Space News Update

— February 8, 2019 —

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1. New Horizons' Evocative Farewell Glance at Ultima Thule

An evocative new image sequence from NASA's New Horizons spacecraft offers a departing view of the Kuiper Belt object (KBO) nicknamed Ultima Thule – the target of its New Year's 2019 flyby and the most distant world ever explored.

These aren't the last Ultima Thule images New Horizons will send back to Earth – in fact, many more are to come -- but they are the final views New Horizons captured of the KBO (officially named 2014 MU69) as it raced away at over 31,000 miles per hour (50,000 kilometers per hour) on Jan. 1. The images were taken nearly 10 minutes after New Horizons crossed its closest approach point.

"This really is an incredible image sequence, taken by a spacecraft exploring a small world four billion miles away from Earth," said mission Principal Investigator Alan Stern, of Southwest Research Institute. "Nothing quite like this has ever been captured in imagery."

The newly released images also contain important scientific information about the shape of Ultima Thule, which is turning out to be one of the major discoveries from the flyby.

The first close-up images of Ultima Thule – with its two distinct and, apparently, spherical segments – had observers calling it a "snowman." However, more analysis of approach images and these new departure images have changed that view, in part by revealing an outline of the portion of the KBO that was not illuminated by the Sun, but could be "traced out" as it blocked the view to background stars.

Stringing 14 of these images into a short departure movie, New Horizons scientists can confirm that the two sections (or "lobes") of Ultima Thule are not spherical. The larger lobe, nicknamed "Ultima," more closely resembles a giant pancake and the smaller lobe, nicknamed "Thule," is shaped like a dented walnut.

"We had an impression of Ultima Thule based on the limited number of images returned in the days around the flyby, but seeing more data has significantly changed our view," Stern said. "It would be closer to reality to say Ultima Thule's shape is flatter, like a pancake. But more importantly, the new images are creating scientific puzzles about how such an object could even be formed. We've never seen something like this orbiting the Sun."

The departure images were taken from a different angle than the approach photos and reveal complementary information on Ultima Thule's shape. The central frame of the sequence was taken on Jan. 1 at 05:42:42 UT (12:42 a.m. EST), when New Horizons was 5,494 miles (8,862 kilometers) beyond Ultima Thule, and 4.1 billion miles (6.6 billion kilometers) from Earth. The object's illuminated crescent is blurred in the individual frames because a relatively long exposure time was used during this rapid scan to boost the camera's signal level – but the science team combined and processed the images to remove the blurring and sharpen the thin crescent.

