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National Aeronautics and Space Administration

Kennedy Space Center's

SPACEPORT MAGAZINE

KENNEDY SPACE CENTER'S

SPACEPORT MAGAZINE

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SpaceX unveils Dragon V2, its first manned spacecraft, at the company's Hawthorne, California, headquarters May 29. The company's founder and CEO, Elon Musk, detailed aspects of the design that was developed in partnership with NASA's Commercial Crew Program.

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The Expedition 40 poster includes Flight Engineer Alexander Skvortsov, Commander Steve Swanson, and Flight Engineers Oleg Artemyev, Alexander Gerst, Maxim Suraev and Reid Wiseman. Photo credit: NASA

NASA'S LAUNCH SCHEDULE

Date: No Earlier Than June 17, 2014
Mission: Orbital 2 Commercial Resupply Services Mission to International Space Station
Description: Launching from the Mid-Atlantic Regional Spaceport at NASA's Wallops Flight Facility, Orbital 2 will deliver cargo and crew supplies to the International Space Station.

Date: July 1, 2014 -- 5:56 a.m. EDT
Mission: Orbiting Carbon Observatory-2 (OCO-2)
Description: OCO-2 is an Earth satellite mission to study carbon dioxide in the atmosphere and provide scientists with a better idea of the chemical compound's impacts on climate change. It will launch on a Delta II 7320 rocket from Complex 2 at Vandenberg Air Force Base, in California.

Date: July 23, 2014
Mission: Progress 56
Description: Launching on a Russian Soyuz from Baikonur Cosmodrome, Kazakhstan, Progress 56 will deliver cargo and crew supplies to the International Space Station.

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SpaceX unveils its Dragon V2 spacecraft designed to carry humans into orbit. Photo Credit: NASA/Dimitri Gerondidakis

NASA partner SpaceX unveils human-carrying Dragon V2

BY STEVEN SICELOFF

The Dragon spacecraft, designed to carry people into Earth's orbit, received a few upgrades as SpaceX refines its vehicle in partnership with NASA's Commercial Crew Program. SpaceX revealed these changes as it unveiled the Dragon V2 at the company's Hawthorne, California, headquarters May 29.

Vehicle upgrades include solar arrays that will be affixed to the side of the spacecraft's trunk instead of on fold-out wings and a new launch escape system that will allow crew members to escape an anomaly at any point during flight. The vehicle is intended to ferry seven astronauts, along with critical cargo and supplies.

SpaceX is one of NASA's commercial partners working to develop a new generation of U.S. spacecraft and rockets capable of transporting humans to and from Earth's orbit from American soil. Ultimately, NASA intends to use such commercial systems to fly U.S. astronauts to and from the International Space Station.

The commercial effort to build a private, human-rated spacecraft began about four years ago and is the first stepping stone in NASA's strategy to send humans on a path to explore deeper into space than ever before, including visits to Mars in the 2030s.

SpaceX is focusing on what the Dragon will need to do to operate successfully in space. Musk said the company has applied scores of lessons learned from flying the cargo-only version of Dragon to the space station and from NASA's more than 50 years of human spaceflight.

The Dragon V2 spacecraft is scheduled to fly for the first time in a pad abort test later this year, followed by an in-flight abort test, as part of the company's Commercial Crew Integrated Capability agreement with NASA.

Morpheus completes first nighttime free-flight

The first free-flight test of the Morpheus prototype lander at night was conducted May 28 at the Shuttle Landing Facility at Kennedy Space Center. The 98-second test began at 10:02 p.m. EDT with the Morpheus lander launching from the ground over a flame trench and ascending more than 800 feet. The vehicle, with its autonomous landing and hazard avoidance technology (ALHAT) sensors, surveyed the hazard field to determine safe landing sites. Morpheus then flew forward and downward covering about 1,300 feet while performing a 78-foot divert to simulate a hazard avoidance maneuver. The lander then descended and landed on a dedicated pad inside the test field.

Project Morpheus tests NASA's ALHAT and an engine that runs on liquid oxygen and methane, which are green propellants. These new capabilities could be used in future efforts to deliver cargo to planetary surfaces. Morpheus and ALHAT are examples of the partnerships that exist within the agency. Seven NASA centers have contributed to the development of these two technologies.

For more information, visit http://morpheuslander.jsc.nasa.gov/

All Hands

Kennedy Space Center Director Bob Cabana announced several new initiatives to streamline efforts to establish as a multi-user spaceport and help meet America's spacefaring needs well into the 21st century. Presentations to the center workforce took place during an all-hands meeting May 29 and in messages sent to employees. -- **BOB GRANATH**

http://go.nasa.gov/1p0lp85

a look online

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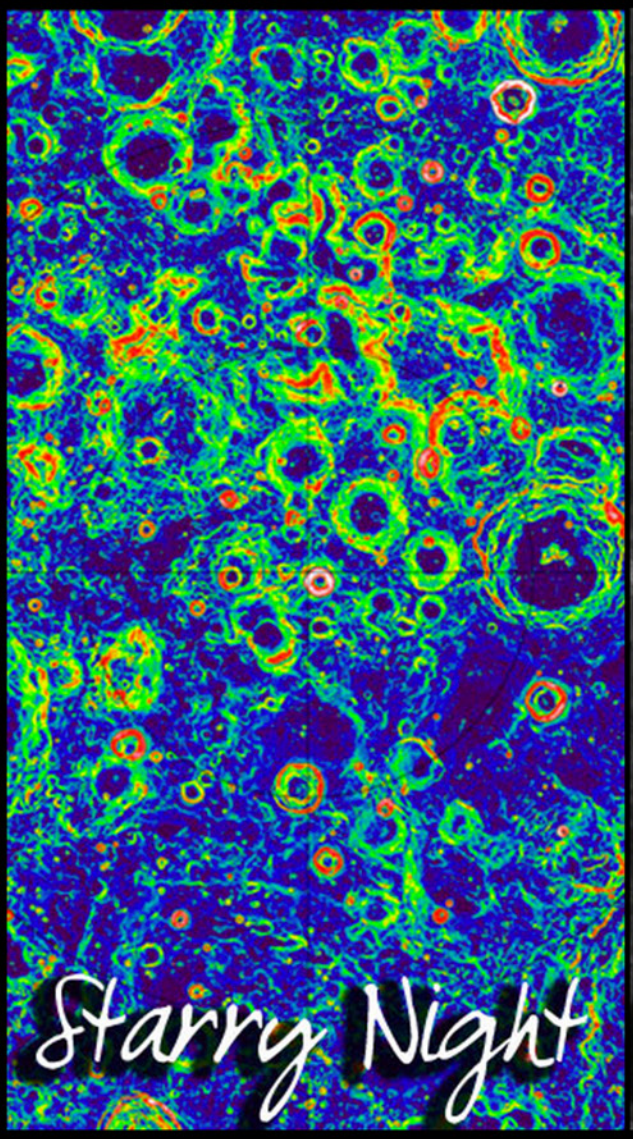

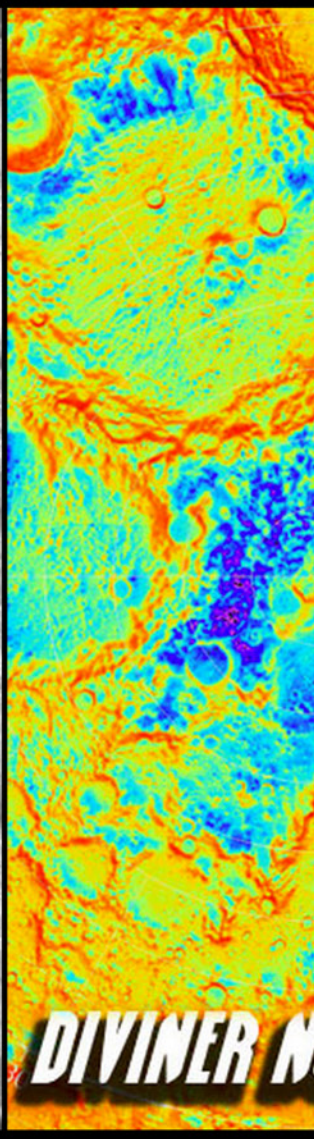

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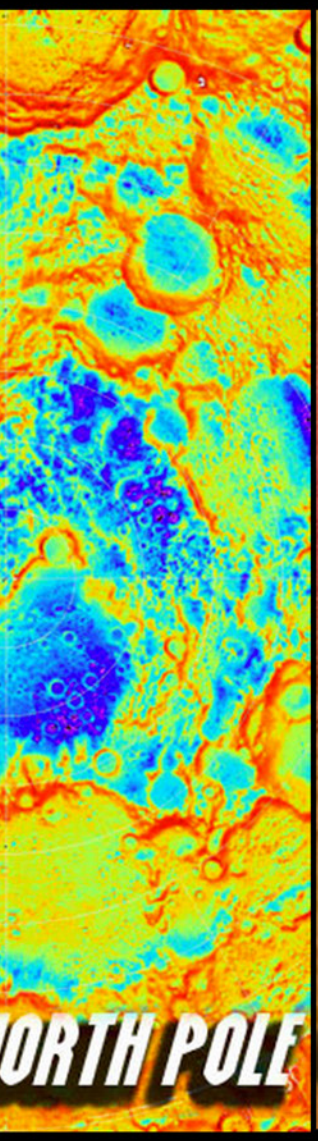
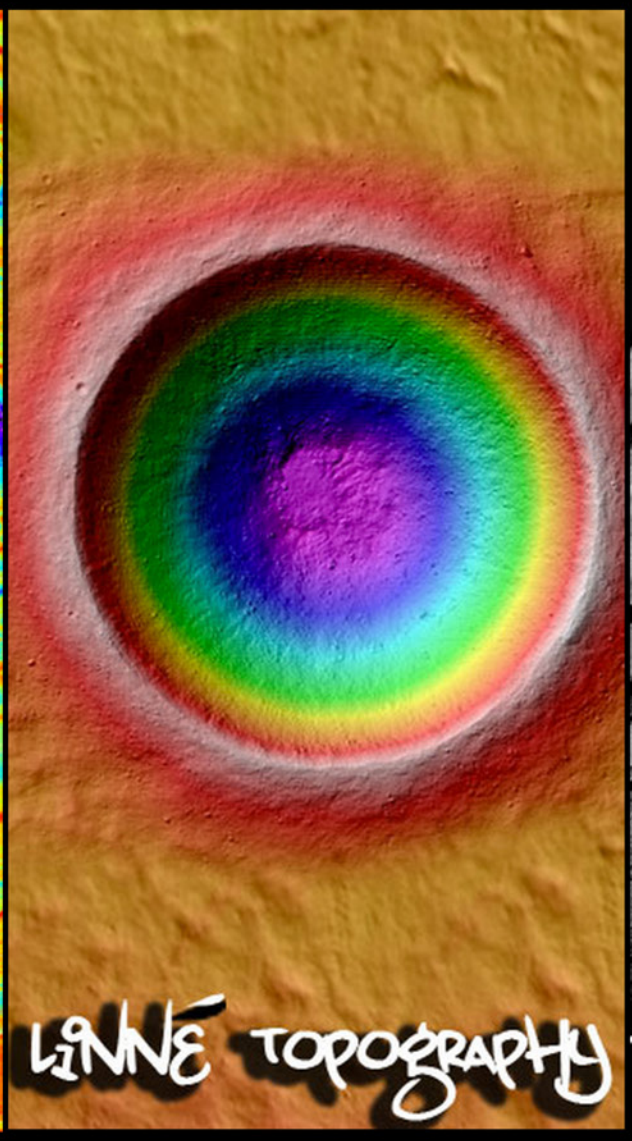




Vote for Linne Topography

Vote for Tycho Central Peak

he LRO's 5th Anniversary, June 18, 2014
e LRO website

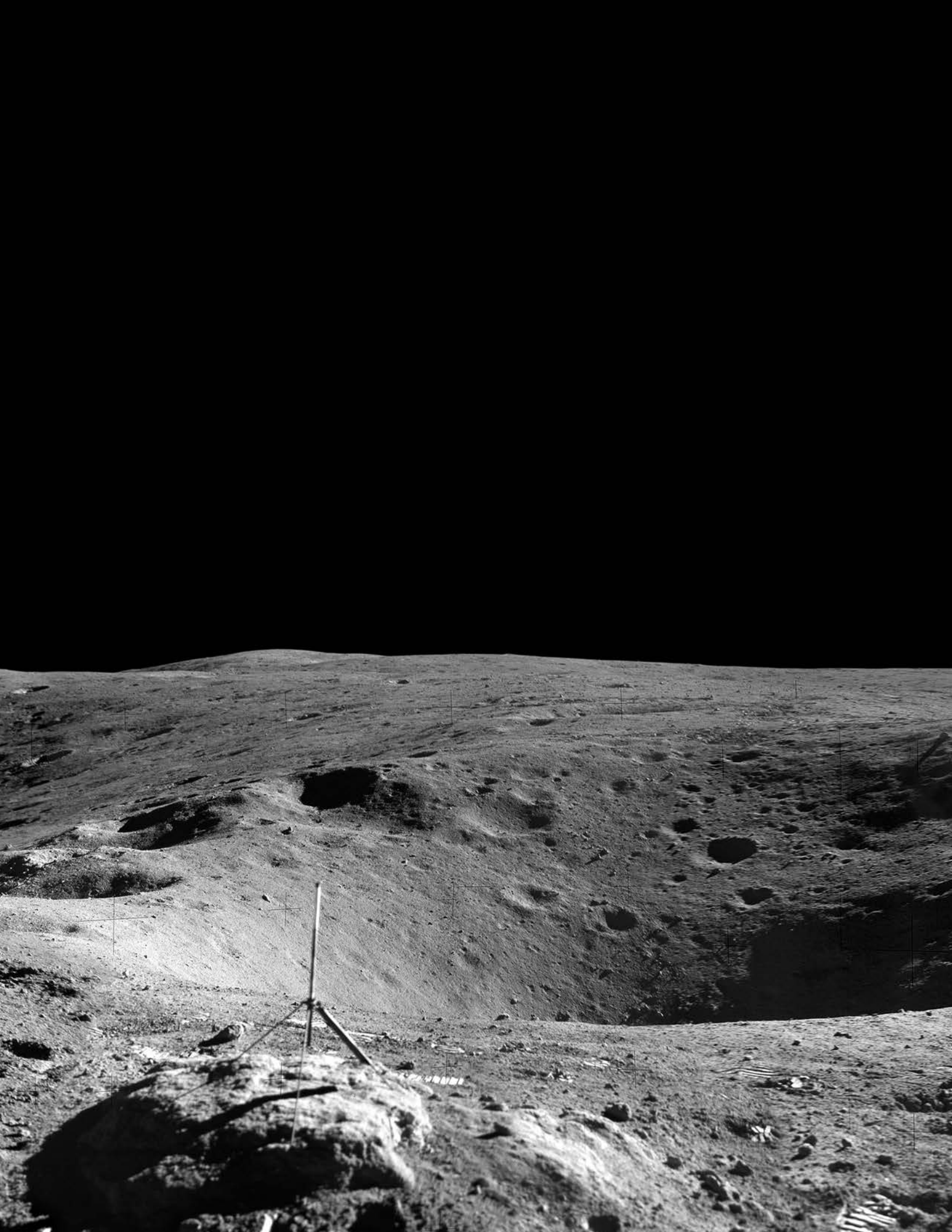
LUNAR LOWDOWN

Workshop focuses on moon, planetary exploration

BY BOB GRANATH

The Earth's nearest celestial neighbor, the moon, received frequent visitors during the 1960s and early 1970s culminating in six landings by humans during the Apollo Program. In recent years, numerous robotic orbiters and landers have returned to the moon, Mars and beyond, creating new interest in the technology needed for extraterrestrial exploration.

