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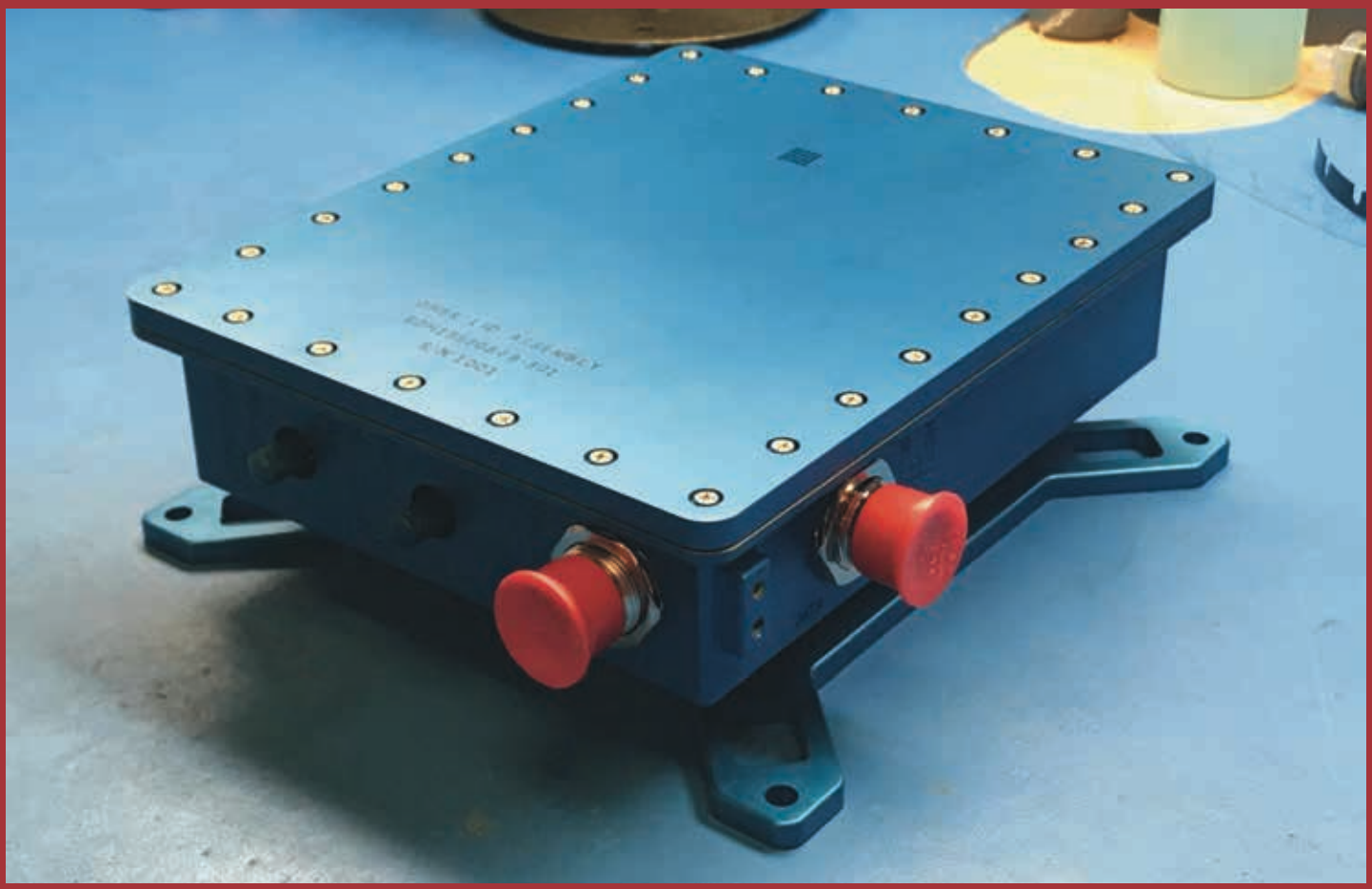
Assisting Orion

The OHSS package will fly on the Orion during the Artemis II mission, the first with astronauts



NASA

The Orion Heat Shield Spectrometer (OHSS) package will be installed on the Orion capsule. A fiber optic cable will connect the OHSS to the Orion's heat shield for the Artemis II mission, the first scheduled crewed mission of NASA's Orion spacecraft. *See story, page 2.*

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Armstrong assists with Orion

