



International Space Station National Lab Status

What is NASA doing to implement National Lab?

Completing the build out of the original multi disciplinary Lab capability

- positioning 2 additional freezer racks, 2 additional Express racks, preserved Habitat Holding rack capability for future customers

Identifying resources and on-orbit capacity available for research

- identified and documented the re-supply capacity of the transportation system
- developed a reference on-orbit hardware list for customers

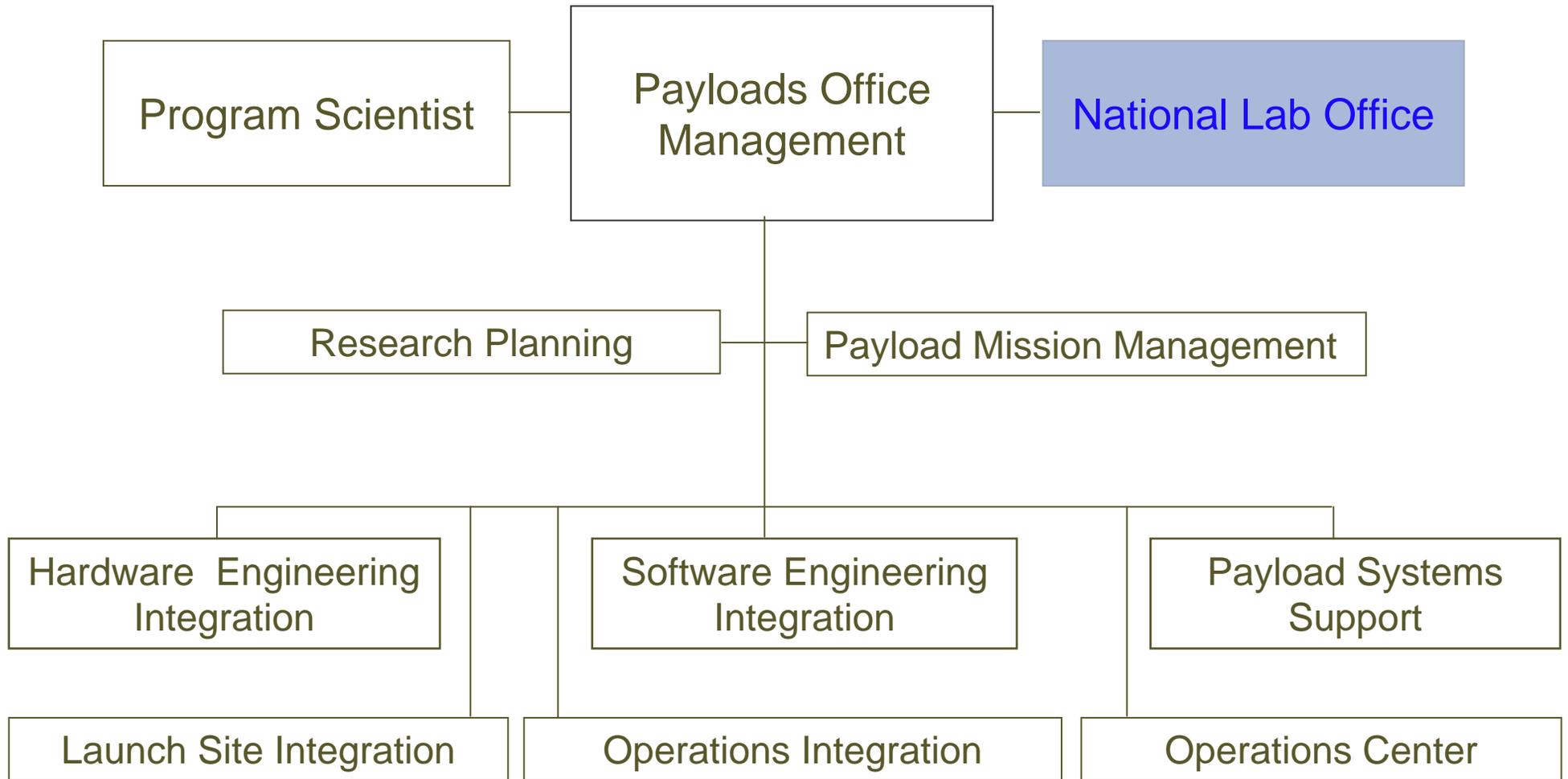
Flying “path finder” National Lab payloads beginning with ISS flight 1JA