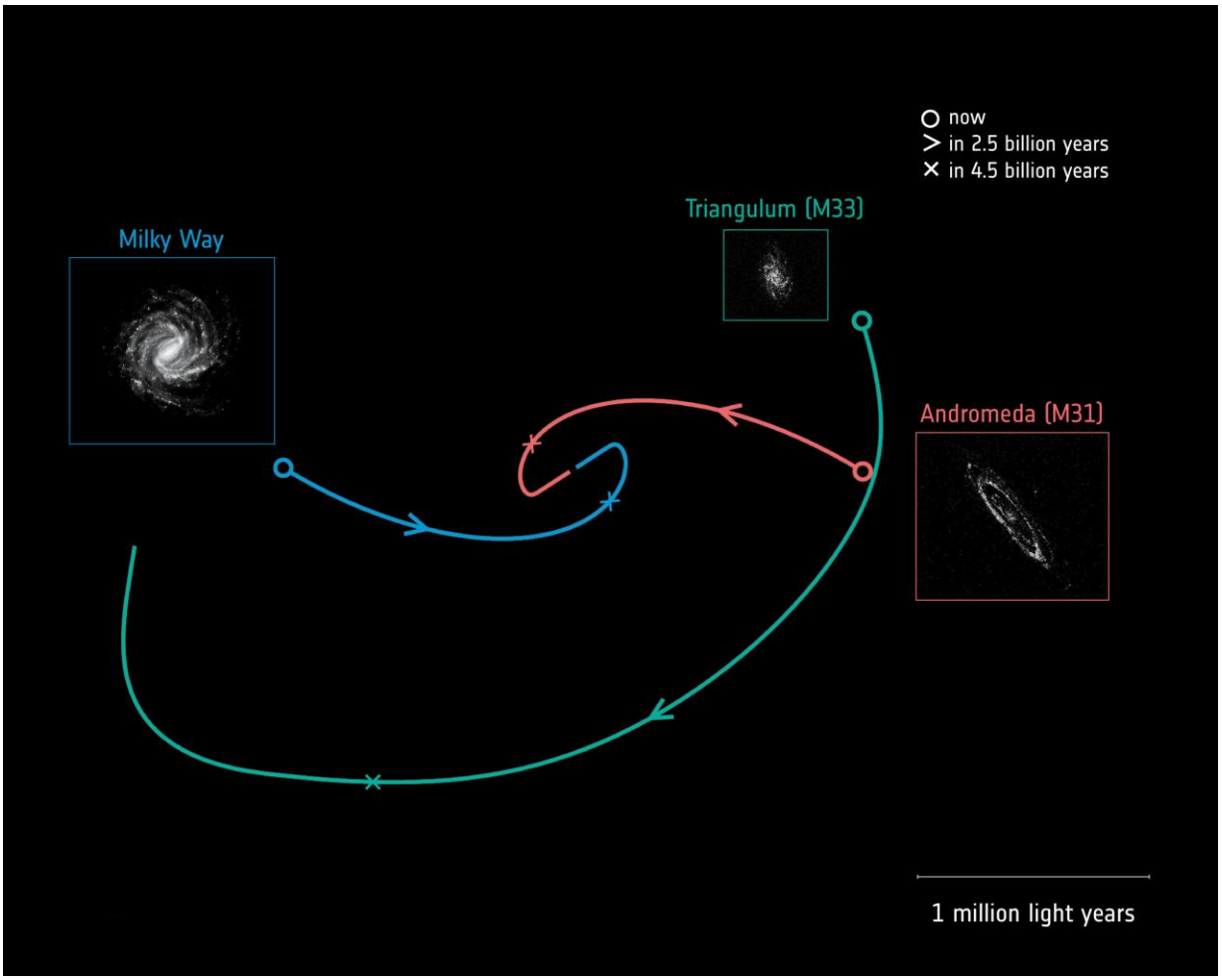
Many background stars are also seen in the individual images; watching which stars "blinked out" as the object passed in front them allowed scientists to outline the shape of both lobes, which could then be compared to a model assembled from analyzing pre-flyby images and ground-based telescope observations. "The shape model we have derived from all of the existing Ultima Thule imagery is remarkably consistent with what we have learned from the new crescent images," says Simon Porter, a New Horizons co-investigator from the Southwest Research Institute, who leads the shape-modeling effort.

"While the very nature of a fast flyby in some ways limits how well we can determine the true shape of Ultima Thule, the new results clearly show that Ultima and Thule are much flatter than originally believed, and much flatter than expected," added Hal Weaver, New Horizons project scientist from the Johns Hopkins Applied Physics Laboratory. "This will undoubtedly motivate new theories of planetesimal formation in the early solar system."

The images in this sequence will be available on the New Horizons LORRI website this week. Raw images from the camera are posted to the site each Friday.

Source: NASA Return to Contents

2. Gaia clocks new speeds for Milky Way-Andromeda collision



ESA's Gaia satellite has looked beyond our Galaxy and explored two nearby galaxies to reveal the stellar motions within them and how they will one day interact and collide with the Milky Way – with surprising results.

Our Milky Way belongs to a large gathering of galaxies known as the Local Group and, along with the Andromeda and Triangulum galaxies – also referred to as M31 and M33, respectively – makes up the majority of the group's mass.

Astronomers have long suspected that Andromeda will one day collide with the Milky Way, completely reshaping our cosmic neighbourhood. However, the three-dimensional movements of the Local Group galaxies remained unclear, painting an uncertain picture of the Milky Way's future.

"We needed to explore the galaxies' motions in 3D to uncover how they have grown and evolved, and what creates and influences their features and behaviour," says lead author Roeland van der Marel of the Space Telescope Science Institute in Baltimore, USA.

"We were able to do this using the second package of high-quality data released by Gaia."
Gaia is currently building the most precise 3D map of the stars in the nearby Universe, and is releasing its data in stages. The data from the second release, made in April 2018, was used in this research.

Previous studies of the Local Group have combined observations from telescopes including the NASA/ESA Hubble Space Telescope and the ground-based Very Long Baseline Array to figure out how the orbits of

Andromeda and Triangulum have changed over time. The two disc-shaped spiral galaxies are located between 2.5 and 3 million light-years from us, and are close enough to one another that they may be interacting.

Two possibilities emerged: either Triangulum is on an incredibly long six-billion-year orbit around Andromeda but has already fallen into it in the past, or it is currently on its very first infall. Each scenario reflects a different orbital path, and thus a different formation history and future for each galaxy.

While Hubble has obtained the sharpest view ever of both Andromeda and Triangulum, Gaia measures the individual position and motion of many of their stars with unprecedented accuracy.

