

# STS 121

by Brad Thomas

**NASA** will continue the on-orbit testing of new equipment and repair procedures for space shuttles when mission STS-121 visits the International Space Station later this year.

STS-121, the second Return to Flight test mission, will carry on demonstrations of safety improvements that debuted on the first Return to Flight mission, STS-114,

deliver critical hardware and a new crewmember to the space station, bringing the orbital outpost's crew complement back to three.

"The main goals of STS-121, first and foremost, are that we're the second and final Return to Flight test mission," Lindsey said. "The second one... is purely space station objectives. We will be

STS-104 flew to the station in 2001. His new crew is a mixture of veterans and first-time fliers.

The pilot is Mark Kelly, who will make his second trip to the station. Kelly, a commander in the U.S. Navy, served as the pilot of STS-108 in 2001.

Mission Specialist Piers Sellers, who holds a doctorate in biometeorology, will make his second flight into space. Sellers served as a mission specialist on STS-112 in 2002.

Mission Specialists Mike Fossum, Stephanie Wilson and Lisa Nowak will make their first spaceflight on STS-121. Wilson and Fossum worked for NASA before joining the astronaut corps. Nowak came to NASA from the Navy, where she holds the rank of commander.

Also scheduled to fly to the station on *Discovery* is European Space Agency (ESA) astronaut Thomas Reiter. When *Discovery* leaves the station, Reiter will stay behind to work under an agreement between ESA and the Russian Federal Space Agency. Reiter's presence will give the station a three-member crew for the first time since Expedition 6 returned to Earth in May 2003. He will also be the first ESA astronaut to live aboard the space station for a long-term mission.

Reiter said that STS-121 and the arrival of a third station crewmember will be a good sign for the future.

"I think this moment signifies that we are getting back on track, if I may say so," Reiter said. "There has been an interruption of three years where only two

people were working onboard the station, and now we are actually back in a state that we can continue with the assembly."

STS-121 will begin its journey to the station when *Discovery* lifts off from Kennedy Space Center in Florida. After entering orbit, the crew will spend about 48 hours preparing for *Discovery's* arrival at the station and conducting inspections of the orbiter's heat shield.

After docking with the space station on Flight Day 3, the STS-121 crewmembers will conduct joint operations with the station's expedition crew. Activities will include cargo transfers and three spacewalks.

*Discovery* is slated to undock from the station on Flight Day 11 and land at Kennedy's Shuttle Landing Facility on Flight Day 13. STS-121 will be the 115th shuttle mission and *Discovery's* 32nd flight. Also, it will be the 18th space shuttle mission to visit the space station.

The STS-121 crewmembers are scheduled to perform three spacewalks to conduct tests for on-orbit inspection and repair techniques for the orbiter's heat shield, perform station maintenance and install spare parts for future use on the station. Sellers and Fossum will perform all three excursions. Sellers has accumulated 19 hours and 41 minutes of spacewalking time during three spacewalks during STS-112. Fossum will conduct his first spacewalks on this mission.

STS-121's three spacewalks will be performed from the station's airlock while the orbiter is docked to the complex. During one spacewalk, Sellers and Fossum will test a 50-foot robotic arm boom extension as a heat shield repair and inspection platform.

"The idea is that we're going to test the suitability of this system for something to stand on and work from while doing a repair on a shuttle," Sellers said. "We're going to put this whole system through a series of tests to see how well it works as a stable platform."

