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TOUCHDOWN!

NASA's Mars Perseverance Rover Safely Lands on Red Planet

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TOUCHDOWN

NASA's Mars Perseverance Rover Safely Lands on Red Planet

The largest, most advanced rover NASA has sent to another world touched down on Mars Feb. 18, after a 203-day journey traversing 293 million miles (472 million kilometers). Confirmation of the successful touchdown was announced in mission control at NASA's Jet Propulsion Laboratory.

Packed with groundbreaking technology, the Mars 2020 mission launched July 30, 2020, from Cape Canaveral Space Force Station in Florida. The Perseverance rover mission marks an ambitious first step in the effort to collect Mars samples and return them to Earth.

"This landing is one of those pivotal moments for NASA, the United States, and space exploration globally – when we know we are on the cusp of discovery and sharpening our pencils, so to speak, to rewrite the textbooks," said acting NASA Administrator Steve Jurczyk. "The Mars 2020 Perseverance mission embodies our nation's spirit of persevering even in the most challenging of situations, inspiring, and advancing science and exploration. The mission itself personifies the human ideal of persevering toward the future and will help us prepare for human exploration of the Red Planet."

About the size of a car, the 2,263-pound (1,026-kilogram) robotic geologist and astrobiologist will undergo several weeks of testing before it begins its two-year science investigation of Mars' Jezero Crater. While the rover will investigate the rock and sediment of Jezero's ancient lakebed and river delta to characterize the region's geology and past climate, a fundamental part of its mission is astrobiology, including the search for signs of ancient microbial life. To that end, the Mars Sample Return campaign, being planned by NASA and ESA (European Space Agency), will allow scientists on Earth to study samples collected by Perseverance to search for definitive signs of past life using instruments too

large and complex to send to the Red Planet.

"Because of today's exciting events, the first pristine samples from carefully documented locations on another planet are another step closer to being returned to Earth," said Thomas Zurbuchen, associate administrator for science at NASA. "Perseverance is the first step in bringing back rock and regolith from Mars. We don't know what these pristine samples from Mars will tell us. But what they could tell us is monumental – including that life might have once existed beyond Earth."

Some 28 miles (45 kilometers) wide, Jezero Crater sits on the western edge of Isidis Planitia, a giant impact basin just north of the Martian equator. Scientists have determined that 3.5 billion years ago the crater had its own river delta and was filled with water.

The power system that provides electricity and heat for Perseverance through its exploration of Jezero Crater is a Multi-Mission Radioisotope

Thermoelectric Generator, or MMRTG. The U.S. Department of Energy (DOE) provided it to NASA through an ongoing partnership to develop power systems for civil space applications.

Equipped with seven primary science instruments, the most cameras ever sent to Mars, and its exquisitely complex sample caching system – the first of its kind sent into space Perseverance will scour the Jezero region for fossilized remains of ancient microscopic Martian life, taking samples along the way.

"Perseverance is the most sophisticated robotic geologist ever made, but verifying that microscopic life once existed carries an enormous burden of proof," said Lori Glaze, director of NASA's Planetary Science Division. "While we'll learn a lot with the great instruments we have aboard the rover, it may very well require the far more capable laboratories and instruments back here on Earth to tell us whether our samples carry evidence that Mars once harbored life."

