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National Aeronautics and
Space Administration

KENNEDY SPACE CENTER'S

SPACEPORT magazine

SpaceX CRS-10

SpaceX's Falcon 9 takes off from historic Launch Pad 39A cementing Kennedy Space Center as a multi-user spaceport

Aeronautics Research | Mars | Technology | Earth Right Now | ISS | Solar System & Beyond

KENNEDY SPACE CENTER'S

SPACEPORT MAGAZINE CONTENTS

Cover: A SpaceX Falcon 9 rocket lifts off from Launch Complex 39A at Kennedy Space Center. This is the company's 10th commercial resupply services mission to the International Space Station. Liftoff was at 9:39 a.m. EST from the historic launch site now operated by SpaceX under a property agreement with NASA. The Dragon spacecraft will deliver about 5,500 pounds of supplies to the space station, including the Stratospheric Aerosol and Gas Experiment (SAGE) III instrument to further study ozone in the atmosphere.
Photo credit: NASA/Tony Gray

To get the latest Kennedy Space Center updates, follow us on our **Blog**, **Flickr**, **Facebook** and **Twitter**.

KSC BLOG

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NASA'S LAUNCH SCHEDULE

Date: Targeted for March 19
Launch Window: 10:56 p.m. to 11:26 p.m. EDT
Mission: Orbital ATK Resupply Mission to International Space Station (CRS-7)
Description: The Atlas V launch of Orbital ATK's Cygnus cargo craft from Cape Canaveral Air Force Station in Florida is targeted at 12:29 a.m. EST, the beginning of a 30-minute window.
http://go.nasa.gov/2jetyfU

Date: April 10
Mission: Expedition 50 Undocking and Landing
Description: NASA astronaut Shane Kimbrough and cosmonauts Sergey Ryzhikov and Andrey Borisenko of the Russian space agency Roscosmos undock their Soyuz MS-02 spacecraft from the International Space Station's Poisk module and land in Kazakhstan.
http://go.nasa.gov/2gMg3PR

Date: April 20
Mission: Expedition 51 Launch
Description: Expedition 51/52 crew members NASA astronaut Jack Fischer and cosmonaut Fyodor Yurchikhin of the Russian space agency Roscosmos launch to the International Space Station. Yurchikhin will be the Expedition 52 commander.
http://go.nasa.gov/2gMfdmx

Date: No Earlier Than June
Mission: ICON (Ionospheric Connection Explorer)
Description: The Ionospheric Connection Explorer will study the frontier of space: the dynamic zone high in our atmosphere where Earth weather and space weather meet. ICON will launch from Kwajalein Atoll aboard an Orbital ATK Pegasus.
https://www.nasa.gov/icon

Date: Aug. 3
Mission: Tracking and Data Relay Satellite M (TDRS-M)
Description: Orbiting 22,300 miles above Earth, the TDRS spacecraft provide near-constant communication links between the ground and orbiting satellites, such as Hubble, and the International Space Station. TDRS-M will launch from NASA's Kennedy Space Center in Cape Canaveral, Florida on an Atlas V rocket.
http://go.nasa.gov/2l8Hysg

Want to see a launch?
All expendable vehicles launched in Central Florida begin their journeys on the launch pads of Cape Canaveral Air Force Station, next door to Kennedy Space Center. Launch Transportation Tickets are available for some, but not all, of these launches. Call the KSC Visitor Complex at **(321) 449-4444** for information on purchasing tickets.

FROM OUR CENTER DIRECTOR

Kennedy Space Center solidifies multi-user spaceport status

As I reflect on the successful 10th Commercial Resupply Services mission, with a SpaceX Falcon 9 and Dragon carrying supplies and experiments to the International Space Station, I realized every Kennedy directorate had a role to play in the success of the mission. We truly are a multiuser spaceport.

Obviously, the role that Spaceport Integration and Services played in supporting the launch is very visible, as was the role of Exploration Research and Technology Programs in supporting delivery of the experiments and supplies. What may not be as obvious are the many hours of work by Center Planning and Development and the offices of the Chief Financial Officer, the Chief Counsel, and Procurement in developing all the agreements and supporting contracts that made it possible. Or the extensive negotiations that Deputy Director Janet Petro led in getting an agreement that the Air Force, FAA, and NASA could sign, allowing commercial operations off 39A with an FAA launch license that did not require the Air Force as the Launch Decision Authority.

You may not have been aware of all the behind-the-scenes work by Safety and Mission Assurance, ensuring agreements were followed and the right requirements were identified; or the Launch Services Program folks, on console, tracking all the data and processes to support future science missions and Commercial Crew; as well as the Ground Systems Development and Operations folks in the Emergency Operations Center, watching over Pad 39B assets; and our engineering team was embedded throughout it all. Our Communication and Public Engagement team, with support from Information Technology and Communications Services, did an outstanding job telling the story to our nation and hosting all of our guests. Truly, there wasn't an organization in our contractor/civil service team at Kennedy that wasn't at least a little bit involved in some aspect of this mission.

I could not be more proud of Kennedy's team, of how exceptional this achievement was, especially since it's only been a little less than three years since we signed the Pad A agreement with SpaceX. What has been accomplished in the last five years since the end of the Space Shuttle Program is phenomenal. When you stand on the balcony of the Operations Support Building II, looking from west to east and north to south, the story of our remarkable transformation tells itself. This is just the beginning of more great things to come for KSC.

Keep Charging!

Bob Cabana

SPACEX COMMERCIAL RESUPPLY

NASA cargo headed to space station includes important experiments, equipment

BY STEVEN SICELOFF

A SpaceX Falcon 9 rocket lifts off from Launch Complex 39A at Kennedy Space Center. The Dragon spacecraft delivered about 5,500 pounds of supplies to the space station. Photo credit: NASA/Tony Gray

About 5,500 pounds of research equipment, cargo and supplies were delivered to the International Space Station by the SpaceX Dragon spacecraft after its liftoff Feb. 19 aboard a Falcon 9 rocket on the CRS-10 mission.

SpaceX's Dragon cargo craft launched from Launch Complex 39A at Kennedy Space Center. This was the first commercial launch from Kennedy's historic pad.

Astronauts Thomas Pesquet of the European Space Agency and Shane Kimbrough of NASA used the space station's robotic arm to capture Dragon when it arrived at the station Feb. 23.

The cargo includes major experiments that will look into a range of scientific disciplines from human health to atmospheric conditions on Earth.

Research materials flying inside the Dragon's pressurized area include a crystal growth experiment that will crystallize a monoclonal antibody that is undergoing clinical trials for the treatment of immunological diseases. Growing the crystal in space will allow it to develop more than it could on Earth where gravity causes crystals to collapse on themselves. Preserving these antibodies in crystals allows researchers a glimpse into how the biological molecules are arranged, which can provide new information about how they work in the body. So far, Earth-grown crystalline suspensions of monoclonal antibodies have proven to be too low-quality to fully model.

Better defining how some bacteria become drug-resistant is the focus of another experiment that aims to develop medicines that counter the resistance. Stem cells like those used to treat strokes and other occurrences also will be studied using experiment supplies brought up on this flight.