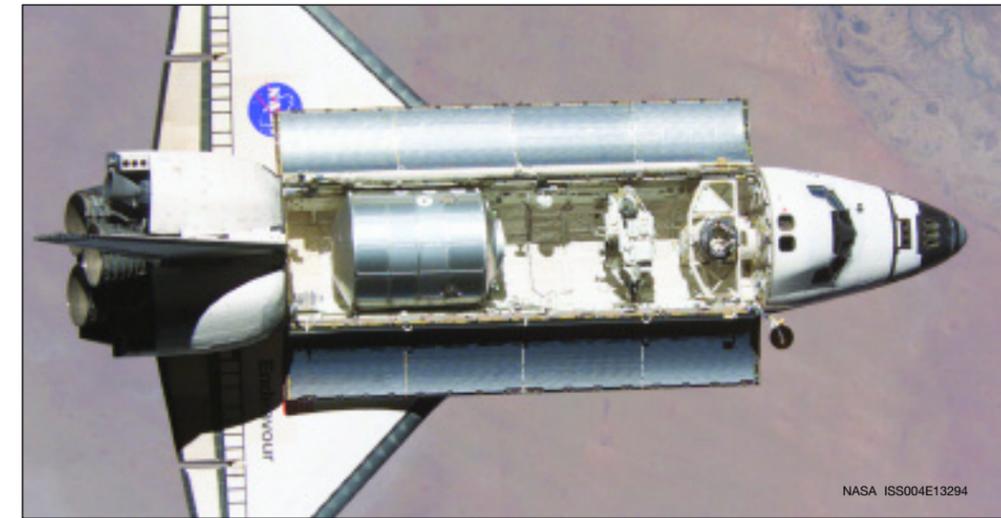
During another spacewalk, Sellers and Fossum will contribute to the construction of the space station by installing a spare part on the outside of the station for future use. The spare part is a pump for the station's thermal control system. They

will also take on tasks to restore operating capability of the station robotic arm's mobile railcar. One of two power, data and video cables for the system was inadvertently cut in December 2005.

A third spacewalk will include tasks to test techniques for inspecting and repairing the reinforced carbon-carbon (RCC) segments that protect the orbiter's

devoted to later shuttle flights is going to come in our MPLM."

On Flight Day 4, the station's robotic arm will lift Leonardo from the payload bay and attach it to the station's Unity Connecting Module. Then the station and shuttle crews will spend the next several days unloading the cargo and refilling Leonardo with trash, equipment and



*The Leonardo Multi-Purpose Logistics Module rests in Space Shuttle Endeavour's payload bay during a previous trip to the space station. Leonardo will make its fourth trip to the orbital outpost during STS-121.*

nose cone and wing leading edges. The inspections will be done with an infrared camera, and the crew will use special sealants and plugs to repair simulated RCC segments in *Discovery's* payload bay.

In addition to a new crewmember, *Discovery* will deliver supplies and equipment to the station. More than two tons of cargo will make the trip to the station inside NASA's Italian Multi-Purpose Logistics Module (MPLM), known as Leonardo. This pressurized cargo compartment will ride in the space shuttle's payload bay along with the spare parts for the station.

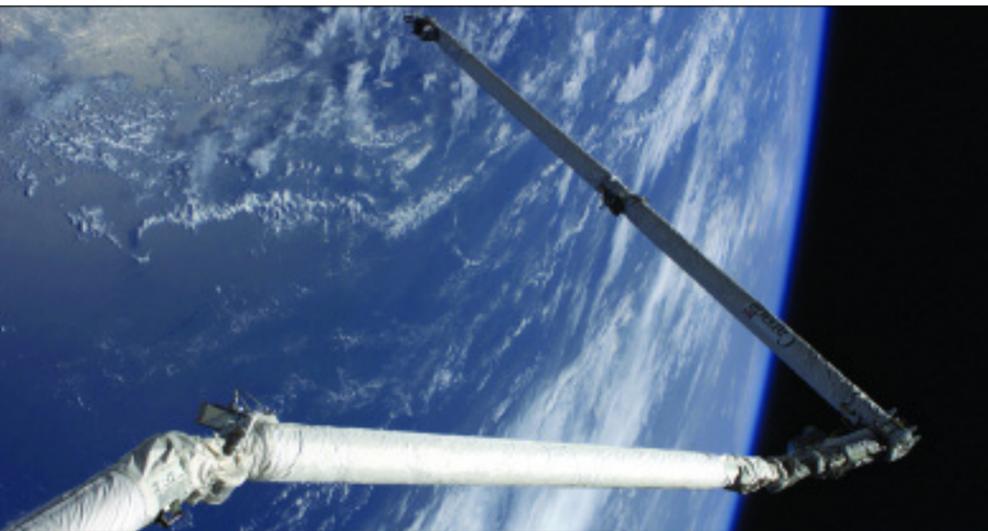
Kelly said that Leonardo will deliver a wide range of cargo to the station. "We've got a lot of supplies for the crew of the space station that will be inside," Kelly said. "We have some racks that will go in the U.S. Laboratory and then a lot of gear. Things tend to wear out in space, so we're bringing a lot of supplies that will replace things within the space station and on the outside of the space station, stuff that's



*The space station soars above the Earth after Space Shuttle Discovery undocked during STS-114 in August 2005. Discovery is scheduled to make its second consecutive visit to the station during STS-121.*

experiments that will return to Earth. The robotic arm will return Leonardo to the payload bay before *Discovery* undocks. STS-121 will be Leonardo's fourth trip to the station.

