Space News Update

— April 3, 2020 —

Contents

1. Third Starship prototype destroyed in tanking test

For the third time in less than five months, a prototype of SpaceX's Starship next-generation launch vehicle was destroyed in a test at the company's South Texas facilities April 3, although this failure may an issue with the test itself.

The Starship SN3 vehicle was on the pad at SpaceX's test site at Boca Chica, Texas, in the early morning hours of April 3 for a cryogenic tanking test, where the vehicle's propellant tanks are filled with liquid nitrogen. Shortly after 3 a.m. Eastern, the cylindrical vehicle appeared to crumple about halfway up, causing the top part of the vehicle to topple.

The accident marks the third time a prototype of Starship failed that cryogenic tanking test. In November 2019, the Starship Mark 1 vehicle suffered a bulkhead failure during a similar test, sending debris flying. The company said at the time that the incident took place in a test intended to "pressurize systems to the max, so the outcome was not completely unexpected."

A second Starship vehicle, SN1, was also destroyed in a cryogenic tanking test Feb. 28, this time with the vehicle bursting near its base. Elon Musk, founder and chief executive of SpaceX, said that the failure in that test appeared to be with a "thrust puck" at the base of the tank that takes the load from the vehicle's Raptor engines.

SpaceX decided to strip the next Starship vehicle, SN2, down to that tank to test the performance of the thrust puck weld. Those tests took place in early March without incident.

Musk, in a tweet shortly after the Starship SN3 incident, suggested the failure may have been caused by a problem with the test itself. "We will see what data review says in the morning, but this may have been a test configuration mistake," he wrote.

Had the tanking test been successful, SpaceX was preparing to perform a static-fire test with Starship SN3. The Federal Aviation Administration issued a notice to airmen, or NOTAM, April 1 for the area around the test site for April 6 through 8, consistent with a static-fire test of the vehicle.

That static-fire test may have been followed by a low-altitude "hop" test, similar to the August 2019 flight of its Starhopper prototype, where the vehicle flew to an altitude of about 150 meters before landing on a nearby pad on the one-minute flight. That test would have required an experimental permit from the FAA's Office of Commercial Space Transportation, which has yet to be issued.

Starship is the upper stage of the company's next-generation launch system that is intended to be fully reusable and support both cargo and crewed missions. With a booster called Super Heavy, Starship will be capable of carrying large payloads into Earth orbit and beyond.

SpaceX published earlier this week the first version of a user's guide for the vehicle. According to the six-page guide, the "baseline reusable design" of the system will be able to place more than 100 metric tons into low Earth orbit, and 21 metric tons into a geostationary transfer orbit. With in-orbit propellant transfer, SpaceX says that Starship can carry more than 100 metric tons to the surface of the moon or of Mars.

A crewed version of the vehicle, the guide states, can accommodate up to 100 people with "private cabins, large common areas, centralized storage, solar storm shelters and a viewing gallery." SpaceX plans Starship launches from both Launch Complex 39A at the Kennedy Space Center and its Boca Chica facility in Texas. The guide, though, did not offer a schedule for beginning such missions, or estimated prices.

Source: SpaceNews Return to Contents

2. New Find Shows Uranus Loses Atmosphere to its Magnetic Field

You may never look at Uranus the same way again. It's always worth combing through data from old space missions for new finds.

NASA's researchers at the Goddard Space Flight Center recently did just that, looking at Voyager 2's lone encounter with the planet Uranus to uncover an amazing find, as the planet seems to be losing its atmosphere to it's lop-sided magnetic field at a high rate. The finding was published in a recent edition of *Geophysical Research: Letters*.

