Serving the Marshall Space Flight Center Community www.nasa.gov/centers/marshall/about/star/index.html November 20, 2013

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Supporting Our Community Partners through CFC

Thanksgiving is just around the corner. As we enter the holiday season, I wanted to take a moment to remind and encourage everyone on the Marshall Team to help our community by finding a way to contribute during the annual Combined Federal Campaign.

When we think of contributing to the well-being of others, many often think of financial donations. However, thanks to the CFC committee, you can also donate your time by volunteering for any of the great non-profit groups listed on the CFC ExplorNet page during our

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Patrick Scheuermann (NASA/MSFC)

Algorithms + F/A-18 Jet = Vital Testing for SLS Flight Control System

By Megan Davidson

Raise your hand if, in a math class, you ever said, "When will I ever use this in my life?"

Four young engineers at NASA's Marshall Space Flight Center can answer that question: They are using math to develop algorithms, or complex step-by-step equations, that can make an F/A-18 fighter jet fly like the Space Launch System (SLS) -- NASA's next heavy-lift launch vehicle.

Marshall's Eric Gilligan and Tannen VanZwieten; Jeb Orr, a Draper Laboratory employee; and John Wall, a Dynamic Concepts employee, are all working in Marshall's Spacecraft and Vehicle Systems Department. They have spent years developing and refining algorithms for the

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Marshall Hosts 'Brown Bag, Red Planet' to View MAVEN Launch

By Shannon Ridinger

Members of the public and NASA Marshall Space Flight Center employees were treated to a flawless launch on Nov. 18 when NASA's Mars Atmosphere and Volatile Evolution (MAVEN) mission began with a smooth countdown from Cape Canaveral Air Force Station's Space Launch Complex 41. The launch was shown live at the "Brown Bag, Red Planet" event at the U.S. Space & Rocket Center for the general public, and at the Activities Building 4316 for Marshall Center employees.

Members of the community and students from the U.S. Space & Rocket Center's Space Camp program attended the event held in the digital theater of the Davidson Center. Attendees were treated to a panel discussion on deep space exploration and Marshall Center's role in exploring our solar system before the launch viewing. The discussion

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From left, Sharon Cobb, Space Launch System assistant program manager; Bill Cooke, Meteoroid Environments Office lead; David Smitherman, Advanced Concepts study lead; Paul Bookout, Deep Space Habitat Concept Demonstrator project manager; and Les Johnson, deputy manager of the Advanced Concepts Office present "Deep Space Exploration: Mars and Beyond" during the MAVEN public viewing event at the U.S. Space & Rocket Center on Nov. 18. (NASA/MSFC/Emmett Given)

Supporting CFC

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Community Service Days.

The theme for this year's charity drive is "Make it Possible." The Marshall Team has made some truly incredible things possible for more than 50 years, and I hope this year that you can do the same for the communities outside the arsenal gates that support our work and families by giving back to the places we call home.

As of this week, we are nearly halfway to our goal of $700,000 with only 25% of the workforce participating and we have less than two months left in our giving drive. Your generosity and community engagement is one of my best memories of my first year as a member of the Marshall Center family. I've seen the power of community involvement firsthand, and I consider the CFC one of our most important partnerships.

Please take a few moments to make a donation or become involved with a local non-profit group and help "Make it Possible" during this season of giving. Thanks to each and every one of you. I hope you have a Happy Thanksgiving!

Patrick

Vital Testing for SLS

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flight control system on the SLS. That system is the "brain" of the vehicle, designed to steer it along the path to destinations beyond Earth's orbit.

"The rocket has a set of equations that describe its motion," Orr said. "It's all just a math operation. When applied to the model of the rocket, it helps us predict the intended performance."

NASA is no stranger to designing flight control systems for launch vehicles, but the Marshall team of engineers is innovating a new automated system that adds additional performance and robustness to the traditional flight design.

"We're expanding the capabilities of SLS a little bit beyond what we'd normally be able to achieve through a traditional analysis process," Orr said. "With an adaptive algorithm, we can be a little more responsive to anomalies in flight, like unpredictable winds, to ensure the vehicle stays on its trajectory."