"We combed through the Gaia data to identify thousands of individual stars in both galaxies, and studied how these stars moved within their galactic homes," adds co-author Mark Fardal, also of Space Telescope Science Institute.

"While Gaia primarily aims to study the Milky Way, it's powerful enough to spot especially massive and bright stars within nearby star-forming regions – even in galaxies beyond our own."

The stellar motions measured by Gaia not only reveal how each of the galaxies moves through space, but also how each rotates around its own spin axis.

A century ago, when astronomers were first trying to understand the nature of galaxies, these spin measurements were much sought-after, but could not be successfully completed with the telescopes available at the time.

"It took an observatory as advanced as Gaia to finally do so," says Roeland.

"For the first time, we've measured how M31 and M33 rotate on the sky. Astronomers used to see galaxies as clustered worlds that couldn't possibly be separate 'islands', but we now know otherwise.

"It has taken 100 years and Gaia to finally measure the true, tiny, rotation rate of our nearest large galactic neighbour, M31. This will help us to understand more about the nature of galaxies."

By combining existing observations with the new data release from Gaia, the researchers determined how Andromeda and Triangulum are each moving across the sky, and calculated the orbital path for each galaxy both backwards and forwards in timefor billions of years.

"The velocities we found show that M33 cannot be on a long orbit around M31," says co-author Ekta Patel of the University of Arizona, USA. "Our models unanimously imply that M33 must be on its first infall into M31."

While the Milky Way and Andromeda are still destined to collide and merge, both the timing and destructiveness of the interaction are also likely to be different than expected.
As Andromeda's motion differs somewhat from previous estimates, the galaxy is likely to deliver more of a glancing blow to the Milky Way than a head-on collision. This will take place not in 3.9 billion years' time, but in 4.5 billion – some 600 million years later than anticipated.

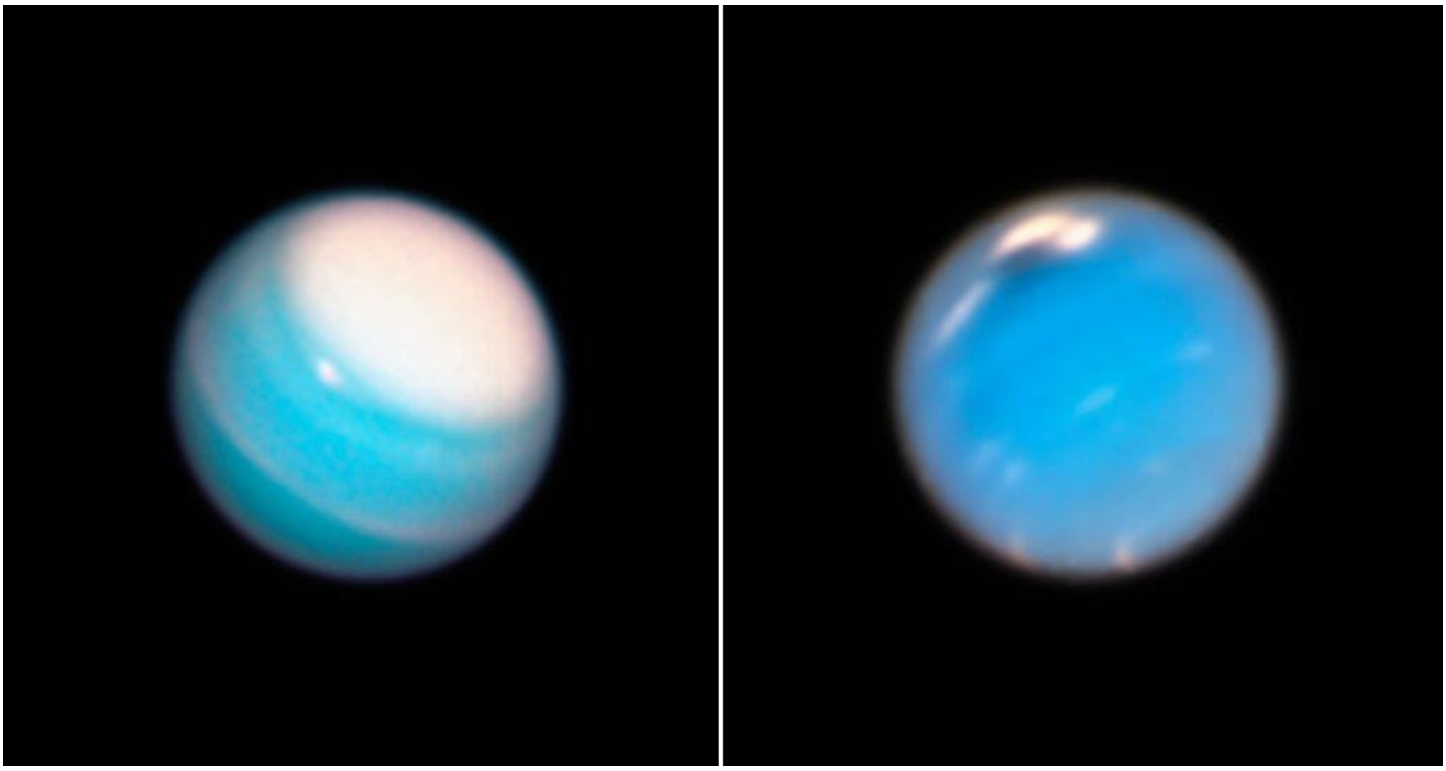
"This finding is crucial to our understanding of how galaxies evolve and interact," says Timo Prusti, ESA Gaia Project Scientist.

