Space News Update

— March 31, 2017 —

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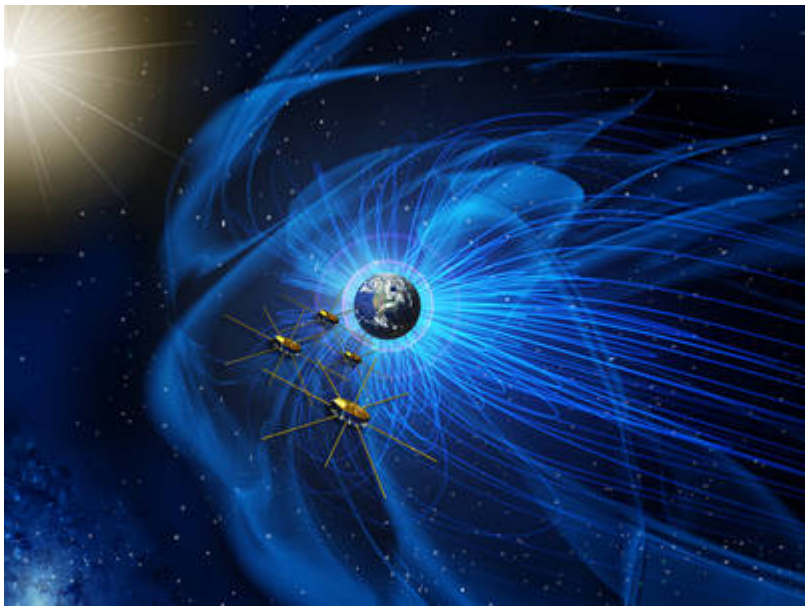
1. NASA Observations Reshape Basic Plasma Wave Physics



When NASA's Magnetospheric Multiscale — or MMS — mission was launched, the scientists knew it would answer questions fundamental to the nature of our universe — and MMS hasn't disappointed. A new finding, presented in a paper in Nature Communications, provides observational proof of a 50-year-old theory and reshapes the basic understanding of a type of wave in space known as a kinetic Alfvén wave. The results, which reveal unexpected, small-scale complexities in the wave, are also applicable to nuclear fusion techniques, which rely on minimizing the existence of such waves inside the equipment to trap heat efficiently.

Kinetic Alfvén waves have long been suspected to be energy transporters in plasmas — a fundamental state of matter composed of charged particles — throughout the universe. But it wasn't until now, with the help of MMS, that scientists have been able to take a closer look at the microphysics of the waves on the relatively small scales where the energy transfer actually happens.

"This is the first time we've been able to see this energy transfer directly," said Dan Gershman, lead author and MMS scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, and the University of Maryland in College Park. "We're seeing a more detailed picture of Alfvén waves than anyone's been able to get before."

The waves could be studied on a small scale for the first time because of the unique design of the MMS spacecraft. MMS's four spacecraft fly in a compact 3-D pyramid formation, with just four miles between them — closer than ever achieved before and small enough to fit between two wave peaks. Having multiple spacecraft allowed the scientists to measure precise details about the wave, such as how fast it moved and in what direction it travelled.

Previous multi-spacecraft missions flew at much larger separations, which didn't allow them to see the small scales — much like trying to measure the thickness of a piece of paper with a yardstick. MMS's tight flying formation, however, allowed the spacecraft to investigate the shorter wavelengths of kinetic Alfvén waves, instead of glossing over the small-scale effects.

"It's only at these small scales that the waves are able to transfer energy, which is why it's so important to study them," Gershman said.

As kinetic Alfvén waves move through a plasma, electrons traveling at the right speed get trapped in the weak spots of the wave's magnetic field. Because the field is stronger on either side of such spots, the electrons bounce back and forth as if bordered by two walls, in what is known as a magnetic mirror in the wave. As a result, the electrons aren't distributed evenly throughout: Some areas have a higher density of electrons, and other pockets are left with fewer electrons. Other electrons, which travel too fast or too slow to ride the wave, end up passing energy back and forth with the wave as they jockey to keep up.

The wave's ability to trap particles was predicted more than 50 years ago but hadn't been directly captured with such comprehensive measurements until now. The new results also showed a much higher rate of trapping than expected.

This method of trapping particles also has applications in nuclear fusion technology. Nuclear reactors use magnetic fields to confine plasma in order to extract energy. Current methods are highly inefficient as they require large amounts of energy to power the magnetic field and keep the plasma hot. The new results may offer a better understanding of one process that transports energy through a plasma.

"We can produce, with some effort, these waves in the laboratory to study, but the wave is much smaller than it is in space," said Stewart Prager, plasma scientist at the Princeton Plasma Physics Laboratory in Princeton, New Jersey. "In space, they can measure finer properties that are hard to measure in the laboratory."

This work may also teach us more about our sun. Some scientists think kinetic Alfvén waves are key to how the solar wind — the constant outpouring of solar particles that sweeps out into space — is heated to extreme temperatures. The new results provide insight on how that process might work.

Throughout the universe, kinetic Alfvén waves are ubiquitous across magnetic environments, and are even expected to be in the extra-galactic jets of quasars. By studying our near-Earth environment, NASA missions like MMS can make use of a unique, nearby laboratory to understand the physics of magnetic fields across the universe.

Related Link

- Learn more about NASA's MMS Mission

Source: NASA

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2. SpaceX Flies Rocket For Second Time In Historic Test Of Cost-Cutting Technology

A SpaceX Falcon 9 rocket sporting a fresh cleaning and several refurbishments took off Thursday from a seaside launch pad in Florida to send an SES communications satellite into space, then landed on a platform in the Atlantic Ocean to repeat a feat the same booster achieved nearly one year ago.

