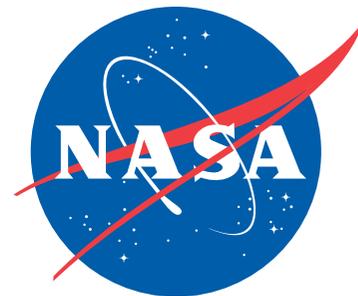


# Spaceport News

John F. Kennedy Space Center - America's gateway to the universe



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## SLF offers Morpheus realistic, rocky road

*By Cheryl Mansfield  
Spaceport News*

An area near Kennedy Space Center's Shuttle Landing Facility (SLF) will be turned into a field of hazards as part of the next phase of tests for the Project Morpheus lander. This next step, which integrates technologies, hopefully will someday be used to build future spacecraft destined for asteroids, Mars or the moon.

The lander has been undergoing testing at NASA's Johnson Space Center in Houston for almost a year in preparation for its first free flight. During that flight testing, it will rise almost 100 feet into the air, fly 100 feet laterally, and then land.

Once the lander has successfully completed a planned series of these free flight tests, the team will move on to its next challenge -- flying a kilometer-long simulated surface approach while avoiding hazards in a landing field. Morpheus integrates an autonomous landing and hazard avoidance technology (ALHAT) payload that will allow it to navigate to clear landing sites amidst rocks, craters and other hazards during its descent, and land safely.

But to put that capability to the test, Morpheus needs rocks, craters and hazards to avoid -- and that's where the SLF comes in. After evaluating several potential testing sites, project managers at Johnson determined that,



CLICK ON PHOTO

The Project Morpheus lander fires its liquid oxygen- and methane-fueled engine for a tethered test on May 4, 2011, at NASA's Johnson Space Center. With the vehicle suspended from a crane, the tethered tests allowed engineers to test their control of the vehicle with little risk of damage to the lander. For more on Project Morpheus, click on the photo.

NASA/JSC

with the addition of some hazards, Kennedy's former shuttle runway would be the best choice.

"Kennedy Space Center offers the perfect combination of capabilities," said Dr. Jon Olansen, Morpheus project manager at Johnson. "Range and airspace availability, hangar facilities, propellant handling capabilities -- and an open and often available runway near which we can build a hazard field to complete the package."

"It will be difficult to turn the relatively flat, grassy area north of the runway into a crater-filled planetary scape for Morpheus to negotiate and land in, but that's the kind of challenge that the Kennedy team thrives on," said Greg Gaddis, Kennedy's Morpheus test

Project Morpheus, one of 20 small projects comprising the Advanced Exploration Systems (AES) program in NASA's Human Exploration and Operations Mission Directorate. AES projects pioneer new approaches for rapidly developing prototype systems, demonstrating key capabilities and validating operational concepts for future human missions beyond Earth orbit.

Although the first test at Kennedy has not been scheduled, it could take place as early as June, with the series scheduled to wrap up by Sept. 30. The testing schedule is dynamic and changes as the vehicle and weather dictate. The public can follow the tests on the Morpheus' Facebook and Twitter. For more information about Project Morpheus and videos of past tests, visit the project's home page at <http://morpheuslander.jsc.nasa.gov/>.



NASA/JSC

Steam billows around the Project Morpheus lander as its plumbing is filled with liquid nitrogen for a cold-flow test on March 17, 2011, at NASA's Johnson Space Center in Houston. Project Morpheus integrates an engine that runs on "green" propellants (liquid oxygen and methane) with NASA's automated landing and hazard avoidance technology into a fully operational lander that could deliver cargo to the moon, asteroids and perhaps Mars.



# Aerospace engineers stay on course at 'Rocket University'

By Steven Siceloff  
Spaceport News

There was a launch March 15 that didn't make the news, but nonetheless was an accomplishment for engineers at NASA's Kennedy Space Center.

The launch had everything one might expect: an open area, an expected course, antennas that could pick up signals and video from the craft as it soared into the sky, and a recovery team. The operation was even led by aerospace engineers.

But this was no rocket. Instead, it was a large balloon designed to climb high into the stratosphere carrying a 6-pound box of instruments and three cameras, plus a parachute and associated equipment.

That it was being launched by engineers accustomed to dealing with space shuttles was the point of the exercise: pushing accomplished specialists out of their comfort zones. By venturing into new areas, they will pick up new technological tips along the way that are expected to pay off for future NASA missions.

The mission was a project for the new "Rocket University," an internal NASA program of courses, workshops, labs and projects offered to engineering and research pros of all types to keep their skills fresh and broaden their experiences. About 20 Rocket University students took part in the balloon launch.

"It's an opportunity for not just Kennedy, but engineers at other centers to take courses and participate in labs and actually build payloads and in some cases build rockets to stay up to speed on the technology, and to learn some really valuable skills," said Nicole Dawkins, project manager



Photo courtesy of Rocket University

NASA systems engineers Norman Peters, left, and Elkin Norena prepare the payload before it is sent aloft on a high-altitude balloon on March 15.

for the balloon mission. "What we're encouraging is, for instance, an avionics person to go off and work as a project manager."

