Space News Update

— January 3, 2017 —

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1. China's Lofty Space Ambitions Include 2018 Landing on Moon's Far Side

China's 60-ton medium-size space station is depicted in this artwork. Credit: CNSA

China's Information Office of the State Council on Tuesday (Dec. 27) released an expansive white paper on that country's space activities in 2016. The document also projected a look at China's space agenda over the coming years, a plan that includes a lunar sample-return mission and the first soft-landing on the far side of the moon in 2018.

In an associated press conference marking the release of the white paper, vice administrator of the China National Space Administration, Wu Yanhua, stated that China plans to develop a new generation of heavy-lift carrier rocket, the "Changzheng-9" or "Long March-9." That booster is intended for future manned lunar landing and deep space exploration missions, according to a report by the website Crienglish.com.

"There is an old saying in aerospace industry, 'If you want to develop space industry, you need to work on space rockets first; and if you want to develop space rockets, you need to work on its engines first," Wu said in the press conference. "So now we need to make progress in the heavy-lift carrier rocket's engine first, to create conditions for the whole project. It is planned that the heavy-lift carrier rocket's maiden flight will be held around 2030."

China's 5-year space plan

The wide-ranging white paper lays out the purpose of China's space program as well as its vision and principles of development. It also includes a summary of China's major developments in space since 2011, and the major tasks ahead for the next five years.

The document also includes policies and measures for development and the role of international exchanges and cooperation.

In terms of deep-space exploration, the white paper explains that China will continue its lunar exploration project, and strive to attain the automated extraterrestrial sampling and returning technology by space explorers.

Three strategic steps

"We plan to fulfill the three strategic steps of 'orbiting, landing and returning' for the lunar exploration project by launching the Chang'e-5 lunar probe by the end of 2017 and realizing regional soft landing, sampling and return. We will launch the Chang'e-4 lunar probe around 2018 to achieve humanity's first soft-landing on the far side of the

moon, and conduct an in-situ and rover detection and relay communications mission from the Earth-moon L2 point."

Also noted is that through China's lunar exploration project, topographic and geological surveys will be implemented and laboratory research conducted on lunar samples; geological survey and research as well as low-frequency radio astronomy observation and research will be carried out targeting the landing area on the far side of the moon for a better understanding of the formation and evolution of the moon.

Next lunar probe

At the press conference hosted by the State Council Information Office, Wu also detailed work underway on Chang'e-5, targeted for liftoff at the end of 2017.

"We will take samples from the surface of the moon as well as different depths of the moon rocks after drilling, and the samples will be used by scientists for scientific research," Wu said. Wu added that work related to Chang'e-5 is going smoothly.

Mars and beyond

Explained in the white paper is that China intends to execute its first Mars exploration operation, and grasp key technologies for orbiting, landing and roving exploration.

China plans to launch this Mars probe by 2020 to carry out orbiting and roving exploration. "It will conduct further studies and key technological research on the bringing back of samples from Mars, asteroid exploration, exploration of the Jupiter system and planet fly-by exploration. When conditions allow, related projects will be implemented to conduct research into major scientific questions such as the origin and evolution of the solar system, and search for extraterrestrial life," the paper explains.

Raising human spaceflight capacity

In the category of human spaceflight, the white paper notes that China plans to launch the Tianzhou-1 cargo spacecraft to dock with the now Earth-orbiting Tiangong-2 space laboratory, "and research and master key technologies for cargo transport and replenishment to accumulate experience in building and operating a space station."

"We strive to acquire key technologies and conduct experiments on such technologies," the paper continues, "to raise our manned spaceflight capacity, laying a foundation for exploring and developing cislunar space."

In June 2016, China's new Wenchang launch center on Hainan Island celebrated its first launch. Renovations have also been accomplished in the Jiuquan, Taiyuan and Xichang launch sites, "forming a launch site network covering both coastal and inland areas, high and low altitudes, and various trajectories to satisfy the launch needs of manned spaceships, space laboratory core modules, deep space probes and all kinds of satellites," the document explains. "The integrated capacities and functions of space launch sites will be enhanced and exploited to meet various needs."