The STS-121 mission has a number of objectives. "It's going to be a full plate," Fossum said, "and there's no one thing that I could say would be my definition of mission success. We're going for all of it."



*The remote manipulator system robot arm and its 50-foot extension, called the orbiter boom sensor system, flex above the Earth during STS-114. The boom will return to action during STS-121 when it is used during inspections of Space Shuttle Discovery's heat shield.*

and build upon those tests. STS-114, which launched in July 2005, was the first shuttle mission to fly since the loss of *Columbia* and the STS-107 crew on Feb. 1, 2003.

*Discovery* and its crew, led by Commander Steven Lindsey, will also

transferring back and forth and re-supplying the station with transfer items, and also taking off the stuff that's used up, old food trays and things like that."

Lindsey, who served as the pilot on two previous shuttle missions, commanded his first shuttle flight when

# High-flying junk

by Brad Thomas

In addition to the International Space Station and other satellites, millions of objects are orbiting the Earth. The majority of these objects are the remnants of robotic and human spacecraft and are known as orbital debris, or space junk.

The Department of Defense (DOD) uses radar to track debris, but not every piece can be tracked. It is important for NASA to know what the entire orbital debris environment is like and the associated risks. Since tracking only gives part of the picture, NASA's Orbital Debris Program attempts to paint the rest of it.

"Our principal job is to characterize the orbital debris environment and analyze the risk to orbital spacecraft," said Nicholas Johnson, chief scientist and program manager for orbital debris.

Orbital debris is defined as human-made materials orbiting the Earth that no longer fulfill a useful function. Space debris includes both orbital debris and meteoroids, which are natural in origin. "Everything now in orbit around the Earth is (human-made), except the moon," Johnson said.

Johnson said that debris larger than 10 centimeters in diameter are tracked by the DOD's Space Surveillance Network, headquartered in

Cheyenne Mountain, Colorado Springs, Colo. The Orbital Debris Program office is responsible for assessing the environment for debris smaller than 10 centimeters.

Currently, the DOD is tracking more than 13,000 objects that are larger than 10 centimeters. Johnson said that more than 100,000 pieces of orbital debris that are between one and 10 centimeters and millions of pieces smaller than one centimeter are circling the Earth.

The threat that debris poses to spacecraft is one that NASA and the DOD take seriously. Johnson said Cheyenne Mountain personnel search every eight hours for objects that could come close to the station.

If an object's orbit places it close enough to the orbital track of the station, with a greater than one in 10,000 chance that it will hit the station, Mission Control will initiate a collision avoidance maneuver. Johnson said an avoidance maneuver is performed about once a year.

To date, if a collision avoidance maneuver had not been performed, the closest that a tracked piece of debris would have come to hitting the station was one kilometer in 2003.

The Orbital Debris Program's work is not limited to human spaceflight endeavors. "Every NASA



John Opiela, orbital debris scientist, displays the distribution of space debris orbits around the Earth.

project has to do an orbital debris assessment prior to launch," Johnson said. "Every report comes through our office and we evaluate if the reports are compliant—if not, we help them."

Johnson said there are four basic principles that the orbital debris group checks. The first principle is the risk of inadvertently creating debris that is not necessary; the second is to limit the probability that an explosion can occur in space; the third involves studying what happens to a spacecraft or a rocket stage once its mission is completed; and the fourth is to look at the danger that any debris can pose to humans on the ground.

Johnson said that all U.S. government agencies and the international community have adopted these four basic principles, which were formulated by NASA in the 1990s.

The Orbital Debris Office also creates models to describe the environment. But before models can be created, data must be collected.

Lead Measurements Scientist Gene Stansbery is one of the people who collects the data. "My job is to figure out how much junk is up there in space and to figure out where it is and where it is going," Stansbery said.