"We see unusual features in both M31 and M33, such as warped streams and tails of gas and stars. If the galaxies haven't come together before, these can't have been created by the forces felt during a merger. Perhaps they formed via interactions with other galaxies, or by gas dynamics within the galaxies themselves.

"Gaia was designed primarily for mapping stars within the Milky Way—but this new study shows that the satellite is exceeding expectations, and can provide unique insights into the structure and dynamics of galaxies beyond the realm of our own. The longer Gaia watches the tiny movements of these galaxies across the sky, the more precise our measurements will become."

Source: Phys.org Return to Contents

3. Hubble reveals dynamic atmospheres of Uranus, Neptune



During its routine yearly monitoring of the weather on our solar system's outer planets, NASA's Hubble Space Telescope has uncovered a new mysterious dark storm on Neptune and provided a fresh look at a long-lived storm circling around the north polar region on Uranus.

Like Earth, Uranus and Neptune have seasons, which likely drive some of the features in their atmospheres. But their seasons are much longer than on Earth, spanning decades rather than months.

The new Hubble view of Neptune shows the dark storm, seen at top center. Appearing during the planet's southern summer, the feature is the fourth and latest mysterious dark vortex captured by Hubble since 1993. Two other dark storms were discovered by the Voyager 2 spacecraft in 1989 as it flew by the remote planet. Since then, only Hubble has had the sensitivity in blue light to track these elusive features, which have appeared and faded quickly. A study led by University of California, Berkeley, undergraduate student Andrew Hsu estimated that the dark spots appear every four to six years at different latitudes and disappear after about two years.

Hubble uncovered the latest storm in September 2018 in Neptune's northern hemisphere. The feature is roughly 6,800 miles across.

To the right of the dark feature are bright white "companion clouds." Hubble has observed similar clouds accompanying previous vortices. The bright clouds form when the flow of ambient air is perturbed and diverted upward over the dark vortex, causing gases to freeze into methane ice crystals. These clouds are similar to clouds that appear as pancake-shaped features when air is pushed over mountains on Earth (though Neptune has no solid surface). The long, thin cloud to the left of the dark spot is a transient feature that is not part of the storm system.

It's unclear how these storms form. But like Jupiter's Great Red Spot, the dark vortices swirl in an anti-cyclonic direction and seem to dredge up material from deeper levels in the ice giant's atmosphere.

The Hubble observations show that as early as 2016, increased cloud activity in the region preceded the vortex's appearance. The images indicate that the vortices probably develop deeper in Neptune's atmosphere, becoming visible only when the top of the storm reaches higher altitudes.

The snapshot of Uranus, like the image of Neptune, reveals a dominant feature: a vast bright stormy cloud cap across the north pole.

Scientists believe this new feature is a result of Uranus' unique rotation. Unlike every other planet in the solar system, Uranus is tipped over almost onto its side. Because of this extreme tilt, during the planet's summer the Sun shines almost directly onto the north pole and never sets. Uranus is now approaching the middle of its summer season, and the polar-cap region is becoming more prominent. This polar hood may have formed by seasonal changes in atmospheric flow.

Near the edge of the polar storm is a large, compact methane-ice cloud, which is sometimes bright enough to be photographed by amateur astronomers. A narrow cloud band encircles the planet north of the equator. It is a mystery how bands like these are confined to such narrow widths, because Uranus and Neptune have very broad westward-blowing wind jets.

