Space News Update
— March 19, 2019 —

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1. A Prehistoric Puzzle in the Kuiper Belt

The farthest object ever explored is slowly revealing its secrets, as scientists piece together the puzzles of Ultima Thule – the Kuiper Belt object NASA’s New Horizons spacecraft flew past on New Year’s Day, four billion miles from Earth.

Analyzing the data New Horizons has been sending home since the flyby of Ultima Thule (officially named 2014 MU69), mission scientists are learning more about the formation, geology and composition of this ancient relic of solar system formation. The team discussed those findings today at the 50th Lunar and Planetary Science Conference in The Woodlands, Texas.

Ultima Thule is the first unquestionably primordial contact binary ever explored. Approach pictures of Ultima Thule hinted at a strange, snowman-like shape for the binary, but further analysis of images, taken near closest approach – New Horizons came to within just 2,200 miles (3,500 kilometers) – have uncovered just how unusual the KBO’s shape really is. At 22 miles (35 kilometers) long, Ultima Thule consists of a large, flat lobe (nicknamed “Ultima”) connected to a smaller, rounder lobe (nicknamed “Thule”).

This strange shape is the biggest surprise, so far, of the flyby. “We’ve never seen anything like this anywhere in the solar system,” said New Horizons Principal Investigator Alan Stern, of the Southwest Research Institute, Boulder, Colorado. “It is sending the planetary science community back to the drawing board to understand how planetesimals – the building blocks of the planets – form.”

Because it is so well preserved, Ultima Thule is offering our clearest look back to the era of planetesimal accretion and the earliest stages of planetary formation. Apparently Ultima Thule’s two lobes once orbited each other, like many so-called binary worlds in the Kuiper Belt, until something brought them together in a “gentle” merger.
“This fits with general ideas of the beginning of our solar system,” said William McKinnon, a New Horizons co-investigator from Washington University in St. Louis. “Much of the orbital momentum of the Ultima Thule binary must have been drained away for them to come together like this. But we don’t know yet what processes were most important in making that happen.”

That meeting may have left its mark on the surface. The “neck” connecting Ultima and Thule is bent, and could indicate shearing as the lobes combined, said Kirby Runyon, a New Horizons science team member from the Johns Hopkins Applied Physics Laboratory in Laurel, Maryland.

Runyon and fellow team geologists are describing and trying to understand Ultima Thule’s many surface features, from bright spots and patches, to hills and troughs, to craters and pits. The craters, while at first glance look like impact craters, could have other origins. Some may be pit craters, where material drains into underground cracks, or a result of sublimation, where ice went directly from solid to gas and left pits in its place. The largest depression is a 5-mile-wide (8 kilometer) feature the team has nicknamed Maryland crater. It could be an impact crater, or it could have formed in one of the other above-mentioned ways.

“We have our work cut out to understand Ultima Thule’s geology, that is for sure,” Runyon said.

In color and composition, New Horizons data revealed that Ultima Thule resembles many other objects found in its region of the Kuiper Belt. Consistent with pre-flyby observations from the Hubble Telescope, Ultima Thule is very red – redder even than Pluto, which New Horizons flew past on the inner edge of the Kuiper Belt in 2015 – and about the same color as many other so-called “cold classical” KBOs. (“Cold” referring not to temperature but to the circular, uninclined orbits of these objects; “classical” in that their orbits have changed little since forming, and represent a primordial sample of the primordial Kuiper Belt.)

“This is the first time one of these ‘ultra red’ objects has been explored, and our observations open all kinds of new questions,” said Carly Howett, a New Horizons science team member from SwRI. “The color imaging even reveals subtle differences in coloration across the surface, and we really want to know why.”

New Horizons scientists have also seen evidence for methanol, water ice and organic molecules on the surface. “The spectrum of Ultima Thule is similar to some of the most extreme objects we’ve seen in the outer solar system,” said Silvia Protopapa, a New Horizons co-investigator from SwRI. “So New Horizons is giving us an incredible opportunity to study one of these bodies up close.”