- fenced allocation on remaining Shuttle missions

Establishing a National Lab Office within the ISS payloads' office

Developing streamlined payload certification processes

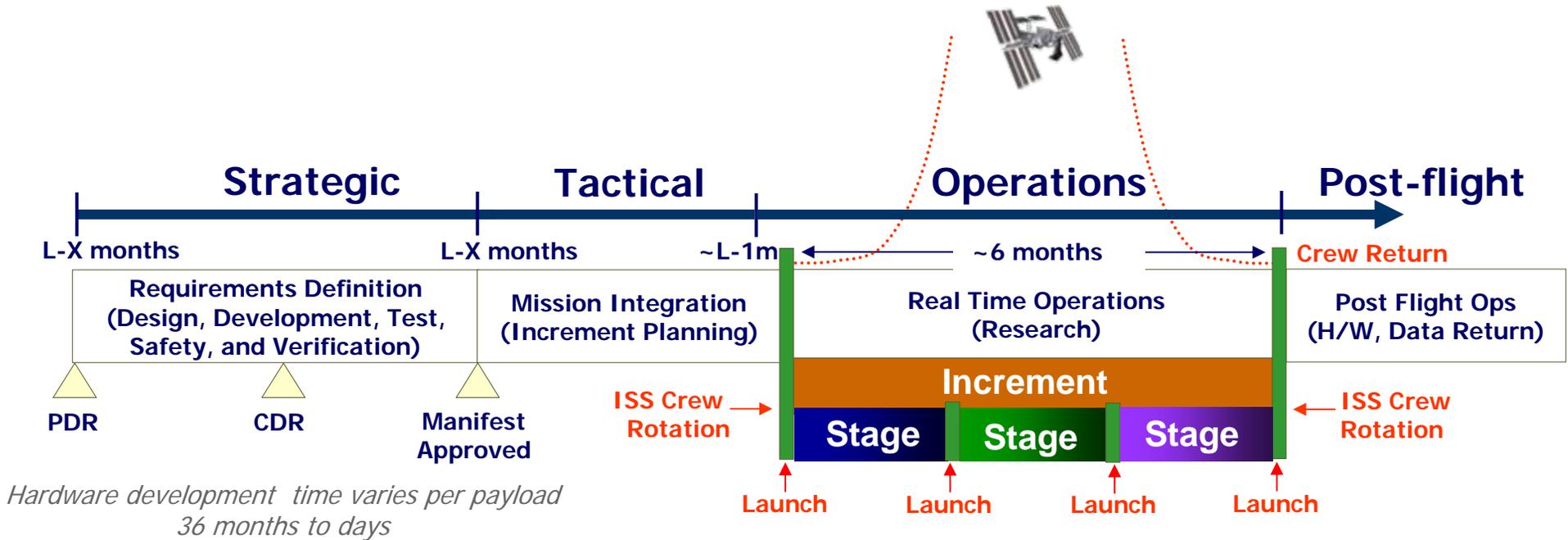
International Space Station Payloads Organization



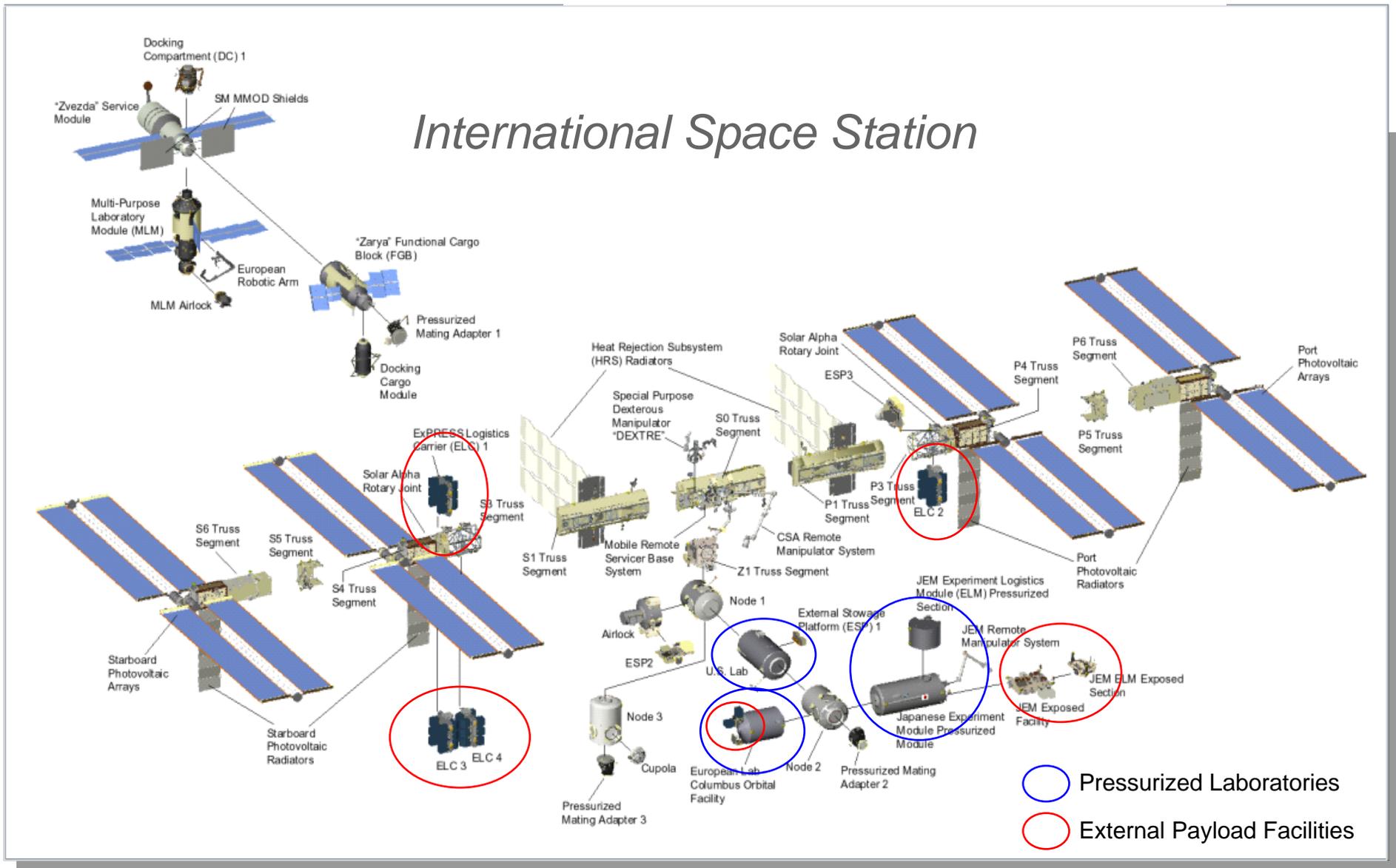
ISS Payloads Office

- Responsible for managing all aspects of ISS payload planning and operations
- Integrate US and International Partner requirements into executable missions
- Establish flight manifest and allocate on orbit resources
- Perform hardware software station to payload interface testing
- Conduct crew training
- Carry out the day to day monitoring and operations of on orbit payloads and support crew operations through the Payload Operations Control Center, Huntsville, Al.

