

International Space Station Status

HEO NAC



"Buona notte" Kelly at 180 days

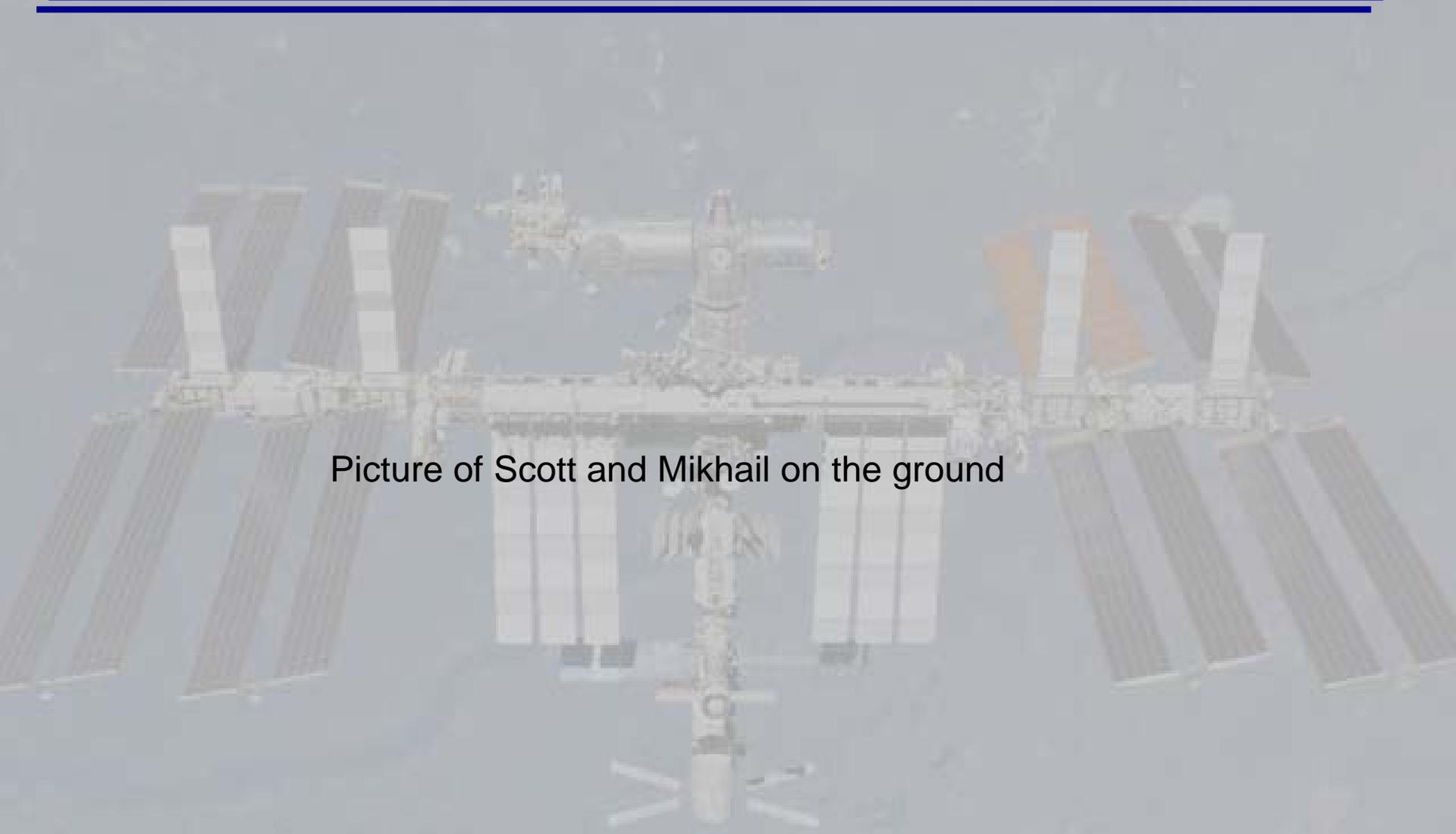
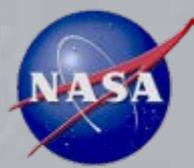
Sam Scimemi/Director, ISS
March 2016



300
DAYS IN SPACE



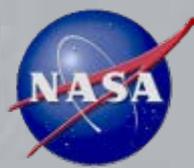
On the Ground After One Year in Space



Picture of Scott and Mikhail on the ground



Increment 46 Overview: Crew



Scott Kelly
CDR- 42S \uparrow / 44S \downarrow



Yuri Malenchenko
FE (R) – 45S



Mikhail Kornienko
FE (R) – 42S \uparrow / 44S \downarrow



Sergei Volkov
FE (R) – 44S



Tim Peake
FE (E) – 45S



Increment 47 Overview: Crew



45S Dock 12/15/15
45S Undock 6/5/16 ("in work" FPIP)

46S Dock 3/19/16 ("in work" FPIP)
46S Undock 9/7/16 ("in work" FPIP)



Yuri Malenchenko
FE (R) – 45S



Tim Kopra
CDR Inc 47 (US) - 45S



Tim Peake
FE (E) – 45S



Jeff Williams
FE (US) – 46S
(CDR Inc. 48)



