the Phoenix mission confirmed and analyzed the buried water ice at 68 degrees north latitude, about one-third of the way to the pole from the northernmost of the eight scarp sites.

The discovery reported today gives us surprising windows where we can see right into these thick underground sheets of ice," said Shane Byrne of the University of Arizona Lunar and Planetary Laboratory, Tucson, a co-author on today's report. "It's like having one of those ant farms where you can see through the glass on the side to learn about what's usually hidden beneath the ground."

Scientists have not determined how these particular scarps initially form. However, once the buried ice becomes exposed to Mars' atmosphere, a scarp likely grows wider and taller as it "retreats," due to sublimation of the ice directly from solid form into water vapor. At some of them, the exposed deposit of water ice is more than 100 yards, or meter, thick. Examination of some of the scarps with MRO's Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) confirmed that the bright material is frozen water. A check of the surface temperature using Odyssey's Thermal Emission Imaging System (THEMIS) camera helped researchers determine they're not seeing just thin frost covering the ground.

Researchers previously used MRO's Shallow Radar (SHARAD) to map extensive underground water-ice sheets in middle latitudes of Mars and estimate that the top of the ice is less than about 10 yards beneath the ground surface. How much less? The radar method did not have sufficient resolution to say. The new ice-scarp studies confirm indications from fresh-crater and neutron-spectrometer observations that a layer rich in water ice begins within just one or two yards of the surface in some areas.

Astronauts' access to Martian water

The new study not only suggests that underground water ice lies under a thin covering over wide areas, it also identifies eight sites where ice is directly accessible, at latitudes with less hostile conditions than at Mars' polar ice caps. "Astronauts could essentially just go there with a bucket and a shovel and get all the water they need," Byrne said.

The exposed ice has scientific value apart from its potential resource value because it preserves evidence about long-term patterns in Mars' climate. The tilt of Mars' axis of rotation varies much more than Earth's, over rhythms of millions of years. Today the two planets' tilts are about the same. When Mars tilts more, climate conditions may favor buildup of middle-latitude ice. Dundas and co-authors say that banding and color variations apparent in some of the scarps suggest layers "possibly deposited with changes in the proportion of ice and dust under varying climate conditions."

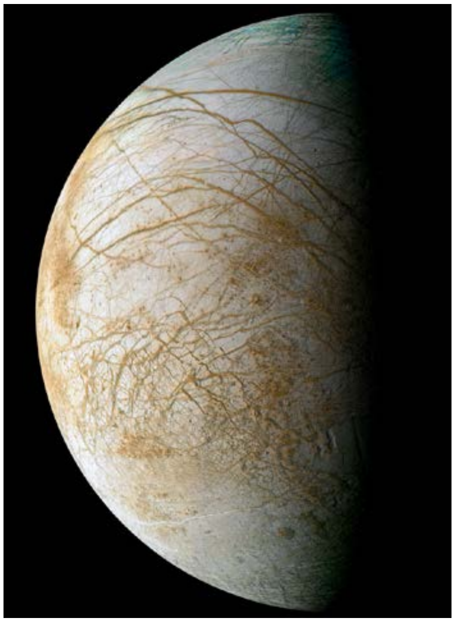
This research benefited from coordinated use of multiple instruments on Mars orbiters, plus the longevities at Mars now exceeding 11 years for MRO and 16 years for Odyssey. Orbital observations will continue, but future missions to the surface could seek additional information.

"If you had a mission at one of these sites, sampling the layers going down the scarp, you could get a detailed climate history of Mars," suggested MRO Deputy Project Scientist Leslie Tamppari of NASA's Jet Propulsion Laboratory, Pasadena, California. "It's part of the whole story of what happens to water on Mars over time: Where does it go? When does ice accumulate? When does it recede?"

