AEROSPACE

ORBITER NEWS

News, announcements, and more.

Aerospace CubeSats for NASA's LLITED Mission to Be Launched by Spaceflight Inc.

March 31, 2021

NASA's plans to study changes in upper atmospheric densities, which affects the impact of the Earth's atmosphere on satellites in low orbit, is getting closer to take-off. Launch services provider Spaceflight Inc. recently announced it has been awarded the contract for integration and launch of NASA's Low-Latitude Ionosphere/Thermosphere Enhancements in Density (LLITED) mission, which features two 1.5U spacecrafts designed, built and operated by The Aerospace Corporation.

The end result of a $2.52 million grant awarded to Aerospace by NASA's Heliophysics Science Division in 2017, the two CubeSats will measure and study two features of the nighttime upper atmosphere: the equatorial temperature and wind anomaly (ETWA) that occurs in the neutral atmosphere, and the equatorial ionization anomaly (EIA) that occurs in the region containing charged particles.

While these features have been observed by other satellites and ground facilities, the altitude region of the ETWA and EIA remains poorly understood in comparison to other regions of the Earth's upper atmosphere. Furthermore, it is at these altitudes that drag on satellites increases. The mission stands to provide a greater understanding of how the ETWA and EIA form and interact, which can then be used to improve upper atmosphere models.

“Aerospace’s innovative CubeSat mission will measure these two features simultaneously, a major new milestone for on-orbit satellite capability,” said. Dr. Rebecca Bishop, principal investigator for LLITED. “By observing this altitude region more closely, scientists will gain a greater understanding of the degree of change in atmosphere density, which in turn affects the amount of drag satellites encounter, as well as reentry rates. Because drag is dependent on atmosphere density, understanding regional changes in density can help predict an object’s reentry time and path.”

The two Aerospace CubeSats will each carry three instruments: GPS radio-occultation sensor provided by Aerospace, an ionization gauge from University of New Hampshire, and a planar ion probe provided by Embry-Riddle Aeronautical University in Florida. Both CubeSats will fly in the same orbit plane at an altitude between 350 and 450 km, but the two CubeSats will be spaced 1/4- to 1/2-orbit apart in order to observe the spatial and temporal changes of the ETWA and EIA.

As part of the LLITED mission, Spaceflight will transport the Aerospace CubeSats to low Earth orbit on its Sherpa-LTC orbital transfer vehicle (OTV) aboard a SpaceX Falcon 9 at the end of the year. The Sherpa-LTC will subsequently make its initial spacecraft deployments and then ignite and maneuver to another orbital destination to deploy both CubeSats.

“Spaceflight’s full-service offering with our portfolio of Sherpa OTVs vehicles greatly increases the scientific opportunities for NASA, universities, and other organizations that require deployments to non-traditional orbital destinations,” said Valerie Skarupa, director of government business development for Spaceflight Inc. “We’ve enjoyed a long relationship with NASA, launching nearly 20 spacecraft for the organization over the years, and are focused on helping them get their spacecraft exactly where they need to be on orbit. This opportunity is especially rewarding as the award recognized Spaceflight’s experience with in-space transportation systems.”

The LLITED team includes scientists and engineers from The Aerospace Corporation, Embry-Riddle Aeronautical University, and University of New Hampshire.

Aerospace has more than 80 specialized laboratories used to test, analyze, and troubleshoot virtually every aspect of rocket and satellite system design, development, construction, deployment, and operation. The success of Aerospace research comes from the diverse and wide-ranging expertise of the laboratories’ technical staff and their ability to stay abreast of new technological advancements and program support issues associated with rapidly evolving space systems.

*This article has been published on **Aerospace.org**.*

Who's Who in Space? Resolving CubeSat Confusion with Identification and Tracking

March 23, 2021

The Aerospace Corporation convened a two-day workshop with government, industry, and the international space community to address challenges and solutions for identifying and tracking the growing number of CubeSats launched into orbit.

Technological advancements and cost reductions have led to an increase in CubeSat launch tempo by a wide spectrum of owners and operators. While this has aided in the democratization of space, the growth has also caused an increase in confusion over the identification, tracking, and debris mitigation approaches involving CubeSats.

