Space News Update

— May 7, 2019 —

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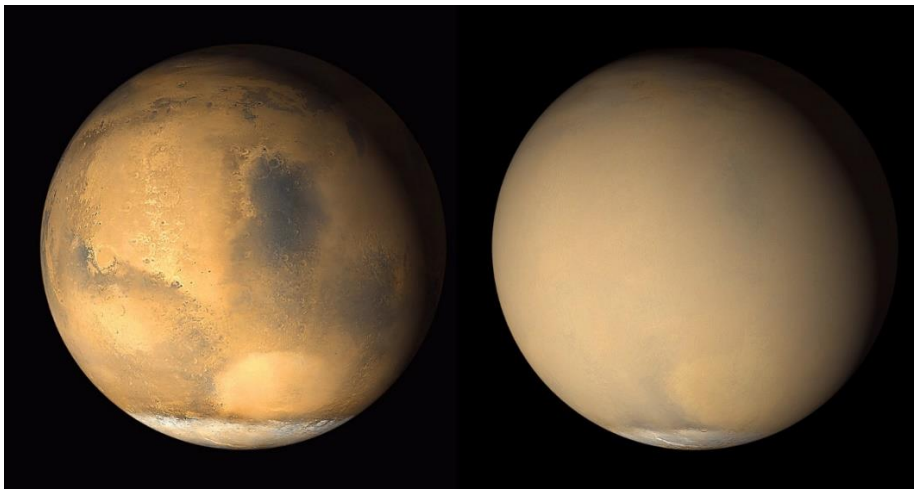
1. Martian Dust Could Help Explain Water Loss, Plus Other Learnings from Global Storm



In mid-July 2018 the NASA/ESA Hubble Space Telescope observed Mars, only 13 days before the planet made its closest approach to Earth in 2018. While previous images showed detailed surface features of the planet, this new image is dominated by a gigantic sandstorm enshrouding the entire planet. Global dust storms — lasting for weeks or months — tend to happen during the spring and summer in the southern hemisphere, when Mars is closest to the Sun and heating is at a maximum, leading to greater generation of winds. Image Credit: NASA/ESA/Hubble STscI

Dust is not just a household nuisance; it's a planetary one, particularly on Mars. Before astronauts visit the Red Planet, we need to understand how the dust particles that often fill the atmosphere could impact them and their equipment.

The global Martian dust storm of summer 2018 — the one that blotted out sunlight for weeks and put NASA's beloved Opportunity rover out of business — offered an unprecedented learning opportunity. For the first time, humans had eight spacecraft orbiting Mars or roving its surface — the largest cadre of robotic explorers ever to watch a global dust storm unfold.

Scientists around the globe are still analyzing reams of data, but preliminary reports include insights on how massive dust storms could have affected ancient Martian water, winds, and climate, and how they could affect future weather and solar power. Martian dust storms are common, especially during southern hemisphere spring and summer. They tend to last a couple of days and can cover regions of the planet the size of the United States. But planet-encircling ones are unpredictable, sometimes lingering for months. Why? "We still don't know what drives the variability, but the 2018 storm gives another data point," says Scott Guzewich, an atmospheric scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, who's a lead in NASA's dust storm investigation.

Here are a few things we saw from space and from the ground during the recent global dust storm that helped address some open questions and exposed new ones: Could global dust storms have blown away the planet's water? Scientists have found loads of evidence that Mars had rivers, lakes and maybe even oceans of water billions of years ago. Dry riverbeds, ancient shorelines, and salty surface chemistry are all clues. But why did much of the water disappear? And how? "The global dust storm may give us an explanation," says Geronimo Villanueva, a Martian water expert at NASA Goddard.

Villanueva worked with colleagues at the ESA (European Space Agency) and Russia's Roscosmos space agency to confirm that powerful, global dust storms appear to loft water vapor from its typical altitude of 12 miles (20 kilometers) above the Martian surface to much higher elevations of at least 50 miles (80 kilometers). NASA's Mars Reconnaissance Orbiter observed a similar phenomenon in 2007.

By thrusting water into the upper atmosphere, global dust storms may interfere with the planet's water cycle, preventing H_2O from condensing and falling back down to the surface. On Earth, H_2O falls back down as rain or snow. The same process could have existed on Mars billions of years ago.

At higher altitudes, where the Martian atmosphere is especially tenuous, solar radiation can easily penetrate to break up the water molecules and blow their component elements into space, Villanueva and his colleagues speculate. "When you bring water to higher parts of the atmosphere, it gets blown away so much easier," says Villanueva, who has spent his career piecing together the history of water on Mars.

Villanueva and his colleagues reported on April 10 in the journal Nature that they found evidence of receding water vapor by using the ExoMars Trace Gas Orbiter at Mars, a spacecraft managed by ESA and Roscosmos. The orbiter measured water molecules at different altitudes before and after the 2018 storm. Scientists saw for the first time that all types of water molecules (there are lighter and heavier ones) reached the "escape region" of the upper atmosphere, which was an important insight into how water may be disappearing from Mars. Now, says Villanueva, scientists will have to take this new information into account in their predictions about how much water flowed on ancient Mars and how long it took for it to disappear.

Global dust storms don't seem to significantly reshape Martian sand dunes. For scientists who track sand dunes shift inches across the surface, the global dust storm offered critical evidence in their investigation of wind patterns on the Red Planet. Only the forceful winds during a global dust storm would be able to move the planet's extensive dunes, scientists once thought, given that Mars' super thin atmosphere makes 100-mile-per-hour wind feel like a breeze. Yet images from orbiters and landers throughout the decades have revealed that Martian sand moves all the time, implying that it doesn't need strong gusts to do so. This was a surprise to researchers.

Now that scientists finally got to watch a global dust storm from the ground through the eyes of NASA's Curiosity rover, they noticed another surprising characteristic of Martian wind: strong gusts don't appear to move sand more than normal. "This has added to the overall mystery of how wind behaves on Mars," says Mariah Baker, a Ph.D. student at Johns Hopkins University in Baltimore, Maryland, who helps track changes in Martian sand ripples

If it turns out sand dunes didn't shift much anywhere on Mars during the storm, there could be a good reason, Baker says: "Winds swirling dust around in the atmosphere might not be the same thing as winds on the surface." Some scientists think that when dust gets lifted into the atmosphere during a global storm, blocking sunlight from reaching the surface, it shuts down the wind-generating process close to the ground that, under normal conditions, is induced by temperature fluctuations between the air and surface.