The University of Arizona operates HiRISE, which was built by Ball Aerospace & Technologies Corp., Boulder, Colorado. The Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland, leads MRO's CRISM investigation. The Italian Space Agency provided MRO's SHARAD instrument, Sapienza University of Rome leads SHARAD operations, and the Planetary Science Institute, based in Tucson, Arizona, leads U.S. involvement in SHARAD. Arizona State University, Tempe, leads the Odyssey mission's THEMIS investigation. JPL, a division of Caltech in Pasadena, California, manages the MRO and Odyssey projects for the NASA Science Mission Directorate in Washington. Lockheed Martin Space, Denver, built both orbiters and supports their operation.

Source: JPL Return to Contents

3. No plumes? No problem. How Europa Clipper will analyze an icy moon's ocean



One of the recurring highlights from NASA's Cassini mission at Saturn was the moon Enceladus, which boasts beautiful plumes spraying water from its subsurface ocean into space. There's evidence suggesting Enceladus is habitable, and its plumes are beacons begging us to explore further.

We aren't going back to Enceladus anytime soon, but in the mid-2020s, we're going to a similar icy moon with a subsurface ocean: Europa. NASA's Europa Clipper will investigate whether Europa is habitable, and scout for a good place to send a future lander for a closer look.

Europa doesn't appear to have plumes—at least, not like the ones at Enceladus. Because of that, my preconceived notion was that Enceladus would be an easier place to search for life, since a spacecraft there could frolic happily in its plumes, directly examining what's in the ocean.

I was wrong. There's plenty of stuff to sample in the actually-not-empty space around Europa to unpack what's in the ocean, and Clipper will be far more advanced in this capability than Cassini. Europa is every bit as interesting as Enceladus, and one Clipper instrument in particular will help discover a "menu" of compounds on which life there could potentially thrive.

Meet MASPEX

If you want to know what's in a subsurface ocean, but aren't capable of drilling through tens of kilometers of ice to find out, one option is a mass spectrometer. By sampling the particles and vapors coming from Europa, scientists can "weigh" specific compounds and figure out exactly what's in the ocean. Clipper actually has two mass spectrometers; one is optimized for solid particles (SUDA, the Surface Dust Analyzer) and the other for gases (MASPEX, the MAss Spectrometer for Planetary EXploration). SUDA and MASPEX will work as a team, but for simplicity, this article will focus on MASPEX.

MASPEX works by ingesting some gas near Europa and zapping it with a beam of electrons. This, in turn, strips electrons off the compounds in the gas, which ionizes them—that is, it gives them an electric charge.

The ions are shunted through an electric field, which accelerates them because they have a charge. Ions from different gases accelerate differently according to their weight, so the electric field creates a little highway where heavy ions travel slower, and lighter ions travel faster. The highway enters a magnetic field, which pushes the ions into lanes based on their speed. The highway ends at an electronic detector, which functions like a toll booth, counting the number of ions in each lane. Those toll booth counts reveal what compounds, and how much of each, were in the gas sample.

MASPEX is under construction at the Southwest Research Institute in San Antonio. The principal investigator is Hunter Waite, who leads a team of deputy and co-investigators that includes Chris Glein (Glein is a pending co-I). Both Waite and Glein hail from SwRI, and have prior experience with Cassini's Ion Neutral Mass Spectrometer (Waite was the PI). The two were co-authors on a key paper announcing the discovery of molecular hydrogen in Enceladus' plumes, which bolstered the odds for the moon's habitability.

Plumes or no plumes?

The Hubble Space Telescope has looked for plumes around Europa several times, with mixed results. Twice, Hubble saw what looked like a plume coming from the same surface location, but during other observations it saw nothing. In the end, the results were slightly ambiguous, despite the fact that scientists pushed the telescope's capabilities to the limit.

When Cassini flew by Jupiter en route to Saturn in 2000, it saw what looked like a faint torus of water around Jupiter matching Europa's orbit. Something is definitely coming from the surface; the question is, what? Could the Europan definition of a plume be different from that of Enceladus? Perhaps the "plumes" could be weak outgassing from the moon's interior (Earth's Moon does something similar), or molecules getting knocked off the surface by Jupiter's intense radiation.