The work, done in cooperation with University of Central Florida professors, is much deeper than hobbyist-level interest and has to stick to proven management processes, said Norman Peters, a NASA systems engineer.

UCF's Dr. Larry Chew worked with the balloon project team.

"It's advancing our ability to support customer needs, when it comes down to it," Peters said. "We're trying to enhance skills."

Working with high-altitude balloons is one area the program deals with. Others include building rockets with payloads, unmanned aerial vehicles and other aerospace specialties. Together, they cover the spectrum from low-speed to high-speed, high-altitude flight.

The 8-foot-diameter balloon the team flew, for

example, soared to 115,000 feet, a region considered near-space that offers lots of opportunities for research. It also was extremely inexpensive and the payload was assembled by the university participants using off-the-shelf parts in the team members' down times.

The launch pad was a baseball field in Oviedo, Fla., about 40 miles inland from Kennedy. Liftoff came at about 10:40 a.m. and the balloon was tracked with GPS instruments riding with it, monitored by six teams spread out along the expected path. As it climbed, it drifted east with the wind and sent back video of the ground, sky and horizon as it went along.

"We saw the burst live (from the on-board camera)," said Steve Pancoast, who worked with the balloon's avionics. "Everything worked like we expected except for some (signal) interference."

It climbed higher and higher every minute until

the pressure inside was too much and it burst. That was when the payload, a Styrofoam box holding the flight computer, cameras and other gear, fell back to Earth, deploying a parachute along the way and splashing down in the ocean about six miles offshore.

Preparing the box, about the size of a small cooler, to land in the water or on land was just one of the steps they took during the two months from start to launch. They also had to build a flight computer and set of instruments that would work in the cold air of the stratosphere and handle the speed changes of a parachute opening.

"We were combining known technologies to make a hybrid," said Elkin Norena, who worked on the power source that operated the cameras and trackers during the flight and for a time after landing so the balloon wouldn't be lost. "We had to fit our requirements into what we could get off the shelf."

"I think off-the-shelf items require a lot more research for those of us who are used to having a part handed to us that was custom-made for a certain task," Dawkins said.

The two-month deadline to build the payload and

launch the balloon provided a much more rapid schedule to the team.

"My experience has been on long-term projects," Peters said. "You're working ground support projects that can take years to come up."

Their work is not over. They just kicked off another effort that will see them drop an aeroshell from a much larger balloon launched from NASA's Wallops Flight Facility in Virginia. The experiment calls for more instrumentation and equipment to test the design, a challenge the group is excited about.

It also may open another research avenue for scientists outside the typical NASA realm, Dawkins said.

The group came away from the balloon mission energized, they said, and eager to start the more-advanced mission.

"I had a ball doing this," Peters said. "Everyone worked together very well."

"I think we've all launched many shuttles, which is probably the highlight of our careers," Dawkins said. "I would say this is the probably the most I've learned and the most fun I've had since the shuttle program ended."



Photo courtesy of Rocket University

Technicians pull in the six-pound payload box from the ocean after it parachuted back to Earth following a ride to 115,000 feet on a balloon March 15.



# Trajectory team targets perfect 'Flight Design'

By *Steven Siceloff*  
Spaceport News

Rocket science is perhaps at its most demanding for the men and women who determine where a rocket needs to go and then track it to make sure it gets there.

They work in what is called "Flight Design" and they are one of the groups most tested on launch day, when the rocket engines are burning and a spacecraft is being lofted into orbit or to a distant world.

On a good day, the rocket follows its predicted course and transmits a nearly constant stream of information to a series of antennas arrayed around the planet. The information the rocket sends is generally known as telemetry, and it tells the launch team how the vehicle is doing, whether it is healthy and the conditions onboard.

On a bad day, well, the path reads differently, the numbers don't match what was expected, and those antennas so carefully laid out months in advance are quickly reset to track a new course.

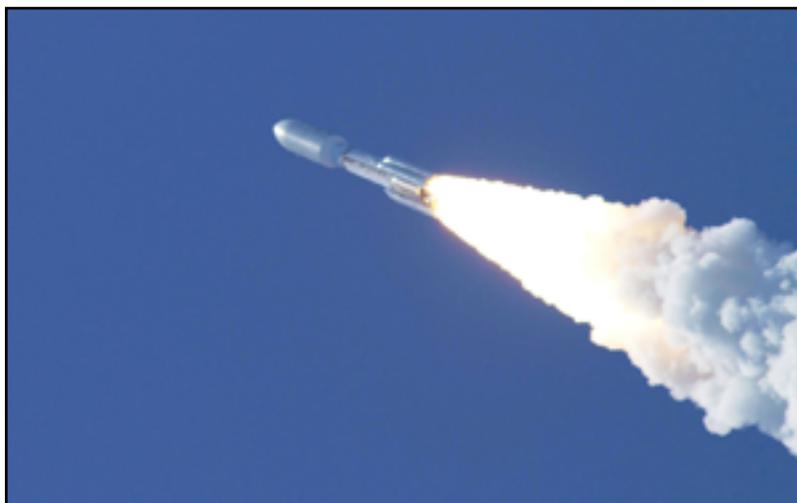
Either way, there's a lot of work for the trajectory folks starting about a year before a launch and not winding up until weeks after. But they wouldn't have it any other way.

