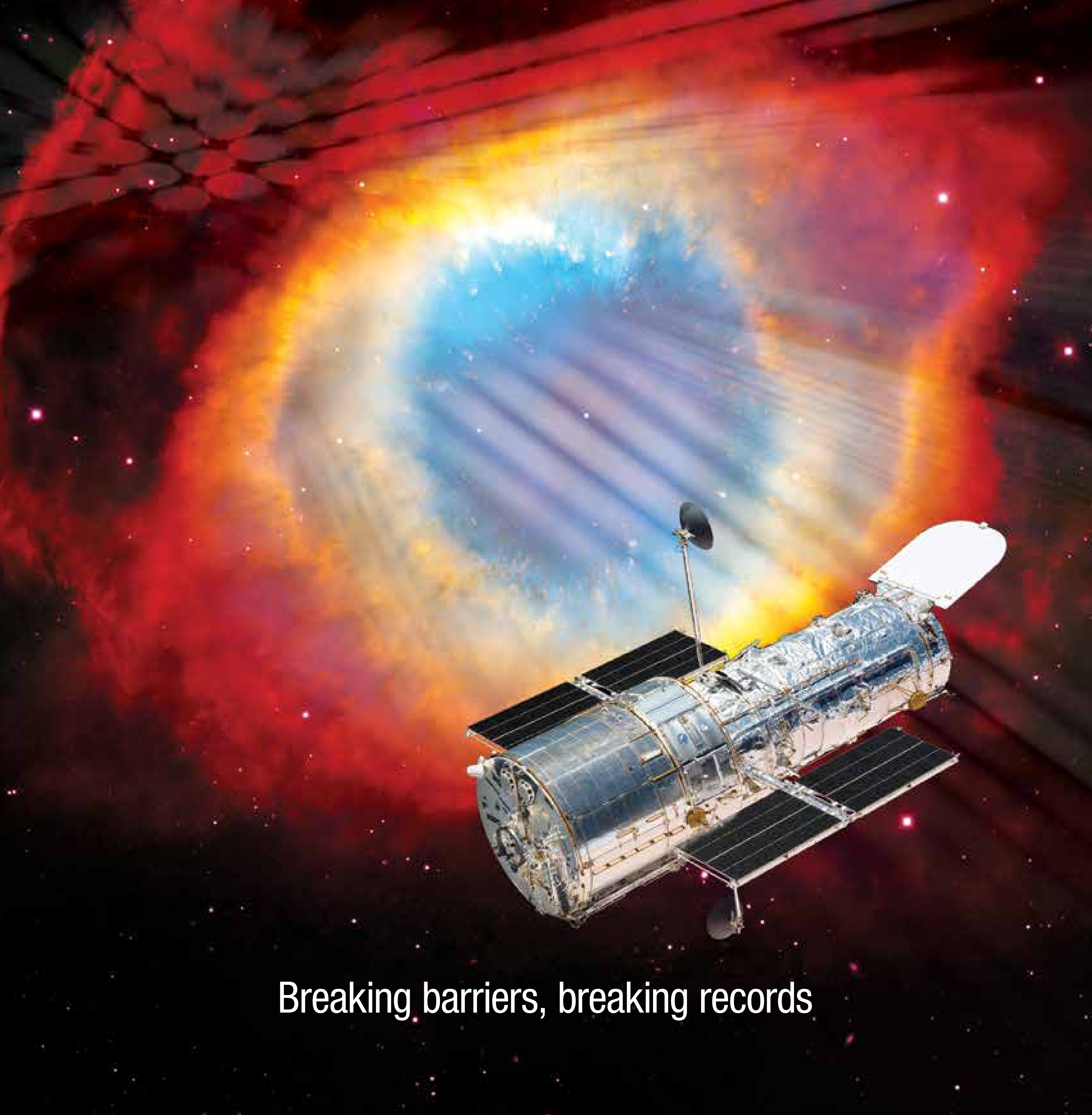
National Aeronautics and Space Administration

Roundup

LYNDON B. JOHNSON SPACE CENTER

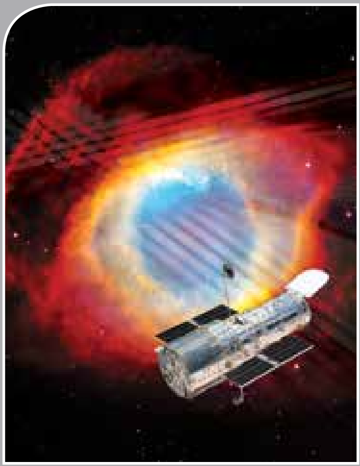
Spring | 2015



Breaking barriers, breaking records

Guest Column

In this edition…



On the cover:

Hubble Space Telescope celebrates 25 years in space this April. On page 6, read about how spacewalking astronauts ensured the longevity of this amazing scientific instrument, which allowed us to peer inside the universe like never before.

Balancing risk: more flight testing of hardware

NASA/PHOTO

Kirk A. Shireman

JSC Deputy Director

CAN WE REDUCE the time and money it takes to design, build, test and then fly hardware on the International Space Station (ISS)? Can we do this and still protect the crew and the station? I believe the answer to both of these questions is yes, and we are off to prove it!