ISS Payload Integration Process



Assembly Complete Configuration



Research Outfitting

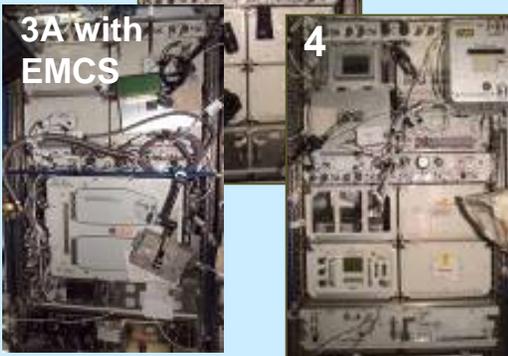
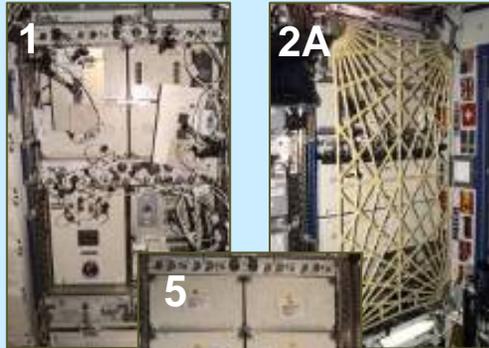
2 Human Research Facility Racks



Microgravity Science Glovebox



5 ExPRESS Racks



Minus Eighty-Degree Laboratory Freezer for ISS

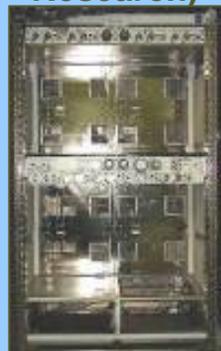


2001-2007

Combustion Integrated Rack



ExPRESS-6 (Galley and Research)



2008

Materials Science Research Rack



Fluids Integrated Rack

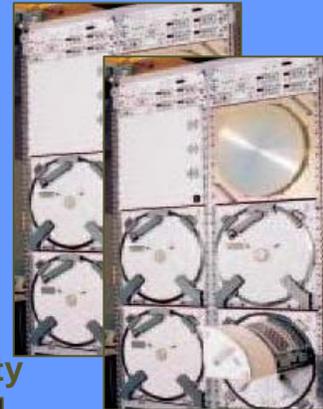


ExPRESS-7 and 8



Added for National Lab

MELFI-2 and -3



Window Observational Research Facility



Added for National Lab

SpaceDRUMS in ExPRESS 5



Muscle Atrophy Research Exercise System (MARES)



2009-2010

- ISS Payload science capability:

determined by

Payload Re-supply allocation within the Transportation plan

and the

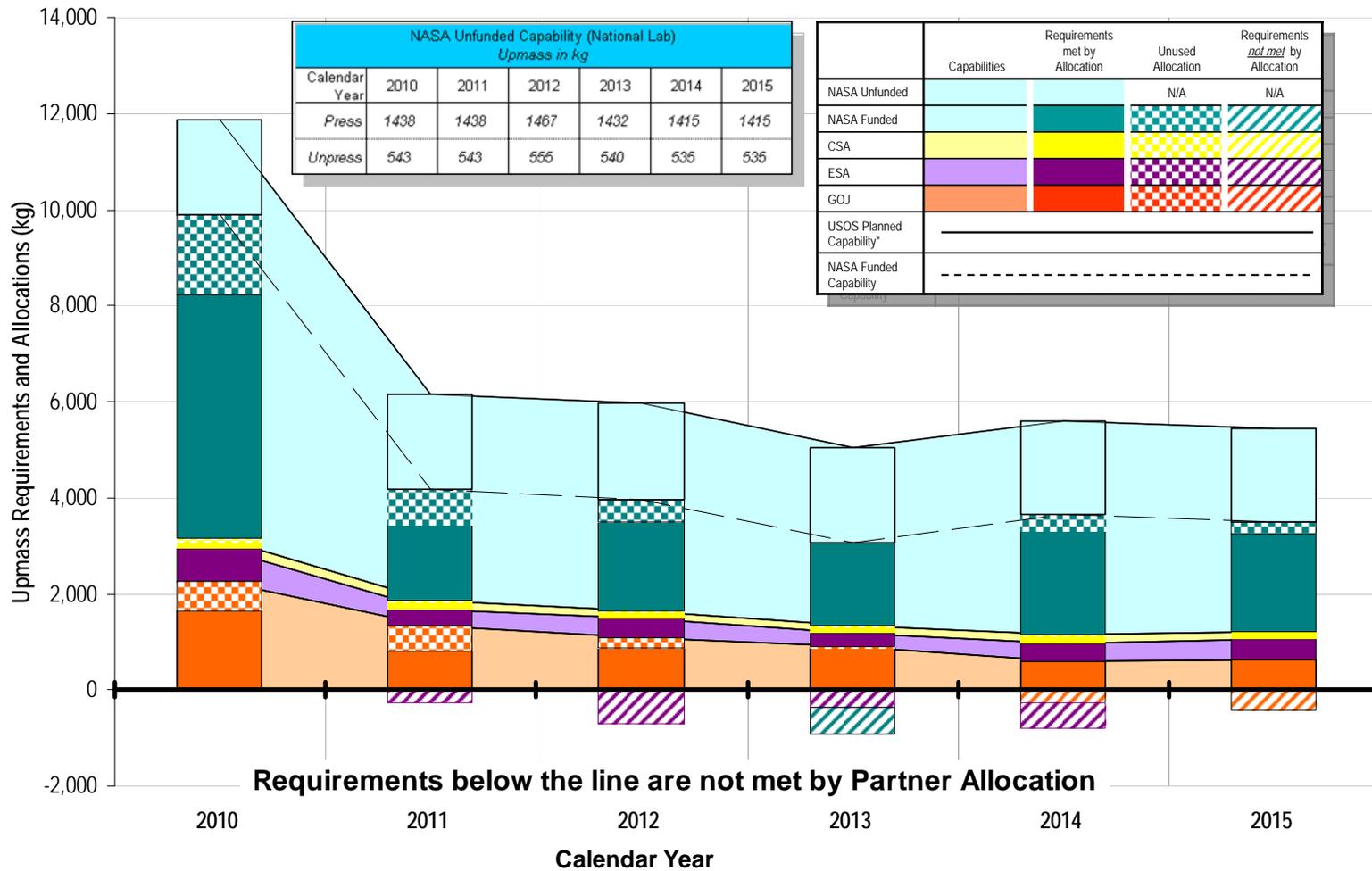
Internal and External on-orbit available accommodations
at assembly complete