For NASA, this is the first application of an adaptive control concept to launch vehicles, adding the ability for an autonomous flight computer system to retune itself -- within limits -- while it's flying the rocket. The system, called the Adaptive Augmenting Controller, learns and responds to unexpected differences in the actual flight versus preflight predictions. This ability to react to unknown scenarios that might occur during flight and make real-time adjustments to the autopilot system provides system performance and flexibility, as well as increased safety for the crew.

"A stumbling block for a lot of people is, 'You've got a rocket algorithm, but you want to test it on an airplane?'" VanZwieten said. "It's not immediately clear how the aircraft could match important dynamic features of SLS, but it does. We're flying a similar trajectory on the airplane as we have with the rocket, and the aircraft rotational dynamics are 'slowed down' to match the maneuvering characteristics of a heavy-launch vehicle.

"Our software that's running on the F/A-18 doesn't know that it's flying an F/A-18," Orr added. "It thinks it's flying SLS."

The F/A-18 test series, called the Launch Vehicle

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Eric Gilligan, 23, a native of Roxbury, N.J., has a bachelor's degree in aerospace engineering from Pennsylvania State University in State College. He joined NASA soon after graduating in 2012. "I've always had an interest in NASA and working on a fast-paced project like this that will actually fly and that will benefit SLS in the future is really cool. I'm really lucky to be a part of it and to work with some of the most talented engineers in the NASA community." (NASA/Dryden)

Tannen VanZwieten, 31, a native of Pompano Beach, Fla., began her NASA career in 2008. She has an extensive educational background, with bachelor's and master's degrees in ocean engineering from Florida Atlantic University in Boca Raton; a master's degree in aerospace engineering from the University of Central Florida in Orlando; and a doctorate degree in electrical engineering, with an emphasis on controls, from the University of Wyoming in Laramie. While a student at the University of Wyoming, VanZwieten connected with NASA through the Graduate Student Researchers Program. "This project has been fantastic. It's exciting to push the envelope of what's used for human spaceflight by developing and incorporating what we believe is a better, safer algorithm." (NASA/Dryden)

Vital Testing for SLS *Continued from page 3*

Adaptive Control (LVAC) experiment, began Nov. 14. Five flights are planned, with more than a dozen tests being conducted during each flight. The jet is in the air for 60 to 90 minutes, and during that time the algorithm is repeatedly tested under different scenarios for approximately 70 seconds at a time.

"We have developed 20 scenarios, each simulating some abnormal conditions, like higher thrust than anticipated or the presence of wind gusts, to see if the algorithm responds as we designed it to do," Gilligan said. "The tests might reveal something we hadn't thought about in our algorithm, which we can go back and modify as necessary."

The team will be manning the control room for all the tests. "We'll be looking at the data coming in real time and making decisions about the test scenarios that will be relayed to the pilot on flight days. We're really excited for the opportunity to get to see our work take off, literally, for the first time," Wall said.

To read the full version of this story, click here.

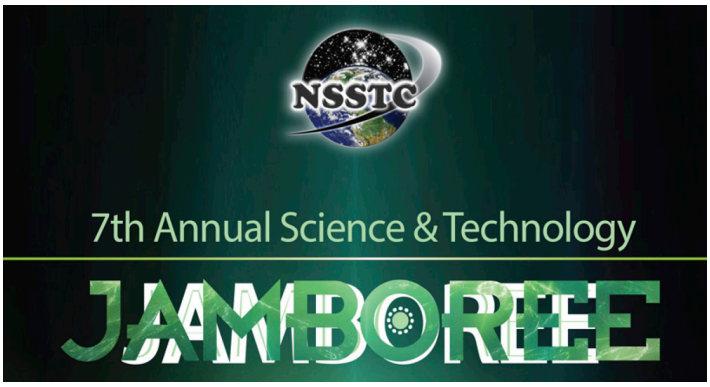
Davidson, an ASRC Federal/Analytical Services employee, supports the Office of Strategic Analysis & Communications.