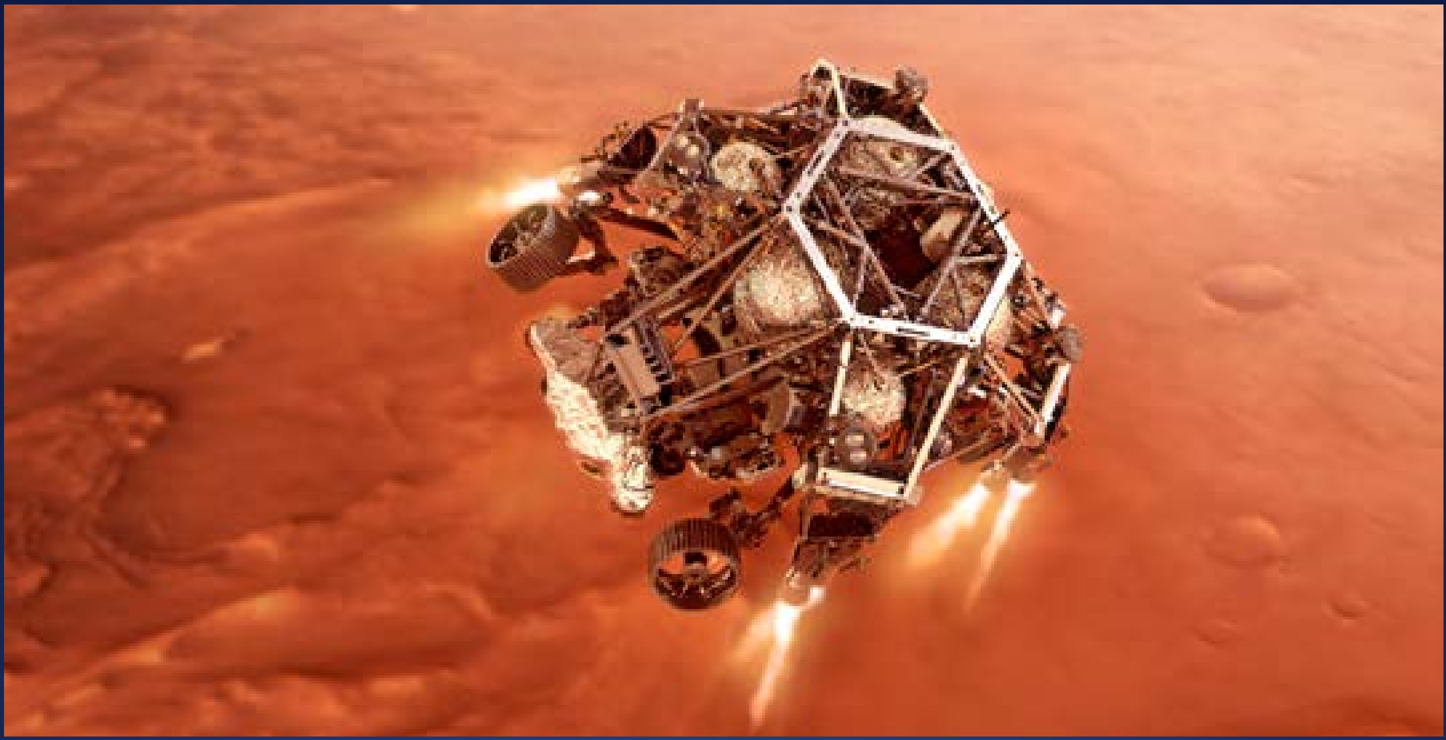
Paving the Way for Human Missions

"Landing on Mars is always an incredibly difficult task and we are proud to continue building on our past success," said JPL Director Michael Watkins. "But, while Perseverance advances that success, this rover is also blazing its own path and daring new challenges in the surface mission. We built the rover not just to land but to find and collect the best scientific samples for return to Earth, and its incredibly complex sampling system and autonomy not only enable that mission, they set the stage for future robotic and crewed missions."

Currently attached to the belly of Perseverance, the diminutive Ingenuity Mars Helicopter is a technology demonstration that will attempt the first powered, controlled flight on another planet.

Project engineers and scientists will now put Perseverance through its paces, testing every instrument, subsystem, and subroutine over the next month or two. Only then will they deploy the helicopter to the surface for the flight test phase. If successful, Ingenuity could add an aerial dimension to exploration of the Red Planet in which such helicopters serve as a scouts or make deliveries for future astronauts away from their base.

Once Ingenuity's test flights are complete, the



rover's search for evidence of ancient microbial life will begin in earnest.

"Perseverance is more than a rover, and more than this amazing collection of men and women that built it and got us here," said John McNamee, project manager of the Mars 2020 Perseverance rover mission at JPL. "It is even more than the 10.9 million people who signed up to be part of our mission. This mission is about what humans can achieve when they persevere. We made it this far. Now, watch us go."

Read Full Story

The Perseverance of Testing

Helping to Assure a Safe Rover Landing in Tricky Terrain

After a nearly seven-month journey to Mars, NASA's Perseverance rover landed Feb. 18 at the Red Planet's Jezero Crater, a rugged expanse chosen for its scientific research and sample collection possibilities.
But the very features that make the site fascinating to scientists also made it a relatively dangerous place to land – a challenge that motivated rigorous testing on Earth for the lander vision system (LVS) the rover counted on to safely touch down.

"There were some large areas in the landing ellipse that were fairly safe, but during the actual landing the spacecraft drifted away from those into terrain with numerous rocks and dunes," said Andrew Johnson, principal robotics systems engineer at NASA's Jet Propulsion Laboratory.

"If Perseverance had landed on one of those hazards, it could have been catastrophic to the mission," he added. "But the LVS estimated the rover's position correctly and the safe target selection feature picked a landing site that was surrounded by hazards but very safe. The lander touched down around five meters from this targeted site."

Terrain-Relative Navigation (TRN), a mission-critical technology at the heart of the LVS, captured photos of the Mars terrain in real time and compared them with onboard maps of the landing area, autonomously directing the rover to divert around known hazards and obstacles as needed.

"The LVS used the position information from the TRN to figure out where the rover was relative to safe spots between those hazards," explained Johnson.
Johnson was confident that LVS would work to land Perseverance safely because the system allows the rover to determine its position relative to the ground with an accuracy of about 200 feet or less. That low margin of error and high degree of assurance are by design, and the result of extensive testing in the lab and in the field.

