



KENNEDY SPACE CENTER'S
SPACEPORT
m a g a z i n e

**NASA's
InSight
Spacecraft
Will Explore
Below Mars
Surface**



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Cover: At Vandenberg Air Force Base in California, the gantry rolls back May 4, 2018, at Space Launch Complex-3 in preparation for the liftoff of NASA's Interior Exploration using Seismic Investigations, Geodesy and Heat Transport, or InSight, Mars lander. The United Launch Alliance Atlas V rocket launched at 4:05 a.m. PDT (7:05 a.m. EDT) on May 5. InSight will be the first mission to look deep beneath the Martian surface. It will study the planet's interior by measuring its heat output and listen for marsquakes. InSight will use the seismic waves generated by marsquakes to develop a map of the planet's deep interior. The resulting insight into Mars' formation will provide a better understanding of how other rocky planets, including Earth, were created. Photo credit: NASA/Charles Babir

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KENNEDY SPACE CENTER

JACQUELINE BROOKS

**Lead Contract Specialist
Procurement, Construction and Environmental Support Office**

I have worked at Kennedy Space Center for approximately 33 years and have been in my current role for 2.5 years.

I began my career at Kennedy as a co-op student in Procurement. I worked as a contract cost/price analyst and contract specialist. As a contract specialist, I supported the Launch Services Program Office and administered the Delta and Atlas contracts. I then worked the Test and Operations Support Contract for a couple of years. I am currently the lead in the Construction Admin Office.

My office administers about 50 contracts totaling a half billion dollars. Some of the projects include the mobile launcher, the Central Campus Headquarters building, several emergency hurricane repairs, major modifications to Launch Pad 39B and the Vehicle Assembly Building, renovation of the Astronaut Crew Quarters, and demolition of structures and facilities across the center.

My biggest challenge is to ensure the contractors working on construction projects understand Kennedy's unique culture in order to meet construction schedules and contract requirements. I've found that the most important approach to overcome this challenge is to continuously communicate and improve the center's construction processes by working with our engineers, contracting professionals and contractors.

My favorite memory while working at Kennedy Space Center is the launch of the New Horizons Pluto mission on Jan. 19, 2006 – my first mission as the contracting officer. It was a planetary mission and it's exciting to hear it still being talked about in the news media.



DEEP SPACE DESTINATION

A United Launch Alliance Atlas V rocket lifts off from Space Launch Complex-3 at Vandenberg Air Force Base in California on May 5, carrying NASA's Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) Mars lander. Liftoff was at 7:05 a.m. EDT (4:05 a.m. PDT). Photo Credit: NASA/Cory Huston

NASA's InSight spacecraft begins its journey to Mars

BY LINDA HERRIDGE

NASA's Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) spacecraft is on its way to Mars. InSight launched on a United Launch Alliance (ULA) Atlas V 401 rocket at 7:05 a.m. EDT (4:05 a.m. PDT) on May 5, from Space Launch Complex-3 at Vandenberg Air Force Base in California.

There were no weather constraints at the time of rocket liftoff. Launch occurred at the beginning of the two-hour launch window.

NASA Administrator Jim Bridenstine spoke to the mission team at Vandenberg by phone. "This has been years of work by a whole host of people, for a very long time, including JPL, and of course the launch crew at Vandenberg," Bridenstine said. "I want to give a special thanks to ULA and congratulate them on 128 total successful launches in a row, 78 specifically for the Atlas V. I want to thank our international partners, CNES and DLR, for their hard work."

"It's been an incredible day," said Tim Dunn, NASA launch director for InSight. "It was a smooth countdown. The mighty Atlas rocket performed very well."

Following two separate engine burns of the ULA Centaur upper stage, NASA's InSight spacecraft separated from the Centaur to fly freely for the first time about 1.5 hours after liftoff. The spacecraft now is on its six-month, 300-million-mile voyage to the Red Planet. InSight will land on Mars on Nov. 26, 2018.

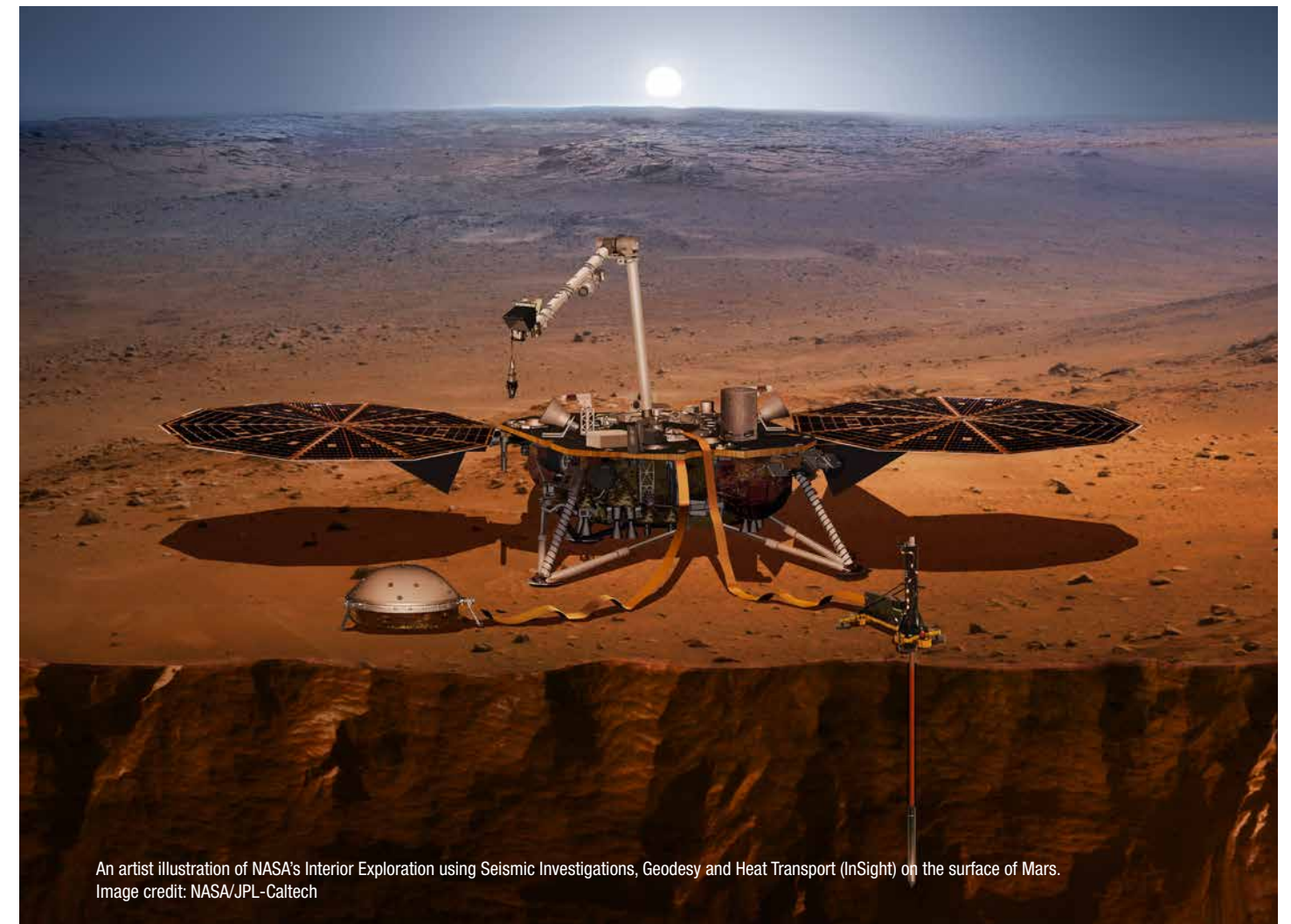
InSight is the first interplanetary mission to launch from the West Coast, and will be the first mission to look deep beneath the

Martian surface. It will study the planet's interior by measuring its heat output and listening for marsquakes. InSight will use the seismic waves generated by marsquakes to develop a map of the planet's deep interior. The resulting insight into Mars' formation will provide a better understanding of how other rocky planets, including Earth were created.