After all, not many people get to enter a Facebook status like that of Samantha "Sam" Harris, a flight operations integration engineer with NASA's Launch Services Program. It read, "Chasing down a rocket in an airplane."

For many on the trajectory team, working so closely with rockets is fulfilling a dream.

"When I was a real little kid, I wanted to be an astronaut," said William "Bill" Benson, a flight design engineer for NASA's Launch Services Program, or LSP. "But this is what I always wanted to do. I always wondered, 'How does the rocket know to go where it wants to go?'"

Benson is part of the team that analyzes the programming that goes into a rocket's flight control computer to make sure the launch will follow its intended course, or



CLICK ON PHOTO

An Atlas V rocket heads into space Aug. 5, 2011, carrying the Juno spacecraft on a mission to study Jupiter. For more on the Juno mission, click on the photo.

NASA/Rusty Backer-George Roberts

trajectory. That means more than simply telling the rocket to start at the launch site and then stop when it reaches orbit.

The programming lays out how much thrust the engines will use at different points throughout the climb to space, when the rocket will need to point its nose toward the horizon instead of straight up, and when to fire the bolts that separate stages and discard the payload fairing that protects a spacecraft during the early portion of launch.

Aligning the launch profile for a spacecraft going into Earth orbit is tricky, but arranging the ascent for a mission to the moon or one of the planets adds more levels of difficulty since the rotation of the Earth has to be matched so that the spacecraft's trajectory will result in a rendezvous with the distant world.

"It is quite a bit more work to do interplanetary (missions)," Benson said. "The targets change at least on a daily basis, sometimes on a minute-by-minute basis."

The team has to make sure that as long as one of the engines on the launcher is firing, the rocket is being tracked and relaying data back to the team. Also, antennas have to be in position to pick up the point when the spacecraft separates from the booster and begins its mission.

When the projected course is ready, the engineers use analytical tools of all sorts, from computer models to their own intellects, to see if the programming will work.

"It doesn't get any deeper into rocket science than that," Benson said. "Being a detective is very much a part of this job."

Once the rocket and its spacecraft are flying, the trajectory team tracks the data and compares it to what was expected to determine whether everything is going well. The numbers sent back from the rocket tell a big picture story of power, speed and altitude, but also include a host of other data that get down into the details of how the rocket is functioning. They often are simple "yes" or "no" signals to indicate whether bolts fired as planned and also can relay data such as vibration and temperature aboard the launcher.

Having the various tracking stations from around the world identified for the launch is the province of a team of specialists including Harris.

"About a year before the mission is when we will start looking at which antennas will be used," Harris said. "We have to have strategically placed antennas all over the world."

It's a lot of work, but the payoff is that the controllers know exactly what occurred during a launch and can duplicate it for the next mission. If something goes wrong, then the telemetry is virtually the only source of information investigators have to search for the problem so it doesn't get repeated.

"We like data, we like to know what's going on," Harris said.

The antennas chosen range from

the powerful arrays permanently in place at and around the launch site such as those at Cape Canaveral Air Force Station in Florida, to facilities at bases in the Caribbean Sea, South Atlantic, Africa and Australia. There are more options all over the world including at bases in Hawaii, California, New Mexico, Europe and even Antarctica.

For areas in between, NASA can call on mobile antennas mounted in airplanes or on ships and even portable arrays that can be erected by a few people who take them to a mountain or coastline in the flight path. They then can be broken down to a couple of suitcase-sized carriers when the launch is complete.

NASA's orbiting Tracking and Data Relay Satellite System, called TDRSS, also is available for some launches to receive telemetry from rockets including United Launch Alliance's Atlas V, Delta II and Delta IV. Other rockets currently rely on ground tracking stations.

Which ones are chosen to track a mission depends on the rocket's planned course, and it can change, too, during the months of preparation and as launch times and events are refined.

"The trajectory is what drives us," Harris said. "It's never really done."

Even the time of day for a launch

See **TRAJECTORY**, Page 4



NASA

Ground tracking stations around the world are equipped with different kinds and sizes of antennas such as this dish at NASA's Kennedy Space Center. Other antennas can be put together and mounted in different locations. Still others can be mounted on aircraft or on a ship to follow a rocket.



# Astronaut gets familiar with SpaceX Dragon capsule

By Cheryl Mansfield  
Spaceport News

NASA mission specialist Megan McArthur was "in the house" March 28 representing NASA's astronaut corps in a crew equipment interface test in preparation for the upcoming SpaceX demonstration flight targeted for April 30.

McArthur worked together with SpaceX flight controllers for five hours in their hangar at Space Launch Complex-40 on Cape Canaveral Air Force Station in Florida, as the team entered its final phase of testing of the Dragon capsule. The upcoming SpaceX Falcon 9 rocket launch is part of NASA's Commercial Orbital Transportation Services (COTS), which aims to begin regular commercial company cargo flights to the International Space Station.