Both planets are classified as ice giant planets. They have no solid surface but rather mantles of hydrogen and helium surrounding a water-rich interior, itself perhaps wrapped around a rocky core. Atmospheric methane absorbs red light but allows blue-green light to be scattered back into space, giving each planet a cyan hue.

The new Neptune and Uranus images are from the Outer Planet Atmospheres Legacy (OPAL) program, a long-term Hubble project, led by Amy Simon of NASA's Goddard Space Flight Center in Greenbelt, Maryland, that annually captures global maps of our solar system's outer planets when they are closest to Earth in their orbits. OPAL's key goals are to study long-term seasonal changes, as well as capture comparatively transitory events, such as the appearance of Neptune's dark spot. These dark storms may be so fleeting that in the past some of them may have appeared and faded during multi-year gaps in Hubble's observations of Neptune. The OPAL program ensures that astronomers won't miss another one.

These images are part of a scrapbook of Hubble snapshots of Neptune and Uranus that track the weather patterns over time on these distant, cold planets. Just as meteorologists cannot predict the weather on Earth by studying a few snapshots, astronomers cannot track atmospheric trends on solar system planets without regularly repeated observations. Astronomers hope that Hubble's long-term monitoring of the outer planets will help them unravel the mysteries that still persist about these faraway worlds.

Analyzing the weather on these worlds also will help scientists better understand the diversity and similarities of the atmospheres of solar-system planets, including Earth.

Source: EurekAlert Return to Contents

The Night Sky

Comet Iwamoto is 7th magnitude this week as it crosses Leo and Cancer high in the late-night sky. See Bob King's Comet Iwamoto Ascends and Brightens, with finder chart.

Friday, February 8

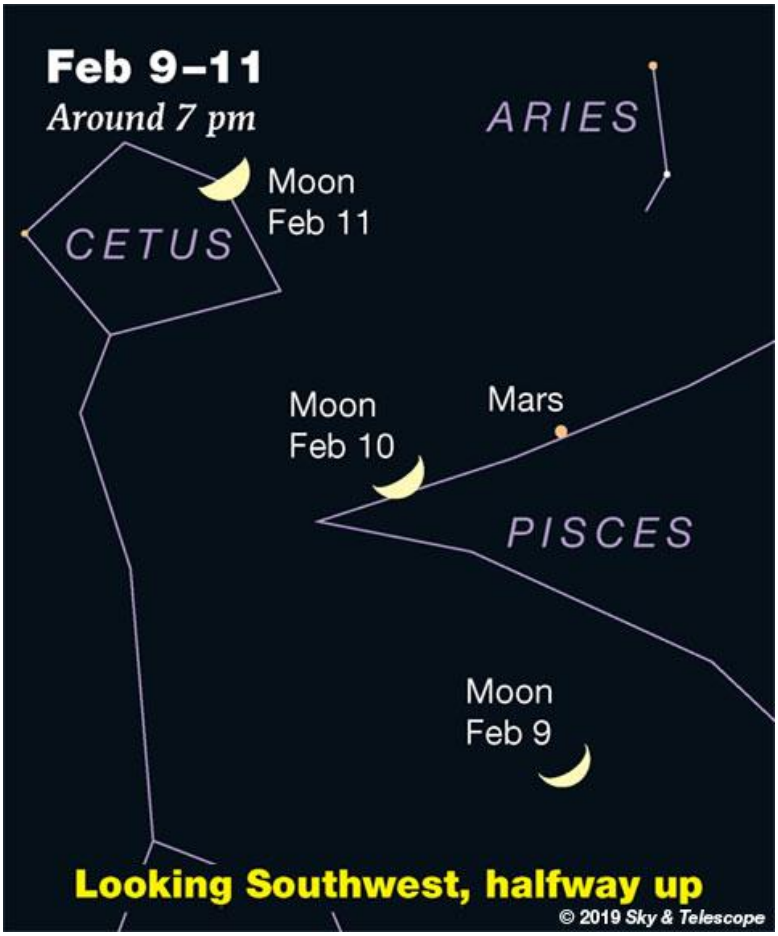
• The waxing crescent Moon shines in the west-southwest at nightfall. Above it by about two fists at arm's length is Mars, diminished far into the distance since its grand display last summer.

Saturday, February 9

• Now the Moon is about *one* fist below Mars right after dark. Look to the Moon's right for the dimmer Great Square of Pegasus, balancing on one corner.

• Under the feet of Orion hides Lepus the Hare. Like Canis Major, this constellation has a connect-the-dots pattern that really looks like what it's supposed to be. He's a crouching bunny, with his nose pointing lower right, his faint ears extending up toward Rigel (Orion's western foot), and his body bunched to the left.

