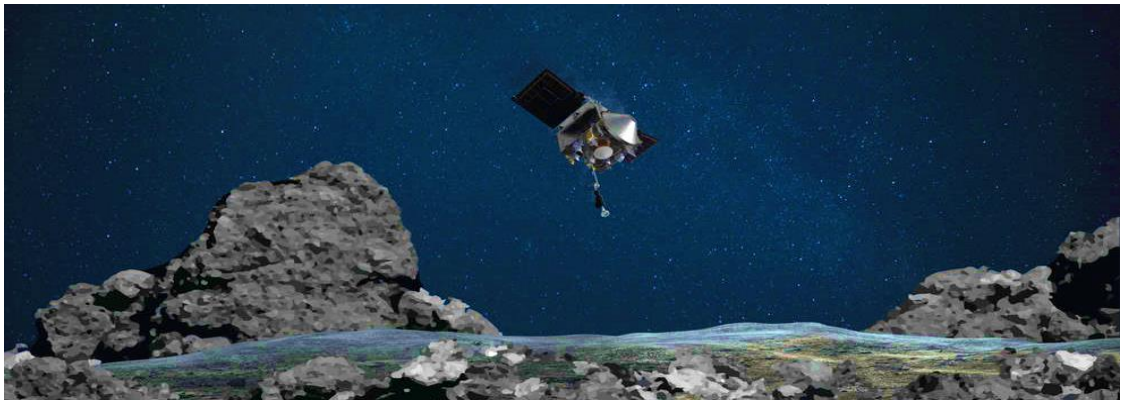
Space News Update

— May 26, 2020 —

Contents

1. NASA's OSIRIS-REx Ready for Touchdown on Asteroid Bennu



This illustration shows NASA's OSIRIS-REx spacecraft descending towards asteroid Bennu to collect a sample of the asteroid's surface. Credits: NASA/Goddard/University of Arizona

Now, we can circle October 20th on our calendars, as the date OSIRIS-Rex will collect its sample. NASA's first asteroid sample return mission is officially prepared for its long-awaited touchdown on asteroid Bennu's surface. The Origins, Spectral Interpretation, Resource Identification and Security – Regolith Explorer (OSIRIS-REx) mission has targeted Oct. 20 for its first sample collection attempt.

"The OSIRIS-REx mission has been demonstrating the very essence of exploration by persevering through unexpected challenges," said Thomas Zurbuchen, NASA's associate administrator for science. "That spirit has led them to the cusp of the prize we all are waiting for – securing a sample of an asteroid to bring home to Earth, and I'm very excited to follow them through the home stretch."

From discovering Bennu's surprisingly rugged and active surface, to entering the closest-ever orbit around a planetary body, OSIRIS-REx has overcome several challenges since arriving at the asteroid in December 2018. Last month, the mission brought the spacecraft 213 ft. (65 m) from the asteroid's surface during its first sample collection rehearsal — successfully completing a practice run of the activities leading up to the sampling event.

Now that the mission is ready to collect a sample, the team is facing a different kind of challenge here on Earth. In response to COVID-19 constraints and after the intense preparation for the first rehearsal, the OSIRIS-REx mission has decided to provide its team with additional preparation time for both the final rehearsal and the sample collection event. Spacecraft activities require significant lead time for the development and testing of operations, and given the current requirements that limit in-person participation at the mission support area, the mission would benefit from giving the team additional time to complete these preparations in the new environment. As a result, both the second rehearsal and first sample collection attempt will have two extra months for planning.

"In planning the mission, we included robust schedule margin while at Bennu to provide the flexibility to address unexpected challenges," said Rich Burns, OSIRIS-REx project manager at NASA's Goddard Space Flight Center. "This flexibility has allowed us to adapt to the surprises that Bennu has thrown at us. It's now time to prioritize the health and safety of both team members and the spacecraft."

The mission had originally planned to perform the first Touch-and-Go (TAG) sample collection event on Aug. 25 after completing a second rehearsal in June. This rehearsal, now scheduled for Aug. 11, will bring the spacecraft through the first three maneuvers of the sample collection sequence to an approximate altitude of 131 ft. (40 m) over the surface of Bennu. The first sample collection attempt is now scheduled for Oct. 20, during which the spacecraft will descend to Bennu's surface and collect material from sample site Nightingale.

"This mission's incredible performance so far is a testament to the extraordinary skill and dedication of the OSIRIS-REx team," said Dante Lauretta, OSIRIS-REx principal investigator at the University of Arizona, Tucson. "I am confident that even in the face of the current challenge, this team will be successful in collecting our sample from Bennu."

During the TAG event, OSIRIS-REx's sampling mechanism will touch Bennu's surface for approximately five seconds, fire a charge of pressurized nitrogen to disturb the surface, and collect a sample before the spacecraft backs away. The mission has resources onboard for three sample collection opportunities. If the spacecraft successfully collects a sufficient sample on Oct. 20, no additional sampling attempts will be made. The spacecraft is scheduled to depart Bennu in mid-2021, and will return the sample to Earth on Sept. 24, 2023.

OSIRIS-REx uncovered a few surprises at Bennu. Shortly after arriving at the asteroid, the spacecraft discovered particles being ejected. That makes Bennu an "active asteroid," or one that is losing mass. In Bennu's case, its mass loss is episodic rather than continuous. Some of the ejected particles orbited the asteroid for a few days before falling back to the surface, while some were ejected into space.