The interface test, known as the CEIT, is an activity that dates back to the Space Shuttle Program, when it provided a training opportunity to prepare astronauts still on Earth for their missions in space by working with the actual hardware they would use.

The CEIT gives astronauts, payload integration personnel and SpaceX engineers a final opportunity to test and familiarize them-

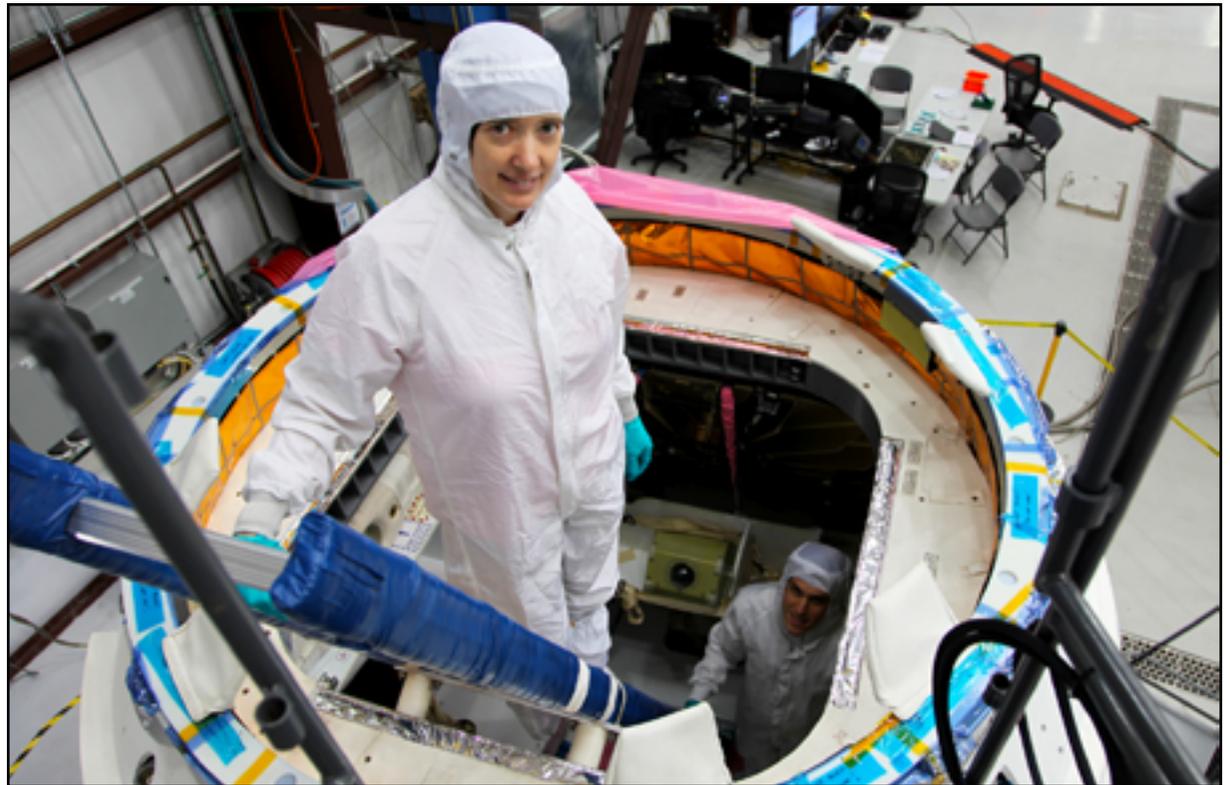


Photo courtesy of SpaceX

NASA astronaut Megan McArthur takes part in a crew equipment interface test inside the Dragon capsule in the SpaceX hangar at Cape Canaveral Air Force Station's Space Launch Complex-40 on March 28.

selves with the Dragon spacecraft. The capsule is as close to flight configuration for launch as possible although it still is undergoing final equipment integration and testing on the ground. The exercise provides a hands-on assessment of the compatibility of the equipment and systems aboard the Dragon with the

procedures to be used by the flight crew and flight controllers.

This was the last time for the SpaceX team to check the capsule's equipment and its associated interfaces.

Flight controllers were able to walk through the procedures they will use once the Dragon is berthed

at the International Space Station.

McArthur spent 13 days in space, serving as a crew member aboard space shuttle Atlantis on the STS-125 mission, the final servicing mission to NASA's Hubble Space Telescope.

McArthur remains an active member of the astronaut corps.

## From **TRAJECTORY**, Page 3

can change which antennas get called up, Harris said. For instance, NASA's Mars Science Laboratory launch had courses that took it over the Indian Ocean, Africa or Australia depending on when it lifted off from Florida. Therefore, NASA had to have antennas at all the locations ready to go to work.

For each adjustment, engineers have to calculate how that will affect the rocket's performance. In other words, if the launcher is told to fly another degree farther south to take it over a particular tracking station, will it still have enough energy to reach orbit?

"There's always a trade-off," Benson said. "Sometimes it's easier to get a mobile antenna in place."

The detailed work, including

all the changes along the way, are important because the researchers relying on the spacecraft have worked so hard for years and years to get everything right, Harris said.