Whatever the reason turns out to be, understanding the behavior of sand dunes today helps us reveal Mars's ancient climate, says Baker: "We can look at wind-shaped sandstones on the surface and look at dunes that are moving now, and say, 'OK, what does that say about the conditions that were here billions of years ago when these dunes were moving and now are cemented into the rock record?'"

Dust devils, which are rotating columns of air and dust, are common on Mars. They form when hot air from the surface rises, creating a current of air that forms a whirlwind. These devils are useful for cleaning off dust from the panels of solar-powered spacecraft, like InSight, as they pass over them. Thus, it's important to understand how often they occur. Curiosity is powered by a nuclear battery, which allowed it to collect data while Opportunity hibernated, with minimal sunlight reaching its solar panels. Through Curiosity, we learned that dust devils disappear during a dust storm, right when we need them most, and for months afterwards. This happens because of an interruption in the same wind-generating process that might affect the movement of sand dunes.

Source: NASA

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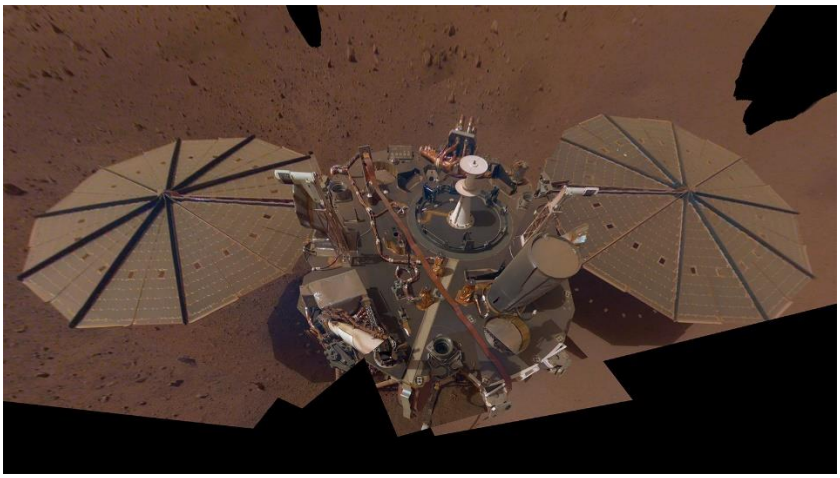
For InSight, Dust Cleanings Will Yield New Science

The same winds that blanket Mars with dust can also blow that dust away. Catastrophic dust storms have the potential to end a mission, as with NASA's Opportunity rover. But far more often, passing winds cleared off the rover's solar panels and gave it an

energy boost. Those dust clearings allowed Opportunity and its sister rover, Spirit, to survive for years beyond their 90-day expiration dates. Dust clearings are also expected for Mars' newest inhabitant, the InSight lander. Because of the spacecraft's weather sensors, each clearing can provide crucial science data on these events, as well — and the mission already has a glimpse at that.



This is NASA InSight's second full selfie on Mars. Since taking its first selfie, the lander has removed its heat probe and seismometer from its deck, placing them on the Martian surface; a thin coating of dust now covers the spacecraft as well. Credits: NASA/JPL-Caltech

On Feb. 1, the 65th Martian day, or sol, of the mission, InSight detected a passing wind vortex (also known as a dust devil if it picks up dust and becomes visible; InSight's cameras didn't catch the vortex in this case). At the same time, the lander's two large solar panels experienced very small bumps in power — about 0.7% on one panel and 2.7% on the other — suggesting a tiny amount of dust was lifted.

Those are whispers compared to cleanings observed by the Spirit and Opportunity rovers, where dust-clearing wind gusts occasionally boosted power by as much as 10% and left solar panels visibly cleaner. But the recent event has given scientists their first measurements of wind and dust interacting "live" on the Martian surface; none of NASA's solar-powered rovers have included meteorological sensors that record so much round-the-clock data. In time, data from dust cleanings could inform the design of solar-powered missions as well as research on how wind sculpts the landscape.