"We have what we call the trifecta of testing," explained JPL's Swati Mohan, guidance, navigation, and control operations lead for Mars 2020.

Mohan said that the first two testing areas hardware and simulation – were done in a lab.

"That's where we test every condition and variable we can. Vacuum, vibration, temperature, electrical compatibility we put the hardware through its paces," said Mohan. "Then with simulation, we model various scenarios that the software algorithms may encounter on Mars – a too-sunny day, very dark day, windy day – and we make sure the system behaves as expected regardless of those conditions."

But the third piece of the trifecta the field tests require actual flights to put the lab results through further rigor and provide a high level of technical readiness for NASA missions. For LVS's early flight tests, Johnson and team mounted the LVS to a helicopter and used it to estimate the vehicle's position automatically as it was flying.

"That got us to a certain level of technical readiness because the system could monitor a wide range of terrain, but it didn't have the same kind of descent that Perseverance would have," said Johnson. "There was also a need to demonstrate LVS on a rocket."

That need was met by NASA's Flight Opportunities program, which facilitated two 2014 flights in the Mojave Desert on Masten Space Systems' Xombie a vertical takeoff and vertical landing (VTVL) system that functions similarly to a lander. The flight tests demonstrated LVS's ability to direct Xombie to autonomously change course and avoid hazards on descent by adopting a newly calculated path to a safe landing site. Earlier flights on Masten's VTVL system also helped validate algorithms and software used to calculate fuel-optimal trajectories for planetary landings.

"Testing on the rocket laid pretty much all remaining doubts to rest and answered a critical question for the LVS operation affirmatively," said JPL's Nikolas Trawny, a payload and pointing control systems engineer who worked closely with Masten on the 2014 field tests. "It was then that we knew LVS would work during the high-speed vertical descent typical of Mars landings." Johnson added that the suborbital testing in fact increased the technology readiness level to get the final green light of acceptance into the Mars 2020 mission.

"The testing that Flight Opportunities is set up to provide was really unprecedented within NASA at the time," said Johnson. "But it's proven so valuable that it's now becoming expected to do these types of flight tests. For LVS, those rocket flights were the capstone of our technology development effort."

With the technology accepted for Mars 2020, the mission team began to build the final version of LVS that would fly on Perseverance. In 2019, a copy of that system flew on one more helicopter demonstration in Death Valley, California, facilitated by NASA's Technology Demonstration Missions program. The helicopter flight provided a final check on over six-years of multiple field tests.

But Mohan pointed out that even with these successful demonstrations, there was more work to do to ensure a safe landing. She was at Mission Control for the landing, monitoring the health of the system every step of the way.

"Real life can always throw you curve balls. So, we monitored everything during the cruise phase, checked power to the camera and made sure the data was flowing as expected," Mohan said. "And once we got the signal from the rover that said, 'I've landed and I'm on stable ground,' then we could celebrate."

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Artemis II

Armstrong Assists with Orion for First Astronaut Mission

As NASA's human spaceflight centers are busy preparing the Orion spacecraft and its components for the early Artemis missions around the Moon, a NASA aeronautics-focused center is lending a hand.

NASA's Armstrong Flight Research Center in Edwards, California, is providing system engineering and integration expertise to assist with an Orion heat shield spectrometer system (OHSS). The system will be used during the Artemis II mission, the first crewed mission for NASA's Orion spacecraft. It will provide valuable data that will be used to enhance astronaut safety. OHSS is also under consideration for use on the Artemis III, IV and V missions.

Armstrong is helping to meet Orion project requirements and verification documentation for the OHSS acceptance data package. In addition, the center provided project support for the system acceptance review.

The heat shield protects the capsule and the astronauts inside from the nearly 5,000 degrees Fahrenheit temperatures, about half as hot at the Sun, experienced when coming home from lunar velocities. The OHSS system is designed to collect shock layer radiation data from the heat shield during atmospheric entry of the Orion crew module, said Patty Ortiz, NASA Armstrong OHSS deputy project manager.

The OHSS will be mounted to a structure outside the Orion pressurized crew module and underneath the backshell thermal protection system, and a fiber optic cable will connect the spectrometers to the heat shield optical sub-assembly. The spectrometer will collect photons created by the super-heated gas in the atmosphere generated by the spacecraft's entry and collect the data between the infrared and ultraviolet wavelengths. Technicians will retrieve the stored data when the Orion spacecraft returns to Earth, and engineers will use the data to help characterize the flow field around the vehicle.

"Current radiometers only measure the integrated radiation environment and flight radiation physics can't be recreated on the ground," Ortiz explained. "However, the OHSS will be able to provide more detailed data that will lead to improved computer modeling and heating predictions to validate and improve how researchers understand radiative heating environments like Orion's re-entry. Improved predictions can allow for potential mass reduction in the heat shield materials and the extension of the design for higher speed entries."