Harris began her trajectory career when she was 24, a choice she made so she could be in a job that was not the same thing, day-in and day-out.

"I would say I scored my dream job right out of college," she said. "It's a lot more hands-on than I expected and it's a lot more work than I expected and I love it for that."

Harris was flying inside an airplane assigned to track the Glory spacecraft's launch into orbit from Vandenberg Air Force Base, Calif. When the fairing on the Orbital Sciences Taurus rocket failed to separate as planned, the rocket changed its course because it was

heavier than expected.

Suddenly, the airplane's crew had to adjust its own course to keep the antenna pointed at the rocket as long as it could to retrieve the critical data that would allow engineers to pinpoint what went wrong.

Benson was part of the launch team looking at the data from the Glory mission as it came in. He said it was apparent quickly that the launch was failing.

"There were 'discretes,'" Benson said. "The switches that would show the payload fairing separated, they didn't change status when the separation command was issued. The temperature data inside the fairing didn't change."

There have been many successful launches, too, with a number of notable achievements coming in the past year, such as the GRAIL

mission to the moon, the Curiosity rover also known as the Mars Science Laboratory, and the Juno mission to study Jupiter and its magnetic field in detail.

The teams of engineers are working now with the upcoming NuSTAR mission to launch an observatory into Earth orbit that will survey the cosmos for black holes and the remnants of stars that recently exploded.

The conclusion of every mission leads to an intense data review during which engineers pore over all the telemetry the rocket and spacecraft sent during the time it took to get into space.

The returns are crucial, Benson said.

He added, "If we didn't have telemetry, we'd never be able to improve."



# Scenes Around Kennedy Space Center



NASA/Jim Grossmann

Lt. Governor of Florida Jennifer Carroll visits Kennedy Space Center on April 5 to meet with Center Director Bob Cabana. Cabana provided Carroll a tour of Kennedy's Orbiter Processing Facility-1 and space shuttle Atlantis, which included sitting in the commander's seat on the flight deck. The spacecraft is being prepared for public display at the Kennedy Space Center Visitor Complex.



CLICK ON PHOTO

NASA/Cory Huston

Mike Williams, a thermal protection system technician with United Space Alliance, arranges weights atop a freshly installed section of tile on the right wing of space shuttle Endeavour at Kennedy Space Center on April 3. The weights will hold the section in place while the adhesive hardens beneath. Ongoing transition and retirement activities are preparing the spacecraft for public display at the California Science Center in Los Angeles. Endeavour flew 25 missions during its 19-year career. For more on the space shuttles' transition and retirement, click on the photo.



NASA/Tim Jacobs

A Pratt and Whitney Rocketdyne space shuttle main engine, or SSME, is rotated into a horizontal position with the aid of an engine-handling device attached to a crane inside the SSME Processing Facility, the engine shop at Kennedy Space Center, on March 28. The engine will be placed in a horizontal position on a portable workstand. The engine is one of the last SSMEs remaining at Kennedy and is being prepared for shipment to NASA's Stennis Space Center in Mississippi. The first two groups of engines were shipped from Kennedy to Stennis in November 2011 and January 2012. The remaining engines are scheduled to depart on April 9. Altogether, 15 shuttle-era engines will be stored at Stennis for reuse on NASA's Space Launch System heavy-lift rocket, under development.

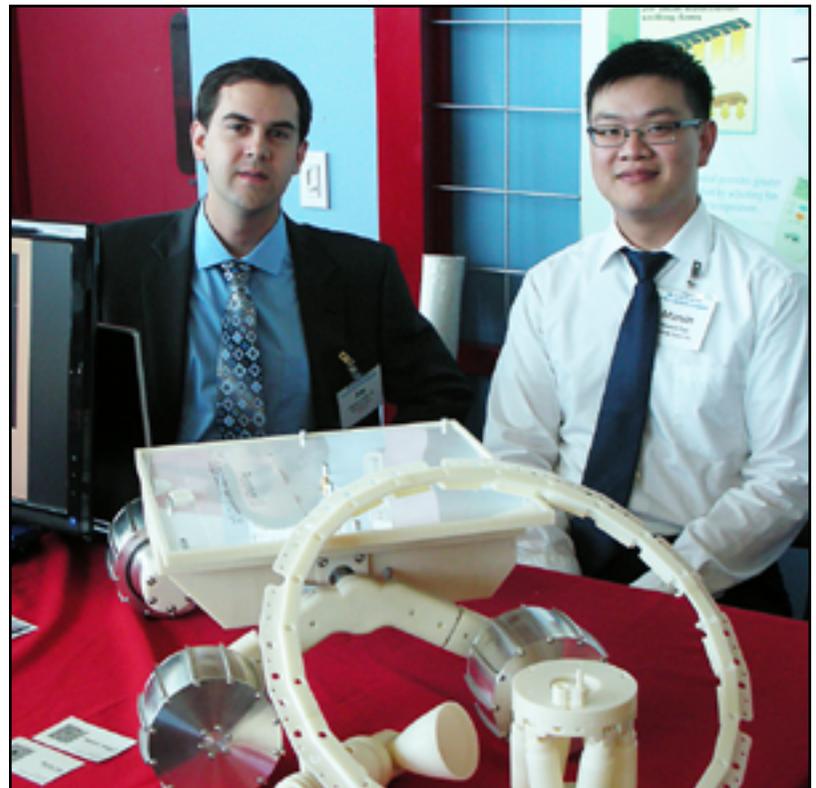


Photo courtesy of Space Florida

Joe Palaia and Marvin Tsoi, from Florida's Omega Envoy Team, inform attendees about their progress and the hardware they use as they prepare to build a lunar lander prototype and compete in the Google Lunar-X Prize Competition during the Space Florida and the NASA Florida Space Grant Consortium "Space Flight Payloads Workshop" at the Florida Solar Energy Center in Cocoa on March 23.