The InSight lander is equipped with two science instruments that will conduct the first "check-up" of Mars, measuring its "pulse," or internal activity; its temperature and its "reflexes," or the way the planet wobbles when it is pulled by the Sun and its moons.

The science payload comprises two instruments: the Seismic Experiment for Interior Structure (SEIS), provided by the French Space Agency, with the participation of the Institut de Physique du Globe de Paris (IPGP), the Swiss Federal Institute of Technology, the Max Planck Institute for Solar System Research, Imperial College and the Jet Propulsion Laboratory. The second instrument, the Heat Flow and Physical Properties Package (HP3), is provided by the German Space Agency. Also, the Rotation and Interior Structure Experiment (RISE), led by JPL, will use the spacecraft communication system to provide precise measurements of planetary rotation.

Hitching a ride with InSight was NASA's technology experiment, Mars Cube One (MarCO), a separate mission of its own, also headed to Mars. The two mini-spacecraft, called CubeSats, launched one at a time from dispensers mounted on the aft bulkhead carrier of the Centaur second stage. They were designed and built by



An artist illustration of NASA's Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) on the surface of Mars. Image credit: NASA/JPL-Caltech

NASA's Jet Propulsion Laboratory in Pasadena, California, and are the first test of CubeSat technology in deep space. Their purpose is to test new communications and navigation capabilities for future missions, and may provide real-time communication relay to cover the entry, descent and landing of InSight on Mars.

JPL manages InSight for NASA's Science Mission Directorate. InSight is part of NASA's Discovery Program, managed by the agency's Marshall Space Flight Center in Huntsville, Alabama. The InSight spacecraft, including cruise stage and lander, was built and tested by Lockheed Martin Space in Denver. NASA's Launch Services Program at the agency's Kennedy Space Center in Florida is responsible for launch service acquisition, integration, analysis, and launch management. United Launch Alliance of Centennial, Colorado, is NASA's launch service provider.

"This is a big day. We're going back to Mars; we did it from the West Coast, which is a first ever," Bridenstine said. "And of course, the launch of our CubeSats into deep space. This is an extraordinary mission with a whole host of firsts."

InSight's lander will spend two years investigating the deep interior of Mars. For more information visit https://www.nasa.gov/mission_pages/insight/overview/index.html.



In the Astrotech facility at Vandenberg Air Force Base in California, the heat shield is placed on NASA's Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) Mars lander on March 29, 2018. Photo credit: USAF 30th Space Wing/Chris Wiant

PRACTICE MAKES PERFECT

Simulated countdown another step toward Exploration Mission-1

BY BOB GRANATH

“NTD you are GO to proceed with the count.”

With words such as these, NASA Launch Director Charlie Blackwell-Thompson will authorize the NASA Test Director, whose call sign is NTD, to proceed with launching the agency’s Space Launch System (SLS) rocket and Orion spacecraft on Exploration Mission 1 (EM-1), the first integrated test of the new vehicles.

SLS and Orion are part of NASA’s deep space exploration systems designed to send humans to distant destinations, such as the Moon and Mars. An important step in preparation for that first flight took place on March 29 with a demonstration of a portion of the countdown focused on fueling the new launch vehicle.

“This demonstration is important because we are getting an early feel for our tanking operations, the timelines for this work and the kinds of issues that can arise,” said Blackwell-Thompson. “We’ve already started writing our launch countdown procedures for SLS and having an opportunity to run through those operations is extremely beneficial. What we learn from this demonstration and other simulations to come will be rolled into our launch countdown processes and procedures.”

A veteran engineer who has worked at Kennedy since 1988, Blackwell-Thompson will lead the launch team for the first flight test of this next-generation launch system. As launch director, she will make the final “go/no-go” decision prior to liftoff. The NTD is the leader of the SLS test team and is responsible for directing and integrating all flight and ground support testing throughout the countdown.

For EM-1, the countdown is expected to take about 45 hours and 40 minutes beginning two days prior to liftoff. During that time, the SLS core stage and upper stage will require about six hours to load 730,000 gallons of cryogenic liquid hydrogen and liquid oxygen to fuel the four core stage and single upper stage engines.

The countdown is a carefully planned set of procedures leading up to ignition of a rocket’s engine and liftoff. For the recent demonstration, the countdown began at the L-minus 16-hour mark when activities included preparations for propellant loading, and later skipped ahead in the count, altogether taking about five hours.

While there was no SLS at Kennedy’s Launch Complex 39B for the simulation, software called an “emulator” provided a virtual experience of what would be happening with the rocket.

The simulated countdown took place in **Firing Room 1** of Kennedy’s Launch Control Center, which is where the team will be on launch day. The firing rooms are the heart of the center’s command and control system. All activities involved with preparing rockets, spacecraft and payloads are controlled by NASA and contractor managers and engineers seated at computer terminals. Likewise, all activities at the launch pads can be operated from a firing room.

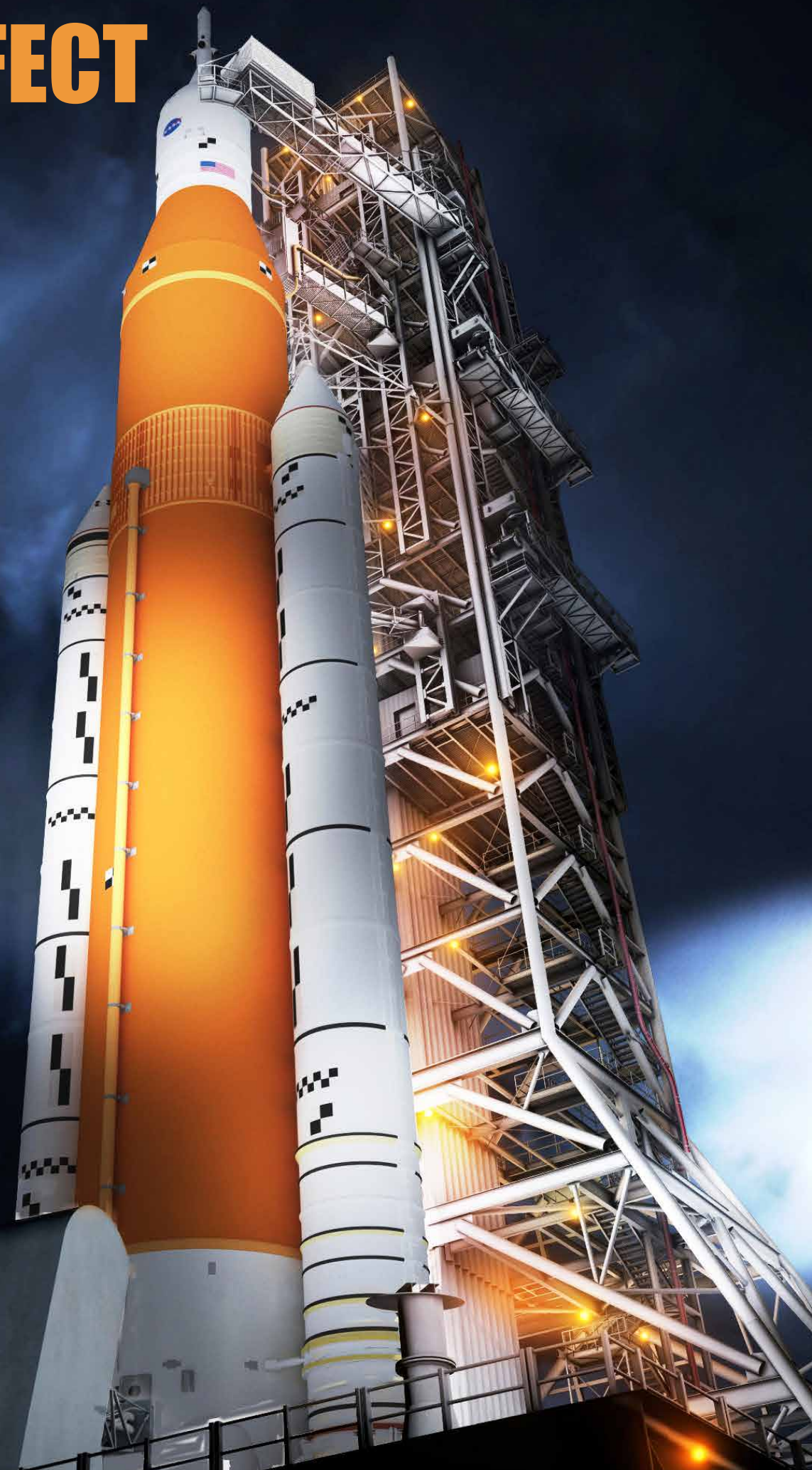
During the recent simulation, the launch team became acquainted with new consoles, improved software and the procedures for the SLS.