Alexey Ovchinin
FE (R) – 46S

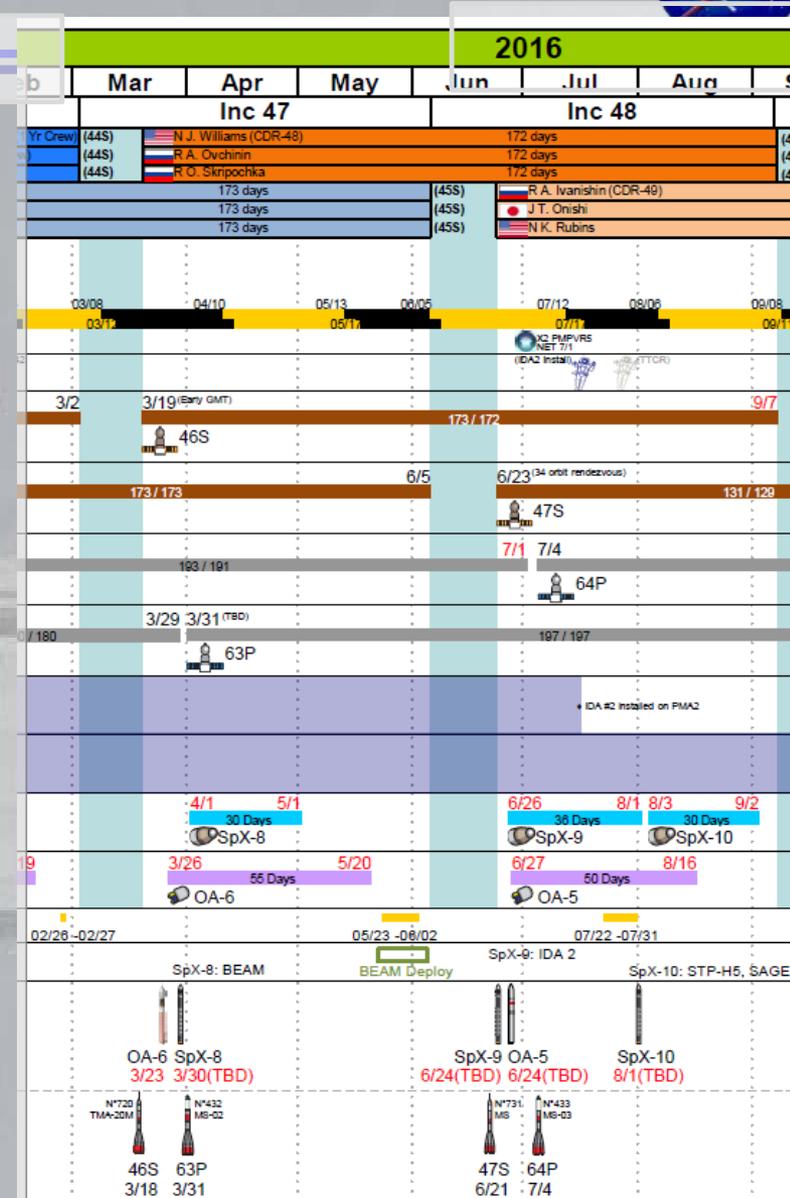


Oleg Skripochka
FE (R) – 45S



Increment 47 Overview: Major Stage Objectives

- Increment 47: 96 Days
 - Stage 47-3: 44S Undock to 46S Dock: 17 days
 - Stage 47-6: 46S Dock to 45S Undock: 79 days
 - Cargo vehicles:
 - *OA-6 Berth/Capture (3/26) / Unberth (5/20)
 - *61P Undock (3/29)
 - *63P Launch/Dock (3/31)
 - *With above Progress dates, SpX-8 Capture/Berth would occur ~4/6 and Unberth ~5/6
- *Dates under review
- Science/Utilization:
 - Rodent Research 3 (SpX-8↑, SpX-9↓)
 - J-SSOD M1, NRCSD Cubesat deploys
 - BEAM deployment
 - EVA's:
 - No planned EVA's
 - Stowage Ops:
 - Dual berthed visiting vehicle operations
 - Maintenance/Outfitting:
 - USOS reconfig (e.g., vestibule depress connections), C2V2, galley rack as time and priorities allow





EVA 35 SEMU 3011 Anomaly



- During EVA 35 on 1/15/16, EV1/Kopra reported water in his EMU helmet at PET 4:07 and the decision was made to terminate the EVA
 - Decision to terminate was made based on procedures and other operational products implemented after EVA 23
 - Following airlock repress the crew assessed the water in EV1's helmet
 - Rough estimate of total water is 200– 250 cc as compared to 1000-1500 cc on EVA 23
 - On-orbit troubleshooting was performed in order to learn more about the failure mechanism
 - Troubleshooting results indicated that the Fan/Pump/Separator (which was the cause of the EVA 23 anomaly) was performing nominally during the test
 - Troubleshooting also indicated that other parts of the EVA system were not leaking
 - Test results do not rule out an intermittent failure which could have occurred during EVA 35 and then cleared
 - Troubleshooting continues

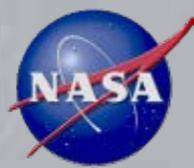




Forward Plan

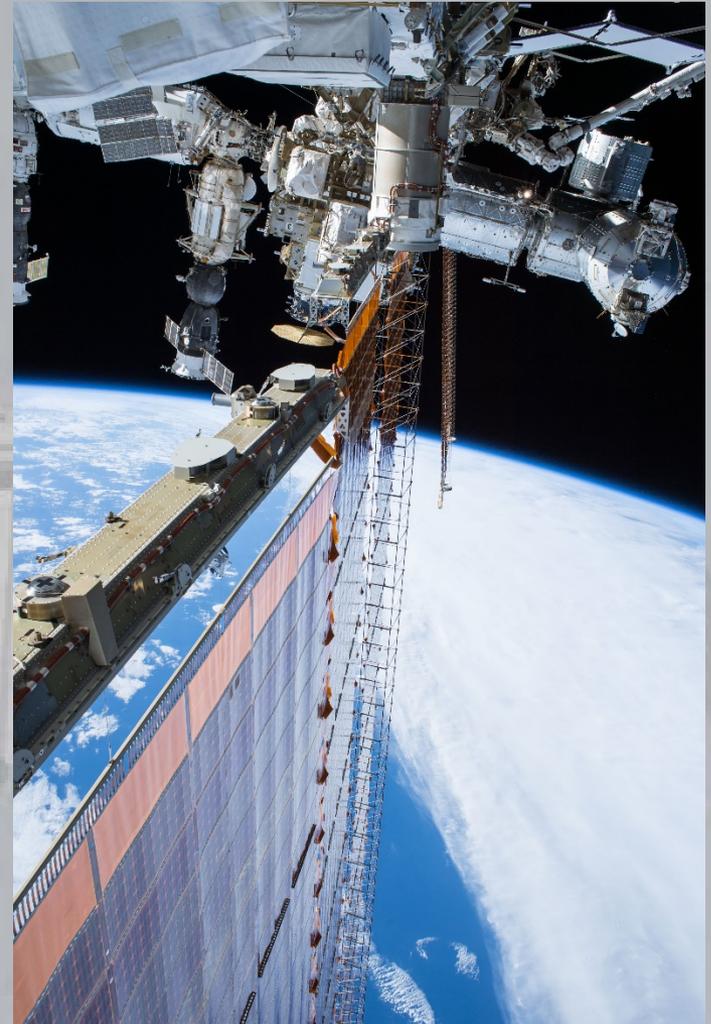
- A Problem Resolution Team has been established which will be co-chaired by ESOC and XX
 - Weekly meetings will start on Thursday 2/11/16 and will include reps from all stakeholders (Engineering, FOD, Safety, etc.)
 - Splinter meetings will be scheduled as required for in depth technical topics and results will be briefed to the PRT
 - Fault tree closures will be taken to the EVA CCB for formal approval and status briefing will be brought to the SSPCB
- Investigation task list includes the following
 - Review of ground and on-orbit SEMU performance data for trending
 - Data for all suits will be reviewed again in an effort to identify any early indicators of degraded performance
 - Fault tree analysis
 - Work through formal closure as data becomes available
 - TT&E plans
 - Hardware and water samples on 44S
 - SEMU 3011 on Spx-8
 - SEMU 3005 (returned once SEMU 3006 is on-orbit)