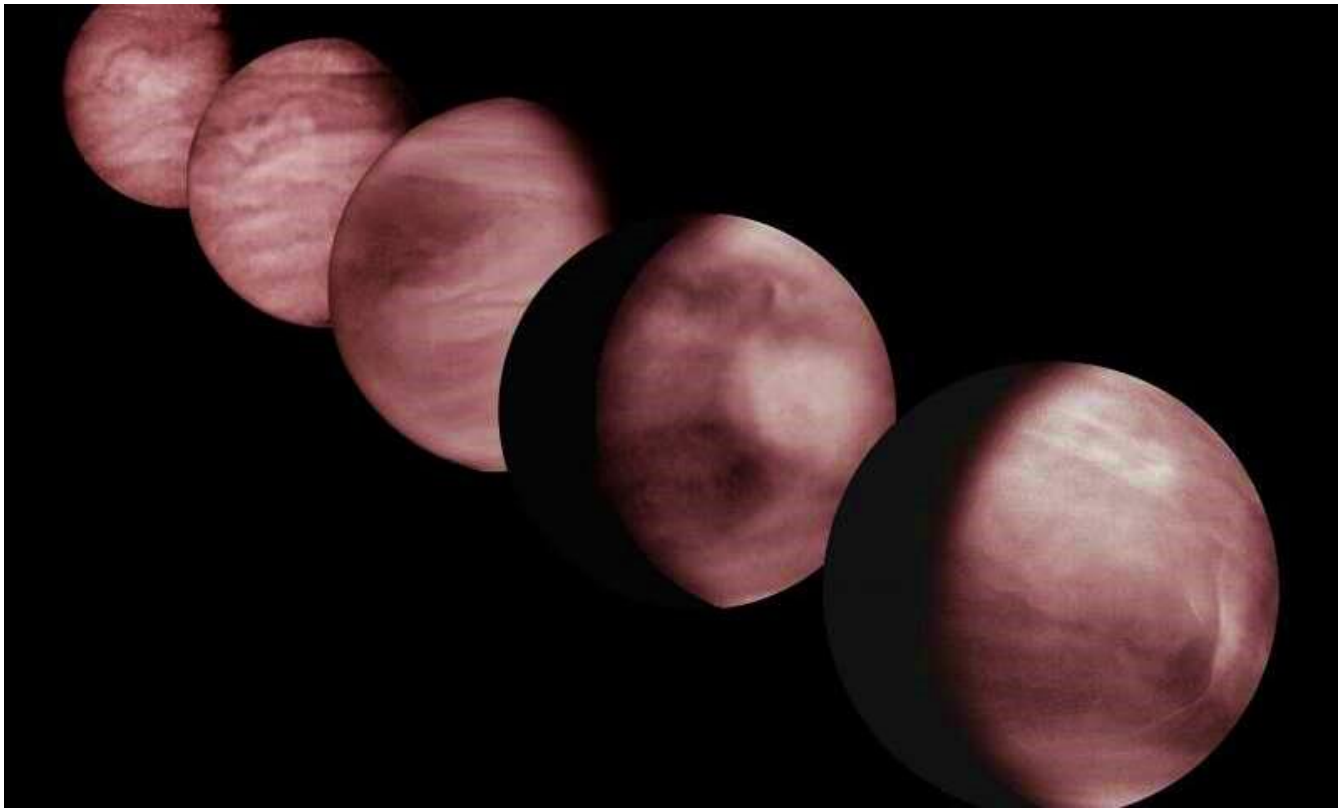
Engineers regularly calculate a "dust factor," a measure of how much dust is covering the panels, when analyzing InSight's solar power. While they saw no change in dust factor around the time of this passing dust devil, they saw a clear increase in electrical current, suggesting it did lift a little bit of dust.

"The absolute fastest wind we've directly measured so far from InSight was 63 miles per hour (28 meters per second), so the vortex that lifted dust off our solar panels was among the strongest winds we've seen," said InSight participating scientist Aymeric Spiga of the Dynamic Meteorology Laboratory at Sorbonne University in Paris. "Without a passing vortex, the winds are more typically between about 4-20 miles per hour (2-10 meters per second), depending on time of day."

Each of InSight's dinner-table-size solar panels has gathered a thin dust layer since landing. Their power output has fallen about 30% since then, due both to dust as well as Mars to moving farther from the Sun. Today the panels produce about 2,700 watt-hours per sol — plenty of energy for daily operations, which require roughly 1,500 watt-hours per sol. The mission's power engineers are still waiting for the kind of dust cleaning Spirit and Opportunity experienced. But even if they don't see one for a while, they have ample power.

Source: NASA Return to Contents

2. New Research Takes Deeper Look at Venus's Clouds



The strong variability of the middle clouds of Venus as shown in 900-nm mages acquired by the camera IR1 onboard JAXA's orbiter Akatsuki during the year 2016. Clear hemispherical asymmetries, zonally-oriented stripes and sharp discontinuities are visible on the middle clouds' albedo. Image dates (from left to right): 2, 3 and 17 of May, 23 of June and 1 of July. Credits: JAXA

Venus is known for its clouds of sulfuric acid covering the entire planet and its super-fast winds moving at hundreds of kilometers per hour, but our neighboring planet's thick clouds make it difficult for scientists to peer deep inside its atmosphere.

Now, researchers have used infrared images to spy into the middle layer of Venus's clouds and they have found some unexpected surprises.

The new research, published in the AGU journal *Geophysical Research Letters*, finds this middle layer of clouds shows a wide variety of cloud patterns that change over time and are very different from the upper layer of Venus's clouds, which are usually studied with ultraviolet images. The study also found changes in the albedo of the middle clouds, or how much sunlight they are reflecting back to space, which could indicate the presence of water, methane or other compounds absorbing solar radiation.

The motions of the middle clouds, combined with previous observations, allowed researchers to reconstruct a picture of the winds on Venus over 10 years, showing the super-fast winds in the planet's middle clouds are fastest at the equator and, like the upper clouds, change speed over time.

These new observations could help scientists better understand our neighboring planet and shed light on other planets and exoplanets with similar features, according to the study's authors.

"We observed completely unexpected events," said Javier Peralta, ITYF researcher at the Japan Aerospace Exploration Agency (JAXA) and lead author of the new study. "We have discovered that the middle clouds are not as quiet or as boring as they seemed during previous missions."

Observing Venus's clouds

The new study used images taken by JAXA's Akatsuki spacecraft, which arrived at Venus in December 2015 and whose main goal is to understand Venus's super-rotation. Super-rotation is a puzzling phenomenon also seen on Titan and many exoplanets that makes the atmosphere move much faster than the solid planet. It takes Venus 243 Earth days to complete a rotation. However, it takes only four Earth days for the planet's atmosphere to go all the way around Venus – about 60 times faster than the planet's rotation.

In the new study, researchers analyzed nearly 1,000 infrared images of Venusian clouds captured by one of Akatsuki's cameras over one year. The camera was designed to observe the middle cloud layer, which sits 50 to 55 kilometers above the planet's surface. Photons at infrared wavelengths can penetrate deeper into the clouds before being reflected, allowing scientists to peer deeper into this cloud layer.

Previous missions studying Venus's top-most clouds have seen glimpses of the middle cloud layer but had been unable to get a good, long look at it with infrared images. In order to see how the middle clouds evolve, instruments have to look at them for a longer time than was done during previous missions, according to Peralta.

The new images taken by Akatsuki show the middle layer of clouds change over time and are also very different than Venus's upper cloud layer, which sit at a height of about 70 kilometers. Sometimes, the images show a slightly darker band of clouds invaded by bright clouds that at times exhibit swirl shapes or look mottled. These observations are suggestive of convection, the vertical movement of heat and moisture in the atmosphere. On Earth, convection can cause thunderstorms. At other times, the images showed clouds that are less turbulent and appear homogenously bright or featureless, with multiple stripes.

