

National Aeronautics and Space Administration



Roundup

LYNDON B. JOHNSON SPACE CENTER

Summer | 2013



JSC 2.0

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NASA/BILL INGALLS

On the cover:

The Space Shuttle *Enterprise* is seen mated on top of the NASA Shuttle Carrier Aircraft at Washington Dulles International Airport on April 20, 2012, in Sterling, Va.

Why Am I Doing This?

IF YOU HAVE BEEN WORKING at Johnson Space Center over the past few years, you will have noticed that we are in a cycle of repeated cuts across both institutional and programmatic budgets. When the sequester began, we took further cuts. Of course, the sequester also brought a full range of additional delights, such as many additional restrictions and processes for travel and conference attendance, though fortunately, NASA was able to avoid furloughs. Pay freezes already in effect were continued, and we also have a freeze on monetary awards.

There are probably some of you out there at this point wondering if anybody still cares about the work you do. I'm not above wondering that sometimes myself, and there was a point recently where I did just that.

Someone I respected and admired had just decided to leave the government and go to private industry. It made me think about how nice it would be to be a manager in the corporate world, to be able to give employees raises when they deserve them, to be able to send them to necessary training and conferences without a 172-step process, to know in advance what my budget would be—little luxuries that would make life at work so much more efficient and pleasant on a daily basis. Having said all that, I did think about it and this is what I realized.

I came to NASA, and to JSC in particular, because I wanted to be part of something that would change the world. I wanted to be part of building the International Space Station. I wanted to be part of human spaceflight. I'm here because this work matters. I'm here because the work we do here every day and every year changes the world around us and makes it a better place. People from our team live and work off the planet for months—and soon—years at a time. They are pioneers in teaching the human race how to do that. Hubble and the Alpha Magnetic Spectrometer are fundamentally changing physics and exponentially increasing our knowledge of the universe and its origins. Wearable technologies that we are developing are changing how we live our lives and how we work in space. When a meteorite hits the other side of the Earth, other countries send the pieces here for us to analyze.

I love this work. It is amazing and critically important to our nation and the world. Budget cuts, pay freezes and bureaucracy are a distraction, and an annoying one at that. But they are not what we do. Take a look at the articles in this *Roundup*. That is what we do, and plenty of people care about that.



NASA/PHOTO

Melanie Saunders

Associate Director (Management)



CREDIT: NASA/JPL-CALTECH/SSI

Photo of the month:

Hurricanes aren't limited to Earth in *this* solar system. Captured by imaging cameras aboard NASA's Cassini spacecraft, this image is among the first sunlit views of Saturn's north pole. Measurements size the eye at a staggering 1,250 miles across, with cloud speeds as fast as 330 mph.



By Lori Keith

The Amine Swingbed scrubs for CO₂

PROVIDING BREATHABLE, oxygenated air is a necessity and top priority for human exploration spacecraft designers. The ability to remove carbon dioxide (CO₂) that humans exhale is just as important. Too much CO₂ can cause dizziness, confusion and breathing difficulties for astronauts. The latest technology, the Amine Swingbed, is on the path to being a smaller, capable source of CO₂ and moisture removal for future spacecraft. The Amine Swingbed completed its troubleshooting in April, followed by a final leak check, and now is ready to move on to a rigorous 1,000 hours of testing.

CO₂ is naturally occurring and is the fourth most abundant gas in Earth's atmosphere. It is produced from plant decay, when we exhale and as a result of burning fossil fuels like gas, coal, oil and wood. CO₂ also can form as a liquid or a solid, depending on temperature and pressure. Dry ice is the solid form of CO₂, changing from a solid back into a gas as it melts. Many factors affect CO₂ levels, including the size of the area, number of people and amount of time the area is occupied.

To combat this colorless, odorless gas on the International Space Station, a primary system is in place as part of the Environmental Control and Life Support System. The U.S. portion of the space station has the Carbon Dioxide Removal Assembly, and the Russian segment has Vozdukh. Both systems keep the station atmosphere clean of CO₂. However, it would be beneficial if a smaller, more efficient unit were available for use with other closed-volume areas like submarines and NASA's new Orion spacecraft. In response to that challenge, engineers developed the Amine Swingbed assembly. This technology is being developed for Orion, and the design will control CO₂ levels for a crew of six in the multi-purpose crew vehicle.

The heart of the Amine Swingbed assembly is the Carbon dioxide And Moisture Removal Amine Swingbed (CAMRAS). Hamilton Sundstrand developed the test equipment for the Crew and Thermal Systems Division at Johnson Space Center. CAMRAS has several layers of amine-based filter beds that remove carbon dioxide and water vapor from the station's environment. An amine is a nitrogen-containing organic compound. Once the filter beds



NASA astronaut Don Pettit, Expedition 31 flight engineer, poses for a photo with the Amine Swingbed assembly during in-flight maintenance in the Harmony node of the International Space Station.

NASA/PHOTO ISS031E096083

are full, the assembly rotates to vent CO₂ and moisture into space. This venting cleans the filter beds and makes for uninterrupted CO₂ removal.