The Ultima Thule data transmission continues, though all of the data from the flyby won’t be on the ground until late summer 2020. In the meantime, New Horizons continues to carry out distant observations of additional Kuiper Belt objects and mapping the charged-particle radiation and dust environment in the Kuiper Belt.

The New Horizons spacecraft is 4.1 billion miles (6.6 billion kilometers) from Earth, operating normally and speeding deeper into the Kuiper Belt at nearly 33,000 miles (53,000 kilometers) per hour.

Additional media and information:

Ultima Thule Video - Silent Version  http://pluto.jhuapl.edu/multimedia-db/fullmovie_v1.mp4

Ultima Thule Video - Version with Soundtrack  http://pluto.jhuapl.edu/multimedia-db/fullmovie_v4_withBMv3audio.mp4

Source: NASA
Engineers are still trying to understand why one of the main instruments on NASA’s InSight Mars lander is stuck just below the Martian surface.

In presentations at the 50th Lunar and Planetary Science Conference here March 18, project officials said they plan to spend the next few weeks determining why the probe on the Heat and Physical Properties Package (HP³) instrument, designed to measure the heat flow in the interior of the planet, is stuck about 30 centimeters below the surface, well short of its desired depth of three to five meters.

The probe, known as a “mole”, started to burrow into the surface Feb. 28, hammering its way into the surface. Tilman Spohn of the German space agency DLR, principal investigator for HP³, said that it appeared to reach a depth of about 30 centimeters after a four-hour hammering session. The probe, though, went no deeper during a second, five-hour hammering session March 2, after which the instrument team decided to hold off on further efforts to burrow into the surface.

Spohn said at the conference that the team speculated that the probe hit a rock shortly after burrowing into the surface that deflected it by about 15 degrees but allowed it to continue. “At about 30 centimeters depth we encountered something,” he said. “We don’t know yet if it’s a harder layer of regolith or a rock.”

The instrument team is working to diagnose the problem, he said, including seeing if the problem is with the instrument itself or the material it is trying to penetrate. One possibility is to use the lander’s robotic arm to pick up the support structure on the surface to see if the mole is sticking out, but Spohn said any such plan would need to be “carefully considered” first.

If the problem is with the Martian subsurface, he said, “I think what we can do is just continue hammering and see if we get through that layer or not.”

Bruce Banerdt, principal investigator for the overall mission, said that the spacecraft is taking images of the instrument on the surface to help diagnose the problem. “We can probably start trying to penetrate again in a few weeks,” he said. “Before that, we want to make sure we’re doing the right things.”

The other main instrument on InSight, a seismometer called the Seismic Experiment for Interior Structure, is working well. The instrument is now in place on the Martian surface and covered with a wind and thermal shield. Banerdt noted that the instrument’s noise level is about a factor of 100 below the best seismometers on Earth.

The only problem with the seismometer is that it has yet to detect a Marsquake, a lack of activity he said is not surprising. “This is exactly where we expected to be,” he said. The instrument has been fully operational for about a month, he said, and before the mission he expected to detect 10 to 12 quakes per Earth year.

Philippe Lognonné, principal investigator for the instrument, said in a separate presentation that the seismometer was working well. “Now, of course, we are waiting for a quake.”

Source: Space News
3. Storm Rages in Cosmic Teacup

Fancy a cup of cosmic tea? This one isn't as calming as the ones on Earth. In a galaxy hosting a structure nicknamed the "Teacup," a galactic storm is raging.

The source of the cosmic squall is a supermassive black hole buried at the center of the galaxy, officially known as SDSS 1430+1339. As matter in the central regions of the galaxy is pulled toward the black hole, it is energized by the strong gravity and magnetic fields near the black hole. The infalling material produces more radiation than all the stars in the host galaxy. This kind of actively growing black hole is known as a quasar.

