National Aeronautics and
Space Administration

2017 Marshall Star Year-In-Review

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Director's Corner

Todd May, Director, Marshall Space Flight Center

2017: Meeting Every Challenge, Seizing Every Opportunity

A few weeks ago, I spoke to some local citizens about space exploration and how it advances innovation and progress. My presentation was part of Huntsville's Downtown Speaker Series -- a monthly event that draws together folks who enjoy a good conversation about locally relevant topics. Not surprisingly, when I asked for a show of hands from any engineers in the audience, almost everyone raised one. Two things were clear at that moment: Huntsville has no shortage of American Institute of Aeronautics and Astronautics members; and I better be on my "A-Game" when it comes to the details. However, one young woman didn't raise her hand -- she was only 12 years old.

After my talk, I had the opportunity to meet her. She asked her mother to bring her so she could learn more about Marshall and space exploration. As fun as it is to engage with Huntsville's professionals, seeing a child in the audience -- excited about what we do -- really underscores the magnitude of our work. In a year filled with moments that remind us of what is at stake on any given day, a child, wide-eyed and curious, is a precious reminder that what we do today is an investment in the promise of the future -- her future.

2017 was a year defined by the future made real; ideas became huge pieces of hardware, transported by giant vehicles and loaded into massive facilities. Decades of specialized astrophysics expertise led to a winning mission proposal and historic scientific breakthrough. We executed our Plan to Thrive, with new organizations, roles, and talent setting the stage for enduring success. This team came together and delivered across the board -- on our program commitments, organizational challenges, and as citizens:

- You made Vice President Mike Pence's visit an unequivocal success. You showed him how Marshall is paving the way for a new era of human space exploration -- that we are essential to a 21st century space program.
- Your proposal for a spacecraft that peers into the heart of black holes and other high-energy phenomena was selected for NASA's next Astrophysics Explorer Mission. When the Imaging X-ray Polarimetry Explorer launches, it will help advance our understanding of the universe.
- You worked with community leaders from across the area to put together a symposium that looked at how we can make the "Rocket City" an innovative and inclusive destination for the nation's best and brightest.
- You delivered the flight hardware for NASA's Space Launch System, completed all the vital testing infrastructure, and moved the rocket beyond the manufacturing phase and into the critical testing and integration phase.
- You put together another great NASA in the Park event -- a terrific opportunity to show Huntsville how we're shaping future space exploration and science.
- You teamed up with scientists from around the world to observe a neutron star merger -- a game-changing event for astrophysics and astronomy. Our team members were involved with three key observatories studying the phenomena: LIGO, Fermi and Chandra.
- You made your voice heard, with over 82 percent of eligible employees responding to the 2017 Federal Employee Viewpoint Survey -- a powerful tool for affecting change.
- You kept the science humming on the International Space Station -- 24/7, 365 days a year -- and made it possible to double science operations on the world's most advanced orbiting laboratory.

These achievements are by no means a full representation of the outstanding work you did last year, or a true measure of the its value -- words cannot fully quantify these things. The beauty of our line of business is that we are always pursuing something bigger. And we are in a strong position to realize our potential as a center, and do it in a way that is smart and sustainable. Not only have we strengthened Marshall as an organization, but delivered on our entire portfolio of work. And now that White House Space Policy Directive 1 is in place, we have a framework aligned with our present and future -- the road to the Moon, Mars and beyond goes through Marshall. With milestones like delivery of the SLS Core Stage to Stennis Space Center slated for the end of 2018, the next year promises to be an even busier one.

So, Happy New Year Marshall and thank you for an amazing 2017 -- a year that was very successful by any measure. I can't wait to see what you do in the days and months ahead.

JANUARY

Construction Complete: Stand Prepares to Test SLS's Largest Fuel Tank

A busy year for NASA's Space Launch System began with completion of major construction on the largest new SLS structural test stand, and engineers began installing equipment needed to test the rocket's biggest fuel tank. In December 2016, contractors and steelworkers handed the 221-foot stand over to Marshall engineers, who began installing complex networks of cables, pipes, valves, control systems, cameras, lighting and specially designed test equipment. The stand will simulate the powerful dynamics of launch and flight by pushing, pulling and bending the SLS liquid hydrogen qualification test article. The 149-foot-long test article consists of a liquid hydrogen tank and equipment attached at each end to simulate the other parts of the 212-foot-long core stage -- the backbone of the rocket.

