

International Space Station

Overview

Research and On-Orbit Facilities

Non-Partner Participation



Rod Jones
NASA ISS Payloads Office
February 2011

International Space Station

Created by a partnership of 5 space agencies
representing 15 countries

10 years and over 30 missions to assemble

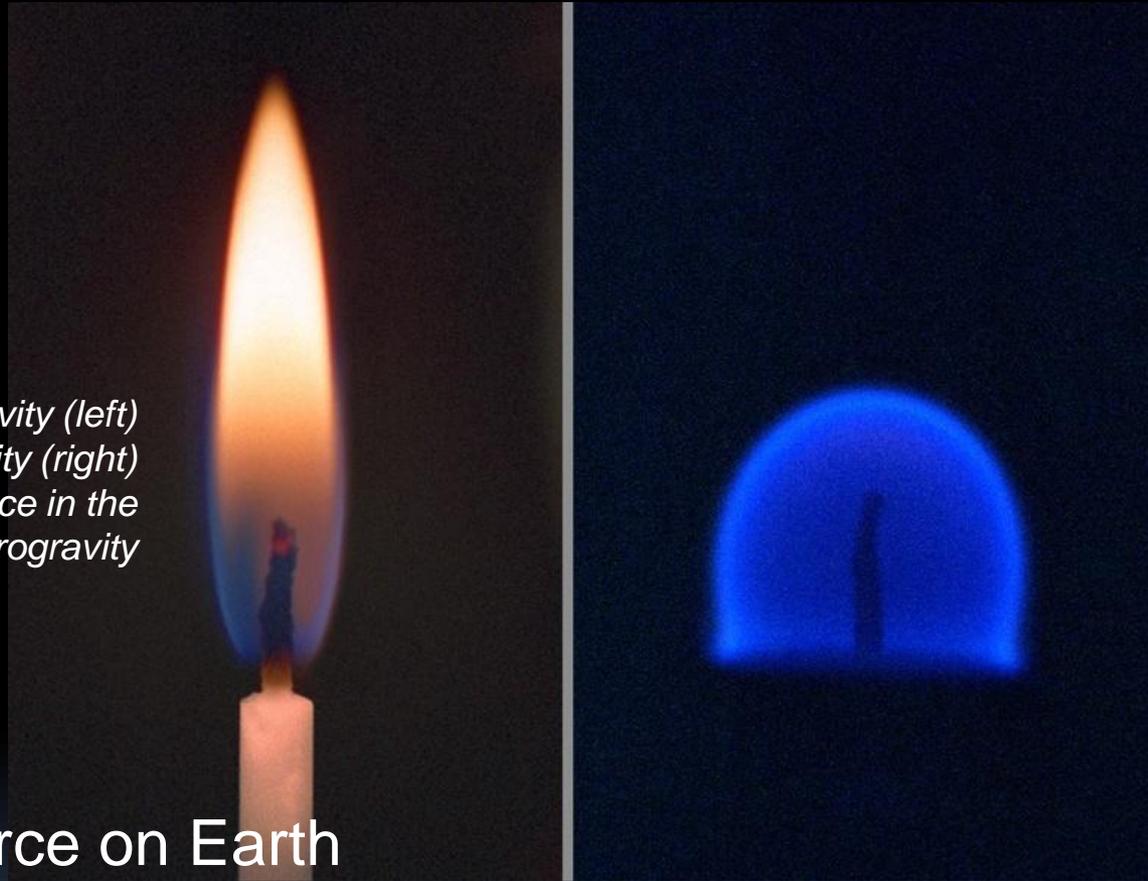


International Space Station Unique Features

- Robust, continuous, sustainable **microgravity** platform
- Continuous human presence in space
- Access to the ultra high vacuum of space
- 30kw steady state power for payloads
- Unique altitude for observation and testing
- Payload to orbit and return capability

Why **Microgravity** Research?