In October 2014, a cross-center team consisting of the ISS Program, Engineering, Human Health and Performance, Safety and Mission Assurance, Center Operations and Procurement met and defined a new class of hardware to be called **Experiment Flight Hardware**, or Class 1-E. This team took the challenge to take our baseline set of requirements for developing flight hardware and cut it down to just "Don't hurt the crew" and "Don't hurt the station." This very lean set of requirements and associated process has been dubbed "1-E" to imply Experimental Flight Hardware. The idea is to decrease the time and money required to develop hardware, with an increase in the performance risk—but not an increase in safety risk to the crew or station. Anyone can use this process for technology demo, payload and other types hardware on the space station; you just need hardware customer approval.

While the "1-E" process isn't for all flight hardware, it does open the door to develop some of the hardware that is needed for exploration and the ability to test it on station. The goal of building two flight hardware projects using this process, and flying them in this calendar year, was dubbed "2 x 2015." This is one of the center's top JSC 2.0 goals for this year. (See more at: http://strategicplan.jsc.nasa.gov/default.aspx)

The ISS Program recently funded five hardware items to be designed, built and flown by the end of this calendar year. Yes, it was supposed to be two—but now it's five. We are stretching the stretch goal!

This process is also being exported. Marshall Space Flight Center is using this method, and the ISS Program recently funded one flight hardware project there. Experimental Flight Hardware is also being evaluated at Kennedy Space Center for use in its developments.

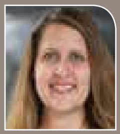
It is amazing what we can accomplish working toward the same goal. Look for updates on the status of these hardware items as they are being developed throughout the year on the JSC 2.0 website.

NASA/PHOTO

Photo of the quarter:

International Space Station astronaut Terry Virts (@AstroTerry) tweeted this image of a Vulcan hand salute from orbit as a tribute to actor Leonard Nimoy, who died on Feb. 27. Nimoy played science officer Mr. Spock in the "Star Trek" series that served as an inspiration to generations of scientists, engineers and sci-fi fans around the world. Cape Cod and Boston, Massachusetts, Nimoy's hometown, are visible through the window.

ISS Science Corner



Laura Niles

Space station worms' research potential is anything but flat

FOR YEARS, it was assumed the world was flat. Now, we have a laboratory that orbits our big, blue marble. So, it's funny to think of returning to flatness aboard the International Space Station, but this outpost currently houses flatworms for research. The study of these creatures has the potential to be rather robust in implications for regenerative medicine, an area of treatment for repairing or replacing human cells, tissues or organs on Earth to restore normal function. A study launched aboard SpaceX's fifth commercial resupply services (CRS) mission to the space station in January examined the reparative processes of flatworms in microgravity.

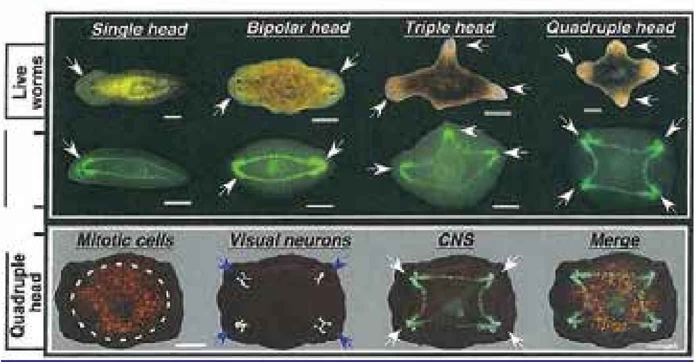


IMAGE CREDIT: DR. MICHAEL LEVIN, TUFTS UNIVERSITY

Image representations of live worms with single, bipolar, triple and quadruple heads for the Flatworm Regeneration investigation aboard the International Space Station.

As flatworms age, or should they encounter cellular damage, they have the ability to renew their cells. For example, if they lose their tail, they can regrow it. A team of researchers from Kentucky Space LLC and the Center for Regenerative and Developmental Biology at Tufts University in Medford, Massachusetts, used the worms to observe repair processes and wound-healing done by cells in space during the Flatworm Regeneration investigation. This insight could influence the development of medicine on Earth with new methods for repairing damaged tissue from injury or physical impairment.

"We are specifically looking at regenerative processes and applications that could be potentially valuable for use on Earth," said Kris Kimel, president and founder of Kentucky Space. "Much of what has been done in the past has been focused on astronaut health, and you can learn a lot from that, but we're focused primarily on the cellular and molecular level processes that could impact regenerative processes on Earth."

This investigation is a first step toward understanding how gravity affects an organism's mechanisms for repair and renewal. Researchers hope to map the cell signaling processes that help the worms' bodies locate cellular damage and instruct an area or appendage to regrow. They are observing the worms in space to find out how these processes may be disrupted by the lack of gravity.

The research implications not only apply to regenerative medicine, but also to technology development. Engineers may be able to create new algorithms—a set of steps used in mathematics or to design computer processes—based on the knowledge gained from the flatworm study in orbit. This could lead to technology that employs these algorithms to reconfigure their own components and energy use in deep space.

Flatworms with amputated heads or tails were contained inside sealed test tubes for the study and were left to regenerate without power or interaction from the station crew.

"It's a potentially valuable experiment in terms of the results, but in this first iteration, we're making it as self-sustaining as we can," Kimel said.

With their return on SpaceX CRS-5 on Feb. 10, the research team plans to analyze regeneration patterns of the space-flown worms and compare them with control worms living in similar conditions on Earth during the study time period.