NASA Selects Mission to Study Black Holes

NASA has selected a science mission that will allow astronomers to explore, for the first time, the hidden details of some of the most extreme and exotic astronomical objects, such as stellar and supermassive black holes, neutron stars and pulsars. The Imaging X-ray Polarimetry Explorer, IXPE, mission will fly three space telescopes with cameras capable of measuring the polarization of these cosmic X-rays, allowing scientists to answer fundamental questions about these turbulent and extreme environments where gravitational, electric and magnetic fields are at their limits. The mission is slated for launch in 2020 and will be led by principal investigator Martin Weisskopf of Marshall with Ball Aerospace in Broomfield, Colorado, providing the spacecraft and mission integration.

The 221-foot-tall Test Stand 4693 was designed and developed by Marshall's Test Laboratory and the Office of Center Operations. (NASA/MSFC/Emmett Given)

FEBRUARY

Michoud Assembly Facility Reopens in Wake of Tornado

On Feb. 7 at 11:25 a.m., NASA's Michoud Assembly Facility was struck by a tornado that tore through the east New Orleans area. Less than one week later, the rocket manufacturing facility, managed by Marshall Space Flight Center, reopened for normal operations; other areas of Michoud, including some of the United States Department of Agriculture offices, remained closed. Five team members suffered injuries during the storm, while approximately 50 percent of the buildings at the facility sustained damage -- including three with significant damage. Building 103 -- home to NASA's 43-acre rocket factory where NASA and Boeing teams are building the Orion spacecraft and the core stage for the Space Launch System rocket -- protected the flight hardware from sustaining any damage. NASA's Pegasus barge, docked at Michoud, was also undamaged during the storm.

Marshall Realignment Finalized Feb. 5

After months of planning, Marshall's realignment was formally enacted Feb. 5, structuring center organizations to be more agile and adaptive, according to Center Director Todd May. The most noticeable changes under the realignment plan were the creation of the Human Exploration Development and Operations Office and a consolidated Science and Technology Office.

Major Review Completed for NASA's New SLS Exploration Upper Stage

In February, the agency successfully completed the exploration upper stage preliminary design review for the Space Launch System rocket. The detailed assessment is a big step forward in being ready for more capable human and robotic missions to deep space. The preliminary design review kicked off Nov. 30, 2016, with approximately 500 experts from across NASA and industry assessing more than 320 documents and data. The preliminary design review board was completed Jan. 19, with the board voting unanimously that it is ready to move to the critical design phase.

Acting NASA Administrator Robert Lightfoot, right, views SLS hardware and tooling at Michoud Feb. 13. Joining Lightfoot are Jackie Nesselroad of Boeing, left, and Steve Doering, SLS stages manager. (NASA/ Michoud/Jude Guidry)

MARCH

Additional Crew Flights Boost Space Station Research, Set Record for Science

NASA agreed in March to pay Boeing for additional flights to the International Space Station via a Soyuz spacecraft, increasing crew size on the station's U.S. segment from three astronauts to four and extending the time dedicated to scientific research on the orbiting facility. In March, crew members aboard the station set a record for scientific study, conducting nearly 86 hours of experiments and investigations in the course of a single week -- and beating the previous record, set in 2014, by two hours. All the investigations were coordinated and managed by flight controllers in the Payload Operations Integration Center at Marshall, the agency's "science mission control" for the orbiting research facility.

Flight Hardware for SLS Arrives at Cape

The first integrated piece of flight hardware for the Space Launch System rocket, the interim cryogenic propulsion stage, made its way by barge to United Launch Alliance's Delta IV Operation Center at Cape Canaveral Air Force Station. The ICPS is a liquid oxygen/liquid hydrogen-based system that will provide the thrust needed to send NASA's Orion spacecraft and 13 secondary payloads beyond the Moon before Orion returns to Earth.

Symposium On NASA's Role in the 'Long' Civil Rights Movement

Researchers, scholars and NASA officials gathered March 16-17 at the U.S. Space & Rocket Center in Huntsville to discuss the role the American space agency played in the civil rights movement. The symposium, titled "NASA in the 'Long' Civil Rights Movement," was hosted by Marshall and the University of Alabama in Huntsville.

