



# Human Exploration and Operations Committee Status

**Ken Bowersox**  
**Committee Chair**  
**January 15<sup>th</sup>, 2015**



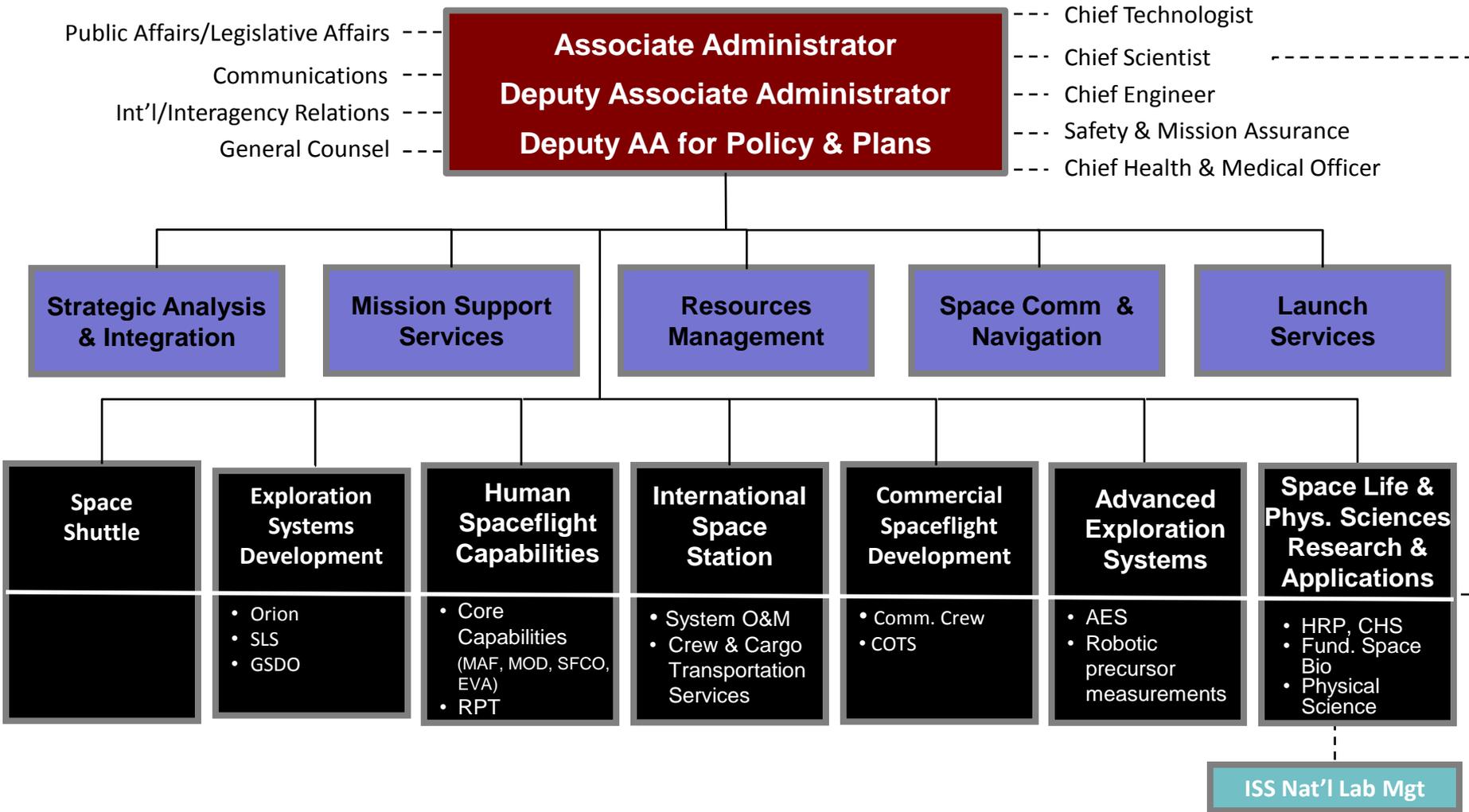
# NAC HEO Committee Members



- Ms. Bartell, Shannon
- Mr. Bowersox, Ken, **Chair**
- Ms. Budden, Nancy Ann
- Dr. Chiao, Leroy
- Dr Condon, Stephen "Pat"
- Mr. Cuzzupoli, Joseph W.
- Mr. Holloway, Tom
- Mr. Lon Levin
- Dr. Longenecker, David E.
- Mr. Lopez-Alegria, Michael
- Mr. Malow, Richard N.
- Mr. Odom, Jim (James)
- Mr. Sieck, Robert
- Mr. Voss, James

# Human Exploration & Operations Mission Directorate

## Organizational Structure





## ISS

2 Soyuz Launches and Landings

EVAs

AMS Results Announcement

Delivery of two external payloads by Dragon – CATS and RapidScat

Daily science activity

Multiple cargo vehicle visits, including CRS

CRS

- SpaceX 4 and 5

- Loss of Orb 3 Antares and Cygnus on Launch

# Major Events Since Last NAC Meeting



- SLS
  - Test firing of RS25
  - Movement of expected launch date to early 2018 from late 2017
- Orion
  - Successful Completion of EFT-1 Mission
- Commercial Crew
  - CCtCAP Awards to Boeing and SpaceX
  - Protest of CCtCAP Awards by Sierra Nevada, and Announcement of GAO Decision – Decision in final review
- Other Exploration Activities
  - Collaboration for Commercial Exploration – selection of Final Frontier Designs, ATK, SpaceX and ULA for unfunded Space Act Agreements
  - Evolvable Mars Campaign cycle completed for 2014, with results to be published early 2015