“It was important to get the launch team in the Firing Room, practicing reporting protocols, taking a look at our displays, and seeing how our emulators and simulators perform,” said Blackwell-Thompson. “What we learn here will help us determine where changes are needed as we progress. There will no doubt be adjustments, but the Firing Room is now set up, pretty much, as it will be on EM-1 launch day.”

Much work and many more multifaceted countdown simulations remain before the launch team will be ready for the first SLS lift-off. Blackwell-Thompson noted that it took a lot of work to get ready for the recent demonstration, and praised the launch team for their outstanding efforts.

“When I think about this team, I think about their skill, the expertise, the love and the passion they bring to their work,” she said. “They are outstanding, and I feel blessed to work with such amazing people. I am confident that this team will be ready for the work ahead and any challenges that come on launch day.”

The first in a series of increasingly complex missions, EM-1 will be an uncrewed flight test that will provide a foundation for human deep space exploration. During this flight, Orion will travel 280,000 miles from Earth, thousands of miles beyond the Moon over the course of about a three-week mission. The second flight of Orion, **Exploration Mission-2**, will carry crew to test the spacecraft’s crucial systems and prepare for future missions to the Moon, and eventually to Mars.



During the launch countdown simulation in Firing Room 1 on March 29, 2018, NASA Launch Director Charlie Blackwell-Thompson follows activities from her new console built by agency interns and students from the University of Central Florida. Photo credit: NASA/Cory Huston

FRESH IDEAS

NASA interns, UCF students build innovative launch director’s console

BY BOB GRANATH

When Charlie Blackwell-Thompson took her position at the Launch Director’s console for the recent Space Launch System propellant tanking demonstration, she put to use state-of-the-art technology harnessed by NASA interns and University of Central Florida students.

“Our Information Technology team was working with the interns and students,” she said, “One of their projects was to design an innovative console.”

The goal was to incorporate the latest applicable technologies to enhance existing console capabilities. A few programmatic requirements such as integrating communication, imagery and data systems essential to launch operations were carefully considered to ensure the proposed console design solution supported the Exploration Mission-1 needs. Beyond that, the team had a clean sheet of paper to design what they thought was best.

“It was designed for use anywhere here in the Firing Room,” Blackwell-Thompson said. “Since we didn’t have a console for the launch director, I volunteered “to give it a test drive.”

“The team did a great job on thinking of the end user needs,” she said. “I like to stand up and see the team, so the monitors raise and lower. The way the headset jack is secured is a nice feature when you are moving around to talk to someone off net. Little details like that make it a great design.”

The simulation on March 29 was its first use.

“It’s great to have this console installed and working,” she said, “and it performed wonderfully!”

Dragon Set to Deliver Supplies to International Space Station

COMMERCIAL RESUPPLY SERVICES MISSION:
SpaceX CRS-15

LAUNCH:
Late June 2018

LIFT OFF:
Space Launch Complex 40 at Cape Canaveral Air Force Station in Florida

LAUNCH VEHICLE:
SpaceX Falcon 9, 230 feet-tall

SPACECRAFT:
Dragon, 20 feet high, 12 feet-in diameter

PAYLOAD:
Dragon will deliver cargo and material to support science investigations aboard the International Space Station.

RETURN TO EARTH:
After about one month attached to the space station, Dragon will return with results of earlier experiments, splashing down in the Pacific Ocean off the coast of Baja California.



The two-stage SpaceX Falcon 9 rocket lifts off Space Launch Complex 40 at Cape Canaveral Air Force Station on April 2, 2018, carrying the Dragon resupply spacecraft on the company's 14th Commercial Resupply Services mission for NASA to the International Space Station. Photo credit: NASA/Tony Gray, Tim Powers and Tim Terry

A brilliant blue sky serves as the backdrop for a panoramic view taken Feb. 6, 2018 of the iconic Vehicle Assembly Building, mobile launcher at left, and Launch Control Center at right, at NASA's Kennedy Space Center. These facilities are being upgraded for the agency's Space Launch System and Orion spacecraft for launches to deep space destinations, including the Moon, Mars and beyond. Photo credit: NASA/Glenn Benson



“It’s real—Kennedy is a multi-user spaceport. Our job is to make sure everyone is successful.”

— Greg Gaddis
Kennedy Space Center’s master integrator

WORKING TOGETHER

Multi-user spaceport is home to diverse activities

BY BOB GRANATH

On Aug. 14, 2017, a SpaceX Dragon spacecraft was launched atop a Falcon 9 rocket from Launch Complex 39A at NASA’s Kennedy Space Center in Florida. It was a commercial resupply mission delivering supplies to the [International Space Station](#). Four days later, the agency’s Tracking and Data Relay Satellite-M lifted off on a United Launch Alliance (ULA) Atlas V from Space Launch Complex 41 at Cape Canaveral Air Force Station.

This kind of diverse activity is typical at a multi-user spaceport.

For nearly half a century, Kennedy operated as a NASA-only space center. Originally constructed to support the Apollo Program, facilities were built to prepare rockets and spacecraft for the lunar landing effort. In the mid-1970s, many buildings were converted for the Space Shuttle Program and new ones added.

As the shuttle program came to an end and Kennedy began preparing to support NASA’s [Space Launch System](#) (SLS) rocket and [Orion](#) spacecraft, it became apparent NASA would no longer need some of the existing facilities. But the anticipation of an

emerging commercial space industry resulted in center leadership developing an innovative concept of a multi-user spaceport to change focus from a big government, NASA-only space center to the agency partnering with other organizations.

In 2015, Kennedy met the objective of becoming a premier, [multi-user spaceport](#).

WORKING SIDE BY SIDE

According to Tom Engler, director of Center Planning and Development at Kennedy, the impact of having multiple partners working together at Kennedy is the result of creating an environment where both commercial and governmental space processing and launch activities are able to operate side by side.

“This only serves to enhance the overall success of all entities here at Kennedy because of the ability to cooperate and help each other out,” he said. “With four separate and distinct human spaceflight development activities occurring at the same time, it has



A SpaceX Falcon 9 rocket lifts off Launch Complex 39A at NASA’s Kennedy Space Center on Aug. 14, 2017, in the photo on the left. It was carrying a Dragon resupply spacecraft to the International Space Station. In the image on the right, a United Launch Alliance Atlas V rocket lifts off Space Launch Complex 41 at Cape Canaveral Air Force Station on Aug. 18, 2017, placing NASA’s Tracking and Data Relay Satellite in orbit. Photo credits: NASA/Tony Gray and Sandra Joseph

created an environment that is unparalleled anywhere in the world.”

The spaceflight development activities include not only the Orion spacecraft and SLS rocket, but Commercial Crew Program spacecraft - Boeing’s CST-100 Starliner and the SpaceX Crew Dragon, as well as the development of the Blue Origin New Glenn rocket.

The Center Planning and Development team took a lead role in implementing the concept of a multi-user spaceport along with Spaceport Integration and Services, Chief Counsel, Chief Financial Officer and Safety and Mission Assurance. The result completely changed the way business is done at the center. Making the best

use of taxpayer funded resources has been a key objective, from reorganizing the spaceport’s management structure to providing optimum utilization of available assets.

“It’s real -- Kennedy is a multi-user spaceport,” said Greg Gaddis, the center’s master integrator. “Our job is to make sure everyone is successful.”

The Customer Service and Integration Branch of Spaceport Integration and Services helps ensure success through situational awareness into the diverse organizations’ daily activities.