Scientists, engineers and entrepreneurs interested in research beyond Earth recently participated in the 4th International Workshop on Lunar Science and Technology Applications in Cocoa Beach, Florida, April 8-11. The event was designed to foster collaborative work among those interested in solving the challenges of exploring the solar system.



Kennedy Space Center Deputy Director Janet Petro served as one of the final day's keynote speakers, relating how NASA is leading the way in exploration beyond Earth.

"We're continuing to build on our nation's compelling scientific discoveries and achievements in space with science missions that will reach farther into our solar system, reveal unknown aspects of our universe and provide critical knowledge to all," she said. "We can only do these things through partnerships, innovation and technology."

Petro explained why she believes the United States remains the world leader in space exploration and scientific discovery.

"American ingenuity drives innovation, and our industry partners are helping create new transportation systems to reach low-Earth orbit and end our reliance on foreign launch providers," she said. "NASA is also making critical investments in the cutting-edge technologies needed to execute the nation's exploration and discovery goals, providing spinoff benefits to U.S. industry and Americans in their everyday lives."

Janet Petro

"We're continuing to build on our nation's compelling scientific discoveries and achievements in space with science missions that will reach farther into our solar system, reveal unknown aspects of our universe and provide critical knowledge to all."

In the second keynote address, Kennedy's chief technologist, Karen Thompson, related how NASA experts already are hard at work developing the technologies that will be needed during the next several decades to send humans to a range of destinations beyond low-Earth orbit, including asteroids, the moon and Mars.

Among the innovations is learning how to live off the land.

"We are developing technologies that will reduce the weight we launch as we travel to future destinations," she said. "We need to concentrate on ways to reduce the cost of our launches and only carry the types of payloads we really need for our exploration goals."

Called "in-situ resource utilization," the concept involves relying on available resources that will enable more affordable extraterrestrial exploration and operations. This will minimize the amount of materials carried from Earth. Advanced, autonomous devices could help astronauts benefit from available in-situ resources on the moon, Mars or other planets.

Thompson pointed out that results from the Lunar Reconnaissance Orbiter (LRO) and the Lunar Crater Observation and Sensing Satellite (LCROSS) have located potential resources just below the moon's soil.

"Images from the moon have shown that water is about one meter below the surface," she said. "One experiment we are developing (for future exploration), will drill down about one meter to look for water and minerals that are near the surface."

LRO was launched by NASA together with LCROSS on June 18, 2009, as part of the shared

NASA's Lunar Reconnaissance Orbiter and Lunar Crater Observation and Sensing Satellite are being prepared for fairing installation prior to launch from Cape Canaveral Air Force Station in May 2009. Photo credit: NASA file/2009

opposite:
Janet Petro, deputy director of Kennedy Space Center explains how NASA is leading the way in exploration beyond Earth. Photo credit: NASA/Daniel Casper

Andrew Nick of Kennedy Space Center's Swamp Works shows off RASSOR (Regolith Advanced Surface System Operations Robot), which is designed to climb over difficult terrain and scoop up regolith on a surface such as the moon or Mars. Photo credit: NASA/Kim Shiflett

Lunar Precursor Robotic Program. The LRO is a NASA spacecraft currently orbiting the moon in a polar orbit, swooping as low as 31 miles above the surface. The data returned is providing detailed, three-dimensional maps that not only will identify safe landing sites, but also locate potential resources on the moon.

LCROSS was a NASA robotic spacecraft designed to determine the nature of hydrogen detected at the polar regions of the moon. The primary objective was to determine the presence of water ice in a permanently shadowed crater near a lunar polar region. It was successful in discovering water in a crater in the moon's southern hemisphere.

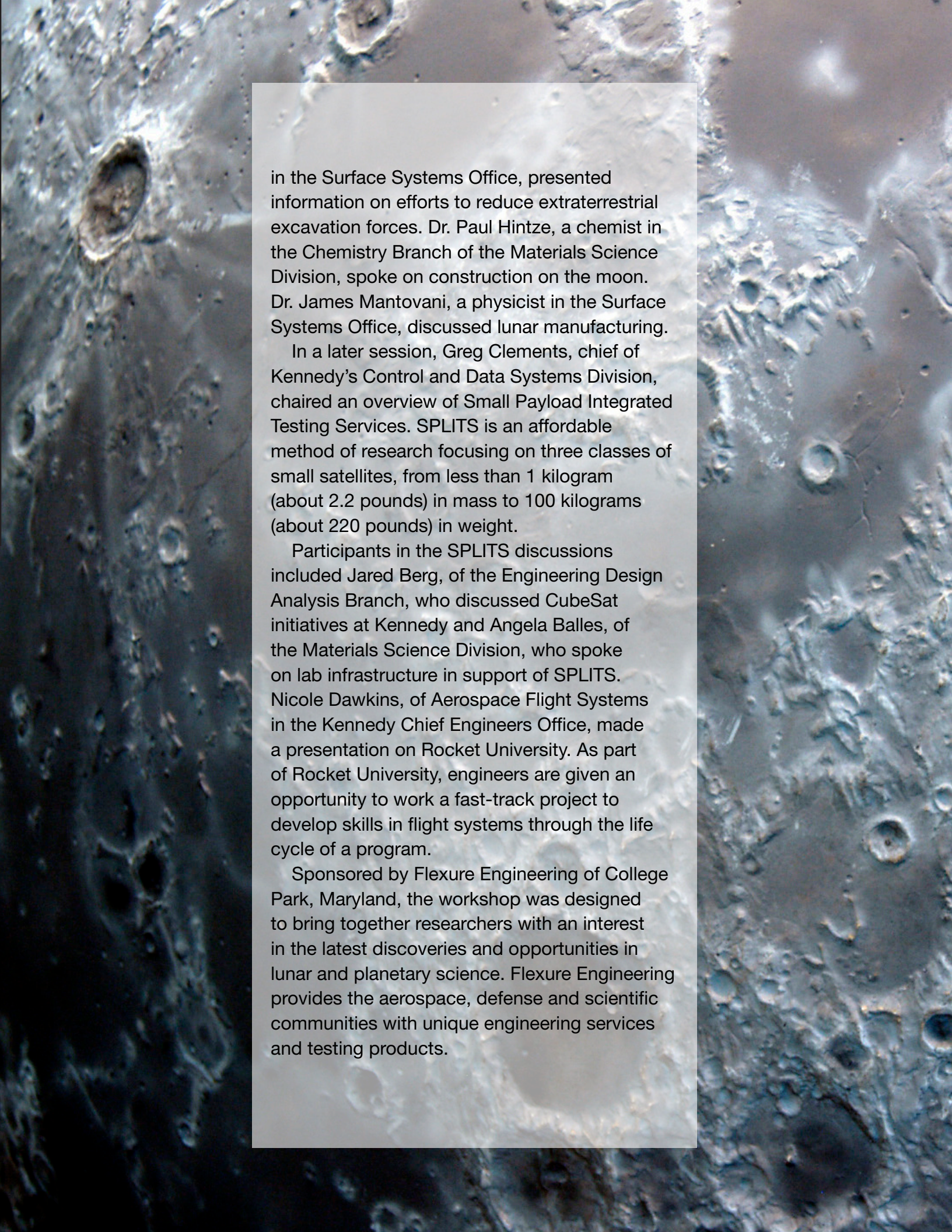
One of the innovations currently being developed at Kennedy may help future explorers live off the land. That's one of the projects scientists and engineers are studying at Kennedy's Swamp Works. Established to provide rapid, innovative and cost effective exploration mission solutions, Swamp Works leverages partnerships across NASA, industry and academia.

"One of the interesting robots that the Swamp Works has been working on is called RASSOR, for Regolith Advanced Surface System Operations Robot," Thompson said. "This robot is fashioned in a way to actually climb over very difficult terrain. It also has wheels with scoops that pick up regolith. It could be used to collect samples or excavate a landing pad for future landers."

Regolith is a layer of loose material covering solid rock. It includes dust, soil, broken rock, and other related materials and is present on Earth, the moon, some asteroids and Mars.

Among other NASA presenters at the workshop was Jack Fox, technical assistant for Kennedy Engineering and Technology's Four Lines of Business, who chaired a session on Lunar Surface Activities.

As part of that session, Adam Swanger, a cryogenic engineer in the NASA Fluids Test and Technology Development Branch, discussed characterizing low-temperature regolith properties. Drew Smith, a robotics engineer



in the Surface Systems Office, presented information on efforts to reduce extraterrestrial excavation forces. Dr. Paul Hintze, a chemist in the Chemistry Branch of the Materials Science Division, spoke on construction on the moon. Dr. James Mantovani, a physicist in the Surface Systems Office, discussed lunar manufacturing.

In a later session, Greg Clements, chief of Kennedy's Control and Data Systems Division, chaired an overview of Small Payload Integrated Testing Services. SPLITS is an affordable method of research focusing on three classes of small satellites, from less than 1 kilogram (about 2.2 pounds) in mass to 100 kilograms (about 220 pounds) in weight.

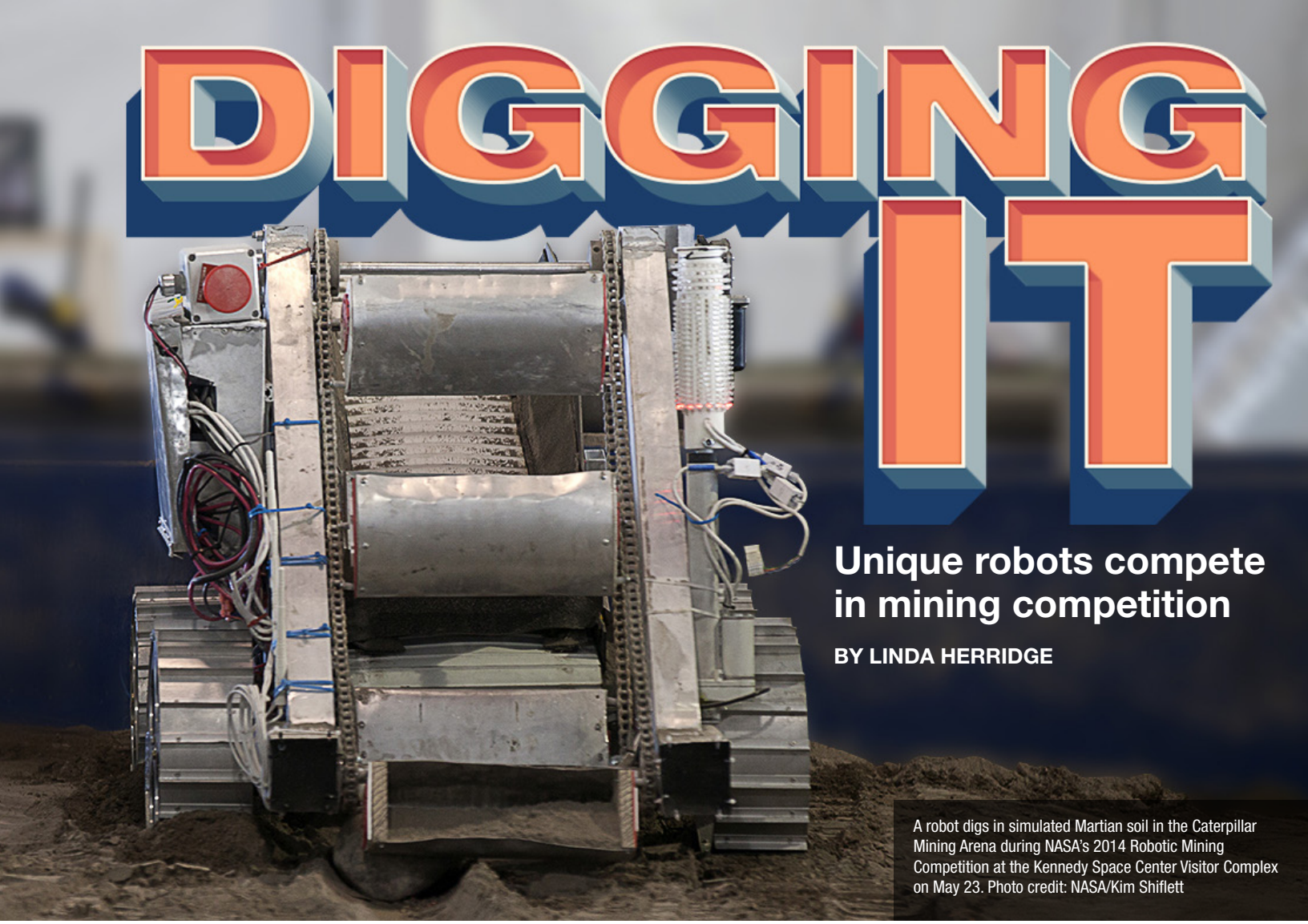
Participants in the SPLITS discussions included Jared Berg, of the Engineering Design Analysis Branch, who discussed CubeSat initiatives at Kennedy and Angela Balles, of the Materials Science Division, who spoke on lab infrastructure in support of SPLITS. Nicole Dawkins, of Aerospace Flight Systems in the Kennedy Chief Engineers Office, made a presentation on Rocket University. As part of Rocket University, engineers are given an opportunity to work a fast-track project to develop skills in flight systems through the life cycle of a program.

Sponsored by Flexure Engineering of College Park, Maryland, the workshop was designed to bring together researchers with an interest in the latest discoveries and opportunities in lunar and planetary science. Flexure Engineering provides the aerospace, defense and scientific communities with unique engineering services and testing products.

DIGGING IT

Unique robots compete in mining competition

BY LINDA HERRIDGE



A robot digs in simulated Martian soil in the Caterpillar Mining Arena during NASA's 2014 Robotic Mining Competition at the Kennedy Space Center Visitor Complex on May 23. Photo credit: NASA/Kim Shiflett

Team "Astrobotics," from the University of Alabama in collaboration with Shelton State Community College, received the top award, the Joe Kosmo Award for Excellence, at NASA's Fifth Annual Robotic Mining Competition awards ceremony. The mining competition, coordinated by Kennedy Space Center's Education Office, was held May 19-23 at the Kennedy Visitor Complex.

"It's awesome to win," said Kellen Schroeter, an aerospace engineering student from the University of Alabama. "Each member played an important role in our efforts. In our fifth year of competition, it was definitely a dream team for us this year."

Joseph Kosmo is a pioneer in extravehicular and space suit hardware, and worked on the Desert Research and Technology Studies (RATS) project to field test prototypes. This year, Kosmo was on hand to serve as one of the on-site mining inspection judges.

The weeklong competition featured teams of undergraduate and graduate students from 36 colleges and universities across the United States, from as far away as Alaska and Hawaii, and as nearby as Melbourne and Orlando. Before traveling to the Space Coast, each team spent eight months to a year designing and building robots that could mine in a simulated Martian terrain, excavate Martian regolith and deposit it into a collector bin within 10 minutes.

Hortense Diggs, Education Office chief at Kennedy, said the mining competition brings excitement about learning to the center.

"The knowledge that

students gain on a robotic mining competition team could never be attained in a classroom setting. And engineers here at Kennedy get excited about the opportunity to see so many different prototypes that one day could be built upon and used as space hardware," Diggs said.

From control rooms near the mining arena, teams commanded their robots to perform the intricate movements to collect the regolith and maneuver through the rocky terrain to deposit it in collection bins.

Because last year's teams were not able to achieve full autonomy with their robots, this year's competition went to a tiered autonomy system, according to Gloria Murphy, Robotic Mining Competition project manager and education specialist at Kennedy.

Team members watch their robots dig in the simulated Martian soil in the Caterpillar Mining Arena during NASA's 2014 Robotic Mining Competition at the Kennedy Space Center Visitor Complex on May 22.
Photo credit: NASA/Kim Shiflett

In the past, it was all or nothing for autonomy, 500 points or zero. Now there are four different point levels for achieving various levels of autonomy.