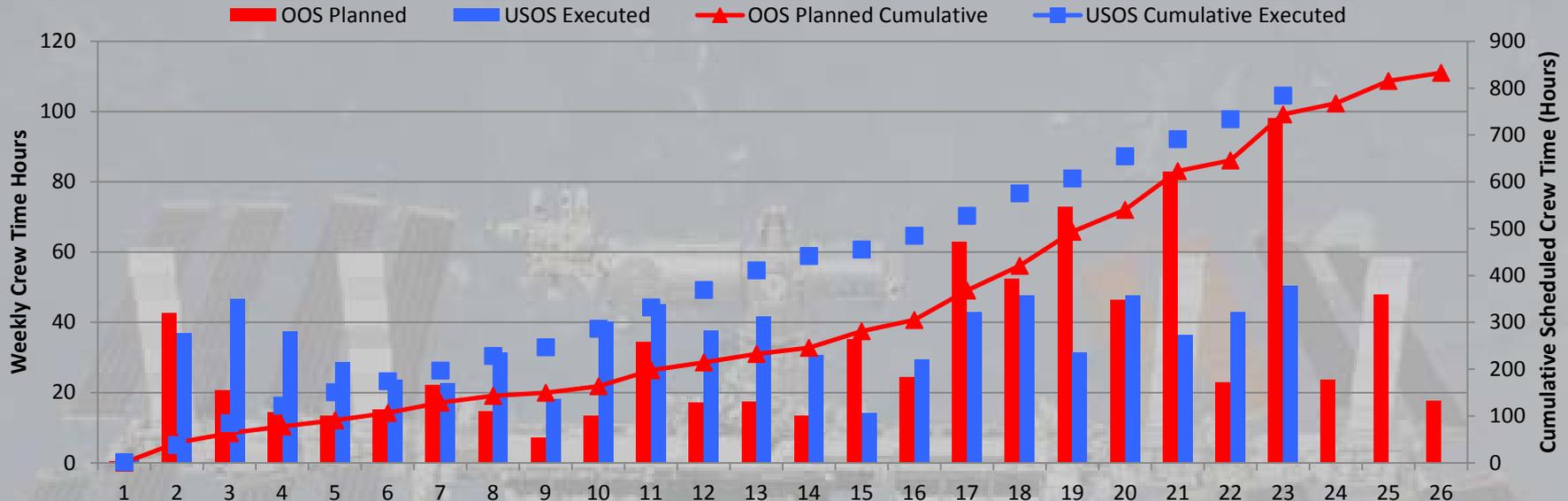
Forward Plan (cont.)

- Investigation tasks (cont.)
 - Review all operational products related to vent loop flooding (including water separator performance verification via pump priming valve) and determine if any changes, additions, or clarifications are required
 - Analyze the EVA 35 environments and latent heat load transients and compare to other EVAs
 - May be able to quantify the contribution of latent heat loads and environment to the anomaly





Inc 45 - 46 Utilization Crew Time



6-Crew										3-6		6-Crew					
Increment 45												Increment 46					
Sep	Oct			Nov			Dec			Jan			Feb			Mar	

Color Key:
 Completed (Blue)
 Final OOS (Red)
 FPIP Plan (Black)

HTV5
 Unberth 9/28/15

US EVA (ISS Upgrades) 10/28/15
 US EVA (P6 RTOC) 11/6/15

OA-4 →
 Berth 12/6/15
 Berth 12/9/15
 Unberth 2/4/16
 Unberth 2/7/16

US EVA (MT Rescue) 12/21/15

SpX-8
 Berth 01/3/16
 Berth 3/22/16
 Unberth 02/1/16
 Unberth 04/21/16

US EVA (SSU) 1/15/16

SpX-9 and SpX-10 were not planned in the Final OOS.

Executed through Increment Wk (WLP Week) 23 =	21.0 of 23.6 work weeks	88.98% through Increment
USOS IDR Allocation:	826 hours	
OOS USOS Planned Total:	832.91 hours	
USOS Actuals:	784.17 hours	
	94.94% through IDR Allocation	
	94.15% through OOS Planned Total	
Total USOS Average Per Work Week:	37.34 hours/work week	
Voluntary Science Totals to Date:	3.5 hours (Not included in the above totals or graph)	
RSA/NASA Joint Utilization to Date:	49.33 Hours (not included in the above totals or graph)	