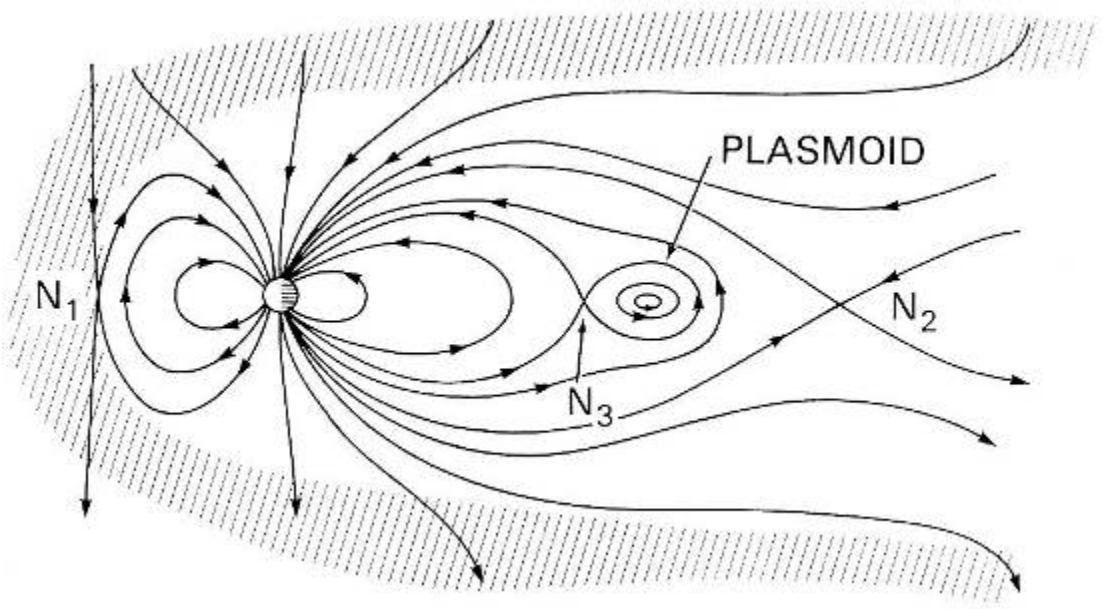
Voyager 2 flew just 50,600 miles (81,400 kilometers) past the cloudtops of Uranus on January 24, 1986. The outer ice giants were secondary targets for the Grand Flyby exploration of the outer solar system and to date, Voyager 2 is the only mission to visit Uranus and Neptune up close.

Voyager 2 meticulously studied Uranus during the key two hours of closest approach, and data collected during the encounter later revealed two new ring systems and 11 new moons. But it was a blip in the magnetometer readings relayed by Voyager 2 that recently gave researchers pause.

The anomaly is thought to have been a plasmoid — a giant plasma bubble clipped off by the planet's magnetic field and hurled into space. Voyager 2 happened to pass briefly through this bubble, though it took researchers over three decades to realize it.

We see other worlds shedding atmosphere throughout the solar system. Such plasmoids are common around the giant planets of Jupiter and Saturn. In the inner solar system, Venus and Mars are both devoid of protective magnetic fields, and are at the mercy of losing upper atmosphere directly to the solar wind. In the case of Earth, this effect is tiny: but Mars missions such as the Mars Atmosphere and Volatile Evolution (MAVEN) and the European Space Agency's Trace Gas Orbiter highlight just how extreme this loss can be.

"Mars used to be a wet planet with a thick atmosphere," says Gina DiBraccio (NASA-GSFC) in a recent press release. "It evolved over time to become the dry planet we see today."



A diagram of a plasmoid disconnection event. Credit: Public Domain/Wikimedia Commons.

And when it comes to the wacky world of Uranus, rotational orientation matters. Orbiting the Sun once every 84 years, Uranus spins on its side: a 'season' is 21 years long on Uranus, with either pole aiming at the Sun 19 Astronomical Units (AU) distant once every 42 years. The oddball of the solar system, Uranus's magnetosphere and the space it carves out wobbles 60 degrees out of sync with its rotational axis.

Though Voyager only made a brief 60 second transit through the plasmoid bubble, the implied dimensions were stunning: with a cylindrical volume of 127,000 miles (204,000 kilometers) wide by 250,000 miles (400,000 kilometers) long, the bubble would stretch from Earth to the Moon.

Attack of the Plasmoids

Another unique feature of the Uranus plasmoid was the clean closed loops observed by Voyager 2, in sharp contrast to the twisted magnetic field typical of plasmoids around Jupiter or Saturn.

"Imagine if one spacecraft just flew through this room and tried to characterize the entire Earth," says DiBraccio in the recent press release. "Obviously, it's not going to show you anything about what the Sahara or Antarctica is like."

Though this is indeed only a tantalizing statistical sample of one, such an event, if typical, could account for 15 to 55% of the atmospheric mass loss for Uranus… more than the proportion seen at any other world in the solar system.