The equipment aboard the Dragon includes a major instrument that will survey Earth's upper atmosphere in a continuation of one of NASA's longest-running Earth-observing programs. Called SAGE III for Stratospheric Aerosol and Gas Experiment, the instrument examines the levels of ozone, aerosols, nitrogen dioxide and water vapor in the stratosphere and troposphere high above Earth. It is the latest version of an experiment that began in 1979 and has created a multi-decade record of measurements. The 2,200-pound instrument will be connected to the outside of the station to make daily observations for several years.

The mission is the company's tenth cargo flight to the station under NASA's Commercial Resupply Services contract. Dragon's cargo will support dozens of the more than 250 science and research investigations during the station's Expeditions 50 and 51.

Dragon is scheduled to depart the space station later this month, returning nearly 5,000 pounds of science, hardware and crew supplies.

Keep up with the International Space Station, and its research and crews, at:
– http://www.nasa.gov/station

Get breaking news, images and features from the station on Instagram and Twitter at:
– http://instagram.com/iss
– http://www.twitter.com/Space_Station

Learn more about SpaceX's resupply mission at:
– http://www.nasa.gov/spacex

To watch the SpaceX Falcon 9 rocket launch from Launch Complex 39A at Kennedy Space Center, go to:
– http://go.nasa.gov/2lCHD6I

A SpaceX Falcon 9 rocket lifts off from Launch Complex 39A at Kenney Space Center on Feb. 19. This is the company's 10th commercial resupply services mission to the International Space Station. Photo credit: NASA/Tony Gray

ALWAYS EXPLORING

"Work with great people and you can achieve great things!"

I am currently the lead for the Lunar Advanced Volatile Analysis subsystem in the RESOLVE payload. The hardware we are building is part of the payload on Resource Prospector that will tell us what volatile resources are in the polar regions of the moon that we can use to enable exploration. I started going to school for marine and atmospheric chemistry at the University of Miami and continued to pursue chemistry at Georgia Tech. I was lucky enough to meet the right mentor at the right time and was hired to work here at KSC on various projects including sensors and in-situ resource utilization.

Actually, in graduate school I told my advisor that I wanted to focus on atmospheric chemistry rather than planetary chemistry because I didn't think there were any jobs in space, and now here I am focusing on the moon and exploration technology!

The coolest thing for me is to hear people outside of our team get excited about our mission, and to look at the moon and think that maybe one day the hardware I've helped build here at KSC will be on that surface so far away.

To learn more about Dr. Captain, watch https://youtu.be/zgPXkPps59w

Dr. Janine Captain
Chemist

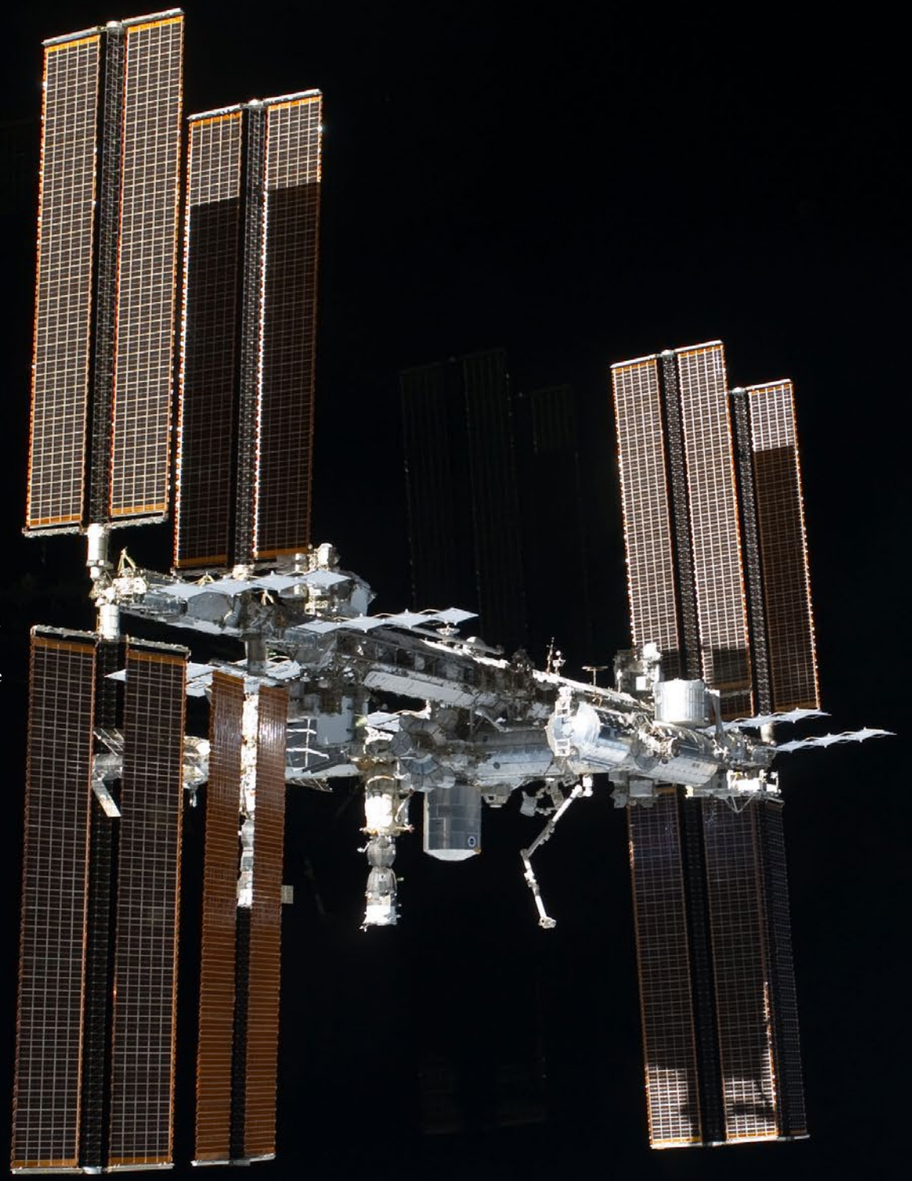
Exploration Research and Technology Programs

SP-2017-01-039-KSC

CABBAGE PATCH

Fifth crop harvested aboard space station

BY AMANDA GRIFFIN



After spending nearly a month tending to the International Space Station's first crop of Chinese cabbage, astronaut Peggy Whitson harvested the leafy greens on Feb. 17.

At first, one of the six seeds of the Tokyo Bekana Chinese cabbage variety seemed to have been planted higher than the rest, keeping it from getting wet enough in the beginning. But the on-orbit gardener would not be deterred.

"Peggy is doing an amazing job," said Veggie Project Manager Nicole Dufour. "She wouldn't give up and she was able to get the seed in pillow D to germinate."

While the space station crew will get to eat some of the Chinese cabbage, the rest is being saved for scientific study back at Kennedy Space Center. This is the fifth crop grown aboard the station, and the first Chinese cabbage. The crop was chosen after evaluating several leafy vegetables on a number of criteria, such as how well they grow and their nutritional value. The top four candidates were sent to Johnson Space Center's Space Food Systems team, where they brought in volunteer tasters to sample the choices. The Tokyo Bekana turned out to be the most highly rated in all the taste categories.