OHSS will provide data to enhance astronaut safety

By Jay Levine
X-Press editor

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

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NASA/Isaac Watson

Above, *technicians at NASA's Kennedy Space Center in Florida meticulously applied more than 180 blocks of ablative material to the heat shield for the Orion spacecraft set to carry astronauts around the Moon on Artemis II.*


NASA

At left*, The Orion Heat Shield Spectrometer flight unit assembly is pictured without the top lid installed.*

Below, *The Orion spacecraft for NASA's Artemis I mission is in view inside the Neil Armstrong Operations and Checkout Building high bay. Attached below Orion are the crew module adapter and the European Service Module with spacecraft adapter jettison fairings installed. NASA Armstrong is assisting with the Orion Heat Shield Spectrometer system for the Artemis II mission to be installed on Orion and connect through a fiber optic cable to the heat shield. The Orion capsule is the silver item in the stack.*


NASA/Ben Smegelsky

U.C. Merced/Miguel Vega

Former University of California (UC) Merced student Victoria Arias is shown participating in research during her 2018 internship at NASA's Langley Research Center in Virginia. NASA's Minority University Research and Education Project Institutional Research Opportunity funded the Merced nAnomaterials Center for Energy and Sensing at UC Merced in 2015.

Advancing STEM

Partnership with UC Merced advances minority growth in STEM education

By Teresa Whiting
NASA Armstrong Public Affairs
And **Alexis Alfred**
MIRO specialist

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.

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U.C. Merced/Juan Rodriguez

Through NASA's Minority University Research and Education Project's Institutional Research Opportunity, University of California Merced student Yaneth Hernandez works in a chemistry lab with carbon nanotubes.

News at NASA

Lucy gets installation of its third instrument

With less than a year to launch, NASA's Lucy mission's third and final scientific instrument has been integrated onto the spacecraft.

The spacecraft, which will be the first to explore the Trojan asteroids – a population of small bodies that share an orbit with Jupiter – is in the final stages of the assembly process. Just five months ago, at the beginning of the Assembly, Testing and Launch operations (ATLO) process, the components of the Lucy spacecraft were being built all over the country. Today, a nearly assembled spacecraft sits in the high bay in Lockheed Martin Space in Littleton, Colorado.

The final instrument, L'Ralph, was built by NASA's Goddard Space Center in Greenbelt, Maryland, and was received at Lockheed Martin on Jan. 21 and integrated on to the spacecraft on Jan. 26. L'Ralph is the most complicated instrument that will fly on Lucy, as it is actually two instruments in one. The Multispectral Visible Imaging Camera (MVIC), will take visible light color images of the Trojan asteroids. The Linear Etalon Imaging Spectral Array (LEISA), will collect infrared spectra of the asteroids. Both of these components will work together to allow Lucy to determine the composition of the Trojan asteroids and provide insight into the early history of our solar system.

AFRC2020-0136-08 NASA/Ken Ulbrich

The future home of the X-59 Quiet SuperSonic Technology aircraft is taking shape at NASA Armstrong. Some of the staff members working on the project include from left to right Hector Mendoza, CJW/MZT Joint Venture site superintendent, Tim Nazer, CJW/MZT quality control manager, Collin Morris, CJW/MZT project manager and Bryan Watters, NASA civil/structural engineer and project manager.

Future home

Renovated Building 4826 will house X-59 QueSST

By Jay Levine
X-Press editor

When the X-59 Quiet SuperSonic Technology, or QueSST, aircraft comes to NASA Armstrong 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

Lockheed Martin

NASA's X-59 Quiet SuperSonic Technology X-plane, or QueSST, is designed to fly faster than the speed of sound, without producing a loud, disruptive sonic boom, which is typically heard on the ground below aircraft flying at such speeds. Instead, with the X-59, people on the ground will hear nothing more than a quiet sonic thump – if they hear anything at all.

AFRC2019-0173-167 NASA/Ken Ulbrich

This is how Building 4826, the future home of the X-59 Quiet Super-Sonic Technology aircraft, looked prior to the building's renovations.

AFRC2022-0136-15 NASA/Ken Ulbrich

This is how Building 4826, the future home of the X-59 Quiet SuperSonic Technology aircraft, looks as the building's renovations continue.

AFRC2019-0173-082 NASA/Lauren Hughes

On the east side of Building 4826, the future home of the X-59 Quiet SuperSonic Technology aircraft, a conference room, offices, restrooms and a communications room are under construction.

AFRC2020-0135-20 NASA/Ken Ulbrich

Collin Morris, CJW/MZT project manager and Bryan Watters, NASA civil/structural engineer and project manager, discuss items on the east side of Building 4826. A conference room, offices, restrooms and a communications room will be added.