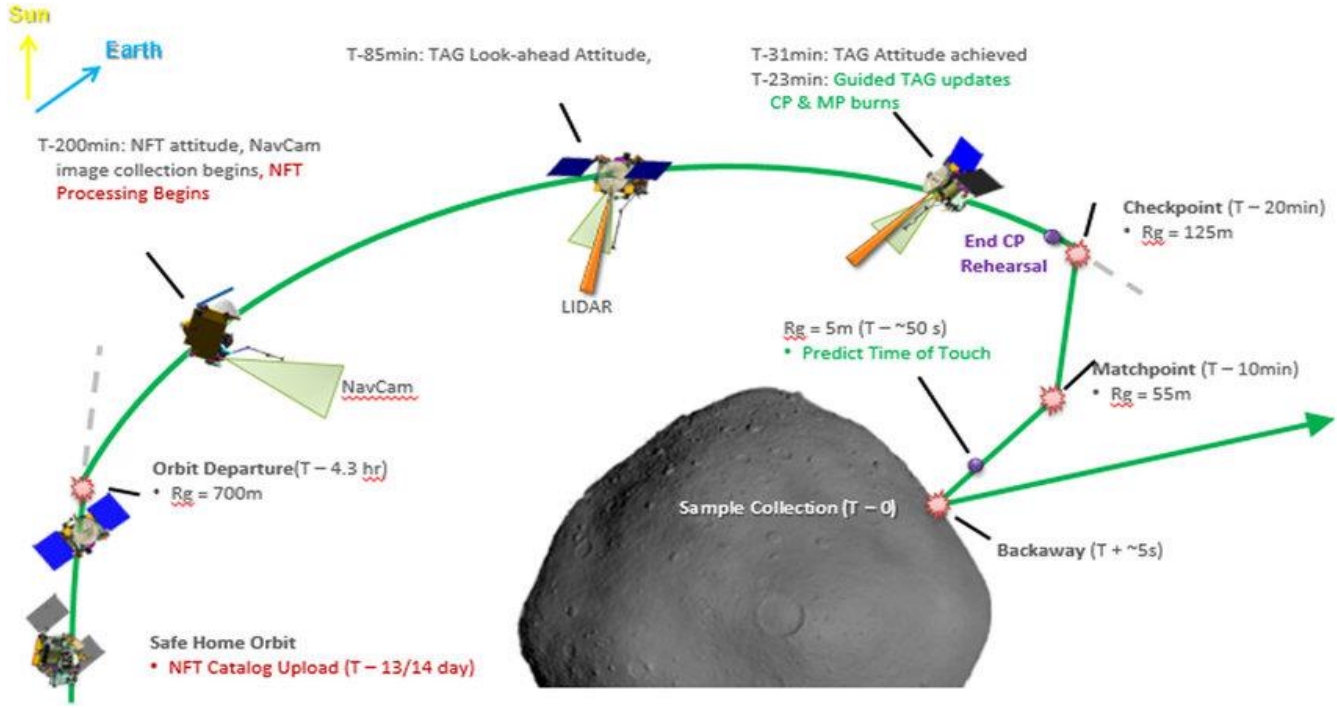
According to one study, there were three causes for these ejected particles: meteoroid impacts, thermal stress fracturing, or release of water vapor.

Bennu's surface was also a surprise. Rather than a more uniform surface with lots of suitable sampling locations, the surface is a mayhem of jumbled, hazardous boulders. That's why finding a sampling site, and a backup site, has takes as long as it has.

On October 20th, OSIRIS-REx will approach Nightingale using its Natural Feature Tracking (NFT) system to guide itself to the surface. The NFT uses a database of onboard images of Bennu's surface, and compares them to what its cameras are seeing in real time as it descends. By comparing the two, the spacecraft can guide itself around hazardous boulders.

If it gets into trouble, it can autonomously abort and put itself back into a safe orbital position. OSIRIS-REx has enough resources for three sample attempts.

The sampling procedure itself will be over fairly quickly. The spacecraft will touch the surface of Bennu with its sampling mechanism, called TAGSAM, or Touch-And-Go Sample Acquisition Mechanism. TAGSAM will emit a puff of nitrogen gas and then collect airborne particles from Bennu's regolith. That puff-then-collect action will take just five seconds.



A diagram showing OSIRIS-REx's sampling maneuver. The maneuver will is now scheduled for October 20th, 2020. Image Credit: NASA/GSFC/UA

Source: NASA and Universe Today

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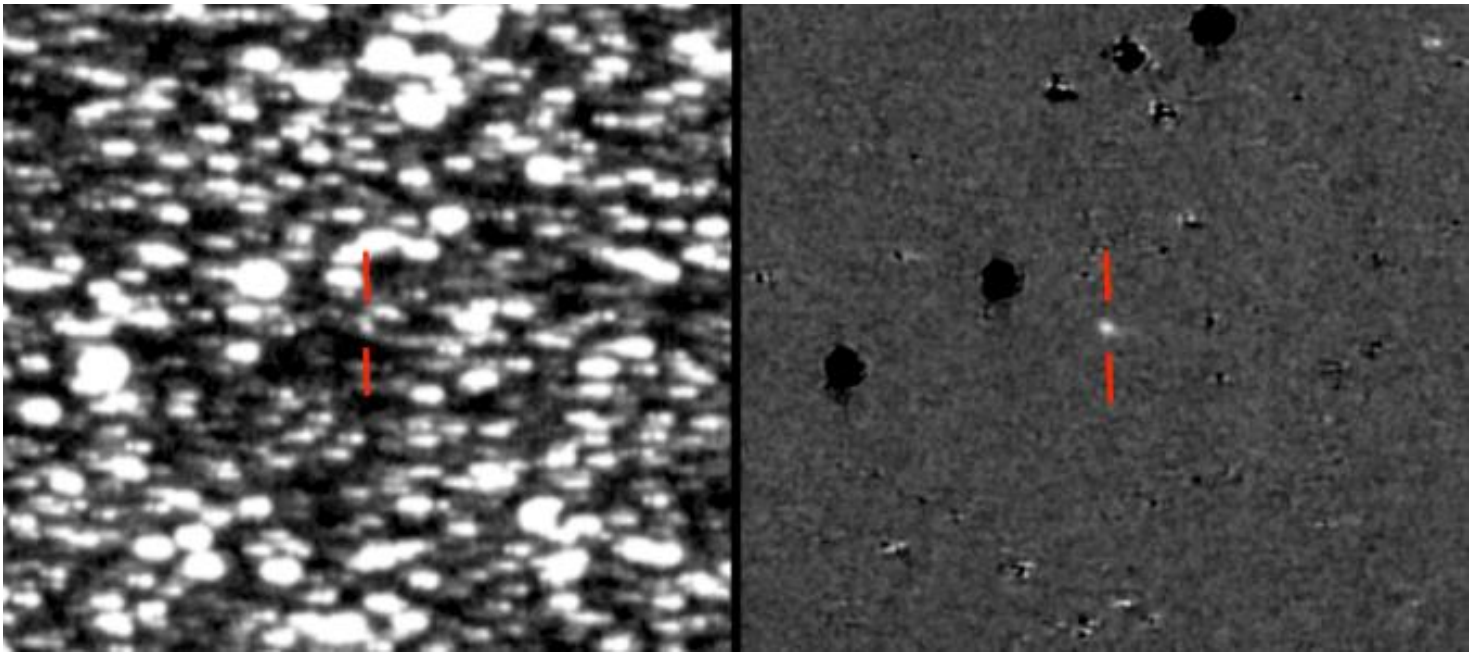
2. Univ. of Hawaii ATLAS Telescope Discovers First-Of-Its-Kind Asteroid