Amine technology is not new, as it was tested first on the space shuttle. What makes the CAMRAS filter different is that it is more efficient than the ones used on shuttle. The system also uses less power and is considerably smaller than the space station's current CO₂ removal system. An update to such an assembly for future exploration vehicles could save space and reduce costs.

Since delivery to the space station for testing, there have been issues with the Amine Swingbed assembly's operations. Systems integration is an engineering challenge that often is a necessary and expected part of the innovation and new technology development process.

"The CAMRAS itself works fine, as years of ground testing (with and without human test subjects) have demonstrated," said Jeffrey Sweterlitsch, Ph.D., principal investigator for the project within the Life Support Systems Branch at JSC. "It is the untested integration of the CAMRAS, with all of the other components (which also work fine individually), that created issues."

After troubleshooting the system integration issues, NASA is working through a plan to begin testing the swingbed assembly on the space station.

Testing the swingbed assembly's performance and reliability will continue aboard station through Expedition 37/38. This technology could help humans venture further and longer into our solar system by taking up less space, and it also could be used to clean purge-gas supply systems on Earth.

NASA/PHOTO

Amine-based filter beads in thermally conductive metal foam make up each bed layer of the Carbon Dioxide And Moisture Removal Amine Swingbed.

Shuttle finishes another chapter for the history books



By Catherine Ragin Williams

THIS SPRING, nearly 32 years after *Columbia* began a new chapter of spaceflight with the Space Shuttle Program's (SSP's) first mission, shuttle concluded its magnificent run for NASA by shutting down its physical offices and closing out. It happened without a lot of fanfare, but many SSP team members had tirelessly worked behind the scenes to reach this milestone on March 31.

"After the landing of STS-135, because our contracts were so large and had accumulated so much property and records over the 30-year history of the program, we had to actually put new contracts in place to do all the close-out work," said Dennis Davidson, deputy manager, Space Shuttle Transition and Retirement Program Office.



NASA/PHOTO STS135-S-313

Xenon lights positioned at the end of Runway 15 spotlight Space Shuttle *Atlantis* as it rolls to a stop at the Kennedy Space Center, completing the 13-day STS-135 mission to the International Space Station and the final flight of the Space Shuttle Program.

The contracts, with roughly a two-year period of performance, would go out and disposition everything shuttle related. It was a daunting task, but SSP team members made it happen.

"We set out for the next two years, doing everything we could to accelerate that and get done early—all of the hardware, property, computers, software, official records—and to get out of all the buildings and facilities we had occupied as a program," Davidson said. "Originally we were targeting for a Sept. 30 end of the program, but we were successful in getting

things done to where even though we're not quite finished, we're past the point where you need an office to manage the remaining work."

ENTER: THE VIRTUAL TEAM

"It was more of a tactical decision on March 31 that we could do things more efficiently as a virtual team," Davidson said. "What happened on that day is that we closed the offices. There's still work going on, but it's just being handled either by the virtual team wherever they happen to be, or by institutional offices that have now picked up whatever small amount of work remains."

Davidson noted that the chief hurdle during transition and retirement was shifting from the operational mindset of flight that had occupied the SSP team's thoughts, activities and goals for largely 30 years.

"You still had to be consistent, you still needed discipline, but it's really a different level of discipline," Davidson said. "The biggest challenge was convincing ourselves that we could do business in a different way, and that it was OK."

MEMORIES ARE FOREVER, AND PAPERWORK—NEARLY SO

Though it will go unnoticed for the most part, Johnson Space Center is still tying up SSP loose ends. Those loose ends may go on for a while, as that is the nature of the beast when it comes to the steps and legalities involved in closing



PHOTO COURTESY OF SPACE CENTER HOUSTON

The future Space Center Houston Shuttle Carrier Aircraft and orbiter replica combo will show visitors how orbiter ferry flights were conducted for the Space Shuttle Program.

out contracts. For the near term, Information Technology (IT) is one of the last elements that will shut down.

"We needed to keep our computer systems up and functioning, all the networks up, for the entire time we were doing transition and retirement," Davidson said. "By definition, IT was going to be the last thing that we would do, and there is some lagging property that hasn't been dispositioned yet."

To shut down a spaceflight program of such magnitude and history doesn't happen every day, and that's something the agency respected when it benchmarked other government programs that had gone through similar endings. The lessons we hold not only from shuttle, but of closing out a massive undertaking, will live on as we embark on new adventures beyond Earth orbit.

MISSING SHUTTLE ALREADY? GO SEE SOME MAJOR ARTIFACTS

In Houston:

- Shuttle Avionics and Integration Laboratory (on-site) at JSC
- Shuttle Carrier Aircraft 905 (coming soon!) and replica orbiter at Space Center Houston

In Texas:

- Motion Based Simulator, Texas A&M University

Around the United States:

- *Atlantis*, Kennedy Space Center Visitor Center, Fla.
- *Discovery*, Udvar-Hazy Center, Va.
- *Endeavour*, California Science Center, Calif.
- *Enterprise*, Intrepid Museum, N.Y.
- Full Fuselage Trainer, Museum of Flight, Wash.
- Fixed Base Simulator, Adler Planetarium, Ill.
- Crew Compartment Trainer-1, Museum of the Air Force, Ohio
- Crew Compartment Trainer-2, Udvar-Hazy Center, Va.
- Guidance and Navigation Simulator, Wings of Dreams, Fla.
- Shuttle Carrier Aircraft 911, Dryden Flight Research Center, Calif.