The affordability of CubeSats has made it easier for more parties to launch and enabled an increase in large launch payloads involving multiple CubeSat owners. However, there is an alarming lack of standards in place for tracking and identifying CubeSats. As a consequence of this, owners and operators cannot always identify their own satellites, and "dead" satellites become orbital debris, placing mission success and the safety of a $1 trillion space economy at stake.

This January, The Aerospace Corporation convened government, industry, academia, and international stakeholders for a two-day event to address these challenges and discuss measures to mitigate CubeSat confusion. The discussions touched on many of the key issues highlighted in *CubeSat Confusion: Technical and Regulatory Considerations*, a recently published paper from Aerospace's Center for Space Policy and Strategy.

The conference included attendees from all over the world, representing U.S. government space and defense agencies, commercial space, the insurance industry, academia, and the international community (including representatives from the European Space Agency; United Kingdom Space Agency; New Zealand's Ministry of Business, Innovation and Employment; France's National Centre for Space Studies (CNES); and the United Nations).

“This business of identifying and tracking [CubeSats] is incredibly important,” said Adm. Cecil D. Haney, US Navy (Ret.) and member of the Aerospace Board of Trustees, in his opening remarks to attendees. “Even at the high school level, you’re involved with small satellites. I know you all have had your share of headaches and concerns in this particular area, and I see that, given this trend, there are some things that I hope can parallel to the point where we can get some regulatory rules of the road to follow, particularly as we can look at how congested space has become.”

Conference panelists identified several factors contributing to CubeSat confusion, including the lack of uniform standards and best practices for CubeSats and the need for operators to be able to identify and track CubeSats after deployment.

“The problem is multifaceted,” said Dr. Andrew Abraham, Engineering Manager in Aerospace’s Mission Analysis and Operations. “You have an expanding, diverse community of CubeSat owner-operators—from large companies down to middle and high schools—trying to deploy single CubeSats or large, proliferated LEO constellations. How do you track all these CubeSats, identify which satellites belong to whom, in order to coordinate their behaviors and activity and make sure they can all fly and operate safely in space?”

Panel discussions yielded several possible solutions to these challenges. The limited number of launch states worldwide presents an opportunity to set a baseline and establish uniform standards. New Zealand, for example, as a launch state has adopted U.S. regulations as baselines for its own requirements.

Possible solutions for distinguishing CubeSats from the ground include ID tags—either reflecting optical wavelengths of light or radar—or flashes of visible light. Another set of technologies would encode satellite ID and GPS signals, and radio them to the ground. Each solution has a set of pros and cons, and the market is still developing around these options, even as the need is widely recognized.

“If you can’t identify CubeSats, it is difficult for owner-operators to contact them,” Dr. Mark Skinner, Senior Project Leader for Space Traffic Management at Aerospace. “If it is not functioning in space, it may not be identified for several months, if ever. This is the nature of CubeSat confusion: which one is which? You must ensure they function, and if they do not, you must be able to tell them apart.”

The space community does not need dead, unidentified CubeSats on orbit, Skinner said, and he noted there is a regulatory desire from the Federal Communications Commission to get out ahead of the issue. Some conference panelists suggested a light regulatory touch on the policy front would help set attainable standards while preserving flexibility for private companies. A U.S. Space Force panel also underscored the need for CubeSat trackability.

Experts also recommended working through international forums—such as the UN Committee on the Peaceful Uses of Outer Space (UN COPUOS), the International Organization for Standardization (ISO) and the Inter-Agency Space Debris Coordination Committee (IADC)—to bring the global space community to consensus on standards and best practices for achieving long-term sustainability guidelines to encourage safety and success. Through collaboration, industry participants can work together to adopt norms and establish pilot programs in order to provide leadership and demonstrate workable solutions.

“As one attendee of our event pointed out, luck has been a large part of the past strategy involving space debris,” Skinner said. “We felt that going forward, we didn’t want that to be part of the strategy for CubeSats, so we hosted this industry day in part to get ahead of the problem and come up with mitigation schemes with the CubeSat community.”