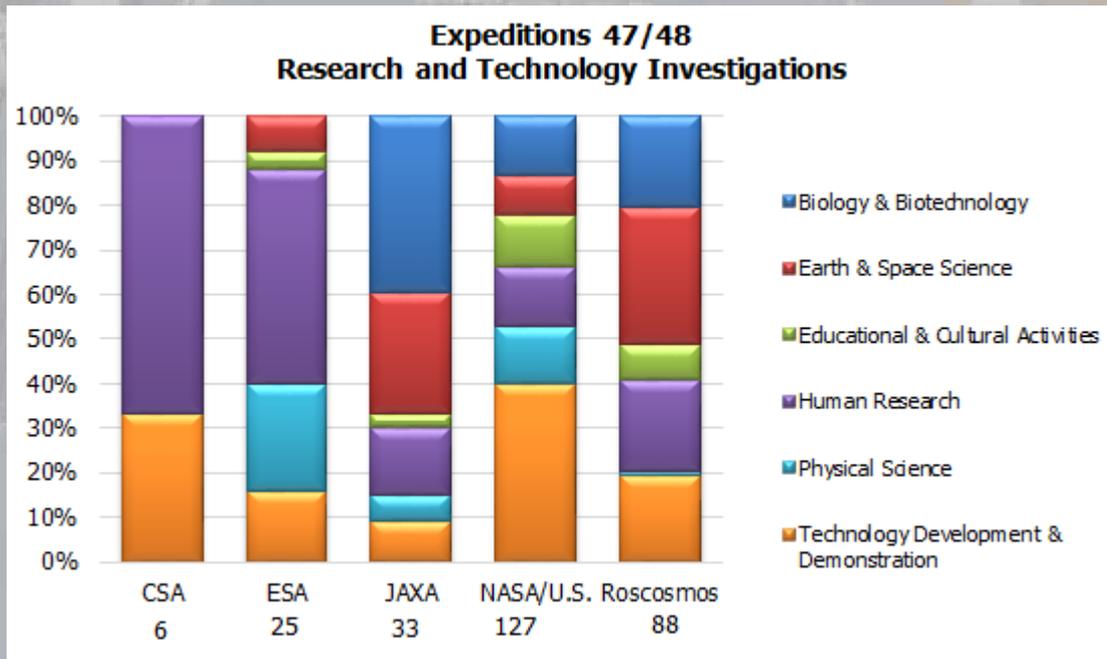
ISS Research Statistics

Working data as of January 31, 2016



Number of Investigations for 47/48: 279

- 127 NASA/U.S.-led investigations
 - 48 NASA/U.S.
 - 3 Roscosmos (Preliminary Data)
- 152 International-led investigations
 - 1 CSA
 - 3 ESA
 - 5 JAXA
- Over 800 Investigators represented
- Over 1200 scientific results publications (Exp 0 – present)



Estimated Number of Investigations Expedition 0-48: 2119* *Pending Post Increment Adjustments

Increments 47 & 48 Research Plan - Investigation List

Human Research

Bone & Muscle Physiology

Bisphosphonates (Control),
Sprint, Marrow, Tbone (P),
Brain-DTI (P), CARTILAGE (P),
EDOS-2, Muscle Biopsy (P)

Cardiovascular & Respiratory Systems

Cardio Ox, Vascular Echo, Airway
Monitoring, IPVT↑

Crew Healthcare Systems

Skin-B

Habitability & Human Factors

Body Measures,
Fine Motor Skills, Habitability

Human Behavior & Performance

Cognition, At Home in Space,
Circadian Rhythms
Synergy (P)

Human Microbiome

Microbiome

Immune System

Salivary Markers, IMMUNO-2, Multi-Omics

Integrated Physiology & Nutrition

Biochem Profile, Telomeres (P), Repository,
Dose Tracker,
Energy, MARES
Biological Rhythms 48hrs

Nervous & Vestibular Systems

NeuroMapping, Field Test (P)
Space Headaches, Straight Ahead in
Microgravity (P)

Vision

Fluid Shifts, Ocular Health

Biology and Biotechnology

Animal Biology

Rodent Research-3
Space Pup↓ Mouse Epigenetics-1

Cellular Biology

Micro 9, Micro 10, NanoRacks Mod-28,
Heart Cells*, WetLab-2
Stem Cells, Cell Mechanosensing-3
Spheroids, Cytoskeleton

Macromolecular Crystal Growth

CASIS PCG 4, NanoRacks PCG, PCG Crystal Hotel,
JAXA PCG Demo 2, JAXA PCG

Microbiology

Microbe-IV, Myco, BRIC-NP*,
BRIC-23*
Microbial Observatory-2 ↓

Plant Biology

Auxin Transport
Plant RNA Regulation*
Veg-03
NanoRacks Mod -33 (Agar)
Plant Gravi Sensing-3

Physical Sciences

Combustion Science

Cool Flame Investigation
(CFI), FLEX 2*

Complex Fluids

ACE H2*, ACE T-1
ACE T-9*

Materials Science

EML Batch - 1 & 2, MSL 2b, SODI
DSC Mix*, Manufacturing Device,
Synthetic Muscle*, NanoRacks
Module -40*, ELF Batch #3,4

Fluid Physics

Marangoni-UVP, Two-
Phase Flow, ZBOT,
PBRE* Microchannel
Diffusion
Fundamental Physics
DOSIS-3D

Earth & Space Science

Astrobiology/Astrophysics/Heliophysics

AMS-02 (E), Meteor, NanoRacks Mod-24*,
Solar-SOLACES/SOLSPEC (E)
CALET (E)†, MAXI (E)

Earth Remote Sensing

CATS (E), HICO-RAIDS (HREP) (E), ISS-RapidScat (E)
NREP Inserts

Near-Earth Space Environment

SEDA-AP (E), Ex-HAM #1 (E), #2 (E)

Technology Development and Demonstration

Characterizing Experiment Hardware

ESA-Haptics-1,-2*, IN SITU (ASI),
Biomolecular Sequencer, NanoRacks
Mod-29*, MVIS Microcontroller -1

Communications & Navigation

METERON, Vessel ID System, Maritime
Awareness*, Scan Testbed, OPALS↓

Fire Suppression and Detection

Saffire I/II

Multipurpose

Programmable Isolation Mount*

Power and Thermal Management Systems

Phase Change HX, Universal Battery Charger.