# NAC HEO Meeting Summary January, 2015



## NAC HEO Committee Meeting

Monday, January 12, 2015

Stennis Tour

Joint Meeting with NAC Science Committee

Joint HEO and Science Directorate Activities

Evolvable Mars Campaign

Joint Discussion

Tuesday, January 13, 2015

Human Exploration and Operations Status Update

Exploration Systems

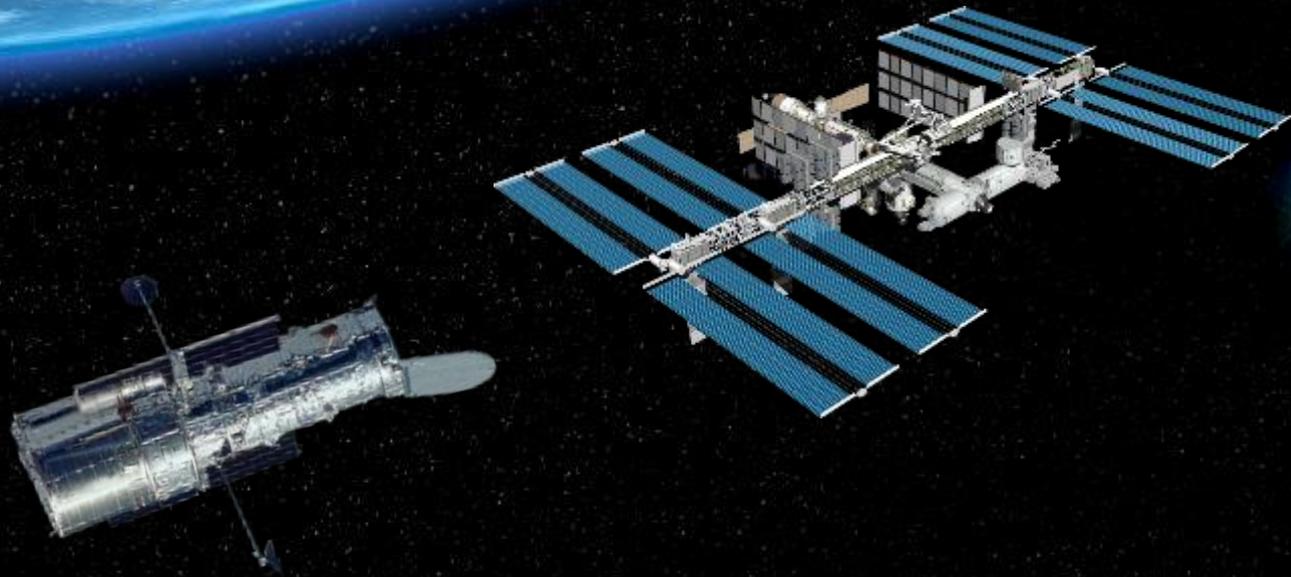
ISS Program Status

Asteroid Redirect Mission

COTS Lessons Learned

Committee Discussion and Deliberation

# Science and Human Exploration and Operations Joint Activities



**John M. Grunsfeld, Associate Administrator  
Science Mission Directorate**

Joint Meeting of the NASA Advisory Council  
Science/Human Exploration and Operations Committees

January 12, 2015



# Present Day HEOMD and SMD Joint Activity Areas

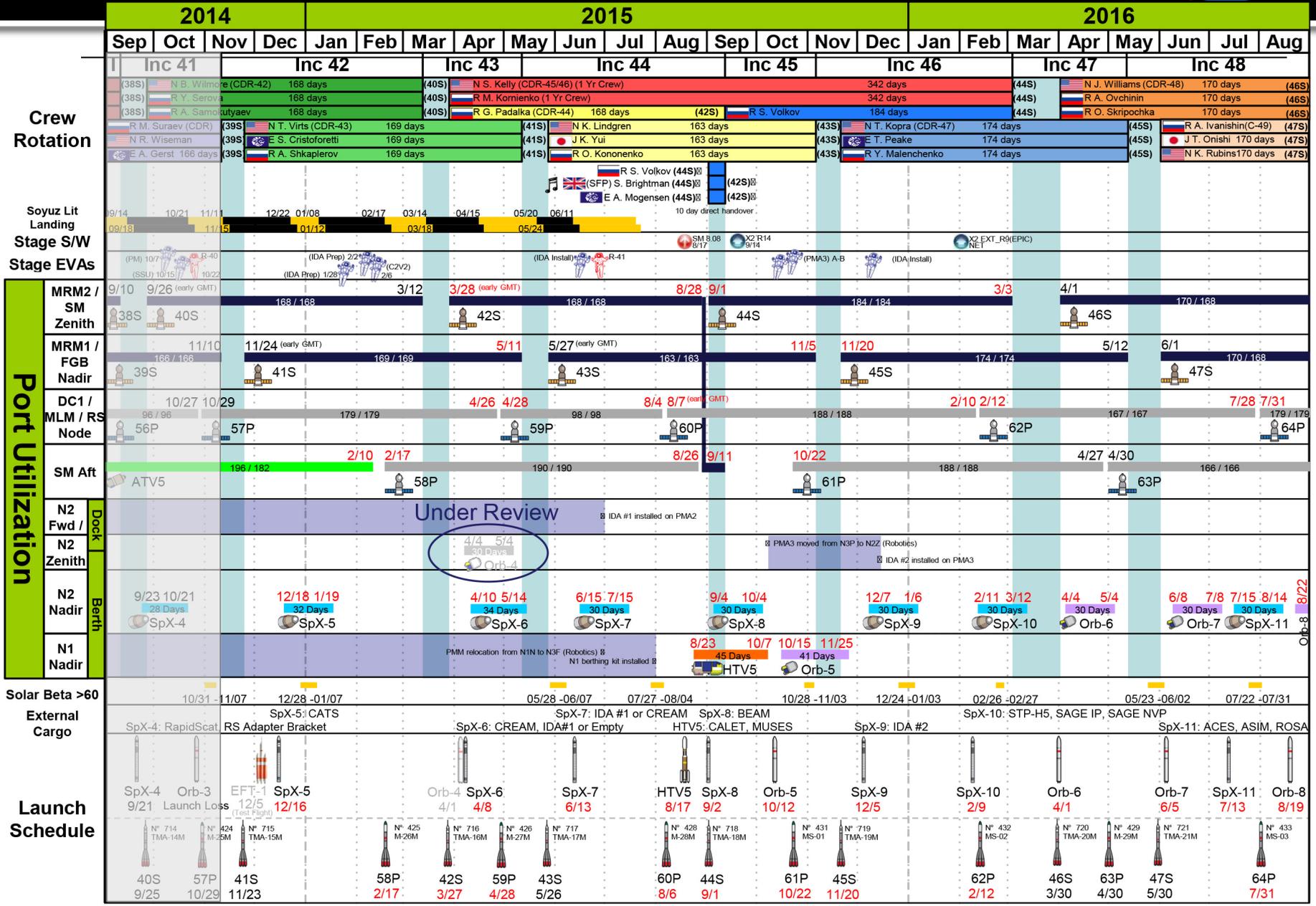
- **Science Instruments on the International Space Station (ISS)**
- **Mars Exploration Program**
  - Mars 2020 Partnership – borne out of current Mars strategy discussions
  - Mars Science Laboratory (Curiosity)
  - Partnership on HEO/Space Technology Mission Directorate (STMD) instrumentation - Mars EDL Instrumentation (MEDLI-2), Mars Oxygen ISRU Experiment (MOXIE), and Mars Environmental Dynamics Analyzer (MEDA)
- **Planetary Protection**
- **Space Communications and Navigation (SCaN)**
- **Asteroid Redirect Mission**
  - improve detection/characterization of Near Earth Objects (NEOs)
  - interplanetary radar capabilities
- **Space Radiation**
  - Space Radiation Working Group
- **Launch Services**
- **Joint Robotic Precursor**
- **In discussions regarding potential collaboration on satellite servicing**