Kimel describes the study as a critical step in specific regenerative medicine research and commercial pathways to space. His research team wishes to focus on projects with specific pathways they are trying to understand. The results obtained in this first flatworm study between Kentucky Space and Tufts University will become the basis for their next phase of research in regenerative medicine.

"When we do something, we look at why we're doing it, where it fits in that pathway and whatever the result, it's going to lead us to another experiment," Kimel said. "Whether the first experiment takes us to step two or it doesn't look like it's going to go anywhere, we're not just doing one-off research studies. We plan to keep trying and move toward more high-value outcomes."

Given the potential reparative impacts for patients suffering from injury or physical impairment on Earth, this microgravity study of worms does not fall flat.

IMAGE CREDIT: KENTUCKY SPACE

Sample test tubes used to contain flatworms during the Flatworm Regeneration investigation aboard the International Space Station.

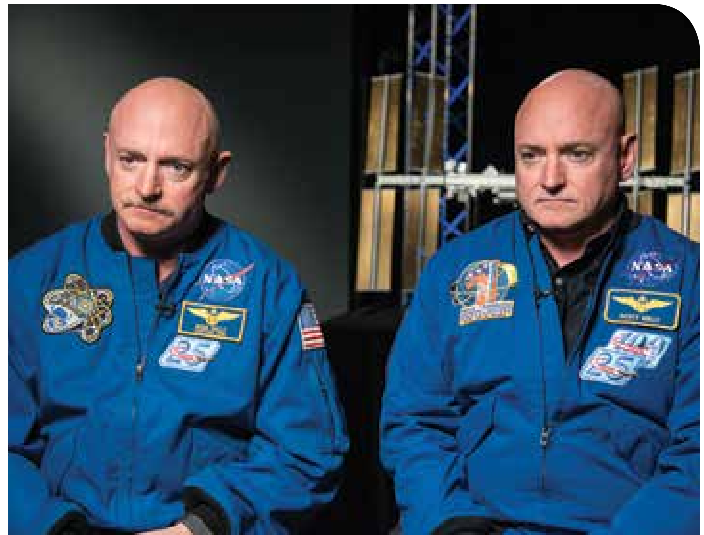
One-year mission to space station will break barriers of spaceflight

By Anna Seils

SPENDING ONE YEAR IN SPACE aboard the International Space Station, NASA astronaut Scott Kelly and Russian cosmonaut Mikhail Kornienko will test the limits of long-duration human spaceflight. Their mission will be a testimony of what the human body is capable of, mentally and physically, as well as offer insight about our world from investigations that will be performed in a zero-gravity environment.

The one-year mission to the space station is about furthering research for longer-duration spaceflights that will be used as a steppingstone for missions to an asteroid, the moon and Mars. This mission is special in that NASA and Roscosmos will share their findings to enhance the knowledge base of extended spaceflight among research communities to benefit all of humanity. Though four other Russian cosmonauts have already spent one year or more in space, this is the first time a NASA astronaut has attempted the feat.

One of the most notable studies that will be undertaken this mission is the twin study, which draws comparisons between Scott and his twin brother, retired NASA astronaut Mark Kelly. Led by the Human Research Program and the National Space Biomedical Research Institute through the Human Exploration Research Opportunities Program, this study consists of genetic investigations between Scott and Mark that will be used to enhance existing knowledge of spaceflight effects for other astronauts. Some of these experiments will include the collection of blood samples, as well as psychological and physical tests. Findings may show the extent to which degeneration, or evolution, may occur in the human body from extended exposure in space.



NASA /PHOTO ROBERT MARKOWITZ

At right, Expedition 45/46 commander, astronaut Scott Kelly, along with his brother, former astronaut Mark Kelly, speak to news media outlets about Scott Kelly's one-year mission aboard the International Space Station.

NASA /PHOTO ROBERT MARKOWITZ

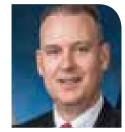
NASA astronaut Scott Kelly, outfitted in an Extravehicular Mobility Unit spacesuit.

There are seven key elements of research for the one-year mission. Functional studies will take place, in which crew member performance is examined after the 12-month span. Behavioral studies will monitor sleep patterns and journal exercises. Visual impairment will be studied by measuring intracranial pressure. Metabolic investigations will examine the immune system and effects of stress. Physical performance will be monitored through exercise examinations. Microbial changes in the crew will be monitored, as well as human factors, like how the crew interacts aboard the station.

Noted from past research, the human body undergoes a variety of degenerative effects from long exposure to a zero-gravity environment and radiation. Some of the symptoms include changes to the eyes, muscle atrophy and bone loss. There are also behavioral evaluations taking place on the effect of living in isolated and small spaces. With the research gathered from the one-year mission, risk management procedures may be improved to better resolve degenerative issues.

The one-year mission has the potential to answer many questions regarding the lingering effects of spaceflight on our astronaut corps—past, present and future. It also will enhance international collaboration among all nations through science and a desire to go farther into the cosmos, which will require extended missions and test human adaptability like never before.

Historic **Mission Control Center** celebrates **50 years**



Norm Knight
Chief, Flight Director Office

AS WE APPROACH the golden anniversary of the Mission Control Center (MCC) in June, we take time to reflect on the significant impact this facility and the people involved have had on human spaceflight.