From April to May of 2016, Venus's northern hemisphere became periodically darkened every four to five days. Scientists had not previously observed this difference between the hemispheres and the cause is yet to be determined, according to the new study. The images also showed other rare cloud features, including a hook-like dark filament extending more than 7,300 kilometers in the northern hemisphere in May and October of 2016.

Akatsuki also saw unexpected high contrasts in the cloud albedo. The new study suggests there could be compounds in the cloud layer able to absorb at the infrared wavelength or, alternatively, there could changes in the thickness of the clouds.

The scientists have also reconstructed Venus's winds over 10 years by combining the Akatsuki images with observations by amateur observers and past missions like ESA's Venus Express and NASA's MESSENGER mission. They found the super-rotating winds in Venus's middle clouds are sometimes fastest at the equator and their speed could change by up to 50 kilometers per hour over several months.

Understanding Venus's super-rotation

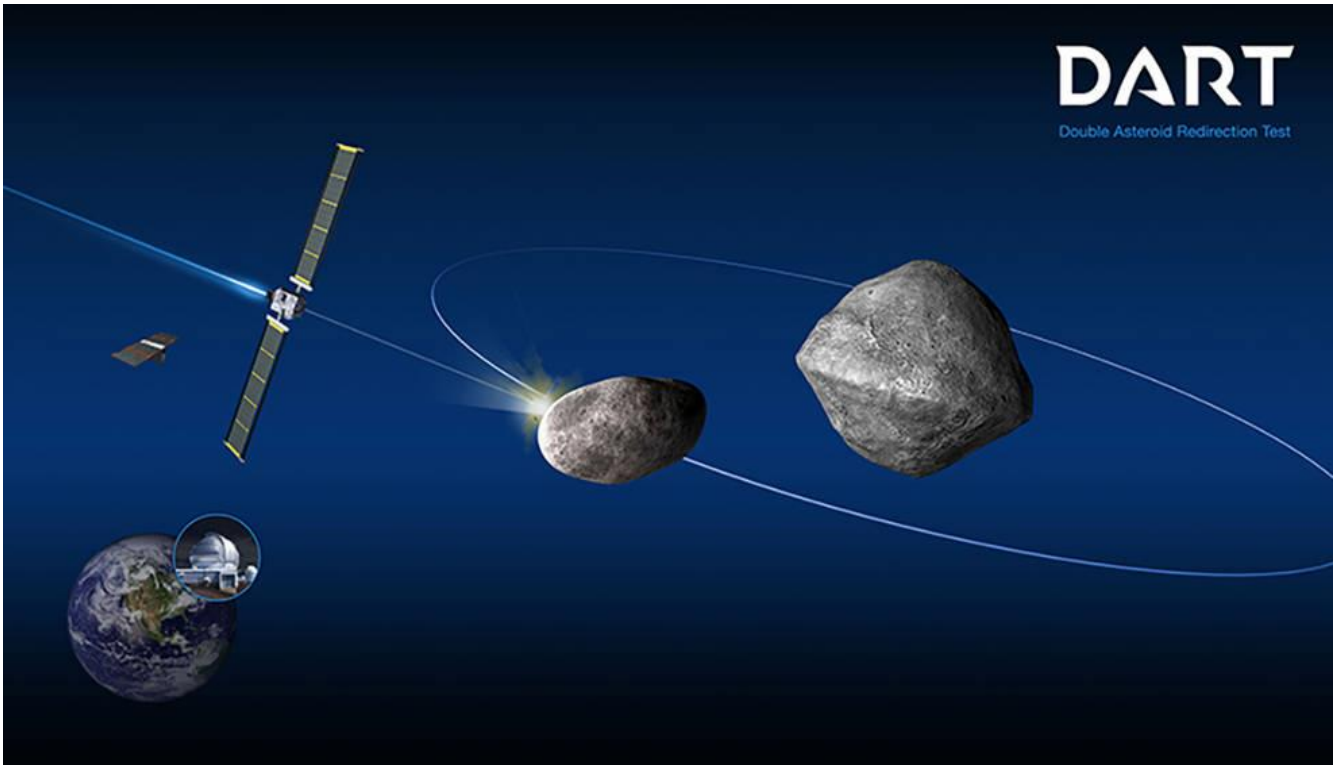
The findings could help scientists better understand Venus's super-rotation. The frictional drag and mountain waves caused by Venus's surface or the periodic heating from the Sun are factors that could be playing a key role in the maintenance of the super-rotation by slowing down or accelerating the winds and defining its long-term evolution, according to Peralta.

Since most of the solar energy is absorbed in the cloud layers and the fastest super-rotating winds also occur there, studying several layers of the clouds is critical to understanding the winds, according to Peralta. Scientists suspect changes in Venus's clouds and their albedo could be linked to the planet's super-rotation, and how the wind's momentum and energy is transported.

Uncovering the cause of the super-rotation on Venus and its potential connection to the planet's runaway greenhouse effect might help scientists understand changes on Earth related to climate change, Peralta said. It could also shed light on the atmospheric super-rotation of other bodies in our solar system like Saturn's moon Titan, and exoplanets orbiting very close to their stars, he said.

Source: American Geophysical Union Return to Contents

3. NASA's First Planetary Defense Technology Demonstration to Collide with Asteroid in 2022



Credits: Johns Hopkins Applied Physics Laboratory

The Double Asteroid Redirection Test (DART) – NASA's first mission to demonstrate a planetary defense technique – will get one chance to hit its target, the small moonlet in the binary asteroid system Didymos. The asteroid poses no threat to Earth and is an ideal test target: measuring the change in how the smaller asteroid orbits about the larger asteroid in a binary system is much easier than observing the change in a single asteroid's orbit around the Sun. Work is ramping up at the Johns Hopkins Applied Physics Laboratory in Laurel, Maryland, and other locations across the country, as the mission heads toward its summer 2021 launch – and attempts to pull off a feat so far seen only in science fiction films.