Astronauts often report that their taste buds dull during spaceflight, and they frequently add hot sauce, honey or soy sauce to otherwise bland-tasting fare. One explanation for this may be that, in a reduced gravity environment, the fluid in astronauts' bodies shifts around equally, rather than being pulled down into their legs as we're accustomed to on Earth. The fluid that fills up their faces feels similar to the congestion from a cold and reduces their ability to smell. Researchers suggest this phenomenon — combined with all the other odors aboard the confined orbiting laboratory competing with the aroma of their food — may ultimately dull their sense of taste.

However, there is a backup plan to ensure the crew's culinary delight. If the fresh Chinese cabbage they grew doesn't awaken their taste buds on its own, packets of ranch dressing were also sent up to help them enjoy the fruits (or veggies) of their labor.

What's up next for Veggie? Two exciting prospects are on the horizon. Later this spring, a second, more efficient, Veggie system will be sent up to be seated next to the current one. It will provide side-by-side comparisons for future plant experiments and will hopefully make astronauts like Whitson happy to have a bigger space garden.

"I love gardening on Earth, and it is just as fun in space . . ." Whitson tweeted in early February. "I just need more room to plant more!"

Additionally, aboard the next resupply mission to the space station will an experiment involving Arabidopsis, a small flowering plant, and petri plates inside the Veggie facility. Arabidopsis is the genetic model of the plant world, making it a perfect sample organism for performing genetic studies. The principal Investigator is University of Florida's Dr. Anna Lisa Paul.

"These experiments will provide a key piece of the puzzle of how plants adjust their physiology to meet the needs of growing in a place outside their evolutionary experience," Dr. Paul said. "And the more complete our understanding, the more success we will have in future missions as we take plants with us off planet."

Later this year, the Advanced Plant Habitat, NASA's largest plant growth chamber, will make its way to the station, increasing the amount of scientific knowledge needed to dig deeper into long-duration food production for missions farther and farther from home.

GROWTH OPPORTUNITY

Scientists prepare Apogee wheat seeds for the science carrier, or base, of the Advanced Plant Habitat inside a laboratory at the Space Station Processing Facility at Kennedy Space Center on Feb. 15. Photo credit: NASA/Bill White

New Plant Habitat will increase harvest on International Space Station

BY LINDA HERRIDGE

A new, nearly self-sufficient plant growth system by NASA is headed to the International Space Station soon and will help researchers better understand how plants grow in space. The Advanced Plant Habitat will be used to conduct plant bioscience research on the space station, and help NASA prepare crew to grow their own food in space during deep-space exploration missions.

Some of the components of this new system have arrived at Kennedy Space Center and are being prepared for delivery to the station on Orbital ATK's seventh commercial resupply mission to the station. The new plant system will join Veggie – NASA's first fresh food growth system already active on station.

Dr. Howard Levine, the project scientist overseeing the development of the advanced system, along with Dr. Gioia Massa, a life science project scientist and deputy project scientist, were two of the researchers who helped design the science requirements for the hardware and the test plan to validate it when it was tested at ORBITEC in Madison, Wisconsin.

"A team of scientists here at Kennedy Space Center have been developing the procedures for the first experiment using a prototype, or engineering development unit, of the plant habitat in the Space Station Processing Facility," Levine said.

Arabidopsis seeds, small flowering plants related to cabbage and mustard, have been growing in the prototype habitat, and will be the first plant experiment, called PH-01, grown in the chamber aboard the space station.

Dr. Oscar Monje, a research scientist, pours a growing substrate called arcillite in the science carrier, or base, of the Advanced Plant Habitat (APH) inside a laboratory at the Space Station Processing Facility at Kennedy Space Center on Feb. 15. The APH will be delivered to the space station aboard future Commercial Resupply Services missions. Photo credit: NASA/Bill White

Bryan Onate is the NASA APH project manager in the Exploration Research and Technology Directorate at Kennedy. He described the new plant habitat as a fully enclosed, closed-loop system with an environmentally controlled growth chamber. It uses red, blue and green LED lights, and broad spectrum white LED lights. The system's more than 180 sensors will relay real-time information, including temperature, oxygen content and moisture levels (in the air and soil, near the plant roots, and at the stem and leaf level), back to the team at Kennedy.

"A big difference in this system, compared to Veggie, is that it requires minimal crew involvement to install the science, add water, and perform other maintenance activities," Onate said. "We are learning how plants grow in space and what levels of commodities, such as light and water, are required so we can maximize our growth with the least resources."

The large, enclosed chamber measures 18 inches square, with two inches for the root system and 16 inches available for growth height. It is designed to support commercial and fundamental plant research or other bioscience research aboard the space station for up to a 135-day science investigation, and for at least one year of continuous operation without maintenance.

"I think that the new plant growth habitat will provide tremendous capabilities to do high quality plant physiology research with a variety of plant types on the space station," Massa said. "The plant habitat will enable much more controlled and detailed studies of plant growth in spaceflight."

The advanced system will be activated by astronauts aboard the space station but controlled by the team at Kennedy, minimizing the amount of crew time needed to grow the plants. The space station crew will still perform plant thinning and harvesting.

"Before PH-01 is initiated, there will be a short grow out of Dwarf Wheat and Arabidopsis as part of the post-installation checkout on the space station," Onate said.

The system's Plant Habitat Avionics Real-Time Manager in EXPRESS Rack, or PHARMER, will provide real-time data telemetry, remote commanding and photo downlink to the Kennedy team. An active watering system with sensors will detect when the plants need water and keep water flowing as needed.

Massa said having Veggie and the advanced system on the station will allow studies of food production in space, from the very simple to the complex and controlled.

When all parts are delivered to the station, the habitat will be installed in a standard EXpedite the PRocessing of Experiments to Space Station (EXPRESS) rack in the Japanese Experiment Module Kibo.

Water sprays onto Launch Complex 39A during a test by SpaceX of the sound suppression system at the launch pad. The water deluge diminishes vibration at the pad during a liftoff to protect the pad structures and rocket itself from excessive shaking.
Photo credit: NASA/Kim Shiflett

I Will **LAUNCH AMERICA**

Restoring America's Human Launch Capability

Rami Intriago
Resident Office Manager
NASA's Commercial Crew Program

I Will Launch America: Rami Intriago

BY DUSTIN W. CAMMACK

Effective relationships are almost as important as engineering in the rocket and spacecraft business. That is particularly true for NASA's Commercial Crew Program, an effort to return America's capability to launch astronauts to and from the International Space Station.

"Commercial crew is really a partnership between NASA and the providers," said Rami Intriago, NASA's resident office manager at Boeing's Commercial Crew and Cargo Processing Facility, or C3PF. "Relationships are built on trust, and building relationships is critical to what we're doing in CCP."

If the program and its industry partners are to be successful, the vehicles and launchers will have to be tested and validated before they fly astronauts. For Intriago, building those relationships successfully means the NASA and Boeing teams can execute a concurrent engineering partnership philosophy to meet the milestones that will lead to launching humans into low-Earth orbit and enable NASA's exploration of deep space.

"NASA CCP management recognized my background with concurrent engineering would help Boeing as they assemble, integrate and test their spacecraft in the C3PF," said Intriago. "I'm focused on building relationships and gaining trust within Boeing to let them know NASA is here to help them."

Intriago's journey started in 1984 studying civil engineering at the University of Florida. He got a summer internship with an aerospace company that ultimately put him on the path to NASA.

"I got to work a summer of doing really cool stuff," said Intriago. "I had never been exposed to engineering before college, but that time really excited me, so I went back to college in the fall semester and switched to mechanical engineering."