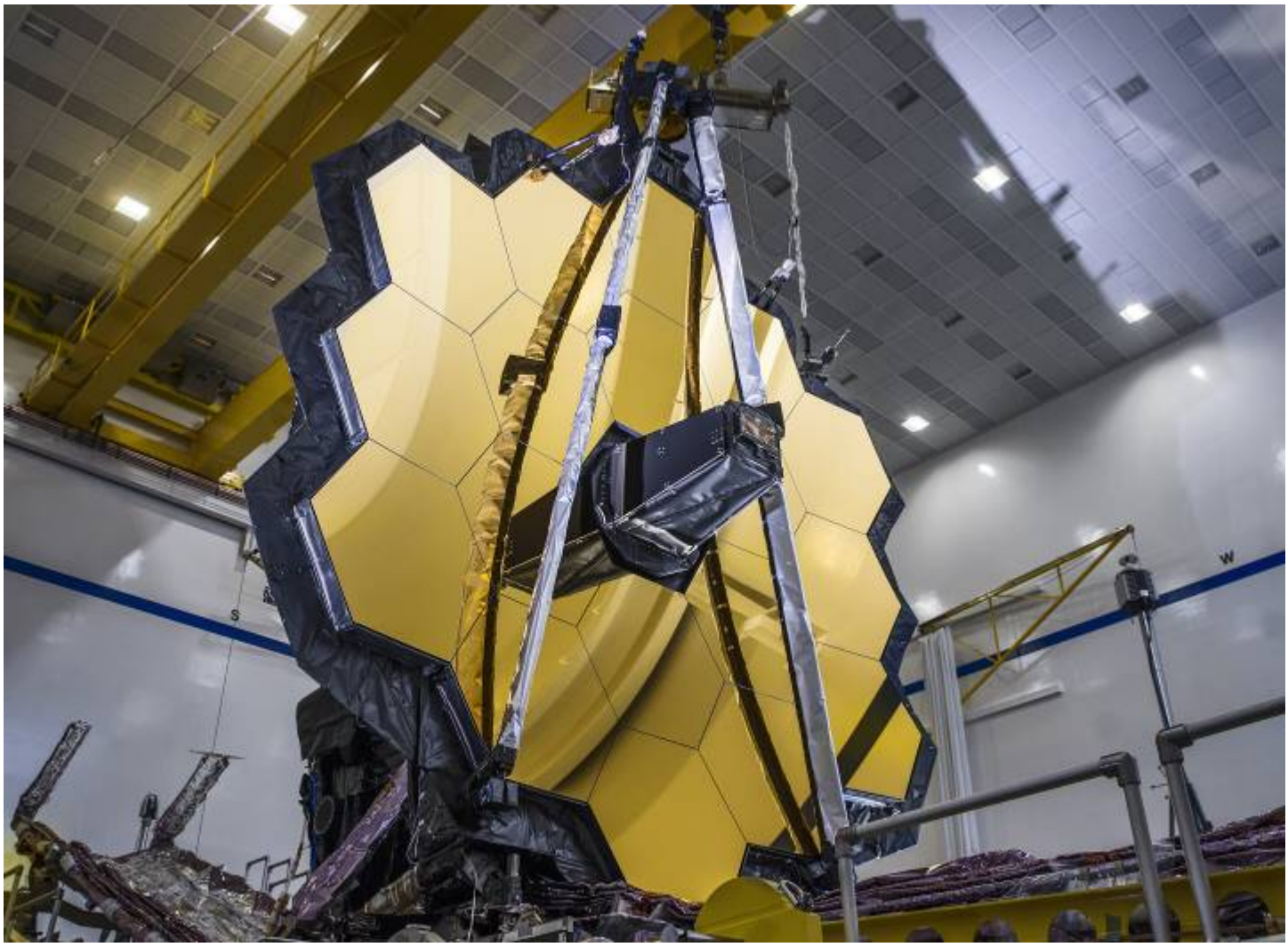
Return to the Ice Giants

There are missions on the drawing board to send dedicated Icy World orbiters to both Uranus and Neptune, though these are still a long ways off, in the 2030 or 2040 time frame.

It great to see new discoveries still coming out of old data… if nothing else, this highlights the need to go back.

Source: Universe Today Return to Contents

3. NASA's James Webb Space Telescope full mirror deployment a success



In a recent test, NASA's James Webb Space Telescope fully deployed its primary mirror into the same configuration it will have when in space.