(Left) ATLAS image of 2019 LD2 almost lost in crowded field of stars. (Right) Shown with stars subtracted, image reveals tiny comet with faint tail. (Photo credit: ATLAS/Ari Heinze/IfA)

Asteroids and comets are often thought of as distinct types of small bodies, but astronomers have discovered an increasing number of "crossovers." These objects initially appear to be asteroids, and later develop activity, such as tails, that are typical of comets.

The University of Hawai'i's Asteroid Terrestrial-impact Last Alert System (ATLAS) is now behind the discovery of the first known Jupiter Trojan asteroid to have sprouted a comet-like tail. The Minor Planet Center (MPC) designated the new discovery as 2019 LD2, found near the orbit of Jupiter. The MPC is the single worldwide location for receipt and distribution of positional measurements of minor planets, comets and outer irregular natural satellites of the major planets. ATLAS is a NASA-funded project using wide-field telescopes to rapidly scan the sky for asteroids that might pose an impact threat to Earth.

"Even though the ATLAS system is designed to search for dangerous asteroids, ATLAS sees other rare phenomena in our solar system and beyond while scanning the sky," said ATLAS project principal investigator Larry Denneau. "It's a real bonus for ATLAS to make these kinds of discoveries."

Early in June 2019, ATLAS reported what seemed to be a faint asteroid near the orbit of Jupiter. Inspection of ATLAS images taken by collaborators Alan Fitzsimmons and David Young at Queen's University Belfast revealed its probable cometary nature. Follow-up observations by UH astronomer J.D. Armstrong and student Sidney Moss on June 11 and 13 using the Las Cumbres Observatory global telescope network confirmed the cometary nature of this body.

In July, new ATLAS images caught 2019 LD2 again—now truly looking like a comet, with a faint tail made of dust or gas. The asteroid reappeared in April 2020 during routine ATLAS observations that confirmed it still looked like a comet. Those observations showed that 2019 LD2 has probably been continuously active for almost a year.