# International Space Station Status



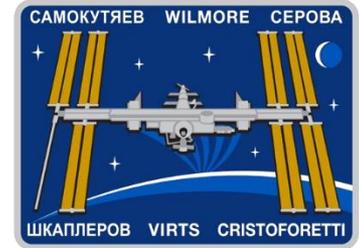
**Sam Scimemi**  
Director, ISS

**HEO NAC**  
January 2015





**Vehicle:** 41 Soyuz  
**Launch:** November 23, 2014 (with 4 orbit rendezvous)  
**Docking:** November 24, 2014  
**Undock/Landing:** May 11, 2015



## 40 Soyuz Crew

**Aleksandr Samokutyayev, Soyuz Commander**  
**Barry Wilmore, Increment 42 Commander**  
**Yelena Serova, Flight Engineer**



## 41 Soyuz crew

**Anton Shkaplerov, Soyuz Commander**  
**Terry Virts, Increment 43 Commander**  
**Samantha Cristoforetti, (ESA) Flight Engineer**

# Increment 42 Highlights



- IMAX
- Nitrogen Oxygen Recharge System (NORS) Airlock Installation Kit
- Cloud Aerosol Transport System (CATS) External Payload (SpX-5)
- Deployment of SpinSat, Special Purpose Inexpensive Satellite
- EVA – International Docking Adapter (IDA1) Prep
  - Pressurized Mating Adapter (PMA2) Umbilical Stow
  - IDA1 Cable Routing
- EVA – IDA1/Latching End Effector (LEE) Lube
  - PMA2 Cover Removal
  - IDA1 Cable Routing
  - SSRMS LEE A Lubrication
- EVA 42-3 Planned Tasks:
  - Complete Common Communication for Visiting Vehicle (C2V2) Route
  - Starboard C2V2 Antenna Install
  - Port C2V2 Antenna Install
- Begin ISS Reconfiguration Modifications
- Rodent Research 2 (SpX-6)
- ATV-5 Reentry Observation

# ISS One-Year Mission



- 2015 marks the launch of astronaut Scott Kelly and cosmonaut Mikhail Kornienko to the ISS for 12 months – the longest mission ever assigned to a US astronaut
  - Joint US/Russian ISS research includes studies on: ocular health, immune and cardiovascular systems, cognitive performance testing, and effectiveness of countermeasure against bone and muscle loss
- HRP study of identical twins astronaut Scott Kelly, and retired astronaut, Mark Kelly
  - Provides unprecedented opportunity to research effects of spaceflight on twin genetic makeup, and better understand the impacts of spaceflight on the human body

<http://www.nasa.gov/exploration/humanresearch/index.html>



Scott Kelly  
STS-103, STS-118, ISS  
25/26

Mikhail Kornienko ISS  
23/24

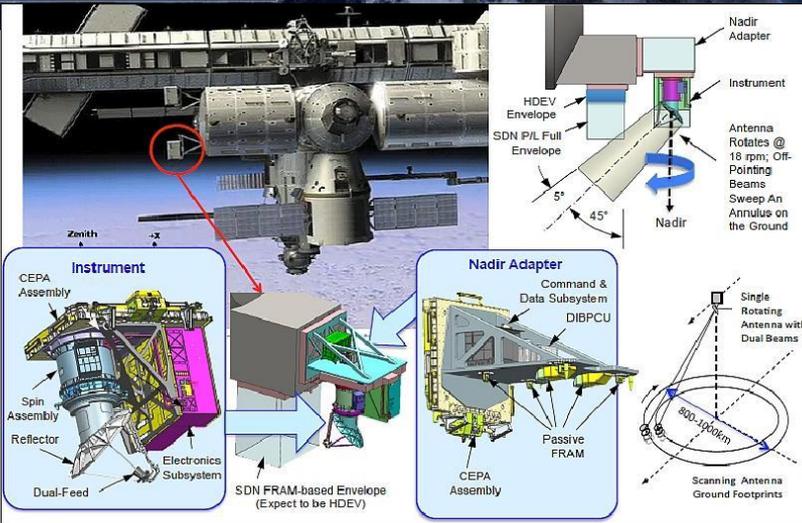


Retired astronaut Mark Kelly (left) and his twin brother, astronaut Scott Kelly, who will spend a year on ISS