The success buoys SpaceX's ambition to eventually land and launch rockets routinely, and at a fraction of the cost of current launch vehicles, according to Elon Musk, the tech entrepreneur who founded the space company in 2002. Musk said the achievement marks a turning point in a "huge revolution in spaceflight." "This represents the culmination of 15 years of work at SpaceX to be able to refly a rocket booster," Musk told reporters Thursday night.

The first stage provides the bulk of the energy needed to put an object into orbit, and Musk said it is responsible for up to 70 percent of the total cost of a rocket flight. "The most expensive part of the whole mission, from a launch standpoint, is the boost stage," Musk said.

Thundering away from launch pad 39A at NASA's Kennedy Space Center, the two-stage rocket turned east over the Atlantic Ocean, climbing into a cloudless early evening sky after blasting off at 6:27 p.m. EDT (2227 GMT). The first stage of the Falcon 9, driven by nine kerosene-burning Merlin 1D main engines, was the star of the show, making a historic relaunch after SpaceX recovered the booster on a mission last April. The rocket stage performed well, officials said, dropping away from the upper part of the Falcon 9 launcher less than three minutes after liftoff.

The Falcon 9's first stage stands about 156 feet (47 meters) tall and 12 feet (3.7 meters) in diameter. Its nine Merlin engines put out about 1.7 million pounds of thrust at full throttle.

The first stage that flew Thursday logged nearly nine minutes of flight time during a space station resupply launch on April 8, 2016, soaring above the 62-mile-high (100-kilometer) internationally-recognized boundary of space before descending to a vertical landing on a platform in the Atlantic Ocean. The previously-flown booster, designated No. 21 in SpaceX's fleet of Falcon rocket cores, pulled off an almost identical feat Thursday, launching and landing as the Falcon 9's expendable upper stage maneuvered in space to deploy the SES 10 communications satellite.

Touchdown on SpaceX's sea-based landing platform occurred around 340 miles (550 kilometers) east of Cape Canaveral, just as the second stage engine placed SES 10 into a low-altitude parking orbit.

The second stage reignited for nearly a minute at 2253 GMT (6:53 p.m. EDT) to push the 11,644-pound (5,282-kilogram) SES 10 spacecraft, built by Airbus Defense and Space, into the correct egg-shaped geostationary transfer orbit. The rocket's navigation computer targeted an orbit with a high point of 22,002 miles (35,410 kilometers), a low point of 135 miles (218 kilometers) and an inclination of 26.2 degrees. Spacecraft separation was confirmed at T+plus 32 minutes, and a rocket-mounted camera streamed down a live view of the SES 10 satellite receding into space.

SES officials confirmed the satellite was in a good orbit and communicating with ground controllers as anticipated. SES 10's own engine will raise its orbit to geostationary altitude of nearly 22,300 miles (about 35,800 kilometers) over the equator in April. At that altitude, SES 10 will move around Earth at the same speed the planet rotates, allowing it to remain in a fixed geographic location.

Once it completes in-orbit testing, SES 10 should be operational by mid-May in a slot at 67 degrees west longitude, giving the spacecraft's antennas and Ku-band transponders visibility from Mexico and the Caribbean to the southern tip of Argentina. "This is an extremely important satellite for SES and the development of our business in Latin America," said Martin Halliwell, chief technology officer of Luxembourg-based SES. "Predominately, this is going to be for video, and predominately, this is going to be for the development of the Ultra HD capability of SES into these various different areas."

Designed from the start to be partially reusable, SpaceX's Falcon 9 rockets have flown 32 times with the conclusion of Thursday's mission. On those 32 flights, SpaceX has tried to recover the first stage — either at sea or back at Cape Canaveral — on 14 occasions with nine intact landings.

Thursday was the first time SpaceX attempted to relaunch one of the previously-flown boosters in the company's inventory. "It's really a great day, not just for SpaceX, but for the space industry as a whole, proving something can be done that many people said was impossible," Musk said.

Halliwell represents one of SpaceX's major commercial customers. He is also one of SpaceX's biggest cheerleaders in the satellite industry. "There have been naysayers," Halliwell said before Thursday's launch. "I can tell you there was a chief engineer of another launch provider — I will not say the name — who told me, categorically to my face, you will never land a first stage booster. It is impossible, and if you do it, it will be completely wrecked."

"You've got to decouple the emotion from the engineering," Halliwell said after Thursday's launch. "The engineering team that Elon has working for him is really second to none. He asks very simple profound questions, and he gets very good answers. The proof is in the pudding."

SpaceX engineers refurbished the first stage last year, taking several months to fully inspect components, replace some hardware, and put the booster through a new round of hotfire testing at the company's development site in Central Texas. "With this being the first reflight, we were incredibly paranoid about everything," Musk said. "The core airframe remained the same, the engines remained the same, but any sort of auxiliary components that we thought might be slightly questionable, we changed out," Musk said.

SES announced in August an agreement to place the SES 10 satellite on the first reused Falcon 9 booster, days before a Falcon 9 rocket exploded on the Complex 40 launch pad at Cape Canaveral Air Force Station, grounding SpaceX missions more than four months and expediting the company's plans to begin launching off nearby pad 39A on NASA property. But SES, operator of around 57 satellites currently in orbit with the launch of SES 10, stuck by its commitment to purchase a flight of a reused rocket.

SpaceX intends to cut down on the refurbishment and hardware swapouts on future reused rockets. Design upgrades are coming soon to address several weak points, such as the booster's steering grid fins, which are prone to heating and can catch fire in flight. "The next thing is to try and figure out how do we achieve very rapid reuse with minimal refurbishment, and without any sort of hardware changes on the vehicle," Musk said.