"It almost seems like it becomes a religious or philosophical point as to whether there are plumes or not," said Hunter Waite in a recent phone interview. "Whereas the answer is there *are* plumes—we just don't know how big they are."

Hubble saw about 1,000 kilograms of material per second coming from Europa. MASPEX on Clipper will be able to analyze a mere 1 kilogram of material per second—1,000 times less than Hubble. "We can look at a lot less dramatic features and obtain extremely interesting information," Waite said.

In the unlikely event MASPEX doesn't get to sniff anything plume-like, there's still probably ocean samples getting knocked off the moon's surface. Europa is littered with cracks and fissures where water and other compounds may ooze onto the surface. Jupiter's radiation splits that water apart, turning minerals and possibly organics dissolved in the water rust-colored, while also blasting some of them into space.

Because there are so many potential sources for what MASPEX sees, a fair amount of detective work, in tandem with other Clipper instruments, will be required to tell Europa's full story. Detecting hydrogen, for instance, could mean there are hydrothermal vents on the ocean floor (this was the conclusion at Enceladus, per the above-referenced paper). But hydrogen can also be created from the radioactive bombardment of surface materials, so the MASPEX team must be careful when pinpointing suspected sources of the compounds they detect. They can do this through a variety of methods, including correlating detections to surface geology, comparing the results to known abundances of compounds from other sources (like interstellar dust) and tracking the altitude, velocity and direction of the materials collected.

A menu for microbes

By measuring Europa's ocean molecules, scientists hope to create a menu of chemicals that microbes use to sustain themselves. Life as we know it requires energy to survive. In the absence of light, it gets that energy by combining certain chemicals, much like rockets that combine fuel and an oxidizer to blast into space.

NASA scientists recently showed molecular hydrogen, which is practically candy for microbes, can be produced below hydrothermal vents. The oxidant needed to release the energy stored in that hydrogen could be a lot of things, including oxygen or even carbon dioxide. Oxygen is produced on Europa's surface by Jupiter's radiation, which frees stray oxygen molecules that find their way to the ocean through the planet's ice plates, which smoosh, grind and slide underneath one another.

Once MASPEX produces a menu for potential life, the next step is proposing recipes. "That can add this new dimension towards understanding exactly how habitable Europa is in more than just a hand-waving fashion, to actually have real hard numbers to start talking about what's cooking," said Chris Glein.

A profound interpretation

I asked Waite and Glein to consider their dream MASPEX result. What would they ideally find?

Organics, for starters. Alone, organics are not an indicator of life—they're everywhere in the solar system, and even hostile environments like comets and Saturn's moon Titan have them—but they are considered the building blocks of life, ready to proceed to the next step should they have the right environment.

A second wish would be detecting "chemically reduced molecules" like methane, ammonia, and hydrogen sulfide, which should only exist if something interesting is happening beneath the Europa's ice. The moon's oxidized, radiation-flooded surface "is the exact type of place a methane molecule doesn't want to be," Glein said, meaning any methane found probably comes from the ocean.

If we find organics and chemically reduced molecules spewing from Europa, it could mean the ocean is teeming with life. Or it could be another process at work. And we might not be able to tell for sure until a future lander mission gives us a better look.

"You'd at least have that really fundamental, profound interpretation," said Glein. "And then we'd probably argue about that to death for the next ten years or so."