Construction of Aerospace's New Colorado Springs Facility Hits Key Milestone

March 22, 2021

In September, Aerospace broke ground on a second state-of-the-art research and development facility in Colorado Springs, Colo. Earlier this month, the last piece of steel for the building super structure was set in place. The milestone was recognized by a small socially distanced topping out ceremony organized by the contractor. Members of the project team in Colorado Springs participated by signing the last beam before it was hoisted into place.

As previously covered on *Orbiter*, Aerospace is investing nearly $100 million for the new facility, which will be the focal point for delivering technical expertise across the space enterprise to outpace threats to national security.

"This is an exciting milestone for Aerospace's plans in Colorado Springs," said Jean Michael, General Manager of the Space Enterprise & Warfighting Division. "The new facility will enable us to better serve our government customers and collaborate with industry colleagues on cutting-edge space war fighting concepts and capabilities established on a foundation of digital engineering."

The building's digital engineering environment will enable high-fidelity analysis and physics-based modeling and simulations as well as development of tactics, techniques, and procedures that will provide insight into space warfighting.

The installation of exterior framing to support the building skin began earlier this month, and the interior framing of secure perimeters is tentatively expected to begin pending approvals. Expansion and remediation of the existing COS-1 parking lot is anticipated to begin in mid-to-late March.

The photo gallery below features photos captured from the topping out ceremony:

Wayne Boback, Business Manager in DSG, signs his name on the final steel beam.

Thomas Murphy, Systems Director in DSG, signs his name on the final steel beam.

Special Security Director Joseph Regan, Jr. signs his name on the final steel beam.

WT worker signing name on the beam.

Dean Bucher, Associate Principal Director in ETG, signs the final steel beam.

Jean Michael, General Manager for Strategic Space Operations, signs the final steel beam.

Signatures on the beam.

The final steel beam is ready to be raised!

The final steel beam is placed!

Here are some key facts about the new facility and Aerospace's Colorado Springs presence:

- The 90,000 square foot building will be majority classified space
- It will have a multipurpose simulation center to support wargaming capabilities and large meetings with industry and government partners
- The building is designed to accommodate about 200 additional employees and is expected to open in 2022
- Aerospace's first Colorado Springs facility opened in 2007. The company has about 240 people located there and at nearby customer sites

Press Release: Space Systems Group SVP Dr. Malina Hills to Retire June 1

March 18, 2021

EL SEGUNDO, Calif., March 18, 2021 – After 34 years of technical leadership and service to The Aerospace Corporation (Aerospace) and its customers, Space Systems Group Vice President Dr. Malina Hills will retire on June 1, 2021.

Previously, Hills served as vice president of Aerospace's Space Program Operations (SPO), working directly with the U.S. Air Force, government, and industry partners to develop military satellites and to advance national security space systems. Previous to that, she served as general manager of the Military Satellite Communications (MILSATCOM) Division.

Hills has held a number of leadership positions at Aerospace, which include general manager of the Systems Engineering Division, principal director of Systems Integration for the Space Based Infrared System program, principal director of the Business and Operations Analysis Subdivision, and principal director of the Research and Program Development Office. She joined Aerospace in 1987 as a technical member of Aerospace's laboratory operations.

Hills earned a bachelor's degree in engineering and applied science from Yale University, and a doctorate in chemical engineering from the California Institute of Technology.

ABOUT THE AEROSPACE CORPORATION

The Aerospace Corporation is a national nonprofit corporation that operates a federally funded research and development center and has approximately 4,000 employees nationwide. With major locations in El Segundo, Calif.; Albuquerque, N.M.; Colorado Springs, Colo.; and Washington, D.C., Aerospace addresses complex problems with agility, innovation, and objective technical leadership across the space enterprise and other areas of national significance. For more information, visit www.aerospace.org. Follow us on Twitter: @AerospaceCorp.