"Our aspiration will be zero hardware changes (with) a reflight in 24 hours, and the only thing that changes is we reload propellant," Musk said. "We might get there toward the end of this year, but if not this year, I'm confident we'll get there next year."

SpaceX hoped to re-fly this booster last year, but the extensive inspections and refurbishment, coupled with the ground of the the Falcon 9 fleet late last year, delayed the SES 10 launch to March.

Officials have not disclosed how much of a discount SES received to be the first customer to fly on one of SpaceX's reused boosters.

Musk aims for a 100-fold reduction in launch costs in the long run, but the pricing effects will be more modest in the beginning. Gwynne Shotwell, SpaceX's president and chief operating officer, said last year the company will initially offer a 10 percent discount to clients willing to put their payloads on previously-flown rockets. "It will be a meaningful discount," Musk said, without citing a number. "We'll figure out some way to pay off the development costs of reusability, so the price discount won't be as much as the cost savings because we need to repay the massive development cost. "But it will certainly be less than the price of our current rockets, and will be far lower than any other rocket in the world," Musk added.

SpaceX says a regular commercial launch of a Falcon 9 rocket now costs about $62 million, already making it the least expensive option in its lift category.

Musk said SpaceX made the Falcon 9 rocket's first stage reusable with entirely private funding, investing at least $1 billion in the effort through development of sophisticated guidance algorithms, heat shields, propulsive steering capabilities, and the outfitting of mobile ocean-going platforms as landing targets.

Thursday's launch also got SpaceX closer to recovering and reusing the Falcon 9's payload fairing, the clamshell-like nose shroud that covers satellites during the first few minutes of flight. Musk said one-half of the fairing launched with SES 10 landed intact in the Atlantic Ocean. "That's definitely the cherry on the cake," Musk said.

"The fairing has its own thruster control system and a steerable parachute," he said. "It's like its own little spacecraft, so the thrusters maintain its orientation as it comes in — as it re-enters — and then we throw out a parachute, and the parachute steers it to a particular location."

According to Musk, the fairing costs about $6 million to produce. "At one point, we were debating whether we should try to recover it," Musk said. "Imagine you had $6 million in cash in a pallet flying through the air, and it's going to smash into the ocean. Would you try to recover it? Yes, you would."

He said the fairing recovery plan is "looking quite promising" after several years of experimenting with the technique. "What we'll have is kind of like a bouncy castle for it to land on, and we aim to reuse the fairing as well," Musk said.

“The only thing left is the upper stage, which we originally didn’t intend for the Falcon 9 to have a reusable upper stage, but it might be fun to try a ‘Hail Mary.'”

The first stage that landed offshore Thursday will return to Port Canaveral in a few days. Musk said the booster will be retired from service and put on display somewhere at Cape Canaveral. “Assuming the fairing reuse works out, and as we optimize the cost of reusing the booster, you’re really looking at maybe three-quarters of the rocket cost dropping by an order of magnitude, and maybe more,” Musk said.

NASA’s space shuttle orbiters and segments of their solid rocket boosters flew dozens of times, but they took months to reconfigure between missions at significant cost, requiring thousands of engineers and technicians in hands-on jobs and in support roles. SpaceX is emphasizing rapid reuse, and other launch firms are trying to catch up.

Blue Origin, the space company founded by Amazon.com’s Jeff Bezos, is developing the powerful New Glenn rocket for a maiden flight from Cape Canaveral in 2020. The methane-fueled New Glenn, named for Mercury astronaut John Glenn, will land on an offshore platform for reuse in a manner similar to the concept pioneered by SpaceX.

“What’s that saying about the best form of flattery?” Musk said. “Actually, I think it’s good if a company shows that a path is working, then other companies should copy that. It would be silly not to … Rapid and complete reusability of rockets is really the key to opening up space and becoming a space-faring civilization, and a multi-planet species, and having a future that’s incredibly exciting that we can all look forward to.”

More entrenched rocket companies are taking a more conservative approach to reuse. United Launch Alliance, a 50-50 joint venture between Boeing and Lockheed Martin, is working on the next-generation Vulcan rocket, which is likely to be powered by Blue Origin-built BE-4 engines. The initial Vulcan flights will be expendable, but ULA is studying a way to retrieve the engines with a heat shield and a parachute.

Europe’s new Ariane 6 rocket will be single-use when it debuts in 2020, but the European Space Agency, the French space agency CNES and Airbus Safran Launchers have partnered to work on the reusable Prometheus engine, which could be installed on a future European booster outfitted to fly multiple times.

ULA and European officials, which oversee rocket programs with near-perfect success records over the last decade, question the economic payoff of reusing rockets, claiming launchers must fly much more often than today to close the business case. “What we want to do is encourage the launcher industry to follow this way forward,” Halliwell said before the launch. “Maybe Bezos will be able to do this. Maybe, one day, Ariane will be able to to this.”

“In order to be competitive in launch costs, I think it’s going to be necessary for other launch companies to do the same thing,” Musk said. “Once it’s clear that something can be done, then I think that will encourage others in that direction, and I hope it does,” Musk said. “I think it shouldn’t be just SpaceX. There should be many other launch companies that succeed.”

SpaceX plans to refly up to six used first stage boosters this year. Two of them will launch as side boosters on the maiden flight of SpaceX’s new Falcon Heavy, now set to lift off in “late summer,” Musk said.

The triple-body Falcon Heavy is made of three Falcon 9 first stages bolted together. The core will be a new vehicle on the inaugural flight, which will be a purely demonstration of the heavy-lifter. Musk said the test flight will be a “high-risk” mission.