- NASA's planned science program does not utilize the full capacity of the available accommodations
- This excess capacity will be utilized by the National Lab customers

2010 -2015 Transportation Plan

From Draft 2008 Concept of Operations and Utilization Plan – based on Interim Rev. J Assembly Sequence

Total Utilization Upmass (Pressurized + Unpressurized) Capabilities, Allocations, and Requirements



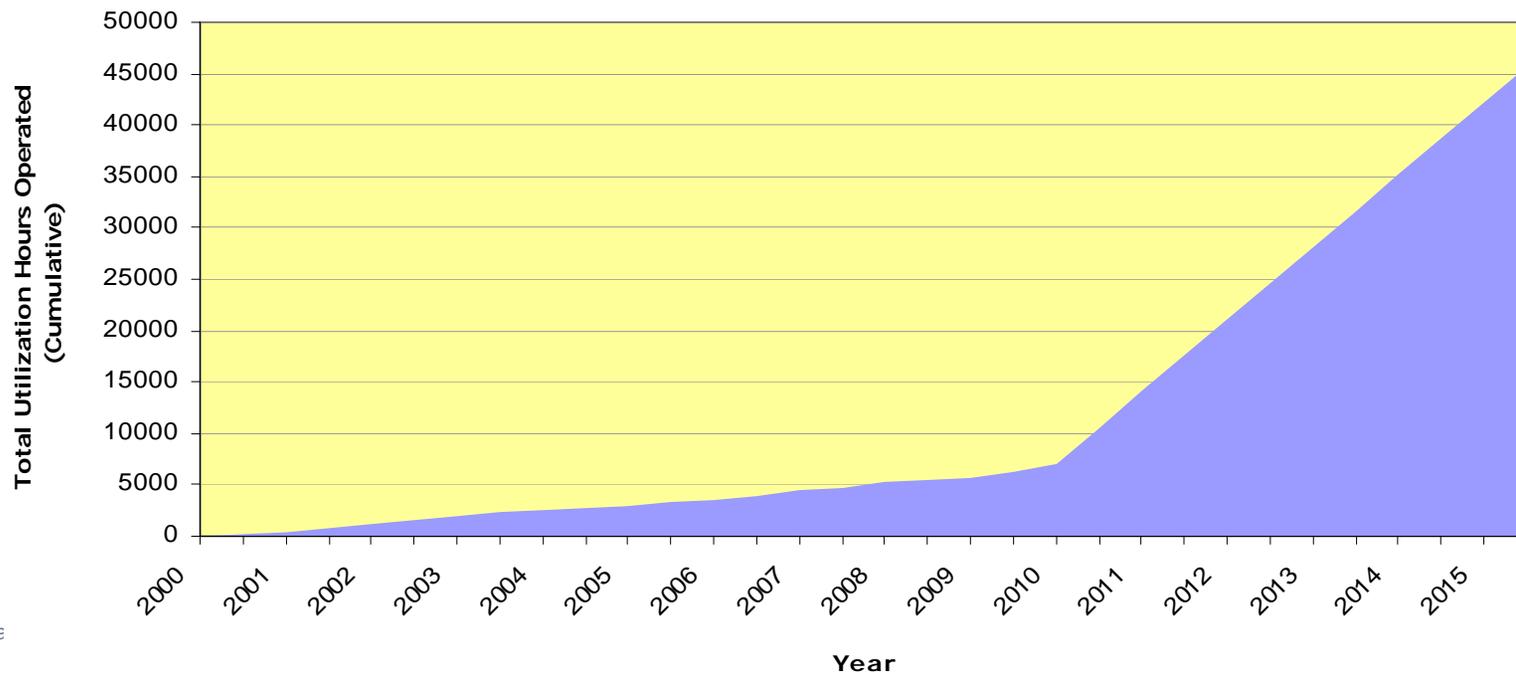
* USOS Planned capability used to derive partner allocations

Importance of 6-crew for Utilization

- Availability of Human Subjects
 - Each subject can participate in approximately 6 experiments
 - Transition from 3- to 6-crew doubles available human subjects for human research experiments
- Increases Total Crew time for Research