COORDINATING SERVICES

According to Gaddis, a key element of coordination is a way to maintain situational awareness.

“We created SIMS - the Spaceport Integrated Master Schedule, a process tool,” he said. “It helps us coordinate activities on a day-to-day basis.”

According to the SIMS document, it establishes processes and supporting products in planning operations and activities for all spaceport partners, ensuring efficient use of resources and providing insight into one activity getting in the way of another.

“Spaceport Integration has people who watch for potential conflicts,” Gaddis said.

An example took place last summer.

A team from NASA’s Armstrong Flight Research Center in California and Langley Research Center in Virginia were flying agency F-18 jets from the Shuttle Landing Facility (SLF). In 2015, the center signed a 30-year [property agreement with Space Florida](#) for the operations and management of the SLF. In August, NASA researchers were measuring the effects of low-altitude turbulence on [sonic booms](#).

On Aug. 31, 2017, SpaceX was planning a 3.5-second static firing of the engines on a Falcon 9 rocket at Launch Complex 39A. NASA signed a **property agreement with SpaceX to operate** the former Apollo and Space Shuttle Program site where the company now is launching its Falcon 9 rockets.



In the Hangar AE Launch Vehicle Data Center, NASA and contractor managers and engineers monitor countdown progress for launch of eight Cyclone Global Navigation Satellite System, or CYGNSS, spacecraft aboard a Pegasus XL rocket Dec. 15, 2016. During launches, the facility provides real-time data, video and voice information for vehicle checkout and operations, and it can be reprogrammed to support any rocket. Photo credit: NASA/Kim Shiflett

The payload launched for the Department of Defense (DOD) on Sept. 7, 2017, was the X-37 Orbital Test Vehicle 5, processed by Boeing in what was bay 1 of the shuttle era's Orbiter Processing Facility.

"SpaceX was concerned about possible sonic booms during critical moments of the countdown for the static test," Gaddis said. "We got the Armstrong and Langley people in touch with SpaceX to work out any conflicts. That's our job, preventing one customer's operations from impacting operations or safety of another."

DIVERSE OPERATIONS

Multiple partners means multiple programs with diverse operations.

When NASA's **Launch Services Program (LSP)** launched TDRS-M on Aug. 18, **Hangar AE** at Cape Canaveral served as their communication center. During launches, the facility provides real-time data, video and voice information for vehicle checkout and operations and it can be reprogrammed to support any rocket.

At the same time LSP teams in Hangar AE were launching TDRS-M, they were demonstrating Kennedy's role as a multi-user spaceport by simultaneously supporting Orbital ATK, the launch provider for a Pentagon spacecraft called Operationally Responsive Space number 5, or ORS-5. The program focuses on providing quick-response tactical space-based capabilities to DOD using smaller satellites. Orbital ATK launched ORS-5 on a Minotaur rocket from Space Launch Complex-46 at the Cape a week after TDRS-M.

"Orbital ATK used Hangar AE as their launch control room for ORS-5 providing a prime example of Kennedy's role as a multi-user spaceport supporting multiple spacecraft and launch providers concurrently," said Reed Divertie, chief of the Ground Systems Integration Branch of LSP.

Other locations, not needed by NASA for the immediate future, have been turned over to industry partners. OPF Bay 3 now is the **Commercial Crew and Cargo Processing Facility** where Boeing is preparing its CST-100 Starliner spacecraft, which is one of two commercial partners that will carry astronauts to the International Space Station from U.S. soil once again.

"We're not done yet," Gaddis said. "We will continue to grow. For example, Blue Origin will be coming on line soon."

The impact of the Blue Origin partnership with Spaceport Florida is already evident with the development of the company's manufacturing facilities in Exploration Park just outside Kennedy's industrial area and the re-development of Space Launch Complex 36 at Cape Canaveral.

"The newest entrant to Kennedy's multi-user spaceport is already beginning to manufacture rocket components and will possibly be ready to launch as early as 2019," Engler said. "According to the approved Kennedy Master Plan and the Notice of Availability that is currently open, we have significant acreage available for partners, both commercial and governmental."

These land uses include, among others, spacecraft launch and landing, spacecraft processing, aerospace research and technology, and clean energy.



Boeing's Structural Test Article of its CST-100 Starliner spacecraft is readied inside the company's Commercial Crew and Cargo Processing Facility at NASA's Kennedy Space Center. Photo credit: Boeing

"We are excited to have the partners that currently reside here at Kennedy and are looking to include more partners into the family," Engler said.

"More growth will require more integration," Gaddis said. "It's all about living and working at a multi-user spaceport."



NASA...60 and counting...

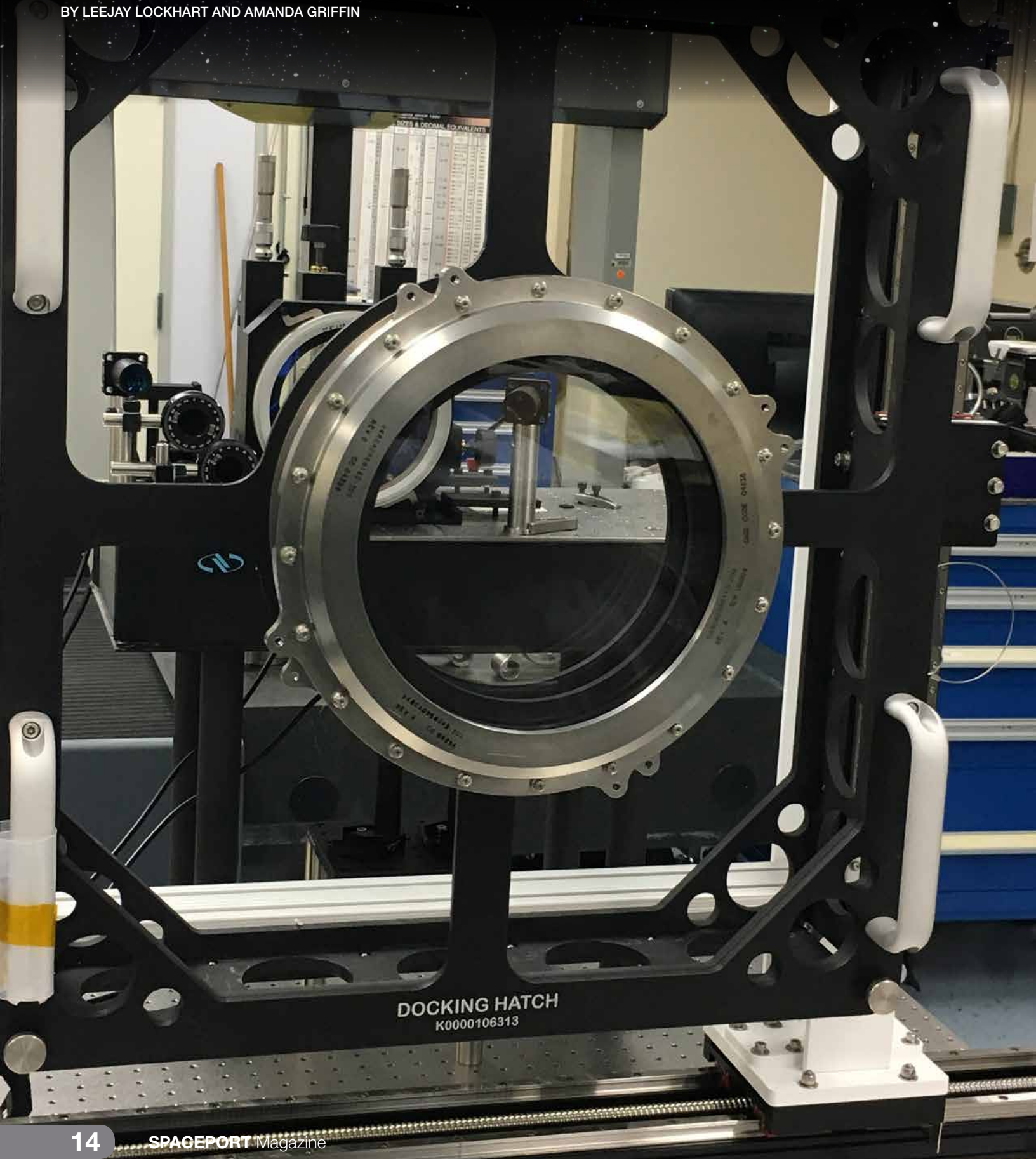
In 2018, NASA will mark the 60th anniversary of its establishment as a U.S. government agency. President Dwight D. Eisenhower signed NASA's founding legislation, the 1958 National Aeronautics and Space Act, on July 29, 1958. NASA considers its birthday to be Oct. 1, the day the agency opened for business. NASA has released an official logo for use in observing this milestone anniversary.