Aerospace Provides Critical Software to NASA's Orbiting Carbon Observatory

March 16, 2021

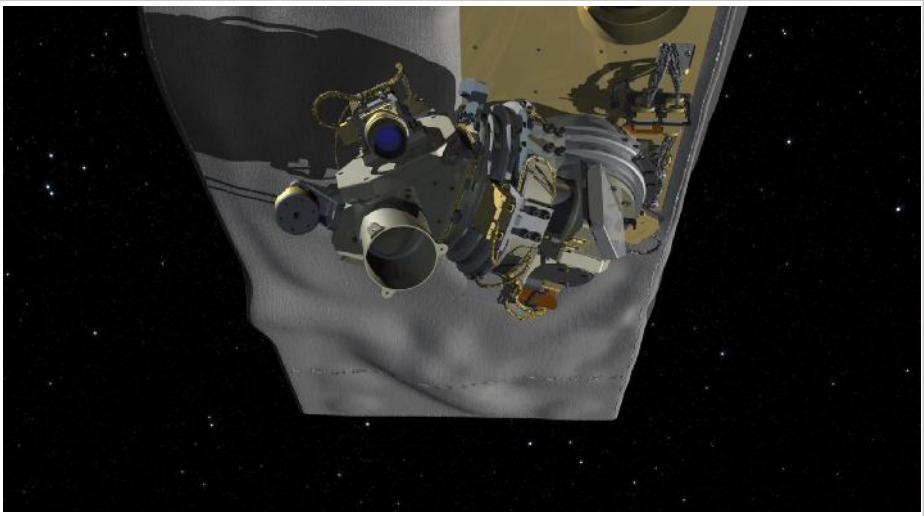


Illustration of NASA's OCO-3 mounted on the underside of the International Space Station. Credit: NASA/JPL-Caltech

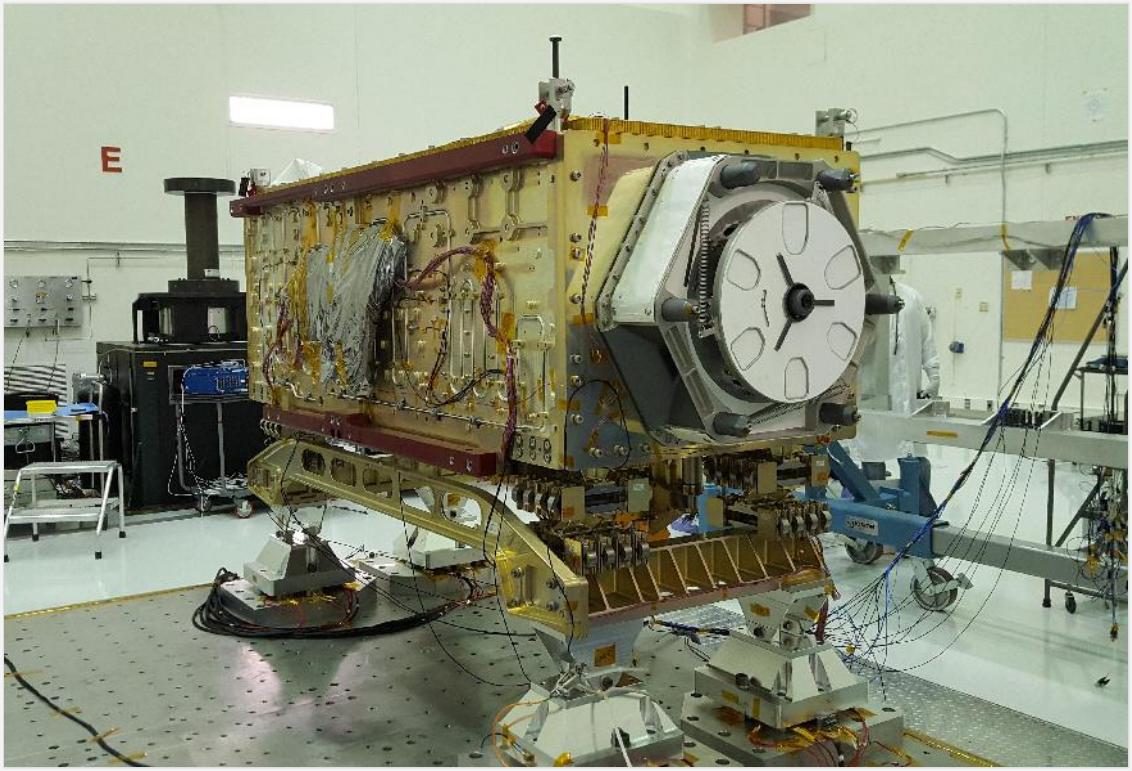
Since the beginning of the Industrial Revolution, the burning of fossil fuels for energy has caused carbon dioxide concentrations in the atmosphere to rise at an alarming rate. While other greenhouse gases have also increased due to human activity, carbon dioxide is far more abundant and remains in the atmosphere much longer. In fact, increases in atmospheric carbon dioxide are responsible for about two-thirds of the total energy imbalance that is causing Earth's temperature to rise, presenting a fundamental threat to humanity and life on Earth.