The Robotic Refueling Mission is removed from the exterior of the International Space Station using a remotely controlled robot arm. The investigation tested tools and procedures to service and repair satellites in space. (NASA/MSFC)

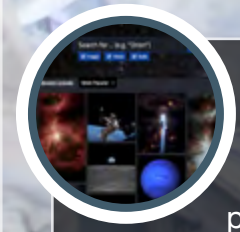
APRIL

NASA Astronauts visit Marshall Following Space Station Missions

Several NASA astronauts shared their experiences with the Marshall workforce, following missions on the International Space Station in 2016-17. In April, Kate Rubins, who became the first person to sequence DNA in space, visited Marshall, while fellow Expedition 48/49 astronaut Jeff Williams, who set the American record for the most cumulative time in space, addressed the Marshall workforce during his visit Feb. 23. Just a few weeks after completing the Expedition 49-50 mission on the station, astronaut Shane Kimbrough visited Marshall Sept. 19 and presented highlights from his mission, which included the Microgravity Expanded Stem Cells investigation.

Integrated Structural Test for Top of SLS Rocket Underway at Marshall

The first major structural test series of SLS, the Integrated Structural Test, put "pressure" on four qualification articles to ensure the upper elements -- the launch vehicle stage adapter, interim cryogenic propulsion stage, Orion stage adapter and the frangible joint -- can withstand the pressures of launch and flight. Large hydraulic systems inside the test stand simulated the extreme loads it will encounter during flight. Information gleaned from the test will ensure the hardware is structurally sound.



NASA Unveils New Public Searchable Video, Audio and Imagery Library

In April, NASA officially launched a new, public resource for the agency's out-of-this-world imagery, videos and audio -- images.nasa.gov. The searchable database consolidates audio, imagery and video from more than 60 collections across the agency.

Expedition 48 Commander Jeff Williams of NASA successfully installs the first of two international docking adapters during an extravehicular activity on the International Space Station. (NASA)

MAY

First Science Results from NASA's Juno Mission

Early science results from NASA's Juno mission to Jupiter portray the largest planet in our solar system as a complex, gigantic, turbulent world, with Earth-sized polar cyclones, plunging storm systems that travel deep into the heart of the gas giant, and a mammoth, lumpy magnetic field that may indicate it was generated closer to the planet's surface than previously thought. Juno entered Jupiter's orbit in 2016 after an almost five-year journey from Earth. The findings from the first data-collection pass of Jupiter's swirling cloud tops was published in August in the Journal of Science and in Geophysical Research Letters.

Marshall Engineers Successfully Test Key Element of Orion Launch Abort System

On April 27, engineers from Marshall; Lockheed Martin Corp., of Bethesda, Maryland; and Orbital ATK of Dulles, Virginia, conducted a landmark test of the motor that will power the Orion spacecraft's Launch Abort System -- a critical safety element protecting astronauts flying on the Space Launch System. The test, conducted at Orbital ATK's Elkton, Maryland, facility, demonstrated the Launch Abort System's ability to safely transport the Orion crew module away from the launch vehicle stack in the event of an emergency on the launch pad or during ascent. Marshall engineers, lending their propulsion expertise to the Launch Abort System project office at NASA's Langley Research Center, were involved in planning and executing the motor test. The motor, along with the crew capsule, will launch on the second integrated flight of Orion and the SLS rocket, which is managed at Marshall.

Test Article Arrives, Integrated Structural Tests Completed

May was one of the busiest months of the year for the Space Launch System, beginning with an engine section structural qualification test article for SLS being loaded onto the barge Pegasus at the agency's Michoud Assembly Facility. After an 18-day journey, the test article arrived at Marshall for structural load testing. Before testing began, Marshall team members took a special behind-the-scenes look at the test article. May concluded with Marshall engineers completing the integrated structural tests, a major test series on SLS hardware. The tests ensure the top part of SLS will be able to endure the stresses of launch and flight during the rocket's first integrated flight with the Orion spacecraft.

Jupiter's south pole, as seen by NASA's Juno spacecraft from an altitude of 32,000 miles. (NASA/ JPL-Caltech/ SwRI/MSSS/Betsy Asher Hall/Gervasio Robles)

JUNE

Fourth Annual 'NASA in the Park' Draws Record Crowd in Downtown Huntsville

More than 8,000 people attended Marshall and Downtown Huntsville, Inc.'s "NASA in the Park" in Big Spring Park in downtown Huntsville June 17. The event, the fourth annual celebration of NASA and the community, featured fun for all ages, live music performed by Marshall team members and a special appearance by former NASA astronaut Robert "Hoot" Gibson.