Historical starting line

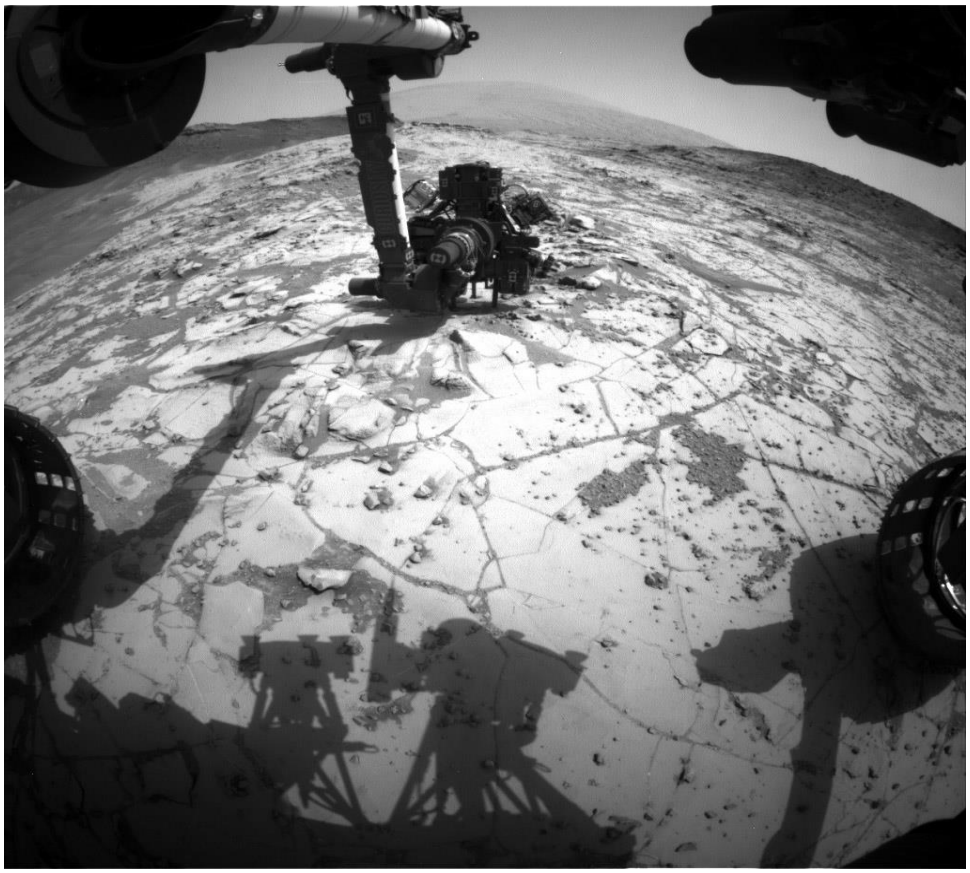
The white paper concludes by noting that the country is "standing at a new historical starting line," with China "determined to quicken the pace of developing its space industry, and actively carry out international space exchanges and cooperation."

Since 2011 China has signed 43 space cooperation agreements or memoranda of understanding with 29 countries, space agencies and international organizations.

To access the full white paper — "China's Space Activities in 2016"
visit: http://www.globaltimes.cn/content/1025885.shtml.

Source: Space.com Return to Contents

2. Internal Debris May Be Causing Problem with Mars Rover's Drill



This view from the wide-angle Hazard Avoidance Camera (Hazcam) on the front of NASA's Curiosity Mars Rover shows the rover's drill in position for a mini-drill test on Jan. 13, 2015. Credit: NASA/JPL-Caltech

Engineers suspect a piece of foreign object debris may be intermittently stalling a motor needed to place the Curiosity Mars rover's drill bit onto rocks, and the robot's ground team is assessing the source of the potential contamination.

More importantly, Curiosity project manager Jim Erickson said, engineers are spending the holidays crunching data from a series of diagnostic tests conducted in recent weeks to analyze the drill's behavior and determine a possible fix.

Curiosity is in its second extended mission — the rover's original primary mission phase ended in 2014 — on the lower flank of Mount Sharp, a three-mile-high (5-kilometer) peak towering over the floor of Gale Crater, the robot's landing site.

The rover's drill pulverizes material from inside Martian rocks into powder, and delivers the samples to two of Curiosity's main science instruments — the Sample Analysis at Mars payload and the Chemistry and Mineralogy package — to look for organic materials and measure mineral content.

Ground controllers believe the drill problem is rooted in a brake on the drill feed mechanism, which is supposed to extend and place the drill bit on the surface of target rocks.