The Aerospace Corporation has provided direct support to NASA's Orbiting Carbon Observatory Project (OCO-3), a NASA-JPL instrument designed to measure carbon dioxide in Earth's atmosphere. Mounted upon the Japanese Experiment Module-Exposed Facility on board the International Space Station (ISS), the instrument identifies sources and sinks of carbon dioxide in oceans and terrestrial ecosystems. In addition, OCO-3 data are expected to significantly improve our understanding of the sources and impacts of carbon dioxide emissions from human activities, using measurements over cities and other areas of interest.

A major component of Aerospace's support of OCO-3 is LunarCal, a flight software module that Aerospace developed and delivered to assist with instrument calibration that uses the moon as a reference source to calibrate the payload sensors. The previous OCO mission used a comprehensive series of calibration capabilities allowing it to observe the Sun, the moon and on-board lamps to calibrate. Because OCO-3 cannot observe the Sun, lunar observations are more critical for tracking the characteristics of its calibration lamps, which vary with time, according to the OCO-3 Science Team. Richard Dolphus, Senior Engineer Specialist in Aerospace's Control Analysis Department (CAD), shared that OCO-3 "needed a more reliable, constant reference and the moon itself is what they found they could use."

To capture images of the moon for calibration, the LunarCal flight software module provides azimuth and elevation angles to the instrument flight software. LunarCal also includes internal checks to provide for safe

operation, incorporating calculations to predict the positions of the ISS solar arrays and radiators that could obstruct the instrument's field of view.



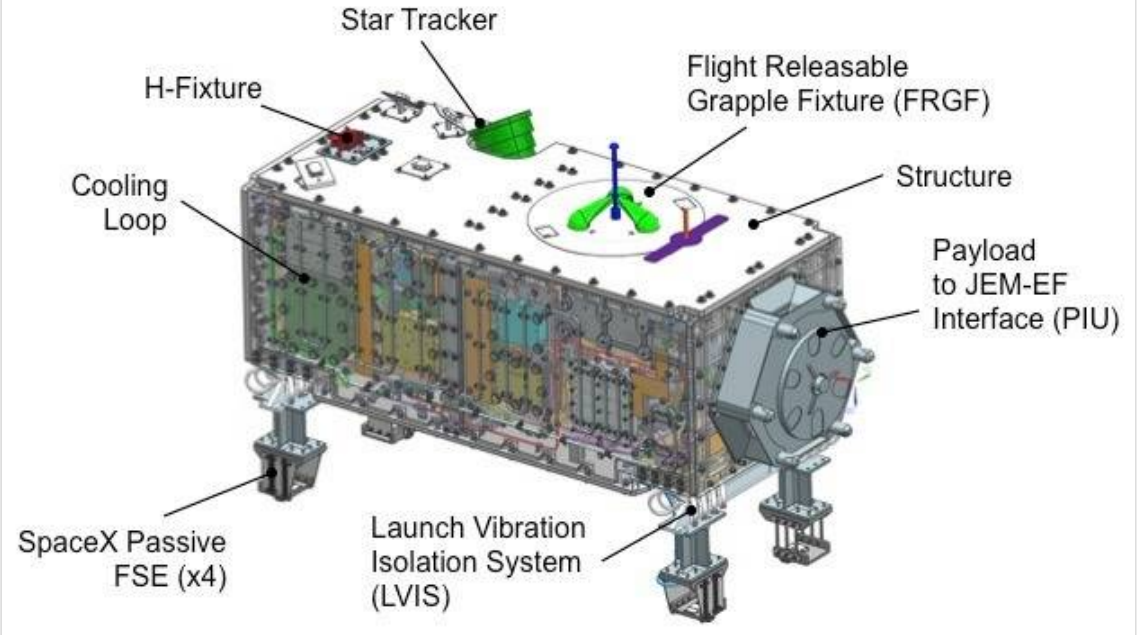
OCO-3 sits on the large vibration table in the Environmental Test Lab at the Jet Propulsion Laboratory. Credit: NASA/JPL-Caltech