His brightest two stars, 3rd-magnitude Beta and Alpha Leporis, form the front and back of his neck. At nightfall this week these two are straight below Rigel, by about one fist.



Sunday, February 10

• As twilight turns into night, the thick crescent Moon shines in the west-southwest. Spot little orange Mars to its right. Mars is actually twice as big as the Moon, but it's currently 620 times farther away.

Monday, February 11

• **Mars and Uranus pass close by each other** this evening through Wednesday evening. Mars is magnitude 1.0. Uranus is almost 100 times fainter at magnitude 5.8, but it's visible in binoculars nonetheless.

Right after nightfall tonight, find Mars to the lower right of the Moon. Uranus is located 1.2° to Mars's left and perhaps a touch higher. (For a sense of scale, a typical 8-power binocular has a field of view 6° or 7° wide.) To help orient yourself, you'll see the brighter star Omicron Piscium, magnitude 4.2, in the same binocular view a little farther below Uranus and a bit left.

• Meanwhile, late this evening for North America, 7th-magnitude Comet Iwamoto passes very close to Eta Leonis, magnitude 3.5, in Leo's Sickle. The timing of this passage is especially good for late-evening observers in the Eastern and Central time zones. See Comet Iwamoto Ascends and Brightens, with finder chart.

Tuesday, February 12

• First-quarter Moon (exact at 5:26 p.m. EST). The Moon shines below Aldebaran and the Pleiades. Mars is far to its lower right.

• Now you'll find Uranus is 1.0° left of Mars and perhaps a bit lower; see yesterday.

Source: Sky & Telescope Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Fri Feb 8, 7:11 PM	2 min	34°	26° above W	28° above S
Sat Feb 9, 6:18 PM	6 min	70°	10° above WNW	10° above SE
Sun Feb 10, 7:06 PM	2 min	13°	13° above SW	10° above SSW
Mon Feb 11, 6:15 PM	3 min	25°	25° above SW	10° above SSE

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

NASA-TV Highlights

(all times Eastern Daylight Time)

February 11, Monday
10:30 a.m. – Space Station In-Flight Event for the Canadian Space Agency with CSA astronaut David Saint-Jacques (Public with interpretation; Media Channel in native language)

February 12, Tuesday
5:45 a.m. – Live interviews from Goddard Space Flight Center on the Van Allen Probes (Media Channel)