"We were thrilled that several teams stepped up to the challenge this year, and two of them, Iowa State University and the University of Alabama, were able to complete a competition attempt with full autonomy," Murphy said. "This is a major engineering milestone for the teams and we were ecstatic to be a part of it."

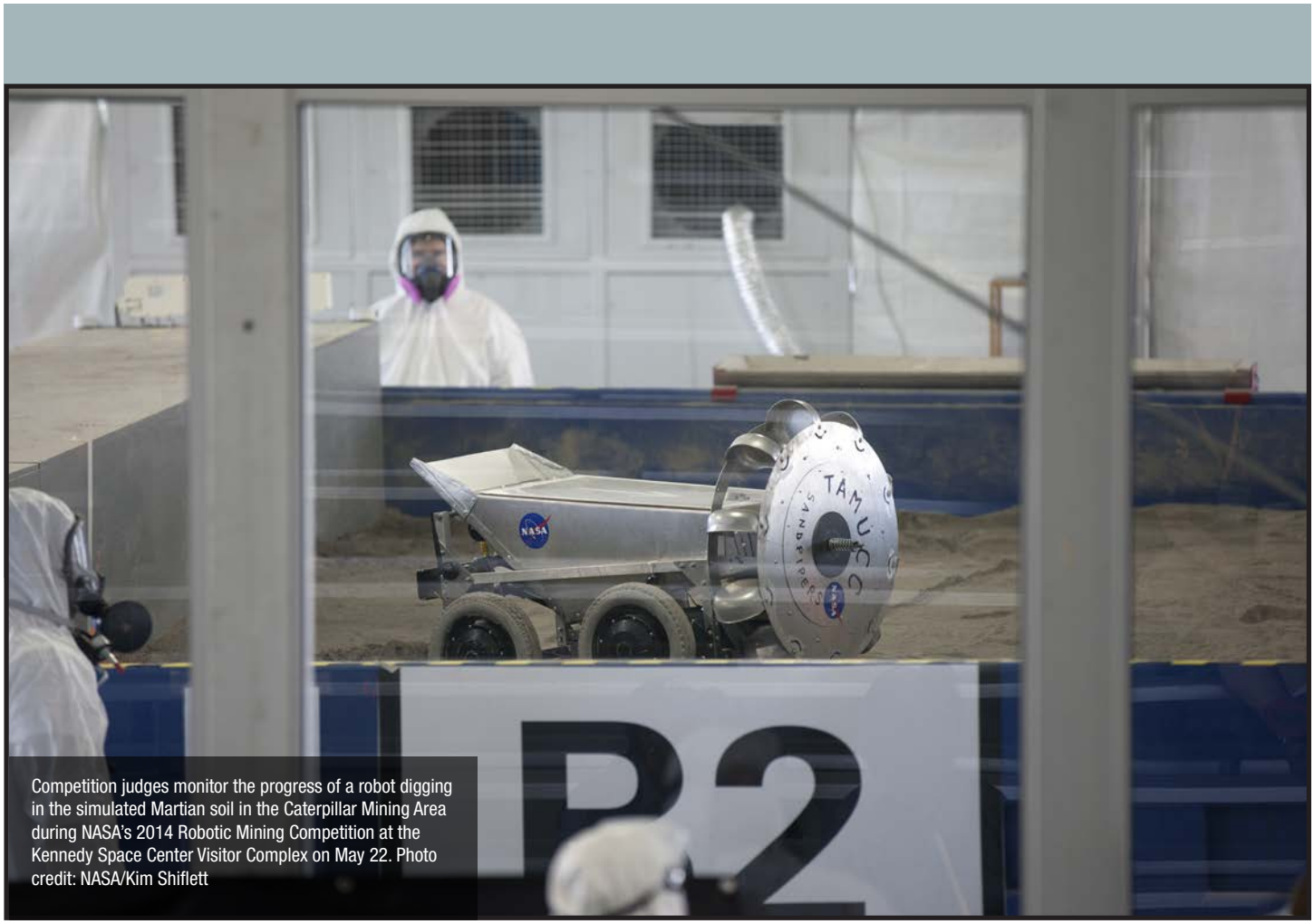
In addition to on-site mining, the competition also included writing a systems engineering paper, performing outreach projects for K-12 students, presenting a slide presentation and demonstration, and sharing team spirit.

In the on-site mining category, the West Virginia University Mountaineers team dug their way to the top and received first place for mining and depositing the most simulated Martian soil during two runs in the mining arena, a total of 222.3 kilograms (about 490 pounds).

"It feels great to win the mining category," said Tim Godisart, a second-year graduate student who is pursuing a Master's in electrical engineering. "This is our school's fourth year competing and the atmosphere was great."

Rob Mueller was lead judge for the mining competition and is a NASA senior technologist in the Surface Systems Office in Kennedy's Engineering and Technology Directorate. Mueller told participants that in-situ resource utilization on other planets, such as Mars, will require the use of robotics.

"We're technology ambassadors to the world," Mueller said. "We have a responsibility to be on the



Competition judges monitor the progress of a robot digging in the simulated Martian soil in the Caterpillar Mining Area during NASA's 2014 Robotic Mining Competition at the Kennedy Space Center Visitor Complex on May 22. Photo credit: NASA/Kim Shiflett

leading edge and accomplish great things -- to push the borders."

A team that pushed the borders this year was the University of Alaska-Fairbanks. They won the Judges' Award for Innovation, which is awarded to the team which has the most novel and useful features in the design, fabrication and operation of their regolith mining robot.

"They built a very minimalist but robust machine, at extremely low cost, with a superior user interface and radically improved on last year's robot which tipped over in the final moments of their round," Mueller said.

"We are transitioning the space center to a multi-user spaceport," said Kelvin Manning, associate director of the center. "NASA's Space Launch System and Orion spacecraft will allow us to send astronauts beyond low-Earth orbit."

Manning said NASA's ultimate destination is Mars. Science, technology, engineering and mathematics (STEM) studies are essential building blocks that will help us achieve this goal.

This year's mining competition was sponsored by Caterpillar, National Instruments, Harris, Honeybee Robotics, igus, Space Florida, SASRA, Moon Express, American Society of Civil Engineers, Lockheed Martin, The Astronauts Memorial Foundation, Ocean Potion, Delaware North Parks & Resorts, and Secor Strategies LLC.

Marc Gramlich, in the blue shirt, visits with this year's West Virginia University team.
Photo credit: NASA/Dimitri Gerondidakis

The Flip Side

Former mining competitor returns to judge contest

BY LINDA HERRIDGE

Imagine competing for three years in NASA's Robotic Mining Competition with your team from West Virginia University (WVU), graduating from college, getting a full-time job with a robotics company and then being invited back as a judge for this year's competition.

That's just what Marc Gramlich, a computer engineer with Honeybee Robotics in Pasadena, California, did as he sat in a control room near the mining arena at the Kennedy Space Center Visitor Complex. He watched as teams from 36 colleges and universities, including WVU, commanded their robots to dig and collect simulated Martian soil and deposit it in a collector for points. And it brought back memories of his three years as a competitor.

"Having the opportunity to be a judge shows a completely different perspective of the competition and really allowed me to see how much the judges are learning from the students and how much we enjoyed talking to teams and learning what their last nine months of experiences were like," Gramlich said.

As a member of the WVU team in 2011, 2012 and 2013, Gramlich worked with the mechanical team to design and test the robot and created composite parts. In his second year, he decided computer engineering was more to his liking and led the electrical design team in 2012, and then again in 2013.

"I was extremely impressed with the teams this year because a lot of them focused on capitalizing on autonomy points rather than mining large amounts of regolith," Gramlich said. "It seemed that many returning teams kept the same design concepts from last year but improved upon weight, reliability and put in a full effort to achieve autonomy."

In addition to the mining competition, Gramlich also participated in other NASA-funded competitions or projects, including RockSat, Microgravity, RASC-AL Robo Ops, and completed two internships at NASA's Goddard Space Flight Center in Greenbelt, Maryland. During one of the internships he designed a circuit board that currently is mounted to the outside of the International Space Station.

Gramlich graduated from WVU in 2013 with a Bachelor of Science in computer engineering.

"The robotics competition helped put me on the path to computer engineering," Gramlich said.

AND THE WINNERS ARE . . .

JOE KOSMO AWARD FOR EXCELLENCE
University of Alabama in collaboration with Shelton State Community College

ON-SITE MINING AWARD
First Place: West Virginia University
Second Place: Florida Institute of Technology
Third Place: University of Alabama

SYSTEMS ENGINEERING PAPER AWARD
First Place: University of Alabama
Second Place: University of Akron
Third Place: University of Illinois at Urbana-Champaign

SLIDE PRESENTATION AND DEMONSTRATION AWARD
First Place: University of Alabama in collaboration with Shelton State Community College
Second Place: West Virginia University
Third Place: Iowa State University, University of Akron, University of North Carolina-Charlotte

OUTREACH PROJECT REPORT AWARD
First Place: West Virginia University
Second Place: Iowa State University
Third Place: University of Akron

TEAM SPIRIT AWARD
First Place: University of Alabama
Second Place: University of Akron
Third Place: Iowa State University

COMMUNICATION AWARD
University of New Hampshire

JUDGES' INNOVATION AWARD
University of Alaska-Fairbanks

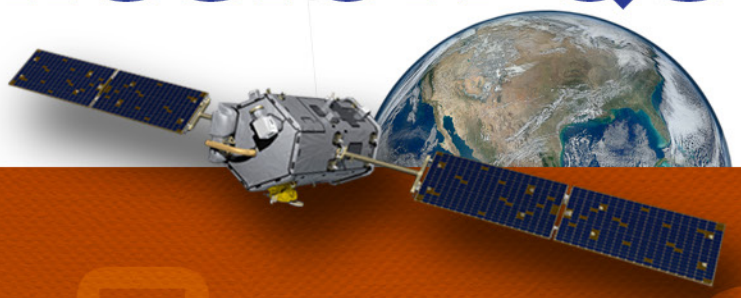
AUTONOMY AWARD
First Place: Iowa State University
Second Place: University of Alabama in collaboration with Shelton State Community College
Third Place: Florida Institute of Technology

PIT PRIDE AWARD
First Place: University of Akron
Second Place: University of Alabama in collaboration with Shelton State Community College
Third Place: Iowa State University

SOCIAL MEDIA AWARD:
University of New Hampshire

At top: The University of Alabama team Astrobotics, in collaboration with Shelton State Community College received the highest award, the Joe Kosmo Award for Excellence, during NASA's 2014 Robotic Mining Competition awards ceremony May 23, 2014, inside the Space Shuttle Atlantis attraction at the Kennedy Space Center Visitor Complex. Photo credit: NASA/Kim Shiflett

MISSION QUIZ



What does OCO stand for?

OCO-2 will launch aboard which rocket?

OCO-2 will fly in which type of orbit?

To check your answers and take the rest of the quiz, or to test yourself on other NASA missions, visit:

http://missionquiz.ksc.nasa.gov/

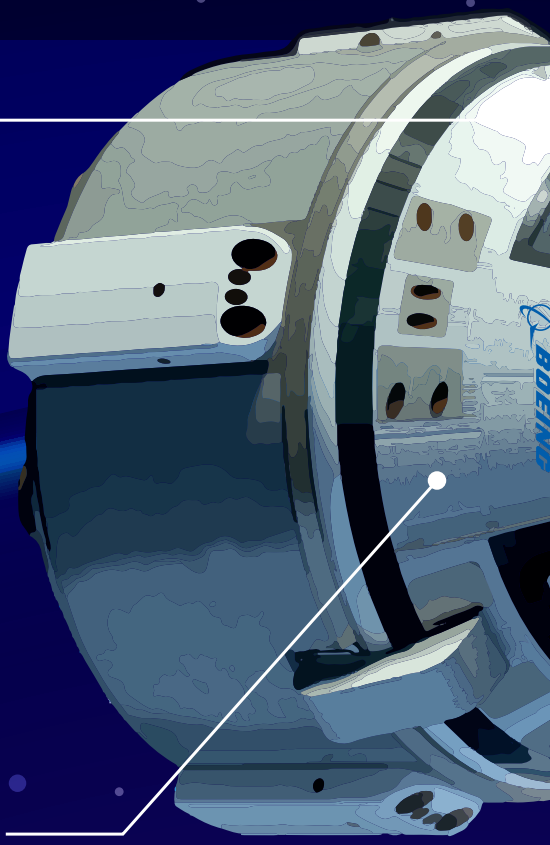
BOEING CST-100 SPACECRAF

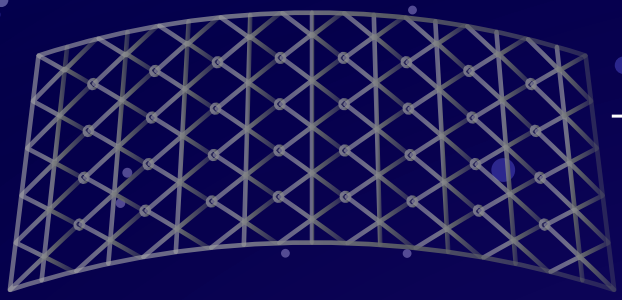
UNDER PRESSURE

The CST-100 pressurized vessel can be reused up to 10 times.

CONNECTED

The CST-100 features Wi-Fi (in-flight movies anyone?), tablets and GPS.





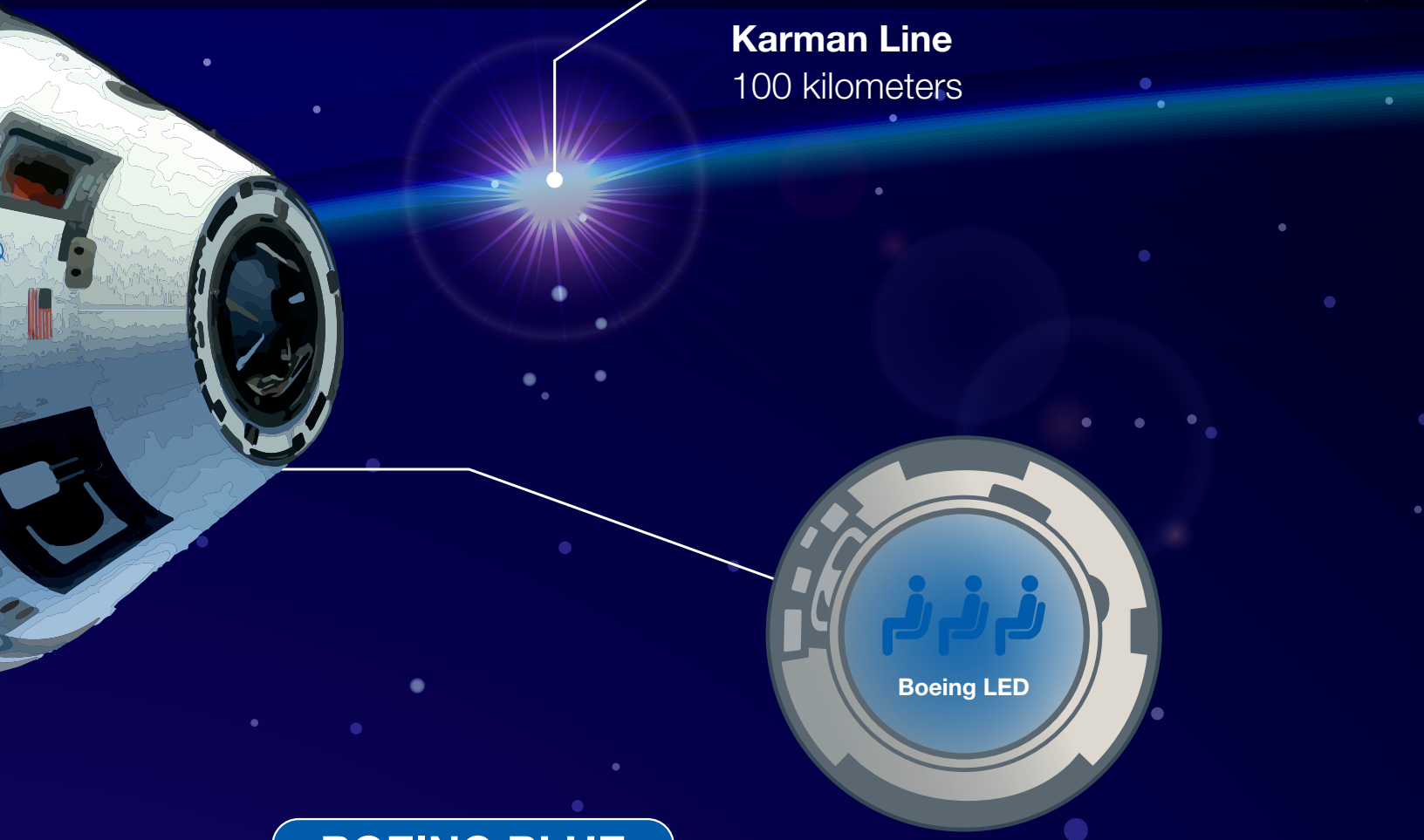
WHAT LIES BENEATH

A weldless honeycomb design reduces weight and cost.

