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Space Image of the Week
One year ago, on March 6, 2015, NASA's Dawn spacecraft slid gently into orbit around Ceres, the largest body in the asteroid belt between Mars and Jupiter. Since then, the spacecraft has delivered a wealth of images and other data that open an exciting new window to the previously unexplored dwarf planet.

"Ceres has defied our expectations and surprised us in many ways, thanks to a year's worth of data from Dawn. We are hard at work on the mysteries the spacecraft has presented to us," said Carol Raymond, deputy principal investigator for the mission, based at NASA's Jet Propulsion Laboratory, Pasadena, California.

Among Ceres' most enigmatic features is a tall mountain the Dawn team named Ahuna Mons. This mountain appeared as a small, bright-sided bump on the surface as early as February 2015 from a distance of 29,000 miles (46,000 kilometers), before Dawn was captured into orbit. As Dawn circled Ceres at increasingly lower altitudes, the shape of this mysterious feature began to come into focus. From afar, Ahuna Mons looked to be pyramid-shaped, but upon closer inspection, it is best described as a dome with smooth, steep walls.

Dawn's latest images of Ahuna Mons, taken 120 times closer than in February 2015, reveal that this mountain has a lot of bright material on some of its slopes, and less on others. On its steepest side, it is about 3 miles (5 kilometers) high. The mountain has an average overall height of 2.5 miles (4 kilometers). It rises higher than Washington's Mount Rainier and California's Mount Whitney.

Scientists are beginning to identify other features on Ceres that could be similar in nature to Ahuna Mons, but none is as tall and well-defined as this mountain.

"No one expected a mountain on Ceres, especially one like Ahuna Mons," said Chris Russell, Dawn's principal investigator at the University of California, Los Angeles. "We still do not have a satisfactory model to explain how it formed."

About 420 miles (670 kilometers) northwest of Ahuna Mons lies the now-famous Occator Crater. Before Dawn arrived at Ceres, images of the dwarf planet from NASA's Hubble Space Telescope showed a prominent bright patch on the surface. As Dawn approached Ceres, it became clear that there were at least two spots with high reflectivity. As the resolution of images improved, Dawn revealed to its earthly followers that there are at least 10 bright spots in this crater alone, with the brightest area on the entire body located in the center of the crater. It is not yet clear whether this bright material is the same as the material found on Ahuna Mons.

"Dawn began mapping Ceres at its lowest altitude in December, but it wasn't until very recently that its orbital path allowed it to view Occator's brightest area. This dwarf planet is very large and it takes a great many orbital revolutions before all of it comes into view of Dawn's camera and other sensors," said Marc Rayman, Dawn's chief engineer and mission director at JPL.

Researchers will present new images and other insights about Ceres at the 47th Lunar and Planetary Science Conference, during a press briefing on March 22 in The Woodlands, Texas.

Source: JPL
2. Mercury's Carbon-Rich Crust is Surprisingly Ancient

Before its planned crash into Mercury last year, NASA's MESSENGER spacecraft gave scientists a parting gift.

In its final orbits, MESSENGER not only confirmed that Mercury's dark hue is due to carbon, but also revealed that the carbon wasn’t deposited by impacting comets, as some researchers suspected.

Instead, scientists now believe they are seeing remnants of the planet’s primordial crust, which likely formed when a global ocean of superheated magma cooled, allowing minerals to solidify.

Computer simulations and experiments show that most of these crystallized minerals would sink -- with one key exception. Graphite, the studies show, would float.

Scientists used an instrument on MESSENGER called a neutron spectrometer to make low-altitude measurements of the darkest regions on the planet’s surface, which were suspected of having the most low-reflectance material (LRM.)

“The measurements showed enhanced fluxes of thermal neutrons over three areas of LRM, so only graphite as the darkening agent fits both the spectral reflectance observations and the neutron measurements,” MESSENGER’s lead scientist Sean Solomon, with Columbia University, wrote in an email to Discovery News.

Scientists also were able to match the carbon-rich material with large impact craters, evidence that the material stemmed from deep within Mercury's crust and was exposed after an impacting body gouged out a crater.