*A candle flame in Earth's gravity (left)
and microgravity (right)
showing the difference in the
processes of combustion in microgravity*

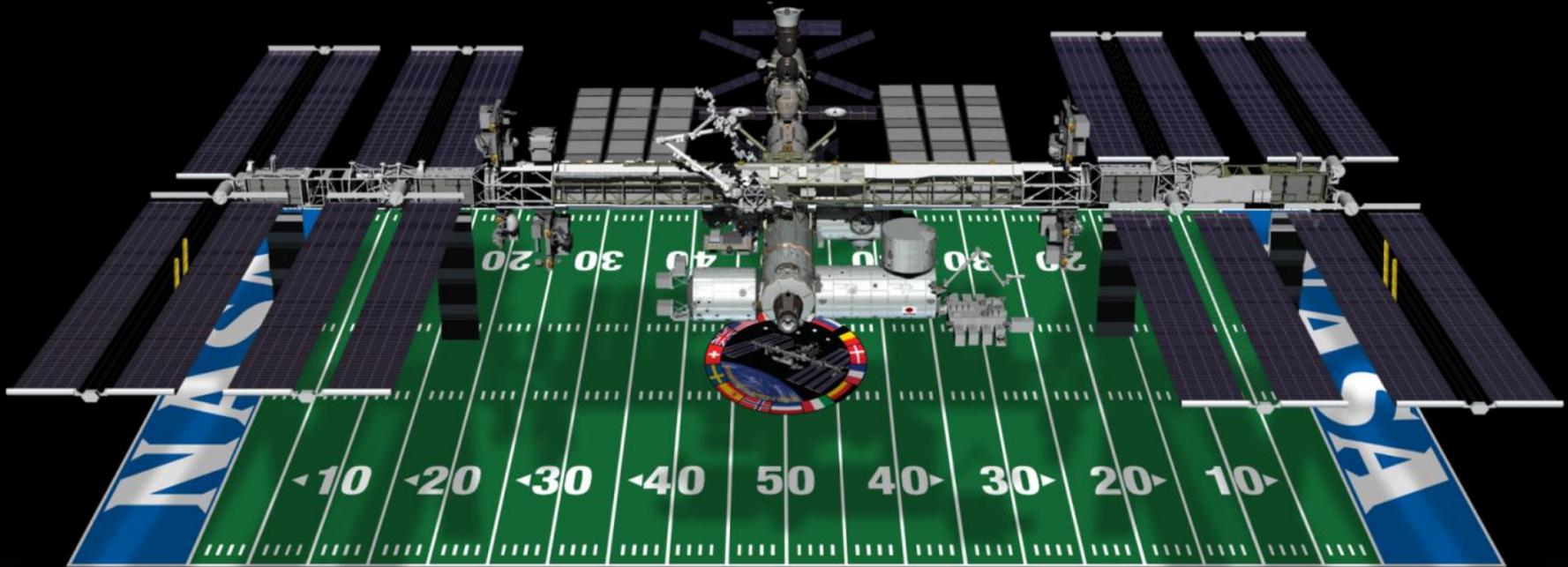


- Gravity is a constant force on Earth
- It cannot be completely controlled or removed in experiments
- It dominates and masks other forces in processes
- The ISS provides a laboratory environment to control this force

International Space Station Key Features

- Supports both external and internal research
- Automated, human, and robotic operated research
- Exposure to the thermosphere
- Nearly continuous data and communication link to anywhere in the world
- Modularity and maintainability built into the design ensures mission life, allows life extension, vehicle evolution and technology upgrades