T

WHAT'S IN A NAME?

The Crew Space Transportation-100 or CST-100 gets its name from the Boeing aircraft heritage and the number 100 stands for the distance of kilometers from Earth to the edge of space, commonly called the "Kármán line."



BOEING BLUE

That blue glow you see inside is Boeing LED Sky Lighting technology. The blue color gives a sky effect to make the capsule feel and appear roomier inside.

FARMING FOOD IN SPACE

Expedition 39 crew activates Veggie growth system

BY LINDA HERRIDGE

If you plant it, will it grow -- in microgravity on the International Space Station? Expedition 39 crew members soon will find out using a plant growth system called “Veggie” that was developed by Orbital Technologies Corp. (ORBITEC) in Madison, Wisconsin, and tested at Kennedy Space Center.

The first fresh food production system, along with the Veg-01 experiment, were delivered to the space station on the SpaceX-3 mission from Cape Canaveral in April and transferred to the Columbus module for storage until it was time for in-orbit activation.

Expedition 39 flight engineers and NASA astronauts Steve Swanson and Rick Mastracchio installed Veggie in the Columbus module May 7 in an Expedite the Processing of Experiments to the Space Station (EXPRESS) rack.

NASA astronaut Steve Swanson activates the Veggie plant growth system and Veg-01 experiment May 8 in the Columbus module on the International Space Station. Photo credit: NASA

Wearing sunglasses, Swanson activated the red, blue and green LED lights inside Veggie on May 8. A root mat and six plant "pillows," each containing 'Outredgeous' red romaine lettuce seeds, were inserted into the chamber. The pillows received about 100 milliliters of water each to initiate plant growth. The clear, pleated bellows surrounding Veggie were expanded and attached to the top of the unit.

Inside each plant pillow is a growth media that includes controlled release fertilizer and a type of calcined clay used on baseball fields. This clay increases aeration and helps the growth of plants.

Dr. Gioia Massa is the NASA science team lead for Veggie. She sees Veggie and Veg-01 representing the initial steps toward the development of bioregenerative food production systems for the space station and long-duration exploration missions.

"The farther and longer humans go away from Earth, the greater the need to be able to grow plants for food, atmosphere recycling and psychological benefits," Massa said. "I think that plant systems will become important components of any long-duration exploration scenario."

About 24 hours after Veggie was activated on the space station, back on Earth, "pseudo-naut" researchers activated identical plant pillows in the Veggie control chamber in the International Space Station Environmental Simulator laboratory at Kennedy's Space Station Processing Facility. Researchers will monitor the plant growth and perform the same procedures as Swanson is doing on the space station.

"My hopes are that Veggie will eventually enable the crew to regularly grow and consume fresh vegetables," Massa said.

One of the plant experiment's goals is to verify the Veggie hardware is working correctly. Another goal is to establish that the space lettuce is safe to eat.

On the space station, the Veg-01 plants will grow for 28 days. Photographs will be taken weekly, and water will be added periodically. The pillow wicks were opened to help the seedlings emerge. As the plants grow, the pillows will be thinned to one plant per

pillow, and microbial samples will be taken to check for any microorganisms that may be growing on the plants. At the end of the cycle, the plants will be carefully harvested, frozen and stored for return on the SpaceX-4 mission later this year.

Veggie will remain on the station permanently and could become a research platform for other top-growing plant experiments. ORBITEC developed Veggie through a Small Business Innovative Research Program. NASA and ORBITEC engineers and collaborators at Kennedy worked to get the unit's hardware flight-certified for use on the space station.

"Veggie could be used as a modular plant chamber for a variety of plants that grow up rather than in the ground," said Gerard Newsham, the Veggie payload support specialist with Jacobs Technology on the Test and Operations Support Contract. "This is just the beginning."

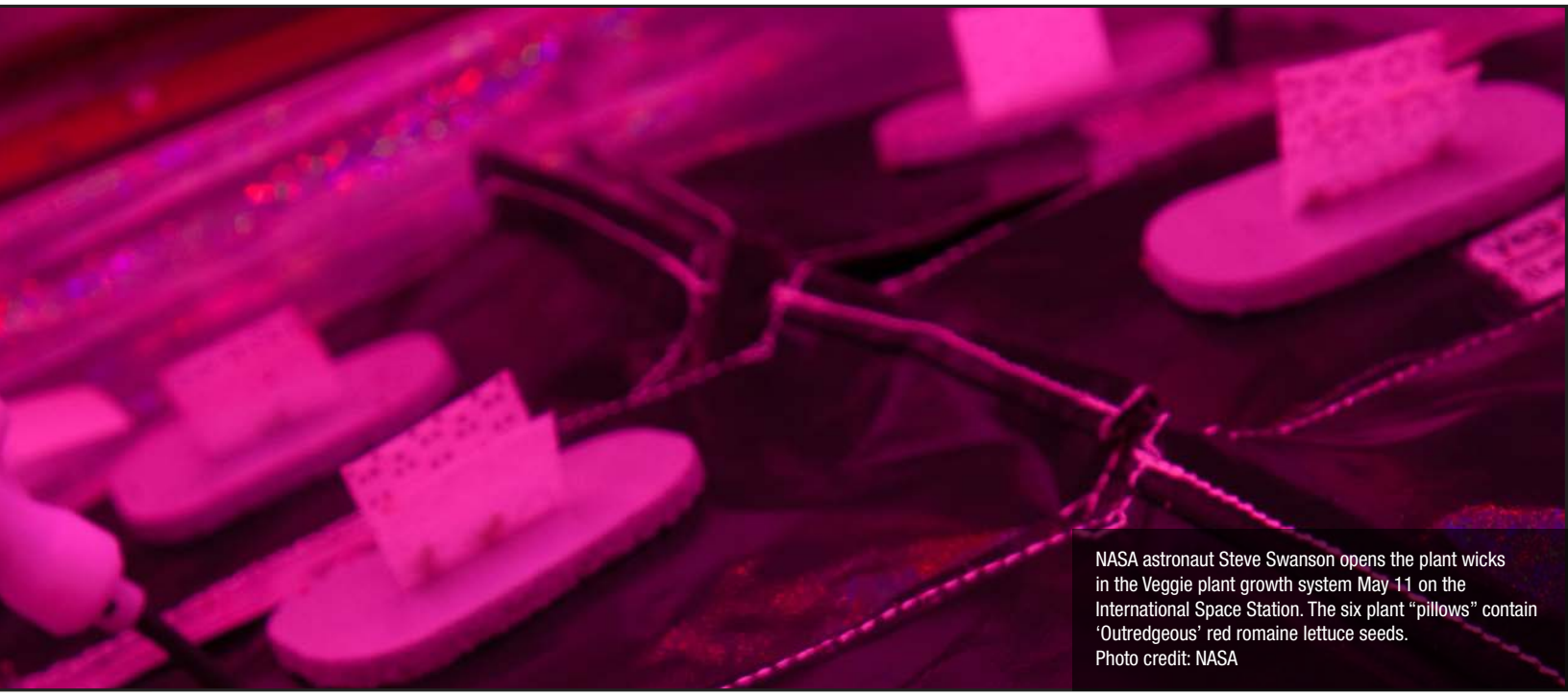
Another set of six plant pillows, containing "Profusion" zinnia seeds could be activated in Veggie for the Expedition crew to grow and enjoy as they wait for word that the red romaine lettuce is safe to eat. If the lettuce is safe to eat, Massa said an additional set of plant pillows containing the romaine lettuce seeds will be activated in Veggie.

"I hope that the astronauts on the space station eventually will use the equipment to 'experiment' with their own seeds or projects," said Nicole Dufour, who coordinated and led the testing of the flight hardware at Kennedy and wrote the crew procedures for the astronauts to use on space station. "Veggie is designed for crew interaction and to enjoy the plants as they are growing."

Dufour said she hopes Veggie serves as a regular facility the crew uses to grow food crops. Dufour is an engineer in the Flight Mechanisms and Flight Crew Systems Branch of the Engineering and Technology Directorate.

Brian Onate, former Veggie project manager, helped shepherd the plant growth system from initiating the build of the flight units in 2012 to just a couple of months before its delivery to the space station.

"I hope to see Veggie's success as the first step in food production that will allow astronauts on the space station to enjoy fresh food and gain knowledge as we explore beyond low-Earth orbit," Onate said.



NASA astronaut Steve Swanson opens the plant wicks in the Veggie plant growth system May 11 on the International Space Station. The six plant "pillows" contain 'Outredgeous' red romaine lettuce seeds.
Photo credit: NASA

Protective Coat

GSDO, corrosion lab tests new coatings for facilities, structures at Kennedy

It is a delicate balance -- combating the constant effects of corrosion while ensuring that preventive measures meet environmentally friendly standards at NASA's Kennedy Space Center. The Technology Evaluation for Environmental Risk Mitigation (TEERM) Principal Center in NASA's Environmental Management Division has partnered with the Ground Systems Development and Operations (GSDO) Program at Kennedy to investigate and test a variety of protective coatings that would serve as a barrier between facilities and the harsh corrosive environment.

-- BY LINDA HERRIDGE

A technician sprays a protective coating on a sample panel for testing at the Beachside Atmospheric Test Facility at NASA's Kennedy Space Center.
Photo credit: NASA/Jerry Curran

a look online

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http://go.nasa.gov/1njS0bH

HONORING LEGENDS

Space walkers inducted into U.S. Astronaut Hall of Fame

BY LINDA HERRIDGE

The Space Shuttle Atlantis attraction served as the backdrop for the U.S. Astronaut Hall of Fame (AHOF) induction ceremony May 3 at NASA's Kennedy Space Center Visitor Complex. Beneath Atlantis, two former astronauts and veteran space explorers, Shannon Lucid and Jerry Ross, were inducted as the class for 2014.

Emcee John Zarrella, former CNN news reporter, said this event is not just about honoring the past, but also about the promise of the future and where we go from here.

The space shuttle Atlantis served as the backdrop for the U.S. Astronaut Hall of Fame Induction ceremony May 3 at NASA's Kennedy Space Center Visitor Complex in Florida. Two former astronauts and veteran space explorers, Shannon Lucid and Jerry Ross, were inducted into the class of 2014. Photo credit: NASA/Kim Shiflett

"It is about inspiration, dedication and a lot of perspiration," Zarrella said. "It's about honoring the legends, but also looking forward to the future."

NASA Administrator and Hall of Famer Charlie Bolden said he was delighted to be part of the celebration. "I want to congratulate Shannon and Jerry. They are explorers and pioneers in their own very respective ways," Bolden said.

"It's a real privilege for me to be here today for the induction of Shannon and Jerry into the U.S. Astronaut Hall of Fame," said Kennedy Space Center director and Hall of Famer Bob Cabana. "I worked closely with both of them and they are extremely deserving of this honor."

"We are honored to celebrate the achievements of two NASA astronauts as they are welcomed into an elite group of space exploration heroes," said Therrin Protze, chief operating officer of Delaware North Parks and Resorts at the visitor complex.

Lucid became a NASA astronaut in 1979 and was a member of the first class of astronauts to include women. She is a veteran of five missions.

Lucid was the first woman and only the second U.S. astronaut to live on Russia's Mir space station. She launched aboard space shuttle Atlantis with the crew of the STS-76 mission March 22, 1996, and spent 188 days aboard Mir. Lucid set the record for the most flight hours in orbit by any woman in the world and held that record from August 1991 to June 2007.

She returned to Earth aboard Atlantis on the STS-79 mission Sept. 26, 1996. In December 1996, then President Bill Clinton presented Lucid with the Congressional Space Medal of Honor. She was the first woman to receive this award. Including four other shuttle missions, Lucid logged 223 days in space, also a record at the time for the most flight hours in orbit by any woman in the world. She retired from NASA in 2012.

"I have so much to be thankful for," Lucid said. "I'm also thankful for being in the right place at the right time to be able to be part of the Space Shuttle Program."

Lucid said NASA's Space Shuttle Program gave us three gifts: it enabled hundreds of

diverse people to learn how to live and work in space, enabled the country to experience international cooperation, and gave us the International Space Station.

Ross is a veteran of seven spaceflights and set the record at the time for the first person to be launched into space seven times. He logged more than 58 days in space, and conducted nine spacewalks. His time spent conducting spacewalks is the all-time second highest among U.S. astronauts.

"It's an honor to be here today," Ross said, "to know that it was my heroes, the original seven astronauts, who formed the Astronaut Scholarship Foundation, and then spun off the Astronaut Hall of Fame from that, and to be joining my childhood heroes. To be enshrined in that hall is very special to me."

He supported the Space Shuttle Program from before the shuttle's first launch in April 1981 to the last landing in July 2011. He also supported the International Space Station Program from its inception through the completion of assembly in 2011. Ross received 15 NASA medals during his career with NASA, and also was awarded the American Astronautical Society's Victor A. Prather Award for his spacewalking achievements.

Ross is the author of the autobiography, "Spacewalker: My Journey in Space and Faith as NASA's Record-Setting Frequent Flyer." He retired from NASA in 2012.

Zarrella introduced past years Hall of Fame recipients who were able to attend this year's ceremony. Twenty-five legendary astronauts and space icons walked the red carpet for the induction ceremony, including 2013 inductees Curt Brown and Bonnie Dunbar. Also attending were John Blaha, Karol "Bo" Bobko, Vance Brand, Dan Brandenstein, Frank Culbertson, Walt Cunningham, Owen Garriott, Hoot Gibson, Dick Gordon, Fred Gregory, Fred Haise, Steve Hawley, Jeff Hoffman, Edgar Mitchell, George "Pinky" Nelson, Charlie Precourt, Brewster Shaw, Loren Shriver, Tom Stafford, Kathy Thornton and Jim Wetherbee.

Shannon Lucid

In addition to Lucid's return to Earth on STS-76, her space shuttle missions were:
STS-51G (June 17-24, 1985)
STS-34 (Oct. 18-23, 1989)
STS-43 (Aug. 2-11, 1991)
STS-58 (Oct. 18 to Nov. 1, 1993)

Lucid flew on space shuttles Atlantis, Columbia and Discovery.