Located about 1.1 billion light-years from Earth, the Teacup's host galaxy was originally discovered in visible light images by citizen scientists in 2007 as part of the Galaxy Zoo project, using data from the Sloan Digital Sky Survey. Since then, professional astronomers using space-based telescopes have gathered clues about the history of this galaxy with an eye toward forecasting how stormy it will be in the future. This new composite image contains X-ray data from Chandra (blue) along with an optical view from NASA's Hubble Space Telescope (red and green).

The "handle" of the Teacup is a ring of optical and X-ray light surrounding a giant bubble. This handle-shaped feature, which is located about 30,000 light-years from the supermassive black hole, was likely formed by one or more eruptions powered by the black hole. Radio emission -- shown in a separate composite image with the optical data -- also outlines this bubble, and a bubble about the same size on the other side of the black hole.
Previously, optical telescope observations showed that atoms in the handle of the Teacup were ionized, that is, these particles became charged when some of their electrons were stripped off, presumably by the quasar's strong radiation in the past. The amount of radiation required to ionize the atoms was compared with that inferred from optical observations of the quasar. This comparison suggested that the quasar's radiation production had diminished by a factor of somewhere between 50 and 600 over the last 40,000 to 100,000 years. This inferred sharp decline led researchers to conclude that the quasar in the Teacup was fading or dying.

New data from Chandra and ESA’s XMM-Newton mission are giving astronomers an improved understanding of the history of this galactic storm. The X-ray spectra (that is, the amount of X-rays over a range of energies) show that the quasar is heavily obscured by gas. This implies that the quasar is producing much more ionizing radiation than indicated by the estimates based on the optical data alone, and that rumors of the quasar's death may have been exaggerated. Instead the quasar has dimmed by only a factor of 25 or less over the past 100,000 years.

The Chandra data also show evidence for hotter gas within the bubble, which may imply that a wind of material is blowing away from the black hole. Such a wind, which was driven by radiation from the quasar, may have created the bubbles found in the Teacup.

Astronomers have previously observed bubbles of various sizes in elliptical galaxies, galaxy groups and galaxy clusters that were generated by narrow jets containing particles traveling near the speed of light, that shoot away from the supermassive black holes. The energy of the jets dominates the power output of these black holes, rather than radiation.

In these jet-driven systems, astronomers have found that the power required to generate the bubbles is proportional to their X-ray brightness. Surprisingly, the radiation-driven Teacup quasar follows this pattern. This suggests radiation-dominated quasar systems and their jet-dominated cousins can have similar effects on their galactic surroundings.

Source: SpaceRef.com
The Night Sky

**Tuesday, March 19**
- The Moon, almost full, shines in the dim hind feet of Leo. Upper right of it after dark is Regulus, about a fist and a half at arm's length away.

  Left of the Moon by about half that distance is Denebola, Leo's tailtip. Denebola is 0.8 magnitude dimmer than Regulus (meaning about half as bright) and it'll also be closer to the Moon's dazzling glare. Depending on the clarity of your air, Denebola may or may not be a challenge to pick out.

**Wednesday, March 20**
- Full Moon (exact at 9:43 p.m. EDT), and this qualities as a supermoon; it's just two days after perigee. The Moon shines a trace bigger and brighter than usual, in the head of Virgo under Leo.

  - Coincidentally, today is also the equinox. Spring begins (in the Northern Hemisphere) at 5:58 p.m. EDT, when the center of the Sun crosses the equator heading north for the season. The Sun rises and sets almost exactly east and west, and very nearly 12 hours apart. (And no, eggs don't balance any better than they usually do!)

**Thursday, March 21**
- Now that it's spring, the signature fall-and-winter constellation Cassiopeia is retreating downward after dark. But for skywatchers at mid-northern latitudes Cassiopeia is circumpolar, never going away completely. Look for it fairly low in the north-northwest these evenings. It's standing roughly on end.