When Curiosity goes in to drill into Martian rocks, the rover extends its robotic arm and two prongs on each side of the drill bit press against the target. The drill feed motor then engages to push the bit onto the rock, then percussive and rotating mechanisms start boring into the target to collect a powder sample.

Erickson told Spaceflight Now that the drill problem, first encountered Dec. 1, has cropped up off and on, but ground controllers have only commanded the motor to move in tiny increments in their testing.

Rover drivers at NASA's Jet Propulsion Laboratory in Pasadena, California, have also sent Curiosity on short trips and activated shakers inside the drill to test the feed motor's response to motion, Erickson told Spaceflight Now in JPL's "Mars yard" facility where engineers test out rover models in simulated Martian terrain. The shakers are normally used to sort the powder sample acquired by the drill.

Experts believe they found a pattern in the way the drill feed motor behaves over time, Erickson said, and the pattern observed so far matches what engineers would expect to see if a piece of foreign object debris, or FOD, was embedded somewhere inside the drill.

Erickson said the ground team is not sure of the source of the potential debris. It could be a piece of Martian soil or a pebble that somehow got into the mechanism and is gumming up the drill feed motor, or it might be something carried from Earth. "It some sense, it probably doesn't matter," Erickson said, detailing how engineers are focused, for now, on recovering use of the drill, one of the rover's primary tools.

He described a "fishbone" diagram used by the investigation team, with arrows splitting off pointing to FOD of terrestrial and Martian origin. Then there's another split in the fishbone, Erickson said, illustrating two more possibilities, assuming the contamination came from Earth. "Was it something that the rover carried from Earth from before the launch, or was it generated after the launch?" Erickson asked.

Parts inside the drill may have rubbed together over the last four years since Curiosity's landing on Mars in August 2012, creating shavings or fragments that are lodged inside the feed motor.

If operating the drill on Mars somehow created the FOD, engineers might be able to change the way they use the instrument, and improve the design of future drills, such as the device in development to fly on NASA's Mars 2020 rover, a spacecraft largely based on Curiosity's design and chassis.

Erickson said the rover team is still examining how to resume drilling with Curiosity, and it is too early to declare that engineers can fully correct the problem, or that the issue will prevent future drillings.

It may turn out that the stalled motor remains intermittent, he said, making it a nuisance for ground controllers commanding the rover, but not fatal for the future of the drill.

Engineers originally thought the problem might be rooted in an encoder associated with electrical sensors that tell the rover's computer how the drill is functioning. In a press conference Dec. 13, Curiosity project scientist Ashwin Vasavada said the problem apparently is with the brake, which is "very much internal to the motor itself."

Curiosity's drill works by boring into rock targets with a combination of a percussive, hammering motion and the rotation of the drill bit. Rock powder excavated by the drill goes into a collection chamber, where the material is sifted and sieved for delivery to miniature laboratory instruments on the rover's science deck.

The target selected for drilling in early December, when the drill feed problem first appeared, was to be the 16th rock drilled by the rover since it landed on Mars in August 2012. It would have been the seventh drilling operation of 2016, according to NASA.

Ground controllers programmed the drill to only use its rotating mechanism on the latest sampling attempt. The percussive mechanism that chisels into rock has had an intermittent electrical short since early 2015, and while that function is still available, officials prefer to avoid using it unless necessary.

Source: Spaceflightnow.com Return to Contents

3. NASA's NEOWISE Mission Spies One Comet, Maybe Two

An artist's rendition of 2016 WF9 as it passes Jupiter's orbit inbound toward the sun.
Credits: NASA/JPL-Caltech

NASA's NEOWISE mission has recently discovered some celestial objects traveling through our neighborhood, including one on the blurry line between asteroid and comet. Another--definitely a comet--might be seen with binoculars through next week.

An object called 2016 WF9 was detected by the NEOWISE project on Nov. 27, 2016. It's in an orbit that takes it on a scenic tour of our solar system. At its farthest distance from the sun, it approaches Jupiter's orbit. Over the course of 4.9 Earth-years, it travels inward, passing under the main asteroid belt and the orbit of Mars until it swings just inside Earth's own orbit. After that, it heads back toward the outer solar system. Objects in these types of orbits have multiple possible origins; it might once have been a comet, or it could have strayed from a population of dark objects in the main asteroid belt.

2016 WF9 will approach Earth's orbit on Feb. 25, 2017. At a distance of nearly 32 million miles (51 million kilometers) from Earth, this pass will not bring it particularly close. The trajectory of 2016 WF9 is well understood, and the object is not a threat to Earth for the foreseeable future.