That decision led to his 28-year career within the industry and now with NASA.

"I was a contractor with United Space Alliance before I came over to NASA in 2007. My background was project engineering – getting all the right stakeholders to accomplish a project together," Intriago said. "We want to implement that concurrent engineering philosophy to have NASA engineers work directly with the Boeing engineers in their critical production and test activities in the C3PF."

Intriago knows the challenges the agency and providers face moving forward will not be easy, but is confident in knowing he has the background and experience to help the program succeed.

"Being in the industry for 28 years, I've been in situations where we had deadlines and a lot of stress and pressure," said Intriago. "It's exciting to know we are approaching the stage of Boeing's development program when they soon will power up their Spacecraft One."

NASA's Commercial Crew Transportation Capability contracts with Boeing and SpaceX are set up differently than any other NASA program, Intriago said. In the past, NASA assumed accountability and responsibility of the system design, development and testing. These contracts shift those responsibilities to the providers, while NASA ensures the systems meet the agency's mission and safety requirements.

Despite the challenges, Intriago remains confident and reflects on the historical nature of the program.

"I remember six years ago when we were trying to figure out what commercial crew was and how to accomplish the idea. It's crazy to see how far we have come and how close we are getting to launching humans from the Space Coast again," said Intriago. "So here I am in the thick of the next human spaceflight program at NASA. To be a part of the program that will return the capability of transporting U.S. astronauts back and forth to the space station on an American rocket – that is pretty special. I'm a blessed man."

The forward skirt for the left-hand solid rocket booster of NASA's Space Launch System (SLS) rocket arrived at Cape Canaveral Air Force Station in Florida from booster prime contractor Orbital ATK's facilities in Promontory, Utah on February 1. The left-hand forward skirt was transported to Hangar AF where it will continue refurbishment to support the first uncrewed flight test of the Orion spacecraft atop the SLS rocket from Launch Pad 39B at Kennedy Space Center. The forward skirts for the left- and right-hand solid rocket boosters are located near the top, or forward assembly, of the boosters. The solid rocket boosters will generate a combined 7.2 million pounds of thrust to help power the massive SLS rocket off the launch pad. The large hangar and several support buildings — as well as Orbital ATK and NASA engineers and technicians — provide the capabilities and expertise to prepare booster hardware for flight. Other parts of the right and left booster structures for the SLS rocket also are being readied for the first flight. Photo credit: NASA/Kim Shiflett

FINISHED

Final work platform installed for NASA's Space Launch System

BY LINDA HERRIDGE

NASA reached a key milestone in the Vehicle Assembly Building (VAB) at the Kennedy Space Center. A year of platform installations came to conclusion in January as the final work platform, A north, was lifted, installed and secured recently on its rail beam on the north wall of High Bay 3 inside the iconic facility.

The installation of the final topmost level completes the 10 levels of work platforms, 20 platforms halves altogether, that will surround NASA's Space Launch System (SLS) rocket and the Orion spacecraft and allow access during processing for missions, including the first uncrewed flight test of Orion atop the SLS rocket.

"Just a year ago, we were meeting the challenges of getting the first half of the first platform installed," said Mike Bolger, Ground Systems Development and Operations (GSDO) Program manager, "It's a great testament to the creativity, persistence and hard work of the team, and it's a terrific indicator that GSDO is on track to process the SLS and Orion flight hardware for the first test mission."

The A platforms will provide access to the Orion spacecraft's Launch Abort System (LAS) for Orion lifting sling removal and installation of the closeout panels. LAS Antenna Testing also is performed on this level.

The platforms were mated with two, 60,000-pound rail beam assemblies that allow the platforms to move towards and away from the vehicle, as well as tie the entire system to the VAB structure. Each platform will ride on four Hillman roller systems on each side — much like how a kitchen drawer glides in and out. The process to lift and install each of the platforms takes about four hours. Each platform weighs more than 300,000 pounds, and measures about 38 feet long and close to 62 feet wide.

"I am very proud of the amount of work that the team accomplished. I am also humbled to have been able to lead this group of amazing people who have been able to complete this very complex and challenging project," said Jose Perez Morales, GSDO VAB Element senior project manager. "I am very pleased with all the work performed by the NASA and contractor team."

Engineers began installation of the first halves, the K-level platforms, about a year ago, followed by the J, H and G platforms. In July 2016, platform installation reached the halfway point, with the fifth of ten levels of platforms, the F-level, completed.

The remaining platforms installed are E, D, C, B and A. Each of the platform levels is strategically located to allow technicians and engineer's access to different systems on the rocket, Orion spacecraft and the Launch Abort System during processing and stacking operations on the mobile launcher.

"This is a huge day for us," said Darrell Foster, GSDO Project Management Division chief. "We cherish these milestones. We're all working toward launch day success."

GSDO, with support from the center's Engineering Directorate, is overseeing upgrades to the VAB, including the installation of the work platforms.

NASA awarded a contract to modify High Bay 3 to the Hensel Phelps Construction Co. of Greeley, Colorado, in March 2014. Hensel Phelps, along with its subcontractors, Institutional Services Contract, Engineering Services Contract, and Test and Operation Support Contract, supported crane operations, lifting, installation and initial inspection of each of the platforms.

Construction workers watch as a crane lifts the final work platform, A north, high up from the transfer aisle in the Vehicle Assembly Building at Kennedy Space Center. The platform will be installed and secured on its rail beam high up on the north wall of High Bay 3. Photo credit: NASA/Frank Michaux

"This is a huge day for us . . . we cherish these milestones. We're all working toward launch day success."

Darrell Foster
GSDO Project Management Division Chief

High up in the Vehicle Assembly Building (VAB) at Kennedy Space Center, a crane lowers the final work platform, A north, for installation in High Bay 3. The platform was installed and secured on its rail beam high up on the north wall of the high bay. In view on the platform are the American flag and a small tree. The installation of the final topmost level completes the 10 levels of work platforms, 20 platform halves altogether, that will surround NASA's Space Launch System rocket and the Orion spacecraft and allow access during processing for missions, including the first uncrewed flight test of Orion atop the SLS rocket in 2018. Photo credit: NASA/Frank Michaux

Shawn Quinn, associate program manager for the Ground Systems Development and Operations Program, signs the platform A North beam in the transfer aisle of the Vehicle Assembly Building on Jan. 10.
Photo credit: NASA/Dimitri Gerondidakis

Before the final platform was installed, the Kennedy Space Center's Engineering Directorate coordinated a platform beam signing event to celebrate the NASA and contractor team's last several years of study, design, construction and installation of all of the new work platforms for the agency's SLS rocket and Orion spacecraft.

Workers involved in the High Bay 3 platform project had the opportunity to sign one of the beams of the final work platform in the transfer aisle of the VAB.

Prentice Washington
Command, Control and Communications
Project Manager

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National Aeronautics and
Space Administration

KENNEDY SPACE CENTER
Exploration Begins Here

Prentice Washington

Command, Control and Communications Project Manager

My name is Prentice Washington. I am the Command, Control and Communications project manager for the Ground Systems Development and Operations (GSDO) Program at Kennedy Space Center.

My responsibilities include serving as the project manager of the Communications Office, which manages all of the transmissions, voice and video projects for the GSDO Program.