As Webb progresses towards liftoff in 2021, technicians and engineers have been diligently checking off a long list of final tests the observatory will undergo before being packaged for delivery to French Guiana for launch. Performed in early March, this procedure involved commanding the spacecraft's internal systems to fully extend and latch Webb's iconic 21 feet 4-inch (6.5 meter) primary mirror, appearing just like it would after it has been launched to orbit. The observatory is currently in a cleanroom at Northrop Grumman Space Systems in Redondo Beach, California.

The difficulty and complexity of performing tests for Webb has increased significantly, now that the observatory has been fully assembled. Special gravity offsetting equipment was attached to Webb's mirror to simulate the zero-gravity environment its mechanisms will have to operate in. Tests like these help safeguard mission success by physically demonstrating that the spacecraft is able to move and unfold as intended. The Webb team will deploy the observatory's primary mirror only once more on the ground, just before preparing it for delivery to the launch site.

A telescope's sensitivity, or how much detail it can see, is directly related to the size of the mirror that collects light from the objects being observed. A larger surface area collects more light, just like a larger bucket

collects more water in a rain shower than a small one. Webb's mirror is the biggest of its kind that NASA has ever built.

In order to perform groundbreaking science, Webb's primary mirror needs to be so large that it cannot fit inside any rocket available in its fully extended form. Like the art of origami, Webb is a collection of movable parts employing applied material science that have been specifically designed to fold themselves to a compact formation that is considerably smaller than when the observatory is fully deployed. This allows it to just barely fit within a 16-foot (5-meter) payload fairing, with little room to spare.

"Deploying both wings of the telescope while part of the fully assembled observatory is another significant milestone showing Webb will deploy properly in space. This is a great achievement and an inspiring image for the entire team," said Lee Feinberg, optical telescope element manager for Webb at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

The evolving novel coronavirus COVID-19 situation is causing significant impact and disruption globally. Given these circumstances, Webb's Northrop Grumman team in California has resumed integration and testing work with reduced personnel and shifts until the Deployable Tower Assembly set up in April. The project will then shut down integration and testing operations due to the lack of required NASA onsite personnel related to the COVID-19 situation. The project will reassess over the next couple of weeks and adjust decisions as the situation continues to unfold.

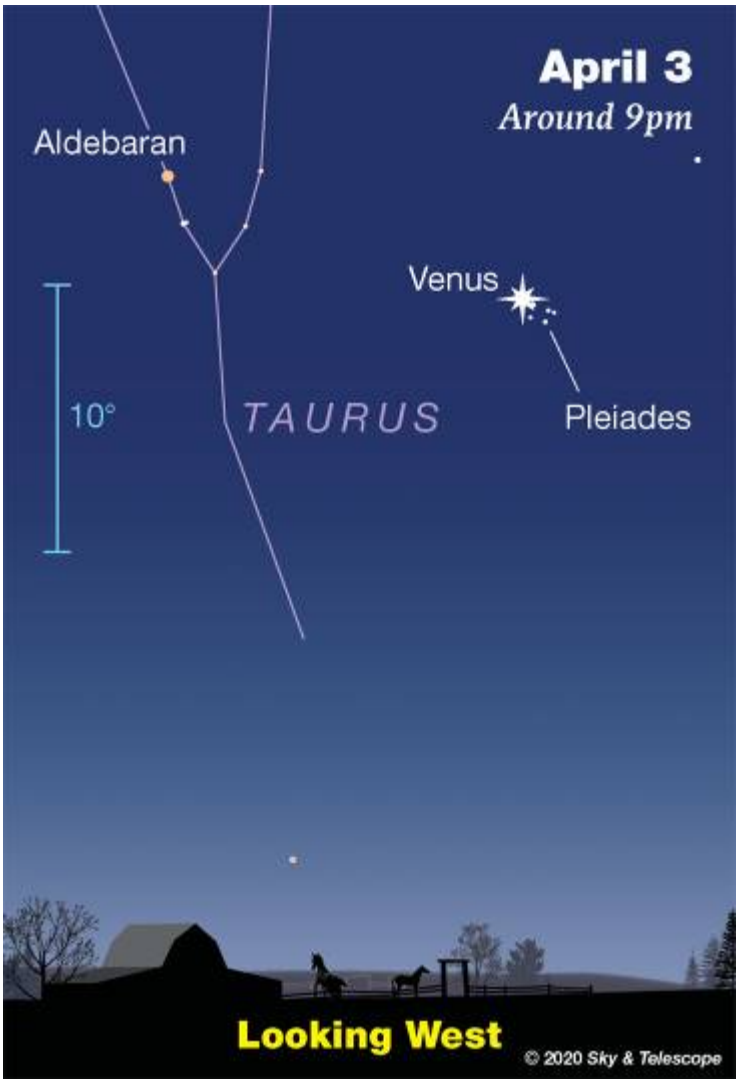
The James Webb Space Telescope will be the world's premier space science observatory when it launches in 2021. Webb will solve mysteries in our solar system, look beyond to distant worlds around other stars, and probe the mysterious structures and origins of our universe and our place in it. Webb is an international program led by NASA with its partners, ESA (European Space Agency) and the Canadian Space Agency.