A different object, discovered by NEOWISE a month earlier, is more clearly a comet, releasing dust as it nears the sun. This comet, C/2016 U1 NEOWISE, "has a good chance of becoming visible through a good pair of binoculars, although we can't be sure because a comet's brightness is notoriously unpredictable," said Paul Chodas, manager of NASA's Center for Near-Earth Object (NEO) Studies at the Jet Propulsion Laboratory in Pasadena, California.

As seen from the northern hemisphere during the first week of 2017, comet C/2016 U1 NEOWISE will be in the southeastern sky shortly before dawn. It is moving farther south each day and it will reach its closest

point to the sun, inside the orbit of Mercury, on Jan. 14, before heading back out to the outer reaches of the solar system for an orbit lasting thousands of years. While it will be visible to skywatchers at Earth, it is not considered a threat to our planet either.

NEOWISE is the asteroid-and-comet-hunting portion of the Wide-Field Infrared Survey Explorer (WISE) mission. After discovering more than 34,000 asteroids during its original mission, NEOWISE was brought out of hibernation in December of 2013 to find and learn more about asteroids and comets that could pose an impact hazard to Earth. If 2016 WF9 turns out to be a comet, it would be the 10th discovered since reactivation. If it turns out to be an asteroid, it would be the 100th discovered since reactivation.
What NEOWISE scientists do know is that 2016 WF9 is relatively large: roughly 0.3 to 0.6 mile (0.5 to 1 kilometer) across.

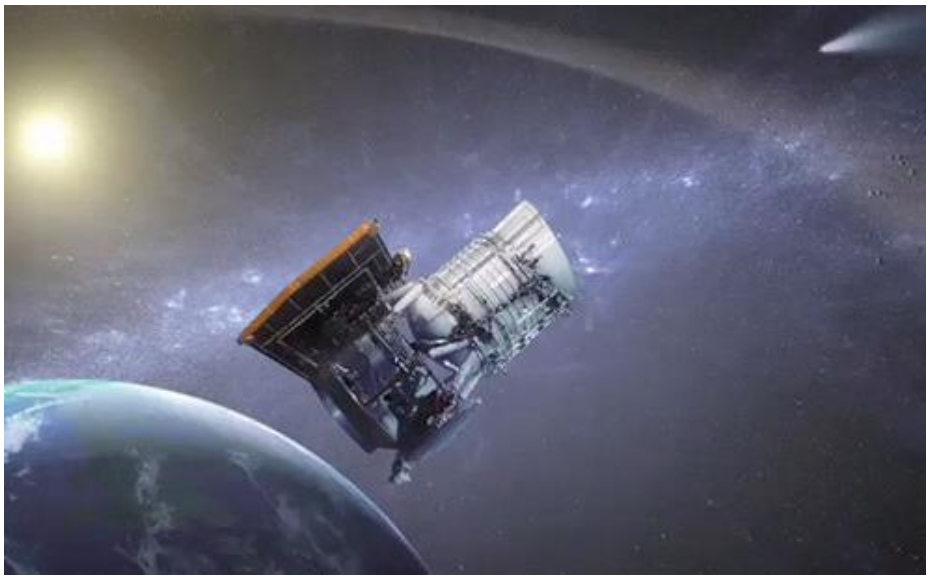
It is also rather dark, reflecting only a few percent of the light that falls on its surface. This body resembles a comet in its reflectivity and orbit, but appears to lack the characteristic dust and gas cloud that defines a comet.

"2016 WF9 could have cometary origins," said Deputy Principal Investigator James "Gerbs" Bauer at JPL. "This object illustrates that the boundary between asteroids and comets is a blurry one; perhaps over time this object has lost the majority of the volatiles that linger on or just under its surface."
Near-Earth objects (NEOs) absorb most of the light that falls on them and re-emit that energy at infrared wavelengths. This enables NEOWISE's infrared detectors to study both dark and light-colored NEOs with nearly equal clarity and sensitivity.

"These are quite dark objects," said NEOWISE team member Joseph Masiero, "Think of new asphalt on streets; these objects would look like charcoal, or in some cases are even darker than that."
NEOWISE data have been used to measure the size of each near-Earth object it observes.

Thirty-one asteroids that NEOWISE has discovered pass within about 20 lunar distances from Earth's orbit, and 19 are more than 460 feet (140 meters) in size but reflect less than 10 percent of the sunlight that falls on them.