I started working at Kennedy in 2000 in the IT ODIN Office. Before working in the IT ODIN Office, I worked for Cooper Tire and Rubber Company. Throughout my career at NASA, I have had the opportunity to expand and gain experience as a special assistant to two deputy center directors, Dr. Woodrow Whitlow and Bill Parsons, and spend a year at Glenn Research Center as deputy chief information officer.

The coolest part of my job is looking for new and innovative systems to reduce costs for the program. The achievement I'm most proud of is working with several colleges to bring students into NASA to work on exciting, innovative projects.

After working as a special assistant for Whitlow and Parsons, in 2005 and 2006, respectively, I was asked by Ruth Gardner, manager of the Constellation Ground Systems Project Division, to apply for a technical assistant position under her in the Constellation Program. From there, I transferred into the GSDO Program in 2012.

I've always been interested in the space program. It's been my dream to work here since I was in eighth grade in a small town in southern Arkansas. From the time my parents bought me a telescope for a birthday present and I was able to see the rings around Saturn, I knew I wanted to work at Kennedy Space Center.

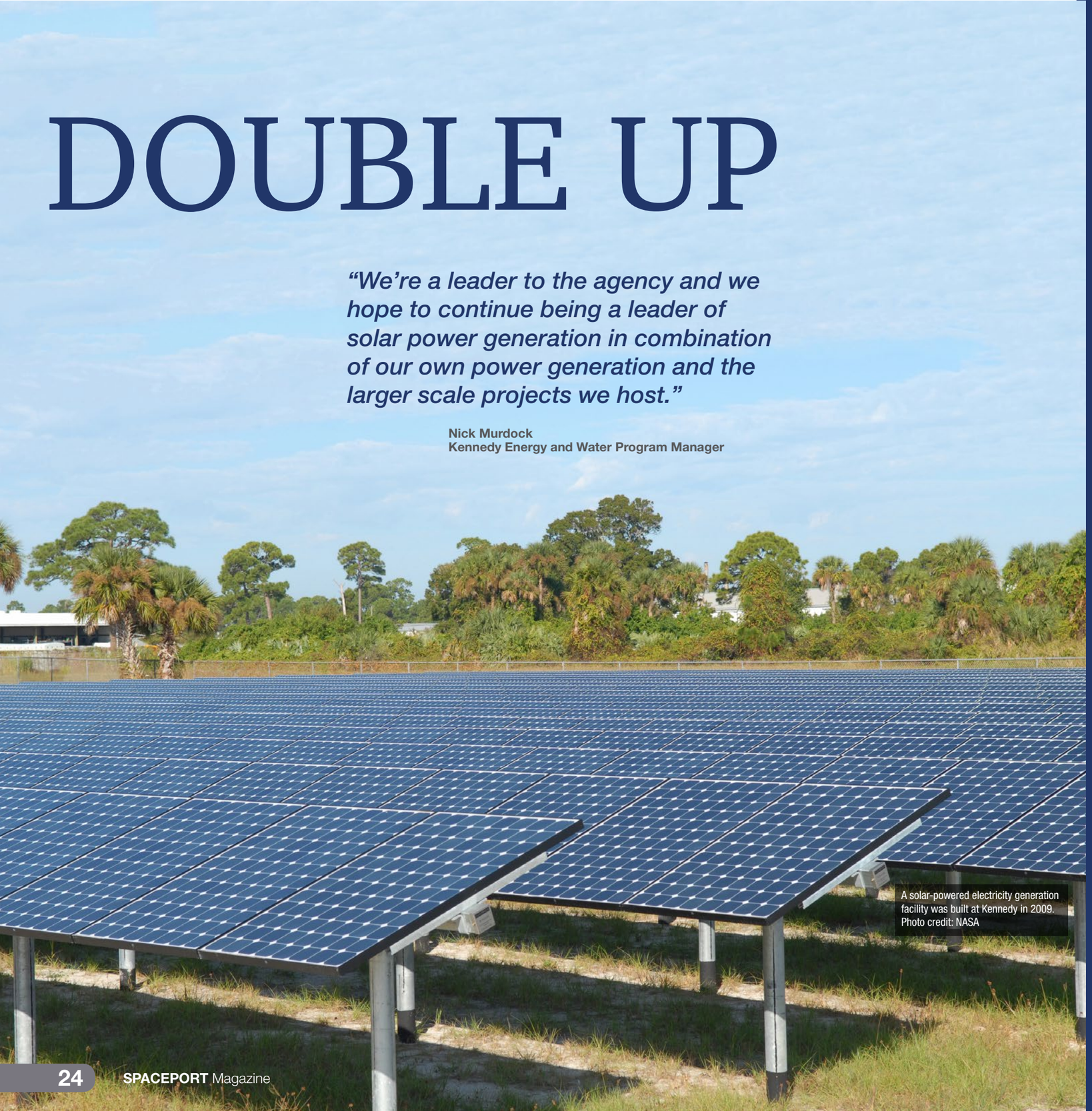
My hometown is Hamburg, Arkansas. I attended the University of Arkansas in Fayetteville, and earned a Bachelor of Science in computer engineering in 1992.

The advice I would give to students interested in pursuing a career in a field similar to mine is to never stop learning. The way technology changes so fast, there is nothing you can't reach and innovate.

DOUBLE UP

"We're a leader to the agency and we hope to continue being a leader of solar power generation in combination of our own power generation and the larger scale projects we host."

Nick Murdock
Kennedy Energy and Water Program Manager



A solar-powered electricity generation facility was built at Kennedy in 2009. Photo credit: NASA

Kennedy increasing solar energy supply

BY STEVEN SICELOFF

Solar power generation at Kennedy Space Center is about to improve as the center expands its ability to produce clean energy in an environmentally friendly manner. A new solar farm is already under construction and is expected to double Kennedy's solar energy supply to four percent of the center's total use, although that number grows to 18 percent and higher when accounting for electricity produced here that is sent into the power grid outside the center.

The eventual goal is to produce 30 percent of Kennedy's energy consumption on the center through renewable processes by 2025, including electricity generated at Kennedy that is used elsewhere. In fact, the solar plant expansion will allow Kennedy to offset electricity costs from the Central Campus building uses, said Israel Marrero Figueroa, co-lead design engineer.

There are two solar farms at Kennedy: one in the Industrial area that produces 1 megawatt of power for the center's use, and another a couple miles south that produces 10 megawatts of electricity for Florida Power and Light. FPL built both and maintains them. They were built in late 2009 and early 2010, respectively.

"It is achieving what we had hoped for, so it's been a positive," said Nick Murdock, Energy and Water program manager for Kennedy. "It helps offset our utility costs and it also works to meet our renewable energy generation goals. It's been a success."

Construction is underway on a new facility similar in size to the 1-megawatt plant. The addition is to open in December. Other expansions also are in planning stages. The center's master plan accommodates several areas that could house new tracts of solar panels without impacting the wildlife refuge that shares the center's grounds.

"The thing that I like is it's a different project than we normally do," said Samori Ball, project manager for the expansion work. "Now that prices have come down for the equipment, we can implement these plants to offset the power usage of an entire facility."

In the years since the two solar power generation facilities began operating, poor weather has had little impact on their production, Murdock said.

"The storms come through and they don't typically stick around," Murdock said. "If anything, they help clear off the dust that accumulates on the panels. For hurricanes, we've not lost a single panel, they are really robust in their construction."