Wearable technology entwines fabric with function



By Mark Carreau

ACROSS THE UNITED STATES, undergrads at some of the nation's top universities are fashioning boots that might enable astronauts to maneuver over the surface of a low-gravity asteroid by moving controls with their toes.

Other bright young men and women preparing to enter the nation's workforce are investigating how they might monitor and visually display the delicate process of inflating modules large enough to house astronauts far from the Earth.

More college students are developing techniques to mitigate the perspiration that builds up from gloves, which is linked to common hand injuries experienced by spacewalking astronauts.

Though a year or two from earning degrees in engineering, computer science, architecture or the fashion arts, these talented students represent an up-and-coming resource for NASA's human exploration ambitions—thanks to guidance from a mentoring network of Johnson Space Center professionals.

"We really need your smarts and your brains as we go forward," Trish Petete, division chief for JSC's Crew and Thermal Systems Division, told nearly 20 college student teams gathered to demonstrate their achievements during a Wearable Technology Symposium on April 22.

Once a seamstress herself, Petete marveled at the creativity brought by the college set to a relatively new field of research that integrates the latest



Georgia Tech student Emily Keen presents her team's final prototype, a low-profile garment that wirelessly detects the position of the wearer's arm.

in electronics and computing with advances in fabrics. NASA believes that the merging of these technologies will help the agency meet the challenges of launching astronauts on future missions to asteroids or Mars.

"It's really important for us to bring in expertise from many different backgrounds," Petete said, ticking off just some of the challenges that include restricting spacecraft mass, improving systems reliability and protecting the health of astronauts while maximizing their performance.

"The possibilities are endless, and you are the ones that can make it endless for us," Petete told an audience of students and instructors from the Virginia Institute of Technology, Georgia Institute of Technology and the University of Minnesota.



Virginia Tech student Mark Koninckx describes his team's inflatable habitat monitoring system to JSC mentor Doug Litteken.

Cory Simon, an engineer in the Human Interface Branch of the Avionics System Division, expressed equal enthusiasm over the student contributions.

"Wearable technology at NASA is just kind of bubbling up," Simon said.

The recent Georgia Tech graduate serves as JSC's point person for a group of about 15 mentors from such branches as Crew and Thermal Systems, Robotics, Structures, as well as Avionics.

By first recognizing safety, performance and comfort as guiding principles, those involved in adapting wearable technologies to spaceflight expect to make future spacecraft, robotic and computing systems extensions of the astronauts themselves.

"They are specifically addressing real-world problems," Simon said.

John Murphy, a Virginia Tech sophomore computer engineering/computer science major, is an example. Working in collaboration with architecture and industrial design majors from his school, Murphy developed a concept for a jetpack control system strategically integrated into the boots worn by an astronaut hovering over the surface of an asteroid.

"You can use your hands to work with tools and still control where you go," Murphy said. "A boot has two buttons activated by depressing or raising the toes. If both toes are depressed, you will go forward. Lift the toes, you go back."

Other combinations would hold stationary, or yaw, the astronaut.

Under plans outlined in NASA's proposed 2014 budget, a robotic spacecraft would be launched well beyond Earth to capture and maneuver a small asteroid into a stable place near the moon, where it could be explored by astronauts. The captive asteroid may be sheltered during its journey by a large inflatable module, another challenge for experts versed in rugged fabrics and control mechanisms.

Engineers in the Structures branch are looking to students to suggest strategies for unfurling and inflating a protective fabric structure without creating damage.

(continued on page 12)

NASA's Shuttle Carrier Aircraft prepares for its next (educational) mission



By Mark Carreau

NASA'S SPACE SHUTTLE FLEET introduced reusability to human spaceflight, a historic step that brought a special challenge. How was the program to transport the winged orbiters, weighing 176,000 pounds or more depending on payloads, from the program's initial runway at NASA's Dryden Flight Research Center in California to the program's primary launch site at NASA's Kennedy Space Center (KSC) in Florida?

Early options included equipping the orbiters with robust jet engines to extend their range during the descent to Earth. Or, until a suitable runway was available at KSC, they might be placed aboard ship for a trip from the West to the East Coast through the Panama Canal.

Ultimately, NASA turned to a third prospect, the Shuttle Carrier Aircraft (SCA), a pair of Boeing 747 commercial airliners modified to carry the orbiters cross country in a distinctive piggyback fashion. Joined by a full-sized shuttle mock-up from the Kennedy Space Center, the oldest of the SCAs, NASA 905, will soon become the centerpiece of a \$12 million, six-story public display at Space Center Houston (SCH), Johnson Space Center's official visitor center.

The SCAs were the brainchild of John W. Kiker, chief of the Mechanisms Branch in the Spacecraft Design Division at JSC. A former World War II pilot trainer with a passion for model building as well as flying, his accomplishments included designs for the parachute and descent systems for the Mercury, Gemini and Apollo spacecraft.