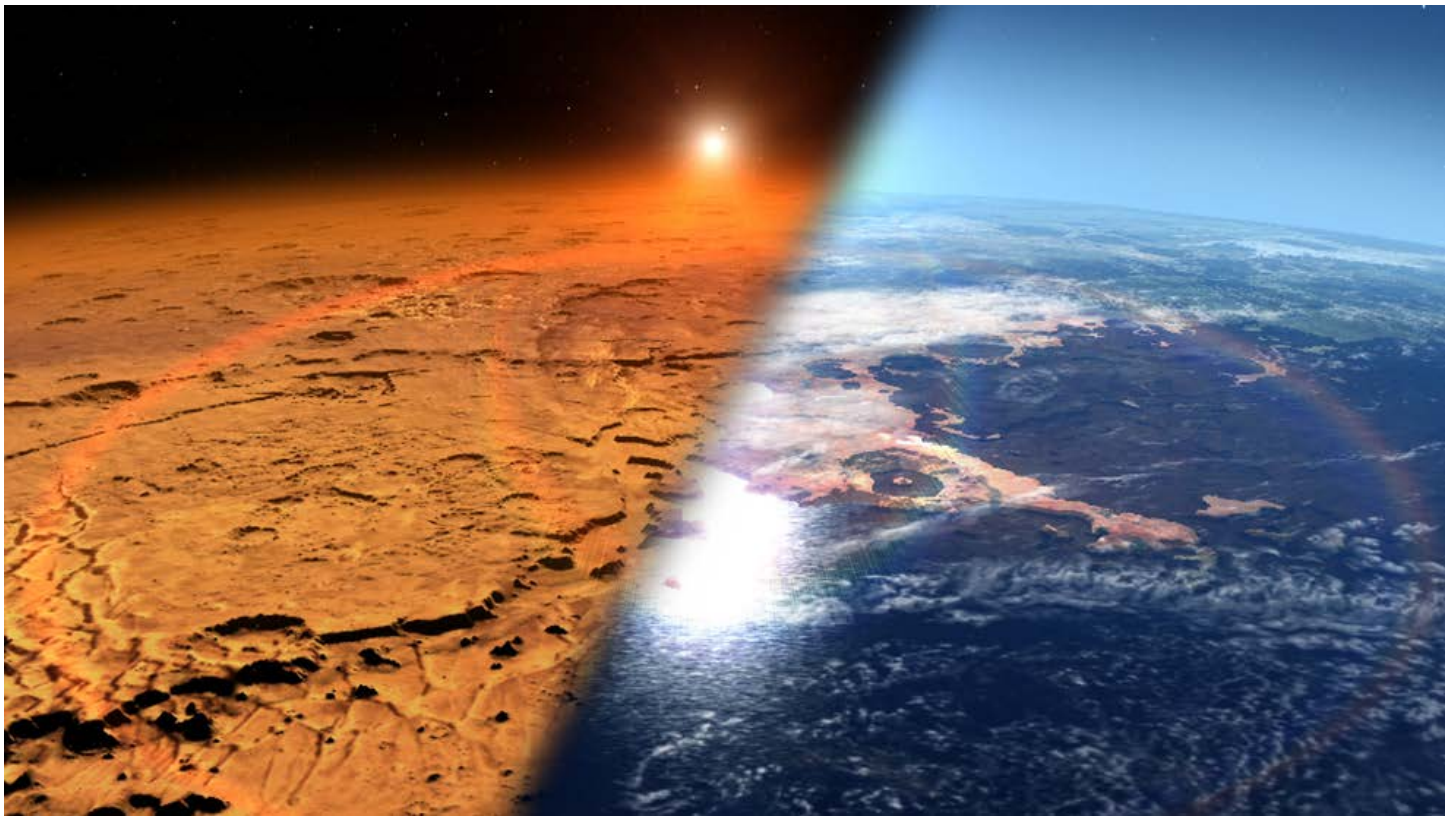
Musk said three or four other other customers have agreements to fly on partially reused Falcon 9 rockets that were contingent upon the outcome of Thursday’s mission. “I think a bunch of companies are waiting to see

(what happens)," an insurance underwriter who works in the satellite and launch markets said before the SES 10 mission. "A lot of it does have to do with the insurance market. If this goes successfully, then a lot of customers are going to assume that the insurance community is OK with reused stages, which will be the case." "The bottom line is reused rockets are here to stay," the underwriter said.

"My belief is within 24 months, SpaceX ... will offer a service to orbit and it'll be irrelevant," Halliwell said. "It'll be irrelevant whether it's new or pre-flown."

Source: Spaceflight Now Return to Contents

3. NASA's MAVEN Reveals Most of Mars' Atmosphere Was Lost to Space



Solar wind and radiation are responsible for stripping the Martian atmosphere, transforming Mars from a planet that could have supported life billions of years ago into a frigid desert world, according to new results from NASA's MAVEN spacecraft.

"We've determined that most of the gas ever present in the Mars atmosphere has been lost to space," said Bruce Jakosky, principal investigator for the Mars Atmosphere and Volatile Evolution Mission (MAVEN), University of Colorado in Boulder. The team made this determination from the latest results, which reveal that about 65 percent of the argon that was ever in the atmosphere has been lost to space. Jakosky is lead author of a paper on this research to be published in Science on Friday, March 31.

In 2015, MAVEN team members previously announced results that showed atmospheric gas is being lost to space today and described how atmosphere is stripped away. The present analysis uses measurements of today’s atmosphere for the first estimate of how much gas was lost through time.

Liquid water, essential for life, is not stable on Mars' surface today because the atmosphere is too cold and thin to support it. However, evidence such as features resembling dry riverbeds and minerals that only form in the presence of liquid water indicates the ancient Martian climate was much different – warm enough for water to flow on the surface for extended periods.