Created by NASA graphic artist Matthew Skeins, the logo depicts how NASA is building on its historic past to soar toward a challenging and inspiring future.

For more information about NASA's 60th anniversary and the design of the logo visit <http://communications.nasa.gov/content/nasa-60th-logo>.

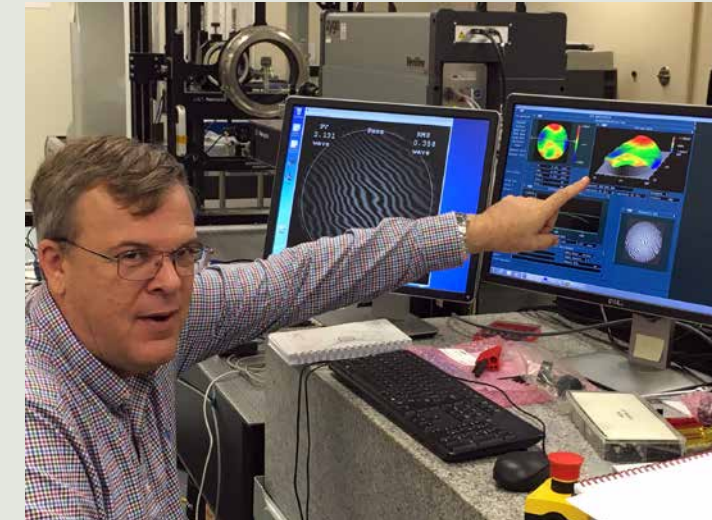
A WINDOW TO SPACE

BY LEEJAY LOCKHART AND AMANDA GRIFFIN



A few multi-layer windows on a spacecraft provide astronauts the view they may need for navigating space and carrying out their exploration mission with visual data. NASA is working to improve the durability of those windows, and reduce cost and weight, while maintaining the clarity astronauts need to carry out their tasks and view the Earth and other destinations as they travel farther into the solar system.

The space shuttle used only glass panes for its primary windows. While these provided good optical quality, they added costly mass to the spacecraft. Modern spacecraft windows incorporate acrylic and other plastics that are lighter, stronger and less brittle, but often provide lower quality optical properties.



Mark Nurge, Ph.D., a physicist in the Applied Physics Lab with the center's Exploration Research and Technology Programs, looks at data during the first optical quality test on a full window stack that is ready for installation in the docking hatch of NASA's Orion spacecraft. Photo credit: NASA/Amanda Griffin

A few years ago, NASA began an effort to ensure the optical quality of the panes used on agency or commercial spacecraft. Each window pane must ensure the view is clear for the astronauts and to help their cameras capture the best possible photographs.

Recently, a team from **Kennedy Space Center's** Exploration Research and Technology Programs performed the first optical quality testing on a window that is ready for installation in the docking hatch of **NASA's Orion** spacecraft. On Orion, three panes comprise the hatch window. This hybrid combination of glass and plastics is a first for NASA and will safeguard the spacecraft's inhabitants as one glass pane shields them from the heat of re-entry, another acrylic pane provides protection from the vacuum that surrounds the craft when it is outside of Earth's atmosphere, and the third pane serves as a redundancy for the glass pane.

When you use multiple panes of material for a window, the image you see out of it could be distorted. The tests performed determine the amount of image distortion – the variations in

the image seen through an optical material. These are wavefront variations. Think of it as looking at something in water when the surface is moving.

However, according to Kennedy's Mark Nurge, this Orion window shouldn't be a problem. "The window assembly was approximately 10 times better than the stated wavefront requirements," he said.

The data from the tests help improve the requirements for optical quality on Orion's windows and verify how the window should perform in space. The Kennedy team is responsible for testing all the viewing and hatch windows for Orion, and also is working with **Commercial Crew Program** providers to test windows for their spacecraft headed to the **International Space Station**.

The primary test measures variations in window pane flatness with an accuracy down to the level of tens of nanometers. The device used in the test can show minute differences between new windows and ones that have been subjected to the simulated pressures of space. The ultimate goal is to determine if there are any distortions outside of the prescribed threshold, so the astronauts aboard the spacecraft can take the most precise images possible.

These window tests are another step towards completion of Orion as the spacecraft is prepared to take humans farther into space than ever before.

Opposite: The first optical quality testing on a full window stack that is ready for installation in the docking hatch of NASA's Orion spacecraft is underway inside a laboratory in the Neil Armstrong Operations and Checkout Building at the agency's Kennedy Space Center in Florida. The test is being performed by a team from the center's Exploration Research and Technology Programs. The data from the tests will help improve the requirements for manufacturing tolerances on Orion's windows and verify how the window should perform in space. Orion is being prepared for its first integrated uncrewed flight atop NASA's Space Launch System rocket on Exploration Mission-1. Photo credit: NASA/Amanda Griffin

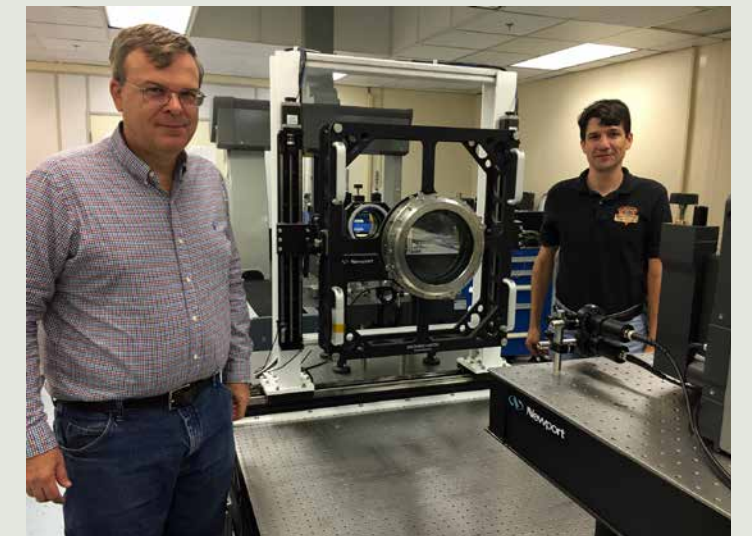
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These window tests are another step towards completion of Orion as the spacecraft is prepared to take humans farther into space than ever before.



Inside a laboratory in the Neil Armstrong Operations and Checkout Building at NASA's Kennedy Space Center, Mark Nurge, at left, and Bence Bartha, Ph.D., a specialist in non-destructive testing with URS Federal Services, performed the first optical quality testing on a full window stack that is ready for installation in the docking hatch of NASA's Orion spacecraft. Photo credit: NASA/Amanda Griffin

LIGHTS OUT

Nesting sea turtles depend on dark skies

BY JIM CAWLEY

Cinco de Mayo, Mother's Day and Memorial Day are all things associated with May. As many Floridians know, the fifth month signifies another important occurrence: the start of sea turtle nesting and hatching season.

Sea turtles are prevalent along the Space Coast, and Kennedy Space Center is no exception. Experts estimate that more than 5,000 turtles nest each year on Kennedy's protected beaches and on land near the center, on the Canaveral National Seashore. The two most common species found in this area are the green turtle, which is on the endangered list, and the loggerhead, which is listed as threatened.

People visiting, living or working near the beach, including spaceport employees, can take steps to help these fascinating reptiles during their six-month critical nesting and hatching period. Two words to keep in mind are: dark skies. Sea turtles — and their hatchlings — need them.