Observing Didymos

To navigate the DART spacecraft to its intended target – a binary asteroid that consists of a small moon (Didymos B) orbiting a larger body (Didymos A) – scientists need to understand how the system behaves. Scientists have been making efforts to observe Didymos from Earth since 2015, and now, an international campaign coordinated by Northern Arizona University's Cristina Thomas, DART's Observing Working Group Lead, is making critical observations using powerful telescopes worldwide to understand the state of the asteroid system before DART reaches it. Current observations will help researchers to better understand the extent of the impact made when DART slams into its target – Didymos B – in September 2022.

The most recent observation campaign took place on Cerro Paranal in northern Chile, where scientists viewed Didymos using the Very Large Telescope, which is run by the European Southern Observatory. The "VLT" comprises four telescopes, each with 8.2-meter mirrors; two of them were used in the recent observations.

"The Didymos system is too small and too far to be seen as anything more than a point of light, but we can get the data we need by measuring the brightness of that point of light, which changes as Didymos A rotates and Didymos B orbits," said APL's Andy Rivkin, DART investigation team co-lead, who participated in the observations. The brightness changes indicate when the smaller moon, Didymos B, passes in front of or is hidden behind Didymos A

from our point of view. These observations will help scientists determine the location of Didymos B about Didymos A and inform the exact timing of DART's impact to maximize the deflection.

The investigation team will observe Didymos again from late 2020 into the spring of 2021. Final ground-based observations will occur as the spacecraft travels toward the asteroid, as well as after impact occurs.

Research with Impact

The telescope observations are key to understanding Didymos, but they're not quite enough to fully understand Didymos B, DART's target. "Even though we are performing ground-based observations, we don't know much about Didymos B in terms of composition and structure," said Angela Stickle, DART's Impact Simulation Working Group Lead from APL. "We need to anticipate a wide range of possibilities and predict their outcomes, so that after DART slams into Didymos B we'll know what our measurements are telling us."

Structure is essential to the equation; in Didymos, researchers aren't sure whether DART will impact an asteroid composed of solid rock, loose rubble or something "softer," more akin to sand. A softer surface would absorb more of DART's force and may not be pushed as drastically as if DART hit a harder surface.

Extensive modeling and simulation, part of a large international campaign that started in 2014, is being done in conjunction with Lawrence Livermore National Laboratory and other members of the investigation team to help researchers predict what will happen to DART's target after impact. They've considered these various factors—along with the added momentum from DART's impact and the resulting debris ejected from the crater it creates – as they've run various simulations. These simulations help the team shape its expectations for impact.

Eyes on DART and Didymos

Researchers will have the ability to eventually see the Didymos asteroid system close-up – albeit briefly – thanks to DART's onboard DRACO imager and a planned ride-along CubeSat, the Italian Space Agency's LICIACube.

Released just before impact, the shoebox-sized LICIACube would document DART's impact and its aftermath. The CubeSat recently passed its preliminary design review and has moved into the next phase of development.

DRACO – the Didymos Reconnaissance and Asteroid Camera for Op-nav – is DART's only onboard instrument. It will serve primarily as DART's optical navigation system, capturing images that help the spacecraft reach its target.

DRACO will feed its images into the APL-developed Small-body Maneuvering Autonomous Real-Time Navigation (SMART Nav) algorithm – the system that, in the spacecraft's final hours, will precisely and automatically guide DART into Didymos B. SMART Nav is preparing to undergo a series of tests on simulated spacecraft avionics, which will boost engineers' confidence that the system will be ready to operate successfully when the mission will be relying on it.

Wired for Success

While much of the work on DART so far has been modeling and simulation, many parts of the spacecraft have started to take shape. A full-scale mock-up of DART now serves as a placeholder for the assembly of cables and connectors that will eventually make up the wiring harness. The mission has signed off on the manufacturing of several flight hardware components, specifically the spacecraft's solar arrays—which passed the critical design review stage—as well as the radio and power system electronics.

In a recent design change, DART will now be able to complete its mission by relying on small hydrazine thrusters in addition to having the ability to utilize the electric propulsion system, NASA's Evolutionary Xenon Thruster Commercial (NEXT-C) ion engine, which will also push the start of the primary launch window to July of 2021, shortening the mission flight time. "For a mission that relies on one chance, it's a move that will provide DART with more options to ensure it hits its mark," said Ed Reynolds, DART project manager at APL.

Sources: NASA Return to Contents

The Night Sky

Tuesday, May 7

•The crescent Moon hangs in the west-northwest at dusk near Mars and Beta Tauri (which is to Mars's left), and very close to or even on top of 3rd-magnitude Zeta Tauri.

Will the Moon occult Zeta for your location? It will if you're in Florida or the deep south (where the Moon will be low in darkness), the mid-south (with the Moon higher in twilight), or much of Mexico and Central America. See map and timetables from IOTA. (The text there consists of three timetables: for the star's disappearance, its reappearance, and the locations of the cities and towns. Watch for the divisions between the tables as you scroll.)

Wednesday, May 8

• The crescent Moon this evening shines in the feet of Gemini, far below Pollux and Castor. While twilight is still fading, look for Betelgeuse twinkling a similar distance below the Moon.

• Arcturus is the brightest star high in the east these evenings. Spica shines lower right of it by about three fists at arm's length. To the right or lower right of Spica, by half that distance, is the distinctive four-star constellation of Corvus, the Crow of Spring.