“This discovery is a significant step toward unraveling the mystery of Mars' past environments,“ said Elsayed Talaat, MAVEN Program Scientist, at NASA Headquarters in Washington. “In a broader context, this information teaches us about the processes that can change a planet’s habitability over time.”

There are many ways a planet can lose some of its atmosphere. For example, chemical reactions can lock gas away in surface rocks, or an atmosphere can be eroded by radiation and a stellar wind from a planet's parent star. The new result reveals that solar wind and radiation were responsible for most of the atmospheric loss on

Mars, and the depletion was enough to transform the Martian climate. The solar wind is a thin stream of electrically conducting gas constantly blowing out from the surface of the sun.

The early Sun had far more intense ultraviolet radiation and solar wind, so atmospheric loss by these processes was likely much greater in Mars' history. According to the team, these processes may have been the dominant ones controlling the planet's climate and habitability. It's possible microbial life could have existed at the surface early in Mars' history. As the planet cooled off and dried up, any life could have been driven underground or forced into rare surface oases.

Jakosky and his team got the new result by measuring the atmospheric abundance of two different isotopes of argon gas. Isotopes are atoms of the same element with different masses. Since the lighter of the two isotopes escapes to space more readily, it will leave the gas remaining behind enriched in the heavier isotope. The team used the relative abundance of the two isotopes measured in the upper atmosphere and at the surface to estimate the fraction of the atmospheric gas that has been lost to space.

As a "noble gas" argon cannot react chemically, so it cannot be sequestered in rocks; the only process that can remove noble gases into space is a physical process called "sputtering" by the solar wind. In sputtering, ions picked up by the solar wind can impact Mars at high speeds and physically knock atmospheric gas into space. The team tracked argon because it can be removed only by sputtering. Once they determined the amount of argon lost by sputtering, they could use this information to determine the sputtering loss of other atoms and molecules, including carbon dioxide (CO_2).

CO_2 is of interest because it is the major constituent of Mars' atmosphere and because it's an efficient greenhouse gas that can retain heat and warm the planet. "We determined that the majority of the planet's CO_2 was also lost to space by sputtering," said Jakosky. "There are other processes that can remove CO_2, so this gives the minimum amount of CO_2 that's been lost to space."

The team made its estimate using data from the Martian upper atmosphere, which was collected by MAVEN's Neutral Gas and Ion Mass Spectrometer (NGIMS). This analysis included measurements from the Martian surface made by NASA's Sample Analysis at Mars (SAM) instrument on board the Curiosity rover.

"The combined measurements enable a better determination of how much Martian argon has been lost to space over billions of years," said Paul Mahaffy of NASA's Goddard Space Flight Center in Greenbelt, Maryland. "Using measurements from both platforms points to the value of having multiple missions that make complementary measurements." Mahaffy, a co-author of the paper, is principal investigator on the SAM instrument and lead on the NGIMS instrument, both of which were developed at NASA Goddard.

The research was funded by the MAVEN mission. MAVEN's principal investigator is based at the University of Colorado's Laboratory for Atmospheric and Space Physics, Boulder, and NASA Goddard manages the MAVEN project. MSL/Curiosity is managed by NASA's Jet Propulsion Laboratory, Pasadena, California.

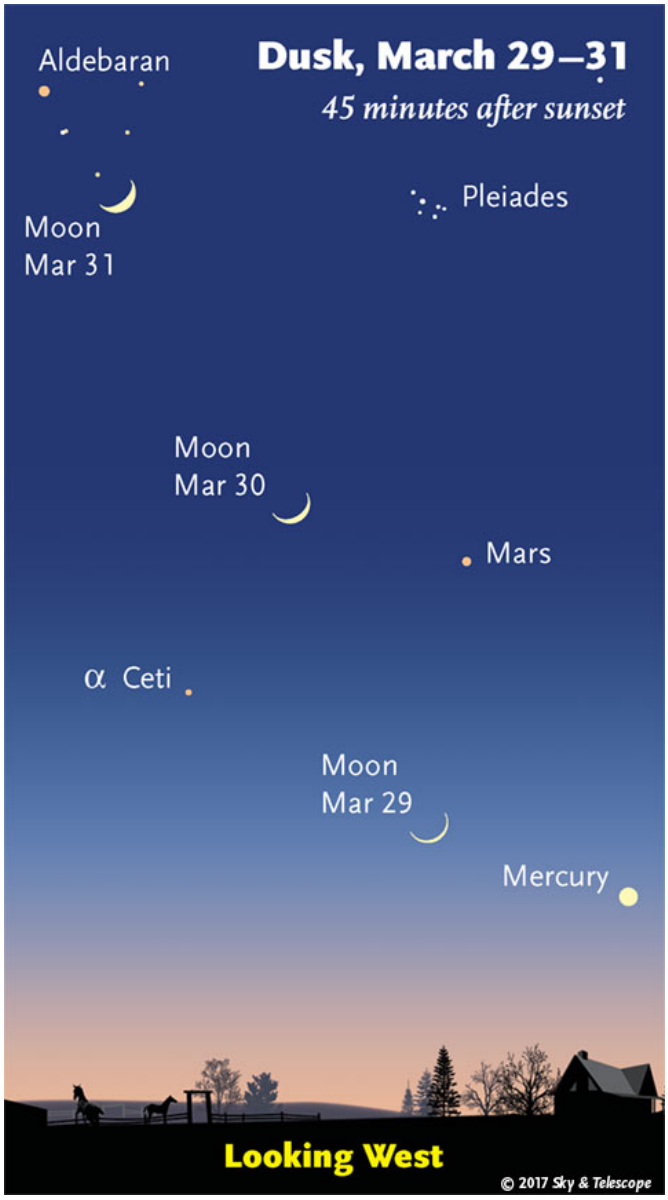
For more information on MAVEN, visit: http://www.nasa.gov/maven

Source: NASA Return to Contents

The Night Sky

Friday, March 31

• The waxing crescent Moon is approaching Aldebaran and the Hyades this evening, as seen at right.