Source: Planetary Society Return to Contents

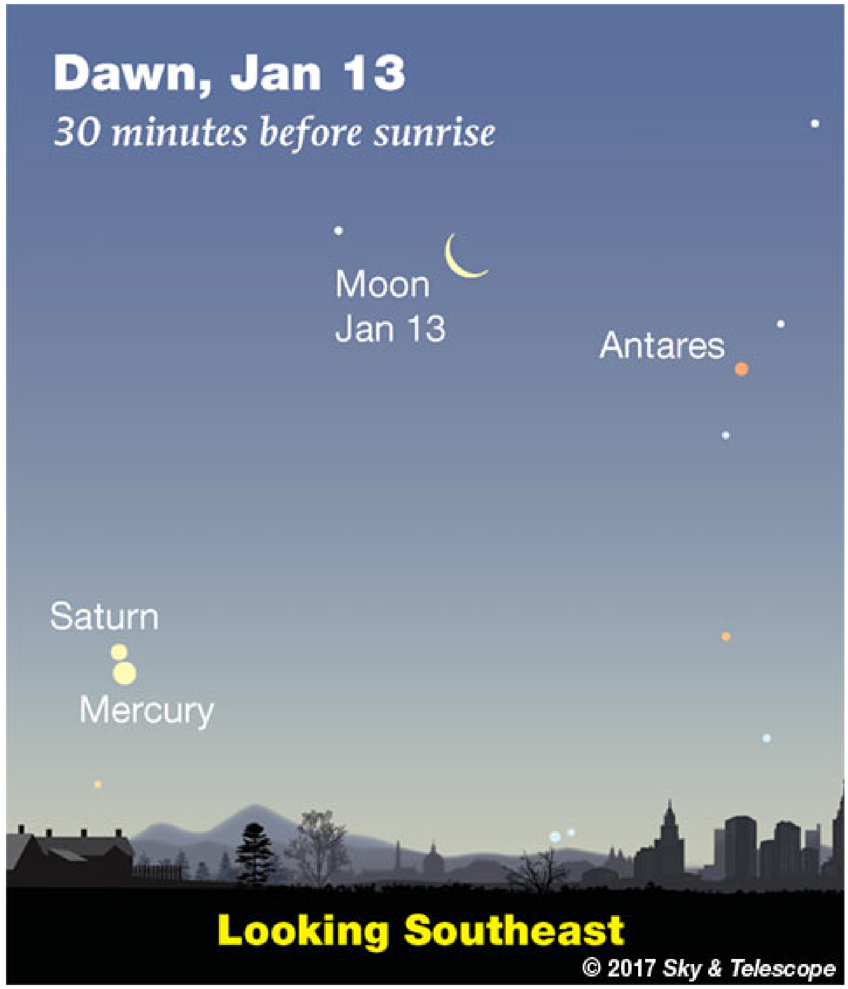
The Night Sky

Friday, January 12

• Sirius, the Dog Star, rises in the east-southeast around the end of twilight now, if you're near latitude 40° north (New York, Denver, Madrid, Athens). From such latitudes, Procyon — left of Sirius, by 2½ fists at arm's length — precedes it up; "Procyon" is from the ancient Greek for "before the dog."

• The eclipsing binary star Algol should be at its minimum brightness, magnitude 3.4 instead of its usual 2.1, for a couple hours centered on 9:45 p.m. EST. Algol takes several additional hours to fade and to rebrighten.

• As dawn brightens on Saturday the 13th, the waning crescent Moon hangs far to the lower left of Jupiter and Mars (outside the chart here), and upper left of Antares. Far to the Moon's lower left, near the southeast horizon, use binoculars to help find Mercury and Saturn. They're in conjunction about 0.8° apart (depending on your longitude).



Saturday, January 13

• Vega still twinkles quite low in the northwest after dusk. It’s sometimes called the Summer Star, but it’s way out of season now! It’ll soon be gone, to return to the evening sky next spring.

• In dawn on Sunday the 14th the Moon hangs above Mercury and Saturn, as shown in the series at right.

Sunday, January 14

• The Northern Cross in Cygnus, with Deneb at its top, plants itself nearly upright on the northwest horizon around 7 p.m. this week.

Monday, January 15

• In this coldest time of the year, the dim Little Dipper (Ursa Minor) hangs straight down from Polaris after dinnertime, as if, per Leslie Peltier, from a nail on the cold north wall of the sky. The Big Dipper, meanwhile, is creeping up low in the north-northeast. Its handle is very low and its bowl is to the upper right.

Tuesday, January 16

• After dinnertime, the enormous Andromeda-Pegasus complex runs from near the zenith down toward the western horizon.