NASA /PHOTO

A fully staffed Mission Control Center during the first mission to use it—Gemini IV on June 3, 1965.

Johnson Space Center's MCC began real-time operations with Gemini 4 on June 3, 1965. These Mission Operation Control Rooms (MOCRs), which were a piece of the overall MCC, had traditional government-color-schemed consoles complete with black-and-white displays, color indicator lights, communication panels with an ever-flashing matrix of buttons, tabletop workspaces with headset jacks, and were state of the art and standard issue to the Flight Control teams who brought this technology to life and made some of the greatest achievements in human history that many thought to be impossible.

These original MOCRs supported nine Gemini missions, 11 Apollo missions (including the historic Apollo 11 moon landing and Apollo 13), the first U.S. space station Skylab, Apollo/Soyuz and and 76 Space Shuttle Program missions. Visitors recognize the third-floor MOCR as the historic Apollo Mission Control Center, which is a National Historic Landmark preserved for future generations to reflect on and learn from.

During this time, the MCC changed slightly to support these new programs.

NASA /PHOTO

Spacecraft communicators are pictured as they keep in contact with the Apollo 11 astronauts during their lunar landing mission on July 20, 1969. From left to right are astronauts Charles M. Duke Jr., James A. Lovell Jr. and Fred W. Haise Jr.

However, the most significant change occurred when the teams transitioned into the "digital age" with a new wing to the building and the addition of the Red/White/Blue Flight Control Rooms (FCRs). These were used for the remaining space shuttle missions, the first half of International Space Station

> *"The MCC is more than just a facility—it's about the teams that bring it to life."*

assembly and, most recently, Orion's first flight test, Exploration Flight Test-1. Both past and present met once again when the second-floor MOCR was remodeled and upgraded as FCR-1 to house the teams that completed space station assembly and continue to support 24/7 station operations.

The teams that work in this facility are the lifeblood of the command and control operation, where the planning and training transition into real-time

NASA /PHOTO

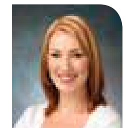
Orion's first test flight was completed in an FCR equipped with the latest technology of this digital age.

mission execution. The combination of the facility and the culture of the people working within result in what many say is a "laboratory of leadership," where the foundations of flight operations were forged and continue to be honed (discipline, competence, confidence, responsibility, toughness, teamwork and vigilance). Where impossible scenarios are actively wrestled into manageable elements with an "improvise and overcome" critical-thinking mental attitude, and where "failure is not an option." Where success is celebrated, but focus remains on where we can improve. Where our shortfalls are recognized and responsibility is taken to never allow them to repeat. Where men/women enter the ranks as apprentices and grow into seasoned leaders for our agency and country.

The plaques on the walls in these FCRs are a testament to the many successful missions and the teams that made them a success.

As we celebrate 50 years and see the reflection of what the MCC has accomplished, this provides reassurance that the future of human spaceflight is in great hands as we evolve from missions that were yesterday's dream to missions that will become tomorrow's reality.

Destined for each other



Hubble Space Telescope shares 25 years of scientific discovery thanks to spacewalkers

By Catherine Ragin Williams

BEFORE THE HUBBLE SPACE TELESCOPE (HST) was released into its floating home in low-Earth orbit on April 25, 1990, it had already been predetermined that this scientific vehicle would know spacewalking NASA astronauts. In fact, the telescope had been built with the idea that it could be serviced—as easily as one *could* service a complex instrument in the hazardous environs of space—as necessary through precisely orchestrated extravehicular activities (EVAs). It was a radical concept at the time, but one that ensured the longevity of one of the most popular scientific instruments the world has come to rely on.

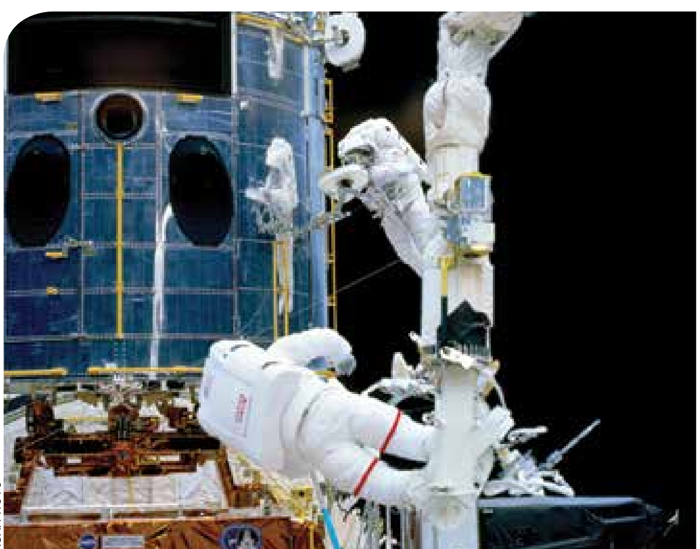
"I can remember being very early in my career as an EVA flight controller, and EVA was kind of considered a last resort contingency—to be avoided as much as possible," said Jim Thornton, now a special assistant to the director of the Flight Operations Directorate (FOD).

"We didn't do EVAs often," echoed Calvin Seaman, a 30-year aerospace engineer veteran concentrating on Technology Development and Partnership Outreach. "I was in the EVA Project Office at the time, and we'd come to a realization that we were going to build the International Space Station … and we coined the phrase 'wall of EVA.'"