Jeb Orr, 31, who was born in Philadelphia and moved all over the United States as a military kid, considers Huntsville home. He has a bachelor's degree in computer engineering; a master's in electrical engineering; and a doctorate in electrical engineering, with an emphasis in dynamics and controls -- all from the University of Alabama in Huntsville. He has supported NASA as a contractor since 2008, currently working for Draper Laboratory. "I've been fascinated with space exploration for as long as I can remember. We have an exceptional opportunity as early-to-mid-career engineers on this project, doing something that is really unprecedented in human spaceflight from the standpoint of algorithm design, development and flight certification." (NASA/Dryden)

John Wall, 30, a native of Huntsville, is following the footsteps of his grandfather, father and uncle, who all have worked or are currently working for NASA. He has a bachelor's degree in mechanical engineering from Christian Brothers University in Memphis, Tenn., and a master's in the same field from Auburn University in Auburn, Ala. He has supported NASA as a contractor with Dynamic Concepts since 2007. "I'm doing exactly the kind of work I was passionate in pursuing in college. This is the first opportunity I've had to see a concept go from nuts and bolts all the way to flight. That's a huge deal, especially being so early in my career." (NASA/Dryden)

Seventh Annual Science & Technology Jamboree to be held Dec. 6

The seventh annual Science & Technology Jamboree – in which team members can show off their science work to NASA's Marshall Space Flight Center community -- will be held Dec. 6. The event will be from 9 a.m. to noon, at the National Space Science and Technology Center on Sparkman Drive in Room 4078.



Presenters' slides are due by 5 p.m., Dec. 3. For details on how to present and submit material, contact George Fletcher at George.Fletcher@nasa.gov.

A holiday party will follow the presentations. For food sign-up, contact Marcia Crowe at Marcia.e.crowe@nasa.gov or 256-961-7342.

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featured Paul Bookout, Deep Space Habitat Concept Demonstrator project manager; Bill Cooke, Meteoroid Environments Office lead; Sharon Cobb, Space Launch System assistant program manager; David Smitherman, Advanced Concepts study lead; and Les Johnson, deputy manager of the Advanced Concepts Office.

Members of the public and employees who couldn't be at either event were able to watch the panel discussion and launch live on Marshall Center's Ustream account. Audience members were also encouraged to ask questions of the panel, and questions were also taken live from the center's social accounts, including Twitter and Ustream.

Students attending Space Camp eagerly ask questions of the deep space exploration panel at the MAVEN public viewing event at the Space & Rocket Center. (NASA/MSFC/Emmett Given)

The United Launch Alliance Atlas V rocket carrying the 5,400-pound MAVEN spacecraft lifted off at 12:28 p.m., the mission's first opportunity for launch. MAVEN's principal investigator is based at the University of Colorado Laboratory for Atmospheric and Space Physics in Boulder. The university provides science instruments and leads science operations, education and public outreach. NASA's Goddard Space Flight Center manages the project and provided two of the science instruments for the mission. Lockheed Martin built the spacecraft and is responsible for mission operations. The University of California at Berkeley's Space Sciences Laboratory provided science instruments for the mission. NASA's Jet Propulsion Laboratory provides navigation support, Deep Space Network support and Electra telecommunications relay hardware and operations.

For more information about the MAVEN mission and to follow the spacecraft on its journey, visit NASA's mission website: http://www.nasa.gov/maven.

Ridinger is a public affairs officer in the Office of Strategic Analysis & Communications.

Marshall Center Celebrates International Space Station 15th Anniversary

By Tracy McMahan

This week employees at NASA's Marshall Space Flight Center joined the world in celebrating the 15th anniversary of the International Space Station (ISS) and the valuable science results the orbiting laboratory continues to reveal. People at Marshall played a pivotal role in station design and construction, and they continue to support thriving science operations.

On Nov. 20, 1998, the Russians launched the Zarya control module. A few weeks later on Dec. 4, the space shuttle STS-88 mission delivered the first U.S. element of the space station, the Unity module, built in an advanced manufacturing area at Marshall by The Boeing Company, the station's prime contractor.

"When astronauts joined Zarya and Unity on Dec. 6, a dream long held by space pioneers and science fiction writers became a reality," said Teresa Vanhooser, Marshall Center deputy director. During station construction, Vanhooser led the team that provides around-the-clock support for station science. "We are proud of Marshall's advanced manufacturing capabilities that enabled the construction of station elements and facilities, including the U.S. Destiny laboratory and the station's life support system."