Cumulative ISS Utilization Crewtime by All Partners

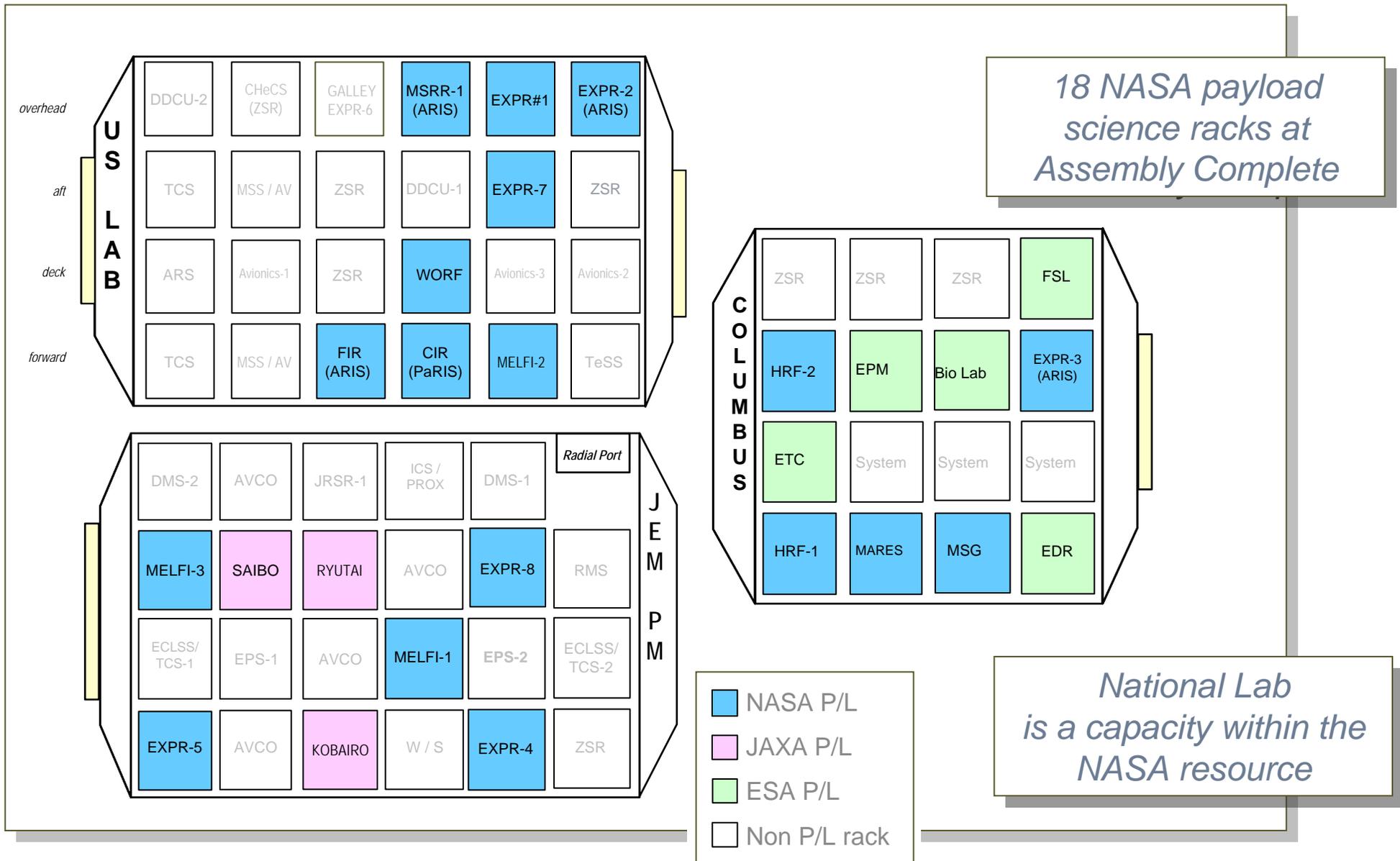


Internal Payload Accommodations Summary

- There are 18 NASA Payload Racks that are dedicated to support science at assembly complete
- They are made up of
 - 7 Express Racks are the primary payload accommodations capability
 - » EXP 1, 2, 3, 4, 5, 7 and 8
 - *EXP 6 is being utilized to house Crew Galley equipment*
 - 5 Facility Class Racks
 - » FIR, CIR, MSRR, MSG, WORF
 - 3 Cold Storage support Racks
 - » MELFI 1, 2, and 3
 - 3 Human Research Facility Racks
 - » HRF1, HRF2, MARES

Space available for research

Science Rack Topology



Internal Payload Utilization Summary

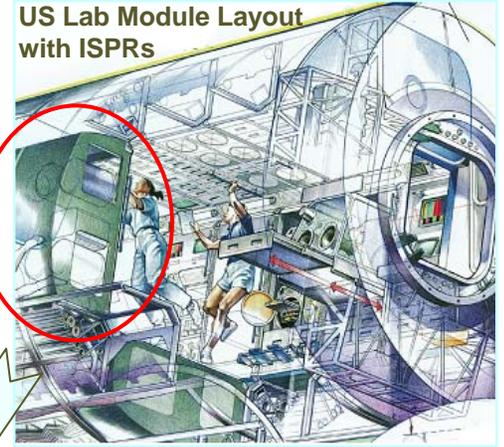
- At this time the NASA funded science program is projected to utilize approximately 50% of the U.S. internal payload accommodations
- 7 Express Rack physical capacity
 - 59 Lockers available, 25 have planned use, 34 available for National Lab
 - 13 Drawers available, 7 have planned use, 6 available for National Lab
- 5 Facility Class Racks can accommodate additional science investigations if National Lab customers are identified
- 3 Cold Storage Racks
 - One MELFI rack is required for NASA science
 - One MELFI rack available for National Lab
 - One MELFI rack is maintained as a spare or combination of NASA and National Lab
- 3 Human Research Facilities could accommodate additional science investigations if National Lab customers are identified at their objectives are collaborative with NASA's