• The huge, bright Winter Hexagon is still in view after dusk, filling the sky to the southwest and west. It's the biggest well-known asterism in the sky. Start with brilliant Sirius in the southwest, the Hexagon's lower left corner. High above Sirius is Procyon. From there look even higher for Pollux and Castor, rightward from Castor to Menkalinan and bright Capella, lower left from there to Aldebaran (near the Moon tonight), lower left to Rigel at the bottom of Orion, and back to Sirius.

Saturday, April 1

• Mercury this evening is at its highest sunset altitude of the year for skywatchers around 40° north latitude. Look for it moderately low in the west about 45 to 60 minutes after sunset. Fainter Mars is 15° above it.

• This evening Aldebaran is lower right of the Moon, and Betelgeuse is a bit farther to the Moon's lower left (for North America). Have you ever closely compared the colors of Betelgeuse and Aldebaran? Can you detect any difference in their color whatsoever? I can't, really. Yet Aldebaran, because it's spectral type *K*5 III, is often called an "orange" giant, while Betelgeuse, spectral type *M*1-*M*2 Ia, is usually called a "red" supergiant. Their temperatures are indeed a bit different: 3,910 and 3,590 kelvins, respectively.

A complication: Betelgeuse is brighter. And to the human eye, the colors of bright objects appear, falsely, to be desaturated: appearing paler (whiter) than they really are.

Sunday, April 2

• The Moon shines in the top of Orion's dim, upraised Club this evening, under the feet of Gemini.

Monday, April 3

• First-quarter Moon (exact at 2:29 p.m. EDT). The Moon after dark shines under Pollux of the Castor-and-Pollux pair. The Moon is a similar distance upper right of brighter Procyon. Look way below Procyon for Sirius, brighter still.

Source: Sky & Telescope

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ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Fri Mar 31, 7:44 PM	1 min	25°	25° above NNE	11° above NE
Fri Mar 31, 9:19 PM	2 min	13°	13° above NNW	10° above NNE
Sat Apr 1, 8:26 PM	3 min	17°	16° above NW	11° above NNE
Sun Apr 2, 9:11 PM	2 min	10°	10° above NNW	10° above N
Mon Apr 3, 8:18 PM	2 min	12°	11° above NNW	10° above NNE
Tue Apr 4, 9:03 PM	1 min	10°	10° above N	10° above N

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

NASA-TV Highlights

(all times Eastern Daylight Time)

Friday, March 31

4 p.m., Replay of the NASA Television Video File Feed of the ISS Expedition 51-52 Crew (Fischer and Yurchikhin) Qualification Training at the Gagarin Cosmonaut Training Center in Star City, Russia (Recorded on March 30-31) (NTV-3 (Media))

7 p.m., 9 p.m., Replay of the NASA Television Video File Feed of the ISS Expedition 51-52 Crew (Fischer and Yurchikhin) Qualification Training at the Gagarin Cosmonaut Training Center in Star City, Russia (Recorded on March 30-31) (all channels)

8 p.m., Replay of SpaceCast Weekly (all channels)

Saturday, April 1

8:30 a.m., Simulcast of the NASA Rover Challenge from the U.S. Space and Rocket Center -- Huntsville, Alabama (NTV-1 (Public))

4 p.m., 7 p.m., Replay of SpaceCast Weekly (all channels)

5 p.m., 8 p.m., 10 p.m., Replay of the NASA Television Video File Feed of the ISS Expedition 51-52 Crew (Fischer and Yurchikhin) Qualification Training at the Gagarin Cosmonaut Training Center in Star City, Russia (Recorded on March 30-31) (all channels)

6 p.m., 9 p.m., Replay of "Celebrating Women's History Month – Getting Excited About STEM" (NTV-1 (Public))

Sunday, April 2

6 a.m., 10 a.m, Replay of SpaceCast Weekly (all channels)

6 a.m., 2 p.m., 8 p.m, Replay of the NASA Television Video File Feed of the ISS Expedition 51-52 Crew (Fischer and Yurchikhin) Qualification Training at the Gagarin Cosmonaut Training Center in Star City, Russia (Recorded on March 30-31) (all channels)

8 a.m., Replay of “Celebrating Women’s History Month – Getting Excited About STEM” (NTV-1 (Public))

6 p.m., Replay of “Celebrating Women’s History Month – Getting Excited About STEM” (NTV-1 (Public))

Monday, April 3

11:30 a.m., ISS Expedition 50 Educational In-Flight Event with the Betsy Ross Elementary School in Anaheim, California and ISS Commander Shane Kimbrough and Flight Engineer Peggy Whitson of NASA (Starts at 11:40a.m.) (all channels)

4 p.m., Replay of the ISS Expedition 51-52 Crew (Fischer and Yurchikhin) News Conference at the Gagarin Cosmonaut Training Center in Star City, Russia (all channels)

4:30 p.m., NASA Television Video File Feed of the ISS Expedition 51-52 Crew’s (Fischer and Yurchikhin) Ceremonial Visit to the Gagarin Museum at the Gagarin Cosmonaut Training Center and Visit to Red Square and the Kremlin in Moscow (starts at 4:45 p.m.) (all channels)