New Window Improves View of Science on Space Station

A new window on the Microgravity Science Glovebox was introduced on the International Space Station in 2017 and has saved dozens of hours on a variety of experiments for crew members aboard the orbiting laboratory. The large front window that was affixed to the glovebox was replaced with a new frame and window that can be unlatched and removed in seconds -- giving astronauts easy access to the relatively spacious interior of the glovebox. A duplicate version housed at Marshall is used to make sure scientists' experiments work properly with the glovebox on orbit.

SLS Core Stage Structural Tests Begin; Universal Stage Adapter Development Contract Awarded

With testing for the first flight of SLS underway, plans were announced for the rocket's second flight and beyond. A structural test version of the SLS engine section was installed into a Marshall test stand where it was subjected to loads to verify and validate the hardware's design. On June 7, NASA selected Dynetics Inc. of Huntsville to develop and build a universal stage adapter for future SLS flights. The adapter will connect Orion and provide additional cargo space for future SLS configurations.

More than 8,000 people attended Marshall and Downtown Huntsville, Inc.'s "NASA in the Park" in Big Spring Park in Huntsville June 17. (NASA/MSFC/Fred Deaton)

JULY

SLS Test Hardware Loaded into NASA's Super Guppy Aircraft

In July, engineers at Marshall loaded a structural test version of the Orion stage adapter for the Space Launch System onto NASA's Super Guppy aircraft for delivery to Lockheed Martin in Denver for further testing. The adapter, connects the Orion spacecraft to the Interim Cryogenic Propulsion Stage, which will give the spacecraft its boost into deep-space for its first integrated flight with SLS. The adapter was built at Marshall and used in integrated structural testing for the top of the SLS rocket. The Guppy has a unique hinged nose that can open 110 degrees to allow large pieces of cargo to be loaded and unloaded from the front. Its cargo compartment is 25 feet tall, 25 feet wide, 111 feet long and can carry up to 24 tons.

Sit-Down with Singer Initiative a Success

Marshall Deputy Director Jody Singer met with employees from nine organizations in the past year as part of her Sit-Down with Singer initiative, where she talked about Marshall's mission, shaping our workforce and hosted a Q&A with employees. In July, Singer met with a group of NASA and space industry veterans at the International Space Station Research & Development Conference in Washington, was the guest speaker at Marshall's July Shared Experiences Forum and spoke at National Space Club Huntsville's July breakfast.

Agency's Prize Program Awards Citizen Inventors $1.32M for Innovations in Three Technology Areas

NASA's Centennial Challenges program conducted six competition events and awarded $1.32 million in prize money to citizen inventor teams. The Space Robotics Challenge, which focuses on advancing humanoid robotic skills and capabilities, awarded $555,000 total to 23 teams. The fourth and final Ground Tournament of the Cube Quest Challenge was completed, with a total of $60,000 and payload spots on the first flight of the Space Launch System awarded to the top three teams to continue the competition in space. Cube Quest is pursuing advancements in CubeSat propulsion and communication. Top teams in the 3D-Printed Habitat Challenge won a total of $701,024 in Phase 2 of the event, which seeks to advance additive construction technology to create habitats on Mars and beyond. Phase 3 was also opened for registration.

NASA's Super Guppy Aircraft lands at Redstone Arsenal Airfield to pick up a structural test version of the Orion Stage Adapter for delivery to Lockheed Martin in Denver. (NASA/MSFC/Derek Hooper)

AUGUST

NASA, Nation Watch in Awe as Eclipse Crosses America Aug. 21

NASA researchers nationwide, along with Americans from coast to coast, looked to the sky Aug. 21 to observe a rare total solar eclipse over the continental United States. Researchers and experts from Marshall joined participants from across the agency for a multihour broadcast to offer unprecedented live video of the celestial event. Marshall experts were at several locations, including Hopkinsville, Kentucky, and Austin Peay State University in Clarksville, Tennessee.

Interim Cryogenic Propulsion Stage Moves to Space Station Processing Facility

The SLS program hit a major milestone in August with the delivery of the first piece of flight hardware to Kennedy Space Center: the Interim Cryogenic Propulsion Stage arrived at Kennedy's Space Station Processing Facility. This stage, located at the very top of the SLS just below the Orion spacecraft, will give Orion the big in-space push needed to fly beyond the Moon before returning to Earth. NASA also made progress on manufacturing the largest SLS structure, the 212-foot-tall core stage. At the Michoud Assembly Facility, engineers completed welding of a liquid oxygen tank test article and a flight version of the liquid oxygen tank. The liquid oxygen tank, along with the liquid hydrogen tank, are the parts of the massive SLS core stage that will hold more than 700,000 gallons of propellant to power the rocket's four RS-25 engines. Later in 2017, NASA completed welding on all core stage structures, including the liquid hydrogen tank.