Stansbery said the group uses information gleaned from statistical sampling based on data gathered from a worldwide network of radars, telescopes and other tools.

The orbital debris group assesses the debris environment up to 40,000 kilometers. Stansbery said the greatest concentration of orbital debris is found at an altitude of 850 to 1,000 kilometers. Fortunately, the shuttle and station, which orbit the Earth at an altitude below 600 kilometers, are in an area that is less dense.

"The shuttle and station are flying in an area where atmospheric drag cleans out debris," Stansbery said. "The issues we have with debris would be worse if they were at a higher altitude."

After the data are collected and analyzed, the orbital debris team creates a series of models. Dr. Mark Matney, a space scientist, is the modeling lead.



Heather Rodriguez, orbital debris scientist, places a simulated orbital debris sample on a robotic arm to study its optical properties.

"The objects we see are the tip of the iceberg," Matney said. "There are a lot that are too small to track but just as serious."

Since they are too small to track, one must fall back on statistical modeling. "We take the data from the instruments and turn it into useful information," Matney said.

In addition to the environmental models, there are numerous other models. One of them is used to predict how much debris would be created by an explosion. Another model predicts what will happen in the debris environment if no further action is taken. The group also models what can happen during a shuttle mission.

The models fill in the gaps not covered by known data. "Modeling is behind everything," Matney said. "We have to make sense of the data to hand off to the engineers."

Matney said orbital debris should be a concern for all. "The orbital debris environment has no international boundaries," he said.

Like pollution on Earth, orbital debris is a worldwide problem. Johnson, who is also the U.S. expert to the United Nations for

orbital debris, said that if orbital debris was left unchecked the problem would get worse. Johnson said that NASA and other groups are making progress on space operations with the guidelines and other steps. He credits the four guidelines that NASA adopted in the 1990s with the reduction of newly created orbital debris.

"It is easier not to pollute than to clean it up," Johnson said.

The Orbital Debris Program is also involved in identifying objects that fall back to Earth as well as predicting what objects will reenter the atmosphere.

Four days before an object is forecast to fall back to Earth the DOD will begin providing information on the reentry point.

Johnson said the group gets a few calls a year from people who claim to have pieces from a spacecraft, and in some instances they do. "We can confirm satellite debris within minutes," Johnson said.

So far, orbital debris has not caused harm to humans or property on Earth's surface. "In almost 50 years, there have been no reports of injuries or significant damage," Johnson said.

# Giving NASA a voice

THE SPEAKERS BUREAU ALLOWS JSC EMPLOYEES TO SPEAK OUT ABOUT A TOPIC NEAR AND DEAR TO THEIR HEARTS—THE SPACE PROGRAM

by Catherine E. Borsché

What would happen if everyone in a choir had the same voice and tone when they sang? The music the singers would produce would be pretty dull, and not many would choose to hear it. However, consider what would happen if you added many different singers to a choir, each with a unique sound and musical quality. The music they produced would be stunning, with a wide array of melodic sounds and harmonies. Wouldn't you rather listen to that second choir sing?

That is how it is when one chooses to be an ambassador for the space program. The fewer people involved in spreading NASA's story, the less likely it is that the public will clamor to hear about what we are doing to benefit the world.

"I think there's a lot of misconceptions [about NASA], because really the only things the public hears about NASA is what's on the news or what they choose to go and read themselves," Jennifer Rochlis, human factors and robotics engineer, said.

The Speakers Bureau works daily to change that with a force of almost 200 speakers. The Speakers Bureau is responsible for coordinating speaking requests from the public, including schools, universities, conferences, clubs and more, and matching the requests with NASA civil servant speakers.

"In addition to speakers educating audiences on the roles they play in support of the space program, they inspire public support by personalizing NASA's presence in their everyday life. Most Americans know about astronauts, but are unaware of the scientists and other professionals that make up the majority of the NASA workforce," Linda Matthews-Schmidt, community relations manager, said.

"Young people in particular don't realize, unless they hear from a NASA speaker, that they can follow their chosen profession, be it a doctor, lawyer, accountant, engineer or even journalist, and still work for NASA."

To become a part of this "ambassador corps" only takes a few minutes.