“Because LRM deposits on Mercury are all associated with material excavated from depth by large impact craters, they must come from the mid to lower crust,” Solomon said.

Scientists estimate the ancient crust was about .62 mile, or 1 kilometer, thick.

The crust of present-day Mercury has been bashed by impacts, covered with lava, melted and otherwise disturbed.

“The processes ... would dilute any primordial crust,” physicist Patrick Peplowski, with Johns Hopkins University Applied Physics Lab, and colleagues write in a paper published this week in Nature Geoscience.
The finding also reinforces theories that Mercury's birthplace had higher concentrations of carbon than where the rest of the inner planets formed.

“This inference adds to our deepening appreciation that Mercury formed from a portion of the early solar nebula that was chemically much more reduced and was rich in other volatiles (such as sulfur, sodium, potassium and chlorine) compared with the portions of the nebula well sampled by Venus, Earth and Mars,” Solomon said.

Source: Discovery News
3. A Perfectly Still Laboratory in Space

Following a long series of tests, ESA’s LISA Pathfinder has started its science mission to prove key technologies and techniques needed to observe gravitational waves from space.

Predicted by Albert Einstein a century ago, gravitational waves are fluctuations in the fabric of spacetime produced by exotic astronomical events such as supernova explosions or the merging of two black holes.

Recently, the first direct detection of these waves inaugurated the era of gravitational astronomy.

A future observatory in space, sensitive to gravitational waves with longer wavelengths than those detected on the ground, would be an essential tool to exploit this new field of study by probing some of the most massive and powerful objects in the Universe.

With LISA Pathfinder, scientists and engineers are testing the technology needed to extend the quest for gravitational waves to space.

In particular, LISA Pathfinder is designed to achieve the purest-known ‘freefall’, the extremely challenging condition necessary to build such an observatory. To do so, the team released two test masses – a pair of identical 2 kg gold-platinum cubes measuring 46 mm – inside the spacecraft and is now verifying that they are truly moving under the effect of gravity alone.

This is by no means trivial: even in space, there are forces capable of disturbing the cubes, including the radiation and wind from the Sun, and they need be isolated from all of these non-gravitational influences. To do so, LISA Pathfinder continually measures their positions and manoeuvres around them with microthrusters to avoid ever touching them.
“As they fall freely through space, the two test masses should be extraordinarily still, since no other force is perturbing their gravitational motion – only a gravitational wave could jiggle them around,” explains Stefano Vitale of University of Trento and INFN, Italy, Principal Investigator of the LISA Technology Package, the mission’s core payload.

LISA Pathfinder, however, is not capable of detecting gravitational waves itself. For this crucial technology demonstration, the two freefalling cubes are only 38 cm apart – too close to record the minute wobbles in the fabric of spacetime.

The variation in distance caused by a passing gravitational wave is so small that a full-scale space observatory will need test masses separated by roughly a million kilometres, and be able to detect changes in that separation of about one millionth of a millionth of a metre.

“The precision we need to attain for future observations of gravitational waves from space is so high that it demands an unprecedented understanding of the physical forces at play on the test masses,” says Paul McNamara, ESA’s Project Scientist.

Click here to view the mission overview video.

Source: ESA
The Night Sky

Tuesday, March 8

• Jupiter is at opposition. Jupiter is the brightest light in the east these evenings, next to the faint hind foot of Leo. The rest of Leo extends to its upper right.


Webcasts are planned by Exploratorium (7 to 10:15 p.m. March 8th EST; 0:00 to 3:15 March 9 UT), by Slooh (6 to 9 p.m. EST), and on NASA TV (starting 8 p.m. EST; totality at the camera's site will be from 8:38 to 8:42 p.m. EST).

The eclipse is partial across much of East Asia, parts of Australia, and the Pacific including Hawai`i, where the partial eclipse happens during the hour before sunset.

Wednesday, March 9

• To telescope users, Gemini is known for its double star Castor and for the Clown Face Nebula, the planetary nebula NGC 2392. But maybe you didn't know about its four fine open clusters. And what about the asterism O’Neal 9? Explore them with Sue French's Deep-Sky Wonders article, chart and photos in the March Sky & Telescope, page 54.