Watch a time-lapse video of the test here.

Source: Phys.org Return to Contents

The Night Sky

Friday, April 3



■ Venus this evening shines in the upper left edge of the Pleiades, as shown above. How soon before the end of twilight can you first begin to see the little cluster? Bring your telescope, binoculars, and/or long-focus camera! This is a once-in-eight-years event. For more see Bob King's The Pleiades Welcome Venus, with photo tips.
Of course they're nowhere near each other, really. Venus this evening is 5.2 light-minutes from us, while the Pleiades are 440 light-*years* in the background. That's 45 million times farther away. To put this in scale-model perspective: If Venus were a shiny dust speck floating three inches in front of your eye, the Pleiades stars would be 1,200 miles behind it halfway across the continent: blue-white-hot marbles and peas, searingly brilliant, scattered in a volume of black space about 30 miles wide.

Saturday, April 4

■ At this time of year, the two Dog Stars stand vertically aligned around the end of twilight. Look southwest. Sirius in Canis Major is the brightest point in the sky after Venus. Procyon in Canis Minor is above Sirius, by about two fists at arm's length.

■ Look to the right or lower right of the gibbous Moon this evening for Regulus, the leading star of Leo. They're about 5° apart for North America. Above the Moon by a similar distance or a bit more is Algieba, the second-brightest star in the Sickle of Leo after Regulus. The Sickle, a backward question mark, forms the stick-figure Lion's head, neck, chest, and front foot.

Sunday, April 5

■ Right after dark, Orion is still well up in the southwest but in his spring orientation: striding down to the right, with his belt horizontal. The belt points left toward Sirius and right toward Aldebaran and, farther on, Venus and the Pleiades.

Look at Orion's two shoulders. Orange Betelgeuse is obviously brighter than Bellatrix to its lower right, now that Betelgeuse has been steadily recovering brightness for almost two months. In early February it bottomed out at magnitude 1.6, the same as steady Bellatrix. As of March 29th Betelgeuse had doubled in brightness back to 0.9. The dust clouds in its outer atmosphere are clearing, if that's what its problem was.

Monday, April 6

■ Vega, the bright "Summer Star," rises in the northeast late these evenings. Exactly where should you watch for it to come up? Spot the Big Dipper almost overhead in the northeast. Look at Mizar at the bend of its handle. If you can see Mizar's tiny, close companion Alcor (binoculars show it easily), follow a straight line from Mizar through Alcor all the way down to the horizon. That's where Vega will be when it makes its appearance.

Tuesday, April 7

■ Full Moon (exactly so at 10:35 p.m. EDT). This is a "supermoon," meaning it appears just a trace larger than average; the Moon was at perigee less than a day ago.

The Moon shines in central Virgo. Look for bright Arcturus two or three fists at arm's length to its left, and Spica much closer below the Moon or to its lower right.

Source: Sky & Telescope Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height*	Appears	Disappears
Fri Apr 3, 8:49 PM	3 min	67°	22° above NW	47° above E
Sat Apr 4, 8:01 PM	5 min	40°	15° above NW	12° above ESE
Sat Apr 4, 9:38 PM	1 min	19°	12° above W	19° above WSW
Sun Apr 5, 8:52 PM	2 min	37°	27° above W	26° above S
Mon Apr 6, 8:05 PM	4 min	67°	42° above WNW	11° above SE
Tue Apr 7, 8:55 PM	2 min	12°	10° above WSW	10° above SSW

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

NASA-TV Highlights

(all times Eastern Daylight Time)

April 3, Friday
11 p.m. - SpaceCast Weekly - (All Channels)