Armstrong's role began in November 2019 with

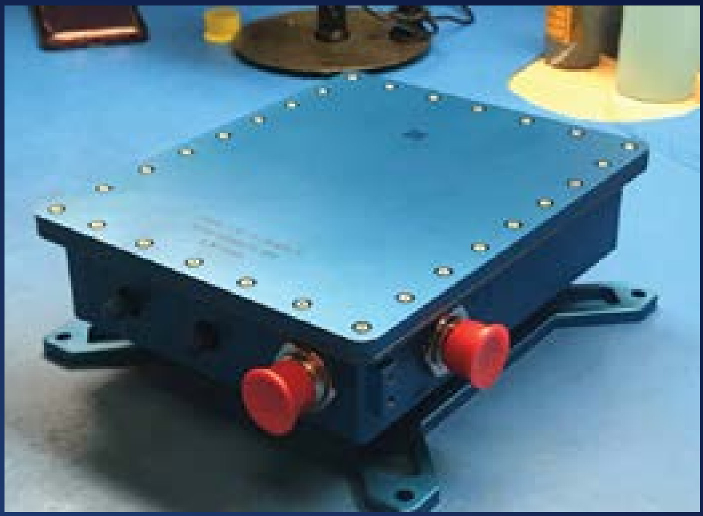
systems engineering and integration expertise to verify Orion's project requirements and to generate verification documentation for the OHSS project. Armstrong also provided project management support to compile the acceptance data package for system acceptance review in November 2020.

Technicians completed work on the system at NASA's Johnson Space Center in Houston. The OHSS flight unit is complete and has passed about 200 hours of acceptance testing at DynaQual Test Labs in Houston, about an hour north of Johnson. The testing included vibration, thermal cycle and burn-in testing, the process of running the component for an extended time to validate it functions properly. Also included was thermal cycle testing, where the OHSS system was exposed to a range of temperatures to validate its durability.

The unit performed as expected during testing and engineers at Johnson completed additional functional checkouts of the flight unit. Additional checkouts included an inspection for sharp edges and mass and volume measurement prior to packaging the unit for shipping to NASA's Kennedy Space Center in Florida.

Teams plan to perform a functional check out of the OHSS system at Kennedy in 2021, followed by installation on the Orion spacecraft. They plan to conduct a full end-to-end test of the unit in 2022, which will include additional calibration and check out of the OHSS box, the fiber optic cables and the heat shield optical subassembly.

NASA Armstrong has also supported the Artemis program through a larger role with the Orion's Ascent Abort-2 on July 2, 2019. That test validated the spacecraft's launch abort system could safely move astronauts away from the rocket in the event of an emergency during the launch. The center also had a major role in the Pad Abort-1 test in 2010, where the launch abort system demonstrated it could help astronauts escape an emergency on the launch pad.



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All Electric X-57

NASA to Begin High-Voltage Ground Testing

NASA is set to start high-voltage functional ground testing of the agency's first all-electric X-plane, the X-57 Maxwell, which will perform flights to help develop certification standards for emerging electric aircraft. NASA is also supporting these new electric aircraft by developing quiet, efficient, reliable technology these vehicles will need in routine use.

The testing will take place at NASA's Armstrong Flight Research Center in Edwards, California, marking a pivotal milestone for the project as NASA proceeds from the component design and prototype phase to operation of the vehicle as an integrated aircraft, taking a critical step closer toward taxi tests and first flight.