International Space Station Facts



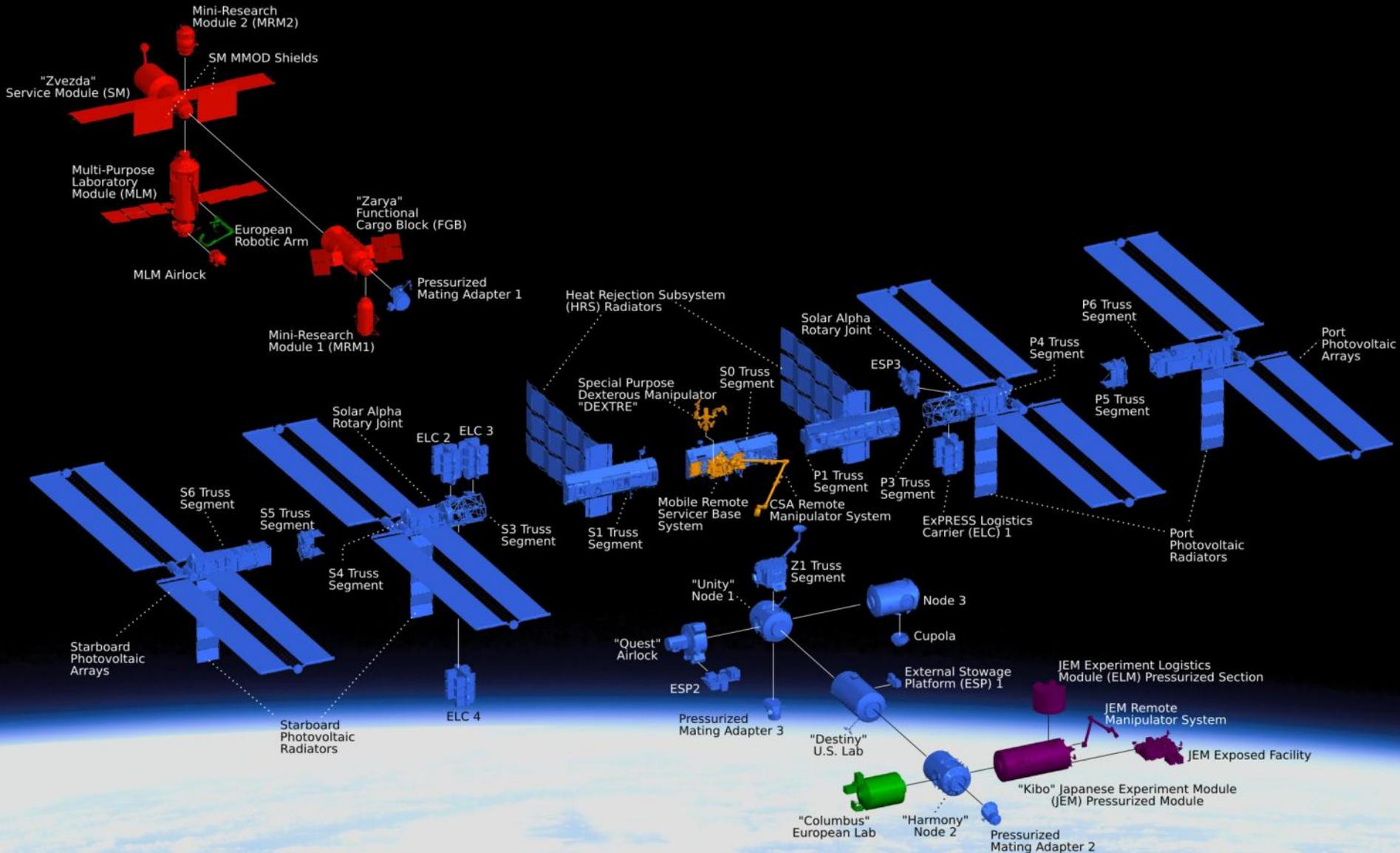
Spacecraft Mass: +800,000 lb (+362,874 kg)

Velocity: 17,500 mph (28,200 kph)