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.

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AFRC2019-0173-084 NASA/Lauren Hughes

This 8,800-square-foot canopy area near Building 4826 on the lake bed side where the offices were added was demolished.

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"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."

At the current stage of construction, the insulation for the building's walls and the massive epoxy flooring represent the two most major items left to complete, Morris explained. Added to this work is a contract modification that was recently negotiated and includes unforeseen sewer line replacement and additional electrical and communications work, Watters added.

Every project has its share of challenges and this one was no exception.

"It's not unusual on jobs, but we had a lot of discrepancies in some of the drawings," Morris explained. "Being that it's a renovation, it makes it more difficult because there are a lot of unknowns in these kinds of buildings. When it is designed, they look at the overall picture of the building but until you get into it, all kinds of different things are discovered.

"We ran into underground challenges outside and inside the building. There's a lot more than what is shown on the drawings. From the beginning we had a lot of meetings and a lot of clarifications."

Watters agreed with Morris's assessment, and pointed out that two previous NASA project managers for this effort were assigned elsewhere or took a different position before Watters came onto the project and learned the status of the work. Additional challenges arose from the pandemic, interrupting the crews' ability to get on base for several months.

AFRC2020-0136-21 **NASA/Ken Ulbrich**

Work continues at Building 4826, the future home of the X-59 Quiet SuperSonic Technology aircraft, at NASA Armstrong. Included in the renovations are new offices, a conference room, rest rooms and a communications area on the east side of the building.

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."

The Building 4826 refurbishment is a part of NASA Armstrong's Master Plan, which details construction plans through 2037. The Life Support and Communication buildings replacements are the next major projects tentatively slated to start in 2023 and 2024. The plan includes replacement of key buildings, such as the main administration building and the consolidation of Building 703 in Palmdale back to the main campus in a new facility intended to house the science aircraft in 2027.

STEM... from page 3

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 Armstrong's Office of STEM Engagement, 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 and Space Technology. There are 20 active MIRO awardees across 14 U.S. states and territories.

NASA/Mark Knopp

University of California Merced student Calista Lum is shown posing in a flight suit at NASA Langley during her internship in 2019. At NASA, she worked on a project related to understanding suitable nanomaterials that could shield space suits, ships and habitats from solar radiation.

U.C. Merced/Juan Rodriguez

Through MIRO, University of California Merced student Jacqueline Bustamante is involved in the development of energy storage batteries that could be used for long-duration and deep-space missions.

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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.

SOFIA begins first flights from Germany

By Alison Hawkes
Ames Research Center
and Elizabeth Landau
NASA Headquarters

NASA's Stratospheric Observatory for Infrared Astronomy, SOFIA, will conduct its first ever series of science observations from Germany in February and March 2021. Many of the observations seek to answer fundamental questions in astronomy, including how stars can transform galaxies and what is the origin of cosmic rays in the Milky Way galaxy.

SOFIA, a joint project of NASA and the German Aerospace Center, DLR, recently completed scheduled maintenance and telescope upgrades at Lufthansa Technik's facility in Hamburg, Germany. Now, the observatory will take advantage of its proximity to science teams at the Max Planck Institute of Radio Astronomy in Bonn and the University of Cologne, which operate the instrument called German Receiver at Terahertz Frequencies, or GREAT, to conduct research flights from the Cologne Bonn Airport.

"We're taking advantage of SOFIA's ability to observe from almost anywhere in the world to conduct compelling astronomical investigations," said Paul Hertz, director of astrophysics at NASA Headquarters in Washington.

Alexander Golz

SOFIA takes off from Hamburg, Germany, after finishing heavy maintenance at Lufthansa Technik.

"This observing campaign from Germany is an excellent example of the cooperation between NASA and DLR that has been the strength of the SOFIA program for over 25 years."

SOFIA regularly flies to Christchurch, New Zealand, to study objects only visible in the skies over the Southern Hemisphere, and completed one science flight from Germany in 2019. But this is the first time a multi-flight observing campaign will be conducted over European soil. Over the course of six weeks, SOFIA will conduct about 20 overnight research flights that will focus on high-priority observations, including several large programs that were rescheduled from spring 2020 due to the COVID-19 pandemic.

With new COVID-19 safety procedures in place, SOFIA will use its GREAT instrument to search for signatures of celestial molecules, ions, and atoms that are key to unlocking some of the secrets of the universe.

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