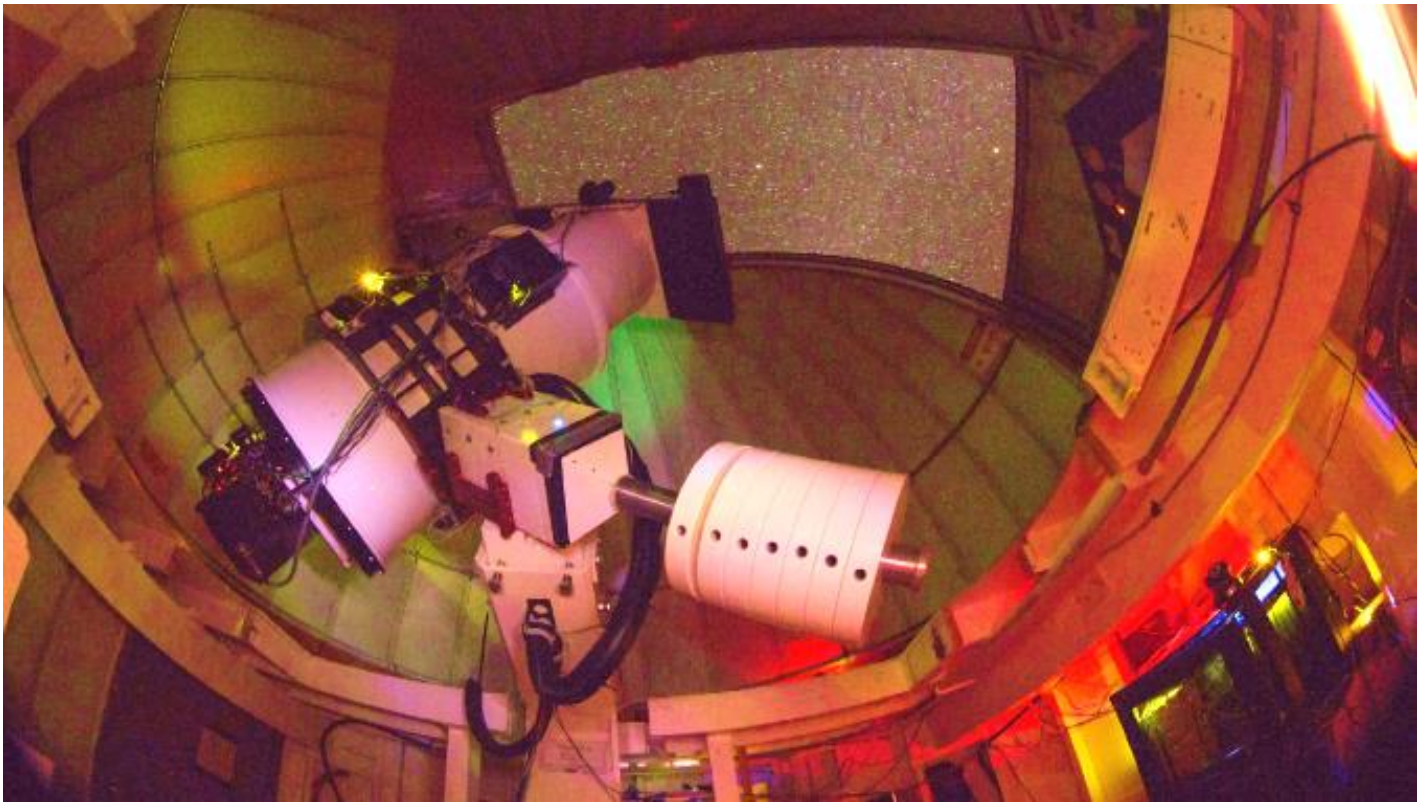
Why this asteroid is considered rare

ATLAS has discovered more than 40 comets but what researchers find extraordinary is 2019 LD2's orbit. The early indication that it was an asteroid near Jupiter's orbit has now been confirmed through precise

measurements from many different observatories. 2019 LD2 is a special kind of asteroid called a Jupiter Trojan, and no object of this type has ever before been seen to spew out dust and gas like a comet.

Trojan asteroids have been captured into these orbits by Jupiter's strong gravity. What fascinates researchers about 2019 LD2, is most thought Jupiter Trojans were captured into orbit billions of years ago. Any surface ice that could vaporize to spew out gas and dust should have done so long ago, leaving the objects quietly orbiting as asteroids–not behaving like comets.

It isn't clear what caused 2019 LD2 to suddenly show cometary behavior. Some believe Jupiter captured it recently from a more distant orbit where surface ice could still survive. Researchers also said it could have suffered a recent landslide or an impact from another asteroid, exposing ice that used to be buried under layers of protective rock. New observations are being acquired and evaluated.



ATLAS telescope unit on Haleakalā, Maui. (Photo credit: Henry Weiland)

Source: University of Hawaii

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3. Laser-Powered Rover to Explore Moon's Dark Shadows

RAT rover by night. Credit: Fernando Gandía/GMV

A laser light shone through the dark could power robotic exploration of the most tantalizing locations in our solar system: the permanently-shadowed craters around the moon's poles, believed to be rich in water ice and other valuable materials.

ESA's Discovery & Preparation program funded the design of a laser system to keep a rover supplied with power from up to 15 km away while it explores some of these dark craters.

At the highest lunar latitudes, the sun stays low on the horizon all year round, casting long shadows that keep sunken craters mired in permanent shadow, potentially on a timescale of billions of years. Data from NASA's Lunar Reconnaissance Orbiter, India's Chandrayaan-1 and ESA's SMART-1 orbiters show these "permanently shadowed regions" are rich in hydrogen, strongly suggesting water ice can be found there.

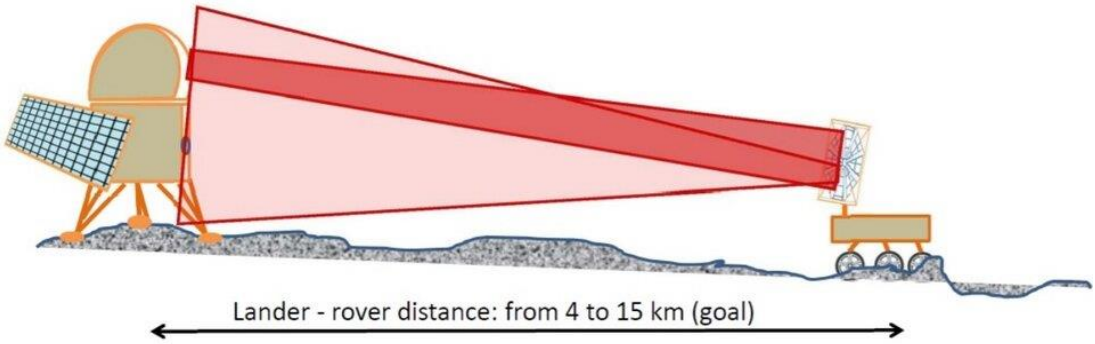
As well as having scientific interest, this ice would be valuable to lunar colonists, as a source of drinking water, oxygen for breathing, as well as a source of hydrogen rocket fuel. But to know for certain requires going into these darkened craters and drilling.

Any rover prospecting the shadowed regions would have to do without solar power, while contending with temperatures comparable to the surface of Pluto, down to –240°C, just 30 degrees above absolute zero.

"The standard suggestion for such a situation is to fit the rover with nuclear-based radioisotope thermoelectric generators," comments ESA robotics engineer Michel Van Winnendael. "But this presents problems of complexity, cost and thermal management—the rover could warm up so much that prospecting and analyzing ice samples actually becomes impractical.

"As an alternative, this study looked at harnessing a laser-based power system, inspired by terrestrial laser experiments to keep drones powered and flying for hours on end."

The 10-month PHILIP, "Powering rovers by High Intensity Laser Induction on Planets," contract was undertaken for ESA by Italy's Leonardo company and Romania's National Institute of Research and Development for Optoelectronics, coming up with a complete laser-powered exploration mission design.