Females come up on the beach after dark to lay and bury their

eggs. With the cooler temperatures, they are less likely to overheat while laying approximately 100-130 eggs. After 55-60 days, the hatchlings emerge from their nests — also at night.

Sea turtles use the light of the Moon and stars to navigate. Artificial lighting from street lights, buildings and flashlights on the beach can disrupt their ability to find their way back to the water. Wrong turns can be perilous for both adults and hatchlings, which have limited energy to make it offshore.

So what can we do? Be aware of lights from nearby facilities or homes that can illuminate the beach. Turn off the lights, draw the shades and use LED or "turtle-friendly" lighting. Kennedy has been diligently working to improve its performance in following these external lighting guidelines every year.

Experts say one hatchling in a thousand will make it to the reproductive stage. Consequently, ensuring dark skies along the eastern seaboard of Florida is crucial to a sea turtle's survival.



Green turtles, which are on the endangered list, are among the two most common species found on the Space Coast. The other is the loggerhead, which is listed as threatened. Photo credit: NASA/Kim Shiflett

When making their way back to the ocean, sea turtles use the light of the Moon and stars to navigate. Photo credit: NASA

RESCUE OPERATIONS TAKE SHAPE FOR COMMERCIAL CREW PROGRAM ASTRONAUTS

BY MARIE LEWIS

As a child watching Apollo 11 land on the Moon, Ted Mosteller dreamed of working for the space program. As leader of **NASA's Commercial Crew Program** Landing and Recovery Team, he directs a multi-agency operation to rescue astronauts in emergency landing scenarios. "It's like insurance," he said. "You have insurance on your car or house, but you hope you never have to use it."

Rescue and recovery involves meticulous planning and close coordination between NASA, the Department of Defense (DOD), and company recovery teams for Starliner and Crew Dragon. These are the spacecraft of commercial partners Boeing and SpaceX that will fly astronauts to and from the **International Space Station** from U.S. soil. In the event of a variety of contingency landings, an elite team is prepared to rescue the crew anywhere in the world.

In preparation for both launch and landing, U.S. Air Force "Guardian Angel" Pararescue forces will be pre-positioned in key locations, alert and ready to deploy at a moment's notice. Should a spacecraft splash down within 200 nautical miles of the launch site, an HC-130 aircraft along with two HH-60 Pave Hawk helicopters will deploy from Patrick Air Force Base in Florida. These aircraft will carry a team of up to nine Guardian Angels—also known as pararescue specialists—along with rescue

equipment and medical supplies.

The pararescue specialists would jump from the aircraft with inflatable boats, an inflatable ring—called a stabilization collar—to steady the capsule in the water, and other equipment. After performing an initial hazard assessment, the team would install the collar and enter the spacecraft to tend to the crew's immediate medical needs before safely moving them onto a specially designed 20-person life raft. From there, the crew would be airlifted out for further medical attention.

For contingency landings outside of the 200 nautical mile-radius, a C-17 aircraft would deploy from either Charleston Air Force Base in South Carolina or Hickam Air Force Base in Hawaii, depending on the splashdown location, with the same type of team and equipment to execute rescue operations.

"The C-17s are faster and have a longer range, so we use them for rescue capabilities worldwide," Mosteller explained. In order to support global rescue, the life raft is equipped with enough food, water and medical supplies to sustain both rescuers and crew for up to three days. In this situation, DOD would complete the rescue by enlisting help from the U.S. Coast Guard, a DOD ship, or a nearby commercial ship of opportunity to transport the crew to safety.

As the name Guardian Angels suggests, these rescuers are



Pararescue specialists, also known as "Guardian Angels," prepare equipment during an astronaut rescue training exercise in April off of Florida's eastern coast. Photo credit: NASA Langley Research Center/Ron Beard



Pararescue specialists from the 304th Rescue Squadron, located in Portland, Oregon, and supporting the 45th Operations Group's Detachment 3, based out of Patrick Air Force Base, deploy their parachutes and prepare to touch down on the Atlantic Ocean surface during an astronaut rescue training exercise in April. Photo credit: NASA Langley Research Center/Ron Beard

trained to protect. "Most people don't even know who we are, but we specialize in problem solving in very dynamic environments," said Brandon Daugherty, space medical contingency specialist with the 45th Operations Group's Detachment 3. "There are only about 500 pararescue specialists worldwide. We are fully qualified paramedics, and able to perform field surgery, if necessary." While NASA's strategy for CCP is to have the commercial partners provide end-to-end crew transportation services, it was determined to be more effective and efficient to rely on the DOD for contingency rescue because of their unique capabilities.

Pararescue specialists have evolved their military capabilities to help the commercial partners and NASA. "We're the only force equipped to do global, worldwide rescue and recovery in any climate. Whether it's the top of a mountain or the bottom of the ocean, we can get there," said Daugherty.

Mosteller's team executed the first joint rescue training development exercise in August 2017, which involved more than 200 individuals from NASA, the U.S. Armed Forces and SpaceX crew recovery teams. This event marked the first open ocean astronaut rescue training development exercise with a commercial spacecraft off the eastern coast of Florida. NASA and the DOD conducted similar exercises for the Gemini, Apollo and Space Shuttle Programs.

The exercise involved multiple marine and air platforms including a U.S. Coast Guard ship, a C-17 aircraft and crew, several support boats and a SpaceX Crew Dragon mockup as well as ground support equipment shared with NASA's Orion Program. The team used the test to develop specific rescue procedures and plans, including how to mitigate potential hazards while entering the spacecraft and safely remove the crew. Since then, rescue and recovery teams for both SpaceX and Boeing have continued to work with NASA and DOD to refine their processes, and have kept pace with the training schedule.

NASA intends to perform a similar open ocean activity with Boeing using the company's water recovery trainer this fall. Even though Boeing's Starliner was designed for land-based returns, and although landing in the water is unlikely, it's critical for teams to practice a variety of landing scenarios. In May, Boeing and pararescue specialists will be practicing water landing scenarios, including crew extraction and equipment interfaces, using a mockup of the Starliner at Johnson Space Center in Houston.

"Pararescue has been a part of the space mission from the beginning. It's extremely patriotic, so I'm honored to be part of this mission," said Daugherty.



Anton Kiriwas, an operations project engineer within the Systems Engineering Division of Exploration Ground Systems at Kennedy Space Center, earned a Rotary National Award for Space Achievement (RNASA) Stellar Award. NASA/Frankie Martin

EGS' Kiriwas takes home prestigious RNASA Stellar Award

BY JIM CAWLEY

When Anton Kiriwas learned he was nominated for a Rotary National Award for Space Achievement (RNASA) Stellar Award, he researched the history and soon discovered its significance. He was particularly impressed by the list of those who had received it, including colleagues and mentors he looks up to at NASA's Kennedy Space Center in Florida.

"I didn't have any expectation of winning, especially after hearing all of the amazing nominations during the RNASA luncheon," said Kiriwas, an operations project engineer within the Systems Engineering Division of Exploration Ground Systems (EGS) at Kennedy. "When I did hear my name, it almost didn't click that I had won. My wife had to poke me and tell me to get up and walk up to the stage."

Kiriwas, who has been with NASA for nine years, was a winner in the early career category. He received the award for his outstanding EGS Ground & Flight Software Applications technical

integration. He also was recognized for exceptional leadership contributing to the success of the Nation's Deep Space Exploration mission.

"Anton is an excellent engineer with strong leadership and communications skills," said Kiriwas' supervisor, Hung Nguyen. "He brings a broad experience base to any team he leads or supports, and he's very passionate about our mission of Human Space Exploration."

As part of the group of 2018 RNASA nominees, Kiriwas was honored during a black-tie banquet at the Houston Hyatt Regency hotel on April 27. That included a handshake with astronaut Peggy Whitson, which he said made him feel "incredibly honored."

Stellar Awards nominations are reviewed by an evaluation panel of distinguished scientists, engineers, managers, and academicians. Winners are chosen based on whose accomplishments hold the greatest promise for furthering future activities in space.