Radiation Measurements

& Shielding
Area PADLES↓, PS-TEPC↑, Radi-N2, REM

Avionics & Software

SNFM, Telescience Resource Kit*

Life Support and Habitation

Mini Exercise Device-2, UBNT

Air, Water and Surface Sampling

Personal CO2 Monitor*

Robotics & Imaging

HDEV (E), Gecko Gripper*, Robonaut, RRM I
Phase 2 (E)

Spacecraft and Orbital Environments

Strata-1, REALM, SPHERES Halo*
SPHERES Tether*

Space Structures and Materials

BEAM, Manufacturing Device, REBR-W

Small Satellites & Control Technologies

NanoRacks NRCSD ext*, JSSODM-1, JSSOD#5,
EFU Adapter RTcMISS, SPHERES UDP*,
SPHERES Slosh*

Educational Activities

Educational Competitions

SPHERES-Zero-Robotics

Educational Demos

ESA-EPO-PEAKE, ISS Ham Radio, Story Time Demo*
JAXA EPO
Sally Ride EarthKAM

Student-Developed Investigations

CASIS Edu 3, NR Modules-16, -18, -20, -21, -22, -51
NanoRacks Module-9, Mod-48*, NR SMILE*, Genes
in Space*

Classroom Versions of ISS Investigations

Windows on Earth

To Be Defined

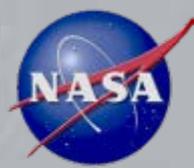
Payload Card-X, JAXA Commercial, JAXA EFU Adapter and HDTV

Key: ■ NASA ■ NatLab ■ CSA ■ ESA ■ JAXA

↓ Ascent/Descent, (P) Pre/Post only, * Added by CEF, (E) External Payload



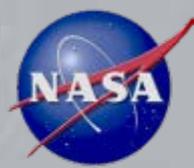
Total ISS Consumables Status



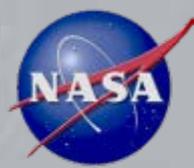
Consumable – based on current, ISS system status	T1: Current Capability		T2: Current Capability + OA-6	
	Date to Reserve Level	Date to zero supplies	Date to Reserve Level	Date to zero supplies
Food – 100%	June 24, 2016	August 10, 2016	August 18, 2016	October 14, 2016
KTO	August 05, 2016	September 27, 2016	September 17, 2016	November 09, 2016
Filter Inserts	January 18, 2017	> January 31, 2017	> January 31, 2017	> January 31, 2017
Toilet (ACY) Inserts	August 06, 2016	September 29, 2016	October 04, 2016	November 26, 2016
EDV + TUBSS (UPA Operable)	December 10, 2016	> January 31, 2017	December 27, 2016	> January 31, 2017
Pre-Treat Tank	August 31, 2016	> January 31, 2017	August 31, 2016	> January 31, 2017
Water (Nominal Usage)	September 05, 2016	December 28, 2016	September 05, 2016	December 28, 2016
Consumable - based on system failure				
EDV + TUBSS (UPA Failed)	July 31, 2016	September 25, 2016	August 09, 2016	October 04, 2016
Water, if no WPA (Ag & Iodinated)	June 25, 2016	August 29, 2016	June 25, 2016	August 29, 2016
O ₂ if Elektron supporting 3 crew & no OGA	February 28, 2016	July 26, 2016	March 31, 2016	August 10, 2016
O ₂ if neither Elektron or OGA	February 09, 2016	April 15, 2016	February 09, 2016	April 23, 2016
LiOH (CDRAs and Vozdukh off)	~0 Days	~14 Days	~0 Days	~14 Days



USOS Consumables Status



Consumable – based on current, ISS system status	U1: Current Capability		U2: Current Capability + OA-6	
	Date to Reserve Level	Date to zero supplies	Date to Reserve Level	Date to zero supplies
Food – 100%	July 27, 2016	September 21, 2016	December 10, 2016	January 30, 2017
KTO	October 17, 2016	December 12, 2016	January 11, 2017	> January 31, 2017
Filter Inserts	> January 31, 2017	> January 31, 2017	> January 31, 2017	> January 31, 2017
Toilet (ACY) Inserts	> January 31, 2017	> January 31, 2017	> January 31, 2017	> January 31, 2017
EDV + TUBSS (UPA Operable)	June 28, 2016	January 18, 2017	August 26, 2016	> January 31, 2017
Pre-Treat Tanks	December 17, 2016	> January 31, 2017	December 17, 2016	> January 31, 2017
Water (Nominal Usage)	> January 31, 2017	> January 31, 2017	> January 31, 2017	> January 31, 2017
Utilization	> January 31, 2017	> January 31, 2017	> January 31, 2017	> January 31, 2017
Consumable - based on system failure				
EDV + TUBSS (UPA Failed)	March 17, 2016	May 12, 2016	April 04, 2016	May 30, 2016
Water, if no WPA (Ag & Iodinated)	April 05, 2016	May 30, 2016	April 05, 2016	May 30, 2016
O ₂ if neither Elektron or OGA	February 10, 2016	April 26, 2016	February 10, 2016	May 11, 2016
LiOH (CDRAs and Vozdukh off)	~0 Days	~13.3 Days	~0 Days	~13.3 Days



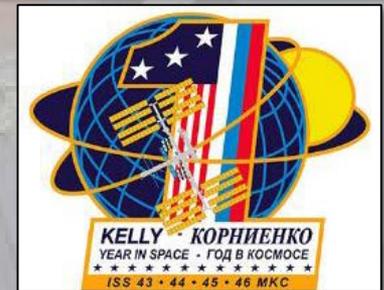
One Year Crew Research
And
Human Research Program



ISS One-Year Mission



- Completed One-year Mission on March 1
 - Mission Successful and Benefits of US/Russian Collaborative Work Realized
 - Astronaut Scott Kelly set the record for the longest duration American space mission (340 days)
 - Research Data Collection to Continue Over the Next Year
 - Future One-year Missions Currently Under Study
- One-year Mission Joint Research Plan Completed
 - Physical and Functional Performance Assessments
 - Behavioral Health Studies and Ocular Health Monitoring
 - Metabolic and Immune System Studies
 - Microbial Population Changes
 - Long-Duration Mission Human Factors Studies
- US/Russian Fluids Shift Experiment
 - Most complex biomedical experiment implemented on ISS
 - Experiment could only be undertaken using both US and Russian hardware, subjects, and crew time
 - Studies body fluids redistribution during long-duration missions that may cause the visual changes in crewmembers





One-Year Mission: Research Objectives



Functional: assess changes in crew member performance (strength/endurance/coordination/balance) using operational functional tasks after one-year in a low-gravity environment



Behavioral Health: study psychological effects of long-duration spaceflight on crew members by conducting cognition tests, neuromapping studies, sleep monitoring, journaling analyses and a reaction self-test



Visual Impairment: examine ocular health changes using ultrasound and high-fidelity optical coherence tomography imaging



Metabolic: study immune system function, salivary markers, biochemical profiles, and biological markers of oxidative/inflammatory stress.