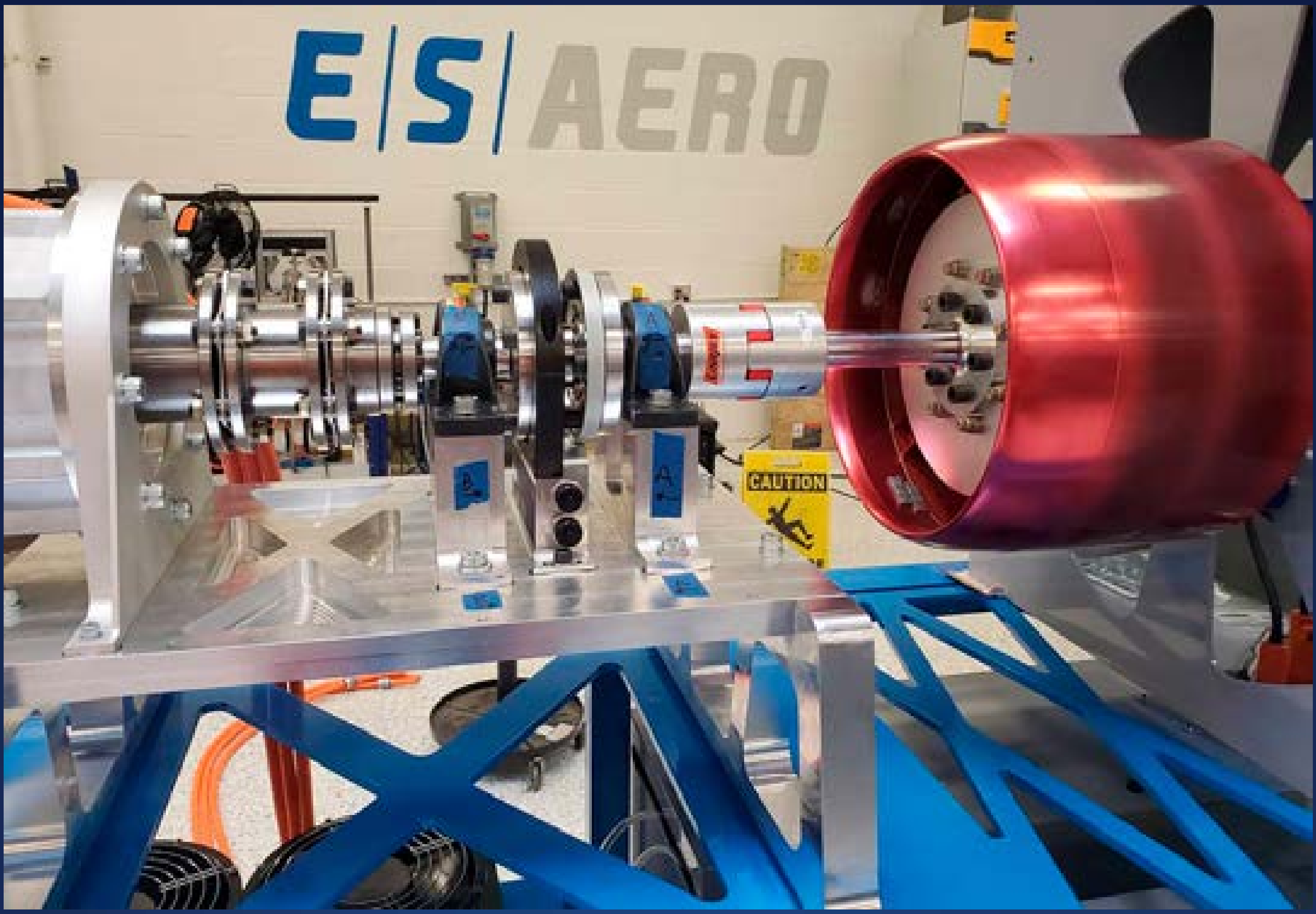
The X-57, currently in its first configuration as an electric aircraft, called Mod 2, will use a battery support system for this phase of testing, drawing power from a large, high-voltage power supply as development on the X-plane's battery control system nears completion.

Testing is expected to start with low power, checking the startup and shutdown sequences and verifying that the new motor control software boots up and controls the motors as expected. This software and other major components were recently redesigned based on lessons learned from previous testing by the project's prime contractor, Empirical Systems Aerospace, or ESAero, of San Luis Obispo, California.

These tests will include higher-power operation of the vehicle. The first pair of electric cruise motors to fly on the X-57, which were delivered by ESAero, will be powered up and activated, allowing engineers to ensure that the vehicle's propellers spin as designed.

This will be followed by throttling up the motors to make sure they provide all the power intended, validating the vehicle's instrumentation system, and verifying whether all the sensors installed across the aircraft are functional.

This high-voltage testing will feed directly into final verification and validation testing, a critical final step before taxi tests begin.



“Many of the team members operating this test will be the same ones who will be sitting in the control room for flight, and that’s why I’m excited,” said Sean Clarke, NASA’s X-57 principal investigator. “We’ve turned a corner from system design and lab tests, to turning it over to the NASA flight systems and operations engineers to actually operate the vehicle. What they’re learning in this test, they’ll take with them into the control room for first flight.”

For more about NASA’s X-57 Maxwell, visit:

http://www.nasa.gov/x57

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X-59 QueSST

NASA Armstrong Building Renovated for New X-plane

When the X-59 Quiet SuperSonic Technology, or QueSST, aircraft comes to NASA's Armstrong Flight Research Center in Edwards, California for flight tests, it will be housed in a newly refurbished building.

The $5.8 million hangar addition and modernization project at Building 4826 was awarded in September 2019 and work began in December. The project is expected to conclude in the fall and be ready for the aircraft. The approximately 100-foot long X-59 QueSST is currently under construction at Lockheed Martin's Skunk Works facility in nearby Palmdale. The X-plane is designed to fly supersonic, or faster than the speed of sound, without producing the loud sonic booms typically associated with such speeds.

"This is a really exciting project to be a part of and prepare for that aircraft," said Bryan Watters, NASA Armstrong's Building 4826 project manager and civil engineer. "The technology involved in designing and constructing the X-59 sounds incredible. I look forward to seeing the construction finished and watching the plane roll in here. That will be awesome."