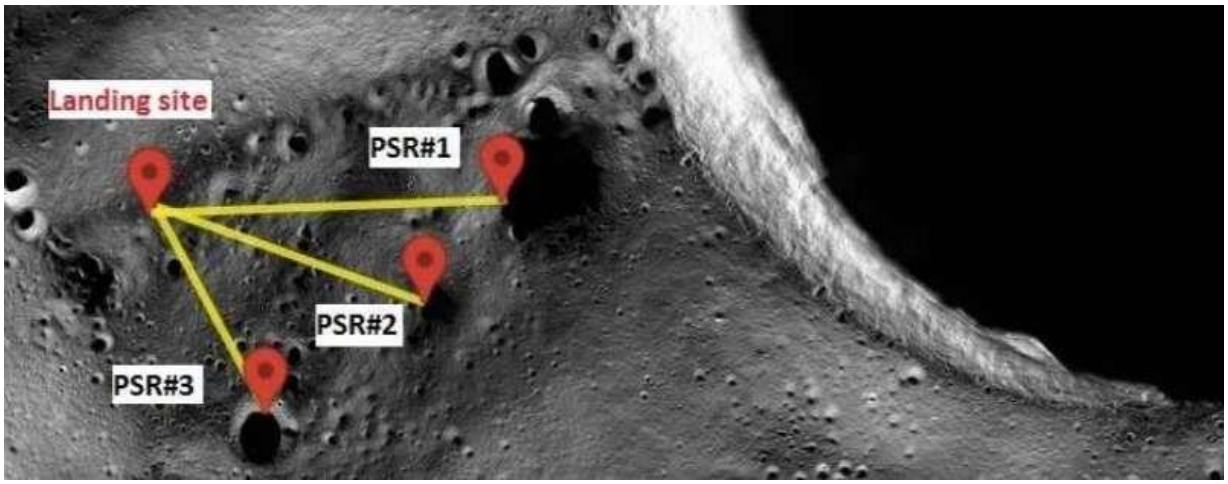


Laser powering moon rover from lander. Credit: ESA/Leonardo

This included selecting a location for the mission lander, in a near-permanently sunlit region between the South Pole's de Gerlache and Shackleton craters. This lander would host a solar-powered 500-watt infrared laser, which it would keep trained on a 250 kg rover as it entered the shadowed regions.

The rover would convert this laser light into electrical power using a modified version of a standard solar panel, with photodiodes on the sides of the panel keeping it locked onto the laser down to centimeter-scale accuracy.

The study identified routes that would take the rover downward at a relatively gentle 10 degrees of slope while keeping it in the lander's direct line of sight. The laser beam could be used as a two-way communications link, with a modulating retro-reflector mounted on the second of the rover's solar panels, sending signal pulses in light reflected back to the lander.



Landing site and exploration options. Credit: ESA/Leonardo

Guiding the project requirements, ESA has previously performed field tests at night in moon-like Tenerife to simulate rover operations in permanent shadow.

Michel adds: "With the PHILIP project completed, we are one step closer to powering rovers with lasers to explore the dark parts of the moon. We're at the stage where prototyping and testing could begin, undertaken by follow-up ESA technology programs."

Source: European Space Agency Return to Content

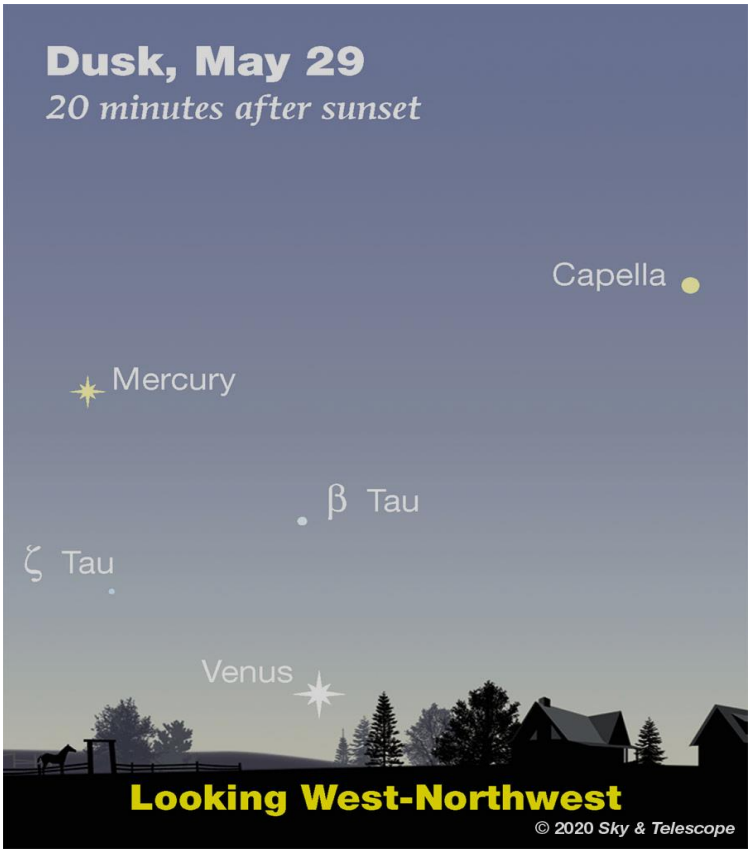
The Night Sky

TUESDAY, MAY 26

- Now the waxing crescent Moon poses in a roughly horizontal line with Pollux and Castor, which shine to its right.
- Have you ever seen Alpha Centauri? At declination –61° it's permanently out of sight if you're north of latitude 29° N. But if you're at the latitude of San Antonio, Orlando, or points south, Alpha Cen skims just above your true southern horizon for a little while late these evenings.
  When does this happen? Just about when Alpha Librae, the lower-right of Libra's two brightest stars, is due south over your landscape. At that time, drop your gaze down from there.

WEDNESDAY, MAY 27

- With summer just three weeks away (astronomically speaking), the last star of the Summer Triangle rises above the eastern horizon at the end of twilight. That's Altair, the Triangle's lower right corner. Its highest and brightest corner is Vega. The third is Deneb, sparkling less far to Vega's lower left.



Wave goodbye to Venus, just five days from its solar conjunction. But in less than a month it'll be jumping up in the eastern dawn.

THURSDAY, MAY 28

- The Moon shines under the Sickle of Leo after dark. The Sickle runs from Regulus, its handle-end left of the Moon, to its dimmer hook at the Moon's upper right (for North America).