Physical Performance: assess exercise effectiveness focusing on changes to bone density and structure, muscle strength, and the cardiovascular output over time in a weightless environment



Microbial: investigate changes in the microbiome of crewmembers.



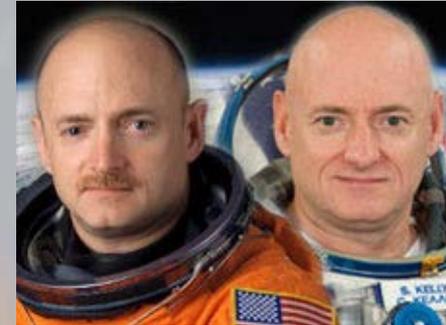
Human Factors: examine how astronauts interact with their environment aboard the International Space Station focusing on fine motor performance, habitability, and training.



Twins Study



- Twins Study (Scott and Mark Kelly)
 - ISS Sample Collection Completed
 - Post Flight Sample Collection to Continue Over the Next Year
- Objective was to Begin Examining Next Generation Genomics Solutions to Mitigating Crew Health and Performance Risks
 - Personalized countermeasures approaches
- Twins Study National Research Team will Examine
 - Genome, telomeres, epigenome
 - Transcriptome and epitranscriptome
 - Proteome, Metabolome, Microbiome
 - Physiology and Cognition
- Significant Privacy and Ethics Issues
 - NASA is developing new genomics policy (modeled after NIH policy) that addresses informed consent, data privacy approaches, and genetic counseling on consequences of discovery (individual, family)

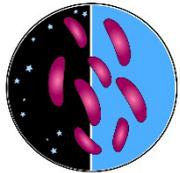




Twins Study: Research Objectives



Molecular/Omics: investigations will look at the way genes in the cells are turned on and off as a result of spaceflight; and how stressors like radiation, confinement and microgravity prompt changes in the proteins and metabolites gathered in biological samples like blood, saliva, urine and stool.



Microbiology/Microbiome: explore the brothers' dietary differences and stressors to find out how both affect the organisms in the twins' guts.



Human Physiology: investigations will look at how the spaceflight environment may induce changes in different organs like the heart, muscles or brain.



Behavioral Health: characterize the effects spaceflight may have on perception and reasoning, decision making and alertness.



Human Exploration and Operations

Human Research Program: Overview



- Develop human health and performance standards, countermeasures, knowledge, technologies, and tools across various disciplines to enable safe, reliable, and productive human space exploration on the path to Mars
 - ISS Medical Project: provide planning, integration and implementation services for HRP research studies aboard ISS and in spaceflight analog environments
 - Space Radiation: ensure crewmembers can safely live and work in space without exceeding acceptable radiation health risks
 - Human Health Countermeasures: responsible for understanding normal physiologic effects of spaceflight and developing countermeasures to those with detrimental effects
 - Exploration Medical Capability: develop medical technologies for in-flight diagnosis and treatment, as well as data systems to protect private medical data
 - Behavioral Health and Performance: conduct and support research to reduce risk of behavioral and psychiatric conditions induced by spaceflight environment
 - Space Human Factors and Habitability: study interaction of the human system with hardware, software, procedures, and the spacecraft environment; understand existence of and exposure to contaminations and toxins; deliver improvements in food and technologies for storage and preparation
- Require ISS utilization to mitigate human health space exploration risks to an acceptable level



Human Exploration and Operations

Human Research Program: Overview (continued)



- Enable NASA human exploration goals by conducting flight and ground research to mitigate highest risks to human health and performance on current and future exploration missions
- Establish research priorities consistent with recommendations from the National Academies and validate them through external independent reviews
- Implement open competitive solicitation process and independent, external scientific review using NASA Research Announcements to ensure highest quality research
- Enable continued collaboration with other NASA organizations, other agencies and international partners, including
 - Research on vision impairment and intracranial pressure and astronaut health in coordination with Crew Health and Safety
 - Coordinate close-out of the NSBRI and USRA cooperative agreements, develop final reports on accomplishments and begin transition to a new single cooperative agreement
 - Mitigate exploration biomedical risks with ISS Program
 - Study microbial alterations and space grown food with Space Biological Sciences
 - Advance space radiation understanding with AES on shielding and monitoring technology
 - Develop exercise and food storage systems with Orion



Human Exploration and Operations



Human Research Program: Integrated Path to Risk Reduction

Revision C (2015)

		FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
Planetary DRM (Mars)	LxC	ISS 1-YR Mission	Asteroid Phase A		CCP	EM-1		ARRM	EM-2			ISS End	ARCM		Mars Phase A	
Risks																
Cardiac Rhythm Problems (Arrhythmia)	3x4															
Sleep Loss/Work Overload (Sleep)	3x3															
Reduced Muscle Mass (Muscle)	3x3															
Reduced Aerobic Capacity (Aerobic)	3x3															
Orthostatic Intolerance (OI)	3x2															
Exploration Atmospheres (ExAtm)	3x3															
Team Performance (Team)	3x4															
Host-Microorganism Interactions (Microhost)	3x3															
Occupant Protection (OP)	3x3															
Altered Immune Response (Immune)	3x3															
Bone Fracture (Fracture)	2x4															
Human-System Interaction Design (HSID)	3x4															
Intracranial Hypertension/Vision (VIIP)	3x4															
Unpredicted Effects of Medication (Stability)	3x4															
Inadequate Food and Nutrition (Food)	3x4															
In-Flight Medical Capabilities (ExMC)	3x4															
Vestibular/Sensorimotor Impacts (Sensorimotor)	3x3															
Behavioral Conditions (BMed)	3x4															
Intervertebral Disk Damage (IVD)																
Pharmacokinetics (PK/PD)																
Inadequate EVA Suit (EVA)	3x3															
Decompression Sickness (DCS)	3x3															
Exposure to Dust & Volatiles (Dust)																
Renal Stone Formation (Renal)	3x4															
Radiation Exposure on Human Health	3x4															

- Uncontrolled
- Partially Controlled
- Controlled
- Optimized
- Insufficient Data

- Assumptions:**
- 450 crew hrs/ Increment pair
 - 3 crew/ Increment pair
 - 6 month missions