Kiker, who died in 2005, enlisted the help of colleagues from the military and the aviation industry to help convince skeptical associates of the SCA's merits.

"The concept grew out of my experience with model airplanes and experience in the military and flying airplanes and doing a lot of testing on big airplanes, B-52s and all," Kiker said in a 1999 interview with JSC's Oral History Project. "It just happened to be one of those things . . . that I was in the right place at the right time."

Assembled in 1970, NASA 905 was acquired from American Airlines in 1974. Crewed by two pilots and a pair of flight engineers, the jumbo jet transitioned from approach and landing tests of the test orbiter Enterprise at Dryden Flight Research Center to SCA missions. The SCA mission required modifications that removed the airline interiors, added two vertical stabilizers, three external attach struts, new instrumentation and a flight crew escape capability.

In all, NASA 905 flew 70 of the 87 SCA missions between 1981 and 2012, including 46 of the 54 post-shuttle mission orbiter ferry flights from Dryden Flight Research Center to KSC. The jumbo jet closed out its SCA career with the widely followed deliveries of Space Shuttles *Discovery*, *Enterprise* and *Endeavour* to their post-retirement museum locations in the Washington D. C. suburbs, New York City and Los Angeles.

The second SCA, NASA 911, was assembled in 1973, acquired from Japan Air Lines, and modified and delivered to NASA in late 1990. It was retired ahead of its older sibling in early 2012.

"After a landing at Dryden, our job was to get the orbiter back to Kennedy quickly, but also as safely and efficiently as possible," said Henry Taylor, who joined NASA's SCA corps as a flight engineer in 1989.



PHOTO COURTESY OF SPACE CENTER HOUSTON

With the Shuttle Carrier Aircraft and orbiter replica combination, Space Center's Houston's new outdoor display could quite possibly become the world's largest aircraft exhibit, with the orbiter's tail rising more than 90 feet above the ground.



NASA/PHOTO S82-33394

Back in 1982, NASA 905, a modified Boeing aircraft, and Space Shuttle *Challenger* make a rare stopover in Houston as part of a special July 4 celebration. NASA 905 will soon reside at Space Center Houston, where it will continue with a more educational mission.

Endeavour was delivered to Los Angeles on the last of the three museum ferry flights in September 2012.

“Basically, it was always a challenge to balance the weather and the weight of the orbiter to determine how far you could go,” Taylor said, who was instrumental in preparing many of the post-mission SCA flight plans.

Re-fueling stops were a necessary part of each cross-country flight, and the orbiters’ fragile and exposed Thermal Protection System tiles had to be protected from the impact of rain drops, whether in flight or while parked at an airport.



NASA/BILL INGALLS

The Space Shuttle *Enterprise* is seen mated on top of the NASA Shuttle Carrier Aircraft at Washington Dulles International Airport on April 20, 2012, in Sterling, Va.

Each ferry flight included a pathfinder, a second jet transport that would fly out ahead of the SCA to provide real-time weather information.

The mass of the orbiter made the SCA flying combination top heavy, requiring special care from the cockpit crews when it came to banking the 747, but the handling characteristics were manageable.

“Overall, it flew very nicely,” Taylor said, who continues to serve as a flight engineer on the 747 assigned to NASA’s Stratospheric Observatory for Infrared Astronomy project, a mission based at Dryden Flight Research Center.

Next stop for NASA 905

Currently parked at Ellington Field, NASA 905 is being prepped for the move to SCH as part of a distinctive marquee display that will include a shuttle orbiter mock-up perched atop. An early 2015 opening is envisioned for an attraction that will uniquely permit visitors to walk through both the SCA and the orbiter mock-up, said SCH Chief Executive Officer Richard Allen.

SCH has averaged 750,000 visitors annually since its 1992 opening.

The display strategy, contingent upon a \$4.7 million fundraising effort and a timeline that is still coming together, includes strong educational themes. Those will feature JSC’s role in developing life support hardware and other technologies crucial to future human space exploration, as



NASA/PHOTO JSC2012E216088

The Space Shuttle *Endeavour* passes over Houston as it is ferried by NASA’s Shuttle Carrier Aircraft on Sept. 19, 2012, en route to Ellington Field, near Johnson Space Center. *Endeavour* and the modified 747 jetliner are on the first leg of a trip to the Los Angeles area, where the shuttle will be placed on public display at the California Science Center. This is the final ferry flight scheduled in the Space Shuttle Program era.

well as in supporting shuttle operations, said SCH Director of Education Melanie Johnson.

“We want to make it current and bring our guests into the future,” Johnson said.

The attraction will accommodate individual, self-guided guests in small groups, as well as classrooms and youth organization tours and possibly sleepovers. Docents with shuttle and SCA experience are also planned as part of the guest experience.

Midsummer, SCH plans to launch a name-the-orbiter contest for the winged mock-up that has been part of the SCH visitor experience since June 2012.

Boeing and Jacobs Engineering Group are among those providing expertise to the work ahead, which will require the 747 to be disassembled at Ellington, moved and reassembled at the entrance to its new home.