Collin Morris, project manager for the contractor CJW Macro-Z Technology Joint Venture, shares Watters' enthusiasm. "For me it's pretty cool because I come from an aviation family and my father is a pilot," Morris said. "I didn't know the extent of the work, or what was going in this hangar at first. Since then, I have learned more about the plane and its systems. It is an experimental aircraft that could be an advantage for future cross-country travel and commercial aviation."

One of the major efforts involved the addition of offices, a conference room, restrooms and a communication room on the east side of the building closest to the historic Rogers Dry Lake. In order to extend the structure's size, there was the need for additional foundations and footings, concrete masonry unit walls, structural steel framing, roofing and additional elements, Watters detailed.

The new addition was the biggest upgrade to the building, which was constructed in 1968. It was originally 37,449 square feet and the office additions of 4,820 square feet increases its size to 42,269 square feet, said Peter Castricone,

Armstrong construction of facilities program manager. Inside the hangar between the insulation and the new flooring system, there used to be a mezzanine that was completely removed to create additional space, Morris explained. Also demolished during the project was a separate 8,800-square-foot canopy area that was not part of the building, but near it on the lake bed side where the offices were added.

In addition, there were some utility upgrades such as a big electrical inverter system to accommodate the X-59. Fire suppression system upgrades include the installation of a hybrid system that has both foam and water for a variety of potential challenges. Additional work included interior metal stud framing, insulation and drywall for the addition.

“This hangar will be state of the art,” Morris said. “It’s being renovated into something I haven’t seen before.”

Among the many unique systems upgrades are those for using and detecting hydrazine.

“Projects like this, to house a one-of-a-kind aircraft like this, takes a level of effort to plan, design and construct,” Watters said. “The planning phase, the design phase and the construction phase are lengthy to get to the end result. It is a lot more involved than a lot of people might realize.”

Read Full Story

STEM Education

NASA Partnership with UC Merced Advances Minority Growth

As NASA continues to push the boundaries of exploration further into space than ever before, the agency is looking to the next generation to join STEM fields, which are critical to mission success.

Students interested in science, technology, engineering and mathematics-focused careers can engage in educational opportunities at several universities around the country. Through an award system, NASA provides minority awardees the unique opportunity to contribute directly to the agency's missions by delivering research and technology concepts.

One of these awardees is The University of California, Merced, where the Merced nAnomaterials Center for Energy and Sensing, also known as MACES, was established through a NASA cooperative agreement in 2015. Since then, MACES has provided research and university student support, aligned with NASA's Space Technology Mission Directorate. These efforts have developed innovative technologies, including sensing platforms that enable lightweight, compact, high-performance energy conversion and storage for future space missions.

MACES has provided support to over 1,600 K-12 students through outreach activities such as hands-on STEM training with local high school students, and has funded 170 undergraduate students with fellowship awards to pursue degrees in STEM. These student awards were distributed to minority students including numerous first-generation college students.

Student Success:

As an undergraduate chemistry major, Yaneth Hernandez has had the opportunity to work in a UC Merced chemistry lab with carbon nanotubes. These tubes are made of composite materials that are potentially useful for space applications, due to their unique combination of electrical, thermal, and mechanical properties. Through the program, Hernandez has observed a rising GPA, gained hands-on experience, and attained fuel for her drive toward obtaining her doctorate in chemistry in the near future.

Undergraduate student Jacqueline Bustamante, a chemistry and materials science major, has partnered with other students in STEM fields through the mentor program. She has been involved in the development and improvement of energy storage batteries that could be used for long-duration and deep-space missions that depend on efficient use of energy sources. Bustamante says she wants to contribute to increasing the role of women in science and give minority groups further opportunities for growth. After completing the MACES undergraduate program, Bustamante plans to attend graduate school, as well as work at a pharmaceutical company as a chemist and researcher.

Calista Lum is an undergraduate physics student who participated in an internship at NASA's Langley Research Center in Hampton, Virginia in the summer of 2019. She was placed with a NASA mentor to work on a project related to understanding suitable nanomaterials that could shield space suits, ships and habitats from solar radiation. Her dream is to one day work at NASA on the mission to Mars.

NASA's Minority University Research and Education Project's Institutional Research Opportunity, or MIRO, managed through NASA's Armstrong Flight Research Center Office of STEM Engagement in California, awards cooperative agreements to universities around the nation to perform research and education.

All MIRO awards are provided to minority-serving institutions to promote research capacity, expand aerospace research, increase workforce diversity, and strengthen STEM skills. These awards directly support NASA's four mission directorates: Aeronautics Research, Human Exploration and Operations, Science and Space Technology. There are currently 20 active MIRO awardees across 14 different U.S. states and territories.

Learn more about MIRO at:
https://www.nasa.gov/stem/murep/miro

Read Full Story

Day of Remembrance

NASA Armstrong Remembers Pilots Who Lost Their Lives

NASA's Day of Remembrance recognizes astronauts who have perished in the efforts to advance the nation's reach into space. It's also a day to reflect on how to keep future astronauts safe and the need to remain vigilant on safety.