  By midnight or 1 a.m. it's at its lowest due north, lying not quite horizontally.

- Algol, descending in the northwest, should be at minimum light for a couple hours centered on 10:04 p.m. EDT (7:04 p.m. PDT). Algol takes several additional hours to rebrighten.

**Friday, March 22**
- Immediately after dark, before moonrise for most of North America, Sirius shines brilliantly in the south-southwest. To its lower left, by about a fist at arm's length, is the triangle of Adhara, Wezen, and Aludra from right to left. They form Canis Major's hind foot, rear end, and tailtip, respectively.

  Just upper left of Aludra, forming a 3rd- and 4th-magnitude arc 7° long, are the three uppermost stars of the constellation Puppis. No it's not a puppy, despite following right behind the Big Dog. It's the Poop Deck (stern) of the giant ancient constellation Argo Navis, the ship of Jason and the Argonauts. These three stars are the only stars of Argo that are readily visible naked-eye from mid-northern latitudes.

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](https://www.nasa.gov/crew/spacestationsighting).

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

**March 19, Tuesday**  
2 p.m. – International Space Station Expedition 59 Spacewalk Preview Briefing (All Channels)  
6 p.m., 8 p.m., 10 p.m. – Replay of the International Space Station Expedition 59 Spacewalk Preview Briefing (All Channels)

**March 22, Friday**  
6:30 a.m. – Coverage of International Space Station U.S. spacewalk with astronauts McClain and Hague. Spacewalk begins at 8:05 a.m. EDT and will last about 7 hours. (All Channels)

Watch NASA TV on the Net by going to the [NASA website](https://www.nasa.gov/).
Space Calendar