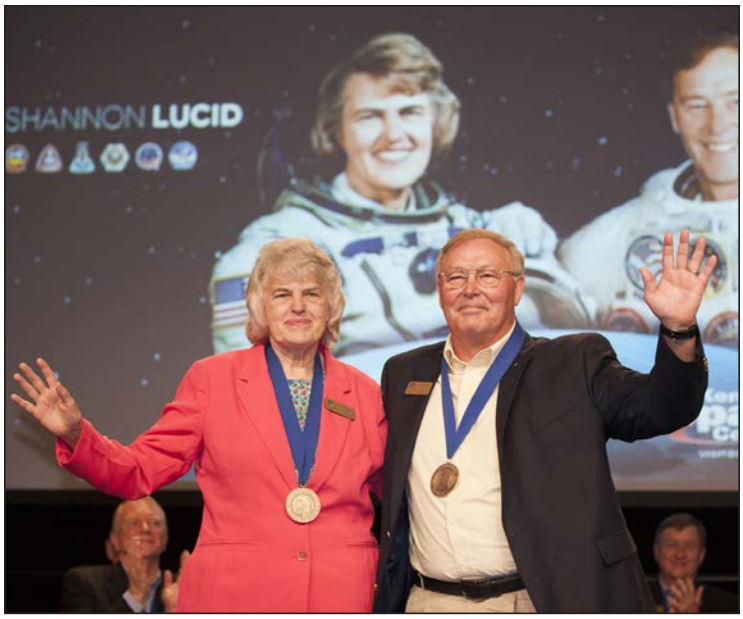
During off-duty time in the Spacehab Module, astronaut Shannon Lucid uses the microgravity of space to fabricate her own kind of easy chair as the days of her lengthy Russian Mir space station stay as a cosmonaut guest researcher come to a close. The photo was taken with an electronic still camera (ESC) during Flight Day 9 on Sept. 24, 1996. Photo credit: NASA

He also mentioned four previous honorees who passed away in the last year: Dale Gardner (1948-2014), Scott Carpenter (1925-2013), Charles Gordon Fullerton (1936-2013) and Bill Pogue (1930-2014).

"These space legends made remarkable contributions to the exploration of space, and their legacy lives on through their respective educational endeavors," Zarrella said.

The 2014 inductees were selected by a committee of Hall of Fame astronauts, former NASA officials, flight directors, historians and journalists. The process is administered by the Astronaut Scholarship Foundation (ASF), which was founded by the original seven astronauts in 1984. To be eligible, an astronaut must have made his or her first flight at least 17 years before the induction. Candidates must be a U.S. citizen and a NASA-trained commander, pilot or mission specialist who has orbited the earth at least once.

Dan Brandenstein, the ASF chairman and U.S. Astronaut Hall of Famer congratulated Lucid and Ross. Brandenstein said the ASF is celebrating its 30th anniversary this year. To date, the foundation has awarded $3.7 million in scholarships to 350 undergraduate science and engineering students nationwide. Several recipients were in the audience.



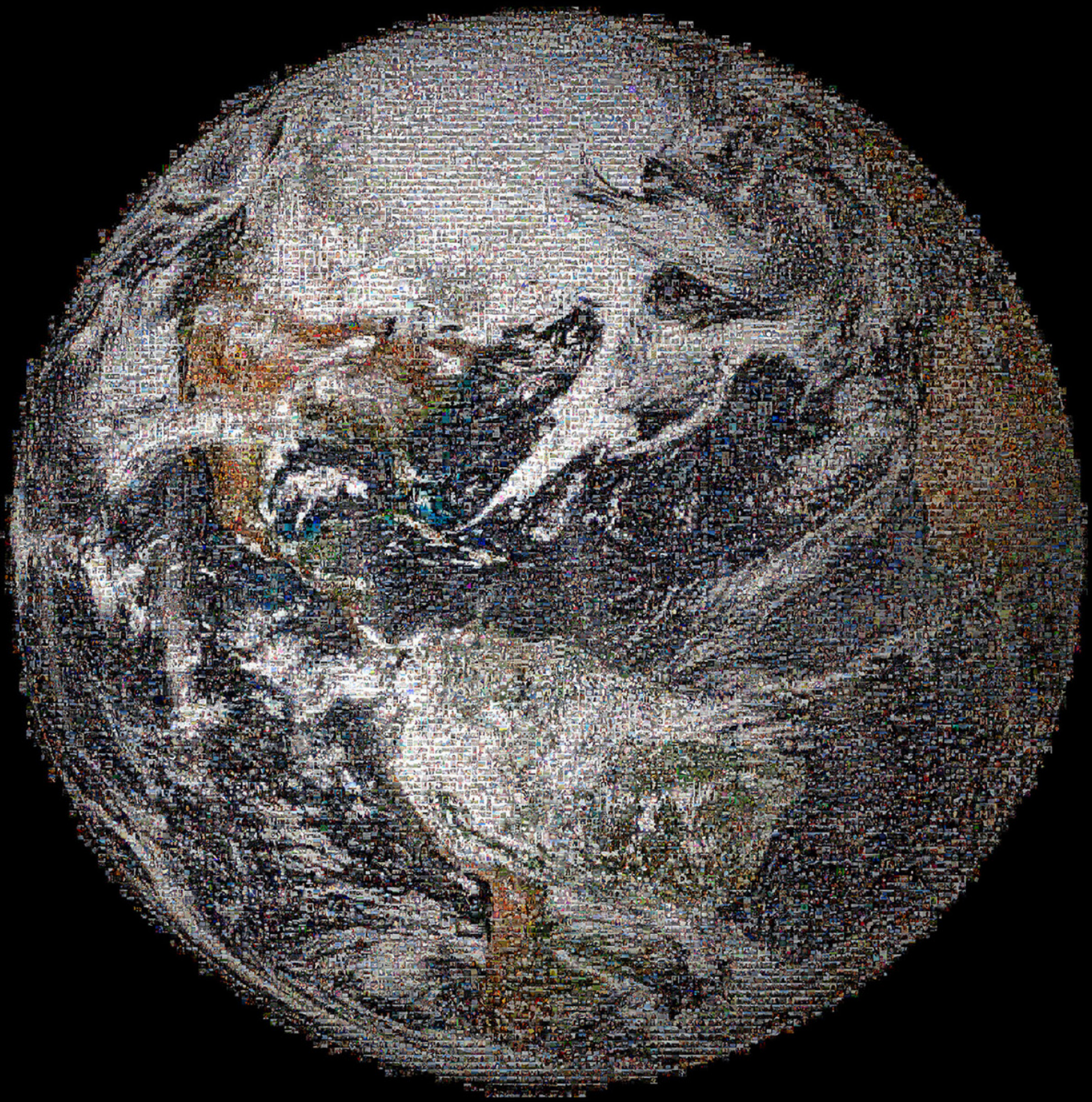
Former astronauts and veteran space explorers, Shannon Lucid and Jerry Ross, were inducted into the U.S. Astronaut of Hall of Fame on May 3 inside the Space Shuttle Atlantis attraction at NASA's Kennedy Space Center Visitor Complex.
Photo credit: NASA/Kim Shiflett

Jerry Ross

Ross' space shuttle missions were:
STS-61B (Nov. 26-Dec. 3, 1985)
STS-27 (Dec. 2-6, 1988)
STS-37 (April 5-11, 1991)
STS-55 (April 26-May 6, 1993)
STS-74 (Nov. 12-20, 1995)
STS-88 (Dec. 4-15, 1998)
STS-110 (April 8-19, 2002)

Ross flew on space shuttles Atlantis, Columbia and Endeavour.

With a view of the Earth below, astronaut Jerry Ross, STS-110 mission specialist, is anchored to the mobile foot restraint at the end of the International Space Station's Canadarm2 on April 16, 2002, during the fourth and final scheduled EVA for the mission. Photo credit: NASA



#GlobalSelfie

more online

On Earth Day this year, NASA asked people all around the world a simple question -- "Where are you on Earth Right Now?"

We asked people to answer the question on social media, with a selfie. The goal was to use each picture as a pixel in the creation of a "Global Selfie" – a mosaic image that would look like Earth appeared from space on Earth Day.

The image was built using 36,422 individual photos that were posted on social media and tagged #globalselfie on or around April 22, 2014. People on every continent -- 113 countries and regions in all -- posted selfies. From Antarctica to Yemen, Greenland to Guatemala, Micronesia to the Maldives, Pakistan, Poland, Peru -- and on. The image was assembled after weeks of curating more than 50,000 #globalselfie submissions -- not all were accessible or usable -- from Twitter, Instagram, Facebook, Google+ and Flickr.

The result is a zoomable 3.2-gigapixel image that people can scan and explore to take a closer look at the variety of pictures. The mosaic is hosted on the Web by GigaPan.

The Global Selfie mosaic and related images and videos are available at: http://go.nasa.gov/1n4y8qp

MISSION: MIGRATION

Eric Reyier, Ph.D., a fisheries biologist for InoMedic Health Applications Environmental Services, holds a black drum fish prior to inserting a small transmitter Dec. 30, 2010. Photo credit: InoMedic Health Applications

Fish spawned at spaceport tracked as far away as N.J.

BY BOB GRANATH

Since the earliest days of America's space program, telemetry has been used to track rockets and spacecraft. Similar technology now is being put to work by marine biologists to aid in studying activities of over a dozen managed fish and sea turtle species in the waters surrounding Kennedy Space Center. Fish spawned at the spaceport are now thriving and being tracked as far away as the coastal areas of New Jersey.

Established in 1962, the Kennedy security zone also functions as the oldest marine reserve in the United States. This has aided scientists at the spaceport who are partnering with other government agencies and universities to aid in preserving many types of marine wildlife.

"This has been a huge success story," said Eric Reyier, Ph.D., an InoMedic Health Applications Inc. fisheries biologist. "Our tagging efforts are helping us better understand and quantify the time Florida sport fish spend within the estuary around the space center."

Reyier pointed out that Kennedy's Ecological Program Office recently received notice from the U.S. Navy in Norfolk, Virginia, and the New Jersey Division of Fish and Wildlife that two black drum fish, tagged with small transmitters at the Florida spaceport, were detected in Chesapeake Bay in May and one later was recorded off the coast of New Jersey. This finding represents the longest migration ever documented for the black drum species.

A popular sport fish, black drum are common to bays and lagoons but also may be found offshore. They tend to be bottom dwellers, often

feeding on oysters.

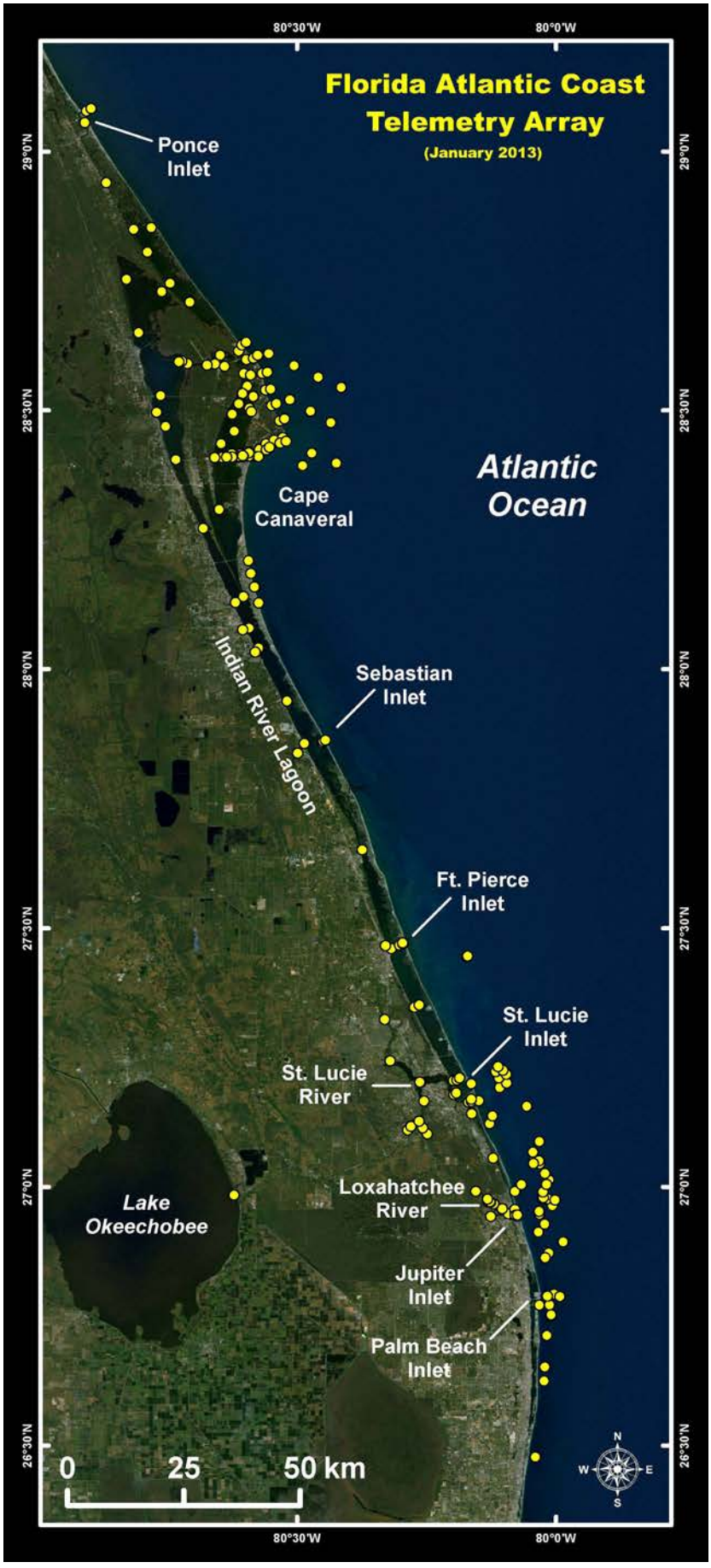
"Along with the black drum, we have also tagged numerous other species such as red drum, spotted sea trout, sheepshead, tarpon, gray snapper, common snook and lemon sharks," Reyier said. "We've also tagged numerous green sea turtles to document their life cycle and movements."

In addition to being a 140,000-acre spaceport, Kennedy also is part of the Merritt Island National Wildlife Refuge established in 1963. It provides a habitat for more than 1,500 species of plants and animals. Add to that the necessary security surrounding Kennedy and Cape Canaveral Air Force Station, and what results is a highly protected environment for local wildlife.

"This gave us a protected area to study exploited fish that are economically valuable," Reyier said. "While this enhances the fisheries throughout east-central Florida, they can also have positive impacts on fisheries over much larger sections of the U.S. East Coast as the black drum example shows."

Marine life that has value for sport or food can be fished, or exploited, to the point where the numbers are diminished. While that may not lead to the species being endangered, coordinated efforts may be needed to, again, make the fish plentiful.

"We started tagging sport fish in 2008," Reyier said. "We often just use a large cast net to catch a fish in the many marshes and estuaries at Kennedy that



Small receivers are placed in the waters around the Kennedy Space Center and the adjacent shore. Similar receivers also have been positioned up and down the Florida coastline by universities and organizations with interests in studying the migration habits of fish.
Image credit: InoMedic Health Applications

are shallow and only ankle- or knee-deep."

The captured fish is sedated with a chemical so it isn't hurt, a small incision is made, the transmitter is inserted, the incision is stitched closed and the fish is released.

The transmitters placed in the fish are slightly smaller than a tube of lipstick, but can last up to 10 years. Receivers are about the size of an aerosol spray can and are placed in the waters around the space center and the adjacent shore. When any fish with a transmitter swims within 500 meters -- about 547 yards -- the movement will be recorded.

Periodically, Reyier or other biologists retrieve the receivers, plug them into a laptop computer and download data that has been recorded.

"Cooperation from numerous organizations collecting similar data has been very helpful," he said.

Receivers similar to the ones placed in the waters around Kennedy are being positioned up and down the eastern seaboard of the United States by organizations with similar interests in studying the life and migration habits of fish.

"We now are partnering with several universities and other government agencies and sharing what we learn," Reyier said.

Biologists from the U.S. Navy, the National Oceanographic and Atmospheric Administration (NOAA), the Florida Fish and Wildlife Conservation Commission, and the Georgia Department of Natural Resources have joined forces with the University of Miami's Bimini Biological Field Station, Florida Program for Shark Research at the University of Florida, University of Central Florida, Florida Institute of Technology, University of North Florida, Florida International University and Stony Brook State University in New York.