# All-American Picnic celebrates 50 years, 'Greenateers'

By Frank Ochoa-Gonzales  
Spaceport News

We've all heard of the Musketeers. Well, some attendees of the 2012 KSC All-American Picnic on April 14 will have the opportunity to be "Greenateers"

"A Greenateer is someone between the ages of 4-17 who participates in the Greenateering Adventure to better understand how being green conserves energy, reduces pollution and saves money," said Alice Smith, Kennedy Space Center's Recycling and Sustainable Acquisition Program manager. "While environmentally friendly activities have been popular for many decades, being a Greenateer takes it to another level."

As Kennedy celebrates its 50th anniversary, the center has proven to be a leader in sustainability. The past five All-American Picnics have diverted more than 7 tons of picnic-related waste from local landfills.

With Earth Day following a week later, on April 22, it's a no-brainer that the picnic will be the site for the annual KSC Earth Day/Sustainability Fair. Kennedy will host vendors that promote green, sustainable products or services for commercial or residential use.

Participants can top by the Sustainability Fair's



CLICK ON PHOTO

Kennedy Space Center Director Bob Cabana, under NASA insignia, and the 2012 All-American Picnic committee display the KSC Picnic ticket. For more information on the picnic, click on the photo.

NASA/Tony Gray

welcome table to learn what they and their families can do every day to keep the planet healthy. They also can find out about Earth-friendly businesses in their communities.

The food and drinks will be served using plates, bowls, cups and utensils that are biodegradable and compostable. They're all made of corn, sugarcane or recycled paper and will become healthy new soil for the Earth in just a few months.

Smith said the plan this year is for the compostable waste to be ground up and buried at KARS Park 1, where it will feed plants and enrich the soil.

## More online

For more information on the 2012 All-American Picnic, go to <http://kscpicnic.ksc.nasa.gov>.

To see images from 30 years of picnic fun, go to <http://kscpicnic.ksc.nasa.gov/thirtyyears.htm>.

To learn to learn more about biocompostable tableware and opportunities for eco-friendly alternatives to everyday products, go to [www.thorpackgreen.com](http://www.thorpackgreen.com) and [www.worldcentric.org/bio/index.htm](http://www.worldcentric.org/bio/index.htm).

There will not be regular trash cans at this picnic, Smith said. Instead, six collection stations will be strategically placed around the park, with separate containers for different types of waste. Helpers and signs at each station will make it easy for everyone to put waste in the right place. A mobile mechanical grinding unit from SOMAT Waste Reduction Technology will be on site to pulp all of the waste material prior to onsite processing.

Fans of corn on the cob, can be rest assured those

leftover cobs won't be heading to a landfill either. The cobs will be collected in special containers around the park and a local farmer will take them to feed his animals. At last year's picnic, more than 800 pounds of corn cobs were collected.

All-time favorites still are on the program, such as the car and motorcycle show and chili cook-off.

Live entertainment will feature Dr. Dan the Magic Man from Cocoa Village and a four-piece, female-fronted band called Landslide.

KSC Idol, KSC's Got Talent, and Earth day activities will all be held at this year's picnic.

In addition, there will be a 50th anniversary-themed exhibit that celebrates the past, present and future of Kennedy.

Exhibits from Kennedy's commercial partners and local groups will display projects and concepts of what the future has in store for space exploration and operating in a sustainable way. This includes fun and interactive events for the

kids with hands-on activities, such as a sustainability scavenger hunt.

Astronauts scheduled to sign autographs and snap photos with attendees are STS-118 and STS-133 Mission Specialist Alvin Drew, Jack Fischer and Serena Auñón, members of the 2009 astronaut class.

"I'm excited to see all the new events in action this year, especially laser tag," said picnic committee chair, Billy McMillan. "But I really am looking forward to the 10 a.m. start time because that's when the daylong celebration of our amazing work force begins."

This year's greening effort is being coordinated by Center Operation's Environmental Management Branch. Primary sustainability support is being provided by United Space Alliance, Innovative Health Applications and URS Corp.

Remember, the Three Musketeers' motto was "All for one, and one for all." Back then, they weren't talking about Mother Earth, but they could have been, considering the importance of going green.



## Be a Greenateer

Five unique stations explain how today's KSC All-American Picnic is helping the Earth. Visit each station – and win a prize! Here's how the adventure works:

- Visit the Sustainability Fair's welcome table and pick up a Greenateering map.
- Mr. E. B. Green marks each Greenateering station on the map.
- Go to each station, read the Greenateering sign, and punch a hole in the map.
- Return the completed map to the Sustainability Fair welcome table to pick up a prize.