"One challenge for OCO-3 is that the structure of the ISS itself tends to block the moon for much of the year, so there may only be 15 or 20 days out of the year where you have an unobstructed view of the moon from the ISS," said Andy Wu, Engineering Specialist at Aerospace's Attitude Estimation and Calibration Section in CAD. "While LunarCal doesn't allow us to capture images of the moon at will, it allows us to track the moon whenever the moon is in the small window that is available to us and make the most of that opportunity."

On Sept. 16, 2020, LunarCal was successfully exercised as part of the first calibration sequence for OCO-3, marking the culmination of much direct, shoulder-to-shoulder work with the OCO-3 Project at the Jet Propulsion Laboratory.

In December 2020, a second calibration sequence was successfully executed, at which time LunarCal assisted in providing the OCO-3 science team with approximately 20 clean sweeps across the moon, providing critical sensor calibration data to be used for making more accurate carbon measurements.

Another key element of Aerospace's support of OCO-3 was to calibrate the payload Azimuth and Elevation gimbal alignments. "This calibration ensures that when the OCO-3 instrument provides information about location, that it's highly precise. This is all due to our expertise in instrument calibration," said Justin F. McNeill, Jr., Senior Project Leader at Aerospace's Systems Formulation and Implementation department. "It's all about making sure that the instrument is behaving as designed, and as you command it."



An overview simple drawing of the OCO-3 payload. Credit: NASA/JPL-Caltech

Currently on a three-year mission, OCO-3 will be another step toward monitoring emissions hotspots, volcanic eruptions and other local carbon sources from space. In addition, OCO-3 will give scientists the first opportunity to observe how carbon dioxide concentrations change throughout the day in many parts of the globe, while also detecting changes in emissions and photosynthesis rates.

OCO-3's high-resolution spectrometers can also observe solar induced fluorescence, a type of radiation emitted from plants during photosynthesis, providing scientists additional insight into the carbon cycle of forests and plants. As climate change has a direct impact on growing seasons worldwide, researchers need to understand when photosynthesis is occurring, especially in inaccessible locations like the Arctic.

Aerospace's software support for the OCO-3 mission contributed to its success, requiring customization based on mission-specific needs.

"We worked with JPL closely, albeit remotely, and iterated with them quickly so that the software would meet their requirements," said Avinash Vakil, Senior Member of Technical Staff at Aerospace. "Our communications with JPL enabled us to understand the architecture of their software and the context in which it would be running, so that when we did go write the software, we were able to write it to fit within their system with very little problem."

*This article has been **published on Aerospace.org**.*

Rosemary Ray's 60-Year Anniversary with Aerospace!

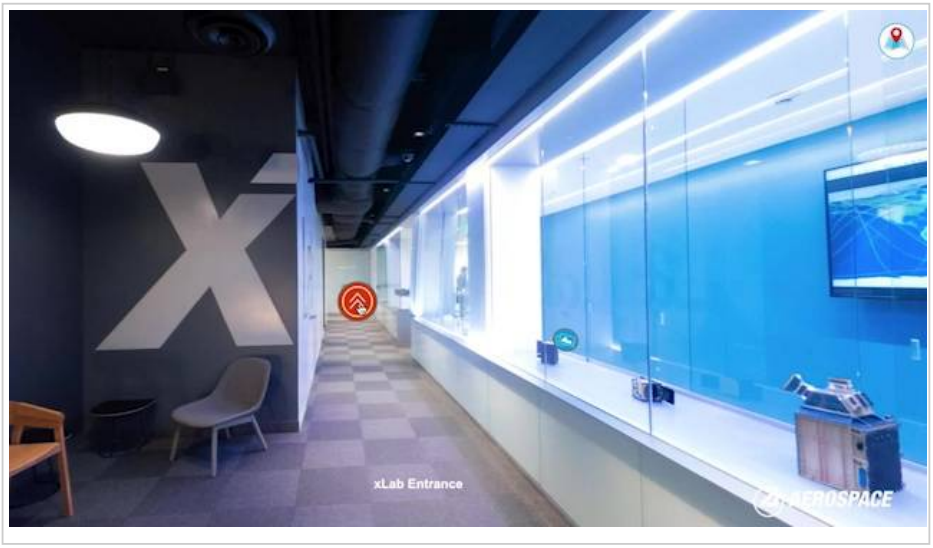
We'd like to congratulate Rosemary Ray, who marks her 60th anniversary at Aerospace this week!