The 22-foot-long, 18-foot-diameter Unity serves as a passageway between the station's living and working areas, and station crews often gather there to eat or relax. Today, the space station, including its large solar arrays, spans the area of a U.S. football field, including the end zones, and has more livable room than a conventional five-bedroom house. NASA and its international partners completed station assembly in 2011, and now the focus is on conducting science in space.

"Our role at Marshall's Payload Operations Integration Center has now taken center stage," said Jay Onken, the director of Marshall's Mission Operations Laboratory. "We help the crew pack as much science as possible into their work day, and even into their weekends when possible. We staff the control center 24/7, operating facilities and experiments 365 days a year because space station science facilities and major systems operate continuously. Science experiments never sleep or take a break."

The Unity node, the first U.S. element of the International Space Station, was built in advanced manufacturing areas at NASA's Marshall Space Flight Center. (NASA/MSFC)

The Marshall team provides sustained engineering support for critical parts of the station constructed and/or tested at the center which include the Environmental Control Life Support System, the Microgravity Science Glovebox, the Materials Science Research Rack, eight EXPRESS (EXpedite the PRocessing of Experiments for Space Station) racks that provide support for station science investigations, and the Window Observational Research Facility that enables the Marshall-managed ISERV Earth observations camera and all other Earth observing investigations.

"Our team ensures these facilities operate as planned," explained Annette Sledd, who manages Marshall's ISS office. "We monitor facility operations, provide replacement parts, help develop procedures for crew maintenance, and assist investigators building experiments to work in station racks and facilities." Marshall's ground-based engineering units, replicas of station facilities, help with these tasks. Sledd estimates about 15 to 20 investigators, or payload developers, visit Marshall each year to test their equipment before it heads to station.

It all started 15 years ago with an aluminum structure called Unity. While Unity may look simple, Brian

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Key Elements of James Webb Space Telescope Complete Testing at Marshall

By Tracy McMahan and Janet Anderson

The primary mirror backplane support structure of the James Webb Space Telescope has completed a rigorous testing regime inside the X-Ray and Cryogenic Test Facility at NASA's Marshall Space Flight Center. The structure is essentially the spine of the massive telescope and is the final component to undergo testing at the facility.

Marshall test facilities have played a key role in ensuring Webb's future mission success. The X-ray and Cryogenic Test Facility is one of the only places on Earth where such large components like the backplane structure on the Webb telescope can be tested in a simulated space environment.

"We've been planning, developing testing techniques, and evaluating technologies for Webb in this facility for about 10 years, and then actually testing flight hardware since 2008," said Jeff Kegley, manager of the X-ray and Cryogenic Test Facility at the Marshall Center. "The tests on the hardware went really well and our team is confident the structures will operate optimally in space. We're glad to have contributed so significantly to the

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Bound for Northrup Grumman in Redondo Beach, Calif., the James Webb Space Telescope's critical backplane testing has been completed at Marshall. Here the backplane is being ferried by big rig to the Redstone Arsenal airfield for transport. The backplane has been at Marshall since late August for cryotesting in the center's X-ray & Cryogenic Test Facility. The backbone of the telescope, the backplane will support its 18 beryllium mirrors, instruments and other elements while the telescope is looking into deep space. (NASA/MSFC/Fred Deaton)

ISS 15th Anniversary

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Mitchell, a Marshall engineer who served as one of the leads for Unity, said, "It is one of the most complex modules on the station because it has six berthing ports that align and capture adjoining modules during assembly and motorized bolts that attach the modules tightly together."

The station elements all connect because of the common berthing mechanism found on all the U.S., Japanese and European modules, as well as on the SpaceX Dragon and Orbital Cygnus spacecrafts. To berth pieces together, the crew uses the shuttle or station remote manipulator arm, and in a carefully choreographed sequence connects two parts of the station or a visiting ship to the station. More than 40 berthings and 31 unberthings have been completed. The berthing mechanism was designed, built and tested in a unique six-degrees of freedom simulator at Marshall where crews also trained.