The Wide-field Infrared Survey Explorer (WISE) has completed its seventh year in space after being launched on Dec. 14, 2009.



NEOWISE
Credit: NASA

Source: NASA

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The Night Sky

Tuesday, January 3

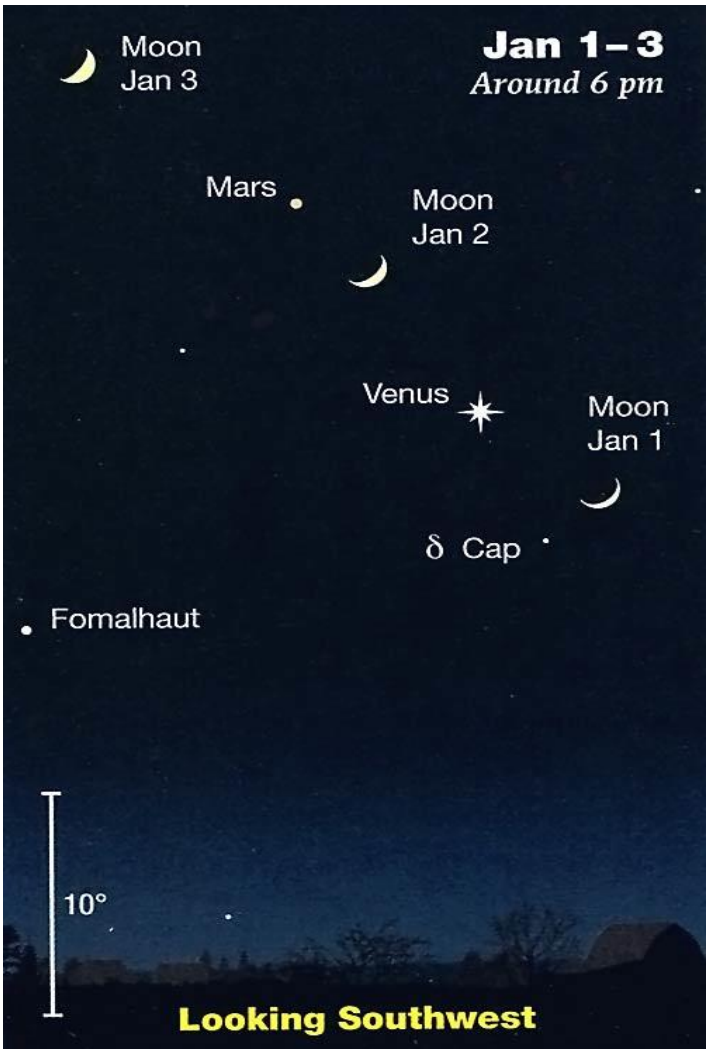
- Now the Moon stands upper left of Mars and Venus during and after dusk.

Wednesday, January 4

- In early evening at this time of year, the Great Square of Pegasus balances on one corner high in the west. The vast Andromeda-Pegasus constellation complex runs all the way from near the zenith (Andromeda's foot) down through the Great Square (Pegasus's body) to fairly low in the west (Pegasus's nose).

Thursday, January 5

- First-quarter Moon (exact at 2:47 p.m. EST). This evening, look to the right or upper right of the Moon for the Great Square of Pegasus. A diagonal through two corners of the Square points toward the Moon.
- Orion is now well up in the east-southeast after nightfall, with his three-star Belt nearly vertical. The Belt points up toward Aldebaran and, even higher, the Pleiades. In the other direction, it points down to where bright Sirius rises around 7 p.m.



As the new year begins, watch the waxing Moon step up eastward past Venus and Mars, as seen here just after dark.

Friday, January 6

- Look above the Moon this evening for the two or three brightest stars of Aries.
- This is the time of the year when Cassiopeia passes highest, just north of overhead, right after dark. When in th position, Cassiopeia is a flattened letter M.

Saturday, January 7

- Aldebaran shines well to the left of the waxing gibbous Moon this evening. Upper right of Aldebaran, spot the Pleiades through the moonlight.
- In this very 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.