For a deeper challenge, hunt the faint galaxies that peer through the Beehive Cluster with Ted Forte's Going Deep article, page 57.

Thursday, March 10

• Sirius now blazes due south on the meridian just as twilight fades away into night. Sirius is the bottom star of the equilateral Winter Triangle. The triangle's other two stars are orange Betelgeuse to Sirius's upper right (Orion's shoulder) and Procyon to Sirius's upper left.

Friday, March 11

• Just after dark, look for the crescent Moon low in the west. Upper right of it by about 14° are the leading stars of Aries. The brightest of them is 2nd-magnitude Hamal.

Upper left of the Moon by about the same distance (depending where you are) is 2.5-magnitude Menkar, Alpha Ceti.

Source: Sky & Telescope
ISS Sighting Opportunities

For Denver:

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

NASA-TV Highlights
(all times Eastern Daylight Time)

7 p.m., Tuesday, March 8 - 2016 Total Solar Eclipse - “Live Telescope Views” (Unedited/No Commentary (NTV-2 (Education))

8 p.m., Tuesday, March 8 - The Exploratorium Presents - Live Coverage of the 2016 Total Solar Eclipse from Micronesia (NTV-1 (Public), NTV-3 (Media))

1:30 p.m., Wednesday, March 9 - Video B-Roll Feed of ISS Expedition 48-49 Crew Training (Ivanishin, Rubins, Onishi) (all channels)

2 p.m., Wednesday, March 9 - ISS Expedition 48-49 Crew News Conference (Ivanishin, Rubins, Onishi) (all channels)

1 p.m., Thursday, March 10 - Smithsonian’s National Air & Space Museum Presents - “What’s New in Aerospace?” - Lunar Reconnaissance Orbiter Camera (NTV-1 (Public), NTV-2 (Education))

9:30 a.m., Friday, March 11 - ISS Expedition 47 In-Flight Interview with Commander Tim Kopra of NASA (starts at 9:45 a.m.) (all channels)