Just west of the zenith, spot Andromeda's high foot: 2nd-magnitude Gamma Andromedae (Almach), slightly orange. Andromeda is standing on her head. About halfway down from the zenith to the west horizon is the Great Square of Pegasus, balancing on one corner. Down from its bottom corner run the stars outlining Pegasus's neck and head, ending at his nose: 2nd-magnitude Enif, due west and also slightly orange.

• New Moon (exact at 9:17 p.m. EST).

Source: Sky & Telescope Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Fri Jan 12, 6:08 AM	3 min	40°	18° above NNW	26° above E
Sat Jan 13, 5:18 AM	1 min	24°	24° above NE	15° above ENE
Sat Jan 13, 6:51 AM	5 min	40°	10° above WNW	16° above SSE
Sun Jan 14, 6:00 AM	3 min	85°	36° above NW	24° above SE
Mon Jan 15, 5:10 AM	1 min	36°	36° above E	20° above ESE
Mon Jan 15, 6:43 AM	4 min	16°	10° above W	10° above S
Tue Jan 16, 5:53 AM	3 min	31°	31° above WSW	11° above SSE

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

NASA-TV Highlights

(all times Eastern Daylight Time)

Friday, January 12

2 p.m. - Replay of SpaceCast Weekly (all channels)

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

11 p.m. - Replay of SpaceCast Weekly (NTV-1 (Public))

Saturday, January 13

4:30 a.m. - Coverage of the Departure of the SpaceX/Dragon CRS-13 Cargo Craft from the ISS (Release scheduled at 5 a.m. EST) (all channels)

Tuesday, January 16

4 p.m. - RS-25 Engine Fire Test from Stennis Space Center (all channels)

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

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Space Calendar

- Jan 12 - UPDATED [Jan 09] Irivine 01 PSLV-XL Launch
- Jan 12 - Moon Occults Asteroid 4 Vesta
- Jan 12 - Comet 250P/Larson Closest Approach To Earth (1.253 AU)
- Jan 12 - Comet C/2017 Y1 (PANSTARRS) Closest Approach To Earth (3.005 AU)
- Jan 12 - Comet 57P/du Toit-Neujmin-Delporte At Opposition (4.076 AU)
- Jan 12 - Comet 57P-A/du Toit-Neujmin-Delporte At Opposition (4.076 AU)
- Jan 12 - Comet 320P/McNaught At Opposition (4.191 AU)
- Jan 12 - Asteroid 7470 Jabberwock Closest Approach To Earth (1.353 AU)
- Jan 12 - Apollo Asteroid 25143 Itokawa Closest Approach To Earth (1.421 AU)
- Jan 12 - Asteroid 6000 United Nations Closest Approach To Earth (1.741 AU)
- Jan 12 - Asteroid 1489 Attila Closest Approach To Earth (2.026 AU)