Rosemary joined The Aerospace Corporation on March 20, 1961, just nine months after it was founded and is currently the longest-serving employee at the company.
In June 2020, she was awarded a **007 pin** in recognition of her years of outstanding service to Aerospace. As part of our 60th Anniversary celebration, she shared her experiences and memories in the video below:

Please join us in celebrating Rosemary and her many contributions to Aerospace!
(Click link to watch video on YouTube: https://youtu.be/ol37WurqgXs)

Virtually Explore Aerospace's State-of-the-Art Facilities

March 11, 2021



To solve the hardest problems in space and advance innovative solutions for our customers, Aerospace strives to provide our world-class technical experts with state-of-the-art facilities and equipment. We've often hosted on-campus tours for a broad range of audience types, including high-ranking officials, students in STEM, and our own employees, who want to learn more about the work our people do and how they do it.

Now, Aerospace has made exploring our facilities even easier and more interactive. The best part is you can do so from the comfort of your own desk. **The Aerospace Virtual Tours** allows you to digitally navigate through some of our labs and engage with informational content, such as articles, videos and photos to enhance the experience.

To start, the Virtual Tours currently feature six unique Aerospace labs, with more facilities across our nationwide locations to come in the future.

Here are the Virtual Tours currently available for you to explore:

The Physical Sciences Laboratories provide robust and innovative applied scientific research to support our customers across the space enterprise. PSL combines the breadth and depth of expertise of our people with cutting-edge tools and facilities to support a diverse research portfolio. There are currently three PSL virtual tours available:

- **Electric Propulsion Lab**
- **Solar Cell Lab**
- **AeroTel**

The newly renovated **xLab** facility equips our technical experts to build innovative prototypes and instruments to advance space technology. xLab, short for Experiments Laboratory, architects, develops, and transitions prototypes at the speed necessary for a changing space environment.

iLab focuses on fostering a vibrant innovative culture that leads to bold ideas, transformative capabilities, and unique insights. iLab runs a variety of programs designed to inspire innovation, funds cutting-edge ideas, and collaborates across the space enterprise.

The STARS Mission Operations Center is where Aerospace's highly-skilled analysts monitor every aspect of a rocket launch to ensure it is successful.

Aerospace is currently developing more Virtual Tours to expand the available library, so be sure to check back often for more!

March 2021 Obituaries

March 01, 2021

Sincere sympathy is extended to the families of:

- **Harry Bernstein,** member of technical staff, hired Dec. 1, 1960, retired Nov. 1, 1991, died Jan. 14, 2021
- **James Coge,** member of technical staff, hired Feb. 1, 1966, retired Sept. 1, 1995, died Feb. 7, 2021
- **Kevin Jackson,** office of technical support, hired May 28, 1985, retired Nov. 1, 2013, died Feb. 3, 2021
- **Robert Kendall,** member of technical staff, hired Sept. 10, 1962, retired March 1, 1984, died Feb. 1, 2021
- **Julio Rivera,** member of technical staff, hired Oct. 5, 1987, retired Oct. 1, 2017, died Feb. 5, 2021
- **James Weaver,** member of technical staff, hired Oct. 2, 1967, retired Aug. 1, 2006, died Feb. 4, 2021
- **Adrielle Williams,** office of technical support, hired June 27, 1988, retired April 1, 2020, died Feb. 12, 2021

To notify Aerospace of a death and have it included in the Orbiter, please contact People Operations at (310) 336-5107.

These articles are reprinted from The Orbiter, a publication of The Aerospace Corporation 2310 E. El Segundo Blvd., El Segundo, CA 90245-4691 310-336-5000
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