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

- Mar 08 - Cassini, Distant Flyby of Titan
- Mar 08 - Jupiter At Opposition
- Mar 08 - Comet 141P/Machholz At Opposition (1.630 AU)
- Mar 08 - Comet 141P-A/Machholz At Opposition (1.631 AU)
- Mar 08 - Comet 19P/Borrelly Closest Approach To Earth (2.298 AU)
- Mar 08 - Comet 25P/Garradd At Opposition (2.346 AU)
- Mar 08 - Comet 48P/Johnson At Opposition (3.791 AU)
- Mar 08 - Apollo Asteroid 2013 TX68 Near-Earth Flyby (0.033 AU)
- Mar 08 - [Mar 05] Apollo Asteroid 2016 ER1 Near-Earth Flyby (0.066 AU)
- Mar 08 - [Mar 06] Apollo Asteroid 2016 EB27 Near-Earth Flyby (0.088 AU)
- Mar 08 - Asteroid 9258 Johnpauljones Closest Approach To Earth (1.394 AU)
- Mar 08 - Asteroid 34901 Mauna Loa Closest Approach To Earth (2.140 AU)
- Mar 08 - 15th Anniversary (2001), STS-102 Launch (Space Shuttle Discovery, ISS)
- Mar 08 - 30th Anniversary (1986), Suisei, Comet Halley Flyby
- Mar 08 - 40th Anniversary (1976), Jilin Meteorite Fall in China
- Mar 09 - [Mar 05] Total Solar Eclipse (Visible in South Pacific)
- Mar 09 - Eutelsat 65 West A Ariane 5 Launch
- Mar 09 - Comet 73P-BB/Schwassmann-Wachmann Closest Approach To Earth (1.714 AU)
- Mar 09 - Comet P/2013 R3 (Catalina-PANSTARRS) At Opposition (2.880 AU)
- Mar 09 - Comet 130P/McNaught-Hughes At Opposition (3.81 AU)
- Mar 09 - Asteroid 115561 Frankherbert Closest Approach To Earth (1.769 AU)
- Mar 09 - Asteroid 878 Mildred Closest Approach To Earth (1.880 AU)
- Mar 09 - 5th Anniversary (2011), Space Shuttle Discovery Makes Its Final Landing (STS-133)
- Mar 09 - 30th Anniversary (1986), Vega 2, Comet Halley Flyby
- Mar 09 - 55th Anniversary (1961), Sputnik 9 Launch (Carried Dog Named Chernushka)
- Mar 09 - 55th Anniversary (1961), 1st Dummy Launched Into Space on Sputnik 9
- Mar 09 - Steve Ostro's 70th Birthday (1946)
- Mar 10 - IRNSS-1F PSLV-XL Launch
- Mar 10 - Mercury Passes 1.5 Degrees From Neptune
- Mar 10 - Comet 73P-AW/Schwassmann-Wachmann At Opposition (0.938 AU)
- Mar 10 - Comet C/2014 W2 (PANSTARRS) Perihelion (2.670 AU)
- Mar 10 - Comet P/2013 R3 (Catalina-PANSTARRS) Closest Approach To Earth (2.880 AU)
- Mar 10 - Comet C/2013 W2 (PANSTARRS) Closest Approach To Earth (4.190 AU)
- Mar 10 - Comet C/2014 G3 (PANSTARRS) At Opposition (4.585 AU)
- Mar 10 - [Mar 04] Apollo Asteroid 2016 EB1 Near-Earth Flyby (0.014 AU)
- Mar 10 - [Mar 06] Amor Asteroid 2016 EL27 Near-Earth Flyby (0.028 AU)
- Mar 10 - [Mar 05] Amor Asteroid 2016 ES1 Near-Earth Flyby (0.090 AU)
- Mar 10 - Asteroid 8084 Dallas Closest Approach To Earth (1.418 AU)
- Mar 10 - Asteroid 14967 Madrid Closest Approach To Earth (1.924 AU)
- Mar 10 - Asteroid 22903 Georgeclooney Closest Approach To Earth (2.026 AU)
- Mar 10 - Asteroid 274020 Skywalker Closest Approach To Earth (2.726 AU)
- Mar 10 - 10th Anniversary (2006), Mars Reconnaissance Orbiter, Mars Orbit Insertion
- Mar 10 - 30th Anniversary (1986), Sakigake, Comet Halley Flyby
- Mar 10 - Laurel Clark's 55th Birthday (1961)
- Mar 11 - Moon Occults Asteroid 21 Lutetia
- Mar 11 - Comet 16P/Brooks At Opposition (3.540 AU)
- Mar 11 - Curt Brown's 60th Birthday (1956)
- Mar 11 - Urbain Le Verrier's 205th Birthday (1811)

Source: JPL Space Calendar

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Food for Thought

Citizen Scientists Help NASA Researchers Understand Auroras

Space weather scientist Liz MacDonald has seen auroras more than five times in her life, but it was the aurora she didn’t see that affected her the most.

On the evening of Oct. 24, 2011, MacDonald was sitting in front of her computer at her home in Los Alamos, New Mexico. Forecasts predicted a geomagnetic storm would hit Earth that night and potentially create beautiful aurora. The aurora didn’t come to Los Alamos, but MacDonald was still amazed — not by any bright, dancing lights in the sky, but by the number of aurora-related tweets on her computer screen.

People across the eastern United States, from Alabama to Chicago, tweeted about seeing the aurora in real-time. This storm became one of the first wide-scale documentations of aurora activity with social media.

After witnessing the viral response, MacDonald, now at NASA’s Goddard Space Flight Center in Greenbelt, Maryland, founded Aurorasaurus — a citizen science project that tracks auroras through the project’s website, mobile apps and Twitter. For the first time, citizen science observations are being used in a concerted effort to track auroras in real-time.

Since inception, Aurorasaurus and its users have documented some of the biggest and recent aurora displays. In a study published online on March 3, 2016, in AGU’s Space Weather journal, the team found that citizen scientists are regularly able to spot auroras farther south of an area where prediction models indicated.

“Using these observations, we can make better short-term predictions of when and where the aurora is for aurora enthusiasts — and scientists,” said MacDonald.