 ISS Required ISS Not Required

▲ Milestones Requires ISS

◇ Milestone Shift

Updated 6/10/15



Human Exploration and Operations

Human Research Program:

Human Risks Disposition for all Design Reference Missions



Human System Risks 07/01/15	In Mission Risk - Operations						Post Mission Risk - Long Term Health					
	Low Earth Orbit	Low Earth Orbit	Deep Space Sortie	Lunar Visit/Habitation	Deep Space Journey/Habitation	Planetary	Low Earth Orbit	Low Earth Orbit	Deep Space Sortie	Lunar Visit/Habitation	Deep Space Journey/Habitation	Planetary
	6 Months	12 Months	30 Days	1 year	1 Year	3 years	6 Months	12 Months	30 Days	1 year	1 Year	3 years
VIIP	A	A	A	A	RM	RM	A	A	A	A	RM	RM
Renal Stone Formation	A	A	A	A	RM	RM	RM	RM	RM	RM	RM	RM
Inadequate Food and Nutrition	A	A	A	A	A	RM	A	A	A	A	A	RM
Space Radiation Exposure	A	A	A	A	A	TBD*	A	A	A	RM	RM	RM
Medications Long Term Storage	A	A	A	A	A	RM	A	A	A	A	A	RM
Acute and Chronic Carbon Dioxide	A	A	A	A	RM	RM	A	A	A	A	A	A
Inflight Medical Conditions	A	A	A	RM	RM	RM	A	A	A	RM	RM	RM
Cognitive or Behavioral Conditions	A	RM	A	RM	RM	RM	A	A	A	A	A	RM
Bone Fracture	A	A	A	A	A	RM	A	A	A	A	A	A
Human-System Interaction Design	A	A	A	RM	RM	RM	A	A	A	A	A	A
Team Performance Decrements	A	A	A	A	RM	RM	A	A	A	A	A	A
Cardiac Rhythm Problems- Under Review	A	A	A	A	RM	RM	A	A	A	A	A	A
Reduced Muscle Mass, Strength	A	A	A	A	A	RM	A	A	A	A	A	RM
Reduced Aerobic Capacity	A	A	A	A	A	RM	A	A	A	A	A	RM
Sensorimotor Alterations	A	A	A	RM	RM	RM	A	A	A	A	A	RM
Injury from Dynamic Loads	A	A	RM	RM	RM	RM	A	A	RM	RM	RM	RM
Sleep Loss	A	A	A	A	RM	RM	A	A	A	A	RM	RM
Altered Immune Response	A	A	A	A	A	RM	A	A	A	A	A	RM
Celestial Dust Exposure	N/A	N/A	TBD	A	TBD	TBD	N/A	N/A	TBD	A	TBD	TBD
Host-Microorganism Interactions	A	A	A	A	A	RM	A	A	A	A	A	RM
Injury due to EVA Operations	A	A	A	RM	A	RM	A	A	A	RM	A	RM
Decompression Sickness	A	A	RM	A	RM	A	A	A	A	RM	A	RM
Toxic Exposure	A	A	A	A	A	A	A	A	A	A	A	A
Hypobaric Hypoxia □	RM	RM	A	RM	RM	RM	RM	RM	A	RM	RM	RM
Space Adaptation Back Pain	A	A	A	A	A	A	N/A	N/A	N/A	N/A	N/A	N/A
Urinary Retention	A	A	A	A	A	A	A	A	A	A	A	A
Hearing Loss Related to Spaceflight	A	A	A	A	A	A	A	A	A	A	A	A
Orthostatic Intolerance	A	A	A	A	A	A	A	A	A	A	A	A
Injury from Sunlight Exposure	A	A	A	A	A	A	A	A	A	A	A	A
Electrical shock	A	A	A	A	A	A	A	A	A	A	A	A
Concern of Intervertebral Disc Damage upon and immediately after re-exposure to Gravity												
Concern of Medication PK/PD												

A - Accepted based on current standards & countermeasures

RM - Requires Mitigation

TBD* - Disposition to be officially determined by the HSRB in the near future

TBD - DRMs have not been assessed to provide rating and disposition

Green – low/very low consequence
 Yellow – low to medium consequence
 Red – high consequence



OA-4 (Orb-4) Mission



OA 4 Mission successfully launched on 12/6/15



Cygnus on orbit during rendezvous and capture phases



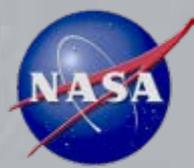
Cygnus hatch opening



OA 4 Mission on orbit with Soyuz



OA-4 Mission Status – Successfully Completed !!



➤ Mission Planning

- First use of Atlas V401 with the Cygnus spacecraft
- Cargo Integration Review (CIR) was completed on 7/29/15
- SRP Phase 3 was conducted on 10/1/15 and 10/13/15
- All Joint Multi-Segment Trainings (JMSTs) were completed by 10/28/15
- Stage Operations Readiness Review (SORR) was conducted on 11/9/15
- Flight Readiness Review (FRR) was conducted on 11/16/15
- Successfully launched on 12/6/15; Unberthed and re-entered on 2/19/16

➤ Pressurized Cargo – 3513 kg planned; 1403 kg disposal

➤ Cygnus Status

- First enhanced Cygnus with a longer Pressurized Cargo Module (PCM)
- Service Module (SM) accommodated changes to the TriDAR/LIDAR configuration
- Initial cargo completed loading into the PCM on 10/21/15
- SM mate to PCM was completed on 10/23/15
- Cargo late load was completed on 11/9/15
- Cygnus mate to the launch vehicle completed on 11/20/15

➤ Atlas V 401 Status

- Booster was shipped to CCAFS on 10/30/15
- Launch Vehicle Assessment reviewed by ISS Program on 11/10/15

Atlas V 401
launch vehicle
planned to carry
Cygnus in OA 4
mission



OA 4 Pressurized
Cargo Module (PCM)

Photo Credit: Orbital



OA-6 Mission Status



➤ **Mission Planning**

- ULA Mission Integration Table Top Review (MITTR) #2, Ground Operations Readiness Review (GORR), and Integrated Systems Review (ISR) were conducted on 12/16/15, 1/11/16, and 1/14/16
- Post Qualification Review (PQR) was conducted on 1/28/16
- Safety Review Panel (SRP) Phase 3 reviews were completed on 2/16/16
- Stage Operations Readiness Review (SORR) is planned for 3/3/16
- ULA President's Mission Readiness Review (MRR) is planned for 3/8/16