FRIDAY, MAY 29

- First-quarter Moon, exact at 11:30 p.m. Eastern Daylight Time. As the stars come out the Moon is high in the southwest, below the belly of Leo's stick-figure lion pattern.

  The Moon forms a nearly equilateral triangle with Leo's Regulus to its lower right and Gamma Leonis (Algieba), slightly fainter, more directly to the Moon's right, depending on your location. The triangle is just about perfectly equilateral, 8° on a side, at the time of late twilight for the East Coast of North America.

SATURDAY, MAY 30

- Bright Capella is still up in the northwest in twilight, as shown above, but it sets in the northwest fairly soon after dark (depending on your latitude). That leaves Vega and Arcturus as the brightest two stars in the evening sky. Both are magnitude 0. Vega shines in the east-northeast. Arcturus is *very* high toward the south.
  A third of the way from Arcturus to Vega, look for semicircular Corona Borealis, the Northern Crown, with 2nd-magnitude Alphecca as its one moderately bright star.

Source: Sky and Telescope

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ISS Sighting Opportunities (from Denver)

Date	Visible	Max Height	Appears	Disappears
Tue May 26, 9:20 PM	2 min	11°	10° above N	10° above NNE
Tue May 26, 10:58 PM	1 min	26°	20° above N	26° above NNE
Wed May 27, 10:10 PM	3 min	19°	17° above N	12° above ENE
Wed May 27, 11:45 PM	1 min	18°	10° above NW	18° above WNW
Thu May 28, 9:22 PM	3 min	15°	13° above N	11° above NE
Thu May 28, 10:58 PM	1 min	50°	22° above NW	50° above NNW
Fri May 29, 10:11 PM	2 min	38°	24° above NNW	30° above ENE
Fri May 29, 11:47 PM	< 1 min	11°	11° above W	11° above W

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

NASA-TV Highlights (all times Eastern Time Zone)

May 26, Tuesday

- 10 a.m. – SpaceX Demonstration Mission 2 Administrator Countdown Clock Briefing (All Channels)
- 3 p.m., 7 p.m., 10 p.m. – Replay of SpaceX Demonstration Mission 2 Administrator Briefing (All Channels)

May 27, Wednesday

- 12 p.m. – Live views of the SpaceX/Falcon 9 rocket on Launch Pad 39-A at the Kennedy Space Center for the Crew Dragon DM-2 launch to the International Space Station (All Channels)
- 12 :15 p.m. - SpaceX Demonstration Mission 2 launch coverage; launch scheduled at 4:33 p.m. EDT - Kennedy Space Center/Hawthorne, California/Johnson Space Center (All Channels)
- 6 p.m. - SpaceX Demonstration Mission 2 postlaunch news conference (All Channels)

May 28, Thursday

- 11:39 a.m. – Docking of the SpaceX/DM-2 Crew Dragon and NASA astronauts Doug Hurley and Bob Behnken to the International Space Station – Hawthorne, California/Johnson Space Center (All Channels)
- 1:55 p.m. – SpaceX/Crew Dragon hatch opening to the International Space Station – Hawthorne, California/Johnson Space Center (All Channels)
- 2:25 p.m. – SpaceX/Crew Dragon and International Space Station crew event aboard the Space Station – Hawthorne, California/Johnson Space Center (All Channels)
- 4 p.m. - SpaceX/Dragon DM-2 post-docking briefing (All Channels)
- 5 p.m. – Video file of SpaceX/DM-2 rendezvous, docking, hatch opening and welcoming ceremony (Media Channel)

May 29, Friday

- 9:30 a.m. - SpaceCast Weekly (All Channels)
- 11:05 a.m. - International Space Station Expedition 63 crew news conference with Commander Chris Cassidy of NASA and astronauts Bob Behnken and Doug Hurley of NASA (All Channels)

Watch NASA TV online by going to the NASA website.

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Space Calendar

- May 26 - Seminar: Parametrization of Stellar Spectra Based on Convolutional Neural Networks, Barcelona, Spain
- May 26 - Online Workshop: Galileo, EGNOS, and Copernicus for Agriculture
- May 26-27 - Planetary Mission Concept Studies Virtual Workshop
- May 26-28 - Gravitational-Wave Open Data Online Workshop #3
- May 26-29 - Conference: Collider, Dark Matter, and Neutrino Physics 2020, College Station, Texas
- **May 27 - SpX-DM2 (Demo 2) Falcon 9 Launch (International Space Station)**
- May 27 - Comet C/2020 F8 (SWAN) Perihelion (0.430 AU)
- May 27 - Apollo Asteroid 2020 JN3 Near-Earth Flyby (0.011 AU)
- May 27 - Apollo Asteroid 2020 KJ3 Near-Earth Flyby (0.020 AU)
- May 27 - Apollo Asteroid 2020 JP2 Near-Earth Flyby (0.030 AU)
- May 27 - Apollo Asteroid 66391 Moshup Closest Approach To Earth (0.160 AU)
- May 27 - Online Colloquium: Emus in Orbit - ANU Payloads for Space-Based Near-Infrared Astronomy and Earth Observation
- May 27 - Webinar: The Unifying Power of Space Debris
- May 27 - Online Seminar: Cyber Warfare in Space
- May 27-28 - 3rd Long-term Ozone Trends and Uncertainties in the Stratosphere (LOTUS) Workshop, Helsinki, Finland
- **May 28 - Aten Asteroid 2020 KJ4 Near-Earth Flyby (0.001 AU**)
- May 28 - Aten Asteroid 2020 KV Near-Earth Flyby (0.018 AU)
- May 28 - Apollo Asteroid 2020 JM1 Near-Earth Flyby (0.024 AU)
- May 28 - Asteroid 4464 Vulcano Closest Approach To Earth (0.990 AU)
- May 28 - NASA Science Virtual Community Town Hall Meeting
- May 28 - Webinar: BASC Session on Aerosols, Air Quality, Short-term Climate Variability, and Virus Seasonality
- May 28 - Online: The Supercluster Conference
- May 28-29 - Virtual: Lunar Surface Science Workshop
- May 29 - Apollo Asteroid 2020 KB Near-Earth Flyby (0.019 AU)
- May 29 - Apollo Asteroid 2020 KD3 Near-Earth Flyby (0.020 AU)
- May 29 - Apollo Asteroid 2020 JV2 Near-Earth Flyby (0.024 AU)
- May 29 - Amor Asteroid 2020 KV1 Near-Earth Flyby (0.0226 AU)
- May 29 - Apollo Asteroid 2020 KU1 Near-Earth Flyby (0.039 AU)
- May 29 - Online Meeting: Future Use of NASA Airborne Platforms to Advance Earth Science Priorities
- May 29-31 - 2nd International Symposium on Atmospheric and Oceanic Sciences, Xiamen, China