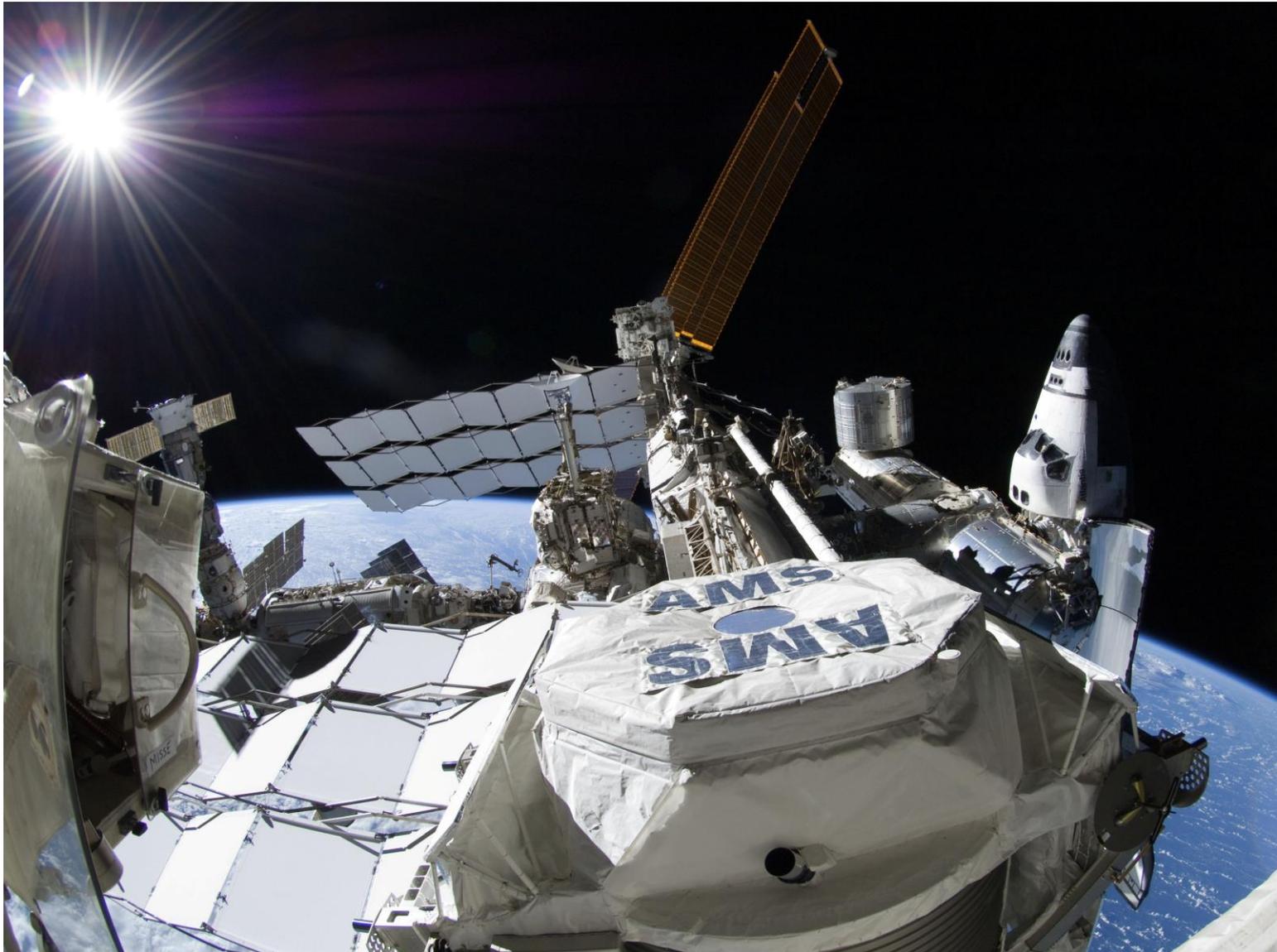
## International Space Station Earth Science Instruments



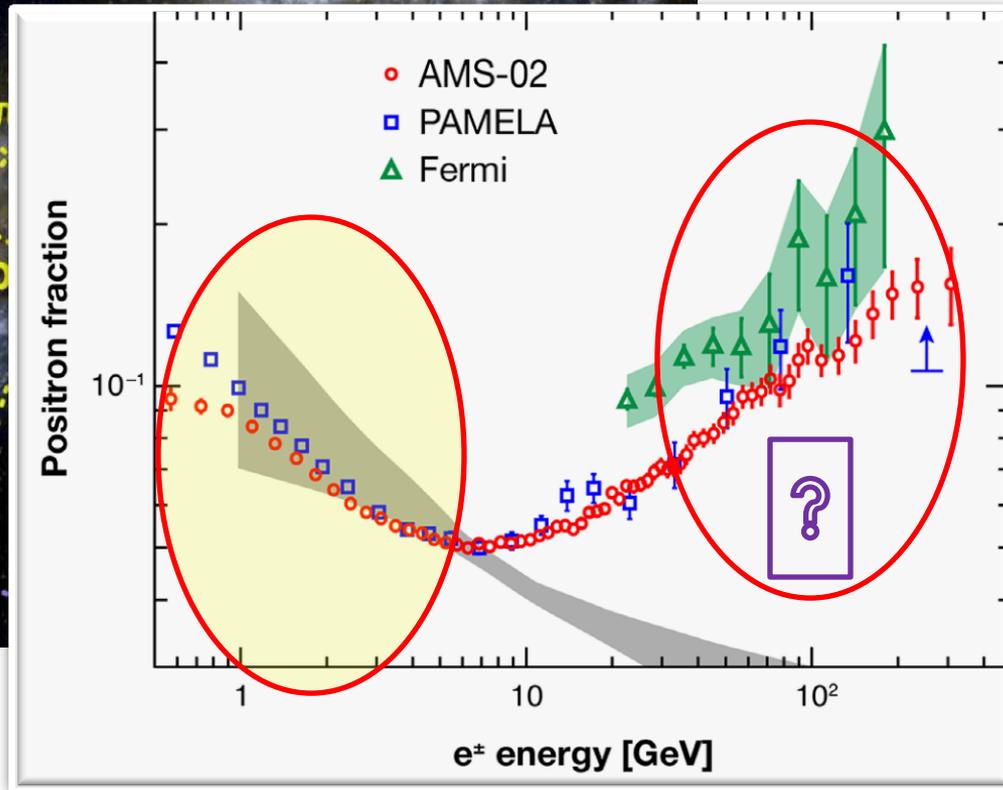
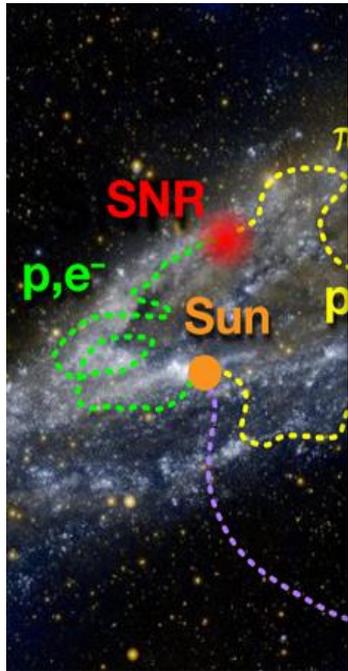
RapidScat launched on SpaceX-4 is already producing operational data products on sea surface winds to weather forecasting worldwide