Jackie Quinn is inducted into the National Inventors Hall of Fame (NIHF) Class of 2018 during a ceremony May 3, 2018 in Washington. Photo credit: NIHF

TECHNOLOGY RECOGNITION

Jackie Quinn inducted into National Inventors Hall of Fame

BY LINDA HERRIDGE

Jackie Quinn, an environmental engineer at NASA's Kennedy Space Center in Florida, was one of just 15 innovators inducted into the National Inventors Hall of Fame (NIHF) Class of 2018. Quinn accepted the award May 3, during the 46th Annual Induction Ceremony at the National Building Museum in Washington.

"The people I met at the NIHF are simply amazing and inspiring," Quinn said. "It's a humbling experience to be with them and learn of their contributions to technological advancement."

In the late 1990's, Quinn and a group of researchers from the Department of Chemistry at the University of Central Florida co-developed emulsified zero-valent iron (EZVI). The technology is used to combat chlorinated solvent contaminants left over from space exploration's early years. It has been used nationally and internationally since its development. Quinn's technology innovation portfolio includes several other cleanup technologies, all targeting environmental contaminants.

Read the full story at
<https://go.nasa.gov/2jWuAuW>.

SPACE TO GROUND

Florida students learn about growing plants in orbit

BY LEEJAY LOCKHART

VEG-03 A Cut-and-Come-Again 1st



Students in Florida asked questions of NASA scientists on the ground and astronauts on the [International Space Station](#) to learn more about how the agency is pioneering the cultivation of plants in space to supplement astronaut diets with fresh, nutritious food. These students have directly bolstered researchers' knowledge in the field of space plant science by participating in the [Growing Beyond Earth](#) part of [The Fairchild Challenge](#), which has promoted education focused on science, technology, engineering and mathematics (STEM) by engaging students to test more than 100 varieties of edible plants during the past three years for their potential viability on the space station.

Trent Smith, Veggie project manager, speaks to high school students about growing plants on the International Space Station at the Kennedy Space Center Visitor Complex. During the event, April 25, 2018, students in central Florida spoke to NASA researchers, while students in Miami who had participated in The Fairchild Challenge spoke in real time to astronauts on the space station about the challenges of living and growing food in space. Photo credit: NASA



Nicole Figueroa, a Pine Ridge High School student, speaks with Gioia Massa, a life sciences project scientist at Kennedy Space Center, after an event that highlighted NASA's partnership with The Fairchild Challenge, an effort to identify plants suitable for growing in space. Photo credit: NASA

Astronauts on the orbiting laboratory use the Vegetable Production System, known as Veggie, to study plants. These experiments also have a practical side. Not only do the plants augment the astronauts' diet with fresh food, according to astronauts, tending the crops is a source of enjoyment and a little piece of home for the crew.

Hundreds of students from eight high schools in central Florida came to the Kennedy Space Center Visitor Complex where NASA treated them to a presentation by Gioia Massa, a life sciences project scientist at the agency's Kennedy Space Center, and Trent Smith, Veggie project manager, along with university students who are interns at NASA also working on growing plants for space. The high school students then had the opportunity to ask the team questions, which covered topics as diverse as using Martian soil for growing plants, to the viability of growing trees in space.

As he answered questions, Smith said working with 150 schools nationwide through The Fairchild Challenge was a tremendous benefit to NASA. Students have identified several strong candidate crops including extra dwarf pak choi and dragoon lettuce, which are undergoing final testing to determine if they are suitable for space.

"I hope to send them up in a resupply spacecraft very soon, giving astronauts new selections to grow and eat in space," Smith said.

Massa told the crowd that The Fairchild Challenge participants had not only evaluated other promising plant varieties including Shungiku, an edible Chrysanthemum, but they also had tested

horticultural techniques like cut-and-come-again which is a repetitive harvest that can increase overall food yield. She said the entire program was "a wonderful collaboration" between NASA and students.

Attention then shifted to South Florida as hundreds of Miami students who had participated in the Growing Beyond Earth portion of the Fairchild Challenge visited the Fairchild Tropical Botanic Garden for a live downlink with crew members aboard the space station.

As part of their [Year of Education on Station](#) activities, astronauts [Ricky Arnold](#) and [Drew Feustel](#) fielded questions from the students and talked about some of the challenges of living in microgravity and trying to grow space plants.

Students including Ashton Santos from Colonial High School in Orlando expressed excitement for being able to come to the visitor complex and learning directly from the people behind the science. "This experience was really valuable to me, and it really piqued my interest about agriculture in space," Santos said. "I hope that I can find out more, and maybe I can be one of the interns there," he added.

Camile Mason, another Colonial High School student, had the opportunity to ask the Veggie team a question and said the visit was an exciting experience. "It was very insightful," Mason said. "It was very interesting learning about how scientists developed and changed the way we can look at agriculture even here on Earth, and how we can study and mimic conditions out in space, here."



Covault, Diller join prestigious 'Chroniclers' group

BY JIM CAWLEY

NASA recently honored a pair of veteran space chroniclers for their contributions to delivering U.S. space exploration news. Craig Covault and George Diller are the newest additions to the facility's "Chroniclers wall," recognized during a ceremony held May 4 at the Kennedy Space Center Press Site in Florida.

Earlier in the week, brass strips engraved with each awardee's name and affiliation were added to the wall and covered. Those strips were unveiled during a special gathering of the honorees' friends and family, media, and current and former NASA officials on Friday. The two men were selected by a committee of their peers to be the 2018 Chroniclers on March 21.

"Chroniclers" recognizes retirees of the news and communications business who helped spread news of American space exploration from Kennedy for 10 years or more. Covault and Diller each far exceeded that amount.

Considered for NASA's journalist in space initiative during the Space Shuttle Program, Covault covered approximately 100 space shuttle launches and missions. The former writer and reporter with Aviation Week & Space Technology is credited with 2,000 news and feature stories on space and aeronautics during his 48-year career.

Diller, known by many as "The Voice of Kennedy Launch Control," retired in 2017 after a 37-year career in NASA Public Affairs. He provided commentary for numerous critical missions, including the space shuttle launch of the Hubble Space Telescope in 1990, and all five of its servicing missions. He called his launch commentary of Atlantis STS-135, which was the final mission of the Space Shuttle Program, "something that I'll never quite forget."

Covault and Diller are the 75th and 76th names to be added to the "Chroniclers wall," which includes Walter Cronkite of CBS news, ABC News' Jules Bergman and two-time Pulitzer Prize winner John Noble Wilford of the New York Times. Photo credit: NASA/Kim Shiflett

SWARMIES!