Carly Garreau, a marine biologist with InoMedic Health Applications, holds a sheepshead fish while standing in a shallow estuary at Kennedy Space Center. The fish was tagged for tracking March 26, 2009.
Photo credit: InoMedic Health Applications

During a helicopter survey of wildlife at Kennedy Space Center, an alligator is seen sharing a shallow marsh with a school of drum fish. Photo credit: InoMedic Health Applications/Russ Lowers

"With so many organizations participating, a great deal of data can be shared with an economy of effort and cost," Reyier said. "In addition to partner groups reporting their findings about fish tagged here, we've been able to pass along information to others on the migration of fish tagged with transmitters originally released as far away as Delaware, New York, Connecticut and Massachusetts."

Experts with Kennedy's Ecological Program have noted that understanding how and why animals move through their environment is important to better understanding their role within a given ecosystem -- a community of living organisms along with other components of their environment.

"Our tagging efforts are helping us better understand and quantify the time Florida sport fish spend within the estuary around the space center."

"From a practical standpoint, this data also helps streamline environmental permitting requirements and, most importantly, helps us identify critical habitats such as fish spawning and schooling areas so human disturbance to these sites can be minimized," said Reyier.

In recent years, telemetry systems have become low-cost, powerful tools in learning about the behavior of marine organisms, habitat preferences and migration patterns without reliance on direct observations or recapturing animals.

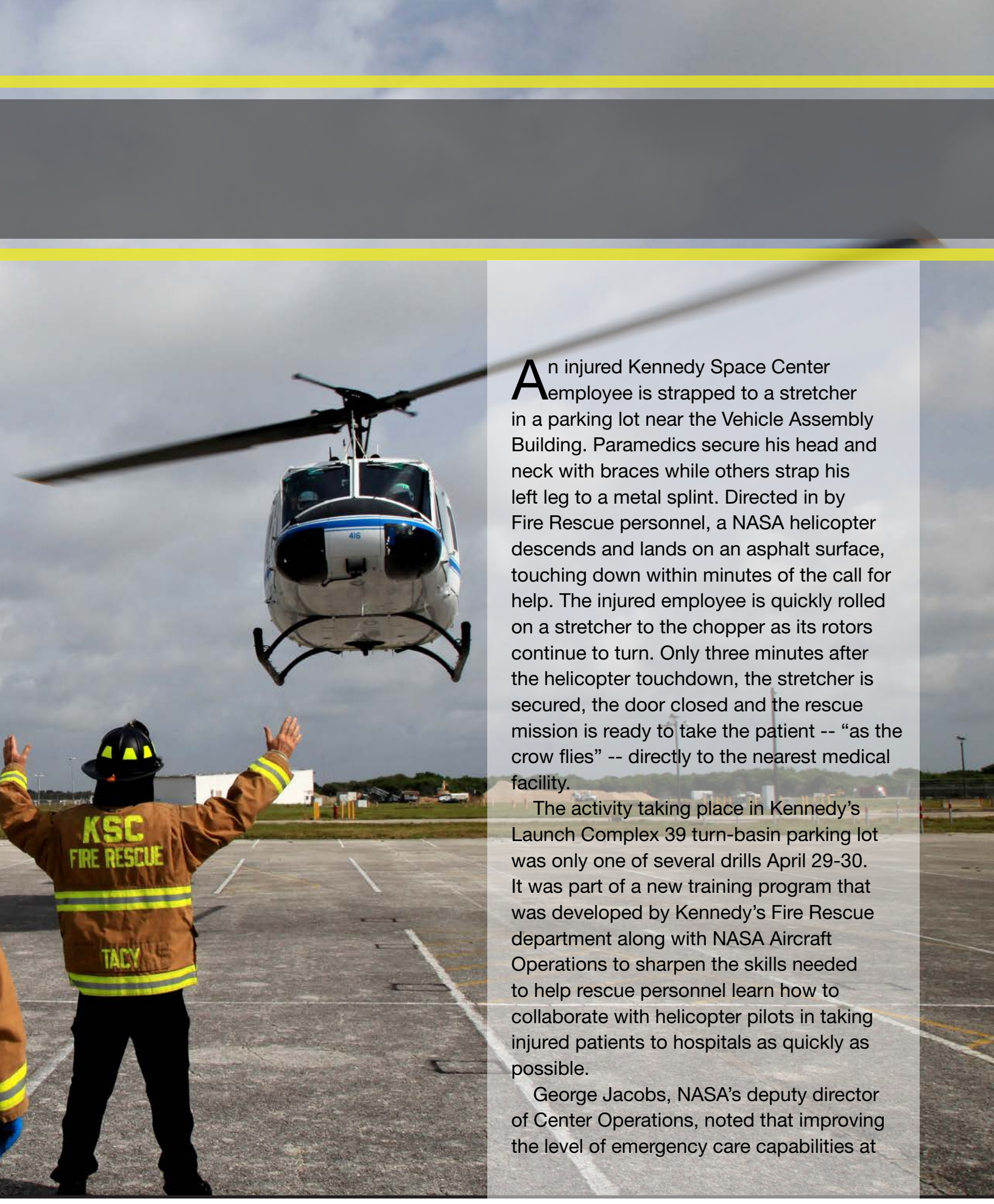
"It's a necessary step for developing sound management strategies for exploited and imperiled species," Reyier said. "The duration and geographic scope of these studies of fish and other mobile animals is giving us valuable new insights which are directly benefiting our conservation efforts."

EMERGENCY EVAC

Fire Rescue training hones in on safe helicopter evacuations

BY BOB GRANATH

From left, NASA Fire Rescue Lt. David Tacy and firefighter Alvis Hickey direct an agency helicopter in for a landing during a training exercise April 30. Photo credit: NASA/Dan Casper



An injured Kennedy Space Center employee is strapped to a stretcher in a parking lot near the Vehicle Assembly Building. Paramedics secure his head and neck with braces while others strap his left leg to a metal splint. Directed in by Fire Rescue personnel, a NASA helicopter descends and lands on an asphalt surface, touching down within minutes of the call for help. The injured employee is quickly rolled on a stretcher to the chopper as its rotors continue to turn. Only three minutes after the helicopter touchdown, the stretcher is secured, the door closed and the rescue mission is ready to take the patient -- "as the crow flies" -- directly to the nearest medical facility.

The activity taking place in Kennedy's Launch Complex 39 turn-basin parking lot was only one of several drills April 29-30. It was part of a new training program that was developed by Kennedy's Fire Rescue department along with NASA Aircraft Operations to sharpen the skills needed to help rescue personnel learn how to collaborate with helicopter pilots in taking injured patients to hospitals as quickly as possible.

George Jacobs, NASA's deputy director of Center Operations, noted that improving the level of emergency care capabilities at

Paramedics and Fire Rescue personnel move a stretcher to a helicopter as they work quickly to have the patient ready to transport five minutes after removal from a vehicle.
Photo credit: NASA/Dan Casper

Kennedy is crucial as facilities are upgraded for future operations.

"As we become more of a multi-user spaceport and go back to human space launches, we will have more and more people coming on the center to work," he said. "New facilities will be built, others will be modified. This capability is for all of us, not just NASA employees, but anyone who is a part of our multi-user spaceport."

Jacobs believes Kennedy's Fire Rescue is already among the best.

"They are world-class," he said. "We're privileged to have these capabilities and resources. Hats off to these guys. They are willing to put themselves in harm's way to save someone else's life and that gives you a good feeling as a Kennedy employee."

In most cases, if an individual is injured at Kennedy and needed a quick evacuation, paramedics would call for a specially equipped helicopter service such as Life Flight to transport the patient to a hospital. This air ambulance uses state-of-the-art equipment and highly skilled medical and aviation professionals making it a flying emergency room. The Florida spaceport's helicopters are available in the event an air ambulance is not.

According to Bill Martin, a URS Federal Technical Services pilot in NASA Aircraft Operations, space center employees and visitors can feel secure in knowing they are in one of the safest areas in Central Florida due to the presence of the skilled and highly-trained Fire Rescue team at the spaceport and the assets available to aid their work.

"There is always a risk of an accident, and there is a possibility that our firefighters here may need to utilize our helicopters to quickly transport patients to a facility providing a higher

level of care," he said. "Kennedy covers a very large area at 140,000 acres. It's relatively difficult to quickly get to all the different areas of the center, so having resources available, such as a helicopter, allows us to get to these remote areas and transport people as fast as possible."

Medical experts note that in an emergency situation, the first 60 minutes after an accident is what they refer to as the "golden hour."

"If rescue personnel can get a critical care patient extricated from the situation and transported to a local trauma center in an hour or less, it greatly improves the chances for survival and recovery," Martin said.

Mark Huetter of Chenega Security and Support Solutions is assistant chief of Training for Kennedy's Fire Rescue. He explains that it is important to conduct this type of training not only for space center fire rescue personnel, but also for Aircraft Operations.

"We all want to be on the same page when transporting a patient, due to the hazardous environment," he said. "There are many obstacles such as trees, debris and poles."

Reducing the risks to both fire rescue personnel on the ground, as well as helicopter pilots in a crisis situation, has been the focus of Landing Zone Coordinator Training led by Martin. A pilot for 35 years, he has performed about 1,100 helicopter emergency medical service (HEMS) flights during the past decade. It is one of the most high-risk occupations in America.

"Whether landing on approved surfaces, grass fields, dirt areas, even roads, there's a lot of things that can cause a great deal of concern," Martin said.

Martin explained that the helicopter evacuation training program took place in three phases and was developed to help NASA Aircraft Operations and NASA Fire Rescue mitigate risks.

"The first phase is a ground school portion which takes about an hour," he said. "The second phase is actually bringing in outside helicopter HEMS providers and getting them familiar with the NASA center, as well as interaction with NASA Fire Rescue crews. And the third phase is actually going out and producing simulations where we set up landing zones and use NASA's aircraft to practice the HEMS operation."

Landing Zone program training coordinators Bill Martin and Mark Huetter prepare for liftoff during rescue simulations at Kennedy Space Center on April 29.
Photo credit: NASA/Dan Casper

Mark Huetter, assistant chief of Training for the Kennedy Space Center's Fire Rescue Department, in the white shirt, discusses the results of a simulated rescue operation with participants in the exercise.
Photo credit: NASA/Dan Casper

According to Huetter, the decision to transport a patient by air or by land is made by the paramedics.

"If they feel the patient must be airlifted out, believing the person needs that higher level of care fast, then they will call in a medical evacuation by helicopter," he said.

On the second day of the training, Lois Dominguez, a Fire Rescue driver with Chenega Security and Support Solutions, reiterated that working quickly is always the goal.

"We want to be on scene and get the injured person out as fast as possible," she said. "That means loading the patient, ideally, in five minutes and, certainly, in no more than 10 minutes."

In this scenario, Jacobs served as the "injured" person. Paramedics removed him from a vehicle, placed him on a stretcher and immobilized his head. At the same time, lieutenants with Kennedy Fire Rescue directed a NASA helicopter into the landing zone. The medical staff moved the stretcher to the waiting helicopter, secured the stretcher in place and closed the door. It took exactly five minutes.

The next decision is where to take the patient.

"What determines where we take a patient really comes down to the medical crew on board the aircraft," Martin said. "The pilot is prepared to take the aircraft and passengers to whatever hospital they need to. Usually in a trauma situation, patients are taken to a trauma center in Brevard County, Orlando, Daytona or even Gainesville depending on the severity of their injuries."

Jacobs noted that launching rockets at a spaceport is dangerous business requiring people to perform activities such as being around caustic propellants and activities at heights.

"As Kennedy moves forward, there will be additional programs such as the Space Launch System, new operations and other launch customers," he said. "So given the future and the road we're following, this capability isn't a luxury, it's a necessity."

NASA Moves!

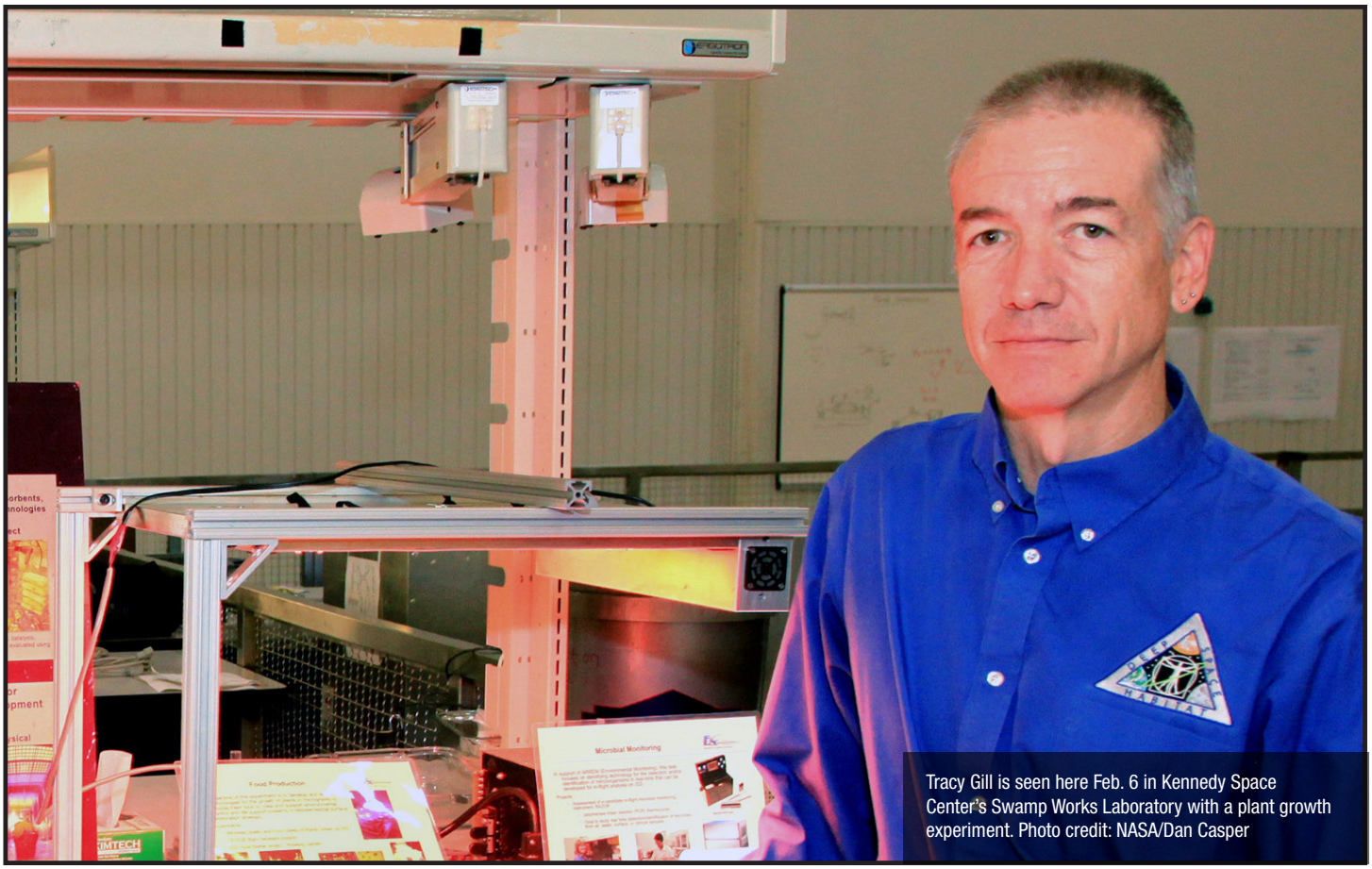
NASA Moves!