Decoding the universe with the Alpha Magnetic Spectrometer



By Catherine Ragin Williams

SCIENTISTS HAVE LONG puzzled over the intricate matrix of our universe, trying to figure out its origin and why particles interact as they do with other elements. With the launch of the Alpha Magnetic Spectrometer (AMS) experiment in 2011, the first findings published this spring show we are well on our way to decoding the mysteries of our universe.

“A theory about the Big Bang says that at the beginning, there should’ve been equal amounts of matter and antimatter,” said Johnson Space Center AMS Project Manager Trent Martin. “If that’s true and there are equal amounts of matter and antimatter . . . where is the antimatter? It should exist. In fact, half the universe should be made out of antimatter.”

What is antimatter? If you looked at matter as we know it, you would see a positively charged proton in the center and negatively charged electrons orbiting the nucleus. If the charges were exactly opposite, you would have antimatter.



Standing next to a model of the Alpha Magnetic Spectrometer (AMS), Nobel laureate Samuel Ting, AMS principal investigator, speaks to Johnson Space Center team members about the wonders of this experiment aboard station.

“AMS can tell the difference between those two,” Martin said. “We can actually determine if something has a mass of a hydrogen atom but the charge is wrong. At present, we have not published anything showing that we have seen any of those. We are confident that we can see them, so if they exist, we will see it with AMS given enough time.”

So if not antimatter, what is the mysterious force manipulating the universe? There is something else out there—we just have not definitively proved it.

“The Hubble telescope has told us that the universe is expanding at a rate greater than what we would expect it to expand, given the amount of mass

that we can see with telescopes,” Martin said. “It implies that there is something else causing the universe to expand that’s imparting gravity on other parts of the universe, and they can’t see it, so they call it dark matter.”

Using the power and data transmission capabilities of the International Space Station, AMS is circling the Earth and sifting through the makeup of our universe: matter, antimatter and other particles that have yet to be confirmed. But if any instrument can help decode the universe, it is AMS.

AMS is composed of a magnet and eight detectors that provide the scientists on the ground with information about the particles that travel through the magnet.

“A simple little idea,” Nobel laureate and AMS Principal Investigator Samuel Ting of the Massachusetts Institute of Technology deadpanned



With the splendor of space in the background, the Alpha Magnetic Spectrometer combs through particles as it orbits the Earth.

about the experiment. “But it took 40 years to figure out how to put a magnet in space.”

The biggest obstacle? Unlike particle accelerators on Earth that protect delicate hardware in the crusade of better understanding physics, “space is very hostile,” Ting said. “I didn’t understand that at all. Most of what we were trying to do, people did not think it was possible.”

Thanks to a partnership with NASA and the space station, AMS resides in space, gathering the data that will bring to light the darkest parts of the universe. As of this summer, AMS has collected data on over 33 billion particle events, accumulating more statistics on charged cosmic rays that have been previously collected in the history of human physics studies. More promising is that the data it has revealed so far shows that we are zeroing in on confirming or disproving current theories of dark matter.

“What AMS is essentially saying is that this is what the data says for electron versus positron electron ratio,” Martin said. “Some theories about dark matter say that if dark matter exists, you should see the same kind of increase that AMS has seen and, at some point, you should see that drop off rapidly. What AMS has not seen is that drop off. There are hints of that drop off at the very far right edge of the data, but we have not published (findings on) any drop off yet.”

Particles passing through AMS are not coming from one particular location, as if originating from a pulsar. Rather, evidence suggests the particles are coming from all over the universe.

Ting will present on AMS at the International Cosmic Ray Convention in Rio de Janeiro in July, and will have more announcements soon concerning new data. With time and more analysis, scientists will get the answers they are seeking.

“Eventually, we will find out the origin of 90 percent of the universe,” Ting said.

Russian meteorite shocks, makes an impact



By Catherine Ragin Williams

ON FEB. 15, A SMALL, 17-meter asteroid slipped under the radar and stole the spotlight over Chelyabinsk, Russia, colliding magnificently with Earth's upper atmosphere. The energy of the explosion exceeded 400 kilotons of TNT. In comparison, the first atomic bombs produced only 15 to 20 kilotons.

While NASA experts had been expecting an asteroid to scoot by the Earth that day, they were tracking a different and slightly larger one (50 meters): 2012 DA14, which would pass only 17,200 miles above Indonesia and was in no danger of colliding with our planet.

The impactor that made a lasting impression on Russia, however, came out of the blue and from the direction of the sun, where no telescope could see it. The resulting shock wave battered windows in hundreds of buildings around Chelyabinsk.

Months later, Johnson Space Center is in possession of two of these meteorite samples, weighing 18.7 and 19.6 grams, respectively, and will study them for clues to the origins of the universe.

"It's taken a while to get to that point where we can make a detailed plan," said Antarctic Meteorite Curator Kevin Righter, Ph.D., who is overseeing the care and subdivision of the Russian samples. "We first had to identify who was interested in analyzing the meteorite. Then we had to identify what form they would like to study the material. Some people would just like a bulk chip or sample, while some would like a thin section mounted on a glass slide that they would look at using a microscope and many other analytical techniques. Some people would prefer to study a powdered material."