- Jan 13 - NEW [Jan 09] LKW 3/ Saudisat 5B CZ-2D Launch
- Jan 13 - Dwarf Planet Ceres Occults TYC 1958-00094-1 (11.7 Magnitude Star)
- Jan 13 - Asteroid 4125 Lew Allen Closest Approach To Earth (1.170 AU)
- Jan 13 - Asteroid 3001 Michelangelo Closest Approach To Earth (1.243 AU)
- Jan 13 - Asteroid 2200 Pasadena Closest Approach To Earth (1.364 AU)
- Jan 13 - Asteroid 2867 Steins Closest Approach To Earth (1.731 AU)
- Jan 13 - 25th Anniversary (1993), STS-54 Launch (Space Shuttle Endeavour, TDRS-F)
- Jan 14 - Comet 217P/LINEAR At Opposition (1.414 AU)
- Jan 14 - Comet 347P/PANSTARRS At Opposition (2.693 AU)
- Jan 14 - Comet P/2005 L1 (McNaught) At Opposition (3.823 AU)
- Jan 14 - Comet 88P/Howell At Opposition (3.876 AU)
- Jan 14 - Aten Asteroid 2017 YU3 Near-Earth Flyby (0.046 AU)
- Jan 14 - Amor Asteroid 2017 YA6 Near-Earth Flyby (0.087 AU)
- Jan 14 - Asteroid 736 Harvard Closest Approach To Earth (1.473 AU)
- Jan 14 - Asteroid 342431 Hilo Closest Approach To Earth (1.731 AU)
- Jan 14 - Asteroid 21811 Burroughs Closest Approach To Earth (1.863 AU)
- Jan 14 - Asteroid 6042 Chesirecat Closest Approach To Earth (2.002 AU)
- Jan 14 - Asteroid 793 Arizona Closest Approach To Earth (2.075 AU)
- Jan 14 - 10th Anniversary (2008), MESSENGER, 1st Mercury Flyby
- Jan 14 - Shannon Lucid's 75th Birthday (1943)
- Jan 15 - Aten Asteroid 2007 WM3 Near-Earth Flyby (0.098 AU)
- Jan 15 - Apollo Asteroid 1864 Daedalus Closest Approach To Earth (1.143 AU)
- Jan 15 - Asteroid 2912 Lapalma Closest Approach To Earth (1.246 AU)
- Jan 15 - Asteroid 12927 Pinocchio Closest Approach To Earth (1.257 AU)
- Jan 15 - Apollo Asteroid 3838 Epona Closest Approach To Earth (1.267 AU)
- Jan 15 - Asteroid 12524 Conscience Closest Approach To Earth (1.654 AU)
- Jan 15 - 45th Anniversary (1973), Luna 21 Moon Landing (USSR Moon Rover Mission - Lunokhod 2)
- Jan 16 - UPDATED [Jan 09] ASNARO-2 Epsilon 2 Launch
- Jan 16 - Comet 324P/La Sagra Closest Approach To Earth (2.528 AU)
- Jan 16 - Apollo Asteroid 438017 (2003 YO3) Near-Earth Flyby (0.071 AU)
- Jan 16 - Asteroid 7169 Linda Closest Approach To Earth (1.625 AU)
- Jan 16 - Asteroid 9951 Tyrannosaurus Closest Approach To Earth (1.738 AU)
- Jan 16 - Asteroid 159814 Saguaro Closest Approach To Earth (2.234 AU)
- Jan 16 - Anatoly Solovyev's 70th Birthday (1948)