Source: Sky and Telescope

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ISS Sighting Opportunities (from Denver)

Not Available

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

NASA-TV Highlights **(all times Eastern Time Zone)**

Tuesday, January 3

- 11 a.m. - ISS Expedition 50 In-Flight Interviews with the Associated Press and the CBS Radio Network with ISS Commander Shane Kimbrough and Flight Engineer Peggy Whitson of NASA (starts at 11:20 a.m.) (all channels)

Wednesday, January 4

- 2 p.m. - ISS Expedition 50 Spacewalk Preview Briefing (all channels)

Friday, January 6

- 5:30 a.m. - Coverage of ISS Expedition 50 U.S. EVA # 38 (Kimbrough and Whitson; spacewalk scheduled to begin at 7:05 a.m. ET; will last appx. 6 ½ hours) (all channels)

Watch NASA TV online by going to the NASA website.

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Space Calendar

- Jan 03 - Moon Occults Mars
- Jan 03 - Moon Occults Neptune
- **Jan 03 - Quadrantids Meteor Shower Peak**
- Jan 03 - Comet 323P/SOHO Closest Approach To Earth (0.374 AU)
- Jan 03 - Comet P/2015 TP200 (LINEAR) At Opposition (2.449 AU)
- Jan 03 - Apollo Asteroid 410777 (2009 FD) Closest Approach To Earth (1.363 AU)
- Jan 03 - Asteroid 4987 Flamsteed Closest Approach To Earth (1.371 AU)
- Jan 03 - Asteroid 39382 Opportunity Closest Approach To Earth (2.308 AU)
- Jan 03 - 140th Anniversary (1877), Warrenton Meteorite Fall (Hit a Tree in Missouri)
- Jan 04 - Earth At Perihelion (0.983 AU From Sun)
- Jan 04 - Comet 319P/Catalina-McNaught At Opposition (3.599 AU)
- Jan 04 - Asteroid 3616 Glazunov Occults HIP 49583 (3.5 Magnitude Star)
- Jan 04 - Apollo Asteroid 2016 YB8 Near-Earth Flyby (0.030 AU)
- Jan 04 - Apollo Asteroid 2016 XK Near-Earth Flyby (0.043 AU)
- Jan 04 - Kuiper Belt Object 230965 (2004 XA192) At Opposition (34.629 AU)
- Jan 04 - 125th Anniversary (1892), 1st Photograph of Aurora Borealis Taken by Martin Brendel
- **Jan 04-07 - National Radio Science Meeting (NRSM), Boulder, Colorado**
- Jan 05 - Comet 143P/Kowal-Mrkos At Opposition (2.912 AU)
- Jan 05 - Asteroid 10799 Yucatan Closest Approach To Earth (1.545 AU)
- Jan 05 - Asteroid 15318 Innsbrook Closest Approach To Earth (1.838 AU)
- Jan 05 - 45th Anniversary (1972), President Nixon Approves Space Shuttle Program
- Jan 06 - Comet 73P-U/Schwassmann-Wachmann Closest Approach To Earth (1.931 AU)
- Jan 06 - Comet 127P/Holt-Olmstead At Opposition (1.963 AU)
- Jan 06 - Comet 74P/Smirnova-Chernykh At Opposition (2.789 AU)
- Jan 06 - Comet 249P/LINEAR At Opposition (3.100 AU)
- Jan 06 - Apollo Asteroid 2016 XJ2 Near-Earth Flyby (0.072 AU)
- Jan 06 - Asteroid 5634 Victorborge Closest Approach To Earth (1.342 AU)
- Jan 06 - Asteroid 896 Sphinx Closest Approach To Earth (1.621 AU)
- **Jan 07 - Iridium NEXT 1-10 Falcon 9 Launch**
- Jan 07 - Comet P/2015 TO19 (Lemmon-PANSTARRS) Closest Approach To Earth (2.448 AU)
- Jan 07 - Comet 197P/LINEAR At Opposition (2.623 AU)
- Jan 07 - Apollo Asteroid 85990 (1999 JV6) Near-Earth Flyby (0.069 AU)

Source: JPL Space Calendar

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Food for Thought

Space Shredder: Sun May Be Tearing Asteroids Apart

An artist's illustration of an asteroid breaking apart in space. A new study suggests this might be the fate of the asteroid 3200 Phaethon. Credit: NASA/JPL-Caltech

With a cloud of trailing debris, a rocky object known as 3200 Phaethon straddles the line between asteroid and comet. But the space rock's days, it seems, might be numbered.

New research suggests that the sun may be slowly shredding Phaethon to pieces due to its close orbit. The same may be happening to another close-orbiting object.