ExPRESS Rack Accommodations

(Expedite the Processing of Experiments for Space Station)



Peggy Whitson works the Advanced Astroculture (ADVASC) plant growth chamber during Expedition 5 in July 2005



US Lab Module Layout with ISPRs

Middeck Locker
P/N V502-661604

2.00 FT³ INTERNAL VOLUME
17.54 (REF) (INSIDE)
30.32 (REF) (INSIDE)
8.97 (REF) (INSIDE)

Features

- 4 rear captive fastener attachments
- Friction hinge
- Dual door locks
- Installation tool guides on 4 corners
- Weight – 12 lbs

International Subrack Interface Standard Drawer
Powered P/N 683-43650
Stowage P/N 683-43656

Features

- 4 PU (Panel Unit)
- Blind Connectors
- Locking Handles
- Weight – 27 lbs
- Rated to at least 37 lbs

EXPRESS 8/2 Configuration

International Standard Payload Rack

Secondary Structure & Subsystems

8/2 Payload Configuration (8 Middeck Lockers, 2 Powered ISIS Drawers)



ExPRESS Rack Resources

(Expedite the Processing of Experiments for Space Station)

System	Middeck Locker Locations	ISIS Drawer Locations	Rack-Level Accommodation
Structural	72 lbs. within cg constraints	64 lbs. within cg constraints	8 Mid deck Lockers 2 ISIS Drawers (4 Panel Unit)
Power	28 Vdc, 0 – 500 W	28 Vdc, 0 – 500 W	2000 Watts 28Vdc power
Air Cooling	≤ 200 Watts	<100 Watts	1200 Watts
Thermal Control System Water Cooling	500 Watts (2 positions per rack)	500 Watts (2 positions per rack)	2 positions per rack
Command and Data Handling	RS422 Analog Ethernet 5 Vdc Discrete	RS422 ±Analog Ethernet 5 Vdc Discrete	RS422 Analog Ethernet 5 Vdc Discrete
Video	NTSC/RS170A	NTSC/RS170A	NTSC/RS170A
Vacuum Exhaust System	1 payload interface per rack	1 payload interface per rack	1 payload interface per rack
Nitrogen	1 payload interface per rack	1 payload interface per rack	1 payload interface per rack

Facility Class Racks

- **Materials Science Research Rack (MSRR)**
 - Facility to support ESA Microgravity Science Lab furnace
 - Left side of rack and MSRR subsystems scarred to support an additional furnace.
- **Fluids Integrated Rack (FIR)**
 - Facility dedicated to fluid physics research, with Light Microscope Module
- **Combustion Integrated Rack (CIR)**
 - Facility dedicated to research in combustion science
- All can accommodate additional science investigations if National Lab customers are identified



MSRR



FIR



CIR

Facility Class Racks

- **Microgravity Sciences Glovebox (MSG)**
 - Principally materials and fluid physics experiments to date



WORF



Expedition 13 crewmember Jeff Williams performing the PFMI experiment in the Microgravity Science Glovebox

- **Window Observational Research Facility (WORF)**
 - Facility to support visual and multi-spectral remote sensing using Lab Optical Window
 - EarthKam and AgCam expected to remain on orbit through 2010 and beyond.

3 Minus Eighty-degree Laboratory Freezer for ISS (MELFI)



- MELFI Racks provide thermal conditioning at +4°C, -26°C and -80°C
- One required for NASA funded research
- One held as a spare
- One is available for National Lab

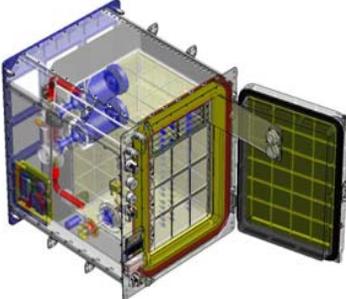


Expedition 14 crewmember Mike Lopez-Alegria conducting TROPI plant growth experiment in EMCS in EXPRESS Rack 3



Expedition 14 crewmember Thomas Reiter removing frozen samples from MELFI

Cold Storage Accommodations

	MELFI	MERLIN	GLACIER	Single and Double Coldbag with ICEPAC's
				
First flight	2006	2007	2008	2006
On-orbit stowage	Yes	Possible	Possible	No
Transport	No	Yes	Yes	Yes
Power	Yes	Yes	Yes	No
On-orbit temperature (°C)	+4, -26, -80	+45 to -20	+4 to -185	N/A
Transport temperature (°C)	N/A	+45 to -5	+4 to -160	+4 to -32
Useable volume (L)	175	19	30	6.8/18.7
External volume	1 rack	1 MLE	2 MLE	0.5/1 MLE

3 Human Research Facilities



Expedition 2 crewmember Susan Helms activating the HRF 1 rack

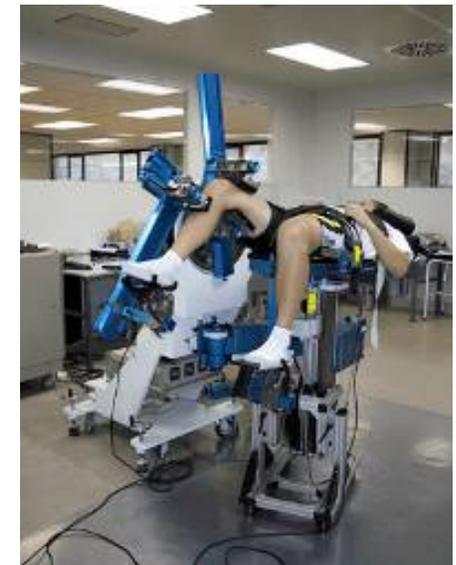
2 Human Research Facility (HRF) Racks - Biomedical investigations, including ultrasound, body mass measurement, metabolic gas analysis, pulmonary monitoring, ambulatory blood pressure measurement, Holter monitor, and experiment unique hardware