NASA Readies 3-D 'Refabricator' Capable of Recycling, Reusing Materials in Orbit

Partnering with Tethers Unlimited of Seattle, Marshall commenced final flight certification in fall 2017 of the "Refabricator," a machine roughly the size of a compact refrigerator, which not only can 3-D print plastic parts and tools but also recycle them -- creating feedstock to remake into other 3-D printed items as needed. Set to be launched to the International Space Station in April 2018, the Refabricator will be remotely controlled from Marshall's Payload Operations Integration Center. With cargo space at a premium on future exploration missions, the Refabricator demonstrates an alternative to packing heavy or relying on resupply missions from Earth. The project, which in time could be adapted to recycle and print metal as well as plastic, sprang from a 2015 Small Business Innovation Research contract awarded to Tethers Unlimited.

Sylvester Dorsey III, avionics lead for the Europa Deorbit Stage Team in Marshall's Engineering Directorate, is joined during Marshall's eclipse-viewing event by his three children, from left, Sylvester IV, Sidney and Sakari. (NASA/MSFC/Fred Deaton)

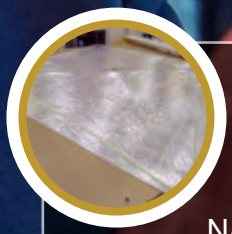
SEPTEMBER

Major Milestones Reached in Manufacturing of SLS

Major welding was completed on the launch vehicle stage adapter and the liquid oxygen flight tank of Space Launch System. The launch vehicle stage adapter was then moved to Marshall's Building 4707 -- NASA's Center for Advanced Manufacturing -- for the application of spray-on foam insulation that will protect it from aerodynamic heating during its ride to space. The adapter will connect two major sections of the upper part of SLS -- the core stage and the interim cryogenic propulsion stage -- for the first flight of the rocket and NASA's Orion spacecraft.

Vice President Pence Calls Space Station Crew, Briefed on SLS Progress During Visit to Marshall

Vice President Mike Pence visited Marshall Sept. 25, where he spoke with astronauts aboard the International Space Station, toured the Space Launch System engineering facility and even took a selfie with employees. The vice president first stopped at the Payload Operations Integration Center where he made the first White House-level call to the space station from Marshall, speaking with Expedition 53 commander Randy Bresnik and flight engineers Mark Vande Hei and Joe Acaba. Later, he toured the SLS facility where the engine section of the rocket's massive core stage is undergoing a major stress test. Vice President Pence also offered his thanks to team members who work on NASA's human spaceflight programs during his tour of Marshall.



NEA Scout Tests Full Solar Sail Deployment

NASA's Near-Earth Asteroid Scout, a small satellite the size of a shoebox, performed a full-scale solar sail deployment test Sept. 13. The satellite uses an innovative solar sail for propulsion that will be deployed after the satellite launches from the Orion capsule of the Space Launch System rocket's first mission in 2019. The test was used to make improvements to the four sail restraint tabs that hold the sail in place during launch and to the booms that deploy the sail in space.

Vice President Mike Pence visited Marshall Sept. 25, touring the Space Launch System engineering facility and speaking with astronauts aboard the International Space Station. (NASA/Bill Ingalls)

OCTOBER

First Four SLS Flight Engines Ready to Rumble

The backbone of the massive Space Launch System rocket -- the largest core stage ever built -- will be powered by four RS-25 engines. As of October 2017, the four engines for the first flight of SLS and Orion spacecraft are ready to rumble. After powering 135 flights of NASA's Space Shuttle Program, the agency's RS-25 fleet is being upgraded, tested and prepared for integration into SLS. An engine for SLS and Orion's second mission, Exploration Mission-2, was successfully tested at NASA's Stennis Space Center during its Founder's Day Open House in October.

Research Suggests Significant Atmosphere in Lunar Past

Research by Marshall lunar volcanologist Debra Needham and planetary scientist David Kring at the Lunar and Planetary Institute in Houston, suggests that billions of years ago the Moon had an atmosphere that could be a source for some, if not all, of the water detected on the Moon. Discovering the ancient lunar atmosphere -- an atmosphere thicker than the atmosphere of Mars today -- and its parameters began with understanding how much lava erupted on the Moon billions of years ago.