# Example of long term research - Alpha Magnetic Spectrometer

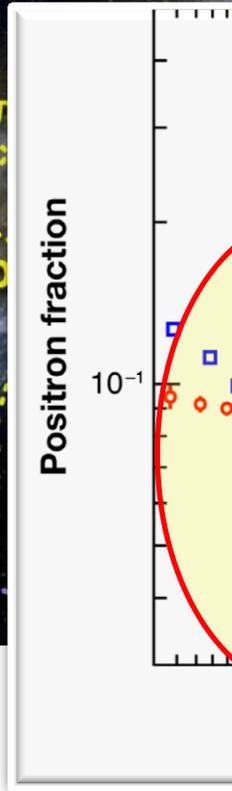
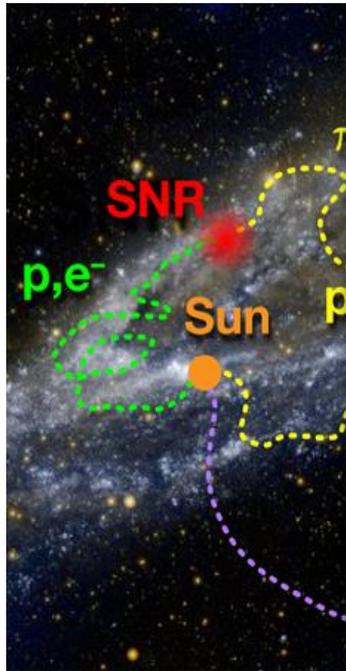




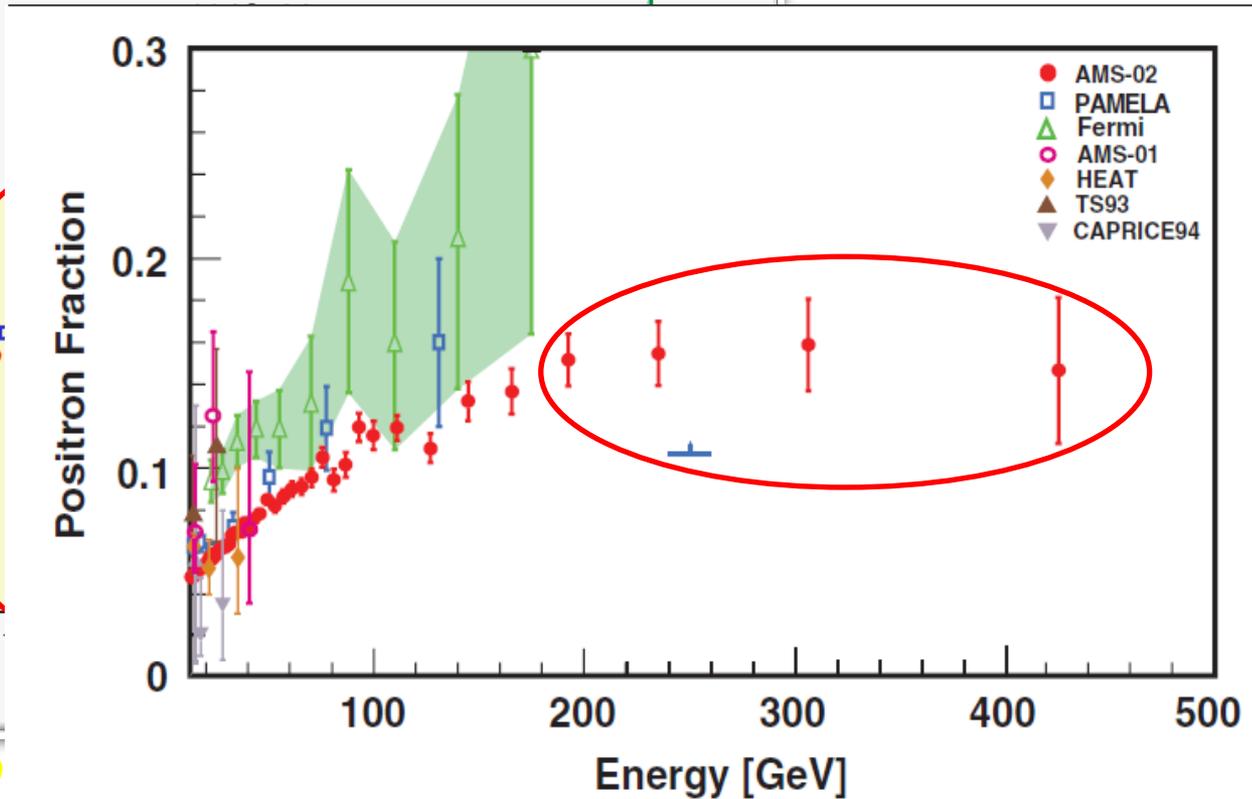


*\*0.5-350 GeV. Measurements Physical Review Letters. April 2013*

“These observations show the existence of new phenomena, whether from a particle physics or an astrophysical origin”\*