1 Muscle Atrophy Research Exercise System (MARES) (2010)

- Facility for musculoskeletal, biomechanical, neuromuscular and neurological physiology measurements
- These facilities could accommodate additional science investigations if National Lab customers are identified at their objectives are collaborative with NASA's



Expedition 12 crewmember Bill McArthur activating the SLAMMD in the HRF 2 rack



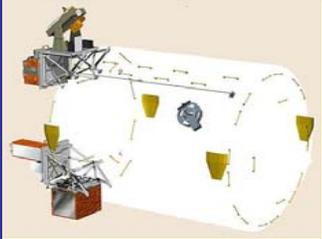
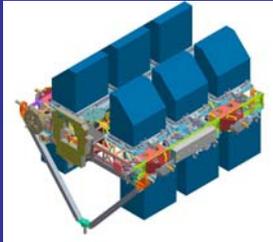
MARES

External Payload Accommodations Summary

At this time the NASA funded science program is projected to utilize approximately 33% of the external payload accommodations

- 8 external sites on the Express Logistics Carriers
 - 4 nadir sites available, 1 has planned use, 3 available for National Lab
 - 4 zenith sites available, 2 have planned use, 2 available for National Lab
- 5 external sites on the JEM EF
 - 2 have planned use, 3 available for National Lab
- 2 external sites on the Columbus EPF
 - 1 site currently in use, available in 2010 for National Lab
 - 1 site available for National Lab

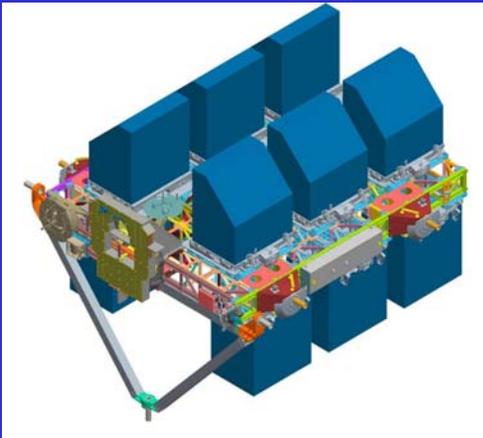
On-orbit External Payload Capability

Payload	2008	2009	2010	2011	2012	2013	2014	2015
 <p>Columbus External Facility</p>								
 <p>JEM External Facility</p>								
 <p>Express Logistics Carriers</p>								

- HTV transportation capability of at least 1 external payload per flight @ 500 kg each
- Future transportation capability in COTS vehicles under development

External Research Accommodations

ELC Single Adapter Resources



Mass capacity	227 kg (500 lb)
Volume	1 m ³
Power	750 W, 113 – 126 VDC; 500 W at 28 VDC per adapter
Thermal	Active heating, passive cooling
Low-rate data	1 Mbps (MIL-STD-1553)
Medium-rate data	6 Mbps (shared)
Sites available per ELC	2 sites
Total ELC sites available	8 sites

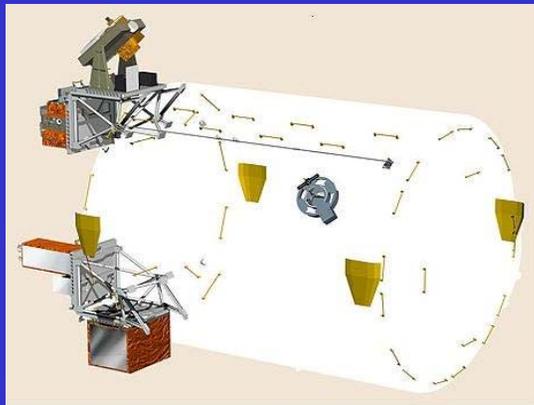
External Research Accommodations

JEM-EF Resources



Mass capacity	550 kg (1,150 lb) at standard site 2,250 kg (5,550 lb) at large site
Volume	1.5 m ³
Power	3-6 kW, 113 – 126 VDC
Thermal	3-6 kW cooling
Low-rate data	1 Mbps (MIL-STD-1553)
High-rate data	43 Mbps (shared)
Sites available to NASA	5 sites

Columbus External Resources



Mass capacity	230 kg (500 lb)
Volume	1 m ³
Power	2.5 kW total to carrier (shared)
Thermal	Passive
Low-rate data	1 Mbps (MIL-STD-1553)
Medium-rate data	2 Mbps (shared)
Sites available to NASA	2 sites

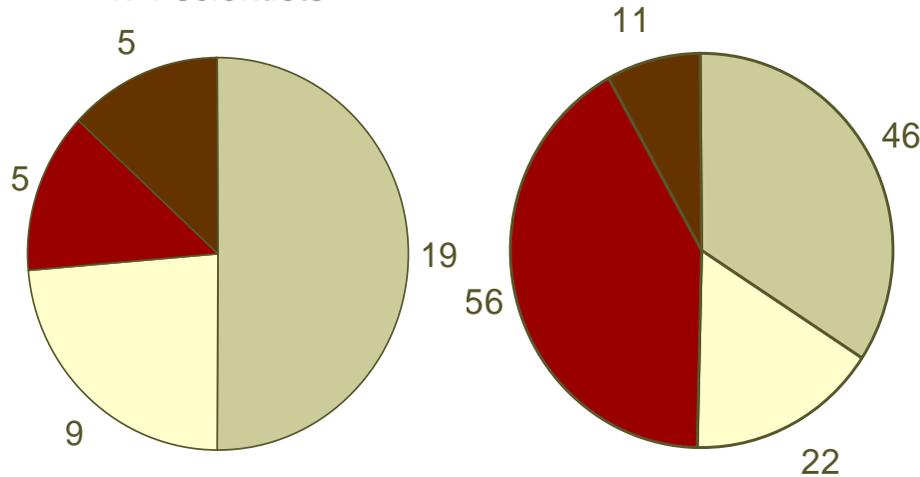
Expedition 0-16 Research Accomplishments