"I am proud to be part of the international team that built the space station and keeps this space research complex operational," said Mitchell. "It is amazing that people almost anywhere in the world can go outside and see space station crossing the night sky with the naked eye as a reminder of our collective accomplishment. Every time I see it, it takes my breath away."

Want to see the International Space Station? As the third brightest object in the sky, the space station is easy to see if you know when to look up. For more information, visit http://spotthestation.nasa.gov/

For more information on the International Space Station, visit: http://www.nasa.gov/station

McMahan is a public affairs officer in the Office of Strategic Analysis & Communications.

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progress of the mission, but sad to see our part come to an end."

The Webb telescope will be 100 times more powerful than the Hubble Space Telescope, and it will operate farther away from Earth. NASA will not be able to service the telescope; therefore its parts must be light, strong and durable. To prepare several components of the Webb telescope to meet the extreme temperatures of space, engineers at Marshall's X-ray and Cryogenic facility have carefully examined telescope components inside a vacuum chamber that simulates the hyper-cold of space.

During the recent backplane testing, engineers attached 130 diodes to the structure to measure the relative motion of key mounting points. The backplane then went through several cycles from room temperature to minus 400 degrees Fahrenheit.

The telescope's backplane supports the beryllium mirrors, instruments and other elements. The backplane will hold the 18-segment, 21-foot-diameter primary mirror nearly motionless while the telescope peers into deep space. The mirrors were measured under the X-ray and Cryogenic facility's super cold conditions from 2008 to 2012. ATK built the backplane structure at its facility in Magna, Utah, under a contract with prime contractor Northrop Grumman. The structure is composed of advanced graphite composite materials mated to titanium and invar fittings and interfaces. Invar is a nickel steel alloy notable for its uniquely low changes due to thermal expansion.

The X-ray and Cryogenic Test Facility has also tested other Webb components. In the summer of 2013, Webb's wings underwent testing in the facility. The wings, also made by ATK, are made up of 900 separate parts of lightweight graphite that fold up allowing the entire mirror assembly to fit inside a rocket for launch.

In addition to the X-ray test facility, the Marshall Center is home to other test facilities that have been vital to the completion of the Webb telescope. The center's environmental test facility also contributed important materials testing for samples of Webb's sunshield.

The sunshield acts like a parasol shading and protects Webb's sensitive mirrors and instruments. In space, the sunshield will experience both hot and cold temperatures. For the test, several sunshield samples experienced temperatures ranging from minus 423 degrees Fahrenheit to 170 degrees Fahrenheit. Marshall engineers performed the tests for ManTech International Corporation which recently completed manufacturing of full-scale sunshield test articles that weigh a mere 18 pounds each, yet are almost 45 feet wide by 70 feet long. The entire sunshield consists of five tennis-court-size, kite-shaped layers that will be folded and deployed once the Webb telescope reaches its destination.

"A sunshield of this size and complexity has never been built before, and it is important that it be tested under the exact thermal and vacuum conditions that it will experience in space," explained Helen Cole, the Marshall Center project manager for Webb testing. "Our Marshall environmental test facility provides a simulated space environment so that any issues can be identified before the flight sunshield was made. This will ensure the sunshield radiates heat away from delicate scientific instruments designed to operate at cold temperatures in order to detect faint astronomical objects."

The sunshield must endure a decade of space operations, so the sunshield material, Kapton, also was exposed to space as part of the Materials International Space Station Experiment, or MISSE. The material spent more than four years in orbit, which helped engineers at NASA's Goddard Space Flight Center, the NASA center managing the telescope, to conclude the material would perform well as a sunshield. Marshall engineers analyzed the samples when they were returned to Earth.

Marshall has several one-of-a-kind facilities necessary for simulating the extreme environments that space hardware is expected to withstand during space operations. These unique facilities allow Marshall to contribute to NASA's diverse suite of flight missions, projects and programs that expand humanity's understanding of the universe.

A joint project of NASA, the European Space Agency and the Canadian Space Agency, the Webb telescope will observe the most distant objects in the universe, provide images of the first galaxies formed and see unexplored planets around distant stars.

For more information about the Webb telescope, visit here or here. For more information about the X-ray and Cryogenic Test Facility, visit here.

McMahan and Anderson are public affairs officers in the Office of Strategic Analysis & Communications.