Building a behemoth space station in space, piece by piece, would require an unheard of number of spacewalks—and there weren't many in the astronaut corps at the time with precious EVA experience. HST filled that void in many ways, giving astronauts much needed spacewalking hours and allowing engineers to perfect the tools and techniques needed for the large-scale engineering project.

"We were pushing hard from the EVA Office to say we need to do more EVAs just to get people out the hatch and get them experience," Seaman said.

Hubble and spacewalks would go hand in hand for 19 years.



NASA/PHOTO

Astronaut F. Story Musgrave (top right center) works with a restraint device near the HST during the first of five STS-61 spacewalks. Astronaut Jeffrey A. Hoffman, who joined Musgrave for three of the five spacewalks, is seen at the bottom of the frame preparing to work with fuse plugs.

NASA/PHOTO

Hubble is released by space shuttle *Atlantis* after Servicing Mission 4 in May 2009 and floats against the background of space. The mission was the last astronaut visit to the telescope.

"We were fortunate enough to be able to take advantage of the fact that Hubble had been designed for EVA from the start," Thornton said. "And just leveraging what we did initially with Hubble and then what we proved out with the first servicing mission, people came to understand what a valuable resource EVA is and started thinking about it differently."

A TELESCOPE WITHOUT WINGS

Sue Rainwater, chief of the EVA, Robotics and Crew Systems Division in FOD, has known the HST since her time at NASA's Marshall Space Flight Center in the late 1980s.

"Marshall was responsible for the development, not of the scientific instruments themselves, but of the EVA capability, sort of the shell," Rainwater said. "I worked up there developing the tools and crew aids."

Before the STS-31 deployment mission, Rainwater came to Johnson Space Center and worked with the telescope on the Mission Operations Directorate (MOD) side. To prepare for Hubble's unveiling in space meant a lot of travel for JSC EVA and MOD teams to become very familiar with the telescope while on the ground.

"You could only do tool fit checks on the weekends when the vehicle was powered down, so we spent many a weekend in bunny suits—actually hands on the telescope—which was really a special experience looking back at it," Rainwater said. "There's not many people in the world who can say they've been inside Hubble. But being able to put hands on the hardware—the importance of that helped people understand that the end-to-end process is so important."

The intimate knowledge of the hardware would prove essential in orchestrating EVAs later on.

"We had to take advantage of the time we had remaining with the telescope to ensure that we were going to be able to achieve some of the

EVA tasks that were envisioned," Thornton said. "Luckily, I think the community of people who were interested in trying to make it as EVA friendly as possible tried to expand what was originally intended to be serviceable on orbit."

A FLAW—THEN A FIX

Shortly after deployment, one thing was abundantly clear—the images Hubble beamed down lacked clarity. The telescope that had been designed to be a scientist's dream was fast becoming a public relations nightmare. NASA received a maelstrom of bad press.

"The news media reports made it sound like the Hubble Space Telescope was completely nonfunctional after the deploy mission," Seaman said. "And nothing could be further from the truth. If you look at the pictures, there is a dramatic difference between the pre and post repair that we executed on STS-61, but it was still better than any ground-based telescope on the planet."

NASA/PHOTO

On Dec. 5, 1993, astronaut F. Story Musgrave, holding to one of many strategically placed handrails on the HST, is photographed during the first of five EVAs on the HST-servicing mission aboard the space shuttle *Endeavour*.

The issue? Hubble's primary mirror had a "spherical aberration." The outer edge of the mirror had been ground too flat by a depth of four microns (roughly equal to 1/50th the thickness of a human hair). Sure, the imperfection seemed negligible—but resulted in fuzzy images.

Thankfully, the HST had been made with spacewalking visitors in mind. Repairs would be forthcoming with a daunting set of five spacewalks during STS-61 in December of 1993. It also meant a lot of unprecedented training and preparation.

"We used what was called a 10:1 training ratio," Seaman said. "For every hour of EVA, there were 10 hours of training underwater. Back then, this was incredibly important to us because we were just getting ready to start assembling space station in the coming years. There were a lot of people in Congress and in Washington staring down their noses at us, saying 'If you can't take care of this telescope, how in the world are you going to take care of a space station?'"

HST MISSIONS

- **STS-31, April 24-29, 1990 – Deployment Mission**
- **STS-61, Dec. 2-13, 1993 – HST Servicing Mission-1 (SM-1)**
- **STS-82, Feb. 11-21, 1997 – HST SM-2**
- **STS-103, Dec. 19-27, 1999 – HST SM-3A**
- **STS-109, March 1-12, 2002 – HST SM-3B**
- **STS-125, May 11-24, 2009 – HST SM-4**

Four of the seven STS-61 crew members were dedicated exclusively to Hubble repairs and the spacewalks it would take to make the telescope work to perfection.

"Leading up to the first servicing mission, there was a team of us that spent two, three months at a time training the crews to do the first servicing mission," Thornton said. "But I think we were well prepared for a lot of the curveballs that could've been thrown at us."

"For the first servicing mission, I think we were fortunate in some ways," Rainwater said. "You're also fortunate because you've prepared so well. One of the solar arrays did not retract, but that was somewhat expected because we knew that it had issues, which was one of the reasons it was being replaced. For the rest of the hardware, there weren't any big hiccups on that mission."