(September 2000 – April 2008)

- Expedition 16 (Oct 2007-Apr 2008)
 - 59 U.S.-integrated investigations
 - » 29 new investigations
 - » 10 completed investigations
 - » 21 International Partner investigations
- Expeditions 0 -16 (Sept 2000-Apr 2008)
 - 156 U.S.-integrated investigations
 - » 102 completed investigations
 - » 23 International Partner investigations

229 scientists

474 scientists

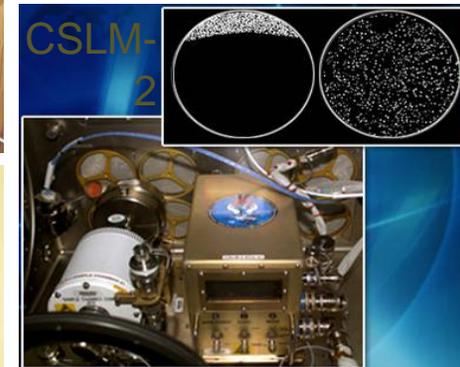


Expedition 16

Expeditions 0 - 16

Disciplines for U.S. Science

- Human Research and Countermeasure Development for Exploration
- Technology Development
- Physical and Biological Sciences in Microgravity
- Observing the Earth and Educational Activities

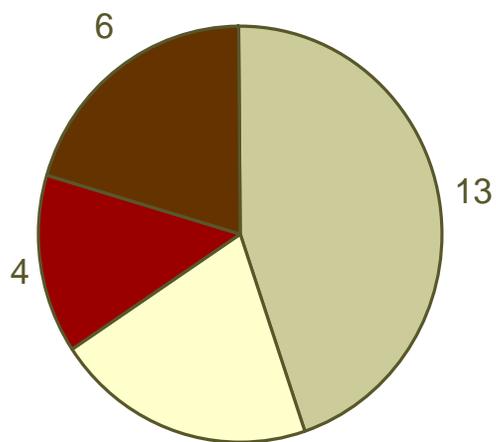


Expedition 17 Research Plans

(Apr 2008 – Oct 2008, data as of June 1, 2008)

- Expedition 17
 - 52 U.S.-integrated investigations
 - » 12 new investigations
 - » 8 reserve investigations
 - » 23 International Partner investigations
 - » *Kibo* module with 2 new research facilities

217 scientists



Expedition 17

Disciplines for U.S. Science

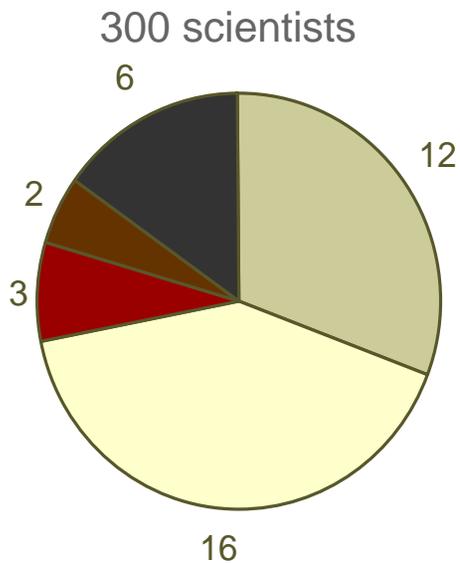
- Human Research and Countermeasure Development for Exploration
- Technology Development
- Physical and Biological Sciences in Microgravity
- Observing the Earth and Educational Activities



Expedition 18 Research Plans

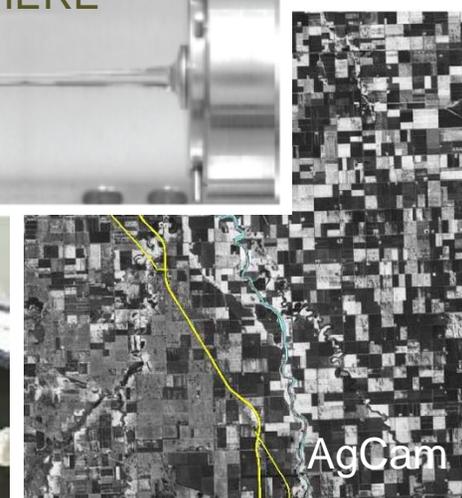
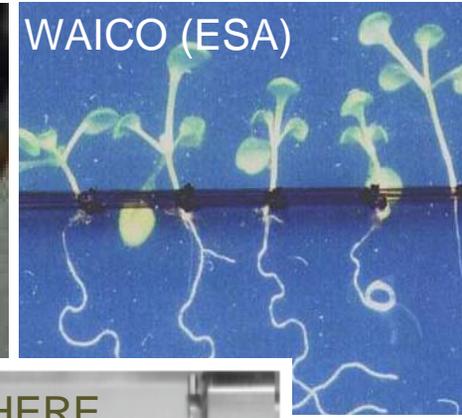
(Oct 2008 – Apr 2009, data as of June 30, 2008)

- Expedition 18
 - 95 U.S.-integrated investigations
 - » 13 new investigations
 - » 12 reserve investigations
 - » 56 International Partner investigations



Disciplines for U.S. Science

- Human Research for Exploration
- Technology Development
- Physical Sciences
- Biological Sciences
- Earth Observation & Education



DomeGENE (JAXA)