April 6, Monday
4 p.m. - Video file of the International Space Station Expedition 63/Soyuz MS-16 rollout to the launch pad and launch pad interviews at the Baikonur Cosmodrome in Kazakhstan – Johnson Space Center via Baikonur, Kazakhstan (Media Channel)

April 7, Tuesday
8:45 a.m. - Coverage of the departure of the SpaceX/Dragon cargo craft from the International Space Station; release scheduled at 9:15 a.m. EDT - Johnson Space Center (All Channels)

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

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Space Calendar

- Apr 03 - Mercury Passes 1.4 Degrees From Neptune
- Apr 03 - Venus Passes 0.3 Degrees from the Pleiades
- Apr 03 - Comet 82P/Gehrels Closest Approach To Earth (3.074 AU)
- Apr 03 - Apollo Asteroid 2020 FK3 Near-Earth Flyby (0.027 AU)
- Apr 03 - Asteroid 15332 CERN Closest Approach To Earth (1.450 AU)
- Apr 03 - Asteroid 22903 Georgeclooney Closest Approach To Earth (1.924 AU)
- Apr 03 - Asteroid 245983 Machholz Closest Approach To Earth (2.231 AU)
- Apr 03 - Asteroid 4772 Frankdrake Closest Approach To Earth (2.363 AU)
- Apr 04 - Comet C/2018 X2 (Fitzsimmons) Closest Approach To Earth (2.881 AU)
- Apr 04 - Comet 59P/Kearns-Kwee At Opposition (3.344 AU)
- Apr 04 - Asteroid 2 Pallas Occults UCAC4 514-095716 (12.1 Magnitude Star)
- Apr 04 -  [Mar 30] Apollo Asteroid 2020 FL6 Near-Earth Flyby (0.013 AU)
- Apr 04 - Apollo Asteroid 2015 FC35 Near-Earth Flyby (0.027 AU)
- Apr 04 - Asteroid 90125 Chrissquire Closest Approach To Earth (1.600 AU)
- Apr 04 - Asteroid 4370 Dickens Closest Approach To Earth (1.635 AU)
- Apr 04 - Asteroid 6 Hebe Closest Approach To Earth (1.951 AU)
- Apr 04 - Amor Asteroid 7358 Oze Closest Approach To Earth (2.240 AU)
- Apr 04 - Asteroid 3174 Alcock Closest Approach To Earth (2.354 AU)
- Apr 04 - Asteroid 300221 Brucebills Closest Approach To Earth (2.595 AU)
- Apr 05 - Comet C/2019 J3 (ATLAS) At Opposition (2.999 AU)
- Apr 05 - Apollo Asteroid 2020 DT3 Near-Earth Flyby (0.045 AU)
- Apr 05 - Centaur Object 31824 Elatus At Opposition (15.230 AU)
- Apr 05 - 10th Anniversary (2010), STS-131 Launch (Space Shuttle Discovery, ISS)
- Apr 05 - 30th Anniversary (1990), 1st Pegasus Rocket Launch
- Apr 05 - Franklin Chang-Diaz's 70th Birthday (1950)
- Apr 05 - Donald Lynden-Bell's 85th Birthday (1935)
- Apr 06 -  [Mar 31] CRS-20 Dragon Capsule Return to Earth (International Space Station)
- Apr 06 - Comet C/2002 R5 (SOHO) Closest Approach To Earth (1.564 AU)
- Apr 06 - Comet 82P/Gehrels At Opposition (3.075 AU)
- Apr 06 -  [Mar 31] Apollo Asteroid 2020 FQ6 Near-Earth Flyby (0.046 AU)
- Apr 06 - Asteroid 7032 Hitchcock Closest Approach To Earth (1.328 AU)
- Apr 06 - Asteroid 1373 Cincinnati Closest Approach To Earth (3.693 AU)
- Apr 06 - 55th Anniversary (1965), Intelsat 1 Launch (1st Commercial Communications Satellite)
- Apr 06 - Andre-Louis Danjon's 130th Birthday (1890)
- Apr 07 -  [Mar 31] Super Pink Moon
- Apr 07 - Comet 87P/Bus Closest Approach To Earth (1.115 AU)
- Apr 07 - Comet 278P/McNaught At Opposition (1.408 AU)
- Apr 07 - Comet 91P/Russell Closest Approach To Earth (1.952 AU)
- Apr 07 - Comet 246P/NEAT Closest Approach To Earth (2.376 AU)
- Apr 07 - Comet P/2005 T2 (Christensen) Perihelion (2.245 AU)
- Apr 07 - Hyperbolic Object A/2019 S4 Perihelion (3.442 AU)
- Apr 07 - Asteroid 2864 Soderblom Closest Approach To Earth (1.475 AU)
- Apr 07 - Asteroid 55555 DNA Closest Approach To Earth (1.801 AU)
- Apr 07 - Asteroid 10792 Ecuador Closest Approach To Earth (2.281 AU)
- Apr 07 - Asteroid 41488 Sinbad Closest Approach To Earth (2.968 AU)
- Apr 07 - Webinar: Illustrating the Impact of the Mathematical Sciences - Climate and Weather