## 2012 All-American Picnic pet policy

The annual KSC All-American Picnic continues its policy of KARS Park which does not permit any pets on the picnic grounds, excluding service or assistance dogs. This policy is enforced out of respect for and safety of all the animals. The nature of some of the events held on the grounds requires caution to prevent possible injury to the animals being exhibited. Also, crowds can be a threat to the safety of pets.

Do not leave pets unattended in parked cars, regardless of whether a window may be open.

KARS Park patrons occupying campsites are permitted to keep pets on their campsites only. These pet owners should exercise caution to prevent possible injury to their pets, exhibited animals and picnic attendees.

For more information, email Sam Talluto at [sammie.s.talluto@nasa.gov](mailto:sammie.s.talluto@nasa.gov).



# SCA crews focus on ferrying shuttles home

By Kay Grinter  
Reference Librarian

Space shuttle missions came to an end in 2011, it's true, but that doesn't mean that the shuttles have stopped flying.

Space shuttles Discovery, Enterprise and Endeavour will each take to the air one final time in 2012, bound for their retirement destinations aboard a Shuttle Carrier Aircraft, or SCA, a modified Boeing 747 jet.

The trio will travel piggyback on NASA 905, the first of two SCAs NASA acquired during the Space Shuttle Program. NASA 905 has been assigned to 65 ferry missions.

Discovery's trip from Kennedy to Washington Dulles International Airport in Sterling, Va., is planned for April 17. NASA 905 will arrive in Florida a week before to allow plenty of time for mate/demate operations with the spacecraft.

NASA's specially trained SCA pilots and flight engineers keep their skills sharp with practice flights in an SCA about every three weeks and simulator training twice a year.

Pilot Jeff Moultrie will serve as the commander of the flight crew for Discovery's ferry flight and will deliver 905 to Kennedy on April 10. He is prepared for any contingency.

"In the simulator, we only practice problem scenarios," Moultrie said. "We have two of the best pilot and engineer instructors in the world: Tom Speer and Tim Sandon. They have a world of experience and are an integral part of our program."

The prime flight crew for Discovery's upcoming ferry also includes SCA pilot Bill Rieke and SCA weather pilot Arthur "Ace" Beall.

"The simulator has a software program installed to simulate the flying characteristics of a mated SCA," Beall said. "It's very realistic. The instructors simulate a variety of emergencies during



NASA/Tony Landis

From left, pilots Jeff Moultrie, Bob Zimmerman and Henry Taylor deliver Shuttle Carrier Aircraft (SCA) NASA 911 to NASA Dryden Flight Research Center's Aircraft Operations Facility on its final flight in February 2012. Moultrie will be the SCA commander for shuttle Discovery's ferry flight April 17 to the Washington Dulles International Airport aboard NASA 905. Taylor, the most experienced SCA flight engineer, will be celebrating his birthday at Kennedy Space Center on April 16. The three remaining shuttle ferry flights will be aboard NASA 905.

the three-day sessions. System malfunctions and engine failures are practiced repeatedly, including two-engine flights, approaches and landings."

Beall will analyze weather conditions aboard a "Pathfinder" aircraft which flies about 100 miles ahead of the SCA.

"The weather pilot advises the SCA crew via radio of the flight conditions on the ferry route," Beall said. "Describing the situation and explaining the alternate route is a dynamic situation, something that is usually changing all the time."

The main weather hazard is rain. "The mass of a raindrop at the speeds being flown will damage the shuttle tiles in a matter of seconds," Beall explained, "so if any rain is encountered or observed, the weather pilot offers alternate routes and altitudes to the SCA crew."

"Additionally, the SCA does not have much extra fuel to maneuver significant distances around rain, so finding the most efficient, rain-free route in a short amount of time can be challenging. Turbulence is also a factor."

During a normal flight, the SCA might use 20,000 pounds of fuel an hour; with an orbiter on its back, that number could double.

The SCA program now has six pilots and two flight engineers, "some

of the best crew members that I have ever worked with," Moultrie said.

"We also are very lucky to have top-notch flight engineers Henry Taylor and Larry LaRose who do a great job running the systems on the airplane and keeping the pilots on the 'straight and narrow.'"

Taylor, the most experienced member of the SCA team, will be at Kennedy as he celebrates his 60th birthday April 16, preparing to do one of the things he does so well.

Once Discovery arrives safely in Virginia, NASA 905 will give the shuttle prototype Enterprise a lift to

the John F. Kennedy International Airport in New York.

Later this year, NASA 905 also will support the last-ever shuttle ferry flight when it transports shuttle Endeavour to the Los Angeles International Airport.

"When flying a mated SCA, there are plenty of eyes watching us," Moultrie said. Crowds often turn out for the perhaps once-in-a-lifetime sight. "From a pilot's perspective, we always want (to execute) a nice landing."

NASA retired its only other SCA, NASA 911, in February. After it was commissioned in 1990, NASA 911 performed 20 of the 85 ferry flights to date.