0.5-350  
2013



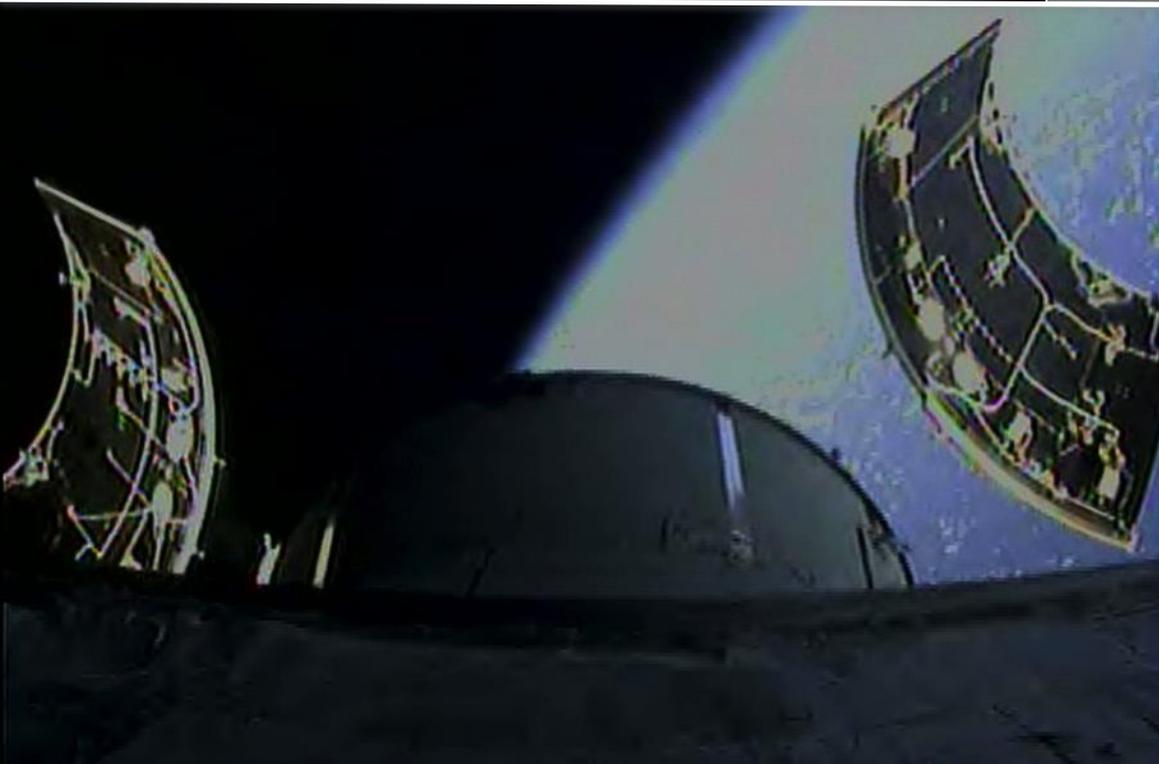
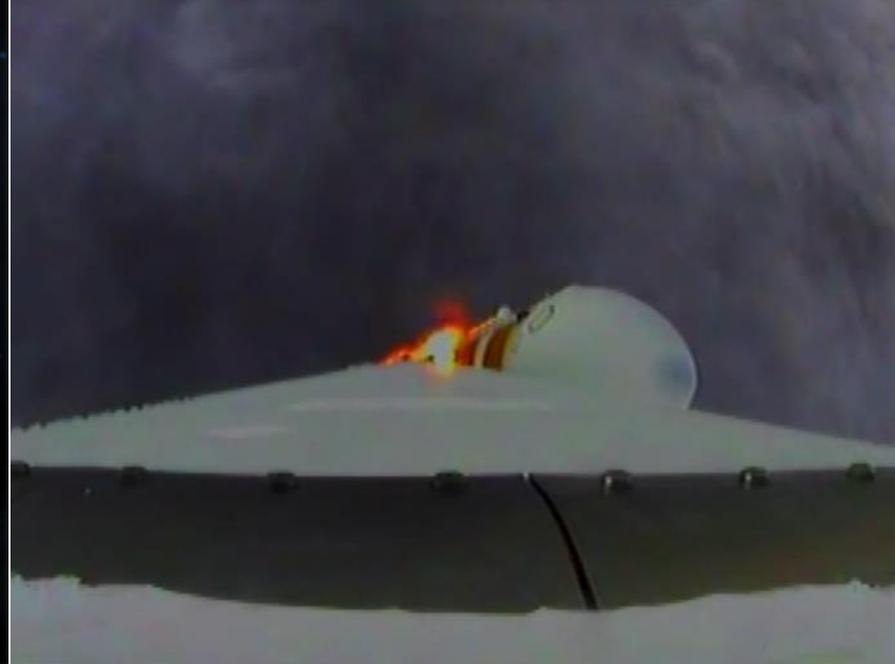
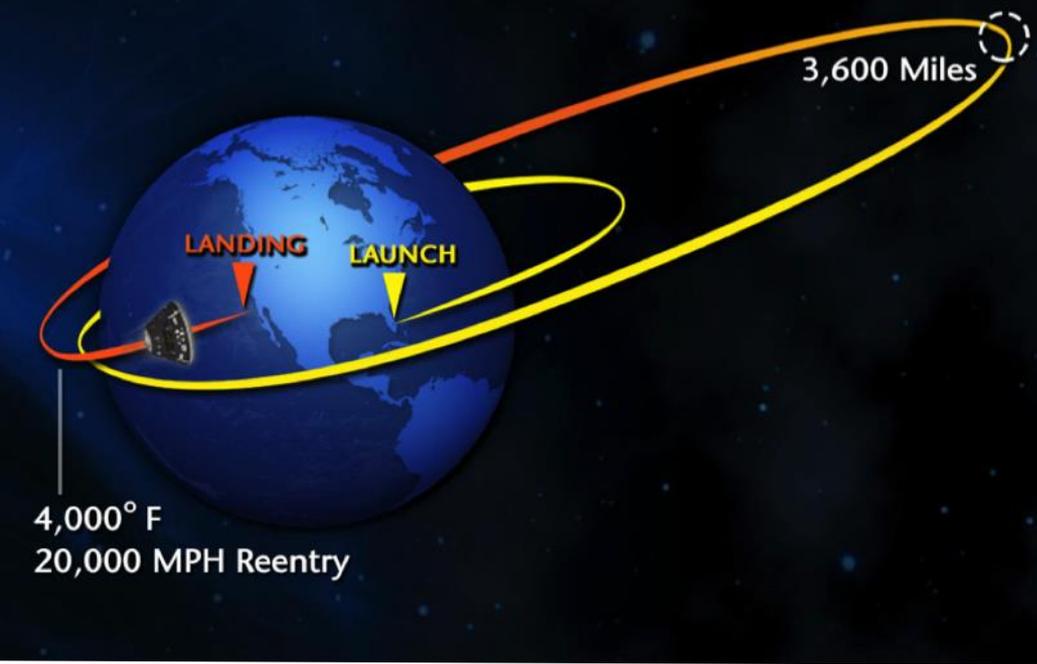
**\*\*0.5-500 GeV. Measurements. Physical Review Letters. Sep 2014**