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

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Space Calendar

- Feb 08 - 50th Anniversary (1969), Allende Meteorite Shower (Hit Houses In Mexico)
- Feb 08 - Comet 375P/Hill Closest Approach To Earth (1.011 AU)
- Feb 08 - Comet 82P/Gehrels Closest Approach To Earth (2.715 AU)
- Feb 08 - Asteroid 433 Eros Occults TYC 1301-677-1 (10.9 Magnitude Star)
- Feb 08 - NEW [Feb 03] Apollo Asteroid 2019 BA5 Near-Earth Flyby (0.036 AU)
- Feb 08 - Asteroid 10797 Guatemala Closest Approach To Earth (1.110 AU)
- Feb 08 - Asteroid 434 Hungaria Closest Approach To Earth (1.160 AU)
- Feb 08 - Asteroid 19620 Auckland Closest Approach To Earth (1.457 AU)
- Feb 08 - Apollo Asteroid 2011 MD Closest Approach To Earth (1.904 AU)
- Feb 08 - Asteroid 228029 MANIAC Closest Approach To Earth (1.935 AU)
- Feb 08 - Arlie Petters' 75th Birthday (1964)
- Feb 09 - Comet P/2007 T2 (Kowalski) At Opposition (1.691 AU)
- Feb 09 - Comet 82P/Gehrels At Opposition (2.715 AU)
- Feb 09 - Comet 88P/Howell At Opposition (3.283 AU)
- Feb 09 - Comet C/2017 AB5 (PANSTARRS) At Opposition (8.615 AU)
- Feb 09 - Atira Asteroid 2010 XB11 Closest Approach To Earth (0.944 AU)
- Feb 09 - Asteroid 275281 Amywalsh Closest Approach To Earth (1.150 AU)
- Feb 09 - Asteroid 101723 Finger Closest Approach to Earth (1.214 AU)
- Feb 09 - Amor Asteroid 8013 Gordonmoore Closest Approach To Earth (1.424 AU)
- Feb 09 - Asteroid 13606 Bean Closest Approach To Earth (1.570 AU)
- Feb 09 - Mario Juric's 40th Birthday (1979)
- Feb 09 - 70th Anniversary (1949), Department of Space Medicine Established (US Air Force)
- Feb 10 - Comet 90P/Gehrels At Opposition (3.852 AU)
- Feb 10 - NEW [Feb 08] Apollo Asteroid 2019 CB2 Near-Earth Flyby (0.007 AU)
- Feb 10 - Asteroid 90022 Apache Point Closest Approach To Earth (1.284 AU)
- Feb 10 - Asteroid 1345 Potomac Closest Approach To Earth (2.352 AU)
- Feb 10 - Asteroid 1373 Cincinnati Closest Approach To Earth (2.819 AU)
- Feb 10 - 45th Anniversary (1974), Mars 4, Mars Flyby
- Feb 10-16 - Workshop: Quantum Structure of Spacetime, Bratislava, Slovakia
- Feb 11 - Comet C/2019 B1 (Africano) Closest Approach To Earth (0.924 AU)
- Feb 11 - Comet 136P/Mueller At Opposition (3.939 AU)
- Feb 11 - Apollo Asteroid 511684 (2015 BN509) Near-Earth Flyby (0.084 AU)
- Feb 11 - Asteroid 3728 IRAS Closest Approach To Earth (1.289 AU)
- Feb 11 - Asteroid 17058 Rocknroll Closest Approach To Earth (1.503 AU)
- Feb 11 - Asteroid 5725 Nordlingen Closest Approach To Earth (1.665 AU)
- Feb 11 - Asteroid 19398 Creedence Closest Approach To Earth (1.700 AU)
- Feb 11 - Asteroid 134346 Pinatubo Closest Approach To Earth (1.973 AU)
- Feb 11 - Asteroid 2597 Arthur Closest Approach To Earth (2.112 AU)
- Feb 12 - NEW [Feb 05] Comet P/2019 B2 (Groeller) At Opposition (1.574 AU)
- Feb 12 - Comet P/1996 R2 (Lagerkvist) Perihelion (2.590 AU)
- Feb 12 - Asteroid 916 America Occults HIP 56061 (6.6 Magnitude Star)
- Feb 12 - Apollo Asteroid 2017 PV25 Near-Earth Flyby (0.019 AU)
- Feb 12 - Asteroid 4148 McCartney Closest Approach To Earth (1.086 AU)
- Feb 12 - Asteroid 12574 LONEOS Closest Approach To Earth (1.549 AU)
- Feb 12 - Asteroid 3975 Verdi Closest Approach To Earth (1.810 AU)
- Feb 12 - Asteroid 8992 Magnanimity Closest Approach To Earth (1.912 AU)
- Feb 12 - Asteroid 12284 Pohl Closest Approach To Earth (2.070 AU)
- Feb 12 - Asteroid 19535 Rowanatkinson Closest Approach To Earth (2.113 AU)
- Feb 12 - 45th Anniversary (1974), Mars 5, Mars Orbit Insertion
- Feb 12 - Emil Lenz's 215th Birthday (1804)

Source: JPL Space Calendar

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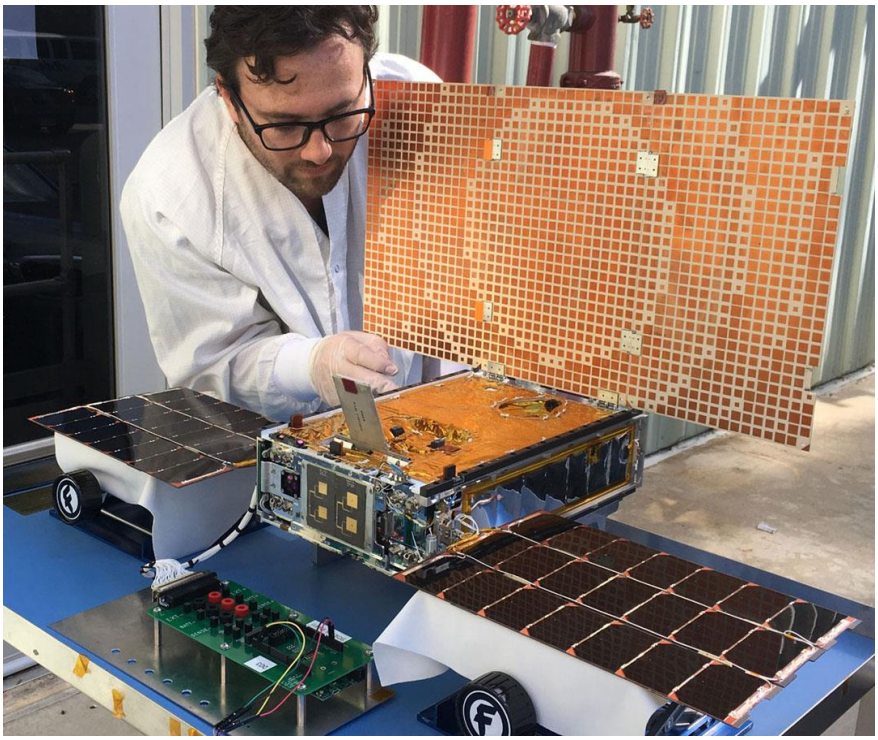
Food for Thought