Murdock said solar power is the most likely source of renewable energy generation at Kennedy for the foreseeable future because it has proven its effectiveness and is approved for use in the refuge. Other machinery such as wind-driven generators have been considered but not chosen, he said.

New technologies that improve solar efficiency also are increasingly available that offer more alternatives for placement in a wider number of areas and increase the amount of power produced.

"Solar's probably the main thing in Florida because we don't have a lot of wind, but we've got a lot of sun," Ball said. He added that solar facilities like those used at Kennedy are easier to maintain because there aren't many moving parts. The panels don't track with the sun, but that doesn't limit their power generation very much, he said.

As the center establishes more solar energy generation, large facilities are not expected to carry all the weight. Instead, numerous small-scale projects could be built instead in unused parking areas or on the roofs of some of Kennedy's buildings. The Propellants North building established the feasibility of that approach with solar panels anchored on its roof and with an automotive canopy housing topped with photovoltaic cells in the parking lot.

With the canopy-based approach, the solar cells can be lit by the sun while providing shade to the cars that park beneath them. The saved energy from the day also can, in turn, power canopy lights at night or in bad weather. The canopies also can be equipped with charging stations for electric vehicles.

"Currently, we're a leader to the agency and we hope to continue being a leader of solar power generation in combination of our own power generation and the larger scale projects we host," Murdock said.

NASA recently took another step in preparations for Orbital ATK's seventh commercial resupply mission to the International Space Station. The United Launch Alliance (ULA) Atlas V booster arrived at the Army Outpost wharf at Port Canaveral, Florida, near the Kennedy Space Center.

The Atlas V rocket was assembled at the ULA plant in Decatur, Alabama, about 20 miles southwest of Huntsville. After completion, the Atlas V was shipped aboard the Mariner cargo ship down the Tennessee River and Tombigbee Waterway, a canal, through the Gulf of Mexico to Port Canaveral.

From the port, the booster was transported to the hangar at the Atlas Spaceflight Operations Center, located south of Launch Complex 41 (SLC-41) at Cape Canaveral Air Force Station. The Atlas V will undergo final testing in that facility. When processing is complete, the Atlas V booster will be moved to the Vertical Integration Facility for stacking about .3 miles from SLC-41.

Scheduled for launch at about 10:56 p.m. on March 19, the Atlas V rocket will boost an Orbital ATK Cygnus cargo spacecraft loaded with thousands of pounds of supplies and equipment for the crew aboard the space station. Additionally, scientific experiments will be aboard for research by the crew on the station to improve life on Earth and drive progress toward future space flight. Photo credit: United Launch Alliance

SPACE LIFE

Tapping resources in space and the community

BY AMANDA GRIFFIN

"There is a reason humans haven't physically visited Mars yet. It is really, really, really difficult to do it safely and affordably."

This was the opening of the Living off the Land in Space class syllabus at Florida Institute of Technology, or Florida Tech, in Melbourne, Florida, this past fall.

The once-a-week, semester-long guest lecture series that challenged 15 students with solving technological challenges involved with pioneering space was the brain child of Dr. Jeff Smith, chief of the Science and Technology Projects Division at Kennedy Space Center, and Dr. Daniel Batcheldor, head of the Physics and Space Sciences Department at Florida Tech.

Dr. Jeff Smith, chief of the Science and Technology Projects Division at Kennedy Space Center, speaks with Florida Tech students during the Living Off the Land in Space lecture series. Photo credit: Florida Institute of Technology

"While our work focuses on tapping into the abundant resources of space, I also wanted to tap into the abundant local university student resources here on the Space Coast," Smith said.

The focus of the series was in-situ resource utilization challenges in space. One of the classes offered was a lecture titled Robotic Systems for Space Mining and Planetary Surface Construction,

Former astronaut Buzz Aldrin speaks with Florida Tech students during the Living Off the Land in Space lecture series. Photo credit: Florida Institute of Technology

which according to NASA senior technologist Robert Mueller, is one of the first steps required for ISRU.

"The students were given an overview of the challenges involved with technology solutions that NASA is developing, which gave them a new perspective on this aspect of living and working in space," Mueller said.

The class was divided into three groups -- each presented with a different challenge either from NASA, Florida Tech or industry partners like the Buzz Aldrin Space Institute. One challenge was Lunar Propellant Architectures, another was Martian Regolith Simulants, and the challenge Smith put forth was Martian ISRU Water Storage Systems.

"I wanted to stimulate a regional interest in the work that we are doing here," Smith said. "The goal is not only to inspire the next generation, but also develop a future workforce that is knowledgeable, informed and involved in the research we do here at Kennedy."

The team that took on Smith's water storage challenge were asked to come up with a solution that can store water on Mars with no power requirements, in a containment system that won't lose more than one percent of stored mass per year, and that can be created robotically on Mars with minimal resources brought from Earth. The students learned to perform trade studies for many different options, weighing the pros and cons of each, and finally arrived at a solution of digging a one-meter deep trench, filling it with the water ice and covering it with Martian regolith. The student's trade study and calculations estimated this solution would last more than 100 years without the need for power, but the proof is in the testing. In the future, the students hope to see their idea put to the test at the Granular Mechanics and Regolith Operations Lab at the KSC Swamp Works, where they can see how much water ice would be lost over time at varying depths under simulated Martian regolith and a simulated Mars environment.

According to one of NASA's leading ISRU experts, Stan Starr, the students represented a wide variety of majors ranging from physics to biological sciences to astronomy, geology and engineering, and brought very interesting perspectives and questions to this important subject.

"I learned a great deal from these perspectives – issues that I had not previously considered," Starr said. "The problems of gathering and using local resources on the moon and Mars will require many new ideas and even breakthroughs before we can achieve sustainable habitation in space."

At the end of the course, the NASA mentors convened a mock design review panel so the students could get an understanding of what it would be like to pitch a project to NASA in the future.

"The Florida Tech student experience is not just about taking exams," said Batcheldor, "but about getting real-world skills that can be applied to a range of STEM careers immediately upon graduation."

According to Batcheldor, many Florida Tech graduates go on to graduate school and to work in the federal and private space industry. "This ISRU class opened the eyes of the students to the challenges we face as we try to pioneer our way through our solar system," he continued, "but at the same time, it showed NASA what our students are capable of."

"The goal is not only to inspire the next generation, but also develop a future workforce that is knowledgeable, informed and involved in the research we do here at Kennedy."

Dr. Jeff Smith
Chief of the Science and Technology Projects Division at Kennedy Space Center

The team of mentors from Kennedy Space Center hope to continue working with students in other area schools. This spring, the NASA Solar System Exploration Research Virtual Institute (SSERVI) and the Center for Lunar and Asteroid Surface Science at the University of Central Florida have gotten together to offer a capstone graduate seminar series at UCF entitled The Technology and Future of In-Situ Resource Utilization. This lecture series will be held at the Florida Space Institute near the UCF campus and many of the guest lectures are on similar topics and include some of the same KSC experts as those who participated in the Living off the Land in Space class at Florida Tech.

"There are abundant resources on the moon, on Mars, and throughout our solar system," said Dr. Smith, "but we need to challenge and inspire the next generation of space explorers to figure out how to get to those resources, collect them and then use them."