"Those who are interested in joining the Speakers Bureau can just call or send me an e-mail and request to be put on the Speakers Bureau e-mail distribution list," Deandra Young, Speakers Bureau coordinator for the JIMMS contract, said. "Once they do that, about each week they'll get a 'Speaking of NASA' e-mail, an electronic flyer that lists all the new speaking opportunities that we have available."

Speakers then use that flyer to sign up for speaking engagements, which are on a first-come, first-served basis. It is also important to know that there are no "qualifications" to be a speaker. Since

each JSC employee's career and story has a unique slant to the overall NASA mission, the more volunteers the better.

JSC speakers believe deeply in their mission to spread the word about NASA.

"The big picture is that the Space Act says the number one purpose of this agency is to share our knowledge with the public," said Jack Bacon, systems engineer in the International Space Station Program Integration Office.

Bacon says that judging from feedback he has received, the public does care deeply about NASA and is reading about the space program. He often gets various questions about crewless missions, micrometeoroid debris and even going to the bathroom in space at speaking events.

Not only does speaking about NASA to the public benefit NASA, but it is also gratifying for the speakers. Many have wonderful memories from their speaking engagements.



JSC team members learn more about the Speakers Bureau and the resources available to them at an annual volunteer recruitment event in the Teague Auditorium.

"The ones that are really fun are the elementary school kids," said Mike Lutomski, risk manager for the International Space Station Program. "It's not as cool for [fourth or fifth graders] to show enthusiasm, but when they are in kindergarten, first, second or third grade, they just go bananas!"

Rochlis had a touching experience after speaking to a group of teachers and students with the NASA Explorer Schools.

"The moment that really stood out for me was when a young girl, probably no more than 7 or 8 years old, came to me and said, 'Oh, I thought that was so interesting. But oh my goodness, I could never be as smart as you,'" Rochlis said. "It really just made my heart break to think that here she is, already thinking that she can't do it, that it's beyond her. Being a young woman specifically doing these kinds of talks, I sat there and talked to her for a few minutes, saying, 'Of course you can, you absolutely can do it. If this is something you're interested in, you should do it full-heartedly. No one's going to stop you.' To me, turning her mind around that day was the most rewarding thing ever."

Jeevan Perera, also a seasoned speaker, had a lot of fun trying to explain to a young student how to use the bathroom in space.

"I recall one kindergarten student asking about how astronauts go 'potty' in space. No matter how I tried to explain that it was essentially the same as here on Earth with some minor differences to deal with the lack of gravity, the mechanics of it just perplexed him beyond explanation," Perera, a Crew Exploration Vehicle risk manager, said.

Speaking to the public also requires JSC employees, by default, to be up-to-date on the most current news within NASA.

"My favorite question was, 'Oh, I heard they discovered planet X.' And I said, 'No, no, it's not true.' And then I got back to my desk and I looked up some information on this new planet we'd found, and I went, 'These kids know more than me!'" Lutomski said. "From then on, I sort of catch up on all the new planetary sciences before I go talk."



Pleased to meet you, "Rocket Man." The Speakers Bureau allows its volunteers opportunities to work at events such as the NBA All-Star Jam session, where you can become someone everyone can look up to.

Speakers not only get to share the wealth of knowledge they have about NASA, but they are also exposed to the newest discoveries and fresh ideas.

"It certainly, in my job, pays to think outside of the box, and it's nice when they let you out of the box every now and again. Particularly when I speak at technical conferences, I learn something from every place I go," Bacon said. "Every now and again I stumble across something that I know we can use—for instance, printed electronics. It's changed the way that we do inventory, track hardware, the way we integrate our procedures. Getting exposed to that was exciting—a real information exchange."

And since the venues cover travel-related expenses for the speaking engagement, it's also a great way to see new places. Speakers have even been able to go overseas to talk about the space program. And, as Lutomski noted, the farther you are from Houston, the more "exotic" it is to be a NASA engineer.

The Speakers Bureau works to share NASA's vision with those who aren't ordinarily exposed to it or don't understand it. Many speakers enjoy the challenge of educating taxpayers on the importance of our exploration goals and what we have already accomplished.

"No matter what I talk about, I always throw in our Vision for Space Exploration. Now we can say, 'We're working on it, and you will be the kids that go to Mars,'" Lutomski said. "Another message I like to take out there is that this is your space program. That's what I try to stress—they are the customers for what we do."