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

Space Calendar

- Mar 31 - CAS-4A & 4B CZ-2D launch
- Mar 31 - Comet C/2017 E4 (Lovejoy) Closest Approach To Earth (0.606 AU)
- Mar 31 - Comet 187P/LINEAR Closest Approach To Earth (3.172 AU)
- Mar 31 - Comet 191P/McNaught At Opposition (4.002 AU)
- Mar 31 - NEW [Mar 28] Apollo Asteroid 2017 FV90 Near-Earth Flyby (0.040 AU)
- Mar 31 - Asteroid 9880 Stegosaurus Closest Approach To Earth (1.386 AU)
- Mar 31 - Asteroid 13926 Berners-Lee Closest Approach To Earth (2.320 AU)
- Mar 31 - Astrophysics Mission Synergy Workshop, Pasadena, California
- Apr 01 - Moon Occults Aldebaran
- Apr 01 - Mercury At Its Greatest Eastern Elongation (19 Degrees)
- Apr 01 - Comet 41P/Tuttle-Giacobini-Kresak Closest Approach To Earth (0.142 AU)
- Apr 01 - Comet 73P-AO/Schwassmann-Wachmann Perihelion (0.972 AU)
- Apr 01 - Comet 157P/Tritton Closest Approach To Earth (2.127 AU)
- Apr 01 - Comet C/2017 E2 (XuYi) At Opposition (3.028 AU)
- Apr 01 - NEW [Mar 28] Apollo Asteroid 2017 FX90 Near-Earth Flyby (0.006 AU)
- Apr 01 - NEW [Mar 28] Amor Asteroid 2017 FO91 Near-Earth Flyby (0.078 AU)
- Apr 01 - Griffith Observatory Monthly Star Party, Los Angeles, California
- Apr 01 - 20th Anniversary (1997), Comet Hale-Bopp Perihelion (0.914 AU)
- Apr 02 - Comet C/2016 VZ18 (PANSTARRS) Closest Approach To Earth (0.528 AU)
- Apr 02 - Comet 73P-AQ/Schwassmann-Wachmann At Opposition (0.717 AU)
- Apr 02 - Comet 73P-AR/Schwassmann-Wachmann Closest Approach To Earth (0.734 AU)
- Apr 02 - Comet 73P-AG/Schwassmann-Wachmann Closest Approach To Earth (0.735 AU)
- Apr 02 - Comet 73P-Z/Schwassmann-Wachmann Perihelion (0.973 AU)
- Apr 02 - Comet P/2008 WZ96 (LINEAR) At Opposition (3.643 AU)
- Apr 02 - NEW [Mar 31] Apollo Asteroid 2017 FU102 Near-Earth Flyby (0.001 AU)
- Apr 02 - Apollo Asteroid 2017 FV Near-Earth Flyby (0.023 AU)
- Apr 02 - Asteroid 88292 Bora-Bora Closest Approach To Earth (1.588 AU)
- Apr 02 - Asteroid 274860 Emilylakdawalla Closest Approach To Earth (1.870 AU)
- Apr 02 - Amor Asteroid 3552 Don Quixote Closest Approach To Earth (3.085 AU)
- Apr 02 - Percy Molesworth's 150th Birthday (1867)
- Apr 03 - Comet 349P/Lemmon Closest Approach To Earth (1.651 AU)
- Apr 03 - Asteroid 3 Juno Occults UCAC4-405-101051 (12.4 Magnitude Star)
- Apr 03 - NEW [Mar 31] Apollo Asteroid 2017 FT102 Near-Earth Flyby (0.003 AU)
- Apr 03 - Apollo Asteroid 2015 BY310 Near-Earth Flyby (0.079 AU)
- Apr 03 - Asteroid 16809 Galapagos Closest Approach To Earth (1.564 AU)
- Apr 03 - Asteroid 7784 Watterson Closest Approach To Earth (1.689 AU)
- Apr 03 - Asteroid 284891 Kona Closest Approach To Earth (2.252 AU)
- Apr 03 - Asteroid 4372 Quincy Closest Approach To Earth (2.275 AU)

Source: JPL Space Calendar

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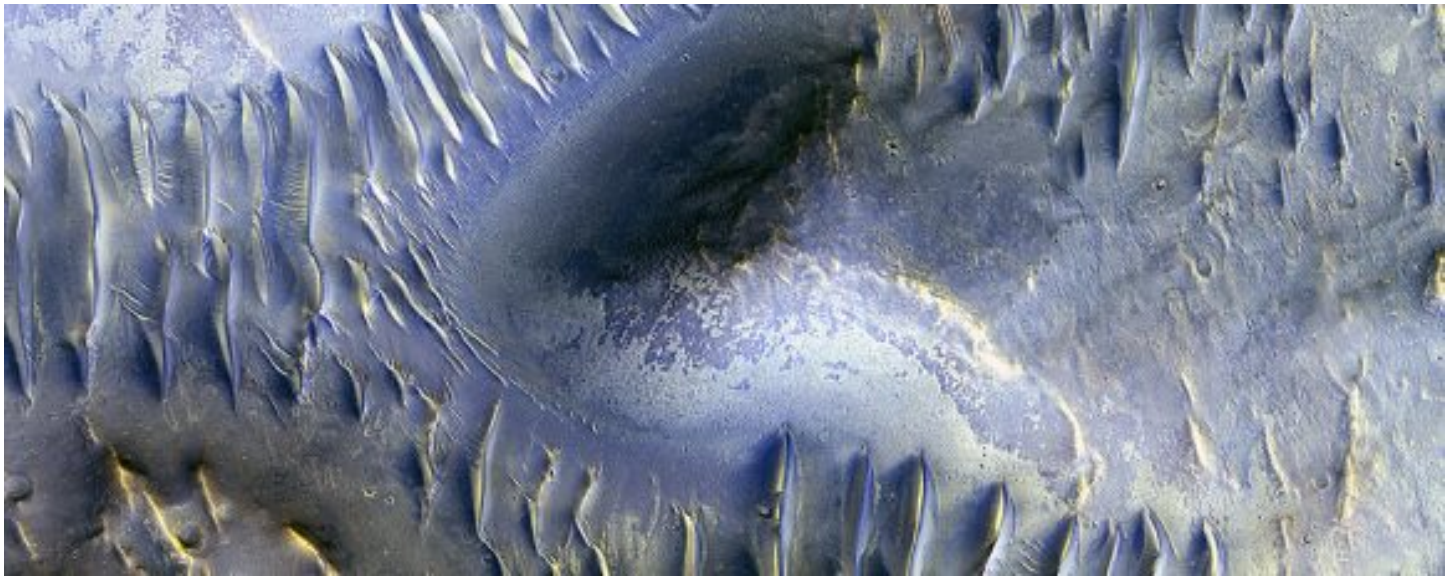
Food for Thought