“This measurement extends the energy range of our previous observation and increases its precision. The results show, for the first time, that above ~200GeV the positron fraction no longer exhibits an increase in energy\*\*”



# EFT-1 Post Flight Quick Look









# Recovery

- CM - Spacecraft looks reusable
  - Other than the expected damage due to recovery (TPS due to horse collar)
    - Very little damage to CM/SM umbilical plate
  - Three suspected MMOD impacts (two backshell, one heat shield shoulder)
    - Further inspection required at KSC
- FBC – Not recovered
  - Appears that FBC chutes stayed attached to water
  - Will confirm with radar track
- Main chutes
  - 2 of 3 main chutes recovered
- Drogues
  - 0 of 2 drogues recovered
- From power down to settled in the ship was 7.5 hours
  - Without EFT-1 unique work (e.g. photography) it could be a 4 hour operation
  - Existing RFA from PDR to relook at the operational concept for crewed missions

# Summary



- **Mission Success Criteria**

- ✓ Successfully launch and deliver EFT-1 into the planned orbit
- ✓ Demonstrate critical separation events during ascent and deorbit
- ✓ Demonstrate TPS performance during high energy return
- ✓ Demonstrate descent, landing and recovery

In work: Successful data recording, analysis, and delivery of flight test data to NASA in accordance with the EFT-1 Data Analysis Plan

- **Flight Test Objectives**

- Current estimate is that we will meet 85 of 87 flight test objectives
- One objective is still in work; we expect to meet it:
  - OFT1.082 Demonstrate CM propulsion system post landing processing of toxic and/or high-pressure elements
- Initial assessment that the following objectives may not be fully met:
  - OFT1.014 Demonstrate the CMUS under operational conditions
    - 1 of 4 measures of performance not met: “All 5 CMUS bags are deployed to proper location”
  - OFT1.106 Determine the performance of the CMUS
    - 1 of 4 measures of performance partially met - “... the CMUS bags should be deployed until recovery operations require deflation” not met
- Minor measure of performance impact noted:
  - OFT1.005 Demonstrate LAS separation during nominal ascent.
    - “Visual observation of LAS jettison to include ... second approach and clearance of the Orion spacecraft and launch vehicle”
    - LAS not seen in its second approach

**MISSION SUCCESS!**

# 2014 Accomplishments



## January

Orion – team completes Exploration Flight Test-1 Service Module

Space Launch System – avionics system sees the first light

Ground Systems – at Launch Pad 39B, space shuttle era flame deflector and Apollo-era brick walls from the flame trench were removed to make way for a new flame deflector and brick walls

## February

Orion – Exploration Flight Test-1 launch prep gets boost as Delta IV rocket arrives in Florida

Space Launch System – 2-percent scale models of the SLS solid rocket boosters and core stage RS-25 engines were designed and built for Base Heating Test

Ground Systems – New roller bearings tested on Crawler-Transporter 2

## March

Orion – Forward Bay Cover Jettison test successful

Space Launch System – NASA Administrator visits Marshall Space Flight Center, views SLS progress

Ground Systems – Contract awarded to modify Vehicle Assembly Building High Bay 3 at Kennedy Space Center

## April

Orion – Testing designed to validate Orion's avionics systems successfully wrapped up inside the Operations and Checkout Building high bay at NASA's Kennedy Space Center in Florida

Space Launch System – NASA engineers prepare game changing Cryotank for testing

Ground Systems – Construction workers have installed the framing and some of the inner walls inside Firing Room 4 in the Launch Control Center in support of NASA's effort to transform Kennedy into a multi-user spaceport.

## May

Orion – KSC, JSC launch and mission control centers simulate Orion's first flight operations

Space Launch System – A-1 Test Stand operations team examines the progress of a cold-shock test on the new A-1 structural piping system, achieving a key milestone leading to RS-25 engine testing

Ground Systems – Orion Test Vehicle undergoes EFT-1 pre-transportation simulation

## June

Orion – Parachutes hit no snags in most difficult test

Space Launch System – NASA turns down the volume on rocket noise through SLS Scale Model Acoustic Testing

Ground Systems – GSDO, Corrosion Lab test coatings for aluminum ground support equipment

# 2014 Accomplishments



## July

- Orion – Orion tests set stage for mission
- Space Launch System – SLS RS-25 engine installed at Stennis for testing
- Ground Systems – Modifications underway in VAB for Space Launch System

## August

- Orion – Engineers and technicians install protective shell on Orion spacecraft
- Space Launch System – NASA Engineers wrapping up Acoustic Testing for Space Launch System
- Ground Systems – NASA completes second Orion Underway Recovery Test

## September

- Orion – Orion in final preparations for launch
- Space Launch System – NASA unveils world's largest rocket welding tool for Space Launch System
- Ground Systems – Third round of Underway Recovery Tests completed

## October

- Orion – Orion assembly complete and ready for move to the launch pad
- Space Launch System – Work begins on a welding wonder, the Vertical Assembly Center, for SLS at Michoud Assembly Facility
- Ground Systems – VAB crane undergoes upgrades for future launch processing

## November

- Orion – NASA's Orion arrives at launch pad, hoisted onto rocket ahead of its first flight
- Space Launch System – SLS engine section barrel hot off the Vertical Weld Center at Michoud
- Ground Systems – Ground support equipment is secured in the well deck of the USS Anchorage at Naval Base San Diego in California in preparation Orion crew module recovery

## December

Orion lifts off at dawn on Friday, December 5, from Cape Canaveral Air Force Station in Florida before splashing down 4.5 hours later off the coast of Baja in the Pacific Ocean where it was met by NASA and U.S. Navy recovery teams. The spacecraft's cross-country return, a 2,700 mile road trip from Naval Base San Diego to Kennedy, sets the stage for in-depth analysis of data obtained during Orion's trip to space. It will provide engineers detailed information on how the spacecraft fared during its two-orbit flight test. The Ground Systems Development and Operations Program led the recovery, offload and transportation efforts. The Space Launch System team was there every step of the way leading outreach efforts and support, while reaching major milestones in the development of the SLS rocket.