While there's still much to learn, we do know some basic facts. First, the rocks are classified as chondrite—specifically, what scientists call an LL5 chondrite.

"Those are pretty numerous in world collections, but (these are) extremely fresh," Righter said. "They were recovered immediately and seem to have a lot of interesting shock and impact features, among which we may find some surprises. I think a lot of the focus of the research will be on characterizing the shock and impact features."

Scientists in JSC Astromaterials Research and Exploration Science

Directorate will apply a broad array of state-of-the-art analytical techniques to characterize the Chelyabinsk samples, including various kinds of optical and electron microscopy, mass spectrometry and infrared and Mössbauer spectroscopy.

The immediate recovery of the Russian samples was like a scientific gift for researchers, who normally deal with meteorites that have been lying undiscovered on the planet for tens of thousands of years or more.

"There are a couple of unique things about samples like these that are observed to fall and then are recovered quickly," Righter said. "Most meteorites that are found or in world collections are what we call finds, which means somebody's walking around outdoors and finds a meteorite,

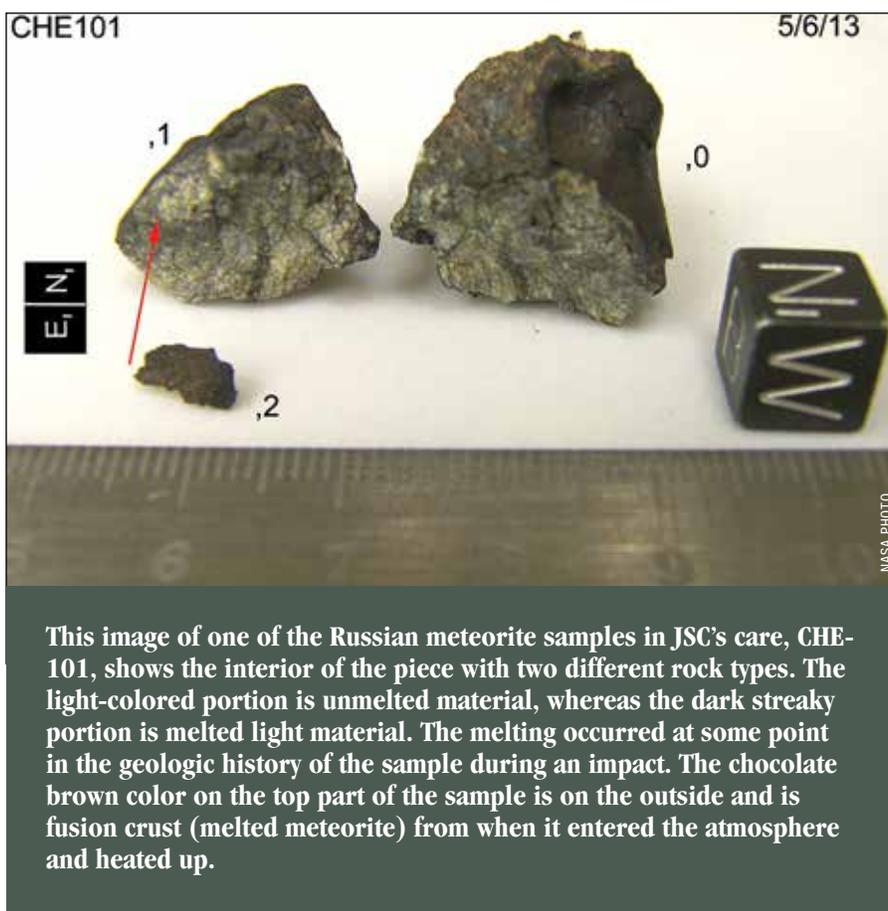
either accidentally or as part of a search. When the meteorites sit at the surface of Earth, a number of things can happen. Water can permeate through the sample and alter it, even in a small way. The exterior of the sample can be what we call weathered or oxidized just by exposure to air and surface conditions, rain and seasonal variations, and so forth."

These Russian samples are about as pristine as meteorites can be after showering down to the ground, allowing researchers to get a relatively unadulterated analysis of the parent asteroid.

"If you recover material quickly, you can be fairly certain that material mostly formed on the parent asteroid,

and that's really important for scientists to know," Righter said. "Most people have seen photographs of asteroids, and one thing you remember is they're full of craters, which means they were bombarded by material over geological history. Those bombardments are the events that cause the shock features that we see in the meteorites and the impact features. In a sense, if we have a chance to study the shock and impact features, we're examining and learning more about the events that led to the current appearance and make-up of the asteroid."

Though our Russian partners may not have welcomed the close encounter with an otherworldly rock, scientists from around the globe and at JSC are anxious to begin a thorough analysis of this snapshot of one corner of our universe.



This image of one of the Russian meteorite samples in JSC's care, CHE-101, shows the interior of the piece with two different rock types. The light-colored portion is unmelted material, whereas the dark streaky portion is melted light material. The melting occurred at some point in the geologic history of the sample during an impact. The chocolate brown color on the top part of the sample is on the outside and is fusion crust (melted meteorite) from when it entered the atmosphere and heated up.