"Phaethon may be a breakup in slow motion," Paul Wiegert, an astronomer at the University of Western Ontario in Canada, said at the Division of Planetary Sciences meeting in Pasadena, California. Wiegert used the Canadian Meteor Orbit Radar (CMOR) to track bodies 1 meter (3.3 feet) wide and smaller. As Phaethon orbits the sun, it appears to be breaking apart and then reforming, Weigert's study found.

Asteroid on the brink

As 3200 Phaethon orbits the sun, it comes closer than any other named asteroid, occasionally traveling half as far away as the orbit of Mercury (which on average is about 35 million miles, or 58 million kilometers) before returning nearly as far out as Earth (which orbits at 93 million miles, or 150 million km). Along the way, the space rock drops off the material that feeds the Geminid meteor shower that peaks in December.

In 2010, scientists realized that Phaethon displayed characteristics similar to a comet as well as an asteroid, producing a tail of material that led to its classification as an active asteroid. Some active asteroids are suspected of forming tails like comets, because they have ice beneath the surface, but Wiegert proposed that Phaethon's debris trail instead results from the rock's sun-skirting orbit.

For nearly two decades, astronomers thought the near-Earth objects (NEOs) that strayed too close to the sun wound up swallowed by the star. Earlier this year (2016), however, Mikael Granvik, an astronomer at the University of Helsinki, revealed that many asteroids instead break into pieces when they spend too much time in the region of space within 10 times the sun's diameter.

Granvik's research suggests the catastrophic breakups of asteroids happen too far away to be explained by tidal effects from the sun. While the precise method remains uncertain, he and his colleagues proposed three possibilities.

Asteroids could be heated by the sun and thus crack, releasing grains that the solar radiation then strips. Another explanation is that solar particles or energy released as material jumps from solid to gas could cause asteroids to rapidly spin until gravity can no longer hold them together. The third option is that volatile materials jumping from solid to gas could create enough pressure to blow the asteroid up from within.

Tracking asteroid breakups

Wiegert and his colleagues used several years of observations taken by CMOR to examine whether the environment around the sun showed signs of super-catastrophic asteroid disruption. They found that the kilometer-size (0.6 miles) asteroids break up into surprisingly small chunks of debris.

"Asteroids don't break up into meter-sized chunks," Weiser said. "Any meter-sized bodies delivered by near-Earth asteroids are soon destroyed as well."

Instead, the material breaks into millimeter-size (0.04 inches) pieces that continue to orbit the sun, the researchers found.

That means an asteroid like Phaethon could be slowly tearing itself apart as it draws too close to the sun. When in a close orbit, such a rock begins to collapse, but as it moves away, it could be coalescing again.

"It may be an asteroid going to the brink [of catastrophic breakup] and then retreating," Wiegert said.

Still, the observations can't confirm the asteroid's slow breakup, he said. It is still possible that Phaethon acts like a comet, with icy material trailing off the surface to create the debris cloud, Wiegert said.

Phaethon isn't the only oddity. At the same conference, Granvik presented evidence that the Comet 322P/SOHO 1 may also be suffering from super-catastrophic disruption. "The question is, 'Is this a really a comet?'" Granvik said. Earlier this year, a team of scientists published research suggesting the comet may actually be an asteroid.

Although the object is active, observations suggest that it is denser than any known comet and that its activity is driven by a different process than other comets, whose tails form as they lose ice.

Phaethon and 322P aren't enough to satisfy Granvik, he said, explaining that he and his colleagues are working to identify other potentially disrupted asteroids in the process of falling apart.

"You always want more," he said.

Source: Space.com Return to Contents

Space Image of the Week

The Magnificent Horsehead Nebula

Image Credit & Copyright: Marco Burali, Tiziano Capecchi, Marco Mancini (Osservatorio MTM)

Explanation: Sculpted by stellar winds and radiation, a magnificent interstellar dust cloud by chance has assumed this recognizable shape. Fittingly named the Horsehead Nebula, it is some 1,500 light-years distant, embedded in the vast Orion cloud complex. About five light-years "tall", the dark cloud is cataloged as Barnard 33 and is visible only because its obscuring dust is silhouetted against the glowing red emission nebula IC 434. Stars are forming within the dark cloud. Contrasting blue reflection nebula NGC 2023, surrounding a hot, young star, is at the lower left. The gorgeous color image combines both narrowband and broadband images recorded using three different telescopes.

Source: NASA APOD

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