Source: JPL Space Calendar

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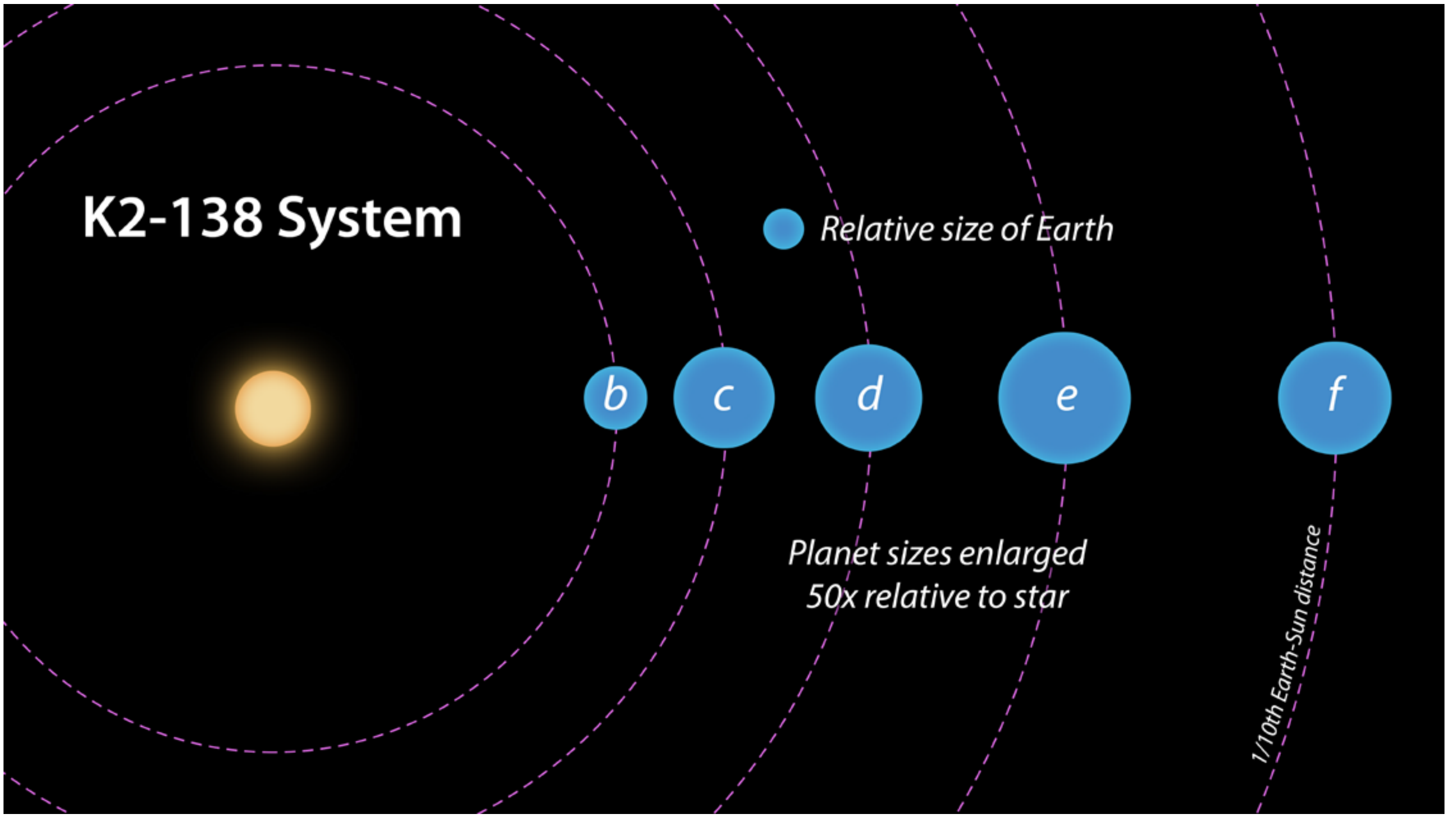
Food for Thought

Citizen Scientists Discover Five-Planet System



In its search for exoplanets -- planets outside of our solar system -- NASA's Kepler telescope trails behind Earth, measuring the brightness of stars that may potentially host planets.

The instrument identifies potential planets around other stars by looking for dips in the brightness of the stars that occur when planets cross in front of, or transit, them. Typically, computer programs flag the stars with these brightness dips, then astronomers look at each one and decide whether or not they truly could host a planet candidate.

Over the three years of the K2 mission, 287,309 stars have been observed, and tens of thousands more roll in every few months. So how do astronomers sift through all that data?

Enter the Exoplanet Explorers citizen scientist project, developed by UC Santa Cruz astronomer Ian Crossfield and Caltech staff scientist Jessie Christiansen. Exoplanet Explorers is hosted on Zooniverse, an online platform for crowdsourcing research.

"People anywhere can log on and learn what real signals from exoplanets look like, and then look through actual data collected from the Kepler telescope to vote on whether or not to classify a given signal as a transit, or just noise," says Christiansen. "We have each potential transit signal looked at by a minimum of 10 people, and each needs a minimum of 90 percent of 'yes' votes to be considered for further characterization."

In early April, just two weeks after the initial prototype of Exoplanet Explorers was set up on Zooniverse, it was featured in a three-day event on the ABC Australia television series Stargazing Live. In the first 48 hours after the project was introduced, Exoplanet Explorers received over 2 million classifications from more than 10,000 users. Included in that search was a brand-new dataset from the K2 mission -- the reincarnation of the primary Kepler mission, ended three years ago. K2 has a whole new field of view and crop of stars around which to search for planets. No professional astronomer had yet looked through this dataset, called C12.