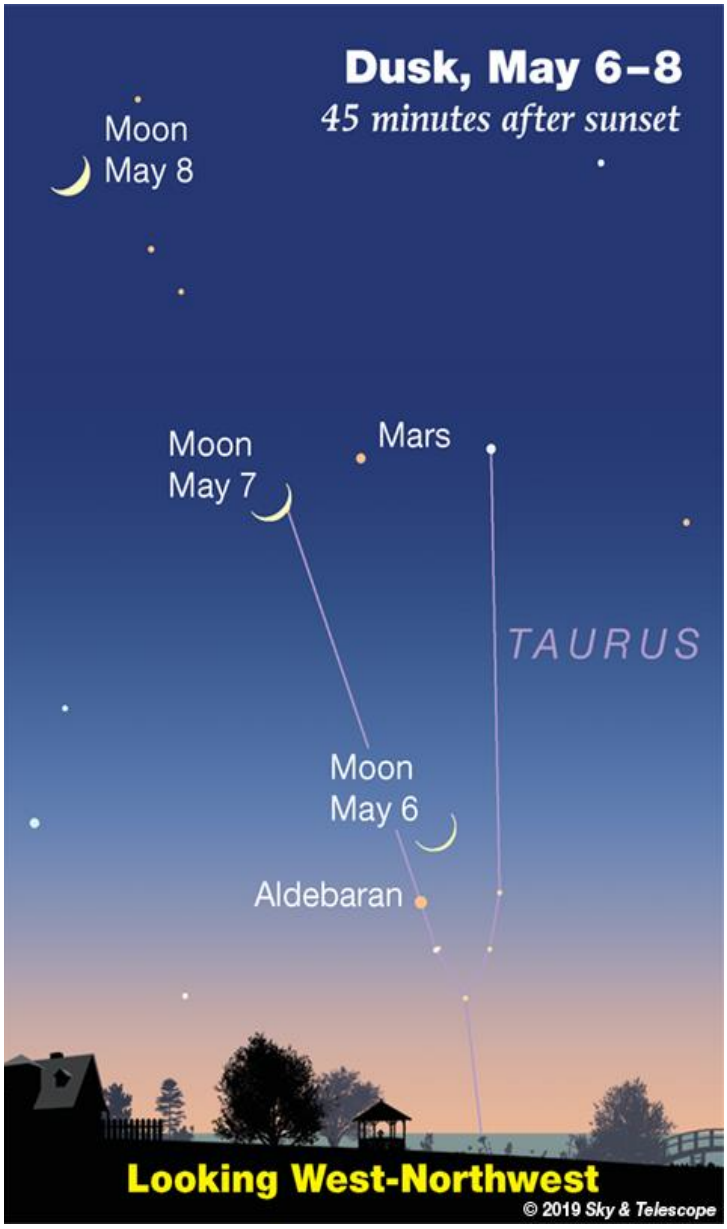
Thursday, May 9

• The thick crescent Moon shines in the west after dusk, with Pollux and Castor to its upper right and Procyon farther to its lower left.

• Summer is more than five weeks away, but the Summer Triangle is making its appearance in the east, one star after another. The first in view is Vega, already low in the northeast as twilight fades.

Next up is Deneb, lower left of Vega by two or three fists at arm's length. It comes above the horizon around when twilight fades into full night (depending on your latitude).

The third is Altair, which shows up far to their lower right around 11 or midnight.



As a new monthly lunation gets under way, the waxing crescent Moon stalks upward through Taurus and into the feet of Gemini. Because we always show the Moon three times its actual apparent size in these scenes, it seems here to be occulting Zeta Tauri on May 7th. In fact it will cover the star in the U.S. only for Florida, the deep south, and the mid-south.

Source: Sky and Telescope

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ISS Sighting Opportunities (from Denver)

Date	Visible	Max Height	Appears	Disappears
Wed May 8, 3:09 AM	< 1 min	21°	21° above N	17° above NNE
Wed May 8, 4:45 AM	2 min	10°	10° above NNW	10° above N
Thu May 9, 3:54 AM	2 min	12°	10° above NW	11° above N
Fri May 10, 3:04 AM	1 min	15°	14° above NNW	12° above N
Fri May 10, 4:41 AM	1 min	10°	10° above N	10° above NNE
Sat May 11, 3:50 AM	1 min	10°	10° above NNW	10° above N
Sat May 11, 5:26 AM	< 1 min	11°	10° above NNW	11° above NNW

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

NASA-TV Highlights (all times Eastern Time Zone)

May 10, Friday

- 10 a.m. – International Space Station In-Flight Educational Event with the Cosmosphere in Hutchinson, Kansas, and NASA astronaut Nick Hague (All Channels)

Watch NASA TV online by going to the NASA website.

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Space Calendar

- May 07 - Comet 222P/LINEAR Closest Approach To Earth (1.281 AU)
- May 07 - Apollo Asteroid 2019 HQ3 Near-Earth Flyby (0.040 AU)
- May 07 - Lecture: The Fiery Fate of Exoplanets, Baltimore, Maryland
- May 07 - Asteroid 6758 Jesseowens Closest Approach To Earth (1.299 AU)
- May 07-08 - 2019 Midwest Magnetic Fields Meeting, Madison, Wisconsin
- May 07-09 - Workshop: Future of Canadian Radio Astronomy, near Penticton, Canada
- May 08 - Mercury Passes 1.4 Degrees From Uranus
- May 08 - Amor Asteroid 2014 KQ84 Near-Earth Flyby (0.080 AU)
- May 08 - Asteroid 6128 Lasorda Closest Approach To Earth (1.292 AU)
- May 08 - Seminar: Simulating Titan's Atmosphere, Madison, Wisconsin
- May 08 - Colloquium: The Wonderful World of the Plankton - A Tour from Biochemistry to Space, Greenbelt, Maryland
- May 08 - Colloquium: The GMRT Cygnus Survey, Greenbelt, Maryland
- May 08-09 - Conference: Copernicus Meets Galileo - Earth Observation - Navigation - GeoIT, Bochum, Germany
- May 08-10 - Argentina Astronomical Infrastructure Workshop, Cordoba, Argentina
- May 09 - Apollo Asteroid 2019 JM Near-Earth Flyby (0.010 AU)
- May 09 - Amor Asteroid 2008 HS3 Near-Earth Flyby (0.037 AU)
- May 09 - Apollo Asteroid 2017 RC Near-Earth Flyby (0.037 AU)
- May 09 - Asteroid 7707 Yes Closest Approach To Earth (1.347 AU)
- May 09 - Webinar: InSight into Planetary Interiors
- May 09 - Seminar: Early Results from the InSight Mission, Houston, Texas
- May 09 - Lecture: Cubesats, Pasadena, California
- May 09 - Lecture: Solving the Puzzles of Planet Formation in the Modern Era of Planet-Hunting, Washington DC
- May 09 - Colloquium: A New Era in the Quest for Dark Matter, Barcelona, Spain
- May 09 - Seminar: Looking for Partially-Massless Gravity, Barcelona, Spain
- May 09-10 - Spring 2019 Meeting: Committee on Seismology and Geodynamics, Berkeley, California
- May 09-12 - 6th International Symposium on Strong Electromagnetic Fields and Neutron Stars (SMFNS 2019), Varadero, Cuba
- May 10 - Asteroid 7169 Linda Closest Approach To Earth (1.304 AU)
- May 10 - Royal Astronomical Society (RAS) Ordinary Meeting, London, United Kingdom
- May 10 - Chesapeake Bay Area Exoplanet Meeting (CHEXO), Laurel, Maryland
- May 10 - Meeting: Neutron Star and Black Hole Binary Mergers - The First Results of the LIGO-Virgo Era, London, United Kingdom
- May 10 - Lecture: Cubesats, Pasadena, California
- May 10 - Lecture: A Star is Born, Pasadena, California
- May 10 - Seminar: Gravitational Waves from Inflation, Barcelona, Spain
- May 10-13 - Conference: Integrations of Satellite and Ground-Based Observations and Multi-Disciplinarity in Research and Prediction of Different Types of Hazards in Solar System, Valjevo, Serbia