As it has been throughout NASA history, a very complicated endeavor seemed to go … flawlessly.

"One of the legacies of MOD is we try to make the hard things look easy, and HST is an example of that," Thornton said. "We were successful, and by all appearances it came off pretty straightforward and easy, but that's the product of a lot of preparation and hours spent by a whole team of people

NASA/PHOTO

Hubble is released by space shuttle *Atlantis* after Servicing Mission 4 in May 2009 and floats against the background of space.

ensuring that it is going to go well—to think about all the possible contingencies and things that could go wrong and to thoroughly prepare for that."

Hubble got the instruments it needed to fix the flaw and further improve the telescope.

"It literally was like putting a pair of glasses on the telescope to compensate for the spherical aberration in the mirror," Seaman said.

EXCEEDS EXPECTATIONS

Through EVA, Hubble revealed the universe to a world hungry for answers and inspiration.

"Hubble was designed for 15 years—15 years was considered a fully successful mission," Seaman said. "It's because it was designed for servicing. Because we built it with the ability to be serviced by EVA astronauts and be upgraded and improved along the way … that was just incredible foresight, and it's paid the dividends of this program and made it so successful."

The people who worked with Hubble, on the ground and in space, at JSC and other NASA centers, all have pride and fondness for the school-bus-sized machine that still—25 years later—takes breathtaking images and transmits valuable scientific data to Earth.

"As a person with a love for astronomy, the Hubble really is one of the best science instruments on, or off, the planet," Seaman said. "It's open, it's shareable with all of humanity … it's a remarkable instrument that has far exceeded its original design limits."

A 'typical' HST servicing mission

- Took about two years of pre-launch preparation and training
- Launch and rendezvous with HST— orbiting at approximately 310- to 330-mile altitude and 28.45-degree inclination
- Grapple with HST spacecraft using the shuttle's robotic arm
- Two "teams" of EVA crew members and four EVA spacesuits
- Conduct four to five spacewalks to restore operational science capabilities, make life-extending changes and improve productivity
- Re-boost HST to highest orbit possible using space shuttle
- 11 middeck lockers containing 285 EVA tools and crew aids
- 10:1 "water tank" training ratio (i.e., 10 hours in the pool for every hour of EVA time in orbit)
- Above all, do no damage—leave the telescope in "as good or better" condition than before the mission

NASA/PHOTO

NASA/PHOTO

On April 25, 1990, the HST was released into space and ready to peer into the vast unknown. Since then, Hubble has reinvigorated and reshaped our perception of the cosmos and uncovered a universe where almost anything seems possible within the laws of physics. Here are a few of the telescope's most awe-inspiring images.

NASA/PHOTO

NASA/PHOTO

Reached the stars—**now back home**

THREE CREW MEMBERS returned to Earth on March 11 after a 167-day mission on the International Space Station (ISS) that included hundreds of scientific experiments and several spacewalks to prepare the orbiting laboratory for future arrivals by U.S. commercial crew spacecraft.

Expedition 42 commander Barry Wilmore of NASA and flight engineers Alexander Samokutyaev and Elena Serova of the Russian Federal Space Agency (Roscosmos) touched down southeast of the remote town of Dzhezkazgan in Kazakhstan.

NASA/PHOTO

The Soyuz TMA-14M spacecraft is seen as it lands with Expedition 42 commander Barry Wilmore of NASA, Alexander Samokutyaev of the Russian Federal Space Agency (Roscosmos) and Elena Serova of Roscosmos near the town of Dzhezkazgan, Kazakhstan, on March 11.

During their time on station, the crew members participated in a variety of research focusing on the effects of microgravity on cells, Earth observation, physical science and biological and molecular science. One of several key research focus areas during Expedition 42 was human health management for long-duration space travel, as NASA and Roscosmos will have two crew members spend one year aboard the space station.

The space station also serves as a test bed to demonstrate new technology. The Cloud-Aerosol Transport System arrived and was installed during Expedition 42, and already is providing data to improve scientists' understanding of the structure and evolution of Earth's atmosphere. This may lead to enhancements to spacecraft launches, landings and communications systems; help guide future atmospheric investigations of Mars, Jupiter or other worlds; and help researchers model and predict climate changes on Earth.

The newly installed Electromagnetic Levitator will allow scientists to observe fundamental physical processes as liquid metals cool, potentially leading to lighter, higher-performing alloys, mixtures of two or more metals or a metal and another material, for use on Earth and in space.

The station crew also welcomed three cargo spacecraft with several tons of scientific investigations, food, fuel and other supplies. In January, the trio helped grapple and connect a SpaceX Dragon spacecraft on the company's fifth contracted commercial resupply mission to the station. The Dragon returned to Earth in February with critical science samples. Two Russian ISS Progress cargo craft docked to the station in October and February. The fifth and final European Automated Transfer Vehicle, bearing the name of Belgian physicist Georges Lemaître, considered the father of the big-bang theory, departed the station in February.

During his time on the orbital complex, Wilmore ventured outside the space station with NASA astronaut Terry Virts on three spacewalks to prepare for new international docking adapters and future U.S. commercial crew spacecraft. Wilmore also completed a spacewalk in October with fellow NASA astronaut Reid Wiseman to replace a failed voltage regulator. Samokutyaev conducted one spacewalk during his time in space.