Source: JPL Space Calendar Return to Contents

Food for Thought

Astronaut Pee Will Help Build Bases on the Moon

In the next few decades, NASA, the European Space Agency (ESA), China, and Russia all plan to create outposts on the lunar surface that will allow for a permanent human presence. These proposals seek to leverage advances in additive manufacturing (aka. 3-D printing) with In-Situ Resource Utilization (ISRU) to address the particular challenges of living and working on the Moon.

For the sake of their International Moon Village, the ESA has been experimenting with "lunacrete" – lunar regolith combined with a bonding agent to create a building material. But recently, a team of researchers conducted a study (in cooperation with the ESA) that found that lunacrete works even better if you add a special ingredient that the astronauts make all by themselves – urine!

More specifically, the chemical urea, an organic compound found in the urine of animals. The team responsible for this find was led by Shima Pilehvar of Østfold University College and included members from Norway, Spain, the Netherlands, and Italy. Their research, which recently appeared in the *Journal of Cleaner Production*, was supported by the ESA's European Space Research and Technology Centre (ESTEC).

This 1.5 tonne building block was produced as a demonstration of 3D printing techniques using lunar soil. Credit: ESA

As they describe in their study, the team conducted several experiments to determine the potential of urea to act as a plasticizer. When incorporated into concrete, they wanted to see if it would soften the initial mixture and make it more pliable prior to hardening. Testing this involved the use of simulated lunar regolith developed by ESA with urea and various plasticizers and then 3-D printing the resulting product.

Ramón Pamies, a professor with the Polytechnic University of Cartagena (UPCT) and a co-author on the study, described how lunacrete will be made by astronauts in a recent Sinc press release:

"To make the geopolymer concrete that will be used on the moon, the idea is to use what is there: regolith (loose material from the moon's surface) and the water from the ice present in some areas. But moreover, with this study we have seen that a waste product, such as the urine of the personnel who occupy the moon bases, could also be used. The two main components of this body fluid are water and urea, a molecule that allows the hydrogen bonds to be broken and, therefore, reduces the viscosities of many aqueous mixtures."

The experiments were carried out at Østfold University College in Norway, where the samples were fashioned and tested. They were also subjected to analysis at UPCT using a technique known as X-ray diffraction. What the experiments showed was that samples made with urea were able to tolerate hight weight loads while remaining almost entirely in the same shape.

To see how they would endure extreme temperature variations, like those present on the Moon, the samples were also heated to 80 °C (176 °F) and then frozen, over and over. After eight freeze-thaw cycles, their resistance was tested again and found to be even stronger. In short, these tests showed that another in-situ practice (using the latrine) could aid in the construction of lunar bases that can handle the elements.

While these results are encouraging (if a bit), the team stresses that further testing needs to be done and an extraction process is yet to be designed. As Anna-Lena Kjøniksen, a researcher from Østfold University College who supervised the study, indicated:

"We have not yet investigated how the urea would be extracted from the urine, as we are assessing whether this would really be necessary, because perhaps its other components could also be used to form the