Source: JPL Space Calendar Return to Contents

Food for Thought

When It Comes To Planetary Habitability, It's What's Inside That Counts

Artist's impression of the surface of the planet Barnard's Star b courtesy of ESO/M. Kornmesser.

Which of Earth's features were essential for the origin and sustenance of life? And how do scientists identify those features on other worlds?

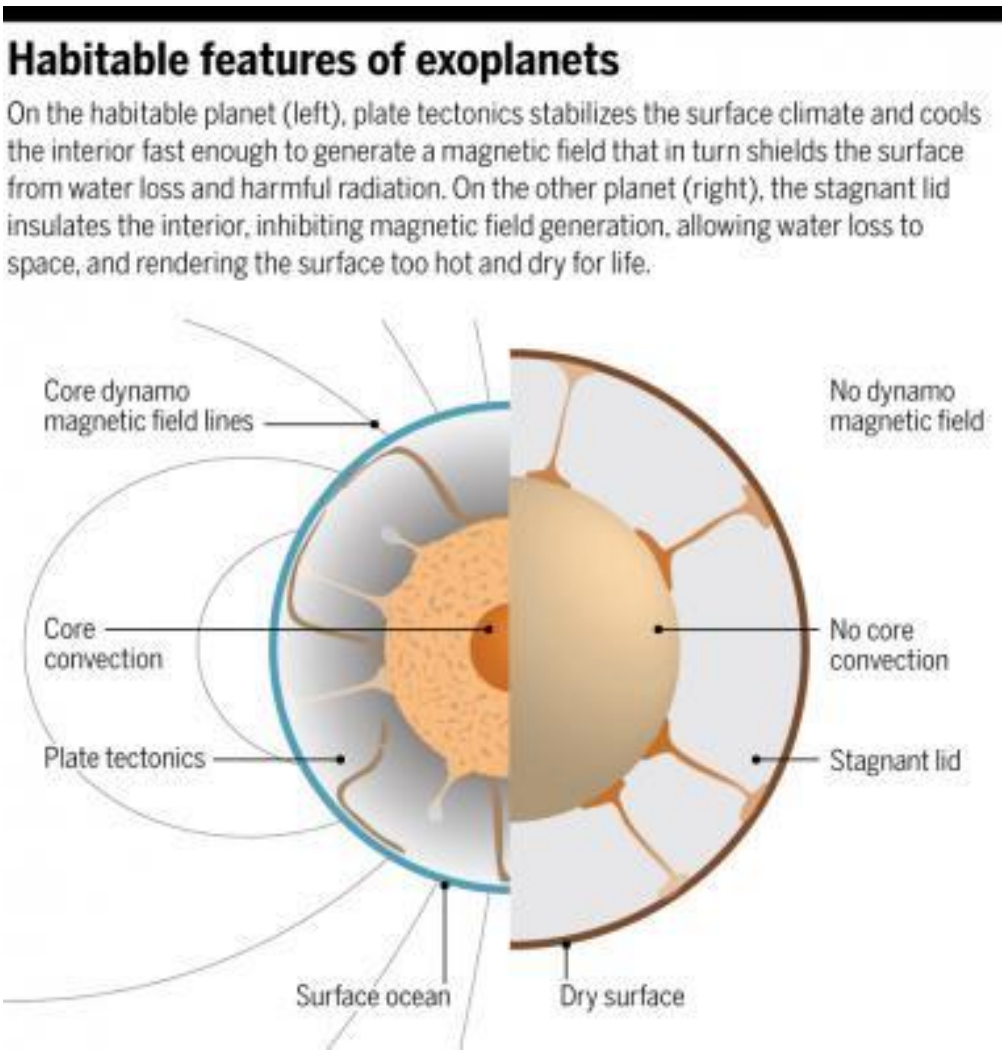
A team of Carnegie investigators with array of expertise ranging from geochemistry to planetary science to astronomy published this week in *Science* an essay urging the research community to recognize the vital importance of a planet's interior dynamics in creating an environment that's hospitable for life.

With our existing capabilities, observing an exoplanet's atmospheric composition will be the first way to search for signatures of life elsewhere. However, Carnegie's Anat Shahar, Peter Driscoll, Alycia Weinberger, and George Cody argue that a true picture of planetary habitability must consider how a planet's atmosphere is linked to and shaped by what's happening in its interior.

For example, on Earth, plate tectonics are crucial for maintaining a surface climate where life can thrive. What's more, without the cycling of material between its surface and interior, the convection that drives the Earth's magnetic field would not be possible and without a magnetic field, we would be bombarded by cosmic radiation.

"We need a better understanding of how a planet's composition and interior influence its habitability, starting with Earth," Shahar said. "This can be used to guide the search for exoplanets and star systems where life could thrive, signatures of which could be detected by telescopes."