With the Living off the Land in Space class and other thought-provoking seminars and courses that may follow, the universities and students of the Space Coast are rising to the challenge, with Kennedy Space Center helping to lead the way.

Technicians monitor the progress as the Cygnus spacecraft's pressurized cargo module (PCM) for the Orbital ATK CRS-7 mission to the International Space Station is rotated to vertical for mating to the service module in the Space Station Processing Facility at Kennedy Space Center. Scheduled to launch on March 19, the commercial resupply services mission will lift off atop a United Launch Alliance Atlas V rocket from Space Launch Complex 41 at Cape Canaveral Air Force Station. Photo credit: NASA/Bill White

SOLID STATE

Next generation batteries could power microsatellites, cubesats

BY LINDA HERRIDGE

Daniel Perez, Ph.D., a graduate student from the University of Miami, displays a piece of the prototype structure for a new solid-state battery in the Prototype Laboratory at Kennedy Space Center. The size of the battery is so small that it could be a prime candidate for use in microsatellites, including CubeSats. Researchers at Kennedy are collaborating with experts at the University of Miami. The university partnership is funded through the Small Spacecraft Technology Program, in NASA's Space Technology Mission Directorate.
Photo credit: NASA/Dimitri Gerondidakis

Sometimes good things come in very small packages. Just ask Dr. Luke Roberson, senior principal investigator for Flight Research within the Exploration Research and Technology Directorate at Kennedy Space Center.

Dr. Roberson is collaborating on research of a new solid-state battery prototype with Dr. Ryan Karkkainen, a composite material expert at the University of Miami. The chemistry and structure for the battery was developed by Xiangyang Zhou, Ph.D., associate professor of mechanical and aerospace engineering, also at the university. Three students from the university currently are working on the prototype with Roberson.

"Creating a structural battery material could revolutionize the way NASA operates small payloads. Rather than placing a battery in the experiment taking up 20 to 35 percent of the available volume, the battery now resides in the payload structure, thereby opening up additional free space for researchers to perform more science," Roberson said.

The size of the battery is so thin (2-3 millimeters) that it is a prime candidate for use in microsatellites, including CubeSats. The university partnership is funded through the Small Spacecraft Technology Program, in NASA's Space Technology Mission Directorate.

Space is key in a CubeSat, which is usually no bigger than a large toaster. They hitch rides as secondary payloads with larger payloads on rocket launches. This new battery's size would occupy about one-third of the area of batteries currently used to power the miniature satellites, thus allowing more space for the compact science payload.

Daniel Perez, a Ph.D. student in mechanical engineering from the University of Miami supporting this project, visited Kennedy to learn how to make the structural pieces for the battery prototype.

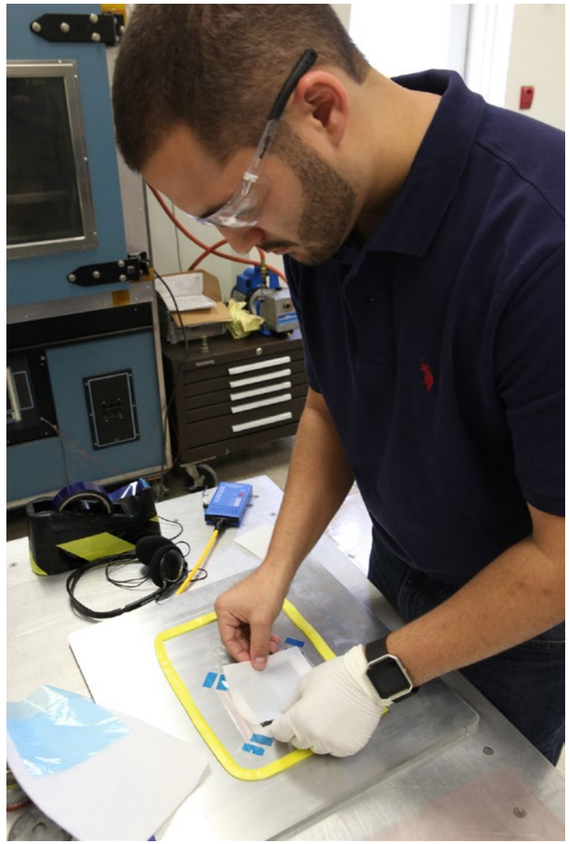
In an area of the Prototype Lab, Perez secured several layers of the small carbon fiber squares on top of each other in a vacuum bag. He attached a vacuum hose to the bag to draw out all of the air from the carbon fiber and compress all of the fibers together, a process called debulking. After about an hour, the squares were carefully uncovered and moved to a 250-degree oven where the resin epoxy in the carbon fiber was cured.

Perez will produce several more layers in the same way. These will serve as the layers that provide the structure for the battery. Back in Miami, two other students are working with Dr. Zhou on a prototype of the solid-state structural battery layers that will be placed between the layers of compressed carbon fiber squares.

"It is a great experience to learn about fabricating composites from NASA professionals at Kennedy Space Center," Perez said. "With the knowledge I gain here, I will be able to apply it to structural battery research to increase the mechanical performance of this technology."

Roberson said composite reinforcement and mechanical/electrical testing will be performed at Kennedy in the near future.

Could this new type of battery transfer to other applications? Roberson thinks so.



Daniel Perez, Ph.D., a graduate student from the University of Miami, prepares layers of the prototype structure for a new solid-state battery in the Prototype Laboratory at Kennedy Space Center. Photo credit: NASA/Dimitri Gerondidakis

"This technology could be used on satellite structural trusses, the International Space Station, or to power habitat structures established on another planet," said Roberson. "Commercial applications could include automobile frames or tabletop battery rechargers."

Power grid fluctuations are a concern for everyone. Roberson said if this type of battery could be added to current homes or buildings or included in the walls during construction, they would be an added or alternate source of power. With the proper structure elements, the batteries can be made to be impact and moisture resistant, and flame retardant.

"We have a great team working on this project, and I hope this technology will become a safe and efficient method to store energy while replacing electrically inert structural components in a wide variety of applications," Perez said. "We're all working hard for this technology to improve our spaceflight systems and contribute to the advancement of this industry."

NATIONAL ENGINEERS WEEK

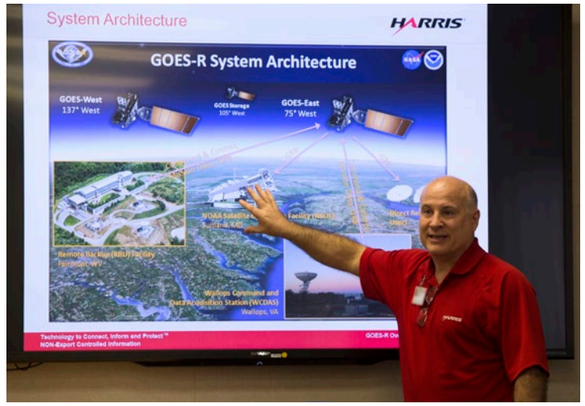
Engineers honor present, past, future

BY LINDA HERRIDGE

Engineering in all of its disciplines was the focus of several special events attended by NASA and contractor workers at Kennedy Space Center to celebrate National Engineers Week, Feb. 21-24. Events were coordinated by the center's Engineering Directorate.

"All of the missions we take on at KSC, in NASA, and indeed across the country, have a little, or a lot, of engineering," said Pat Simpkins, Engineering director. "The celebration of Engineer's Week began in 1952, originally in conjunction with President George Washington's birthday. President Washington was considered the nation's first engineer, and this week is a little celebration of how far we've come."