Source: JPL Space Calendar Return to Contents

Food for Thought

US Seeks to Change the Rules for Mining the Moon

by Scott Shackelford, The Conversation

Antarctica, a continent that by international agreement is has no armed military activity and is dedicated to scientific inquiry. Credit: NASA/JPL

Private industries have helped drop the cost of launching rockets, satellites and other equipment into space to historic lows. That has boosted interest in developing space—both for mining raw materials such as silicon for solar panels and oxygen for rocket fuel, as well as potentially relocating polluting industries off the Earth. But the rules are not clear about who would profit if, for instance, a U.S. company like SpaceX colonized Mars or established a moon base.

At the moment, no company—or nation—is yet ready to claim or take advantage of private property in space. But the US$350 billion space industry could change quickly. Several companies are already planning to explore the moon to find raw materials like water; Helium-3, which is potentially useful in fusion nuclear reactors; and rare earth elements, which are invaluable for manufacturing electronics. What they might find, and how easy the material is to bring back to Earth, remains to be seen.

Anticipating additional commercial interest, the Trump administration has created new rules through an executive order following a 2015 law change for how those companies might profit from operations on the moon, asteroids and other planets. Those rules conflict with a longstanding international treaty the U.S. has

generally followed but never formally joined. The administration also is planning to encourage other nations to adopt this new U.S. perspective on space mining.

As a scholar of space law and policy – and a proud sci-fi nerd – I believe the international community could find new ways to peacefully govern space from examples here on our planet, including deep seabed mining and Antarctica.

Who owns space?

In general, regions of Earth beyond any one nation's control—like the high seas, the atmosphere and Antarctica—have been viewed by the international community as globally shared resources. That principle applied to space, too, until President Donald Trump's executive order specifically rejected the idea that space was any sort of "global commons" shared among all nations and peoples of the Earth.

This step is the latest in a series of decisions by U.S. presidents over the last 40 years that have signaled the country's decreasing willingness to share these types of resources, especially through an international body like the United Nations.

That is one reason why the U.S. has not ratified the U.N. Convention on the Law of the Sea, for example, which was agreed to in 1982 and took effect in 1994.

A similar story played out regarding the moon.

Moon Treaty and international space law

Over the decades, the U.S. has sought to use its space policy in various ways. President John F. Kennedy, for example, considered turning the Apollo moon-landing program into a joint U.S.-Soviet mission to promote peace between the superpowers.

Lyndon Johnson's administration similarly saw space as a shared region, and in 1967 signed the Outer Space Treaty, which proclaimed that space was the "province of all mankind." However, that treaty didn't say anything about mining on the moon—so when the U.S. landed there in 1969, the international community called for regulations.

The U.N.'s eventual Moon Treaty declared the moon the "common heritage of mankind," and sought shared international control over resources found there.

However, that plan wasn't very popular among advocates for a more commercial final frontier. In the U.S., a nonprofit group in favor of space colonization opposed the treaty, fearing it would discourage private investment. The treaty failed ratification in the U.S. Senate. Only 18 nations have, in fact, ratified the Moon Treaty among them Mexico and Australia, none of them major space-faring powers. But even though many countries seem to agree that the Moon Treaty isn't the right way to handle lunar property rights, that doesn't mean they agree on what they actually should do.

This movie was captured on July 11, 2019, when Hayabusa-2 touched down on asteroid Ryugu, using the onboard small monitor camera. The video playback speed is 10 times faster than actual time.

Finding profit in space

As space launches got cheaper, the U.S. SPACE Act, passed in 2015, gave U.S. companies the right to mine materials from asteroids for profit. That conflicts with the shared-resources view of the 1967 Outer Space Treaty.

Since then, there have been further political efforts to remove perceived legal hurtles to space mining. In 2017, a Republican congressman sought to formalize the U.S. rejection of space as any sort of common

property, proposing a bill that said, "outer space shall not be considered a global commons." That bill died, but it was reintroduced in 2019 and is currently awaiting action in the House.

A new space race?

Allowing private control of space resources could launch a new space race, in which wealthy companies, likely from developed countries, could take control of crucial resources—like ice on the moon, which could supply water for people or to fuel rockets—and profit handsomely.

That, in turn, would increase the likelihood of a military arms race, with the U.S., Russia and China developing weapons to defend their citizens' space assets.

Applying lessons from the deep, and Antarctica

In finding common ground, and charting a path forward, it is useful to consider lessons from other frontiers. The Moon Treaty tried to set up a system for sharing the benefits of moon mining similar to how an existing system handled mining the deep sea.

The International Seabed Authority is a U.N. body that lets nations and private firms develop resources from the deep seabed so long as they share the proceeds, particularly with landlocked developing nations. It is recognized by more than 160 nations, though the U.S. is a notable holdout.

Environmental groups have criticized the Authority for not doing enough to safeguard fragile marine environments, but the overall model of sharing the wealth from a collective resource could still be useful. For instance, the Authority's participants are working on a new code of ethics for deep-sea mining that would emphasize environmental sustainability. Those provisions could be mirrored on other worlds.