It all starts with the formation process. Planets are born from the rotating ring of dust and gas that surrounds a young star. The elemental building blocks from which rocky planets form—silicon, magnesium, oxygen, carbon, iron, and hydrogen—are universal. But their abundances and the heating and cooling they experience in their youth will affect their interior chemistry and, in turn, things like ocean volume and atmospheric composition.



Reprinted with permission from Shahar et. al., Science Volume 364:3(2019).

"One of the big questions we need to ask is whether the geologic and dynamic features that make our home planet habitable can be produced on planets with different compositions," Driscoll explained.

The Carnegie colleagues assert that the search for extraterrestrial life must be guided by an interdisciplinary approach that combines astronomical observations, laboratory experiments of planetary interior conditions, and mathematical modeling and simulations.

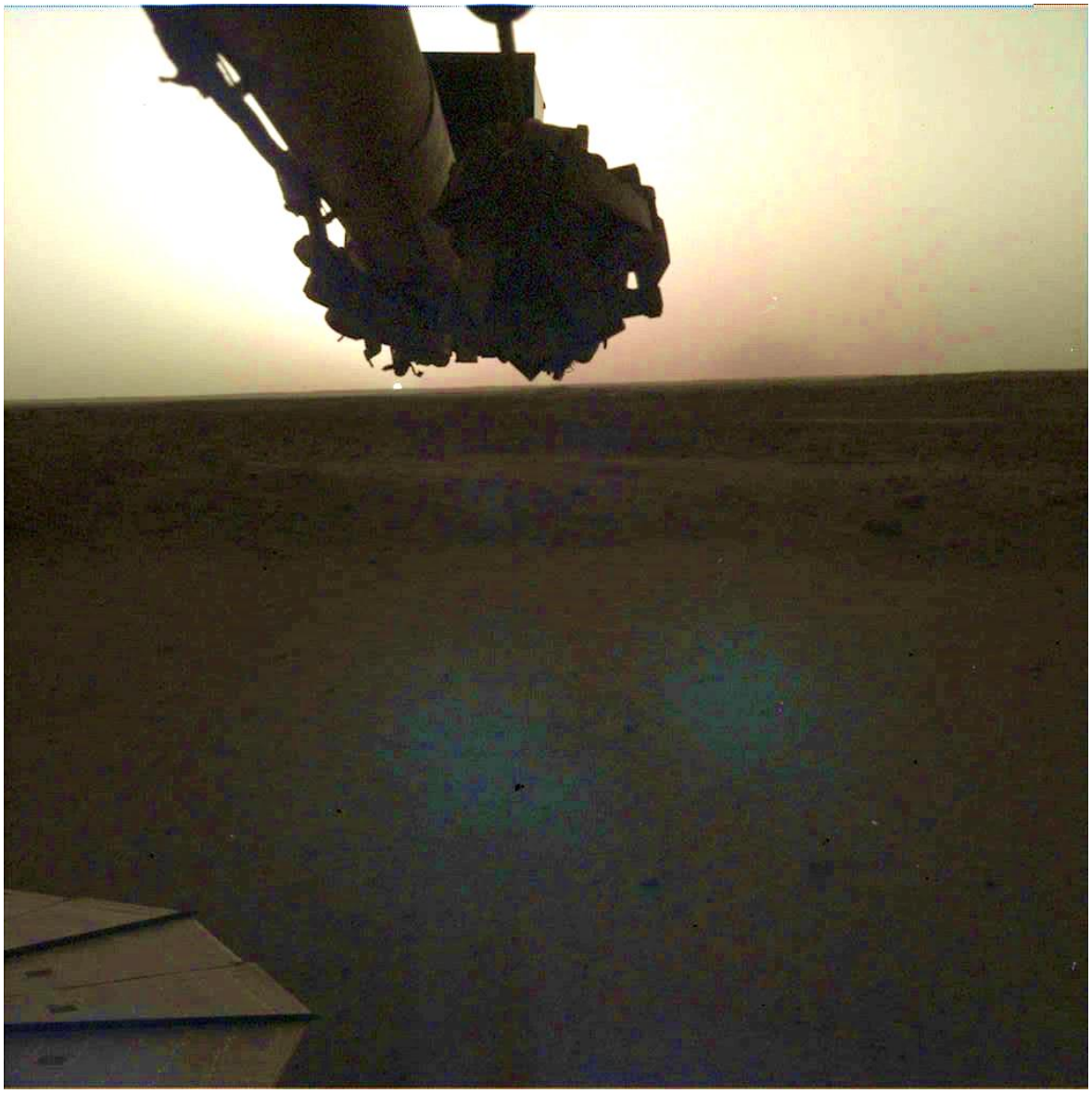
"Carnegie scientists are long-established world leaders in the fields of geochemistry, geophysics, planetary science, astrobiology, and astronomy," said Weinberger. "So, our institution is perfectly placed to tackle this cross-disciplinary challenge."

In the next decade as a new generation of telescopes come online, scientists will begin to search in earnest for biosignatures in the atmospheres of rocky exoplanets. But the colleagues say that these observations must be put in the context of a larger understanding of how a planet's total makeup and interior geochemistry determines the evolution of a stable and temperate surface where life could perhaps arise and thrive.

"The heart of habitability is in planetary interiors," concluded Cody.

Source: Carnegie Institution for Science/EurekAlert Return to Contents

Space Image of the Week



InSight Images a Sunrise on Mars

Image Credit: NASA/JPL-Caltech

Explanation: NASA's InSight lander used its Instrument Deployment Camera (IDC) on the spacecraft's robotic arm to image this sunrise on Mars on April 24, 2019, the 145th Martian day (or sol) of the mission. This was taken around 5:30 a.m. Mars local time.

Shown here is the "raw" version of the image; it's easier to see some details in the raw version; however, a color-corrected more accurately shows the image as the human eye would see it.

The first mission to send back such images was the Viking 1 lander, which captured a sunset on Aug. 21, 1976; Viking 2 captured a sunrise on June 14, 1978. Since then, both sunrises and sunsets have been recorded by the Spirit, Opportunity and Curiosity rovers, among other missions.

Source: NASA JPL

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