Although less utilized, NASA 905 may have had the more "exotic" career, however, teaming up with Enterprise from February and November 1977 for the shuttle program's Approach and Landing Tests at the Dryden Flight Research Center in California. NASA 905 also accompanied Enterprise on a European tour in 1983 that included runway viewings for the public in Germany, at the Paris Air Show and outside London.

The traveling companions returned home to the U.S. amid much fanfare, with thousands turning out in the heat at Dulles for a glimpse from a distance.

Perhaps some of those same fans will show up at Dulles on April 17 to welcome Discovery "home" nearly 29 years later.



NASA file/2009

Space shuttle Discovery returns to Kennedy Space Center atop a Boeing 747 Shuttle Carrier Aircraft, or SCA, on Sept. 21, 2009, following the STS-128 mission to the International Space Station. Discovery was forced to land at Edwards Air Force Base in California after landing opportunities at Kennedy were waved off on two days due to inclement weather. The flight from Edwards to Kennedy's Shuttle Landing Facility required three fueling stops that included an overnight stay in Louisiana. Even so, the SCA weather officer had to navigate the piggybacked shuttle through a line of showers across Louisiana and around Kennedy.

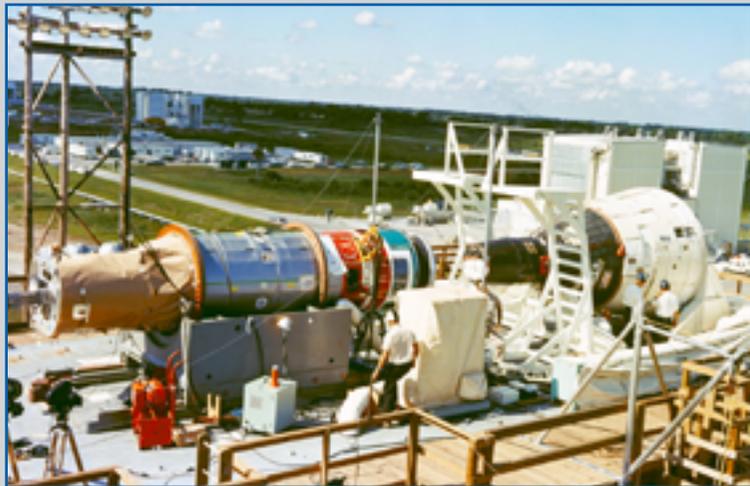
## More information

For more on the history of the shuttle's ferry flights, visit [www.nasa.gov/mission\\_pages/shuttle/flyout/ferryflight.html](http://www.nasa.gov/mission_pages/shuttle/flyout/ferryflight.html)



In celebration of Kennedy Space Center's 50th anniversary, enjoy this vintage photo . . .

# FROM THE VAULT



NASA file/1965

The Gemini 6 spacecraft (right) and the Agena target vehicle (left) undergo tests of the spacecrafts' docking capability on the Boresight Range Tower in the Industrial Area at Kennedy Space Center on Sept. 30, 1965. The Gemini astronauts attempted to dock their spacecraft with the Agena in Earth orbit as practice for the maneuvers that eventually would be required to accomplish a successful lunar landing mission.



CLICK ON PHOTO

NASA

## Parachute drop test demo a success for Boeing Co.

The Boeing Company's CST-100 boilerplate crew capsule floats toward a smooth landing beneath three main parachutes after being released from an Erickson Sky Crane helicopter at about 11,000 feet above Delmar Dry Lake Bed near Alamo, Nev., on April 3. This is one of two drop tests that Boeing will perform for NASA's Commercial Crew Program (CCP) in order to validate the spacecraft's parachute system architecture and deployment scheme, characterize pyrotechnic shock loads, confirm parachute sizing and design, and identify potential forward compartment packaging and deployment issues. For more about CCP and its commercial partners, click on the photo.

## Looking up and ahead . . .

\* All times are Eastern

### 2012

June	Launch/Reagan Test Site Kwajalein Atoll: Pegasus XL, NuSTAR Launch window: TBD
No earlier than May 5	Launch/CCAFS (SLC-41): Atlas V, AEHF 2 Launch window: TBD
Targeted for April 30	Launch/CCAFS (SLC-40): SpaceX Falcon 9, Dragon C2/C3 Launch time: 12:22 p.m.
No earlier than June 28	Launch/CCAFS (SLC-37B): Delta IV-Heavy, NROL-15 Launch window: TBD
No earlier than Aug. 23	Launch/CCAFS (SLC-41): Atlas V-401, RBSP Launch window: 4:07 to 4:27 a.m.
No earlier than September	Launch/CCAFS (SLC-37B): Delta 4, GPS 2F-3 Launch window: TBD
Dec. 1	Launch/VAFB: Pegasus XL, Interface Region Imaging Spectrograph (IRIS) Launch window: 6:32:24 to 6:37:24 a.m.
No earlier than December	Launch/CCAFS (SLC-41): Atlas V, Tracking and Data Relay Satellite-K (TDRS-K) Launch window: TBD



John F. Kennedy Space Center

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