- Mar 19 - Comet 69P/Taylor Perihelion (2.283 AU)
- Mar 19 - Comet 220P/McNaught At Opposition (3.210 AU)
- Mar 19 - Comet P/2014 W12 (Gibbs) At Opposition (3.987 AU)
- Mar 19 - Asteroid 358 Apollonia Occults HIP 19036 (6.7 Magnitude Star)
- Mar 19 - Apollo Asteroid 2019 CL2 Near-Earth Flyby (0.026 AU)
- Mar 19 - Asteroid 3749 Balam (2 Moons) Closest Approach To Earth (1.147 AU)
- Mar 19 - Asteroid 9766 Bradbury Closest Approach To Earth (1.361 AU)
- Mar 19 - Asteroid 3869 Norton Closest Approach To Earth (1.698 AU)
- Mar 19 - Asteroid 9340 Williamholden Closest Approach To Earth (2.061 AU)
- Mar 19 - 140th Anniversary (1879), Tenham Meteorite Shower in Australia
- Mar 19 - William Dawes' 220th Birthday (1799)
- Mar 20 - Vernal Equinox, 21:58 UT
- Mar 20 - Comet C/2019 B1 (Africano) Perihelion (1.596 AU)
- Mar 20 - Comet 49P/Arend-Rigaux Closest Approach To Earth (1.930 AU)
- Mar 20 - Comet C/2018 O1 (ATLAS) Closest Approach To Earth (2.141 AU)
- Mar 20 - Comet 321P/SOHO Closest Approach To Earth (2.844 AU)
- Mar 20 - Comet 238P/Read Closest Approach To Earth (2.914 AU)
- Mar 20 - Apollo Asteroid 2019 CD5 Near-Earth Flyby (0.026 AU)
- Mar 20 - Apollo Asteroid 2015 DS Near-Earth Flyby (0.043 AU)
- Mar 21 - Supermoon
- Mar 21 - PRISMA/ TARANIS Vega Launch
- Mar 21 - Comet C/2014 C1 (TOTAS) At Opposition (0.701 AU)
- Mar 21 - Comet 324P/La Sagra Closest Approach To Earth (2.589 AU)
- Mar 21 - Comet 115P/Mauricechileman Closest Approach To Earth (1.224 AU)
- Mar 21 - Asteroid 71885 Denning Closest Approach To Earth (1.267 AU)
- Mar 21 - Asteroid 7041 Nantucket Closest Approach To Earth (1.567 AU)
- Mar 21 - Asteroid 1655 Comas Sola Closest Approach To Earth (1.888 AU)
- Mar 21 - Walter Elsasser's 115th Birthday (1904)
- Mar 21 - 335th Anniversary (1684), Giovanni Cassini's Discovery of Saturn Moon Tethys & Dione
- Mar 21 - 2nd Physics Days 2019, Famagusta, Cyprus
- Mar 22 - Mercury Passes 3.4 Degrees From Neptune
- Mar 22 - Comet 264P/Larsen Closest Approach To Earth (1.718 AU)
- Mar 22 - Comet 238P/Read At Opposition (2.914 AU)
- Mar 22 - Comet P/2003 L1 (Scotti) Closest Approach To Earth (4.347 AU)
- Mar 22 - Asteroid 3 Juno Occults UCAC5 510-053447 (12.0 Magnitude Star)
- Mar 22 - Apollo Asteroid 2019 DS Near-Earth Flyby (0.043 AU)
- Mar 22 - Amor Asteroid 16912 Rhiannon Closest Approach To Earth (1.172 AU)
- Mar 22 - Asteroid 7755 Haute-Provence Closest Approach To Earth (1.874 AU)
- Mar 22 - Asteroid 1554 Yugoslavia Closest Approach To Earth (2.156 AU)
- Mar 22 - Asteroid 5029 Ireland Closest Approach To Earth (2.233 AU)
- Mar 22 - George Birkhoff's 135th Birthday (1884)
- Mar 22 - 335th Anniversary (1684), Giovanni Cassini's Discovery of Saturn Moon Tethys & Dione
- Mar 22 - 2nd Physics Days 2019, Famagusta, Cyprus
- Mar 22 - Mercury Passes 3.4 Degrees From Neptune
- Mar 22 - Comet 264P/Larsen Closest Approach To Earth (1.718 AU)
- Mar 22 - Comet 238P/Read At Opposition (2.914 AU)
- Mar 22 - Comet P/2003 L1 (Scotti) Closest Approach To Earth (4.347 AU)
- Mar 22 - Asteroid 3 Juno Occults UCAC5 510-053447 (12.0 Magnitude Star)
- Mar 22 - Aten Asteroid 2019 EA2 Near-Earth Flyby (0.002 AU)
- Mar 22 - Apollo Asteroid 4581 Asciepius Closest Approach To Earth (0.138 AU)
- Mar 22 - Asteroid 2074 Shoemaker Closest Approach To Earth (0.950 AU)
- Mar 22 - Amor Asteroid 3199 Nefertiti Closest Approach To Earth (1.062 AU)
- Mar 22 - Apollo Asteroid 1685 Toro Closest Approach To Earth (1.265 AU)
- Mar 22 - Asteroid 13123 Tyson Closest Approach To Earth (1.964 AU)
- Mar 22 - Asteroid 35165 Quebec Closest Approach To Earth (2.211 AU)
- Mar 22 - Friedrich Argelander's 220th Birthday (1799)
- Mar 22 - Ulugh Beg's 625th Birthday (1394)

Source: JPL Space Calendar
Superbugs have colonized the International Space Station -- but there's a silver lining

Astronauts leave behind many things when they boldly go. Bacteria, however, stay with them.

Extreme spaceflight conditions can force these bacteria to toughen up, while simultaneously lowering the immune defenses of the stressed, isolated crew. These effects - and the risk of infection - grow with mission duration.