Having completed his second space station mission, Samokutyaev now has spent 331 days in space. Wilmore, having previously flown as a shuttle pilot on STS-129, has spent 178 days in space. Serova spent 167 days in space on her first flight.

For more information about the International Space Station and its crews, visit: http://www.nasa.gov/station

NASA/PHOTO

On March 1, Expedition 42 Flight Engineer Terry Virts and Commander Barry "Butch" Wilmore ventured outside the International Space Station for their third spacewalk in eight days. Virts and Wilmore completed installing 400 feet of cable and several antennas associated with the Common Communications for Visiting Vehicles system, known as C2V2. Virts (@AstroTerry) tweeted this photograph and wrote, "Out on the P3 truss. #AstroButch handing me his cable to install on the new antenna. #spacewalk"

Spotlight: **Judith Allton**

Solar Wind Sample Curator

Q: Coolest part of your job at Johnson Space Center?

A: Looking at solar wind collectors, moon rocks and meteorites through the microscope. They are so beautiful, so mysterious, so challenging to preserve the science value … and, in the case of the Genesis solar wind collectors, challenging to clean after crashing in Utah. Genesis was a NASA mission to return samples of our sun.

Q: Finish the sentence: Ten years from now, I'd love to …

A: … visit JSC and find that the Mars rocks are curated here by a team of world-class planetary scientists.

Q: Three things that you think are utterly awesome:

A:
1. Planetary sample return.
2. How it is that we mere humans deduce how stars and planets are made.
3. Sitting on oldest rocks on the planet in moonlight in outback Australia.

Q: What would people be surprised to know about you?

A: That I started college as an art major. Then I found chemists were more interesting and geologists hiked outdoors.

Q: If you could trade places with any other person for a week, famous or not famous, living or dead, real or fictional, who would it be?

A: Geologist John Wesley Powell, mapping the Colorado River in 1869. I have stood at the confluence of the Green and Yampa Rivers, where Powell writes about climbing the cliff to measure elevation. His exploration of the remote unknown, depending on his own foresight in planning and adaptability to events along the way, is amazing (and so unlike my timid self!). It would be fun to be adventuresome.

Q: What do you wish you could tell your younger self?

A: Keep a journal.

NASA /PHOTO JSC2005E06101

Q: What are you reading now?

A: Neil Armstrong's biography, "First Man," is giving me some context for life aboard the USS Essex in 1951. My dad served as an aircraft mechanic aboard the Essex in 1952. I would like to capture my dad's story. My dad's gift to me is great curiosity about nature.

Q: What is the neatest thing you've learned on the job?

A: The Apollo stories—the astronauts, the geologists, the families. The science stories—the role of cratering in the early solar system, life on the early Earth. I hope to tell these stories to younger folks. And, of course, the glorious views of the Earth from space.

Q: When did you first become interested in space, and why?

A: As a kid I spent hours sitting outside at night just watching the sky (we did not live in town). It felt peaceful. The moon—beautiful, crisp and luminous—is really a rock. Amazing that I could hold a piece of it in my hand (inside of a glovebox, using tweezers, of course).

Q: What is your favorite memory at JSC or of the space program?

A: Being part of the Genesis solar wind sample return mission was a definite highlight. It was my first time to prepare hardware for flight, and this was a scientifically valuable mission—to establish the composition of the starting materials that resulted in moon rocks, Mars rocks, asteroids, comets and Earth. Here at JSC, the team was a shoestring-budget, inventive "git 'er done" team that usefully applied our Apollo curation experience. We still work very well with the Genesis science team and Jet Propulsion Laboratory (JPL) engineering team. In October, we celebrated the 10th anniversary of sample return—celebrating achievement of the science goals in spite of the crash. What an amazing collaboration of JSC, JPL and investigators worldwide! We think of ourselves as family.

Q: What excites you most about NASA's journey to Mars?

A: The upcoming debate and argument about what Mars is truly like. We have intriguing information from the complex and hardy rovers now on Mars. Just wait until we have Martian samples on Earth that many teams can analyze and challenge each other. It will get way more interesting.

Astronaut spacesuit testing for Orion spacecraft in full swing

Engineers and technicians at Johnson Space Center are busy testing the spacesuit astronauts will wear in the agency's Orion spacecraft on trips to deep space. On March 17, members of the JSC team participated in a Vacuum Pressure Integrated Suit Test to verify enhancements to the suit will meet test and design standards for the Orion spacecraft. During this test, the suit is connected to life support systems, and then air is removed from the 11-foot thermal vacuum chamber to evaluate the performance of the suits in conditions similar to a spacecraft. The suit, known as the Modified Advanced Crew Escape Suit, is a closed-loop version of the launch-and-entry suits worn by space shuttle astronauts. The suit will contain all the necessary functions to support life and is being designed to enable spacewalks and sustain the crew in the unlikely event the spacecraft loses pressure.

NASA/BILL STAFFORD

This is the first in a series of four tests with people in the suits to evaluate the performance of the spacesuit systems in an environment similar to a spacecraft.

Space Launch System booster is all fired up during major ground test

The largest, most powerful rocket booster ever built successfully fired up March 11 for a major-milestone ground test in preparation for future missions to help propel NASA's Space Launch System (SLS) rocket and Orion spacecraft to deep-space destinations, including an asteroid and Mars.