Beyond Mars, the Mini MarCO Spacecraft Fall Silent



Before the pair of briefcase-sized spacecraft known collectively as MarCO launched last year, their success was measured by survival: If they were able to operate in deep space at all, they would be pushing the limits of experimental technology.

Now well past Mars, the daring twins seem to have reached their limit. It's been over a month since engineers have heard from MarCO, which followed NASA's InSight to the Red Planet. At this time, the mission team considers it unlikely they'll be heard from again.

MarCO, short for Mars Cube One, was the first interplanetary mission to use a class of mini-spacecraft called CubeSats. The MarCOs - nicknamed EVE and WALL-E, after characters from a Pixar film - served as communications relays during InSight's landing, beaming back data at each stage of its descent to the Martian surface in near-real time, along with InSight's first image. WALL-E sent back stunning images of Mars as well, while EVE performed some simple radio science.

All of this was achieved with experimental technology that cost a fraction of what most space missions do: $18.5 million provided by NASA's Jet Propulsion Laboratory in Pasadena, California, which built the CubeSats.

WALL-E was last heard from on Dec. 29; EVE, on Jan. 4. Based on trajectory calculations, WALL-E is currently more than 1 million miles (1.6 million kilometers) past Mars; EVE is farther, almost 2 million miles (3.2 million kilometers) past Mars.

The mission team has several theories for why they haven't been able to contact the pair. WALL-E has a leaky thruster. Attitude-control issues could be causing them to wobble and lose the ability to send and receive commands. The brightness sensors that allow the CubeSats to stay pointed at the Sun and recharge their batteries could be another factor. The MarCOs are in orbit around the Sun and will only get farther away as

February wears on. The farther they are, the more precisely they need to point their antennas to communicate with Earth.

The MarCOs won't start moving toward the Sun again until this summer. The team will reattempt to contact the CubeSats at that time, though it's anyone's guess whether their batteries and other parts will last that long.

Even if they're never revived, the team considers MarCO a spectacular success.

"This mission was always about pushing the limits of miniaturized technology and seeing just how far it could take us," said Andy Klesh, the mission's chief engineer at JPL. "We've put a stake in the ground. Future CubeSats might go even farther."

A number of the critical spare parts for each MarCO will be used in other CubeSat missions. That includes their experimental radios, antennas and propulsion systems. Several of these systems were provided by commercial vendors, making it easier for other CubeSats to use them as well.

More small spacecraft are on the way. NASA is set to launch a variety of new CubeSats in coming years.

"There's big potential in these small packages," said John Baker, the MarCO program manager at JPL. "CubeSats - part of a larger group of spacecraft called SmallSats - are a new platform for space exploration that is affordable to more than just government agencies."

Source: JPL Return to Contents

Space Image of the Week

Fox Fur, Unicorn, and Christmas Tree
Image Credit & Copyright: Stanislav Volskiy, Chilescope Team

Explanation: Clouds of glowing hydrogen gas fill this colorful skyscape in the faint but fanciful constellation Monoceros, the Unicorn. A star forming region cataloged as NGC 2264, the complex jumble of cosmic gas and dust is about 2,700 light-years distant and mixes reddish emission nebulae excited by energetic light from newborn stars with dark interstellar dust clouds. Where the otherwise obscuring dust clouds lie close to the hot, young stars they also reflect starlight, forming blue reflection nebulae.
The telescopic image spans about 3/4 degree or nearly 1.5 full moons, covering 40 light-years at the distance of NGC 2264. Its cast of cosmic characters includes the the Fox Fur Nebula, whose dusty, convoluted pelt lies near the top, bright variable star S Monocerotis immersed in the blue-tinted haze near center, and the Cone Nebula pointing in from the right side of the frame. Of course, the stars of NGC 2264 are also known as the Christmas Tree star cluster. The triangular tree shape is seen on its side here. Traced by brighter stars it has its apex at the Cone Nebula. The tree's broader base is centered near S Monocerotis.

Source: APOD

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