On the same solemn day, NASA Armstrong Flight Research Center in California officials remember three pilots in its history who died at the stick of a NASA or National Advisory Committee for Aeronautics (NACA) aircraft.

Howard C. "Tick" Lilly was the first NACA engineering pilot assigned to the Muroc Flight Test Unit, now known as NASA Armstrong. Lilly trained as a Naval aviator and joined the NACA's Langley Memorial Aeronautical Laboratory in Virginia, now known as Langley Research Center in 1942. In 1943 he transferred to the NACA's Lewis Flight Propulsion Laboratory in Cleveland, Ohio, (today's Glenn Research Center) and then to Muroc in 1947.

At Muroc, he flew the Douglas D-558-1 transonic

research aircraft and the Bell X-1. Lilly was the fourth person to exceed the speed of sound. He died May 3, 1948, when components of the D-558-1's engine compressor failed, severing control cables and the airplane crashed. He was the first NACA pilot to die in the line of duty.

It was 18 years later when the center lost another pilot. Joseph A. "Joe" Walker was a chief research pilot at the NASA Flight Research Center during the mid-1960s.

During World War II Walker flew P-38 aircraft for the Army Air Force in North Africa. He joined the NACA's Lewis Flight Propulsion Laboratory in Ohio in 1945 and transferred to the High-Speed Flight Research Station in 1951.

Walker made the first NASA-piloted X-15 flight March 25, 1960, and flew the aircraft 24 times, achieving its highest altitude (354,200 ft.) Aug. 22, 1963; he made the first flight in the Lunar Landing Research Vehicle in 1964 that led to the Lunar Landing Training Vehicle used in Houston to train astronauts to land on the moon. Walker perished June 8, 1966, when his F-104 was caught in the wingtip vortex of the North American XB-70.
In the 1980s, a pilot proficiency flight claimed the life of Richard E. "Dick" Gray.

Gray was an aerospace research pilot at NASA's Johnson Space Center in Houston, from 1978 until he transferred to Ames-Dryden Flight Research Center, now NASA Armstrong.

At JSC he was chief project pilot on the WB-57F high-altitude research aircraft and served as the prime chase pilot in the T-38 aircraft for video documentation of the landing portion of space shuttle orbital flight tests. A Naval aviator, he flew 48 combat missions in F-4s over Vietnam while assigned to squadron VF-111 aboard the USS Coral Sea in 1972.

Gray was fatally injured Nov. 8, 1982, in the crash of a Cessna T-37 aircraft while on a flight to hone his skills flying the airplane.

Read Full Story

Magnetic 'Highway'

Magnetic 'Highway' Channels Material Out of Cigar Galaxy

What's fueling the massive ejection of gas and dust out of the Cigar galaxy, otherwise known as Messier 82?

We know that thousands of stars bursting into existence are driving a powerful super-wind that's blowing matter into intergalactic space. New research shows that magnetic fields are also contributing to the expulsion of material from Messier 82, a well-known example of a starburst galaxy with a distinctive, elongated shape.

The findings from NASA's Stratospheric Observatory for Infrared Astronomy, or SOFIA, help explain how dust and gas can move from inside galaxies into intergalactic space, offering clues to how galaxies formed. This material is enriched with elements like carbon and oxygen that support life and are the building blocks for future galaxies and stars. The research was presented at the meeting of the American Astronomical Society.

SOFIA, a joint project of NASA and the German Aerospace Center, DLR, previously studied the direction of magnetic fields close to the core of Messier 82, as the Cigar galaxy is officially known. This time the team applied tools that have been used extensively to study the physics around the Sun, known as heliophysics, to understand the magnetic field's strength surrounding the galaxy at a distance 10 times larger than before.