# 2015 – Major Milestones



NET Jan: RS-25 engine hot fire (SLS)

March: Orion EM-1 pathfinder 1<sup>st</sup> weld

March: QM-1 Booster fire (SLS)

March: Mobile Launcher structural modification complete

April: heat shield design complete

June: Orion EM-1 pathfinder welds complete

July: SLS Critical Design Review Board

TBD 3<sup>rd</sup> Quarter: Orion EM-1 Parachute Drop Tests

August: SLS LVSA STA Construction Complete

September: SLS LVSA /MSA/ICPS mated and on Test stand

October: SLS Lox/h<sub>2</sub> STA's finished in VAC

November: Crawler Transporter-2 Life Extension Phase II complete



# Areas of Discussion



- HEOMD and SMD Cooperative Efforts
  - Communication of Program Goals and Achievements
  - Program affordability/sustainability
  - Finding from the HEO research subcommittee
- 
- Topics for future Meetings

# HEO Committee Finding



## Proposed NASA Human Exploration and Operations Committee Finding

Name of Committee: Human Exploration and Operations Committee  
Chair of Committee: Mr. Ken Bowersox  
Date of Public Deliberation: January 13, 2015 (HEO Advisory Committee)

Short Title of Finding: Expanding the NASA Research Community

Finding: The Committee endorses the Human Exploration and Operations Directorate's effort to broaden participation in the NASA research community evidenced by the recent NASA Research Announcement in Space Biology, in which 75% of the submitted proposals were from principal investigators new to Space Biology, and 62% of the awards were to new principal investigators. This result followed a year of effort at major scientific conferences to publicize the opportunity to conduct biological research on the International Space Station. Broadening the community and engaging the best new ideas for research from the nation's scientists will greatly strengthen the foundations of space research and enhance the productivity of NASA's investments. NASA should continue to track this metric, and continue to seek to bring in new investigators, within the limits of its available resources.



- Originally started tracking this topic after the December, 2013 NAC meeting.
- Received a briefing on NASA's management instruction NPR 7120.5E in April 2014
- Conducted short data gathering sessions with program management teams at Marshall, Johnson, and Kennedy in the summer and fall of 2014.
- Received a lessons learned briefing from the COTS program manager on January of 2015.

# Summary From 7120 Fact Finding



- Users understand the need for a guidance document on program management.
- The Document is comprehensive and especially useful for training purposes.
- Users realize that some requirements are meant to meet requirements of stakeholders outside of NASA.
  
- Tailoring of requirements is difficult
  - No central advocate for focusing requirements levied by numerous stakeholders
  - While the requirements section of 7120.5E has been reduced, the guidelines portion has grown and guidelines are treated as requirements by stakeholders.
  - Often easier to satisfy a requirement that adds little value in order to avoid the effort of tailoring.
- Multiple layers of independent assessment with a larger number of reviews and review bodies than is necessary interferes with the management team's ability to efficiently run their program.
- Reserve/confidence level guidelines are unrealistic for large programs – reserves too big of a target.



## **TITLE: Focus on Affordable Program Management**

**Recommendation:** The NAC recommends that NASA take action to make programs and projects more affordable by:

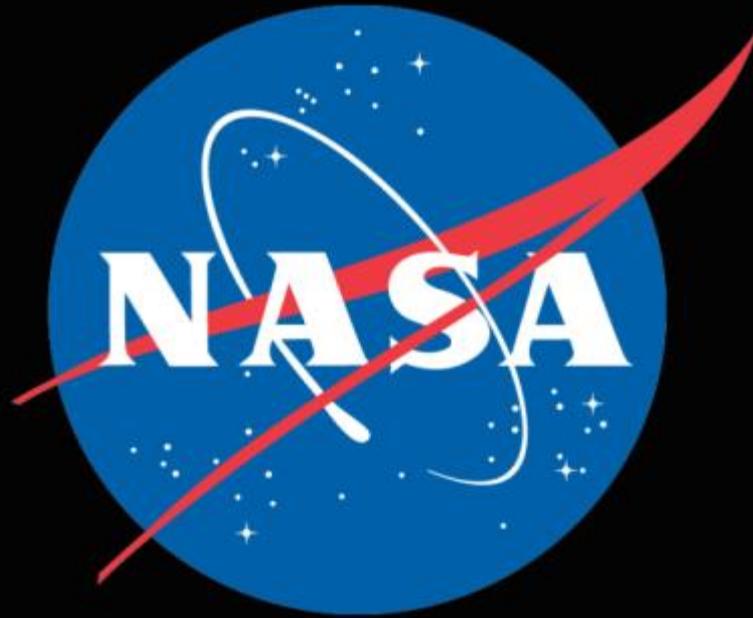
1. Examining the current approach for tailoring mandatory NASA management requirements and making changes to expedite the resolution of tailoring requests.
2. Working with groups that are currently conducting separate reviews of programs to minimize the number and maximize the benefit of reviews and reviewing groups.

## **MAJOR REASONS FOR PROPOSING THE RECOMMENDATION:**

The affordability of NASA's programs is a potential barrier to the achievement of NASA's strategic goals. Some program costs, are within NASA's purview to control, such as internal program management requirements and various program or project reviews which are mandated by various NASA groups. During data gathering efforts by the Human Exploration and Operations Committee on his topic, two specific areas were consistently mentioned by program managers who were interviewed – difficulty of tailoring management requirements, and the overhead of supporting numerous external and internal program reviews.

## **CONSEQUENCES OF NO ACTION ON THE PROPOSED RECOMMENDATION:**

Difficulty or delay in achieving NASA's strategic goals due to program costs which are higher than necessary.



[www.nasa.gov](http://www.nasa.gov)