Back in California, Crossfield and Christiansen joined NASA astronomer Geert Barentsen, who was in Australia, in examining results as they came in. Using the depth of the transit curve and the periodicity with which it appears, they made estimates for how large the potential planet is and how close it orbits to its star. On the second night of the show, the researchers discussed the demographics of the planet candidates found so far -- 44 Jupiter-sized planets, 72 Neptune-sized, 44 Earth-sized, and 53 so-called Super Earth's, which are larger than Earth but smaller than Neptune.

"We wanted to find a new classification that would be exciting to announce on the final night, so we were originally combing through the planet candidates to find a planet in the habitable zone -- the region around a star where liquid water could exist," says Christiansen. "But those can take a while to validate, to make sure that it really is a real planet and not a false alarm. So, we decided to look for a multi-planet system because it's very hard to get an accidental false signal of several planets."

After this decision, Barentsen left to get a cup of tea. By the time he returned, Christiansen had sorted the crowdsourced data to find a star with multiple transits and discovered a star with four planets orbiting it. Three of the four planets had 100 percent "yes" votes from over 10 people, and the remaining one had 92 percent "yes" votes. This is the first multi-planet system of exoplanets discovered entirely by crowdsourcing.

After the discovery was announced on Stargazing Live, Christiansen and her colleagues continued to study and characterize the system, dubbed K2-138. They statistically validated the set of planet signals as being "extremely likely," according to Christiansen, to be signals from true planets. They also found that the planets are orbiting in an interesting mathematical relationship called a resonance, in which each planet takes almost exactly 50 percent longer to orbit the star than the next planet further in. The researchers also found a fifth planet on the same chain of resonances, and hints of a sixth planet as well. A paper describing the system has been accepted for publication in The Astronomical Journal, and Christiansen is speaking about K2-138 at this week's 231st meeting of the American Astronomical Society in Washington, DC.

This is the only system with a chain of unbroken resonances in this configuration, and may provide clues to theorists looking to unlock the mysteries of planet formation and migration.

"The clockwork-like orbital architecture of this planetary system is keenly reminiscent of the Galilean satellites of Jupiter," says Konstantin Batygin, assistant professor of planetary science and Van Nuys Page Scholar, who was not involved with the study. "Orbital commensurabilities among planets are fundamentally fragile, so the present-day configuration of the K2-138 planets clearly points to a rather gentle and laminar formation environment of these distant worlds."

"Some current theories suggest that planets form by a chaotic scattering of rock and gas and other material in the early stages of the planetary system's life. However, these theories are unlikely to result in such a closely packed, orderly system as K2-138," says Christiansen. "What's exciting is that we found this unusual system with the help of the general public."

Source: SpaceRef.com Return to Contents

Space Image of the Week

All the Glittering Stars

This Hubble Space Telescope image of a sparkling jewel box full of stars captures the heart of our Milky Way galaxy.

Aging red giant stars coexist with their more plentiful younger cousins, the smaller, white, Sun-like stars, in this crowded region of our galaxy’s ancient central hub, or bulge. Most of the bright blue stars in the image are likely recently formed stars located in the foreground, in the galaxy's disk. Astronomers studied 10,000 of these Sun-like stars in archival Hubble images over a nine-year period to unearth clues to our galaxy’s evolution.

The study revealed that the Milky Way’s bulge is a dynamic environment of variously aged stars zipping around at different speeds, like travelers bustling about a busy airport.

The researchers also found that the motions of bulge stars are different, depending on a star's chemical composition. Stars richer in elements heavier than hydrogen and helium have less disordered motions, but are orbiting around the galactic center faster than older stars that are deficient in heavier elements.

The image is a composite of exposures taken in near-infrared and visible light with Hubble's Wide Field Camera 3. The observations are part of two Hubble surveys: the Galactic Bulge Treasury Program and the Sagittarius Window Eclipsing Extrasolar Planet Search.
The center of our galaxy is about 26,000 light-years away.

Image Credit: NASA, ESA, and T. Brown (STScI)

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