The Ever-Working Mars Orbiter Passes 50,000 Orbits



Most of us never do one thing 50,000 times in our life. So for NASA's Mars Reconnaissance Orbiter (MRO), completing 50,000 orbits around the red planet is a big deal. And, it only took 10 years to do so.

The MRO could be called one of NASA's flagship missions. It's presence in orbit around Mars has helped open up our understanding of that planet immensely. And it's done so while providing us a steady stream of eye candy.

MRO was launched in 2005 and reached Mars orbit in March, 2006. After 10 years at work, it has accomplished a lot. In a recent press release, NASA calls the MRO "the most data-productive spacecraft yet." Though most of us might know the orbiter because of it's camera, the High-Resolution Imaging Science Experiment (HiRise), the MRO actually has a handful of other instruments that help the orbiter achieve its objectives. In broad terms, those objectives are:

- to study the history of water on Mars
- to look at small scale features on the surface, and identify landing sites for future Mars missions
- to act as a communications relay between Mars and Earth

MRO's HiRise camera gets all the glory, but it's another onboard camera, the Context Camera (CTX), that is the real workhorse. The CTX is a much lower resolution than the HiRise, but its file sizes are much more manageable, an important consideration when every file has to travel from Mars to Earth—an average distance of about 225 million km.

CTX has captured 90,000 images so far in MRO's mission, and each one captures details smaller than a tennis court. In the course of the mission so far, CTX has images that cover 99.1% of the Martian surface. Over 60% of the planet has been covered twice.

"Reaching 99.1-percent coverage has been tricky because a number of factors, including weather conditions, coordination with other instruments, downlink limitations, and orbital constraints, tend to limit where we can image and when," said Context Camera Team Leader Michael Malin of Malin Space Science Systems, San Diego.

Malin said, “Single coverage provides a baseline we can use for comparison with future observations, as we look for changes. Re-imaging areas serves two functions: looking for changes and acquiring stereoscopic views from which we can make topographic maps.”

Because the CTX captures image of the same surface areas twice, it documents changes on the surface. There have been over 200 instances of impact craters appearing in a second image of the same area. Scientists have used this to calculate the rate that meteorites impact Mars.

The instruments on board the MRO work as a team. The CTX can capture images of areas of interest, and the HiRise can be used for higher-resolution images of the same area. By locating fresh impact craters, then studying them more closely, the MRO has helped discover the presence of what looked like sub-surface ice on Mars. A third instrument, the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM), confirmed the presence of ice.

The CTX is the workhorse camera, and the HiRise is the diva, but MRO actually has a third camera: the Mars Color Imager (MARCI). MARCI is a very low resolution camera compared to the others. It’s also a wide-angle camera with really only one purpose: characterizing Martian weather. Every day, MARCI takes about 84 images which together create a daily global map of Mars. You can see a weekly Martian weather report from MARCI here.

The MRO recently manoeuvered itself into position for its next task—helping the InSight Lander. The MRO must receive critical radio transmissions from NASA’s InSight Lander as it descends to Mars. Insight will use its instruments to examine the interior of Mars for clues to how rocky planets form. Not only did MRO help find a landing spot for Insight, but it will hold the lander’s hand as it descends, and it will act as a data relay.

There’s no end in sight for the MRO. It just keeps going and going, and fulfilling its mission objectives on a continuing basis. “After 11 and a half years in flight, the spacecraft is healthy and remains fully functional,” said MRO Project Manager Dan Johnston at NASA’s Jet Propulsion Laboratory, Pasadena, California. “It’s a marvelous vehicle that we expect will serve the Mars Exploration Program and Mars science for many more years to come.”

Source: Universe Today Return to Contents

Space Image of the Week

Nebula with Laser Beams

Explanation: Four laser beams cut across this startling image of the Orion Nebula, as seen from ESO's Paranal Observatory in the Atacama desert on planet Earth. Not part of an interstellar conflict, the lasers are being used for an observation of Orion by UT4, one of the observatory's very large telescopes, in a technical test of an image-sharpening adaptive optics system. This view of the nebula with laser beams was captured by a small telescope from outside the UT4 enclosure. The beams are visible from that perspective because in the first few kilometers above the observatory the Earth's dense lower atmosphere scatters the laser light. The four small segments appearing beyond the beams are emission from an atmospheric layer of sodium atoms excited by the laser light at higher altitudes of 80-90 kilometers. Seen from the perspective of the UT4, those segments form bright spots or artificial guide stars. Their fluctuations are used in real-time to correct for atmospheric blurring along the line-of-sight by controlling a deformable mirror in the telescope's optical path.

Image Credit & Copyright: Stéphane Guisard (Los Cielos de America, TWAN)

Source: Astronomy Picture of the Day

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