NASA PHOTO



Spotlight: Katie Boyles

Aerospace Engineer, Applied Aeroscience and Computational Fluid Dynamics Branch

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

A: I have loved being able to work on a variety of programs/projects (Space Shuttle, International Space Station, Orion and Morpheus), and I feel proud knowing that the aerodynamics and aerothermodynamics products that we produce in our branch are contributing to the design of the vehicle and success of the mission. I'm also truly honored to be able to work with such incredibly smart people on a daily basis who are so dedicated to their work and advancing the aerosciences discipline.

Q: You were recently highlighted for a Women@NASA segment. Do you have some advice for young girls who want to have a career related to space?

A: I would advise young girls to participate in a co-operative (co-op) education or internship program in college. Being part of JSC's co-op program opened so many doors career-wise for me. I would tell them that you need to believe in yourself and your potential, remain dedicated to achieving your dreams, work very hard in school and never give up.

Q: What personal achievement are you most proud of?

A: I am so proud of my family! My daughters (who are 2 and 5 years old) continue to amaze me every day, and I am proud that my husband and I have been married for 10 years. I couldn't imagine a better partner to journey through life with.

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

A: The summer after I graduated from college, I was a breakfast cook at a mountain resort in the Trinity Alps in northern California. If you know me, this is surprising because my husband is really the chef of the family. I don't think I'd scrambled too many eggs before that experience.

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: Neil Armstrong. I would love to have experienced walking on the moon for the first time ...

Q: What is your favorite indulgence?

A: A Starbucks coffee or frappuccino.

Q: What song/artist would you most likely jam on the radio on your way to work in the morning?

A: My 5-year-old daughter and I have been known to rock out to Carly Rae Jepsen and Justin Bieber in the car!

Q: What seemingly "little things" bring you joy?

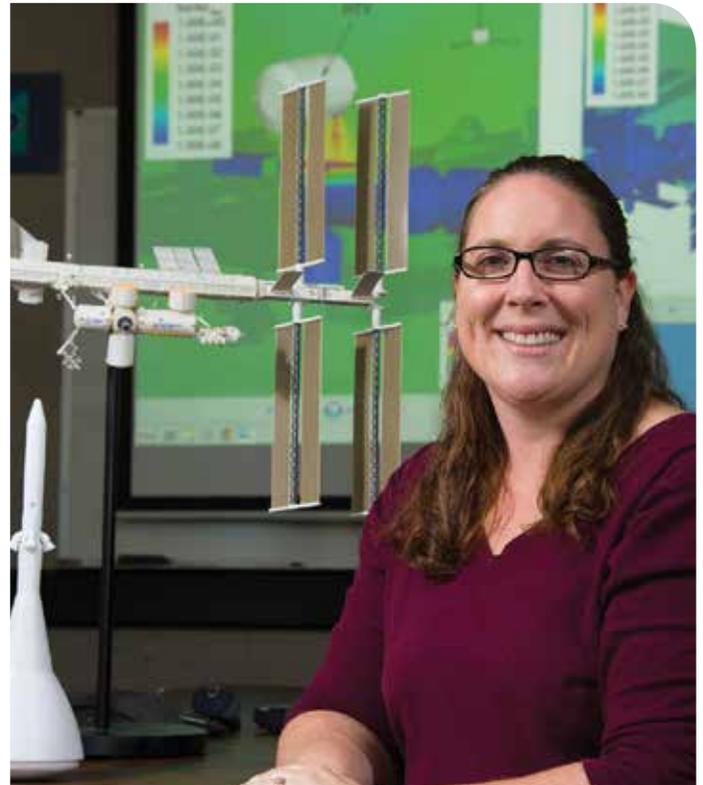
A: Seeing my family healthy and happy, cuddling with my dog (a 10-year-old yellow Lab), spending time with friends and family, a hot cup of coffee in the morning, experiencing those wonderful (but sometimes rare) sunny and cool/crisp days in Houston and any day I get to spend in Lake Tahoe, Calif.

Q: What is your favorite way to spend a few free hours?

A: Playing with my kids! If I'm by myself, then reading a book, getting a massage or writing letters at a coffee shop.

Q: Describe yourself in three words.

A: Caring, dependable, genuine.



NASA/JAMES BLAIR JSC2013E030439

Q: What would we find in your refrigerator right now?

A: Veggies and fruit from a local farm that we buy from weekly, La Croix sparkling waters, string cheese that both of my kids eat on a daily basis and gourmet cheeses that my husband and I love.

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

A: I developed a passion for space exploration after attending NASA's space camp in sixth grade and NASA's Space Academy in high school. In college at the University of California San Diego, I had the incredible opportunity to work on the NASA Earth Knowledge Acquired by Middle School Students payload project with Dr. Sally Ride. Based on those experiences, I knew I wanted to work for NASA and contribute to the nation's space program.