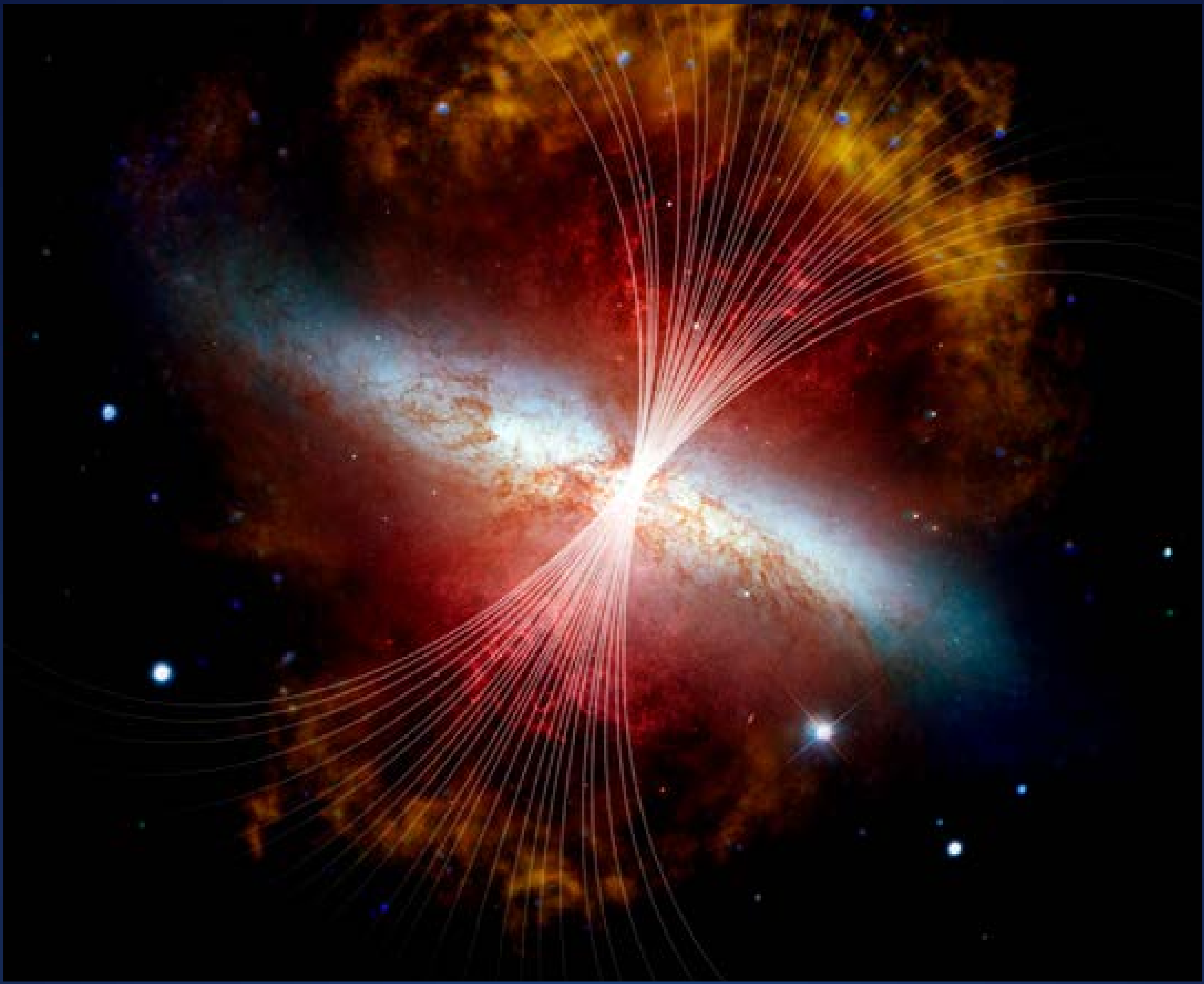
"This is old physics for studying the Sun, but new for galaxies," said Joan Schmelz, a director at the Universities Space Research Association based at NASA's Ames Research Center in Silicon Valley, and co-author of the upcoming paper about this research. "It's helping us understand how the space between stars and galaxies became so rich with matter for future cosmic generations."

Located 12 million light-years from Earth in the

constellation Ursa Major, the Cigar galaxy is undergoing an exceptionally high rate of star formation called a starburst. The star formation is so intense that it creates a "super wind" that blows material out of the galaxy. As SOFIA previously found using the instrumented called the High-Resolution Airborne Wideband Camera, or HAWC+, the wind drags the magnetic field near the galaxy's core so that it's perpendicular to the plane of the galaxy across 2,000 light-years.

Researchers wanted to learn if the magnetic field lines would extend indefinitely into intergalactic space like the magnetic environment in the solar wind, or turn over to form structures similar coronal loops that are found in active regions of the Sun. They calculate that the galaxy's magnetic fields extend out like the solar wind, allowing the material blown by the super wind to escape into intergalactic space.

These extended magnetic fields may help explain how gas and dust spotted by space telescopes have traveled so far away from the galaxy. NASA's Spitzer Space Telescope detected dusty material



20,000 lightyears beyond the galaxy, but it was unclear why it had spread so far away from the stars in both directions instead of in a cone-shaped jet.

“The magnetic fields may be acting like a highway, creating lanes for galactic material to spread far and wide into intergalactic space,” said Jordan Guerra Aguilera, a postdoctoral researcher at Villanova University in Pennsylvania and co-author on the upcoming paper.

With rare exceptions, the magnetic field in the solar corona cannot be measured directly. So, about 50 years ago, scientists developed methods to accurately extrapolate magnetic fields from the Sun’s surface into interplanetary space, known in heliophysics as the potential field extrapolation. Using SOFIA’s existing observations of central magnetic fields, the research team modified this method to estimate the magnetic field about 25,000 light-years around the Cigar galaxy.

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