Similarly, the global management of Antarctica has useful parallels with the moon. The entire continent is governed by a treaty that has avoided conflict since 1959 by freezing national territorial claims and barring military and commercial activities. Instead, the continent is reserved for "peaceful purposes" and "scientific investigation."

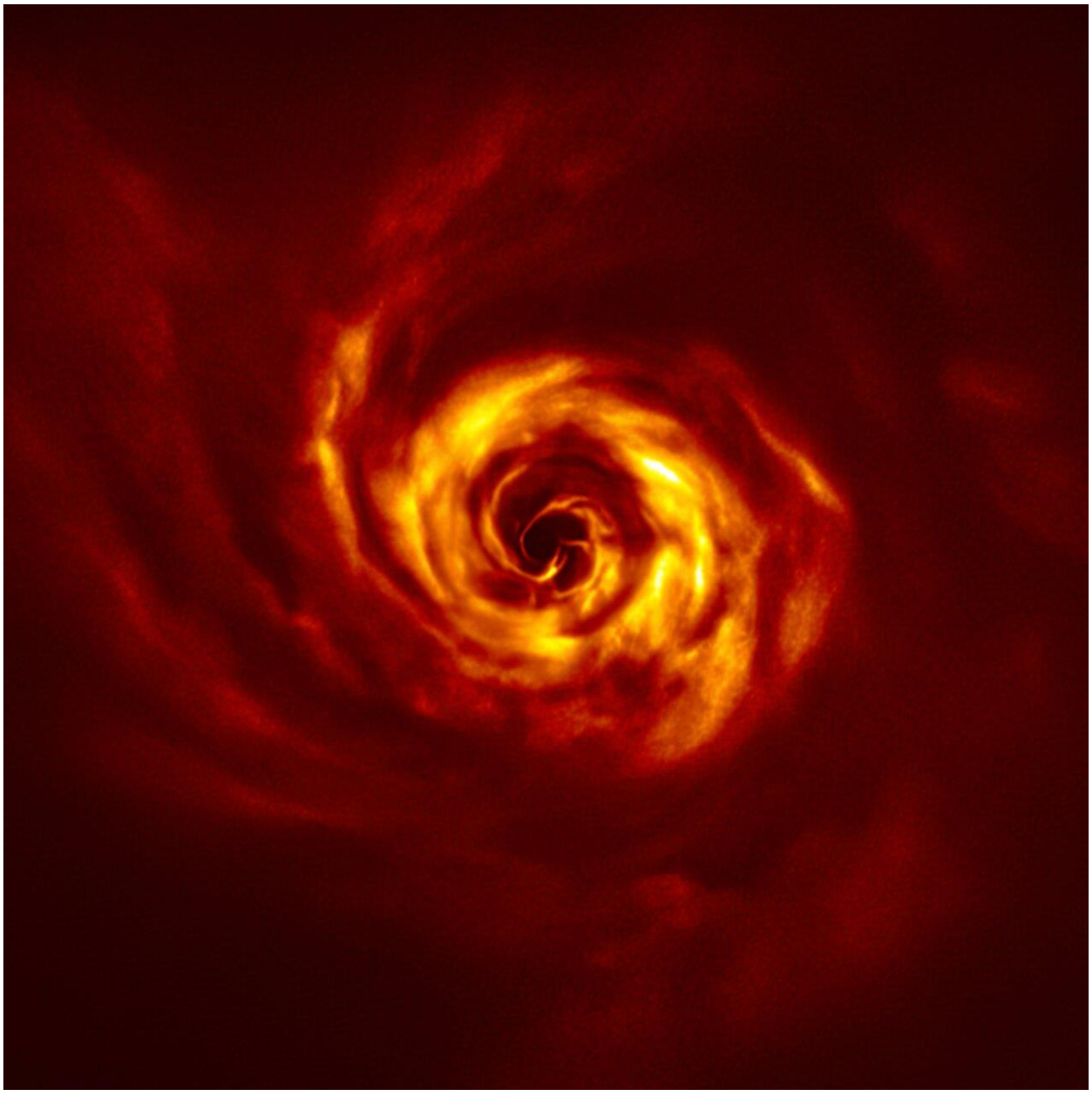
A similar approach could become the core of a second attempt at a Moon Treaty, and could even accommodate a provision for commercial activity along the lines of the deep-sea mining rules. In so doing, we must also learn what has *not* worked in the past, such as ignoring the interests of the private sector and the developing world. Advocates are correct that defining property rights is an important precursor, but it is not a binary choice between a "global commons" or private property, rather there are a universe of rights that deserve consideration and that could provide a proper foundation for sustainable development.

But coming to an international agreement would take time, energy and a widespread willingness to view resources as common assets that should be collectively governed. All those ingredients are in short supply in a world where many countries are becoming more isolationist.

For the immediate future, other countries may or may not follow the U.S. lead, and its influence, toward privatizing space. Japan seems interested, as does Luxembourg, but China and Russia are concerned about their national security, and the European Space Agency is more inclined toward working collectively. Without better coordination, it seems likely that eventually peaceful, sustainable development of off-world resources will give way to competing claims, despite readily available examples of how to avoid conflict.

Source: Phys.org Return to Contents

Space Image of the Week



ESO Telescope Sees Signs of Planet Birth: The Twist Marks the Spot

Credit: ESO/Boccaletti et al.

Explanation: This image shows the disc around the young AB Aurigae star, where ESO's Very Large Telescope (VLT) has spotted signs of planet birth. Close to the center of the image, in the inner region of the disc, we see the 'twist' (in very bright yellow) that scientists believe marks the spot where a planet is forming. This twist lies at about the same distance from the AB Aurigae star as Neptune from the Sun.

The image was obtained with the VLT's SPHERE instrument in polarized light

Source: European Southern Observatory Return to Contents