NASA Marshall Missions Glimpse First Light from a Gravitational Wave Source

For the first time, NASA scientists -- including a team of Marshall astrophysicists -- detected light tied to a gravitational-wave event, thanks to two merging neutron stars in the galaxy NGC 4993, located about 130 million light-years from Earth in the constellation Hydra. The first sign of the Aug. 17 neutron star merger was a short burst of gamma rays seen by the Marshall-managed Gamma-ray Burst Monitor instrument, GBM, on NASA's Fermi Gamma-ray Space Telescope. Shortly after, Laser Interferometer Gravitational-wave Observatory scientists reported detecting gravitational waves that arrived 1.7 seconds before the GBM burst. Nine days later, scientists used NASA's Chandra X-ray Observatory to study the X-ray afterglow emitted by the jet directed toward Earth after it had spread into our line of sight.

This illustration depicts how NASA scientists detected light tied to a gravitational-wave event, thanks to two merging neutron stars in the galaxy NGC 4993, about 130 million light-years from Earth in the constellation Hydra. (NASA's Goddard Space Flight Center/CI Lab)

NOVEMBER

NASA Completes Review of First SLS, Orion Deep-Space Exploration Mission

In November, NASA provided an update on the first integrated launch of the Space Launch System rocket and the Orion spacecraft after completing a comprehensive review of the launch schedule. The review follows an earlier assessment in which NASA evaluated the cost, risk and technical factors of adding crew to the mission, but ultimately affirmed the original plan to fly EM-1 uncrewed. NASA initiated this review as a result of the crew study and challenges related to building the core stage of the world's most powerful rocket for the first time, as well as issues with manufacturing and supplying Orion's first European service module; and tornado damage at the agency's Michoud Assembly Facility.

First SLS Rocket Hardware Turned Over to Ground Systems at Kennedy

NASA reached another key milestone in November in preparation for human deep-space exploration to the Moon, Mars and beyond. Officials with the Space Launch System Spacecraft/Payload Integration and Evolution organization formally turned over processing of the rocket's interim cryogenic propulsion stage to the Ground Systems Development and Operations Program at Kennedy Space Center. The ICPS was the first SLS component to be turned over to GSDO at Kennedy. Over the next year, the rest of the parts of the world's most powerful rocket will be delivered to Kennedy.

An illustration of the SLS rocket on the launch pad at Kennedy Space Center. (NASA)

DECEMBER

NASA Completes Eight Successful RS-25 Engine Tests for SLS

By December 2017, NASA completed eight successful RS-25 engine tests for the Space Launch System. The first test of the year, in February, ran its scheduled 380 seconds while a rainbow appeared for a picture-perfect hot-fire test at NASA's Stennis Space Center. These tests allowed the green run testing of the new RS-25 engine controller that will serve as the "brains" or avionics, allowing communication between the engine and the rocket. Engineers capped a year of SLS testing with a final RS-25 test Dec. 13. The eighth RS-25 test of 2017 and the sixth flight controller to be tested for SLS included a large 3-D-printed part scheduled for use on future RS-25 flight engines.

NASA, International Partners Ready New Research Facility for Space Station

As 2017 wrapped up, Marshall researchers began integrated testing of a new experiment facility, the Life Sciences Glovebox, set to be flown to the International Space Station in 2018. Fully enclosed and roughly the size of a large fish tank, the glovebox will benefit studies to protect deep-space explorers and also help improve human health here on Earth. Once engineers at Marshall finish integrating and testing the glovebox, it will be shipped to Japan for final launch preparations. Its first experiment should begin in late 2018.

New Space Policy Directive Calls for Human Expansion Across Solar System

On Dec. 11, President Donald Trump signed White House Space Policy Directive 1, a change in national space policy that provides for an integrated program with private sector partners for a crewed mission to the Moon, followed by missions to Mars and beyond. The policy grew from a unanimous recommendation by the new National Space Council, chaired by Vice President Mike Pence, after its first meeting Oct. 5. The effort will more effectively organize government, private industry and international efforts in space exploration. Work toward the new directive will be reflected in NASA's Fiscal Year 2019 budget request next year.

The first of eight successful RS-25 tests of 2017 ran its scheduled 380 seconds as a rainbow appeared for a picture-perfect hot-fire test at Stennis Space Center in February. (KSC Unmanned Aerial Systems Team)

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