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

A: One of my favorite memories is when my good friend, astronaut Dottie Metcalf-Lindenburger, called me to say hello from the International Space Station (ISS). I had originally missed her call on my cell phone, and I was kicking myself as I was listening to the voicemail she'd left me from ISS. I literally lived next to my cell phone for the next few days and, luckily, she called me back!

Q: Where do you hope to see NASA 50 years from now?

A: In 50 years, I hope to see NASA focused on exploration and traveling to destinations in the universe that we haven't been before, continuing to make life better here on Earth, inspiring humanity to continue to push the boundaries of what is possible and to respect and appreciate the Earth.

Expedition 36 Soyuz launch

ON MAY 29, a Soyuz rocket with Expedition 36/37 Soyuz Commander Fyodor Yurchikhin of the Russian Federal Space Agency (Roscosmos) and Flight Engineers Luca Parmitano of the European Space Agency and Karen Nyberg of NASA aboard, launched from the Baikonur Cosmodrome in Kazakhstan to the International Space Station. Yurchikhin, Nyberg and Parmitano will remain aboard the station until mid-November.

NASA Flight Engineer Chris Cassidy and Commander Pavel Vinogradov and Flight Engineer Alexander Misurkin of the Russian Federal Space Agency welcomed their crew mates to the orbiting laboratory.

During the five-and-a-half month timeframe of Expedition 36/37, the crew is scheduled to conduct spacewalks to prepare the complex for the installation of the Russian Multipurpose Laboratory Module in December, as well as a Nov. 9 spacewalk to take the Olympic torch outside. The crew also will welcome the arrival of several visiting cargo vehicles: the European Space Agency's "Albert Einstein" Automated Transfer Vehicle-4 in June, a Russian Progress cargo craft in July and the Japan Aerospace Exploration Agency's H-II Transfer Vehicle-4 in August.

Along with the challenges of managing visiting vehicle traffic and six spacewalks, the crew will continue supporting a diverse portfolio of research and technology experiments.



NASA/BILL INGALLS

Destination Station brings the wonders of space station home

WHILE AN UNOBTRUSIVE LABORATORY whirls above our heads 365 days a year, a more intensive campaign is happening on Earthen ground to acquaint the general public with the wonders of the International Space



PHOTO COURTESY OF SPACE CENTER HOUSTON

Station (ISS). The effort started as an outreach campaign with a traveling exhibit called Destination Station, and has evolved to include an interactive exhibit in our own backyard at Space Center Houston (SCH).

Peggy Carruthers, the ISS lead for outreach, explained that until recently, station was not highlighted at Johnson Space Center's official visitor center.

"With the retirement of the shuttle, Space Center Houston wanted to incorporate an exhibit featuring space station," Carruthers said. "We started with updating the (large, overhanging ISS) model, and from there the exhibit evolved into the current display."

The results of the overhaul, which can be seen by visitors right now, rivals collaboration efforts of the past.

"In my 14 years here at Space Center Houston, the new ISS exhibit is the result of the most profound and valuable partnership we have had with JSC's External Relations Office and the ISS Program Office," said SCH Operations Manager Anson Brantley. "This world-class exhibit is now available to more than 700,000 people annually here at Space Center Houston, and will help us exceed our goal in educating the public about NASA's human spaceflight program."

Other compelling features include a display of personal items loaned by station astronauts, Robonaut, huge panels and graphics denoting science and research, micrometeoroid impact items, mock-ups of sleeping compartments and a space toilet. The exhibit, most importantly, highlights station's genesis from construction to, now, full utilization with six-person crews.

Roundup

The Roundup is an official publication of the National Aeronautics and Space Administration, Johnson Space Center, Houston, Texas, and is published by the External Relations Office for all Space Center employees. The Roundup office is located at the Johnson Space Center, Building 2. The mail code is AD94. Visit our website at: <http://www.jsc.nasa.gov/roundup/online/> For distribution questions or to suggest a story idea, send an email to jsc-roundup@mail.nasa.gov.

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Wearable technology entwines fabric with function

(continued from page 5)



NASA/LAUREN BETH HARTNET JSC2013E027580

Forty-eight students from the University of Minnesota, Georgia Tech and Virginia Tech developed and demonstrated prototypes to address NASA's spaceflight challenges related to wearable technology and electronic textiles.

"Most of all, they bring a different perspective, especially the architects," said Doug Litteken, a Structures branch engineer working with a student inflatable team. "It helps the students as well. They get engineering experience. They see all the different things they can be involved with at NASA."

Students from the University of Minnesota's College of Apparel Design, for instance, have proposed the use of fabrics embedded with absorbent polyacrylate crystals to wick away perspiration that accumulates in spacesuit gloves.

The buildup is responsible for painful chaffing, blisters and broken fingernails.

"By far, these are the most enthusiastic of any student groups that I've worked with," said Lindsay Aitchison, an engineer in Advanced Suit Development who serves as a mentor for the glove project. "They feel like part of the team because they are doing something that is useful and beneficial. We do take their ideas and see them through our development chains."



NASA/LAUREN BETH HARTNET JSC2013E027636

University of Minnesota apparel design students discuss their moisture-wicking glove prototype with Crew and Thermal Systems Division Chief Trish Petete.