A strong and energetic workforce is essential as Kennedy Space Center transitions to a multi-user spaceport. Kennedy Director Bob Cabana, right, Florida Surgeon General John Armstrong and special guests from several county health departments led a group of Kennedy employees on an early morning fun run May 19, officially kicking off National Employee Health and Fitness Month with the agency's "NASA Moves!" challenge. -- ANNA HEINEY

http://go.nasa.gov/1hQK6i8

a look online

more online



Tracy Gill is seen here Feb. 6 in Kennedy Space Center's Swamp Works Laboratory with a plant growth experiment. Photo credit: NASA/Dan Casper

EXPLORATION MANAGEMENT

Technology strategy manager helps develop long-term goals

BY BOB GRANATH

As NASA's Technology Strategy manager at the Kennedy Space Center, Tracy Gill is helping develop the agency's long-term goals for exploration beyond Earth. He provides expert representation on behalf of advanced projects as a member of the NASA Research and Technology review board that focuses on how best to apply spaceport investments into advanced research projects.

Gill's work developing strategies for exploration of the moon, an asteroid and Mars is a fulfillment of a childhood dream.

"I became fascinated with NASA watching one of the final Apollo moon landings on television." he said "In high school, I wrote a paper on America's space program and included that this is what I was going to do as a career."

A native Floridian, Gill was born in Sarasota on the state's southwestern gulf coast, growing up 50 miles south in Port Charlotte, Florida. He also spent time living in Gainesville, home of the University of Florida (UF).

"Since I knew I wanted to work for NASA, I majored in

engineering at UF," he said. "I started in mechanical engineering, but switched to electrical engineering because I found it more interesting."

While working on his degree, Gill served an internship at Florida Power and Light, but knew that wasn't what he wanted to do permanently.

"I set my sights on NASA early on and I was going to get there one way or another," he said. "During my senior year, I came to Kennedy and visited with people in the payload organization."

After graduating with his bachelor's degree in December of 1989, Gill joined NASA the following month, supporting space shuttle payload integration.

Gill's early efforts at Kennedy focused on preflight processing of experiments for shuttle Spacelab missions, coordinating efforts from other NASA field centers, contractors, universities, and from international engineering teams from the European Space Agency (ESA), Canada and Japan. This kind of work later evolved into coordinating major payloads for flights to the International Space Station.

"It was rewarding because we were working with flight hardware -- payloads and the Spacelab modules that were flying aboard the shuttle," Gill said. "The mission that stands out most in my memory is Spacelab D-2. It was the second German Spacelab flight and I enjoyed collaborating with all of the international partners."

Tracy Gill mentors Heather Hava, who is working on a doctorate in aerospace engineering sciences at the University of Colorado. Photo credit: NASA/Jim Grossmann

"The knowledge gained from Earth-based research and low-Earth orbit projects, such as the International Space Station, is being used to find out what is required to expand human presence to more formidable environments, such as an asteroid, the moon or Mars."

A total of 11 nations provided 88 experiments for the 10-day mission. Participants included the German Aerospace Research Establishment, NASA and ESA, as well as agencies in France and Japan that contributed to D-2's scientific program.

While working at Kennedy, Gill continued his education, earning a master's degree in space systems in 1994 from Florida Tech and a second master's in aerospace engineering at UF in 2000.

In 2006, Gill participated in International Space University (ISU), an educational program dedicated to the development of space for peaceful purposes through international and multidisciplinary education and research programs. He graduated from the three-month program, which took place in Strasbourg, France, after participating with a group that studied a closed-loop system for living and working on the moon.

The Deep Space Habitat and X-Hab Loft. Tracy Gill participated in the Advanced Exploration Systems Habitation Systems Project chartered to define a Deep Space Habitat element that will enable human exploration to multiple destinations. Photo credit: NASA

"Our research developed a proposed framework for supporting 11 crew members living on the lunar surface for a period of 18 to 36 months," he said. "The report recommended the overall systems architecture, engineering processes, as well as the research, development and orchestration of separately phased precursor missions."

Studies of advanced exploration systems coupled with experience in Spacelab processing helped prepare Gill for the next stage in his career.

"I've gone from working with mature hardware designs about to fly right away to helping develop technologies for future exploration habitats," he said. "I've also been fortunate to work with diverse teams from multiple NASA centers and our international partners. This has helped prepare me for collaboration with academia and industry as we develop complex habitats that will be crucial for long-duration space missions."

Since October 2010, Gill has participated in the Advanced Exploration Systems (AES) Habitation Systems Project, chartered to define a Deep Space Habitat element that will enable human exploration to multiple destinations. The Habitation Systems Project is a multi-center team of NASA architects, scientists and engineers working together to develop sustainable living quarters, workspaces and laboratories for next-generation space missions.

"The knowledge gained from Earth-based research and low-Earth orbit projects, such as the International Space Station, is being used to find out what is required to expand human presence to more formidable environments, such as an asteroid, the moon or Mars," Gill said.

What basic conditions must be met to make living tolerable thousands or even millions of miles from Earth is just one of many questions Gill and a team

of specialists from around the agency were challenged to answer in preparation for NASA's planned venture to an asteroid or other deep-space destination. Their response was the development of the Habitat Demonstration Unit (HDU), a platform that can be used for technology development and architecture validation for lunar and microgravity outposts.

Gill's participation in the effort from concept to prototype culminated in a technology brief on the HDU, earning him recognition from the Johnson Space Center's Inventions and Contribution Board as one of NASA's key innovators.

Gill noted that one conclusion drawn from data collected during the testing is that 80 percent of a habitat's systems can be standard to all missions. Only 20 percent need to be tailored for the destination.

Asked if he thought he could live in the habitat he helped develop, he enthusiastically responded in the affirmative.

"Sure," he said. "We used to fight each other for a chance to stay in there overnight."

The research team now includes students at leading universities, who are contributing through NASA's eXploration Habitat, or X-Hab, Challenge. The agency has identified necessary technologies for deep-space missions and invited

"This is a challenge, not a competition, designed to engage university teams in developing the needed new technologies."

universities from around the country to develop concepts, prototypes and lessons learned that will help shape future space missions.

"This is a challenge, not a competition, designed to engage university teams in developing the needed new technologies," Gill said. "We want to give university students the opportunity to be at the forefront of innovation. Working with the X-Hab students is rewarding since they are the ones who will eventually 'carry the baton.'"

In July 2013, Gill assumed his current role in Kennedy's Research and Technology Management Office.

"We have people now developing innovative technologies for the future," he said. "We have quite a few cool things currently in work."

Many of those efforts are going on in the Florida spaceport's Swamp Works, which establishes rapid, innovative and cost-effective exploration mission solutions through partnerships across NASA, industry and academia. Concepts start small and build up fast, with lean development processes and a hands-on approach.

Gill points to research by Dr. Carlos Calle, lead scientist in Kennedy's Electrostatics and Surface Physics Lab, as an example of groundbreaking technology.

"Dr. Calle is developing instrumentation that would help astronauts deal with the problem of electrostatic dust phenomena during future planetary exploration missions," he said.

An extended stay in the Habitat Demonstration Unit on another planet may not be in the cards for Gill. He is content living in Orlando with his wife Michele, a professor in educational psychology at the University of Central Florida, and their two sons.

"Here at Kennedy, we want to help move technology to maturity," Gill said. "Our Research and Technology Office has an expanding portfolio. We want to be sure we provide the assistance we can to see these innovations from ideas to reality."

“Shocker”

Weight: 400 pounds
Top Speed: 66 mph
Range on one charge: 40 to 50 miles, depending on conditions
Batteries: GBS 4.6Kwh, 72 Volt, Elite Power Solutions
Motor: Mars ME-0709 Perm mag DC
Controller: Alltrax 7234
Cost per mile: $0.008

e-Rider

Otis Deal, who works at Kennedy Space Center, grew tired of the cost of gasoline and converted a gas-burning internal combustion engine 1993 Kawasaki Vulcan 500 into a fully electric motorcycle, which he named Shocker.

Deal took out the engine and replaced it with 24 battery cells, creating a 72-volt system. The only major change he made was replacing the forks, which was necessary to fit/support the batteries.

Deal spent $7,500 to build Shocker. When the batteries get to 50 percent depth of discharge, it takes about two to three hours to charge them. Once the charge is complete, the charger turns off automatically.

Shocker weighs 400 pounds and can go up to 66 mph and travel 40 to 50 miles on a single charge depending on conditions.

NASA's Ground Systems Development and Operations Program, Lockheed Martin and the U.S. Navy are evaluating the hardware and processes at a warehouse at the Naval Base San Diego in California on May 12 for preparing the Orion crew module for Exploration Flight Test-1 for transport to Kennedy Space Center. Photo credit: NASA/Kim Shiflett

FIT CHECK

Orion test vehicle undergoes EFT-1 pre-transportation simulation in California

BY LINDA HERRIDGE

NASA's Ground Systems Development and Operations (GSDO) Program spent five days preparing and evaluating the hardware and rehearsing the processes for readying the Orion crew module for overland transportation from Naval Base San Diego in California to Kennedy Space Center.

After the spacecraft's first trip into space on Exploration Flight Test-1 (EFT-1) later this year, Orion will be recovered by a U.S. Navy ship after splashdown in the Pacific Ocean and brought to the naval base to be prepared for transportation back to Kennedy.

A team of about 20 technicians and engineers from Kennedy, Lockheed Martin, the U.S. Navy and the U.S. Air Force practiced pre-transportation operations and fit-check testing of support equipment with the Orion boilerplate test vehicle May 12-16 at the Mole Pier and a storage facility at the naval base.

"The test was a complete success," said Neil Elton, the GSDO Landing and Recovery Department of Defense liaison. "Largely, everything went as planned."

In a storage facility at the naval base, the Orion test vehicle was lifted by crane and placed in the crew module recovery cradle, built by Lockheed

Martin. Workers then secured Orion to the cradle, which in turn was secured to a pair of container load trailers. Wheels on either side of the trailer allow it to move easily forward and backward. Orion was transported from the storage facility about a mile to the Mole Pier.

Workers built up a protective structure at the pier for Orion. The test vehicle was moved inside to simulate removal and installation of the hatch cover. The test was performed to ensure that the designated support equipment and associated procedures were effective in removing and installing the hatch cover.

After the procedures were confirmed, Orion was moved out of the protective structure. Workers practiced assembling a transportation fixture that will be used to move future Orion crew modules across the country. The crew module transportation fixture base was placed on the flatbed truck. A crane was used to simulate moving the crew module and lowering it in the base of the fixture. Then, the sides were craned into place, and the lid was lowered and secured.

The team then conducted a fit check of the transportation fixture, an environmental control system and generator to ensure the equipment works properly to control the crew module environment during transport. With the fit check complete, each piece of support equipment was removed from the truck and placed back into the storage facility.

Orion is the exploration spacecraft designed to carry astronauts to destinations not yet explored by humans, including an asteroid and Mars. It will have emergency abort capability, sustain the crew during space travel and provide safe re-entry from deep-space return velocities.

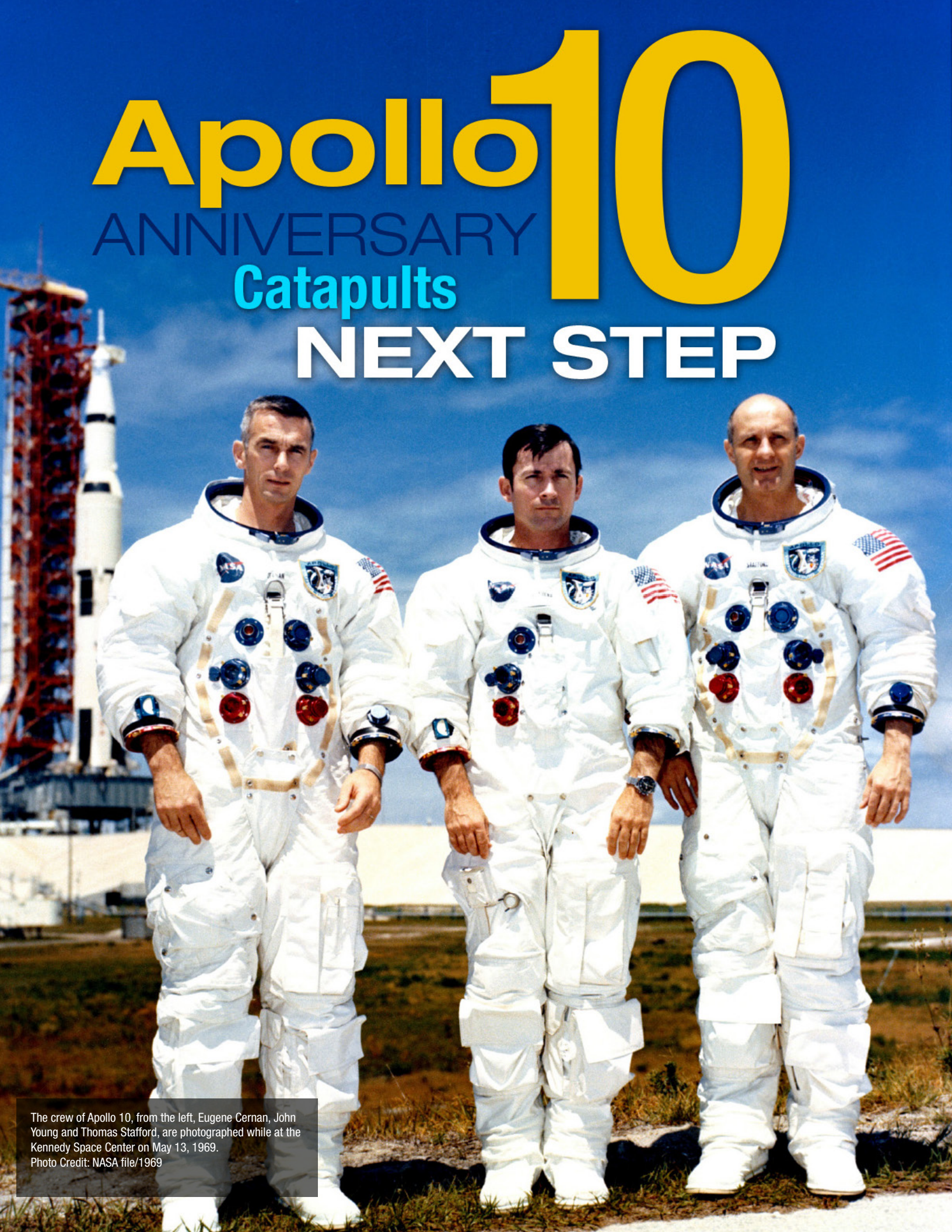
An uncrewed Orion test flight is scheduled to launch later this year atop a Delta IV rocket from Cape Canaveral Air Force Station in Florida to an altitude of 3,600 miles above the Earth's surface. The two-orbit, four-hour flight test will help engineers evaluate the systems critical to crew safety, including the heat shield, parachute system and launch abort system.

For more information, visit
http://www.nasa.gov/orion.