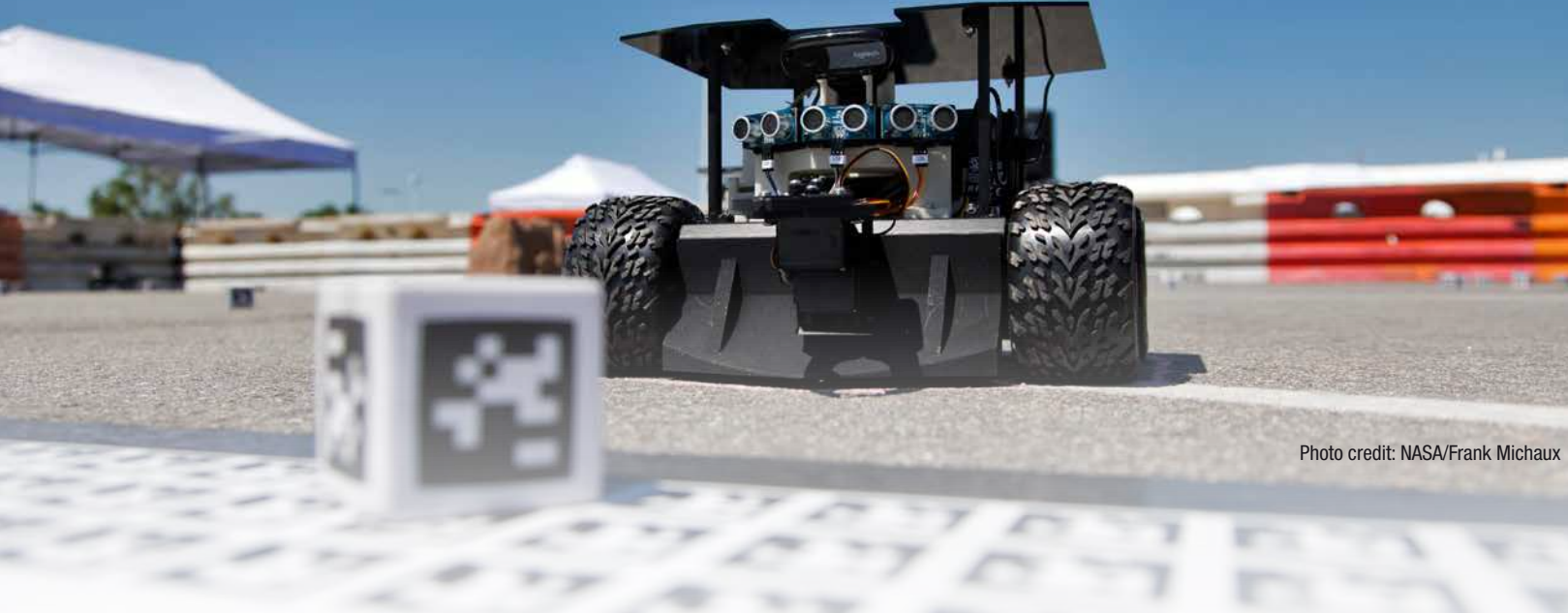


Photo credit: NASA/Frank Michaux

Swarmathon improves student skills in robotics, computer science

BY BOB GRANATH

Students from universities and community colleges across the nation recently participated in the third annual Swarmathon. The robotic programming competition took place at NASA Kennedy Space Center's Visitor Complex April 17-19. Their developments may lead to technology that could help astronauts find needed resources while exploring the Moon or Mars.

In her welcoming remarks, Deputy Center Director Janet Petro noted that work is ongoing to prepare for NASA's new rocket that will send humans to deep space. The Space Launch System with the Orion spacecraft is designed to carry astronauts well beyond low-Earth orbit.

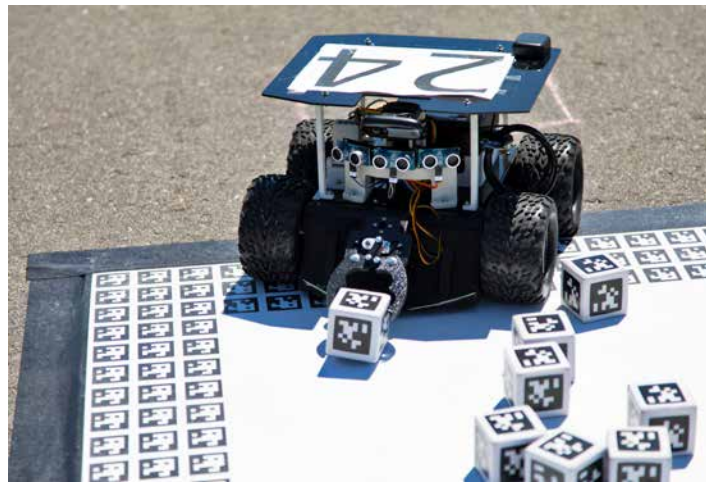
"That will set the stage for you to contribute as part of the teams that will use code similar to what you are using today to help robotics as humans explore the Moon and Mars," she said.

For this year's competition, students participated in the programming competition by developing software code to operate the innovative robots called "Swarmies."

Swarmies are small robotic vehicles measuring about 12 inches by 12 inches by 8 inches. Each Swarmie is equipped with sensors, a webcam, a GPS system and a Wi-Fi antenna. They operate autonomously and can be programmed to communicate and interact as a collective swarm. In the competition, robots searched walled arenas looking for "resources" in the form of small cubes with AprilTags, which are similar to bar codes.

NASA's [Minority University Research and Education Project](#)

(MUREP) hosted the competition as part of the agency's on-going efforts to increase the number of NASA-focused science, technology, engineering and mathematics, or STEM, experiences that engage underrepresented groups in education.



In the April 17-19, 2018, Swarmathon competition at the Kennedy Space Center Visitor Complex, students were asked to develop computer code for the small robots, programming them to look for "resources" in the form of AprilTag cubes, similar to barcodes. Photo credit: NASA/Frank Michaux

According to Theresa Martinez, MUREP STEM Engagement manager in Kennedy's Education Projects and Youth Engagement Office, participants develop practical skills that could aid NASA's exploration goals.

"Swarmathon students gain experience with code integration,



Students from Montgomery College in Rockville, Maryland, follow the progress of their Swarmie robots during the Swarmathon competition at the Kennedy Space Center Visitor Complex. Teams developed search algorithms for the Swarmies to operate autonomously, communicating and interacting as a collective swarm similar to ants foraging for food. Photo credit: NASA/Frank Michaux

hardware testing, software engineering, project management and team collaboration critical to their future success in robotics and computer science," she said. "Their efforts will further advance 'swarm robotics' technology for future NASA space exploration missions and we hope some of the students will return and help us in the future."

At the conclusion of the event, Durham Technical Community College, in Durham, North Carolina, was presented the first-place award, capturing a \$5,000 cash prize. Awarded a \$3,000 prize was City College of New York, in New York, for first place in the virtual competition.

The Swarmathon is the brainchild of Dr. Melanie Moses, associate professor of computer science at the University of New Mexico. It is a cooperative effort with NASA's MUREP program in partnership with the Kennedy Swamp Works, allowing a diverse group of students to use their programming and code skills in a real-life project.

The **Swarmie robots** were originally developed in Kennedy's Swamp Works, which was established for rapid, innovative and cost-effective exploration mission solutions through partnerships across NASA, industry and academia.

Moses says she's hopeful that some of these students will ultimately choose to pursue computer science or STEM as a career.

"Students are able to take the technical skills they learn in programming class and put it to work in a collaborative environment where they must overcome numerous challenges," she said. "One of the most important things they learn is that these are complex problems and there are no right answers, but many approaches to creatively come to a solution."

Martinez noted that interest in the popular Swarmathon is growing. In the spaceport's **first annual Swarmathon**, 12 colleges

participated. Interest increased **last year**, with 20 teams joining in. In this year's Swarmathon, 23 teams represented 24 universities and community colleges involved in the effort. Additionally, seven teams participated in a virtual competition.

"Students are able to take the technical skills they learn in programming class and put it to work in a collaborative environment where they must overcome numerous challenges."

Theresa Martinez
MUREP STEM Engagement
manager
Education Projects and Youth
Engagement Office

Swarmathon participation is designed to improve students' skills in robotics and computer science, further advancing technology for future NASA space exploration missions. The aspiring computer engineers developed search algorithms for robotic swarms. Algorithms are self-contained, step-by-step operations to perform calculation, data processing and automated reasoning. Computer code similar to those designed for Swarmie robots also could be used for other applications, such as cleaning up hazardous waste.

Successful exploration of the Moon and Mars requires the location and retrieval of local resources on the surface of these locations well beyond Earth. Such technologies are needed to find and collect materials such as ice (convertible into liquid water, hydrogen fuel and oxygen to support human life) and rocks, minerals and construction materials to build human shelters.



Inset Photo: Several types of aircraft are on the tarmac at the Shuttle Landing Facility at NASA's Kennedy Space Center in Florida. From left are two Canadian Forces Snowbird CF-18 jets, a NASA Huey helicopter, and two NASA T-38 trainer aircraft. Photo credit: NASA/Kim Shiflett

Canadian Forces Snowbirds fly in formation over NASA's Kennedy Space Center in Florida during a practice flight on May 9, 2018, between their scheduled U.S. air shows. Photo credit: NASA/Kim Shiflett



Canadian Forces Snowbirds fly in formation over NASA's Kennedy Space Center in Florida during a practice flight on May 9, 2018, between their scheduled U.S. air shows. The iconic Vehicle Assembly Building and mobile launcher are in view in the background. Photo credit: NASA/Kim Shiflett

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