To find out more about NASA's Speakers Bureau Program, visit <http://www.nasa.gov/about/speakers>

If you would like to find out how to request a JSC speaker for an event, visit <http://www.nasa.gov/centers/johnson/events/speakersbureau/speakersbureau.html>

To get added to the Speakers Bureau distribution and to begin receiving their weekly electronic "Speaking of NASA" flyer, contact

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Texas A&M has been gathering information on the deer herd since 2003. “Once (Texas A&M scientists) had a population model, they administered a vaccine that rendered some of the does infertile,” Ideler said. “The intent is not to decimate the herd but make it more manageable.”

With JSC being surrounded by an eight-foot fence, Ideler said the deer live on site with very few coming in from the outside. “Some of the old-timers I have talked to say the deer have always been here,” Ideler said.

According to Ideler, the risk increases for a deer/vehicle collision from November to January, which is when does go into heat.

Ideler said that the fertile does will have their babies in May and June. He cautions people against interfering with the does and fawns, even if the fawns appear to be alone.

Ideler said that he hopes JSC team members will not view deer as a problem but enjoy them. “The deer are part of the environment,” Ideler said. “My greatest hope is that they appreciate and understand the deer.”

The majority of critters on site are much smaller than deer. One of the most abundant groups is squirrels. Also, rabbits can be seen

hopping around the center, and the occasional possum or skunk will be seen making its way from one set of shrubs to another.

A wide variety of birds can be found enjoying the landscape at JSC. Sandy Parker, an environmental specialist, said the numbers and varieties at JSC increase in the spring. “Springtime brings an abundance of birds to JSC due to migration from South and Central America,” she said.

Parker also said that there are a few birds of prey that can be seen patrolling the skies at JSC, including red-tailed hawks and falcons.

JSC’s mall is the sight of several ponds that are filled with koi and provide a safe haven for ducks. Walker said that the ducks are wild animals. “[The ducks] could leave if they wanted to,” she said, “but they have it so good here.”

The ponds also attract snakes, some of which are poisonous. All four types of U.S. poisonous snake can be found in the Houston area.

Parker said that workers at JSC should enjoy the wildlife at JSC, but they shouldn’t try to feed the animals. “People feed the squirrels and koi,” Parker said. “People don’t realize they might be doing more harm than good. They mean well.”

Not all of the animals at JSC are roaming free. JSC is taking part in a program with the Houston Zoo to breed the Attwater’s Prairie Chicken, an endangered species that is native to Texas.

“We have a total of 24 birds in the pen located behind Building 423,” Parker said. “These birds are held in captivity for breeding. It is all done under permits.”

People who drive down Saturn Road near JSC’s main gate can get a good look at another “captive” species, the Texas Longhorn. As of the end of February, there were a total of seven steers and heifers and one calf roaming the range—a 60-acre tract of land just west of Rocket Park.

The Longhorn Project, developed jointly by JSC, the Clear Creek Independent School District, the Houston Livestock Show & Rodeo and the Texas Longhorn Breeders Association of America, provides local high-school students with a one-of-a-kind learning environment that combines Western heritage with state-of-the-art technology.

The natural taste of Texas isn’t limited to animals. JSC is now a test site for a new program developed by the Lady Bird Johnson Wildflower Center and the American Association of Landscape

Architects called Sustainable Landscapes. The Sustainable Landscapes program was formed to support the culture and values of the local community, improve and restore desired wildlife habitats and contribute to the overall health of the local ecosystem.

Parker said that the Sustainable Landscapes program brings several benefits to JSC and its workforce including newly designated wildflower areas that were seeded last fall.

“One of the benefits is (the Sustainable Landscapes program) is a potential cost-saving method. If we get the wildflowers established, it will reduce the need for mowing,” Parker said. “Also, if (the wildflowers) get established, it will help to improve the working conditions.”

Parker said that the wildflower explosion may not be as brilliant this spring as it would normally be due to the dry weather that JSC experienced in the fall.

Parker said that the efforts to live with the wildlife and to promote nature at JSC go hand in hand with one of NASA’s missions. “We feel like we are connected to the NASA mission of trying to protect our home planet.”



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