Improving Science with Citizen Reports

Improving forecasts and studying auroras are important because auroras are features of geomagnetic storms. While geomagnetic storms can lead to beautiful auroras, they can also cause power outages and interrupt satellite systems. Though many satellites study the sun and near-Earth space environment responsible for auroras, predicting precisely where, when and how strongly the dancing natural light display — and the geomagnetic storm — will occur on Earth is challenging. One reason is because large geomagnetic storms occur infrequently so scientists do not have as much data on them.

Aurorasaurus can help provide more data points in the form of citizen science observations. Sky watchers can submit their aurora sightings directly to aurorasaurus.org or use the free Aurorasaurus mobile apps. The project also searches Twitter using keywords to find aurora-related tweets. Users can then confirm or deny
these crowdsourced tweets. The submitted observations and verified tweets are displayed on a global map showing real-time auroral visibility.

The map also includes a “view-line” that predicts where a person should see the aurora based on the National Oceanic and Atmospheric Administration’s OVATION Aurora Forecast Model. After a certain number of users have reported aurora sightings in a local area or near the view-line, Aurorasaurus sends out notifications to nearby registered users.

Citizen scientists have helped track auroras worldwide with their observations. On St. Patrick’s Day on March 17, 2015, many sky gazers around the world were entranced by a supersized geomagnetic storm — one of the biggest of the past decade — that lit the sky with red, purple and green auroras. Users from the United Kingdom, Germany, Poland and the northern to mid-United States, including Pennsylvania, Virginia and Colorado, reported more than 160 aurora sightings and verified more than 250 reports from Twitter. The project sent out 361 notifications during the St. Patrick’s Day storm.

After analyzing 500 citizen science aurora observations during March and April 2015 — encompassing the St. Patrick’s Day storm and several smaller storms — the team found that many people reported seeing the aurora further equatorward (that is, farther south in the Northern Hemisphere, and farther north in the Southern Hemisphere) than the OVATION Prime model suggests. The team now incorporates the citizen science observations to improve the aurora view-line on the project’s map.

"Without the citizen science observations, Aurorasaurus wouldn't have been able to improve our models of where people can see the aurora," said the study’s lead author, Nathan Case, a previous Aurorasaurus team member and now a senior research associate at Lancaster University, United Kingdom. "The team is very thankful for our community's dedication and are excited to have more people sign up."

More Participants, More Possibilities

With a larger number of actively participating users, Aurorasaurus can be a great research tool in other disciplines. For example, information scientists from Pennsylvania State University are analyzing Aurorasaurus as a prototype early warning system for emergency responders.

Although an aurora isn’t an emergency or dangerous, the phenomenon has similar qualities as emergencies that can happen without much notice and can be observed over a large area. When a certain number of users in an area report seeing an aurora via social media, the project sends out notifications to other registered users notifying them of the sight.

As part of the Aurorasaurus mission, the project also posts educational material such as blog posts on space weather, quizzes and infographics on their website. Users will also see a solar wind power graph that shows the level of auroral activity on Earth in the next hour.

“The short term vision for Aurorasaurus is to become an interactive hub for aurora enthusiasts at the intersection of citizens and science,” said MacDonald. “Long term, this engaged community can be sustained and evolve together — and the tools can be expanded to be useful in other disciplines within our technological society.”

Source: NASA
**Space Image of the Week**

**Mystery Feature Now Disappears in Titan Lake**

Image Credit: *Cassini Radar Mapper, Cornell, JPL, ESA, NASA*

**Explanation:** What is that changing object in a cold hydrocarbon sea of Titan? Radar images from the robotic *Cassini spacecraft* orbiting *Saturn* have been recording the surface of the cloud-engulfed moon *Titan* for years. When imaging the flat -- and hence radar dark -- surface of the methane and ethane lake called *Ligeia Mare*, an object appeared in 2013 July just was not there in 2007. Subsequent observations in 2014 August found the object remained -- but had changed. In an image released last week, the mystery object seems to have disappeared in 2015 January. The featured false-color image shows how the 20-km long object has come, changed, and gone. Current origin speculative explanations include waves, bubbling foam and floating solids, but still no one is sure. Future observations, in particular Cassini's final close flyby of Titan in 2017 April, may either resolve the enigma or open up more speculation.

Source: *APOD*