Now researchers have taken another small step towards deep space exploration, by testing a new silver- and ruthenium-based antimicrobial coating aboard the International Space Station (ISS). Published in Frontiers in Microbiology, their study shows that the AGXX® dramatically reduced the number of bacteria on contamination-prone surfaces - and could help protect future astronauts beyond the moon and Mars.

A perfect storm

Microgravity. Cosmic radiation. Psychological stress. Unearthly conditions at the ISS create a perfect storm of weakened immune system and strengthened bacteria, that can put its crew at risk.

"Spaceflight can turn harmless bacteria into potential pathogens," says senior study author Prof. Elisabeth Grohmann of Beuth University of Applied Sciences Berlin. "Just as stress hormones leave astronauts vulnerable to infection, the bacteria they carry become hardier - developing thick protective coatings and resistance to antibiotics - and more vigorous, multiplying and metabolizing faster."
To make matters worse, the genes responsible for these new traits can be readily shared among different species of bacteria, via direct contact or in the 'matrix' of slime they secrete - creating new bad guys, Agent Smith-style.

The silver lining

To address this problem, Grohmann and colleagues tested a new antimicrobial coating, AGXX®, on a contamination-prone surface aboard the ISS: the toilet door.

"AGXX® contains both silver and ruthenium, conditioned by a vitamin derivative, and it kills all kinds of bacteria as well as certain fungi, yeasts and viruses. The effects are similar to bleach - except the coating is self-regenerating so it never gets used up," explains Grohmann.

Silver on its own has been used since prehistory to prevent microbial growth. Today it is found in everything from socks to swimming pools - which is perhaps why resistant bacteria have begun to emerge. AGXX® is one of the latest attempts to reinvigorate this ancient antimicrobial.

A ray of hope

The AGXX® coating proved to be highly effective.

"After 6 months exposure on the ISS, no bacteria were recovered from AGXX®-coated surfaces," Grohmann reports.

Even at 12 and 19 months, a total of just 12 bacteria was recovered - a reduction of 80% compared to bare steel. A regular silver coating tested for comparison had only a slight antimicrobial effect, reducing the number of bacteria by 30% versus steel.

"With prolonged exposure time a few bacteria escaped the antimicrobial action. The antimicrobial test-materials are static surfaces, where dead cells, dust particles and cell debris can accumulate over time and interfere with the direct contact between the antimicrobial surface and the bacteria."

Weathering deep space

"Most importantly, no serious human pathogens were found on any surface. Thus, the infection risk for the ISS crew currently is low," stresses Grohmann.

Nevertheless, all bacterial isolates were able to form immunity-evading slimy coatings, and most were resistant to at least three antibiotics. They were also able to share the genes responsible.

"Immunosuppression, bacterial virulence and therefore infection risk increase with duration of spaceflight. We must continue to develop new approaches to combat bacterial infections if we are to attempt longer missions to Mars and beyond," Grohmann concludes.

"For our part, we are continuing to analyze the antimicrobial performance of AGXX®, most recently aboard the joint IBMP-NASA SIRIUS 18/9 isolation mission."

Source: EurekAlert
Space Image of the Week

**M106: A Spiral Galaxy with a Strange Center**

**Image Credit:** NASA, ESO, NAOJ, Giovanni Paglioli; *Assembling and Processing: R. Colombari and R. Gendler*

**Explanation:** What's happening at the center of spiral galaxy M106? A swirling disk of stars and gas, M106's appearance is dominated by blue spiral arms and red dust lanes near the nucleus, as shown in the featured image. The core of M106 glows brightly in radio waves and X-rays where twin jets have been found running the length of the galaxy. An unusual central glow makes M106 one of the closest examples of the Seyfert class of galaxies, where vast amounts of glowing gas are thought to be falling into a central massive black hole. M106, also designated NGC 4258, is a relatively close 23.5 million light years away, spans 60 thousand light years across, and can be seen with a small telescope towards the constellation of the Hunting Dogs (Canes Venatici).

Source: APOD

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