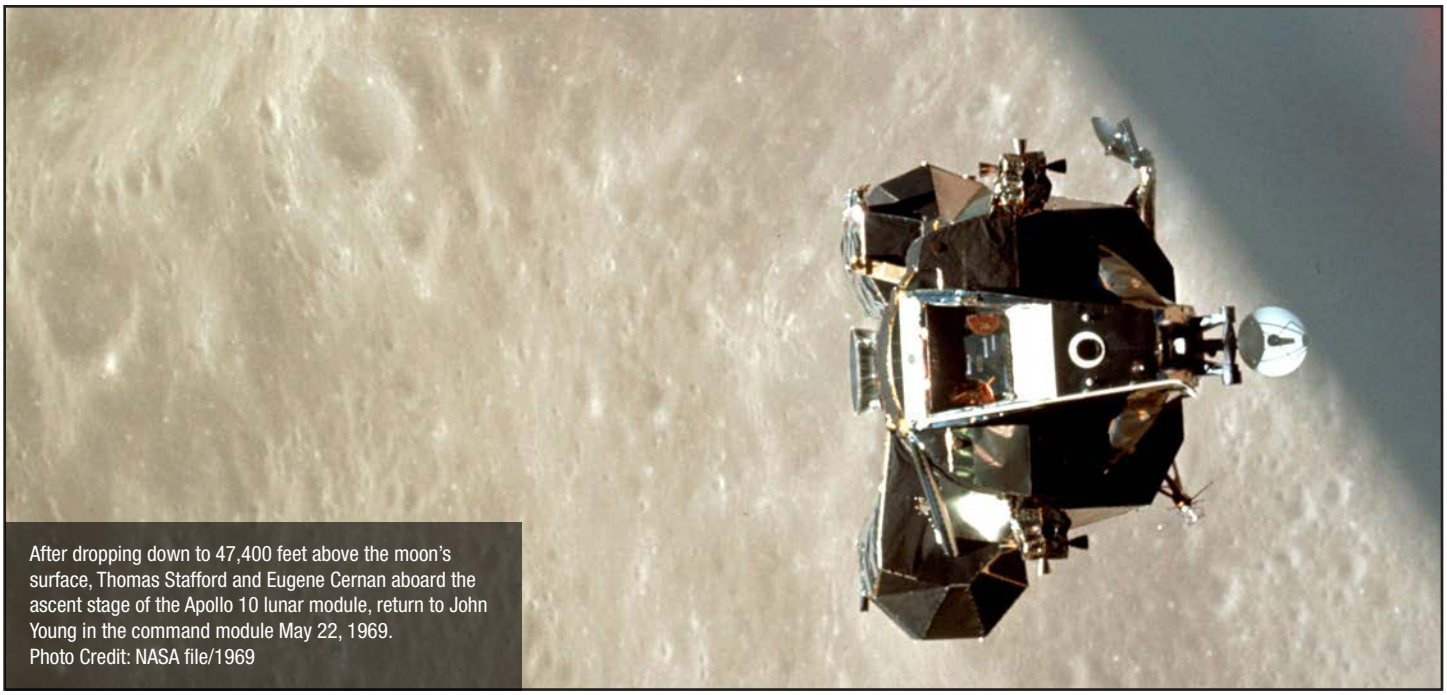
Fans of Major League Baseball's San Diego Padres check out the Orion boilerplate test vehicle on display at Petco Park in San Diego, California, before a game May 12. Photo credit: NASA/Kim Shiflett

Apollo 10 ANNIVERSARY

Catapults NEXT STEP



The crew of Apollo 10, from the left, Eugene Cernan, John Young and Thomas Stafford, are photographed while at the Kennedy Space Center on May 13, 1969.
Photo Credit: NASA file/1969



After dropping down to 47,400 feet above the moon's surface, Thomas Stafford and Eugene Cernan aboard the ascent stage of the Apollo 10 lunar module, return to John Young in the command module May 22, 1969.
Photo Credit: NASA file/1969

Moon-landing missions laid foundation for EFT-1, beyond

BY BOB GRANATH

NASA recently marked the 45th anniversary of Apollo 10, the mission that served as the "dress rehearsal" for the first lunar landing two months later. The agency now is preparing to launch its first human-rated spacecraft capable of not only a trip to the moon, but beyond.

Apollo 10 was the fourth piloted mission in the lunar landing program, testing all the procedures and components without actually landing on the moon. The mission included an all-up test of the lunar module (LM) by the second crew to orbit the moon.

The veteran crew of Thomas Stafford, John Young and Eugene Cernan became the first to lift off Launch Pad 39B at Kennedy Space Center on May 18, 1969.

As they arrived in lunar orbit three days later, the trio came from the back side of the moon and spotted their home planet rising above the moon's horizon.

"We just saw Earthrise and it was magnificent," Cernan said.

On May 22, Stafford and Cernan boarded the LM, which they had named "Snoopy" after the Peanuts comic strip character. They undocked from the command module, named "Charlie Brown," leaving Young orbiting about 60 miles above the moon.

The LM's descent propulsion system engine was fired for 27 seconds, dropping down to a mere 47,400 feet above the lunar surface.

"We is down among 'em, Charlie," Cernan said to fellow astronaut Charlie Duke, serving as spacecraft communicator in Mission Control at the Manned Spacecraft Center (now Johnson Space Center).

On the next mission, the final powered descent to landing would begin from this altitude.

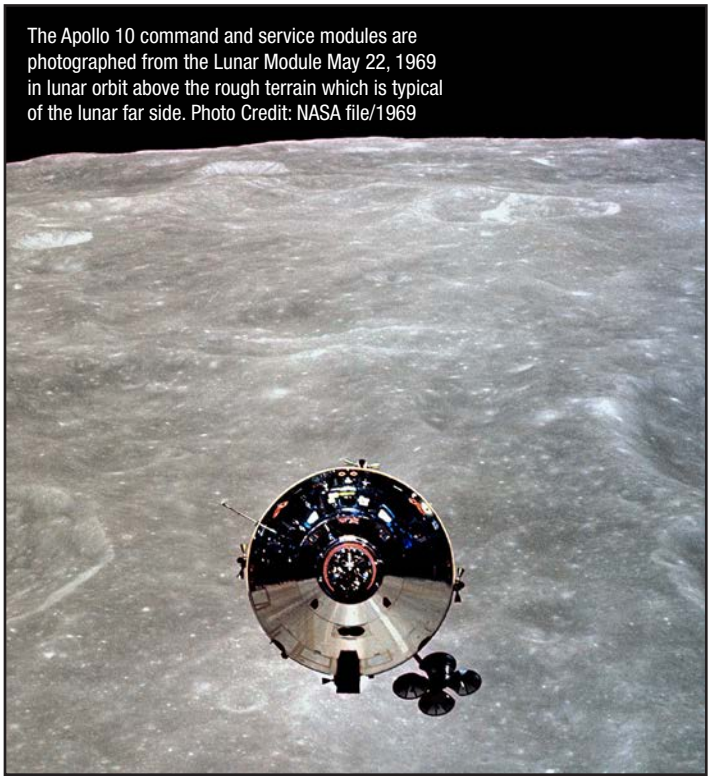
"It's a fantastic sight," Stafford said observing the moon's terrain. "It has different shades of browns and grays."

He and Cernan surveyed and photographed the Sea of Tranquility landing site chosen for Apollo 11, and practiced the approach that would refine knowledge of the lunar gravity needed to calibrate the powered descent guidance system for a landing.

Upon separation of the ascent stage, Stafford and Cernan rode out a momentary gyration in the lunar lander's motion due to a faulty switch setting. They then fired the ascent engine boosting them to a rendezvous and docking with Young in the command module.

The mission put NASA's flight controllers and extensive tracking and control network through a rehearsal. Except for the touchdown on the moon, the mission went exactly as a landing would have gone, both in space and on the ground.

Splashdown occurred in the Pacific Ocean on May 26, 1969, with the astronauts and spacecraft recovered by the aircraft carrier USS Princeton. While all lunar missions entered the atmosphere at similar speeds, Apollo 10 set the record for the highest velocity attained to date by a piloted vehicle at 24,791 mph during the return from the moon.



The Apollo 10 command and service modules are photographed from the Lunar Module May 22, 1969 in lunar orbit above the rough terrain which is typical of the lunar far side. Photo Credit: NASA file/1969

Describing the view out the window, Cernan said the re-entry was like being in "a ball of white and violet flame."

Performance during re-entry will be a crucial focus of the upcoming Exploration Flight Test-1, the first test flight of NASA's new Orion spacecraft.

Orion is designed to take humans farther than they've ever gone before, serving as the exploration vehicle that will carry astronauts to space, provide emergency abort capability, sustain the crew during the space travel, and provide safe re-entry from deep-space return velocities.

"Measuring the performance of the heat shield and other thermal protection material is one of the main focuses of EFT-1," said Stu McClung, deputy director of Orion Production Operations. Based at Johnson, he is assigned to Kennedy to assist with preparations for the upcoming flight.

Set to launch on an unpiloted mission in December this year, Orion will be mounted atop a Delta IV Heavy lifting off from Space Launch Complex 37B at Cape Canaveral Air Force Station. This test will evaluate launch and high speed re-entry systems such as avionics, attitude control, parachutes and the heat shield.

"The Delta IV Heavy will give us enough thrust to send Orion out 3,600 miles on the second orbit," McClung said. "That will allow the spacecraft to hit the atmosphere performing a high-energy re-entry at about 20,000 miles per hour. This will give us about 80 percent of the heating we'd have coming back from a deep-space mission. We believe this will be a very representative entry profile."

According to McClung, Orion's heat shield and other thermal protection materials incorporate technology from the Apollo and Space Shuttle Programs.

"We've picked some of the best from both," he said. "The heat shield on the bottom and the edge shoulders of Orion is ablative material. The back shell sides will be covered with ceramic

tiles similar to those used on the underside of the shuttle."

Ablative heat shields were used on NASA's Mercury, Gemini and Apollo spacecraft. They work using a layer of plastic resin, the outer surface of which is heated to a gas to carry the heat away by convection. The layers of the ablative material simply burn off one at a time, dissipating the heat energy.

Since each space shuttle would fly numerous times, a reusable material was developed using a thermal soak heat shield. This approach uses an insulating material to absorb and radiate the heat away from the spacecraft. The thermal protection material consisted of ceramic or composite tiles over most of the space shuttle's surface, with reinforced carbon-carbon material on the highest heat load points, the nose and wing leading edges.

Engineers and technicians continue assembly and testing of Orion in the Kennedy Space Center's Operations and Checkout Building. On May 15, 2014, the spacecraft was suspended by a crane in position for mating operations. Photo credit: NASA

"We have a great deal of historical data on Apollo re-entries," McClung said, "but Orion is a much larger vehicle."

The Apollo command module was 12 feet, 10 inches wide at the base, weighing 12,807 pounds. By comparison, the Orion command module is 16 feet, 5 inches wide at the bottom and weighs 19,650 pounds.

Engineers believe temperatures on the heat shield bottom will reach 4,000 degrees Fahrenheit. The sides of the capsule are expected to reach about 800 degrees F. McClung explained that information gathered on EFT-1 will pin down whether or not their estimates are correct.

"We have a good idea how Orion should perform on re-entry based on Apollo historical data and our computer models," he said.

Assembly of the Orion spacecraft is taking place inside the high bay of Kennedy's Operations and Checkout Building.

"The Orion heat shield should be fully attached by the end of May," McClung said.

Installation of the thermal protection tiles will be next. There will be nine panels of tiles placed on the Orion back shell. The tiles are manufactured in the Florida spaceport's Thermal Protection System Facility where experts gained extensive experience during the shuttle program.

"There were quite a few lessons learned and process improvements developed over the years we flew the shuttle," McClung said. "We're mainly using the same processes."

In the future, Orion will launch on NASA's new heavy-lift rocket, the Space Launch System. More powerful than any rocket ever built, SLS will be capable of sending humans to deep-space destinations such as an asteroid and eventually Mars. Exploration Mission-1, scheduled for 2017, will be the first mission to integrate Orion and the Space Launch System.

"EFT-1 will be an excellent first test case," McClung said. "It will help us see how well Orion will perform on an actual flight."

EXPEDITION 40

A Soyuz TMA-13M rocket launches with Expedition 40 Soyuz Commander Maxim Suraev, of the Russian Federal Space Agency, Roscosmos, Flight Engineer Alexander Gerst, of the European Space Agency, ESA, and Flight Engineer Reid Wiseman of NASA in the early hours of May 29 at the Baikonur Cosmodrome in Kazakhstan. Suraev, Gerst, and Wiseman will spend the next five and a half months aboard the International Space Station.
Photo Credit: NASA/Joel Kowsky

EXPEDITION 40: RESEARCH OUTPOST IN ORBIT

The International Space Station's (ISS) Expedition 40 crew plans to continue world-class research while hosting several resupply flights delivering supplies and spare parts to support the orbiting outpost.

Expedition 40 Commander and NASA astronaut Steve Swanson, along with Russian cosmonauts Alexander Skvortsov and Oleg Artemiev, launched to the ISS on March 25, from the Baikonur Cosmodrome in Kazakhstan aboard Soyuz TMA-12M.

The trio were joined by U.S. astronaut Reid Wiseman, cosmonaut Maxim Suraev of Russia and European Space Agency astronaut Alexander Gerst of Germany who lifted off to the station from Baikonur on Soyuz TMA-13M on May 28. All three will serve as flight engineers during Expedition 40.

The crew will work with experiments involving researchers across a variety of fields, including human life sciences, physical science investigations and Earth observation.

In June, the Orbital 2 Commercial Resupply Services Mission is due to lift off from the Mid-Atlantic Regional Spaceport at NASA's Wallops Flight Facility in Virginia. The spacecraft will deliver cargo and crew supplies to the International Space Station.

The Expedition 40 crew will spend about six months together before Swanson hands over command of the station to Suraev. Swanson, Skvortsov and Artemiev will then undock their Soyuz TMA-12M spacecraft and head for a landing in Kazakhstan in September 2014.

CREW PROFILE

Steve Swanson (Ph.D.)
Commander
Born: Dec. 3, 1960 Syracuse, New York, but considers Steamboat Springs, Colorado, to be his hometown.
Education: Bachelor's degree in engineering physics from the University of Colorado, a master of applied science in computer systems from Florida Atlantic University and a doctorate in computer science from Texas A&M University
Experience: Selected as an astronaut in 1998, was a mission specialist on STS-117 in 2007 and STS-119 in 2009., launched to the ISS as a member of the Expedition 39 and 40 crews on March 25.

Oleg Artemiev
Flight Engineer
Born: Dec. 28, 1970, in Riga, Latvia
Education: Graduated from Tallinn Polytechnic Institute, 1990. In 1998, graduated from the Moscow Bauman Technical University with a degree in low temperature physics and technology
Experience: Selected as a cosmonaut in 2003, launched March 25 to the ISS as part of the Expeditions 39 and 40 crews.

Alexander Skvortsov
(Col., Russian Air Force)
Flight Engineer and Soyuz Commander
Born: May 6, 1966, in Schelkovo, Moscow Region
Education: Graduated Stavropol Air Force Pilot and Navigator School as a pilot-engineer in 1987 and the Military Red Banner Air Defense Academy in 1997
Experience: Selected as a cosmonaut in 1997, served on Expeditions 23 and 24 in 2010 and currently on Expeditions 39 and 40.

Maxim Suraev
(Col., Russian Air Force)
Flight Engineer and Soyuz Commander
Born: May 24, 1972, in Chelyabinsk, Russia
Education: Graduated from the Kachin Air Force Pilot School as pilot-fighter, 1994. Graduated from the Zhukovski Air Force Academy as pilot-engineer-researcher, 1998, received law degree from the Russian Academy of Civil Service, 2007.
Experience: Selected as a cosmonaut in December 1997, his first spaceflight was ISS Expeditions 21 and 22 during 2009 and 2010.

Reid Wiseman
(Cdr., U.S. Navy)
Flight Engineer
Born: Nov. 11, 1975, hometown is Baltimore, Maryland.
Education: Bachelor's degree in computer and systems engineering, Rensselaer Polytechnic Institute, 1997; master's in systems engineering, Johns Hopkins University, 2006.
Experience: Selected as an astronaut in 2009, Expedition 40 is his first spaceflight.

Alexander Gerst (Ph.D.)
Flight Engineer
Born: May 3, 1976 in Künzelsau, Germany
Education: Graduated from the University of Karlsruhe, 2003, and earned a master's in Earth sciences from the Victoria University of Wellington, New Zealand. In 2010, received a doctorate in natural sciences at the Institute of Geophysics of the University of Hamburg.
Experience: Selected as a European Space Agency astronaut in May 2009, Expeditions 40 and 41 will be his first spaceflight.

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