Presentations featured engineers from the Ground Systems Development and Operations (GSDO) Program, ISS Exploration Research and Technology, Spaceport Integration and Services, and Communication and Public Engagement. They discussed their individual experiences navigating engineering careers and their evolution becoming leaders in their organizations.



Robert Basta, chief systems engineer for the Geostationary Operational Environmental Satellite-R (GOES-R) Ground at Harris Corp., was a guest speaker during National Engineers Week events at Kennedy Space Center. GOES-R launched aboard a United Launch Alliance Atlas V rocket Nov. 19, 2016 from Cape Canaveral Air Force Station in Florida. Basta gave a glimpse into the world of development and discovery of this environmental science mission that is making life better for everyone on Earth. He discussed what happens before and after a science mission launches. Photo credit: NASA/Cory Huston

Robert Noteboom, vice president of Advanced Technology with Moon Express was a guest speaker during National Engineers Week events at Kennedy Space Center. Noteboom shared an update on the company's progress, future plans and how they are helping to pave the way for commercial space activities. Moon Express currently is one of only five teams left in an intense engineering competition for moon rover reconnaissance. Photo credit: NASA/Frank Michaux

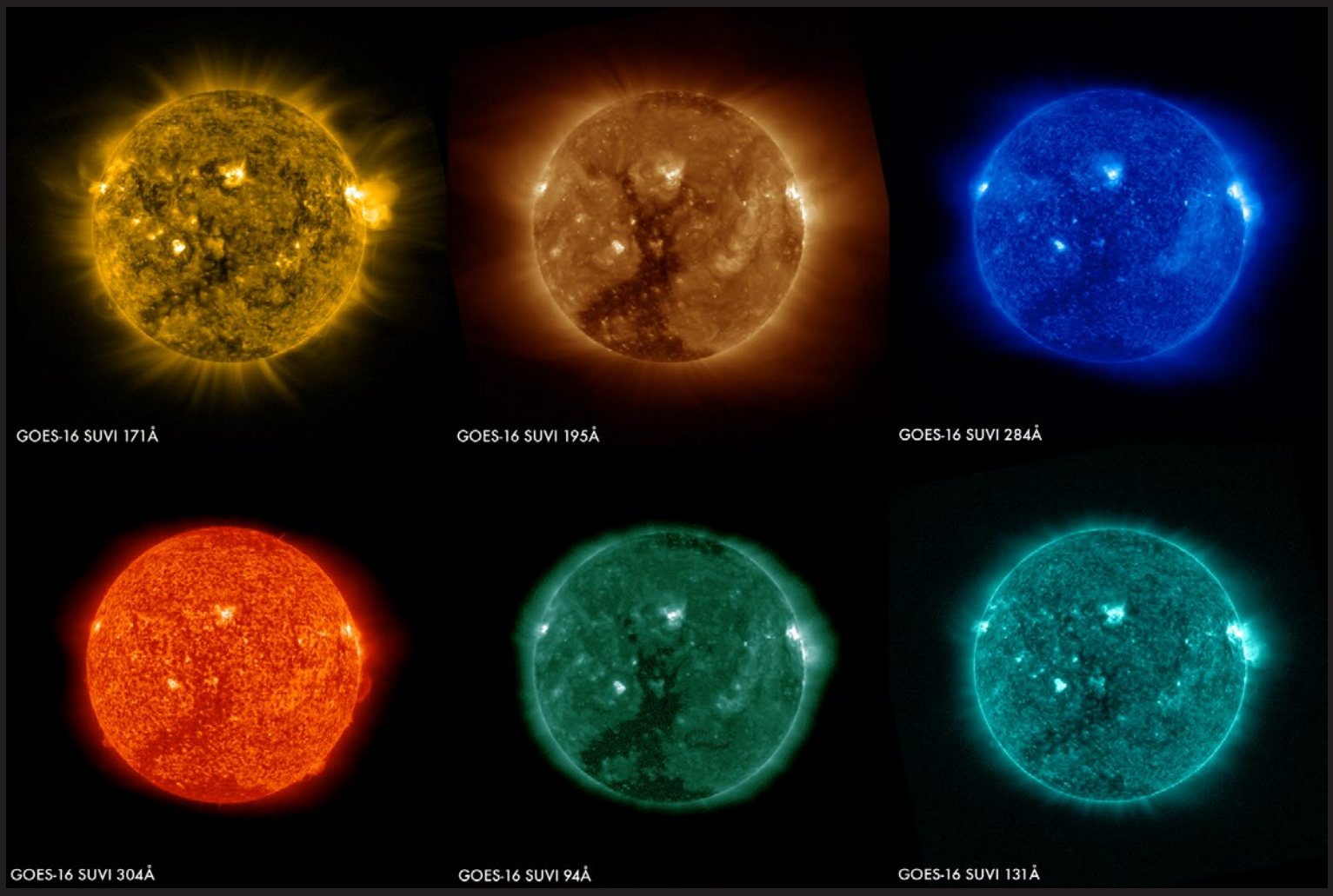
Robert Basta, chief systems engineer for the Geostationary Operational Environmental Satellite-R (GOES-R) Ground at Harris Corp. gave a glimpse into the world of development and discovery of this environmental science mission that is making life better for everyone on Earth. Robert Noteboom, vice president of Advanced Technology with Moon Express shared an update on the company's progress, future plans, and how they are helping to pave the way for commercial space activities.

NASA's Digital Learning Network hosted a series of webcasts as part of "Introduce a Girl to Engineering." Three female engineers from Kennedy were featured guests.

The Engineering Directorate provides support to programs across the center, including GSDO, Launch Services, ISS Exploration Research and Technology, and Commercial Crew. Engineers are helping to transform Kennedy into a multi-user spaceport that supports government and commercial launches.

National Engineers Week, referred to as EWeek, was founded in 1951 by the National Society of Professional Engineers. The society is dedicated to ensuring a diverse and well-educated future engineering workforce by increasing understanding of and interest in engineering and technology careers. Each year, EWeek reaches thousands of schools, businesses and community groups across the U.S.

FIRST SOLAR IMAGES FROM GOES-16 SATELLITE



These images of the sun were captured at the same time on Jan. 29 by the six channels on the Solar Ultraviolet Imager or SUVI instrument aboard NOAA's GOES-16 satellite. Data from SUVI will provide an estimation of coronal plasma temperatures and emission measurements which are important to space weather forecasting. SUVI is essential to understanding active areas on the sun, solar flares and eruptions that may lead to coronal mass ejections which may impact Earth. Depending on the magnitude of a particular eruption, a geomagnetic storm can result that is powerful enough to disturb Earth's magnetic field. Such an event may impact power grids by tripping circuit breakers, disrupt communication and satellite data collection by causing short-wave radio interference and damage orbiting satellites and their electronics. SUVI will allow the NOAA Space Weather Prediction Center to provide early space weather warnings to electric power companies, telecommunication providers and satellite operators. NASA successfully launched GOES-R on Nov. 19 from Cape Canaveral Air Force Station in Florida. It was renamed GOES-16 when it achieved orbit. GOES-16 is now observing the planet from an equatorial view about 22,300 miles above the surface of the Earth. Image credit: NOAA

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