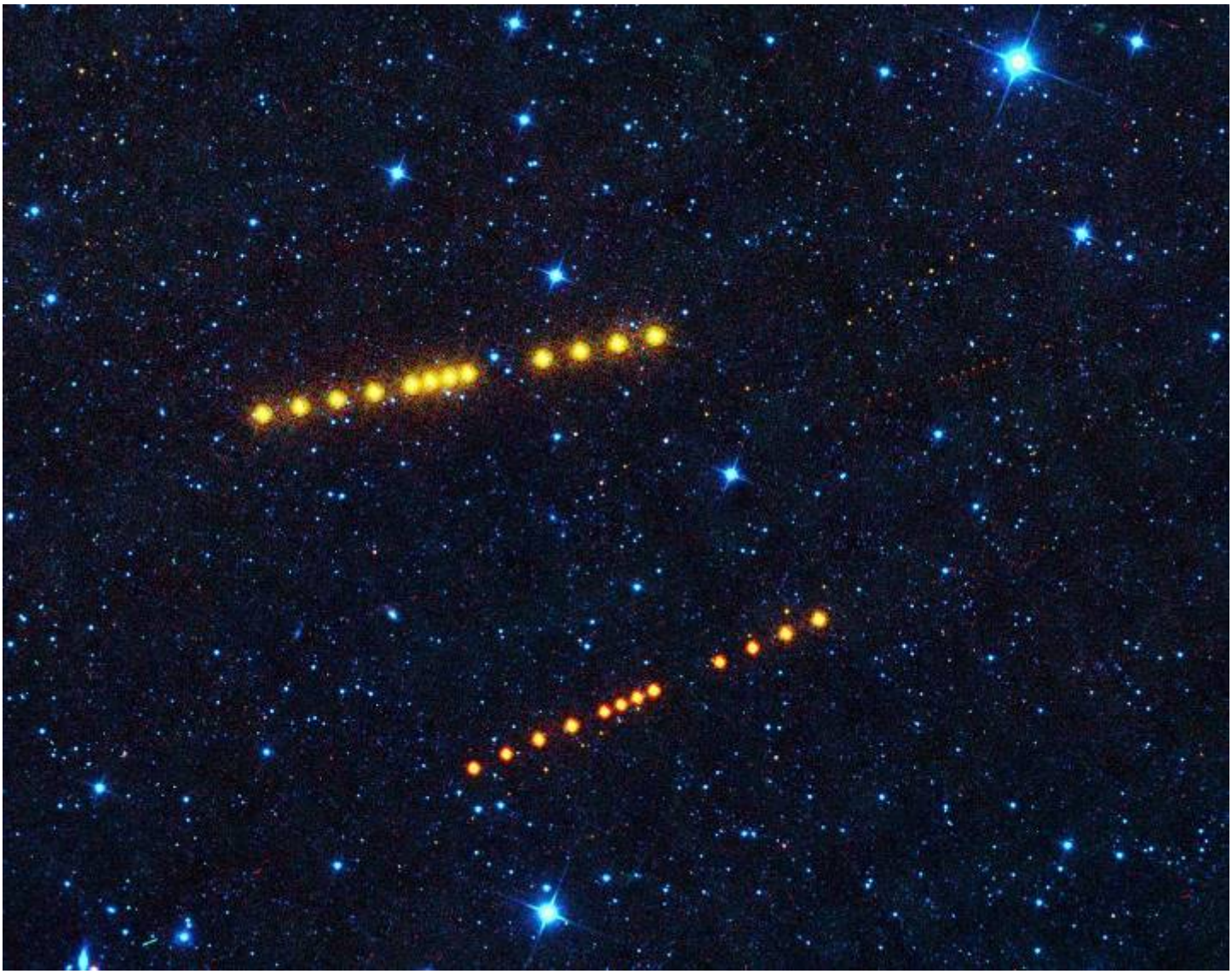
geopolymer concrete. The actual water in the urine could be used for the mixture, together with that which can be obtained on the Moon, or a combination of both."

The team also stressed the need for further testing to see which building material would be optimal for the creation of lunar bases. In addition to resilience and tolerance of extreme heat and cold, it will also need to be something that can be mass-produced by 3-D printers. Alas, these are just one of the challenges of building a lunar base.

But as this study shows, such challenges provide the opportunity to get creative. As get closer and closer to the point where key lunar missions are scheduled – like Project Artemis, just for starters – we can expect that more creative solutions will be proposed.

Source: Universe Today Return to Contents

Space Image of the Week



Klotho and Lina

Appearing as strings of orange dots, the brightest sets of dots belong to asteroids Klotho and Lina. Both orbit out in the main asteroid belt between Mars and Jupiter, while smaller, more distant asteroids can also be seen passing through the image.

These asteroids were imaged by NEOWISE, the asteroid-hunting portion of the Wide-field Infrared Survey Explorer (WISE) mission. NEOWISE harvests measurements of asteroids and comets from the WISE images and provides a rich archive for solar system objects.

Image Credit: NASA/JPL-Caltech/UCLA

Source: NASA

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