The booster fired for two minutes, the same amount of time it will fire when it lifts the SLS off the launch pad, and produced about 3.6 million pounds of thrust. The test was conducted at the Promontory, Utah, test facility of commercial partner Orbital ATK, and is one of two tests planned to qualify the booster for flight. Once qualified, the flight booster hardware will be ready for shipment to NASA's Kennedy Space Center in Florida for the first SLS flight.

It took months to heat the 1.6-million-pound booster to 90 degrees Fahrenheit to verify its performance at the highest end of the booster's accepted propellant temperature range. A cold-temperature test, at a target of 40 degrees Fahrenheit, the low end of the propellant temperature range, is planned for early 2016. These two tests will provide a full range of data for analytical models that inform how the booster performs. During the test, temperatures inside the booster reached more than 5,600 degrees.

For more information on SLS, visit: http://www.nasa.gov/sls

IMAGE CREDIT: ORBITAL ATK

NASA/LAUREN HARNETT

Space Day Texas 2015 reaches out to Lone Star legislators, public

Johnson Space Center, along with aerospace industry partners, traveled to the Texas state capitol in Austin for Space Day Texas 2015 on March 3. In addition to traditional visits with key state legislators, astronauts Randy Bresnik and Tim Kopra, along with JSC Deputy Director Kirk Shireman and NASA legislative visit teams, shared the human spaceflight story with key Lone Star Congress members and highlighted future space developments at a special Astronauts and Ice Cream Reception. Also included in the high-impact schedule were student activities reaching more than a thousand kids on the capitol lawn; public outreach with the Driven to Explore mobile exhibit and Boeing Texas Alliance for Minorities in Engineering mobile exhibit; NASA's journey to Mars depicted with exhibits in the capitol rotunda; astronaut autographs; and Cosmo, JSC's plumped-with-air spacewalking mascot.

Roundup

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A star among us: Dr. Kamlesh Lulla receives 2015 Pravasi Bharatiya Samman Award

By Anna Seils

WITH OFFICE WALLS COVERED with more awards than paint, Dr. Kamlesh Lulla added another achievement to his prestigious collection. Lulla, director of the University Research, Collaboration and Partnership Office within the External Relations Office at Johnson Space Center, received the 2015 Pravasi Bharatiya Samman Award at a ceremony on Jan. 9 in Gandhinagar Gujarat, India.

The Pravasi Bharatiya Samman Award is one of the highest-profile awards given to people of Indian origin. It acknowledges outstanding achievement in the field of scientific research and recognizes valuable contributions in promoting the honor and prestige of India. The award specifically honors those who foster the interests of overseas Indians. Only 15 people from around the world were selected and invited to the award ceremony, which was attended by many prominent officials—including India's vice president, Hamid Ansari. The date of the ceremony marked the 100th anniversary of Mahatma Gandhi's return to India from South Africa on Jan. 9, 1915.

IMAGE CREDIT: DELHI NEWS AGENCY

Dr. Kamlesh Lulla receiving the 2015 Pravasi Bhartiya Samman Award from India's vice president, Hamid Ansari, and Minister for Foreign Affairs and Ministry for Overseas Indian Affairs Sushma Swaraj in Gandhinagar Gujarat, India on Jan. 9. Gujarat Chief Minister Smt. Anandiben Patel and Gujarat Governor Mr Kohli are also seen in this photo.

"This award is over 25 years in the making," Lulla said. "Awards are great recognition, but the greatest recognition is creating knowledge for space exploration."

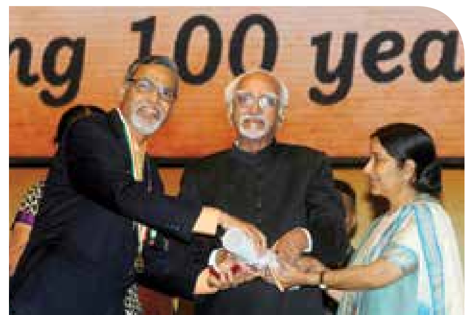

IMAGE CREDIT: DELHI NEWS AGENCY

Houston's own Lulla receiving the 2015 Pravasi Bhartiya Samman Award from India's vice president, Hamid Ansari, and Minister for Foreign Affairs and Ministry for Overseas Indian Affairs Sushma Swaraj.

Lulla has been at NASA for 27 years, researching optical and radar remote sensing, advanced sensor development and image and data processing. He has held many upper-management positions at JSC, including chief scientist for Earth Observation for Space Shuttle and International Space Station Programs, where he directed NASA astronauts in Earth science observation and Earth science payloads. In addition, he's held positions as the director for research and technology collaborations divisions and branch chief, Flight Science Branch and Earth Science Division.

Lulla is a prolific author and has been published on many platforms, the latest being a book on the Space Shuttle Program.

"The book took three years and is my favorite project," Lulla said. "Not only am I helping my research story, but I am helping the agency tell the story."

Before NASA, Lulla was a professor for more than 12 years and has two doctorates. He understands the pathway to achieving one's goals, and that great careers are not built in one day.

"The advice is very simple," Lulla said. "If you are fortunate enough to know what you want to do, find your passion and pursue it. If you follow your passion and pursue it, you will definitely be rewarded."

Lulla explained that in order to think outside the box, one must build the basic skills inside the box first.

"Great endeavors require great sacrifices, great preparation and hard work," Lulla said. "If you want to be involved in everlasting achievement, have the skills."