➤ **Pressurized Cargo** – 3513 kg planned; 1726 kg disposal (*estimated*)

- Final ISS cargo manifest was delivered on 10/14/15 in support of CIR
- Spacecraft Fire Experiment (Saffire) #1 integrated into Cygnus on 1/25/16

➤ **Unpressurized Cargo**

- Nanoracks cubesat deploy planned post unberth

➤ **Cygnus Status**

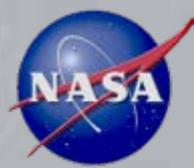
- Pressurized Cargo Module (PCM) testing was completed on 1/21/16
- Final Service Module(SM)/PCM mate was completed on 2/15/16
- Late cargo load is planned from 3/2/16 – 3/4/16

➤ **Atlas V 401 Status**

- 2nd Stage arrived at KSC on 1/23/16 and booster arrived on 2/4/16



OA-5 Mission Status



➤ **Mission Planning**

- Software Stage Test was conducted from 2/15/16 – 2/26/16
- Cargo Integration Review (CIR) is planned for 3/8/16
- Safety Review Panel (SRP) Phase 3 review is planned for 3/23/16
- Mission Readiness Review (MRR) is currently planned for 4/7/16

➤ **Pressurized Cargo** – 3200 kg planned; 1802 kg disposal (*estimated*)

- Saffire #2 payload planned to be integrated into Cygnus

➤ **Unpressurized Cargo**

- Nanoracks cubesat deploy planned post unberth

➤ **Cygnus Status**

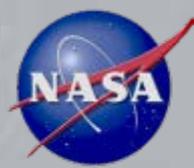
- Service Module (SM) in storage having completed integrated testing
- SM regression testing was conducted from 2/9/16 – 2/29/16
- PCM is planned to arrive at WFF on 3/9/16

➤ **Antares Status**

- Planned launch vehicle is the Antares (0000.7 Core with Engines 4A and 5A)
- RD-181 Certification Review was conducted from 1/12/16 – 1/13/16
- Engines 4A and 5A were mounted to Stage 1 on 1/28/16
- Main Engine Controller (MEC) delivery to WFF on 2/24/16
- RD-181 Quality Audit was conducted from 2/24/16 – 2/26/16
- Stage Test Article (0000.6 Core with Engines 2A/3A) is at WFF preparing for hot fire test on 4/25/16



SpaceX-8 Mission Status



➤ **Mission Planning**

- Safety Review Panel (SRP) Phase 3 Parts 1 & 2 were conducted on 11/5/15 and 11/13/15, respectively
- Post Qualification Review (PQR) was conducted on 11/19/15
- SORR is planned for 3/3/16

➤ **Pressurized Cargo** – 1732 kg planned; 1850 kg return (*estimated*)

- 1 Animal Enclosure Module-Transporter, 2 Polar, NORS O2/N2 tank, and cold bags
- Nominal press cargo load planned on 3/9/16; late load is planned for 3/29/16

➤ **External Cargo** – 1578 kg

- Bigelow Expandable Activity Module (BEAM) was integrated into the trunk on 2/24/16

➤ **Dragon Status**

- Capsule to trunk mate is planned for 3/1/16
- Mate to Falcon 9 is planned for 3/16/16

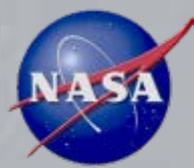
➤ **Falcon 9 Status**

- First CRS Falcon flight with full thrust capability (3rd F9 flight with full thrust)
- M1D and MVacD qualification was completed in Nov 2015
- 1st Stage arrived in TX on 1/28/16; 2nd Stage shipped to TX on 2/2/16





SpaceX-9 Mission Status



➤ **Mission Planning**

- Software Stage Test is planned in Mar prior to PQR
- Post Qualification Review (PQR) planning date is planned for 5/19/16 (under review)
- Stage Operations Readiness Review (SORR) is planned for 6/2/16 (under review)

➤ **Pressurized Cargo** – 2100 kg planned; 1900 kg return *estimated*

- 1 JAXA Rodent Module (potential first flight), 1 Bioculture, 3 Polar, Short Extravehicular Mobility Unit (SEMU), NORS O2 tank, and coldbags
- Pressurized cargo Interface Control Documents (ICDs) are currently out for review and baseline signature

➤ **External Cargo** – 550 kg

- International Docking Adapter (IDA) #2

➤ **Dragon Status**

- Capsule and trunk stacking at Hawthorne for integrated checkouts was completed on 1/26/16
- Electromagnetic Interference/Compatibility (EMI/EMC) testing was conducted the week of 2/8/16
- Trunk is planned to be ready for shipment to the Cape in early Mar

➤ **Falcon 9 Status**

- 1st Stage welding/painting/inspection completed in Jan
- 2nd Stage welding/painting/inspection completed in Feb
- Engines will begin ATP in Mar



Commercial Resupply Services CRS-2 Status

- **CRS-2 Contract award was announced on 1/14/16**
 - Awardees are Orbital-ATK, SpaceX, and Sierra Nevada Corporation
 - Contract post award briefings will be conducted in Mar/Apr
 - A minimum of six missions will be ordered from each provider
 - CRS-2 missions are planned for launch beginning in 2019
 - To bridge the launch gap, the current CRS contracts were extended to provide ordering through Dec 2018





ISS Integration Status of Crew Vehicles



➤ **Mission Planning**

- Plans for vehicle certification are in work
- Development of operational products commenced

➤ **ISS On-orbit Readiness**

- Common Communications for Visiting Vehicles (C2V2) activation is in work
- International Docking Adapter (IDA-2) installation planned with SpaceX-9 mission

➤ **Joint Integration Activities**

- Phase 2 Safety Review Panel in progress
- Baseline of provider Verification and Validation (V&V) Plans and Joint Integration and Verification Test Plans (JIVTP) with expected completion the first week of Mar
- Providing delivery of NASA Docking System (NDS) for Boeing CST-100 and completed 6-DOF testing of the SpaceX built docking system