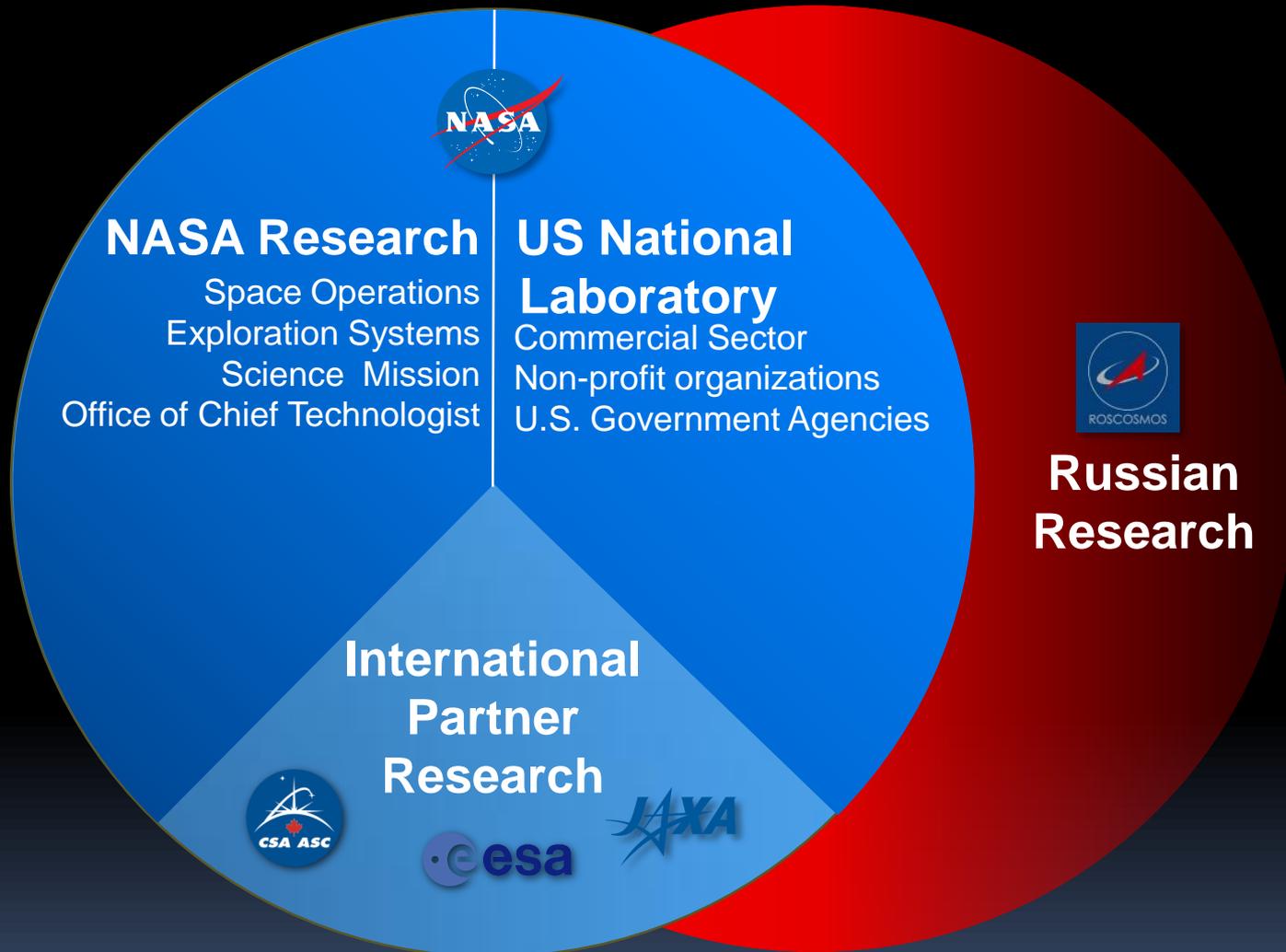
Altitude: 220 miles above Earth

Power: 80 kW continuous

A collaboration of 5 space agencies



Research Resources on ISS

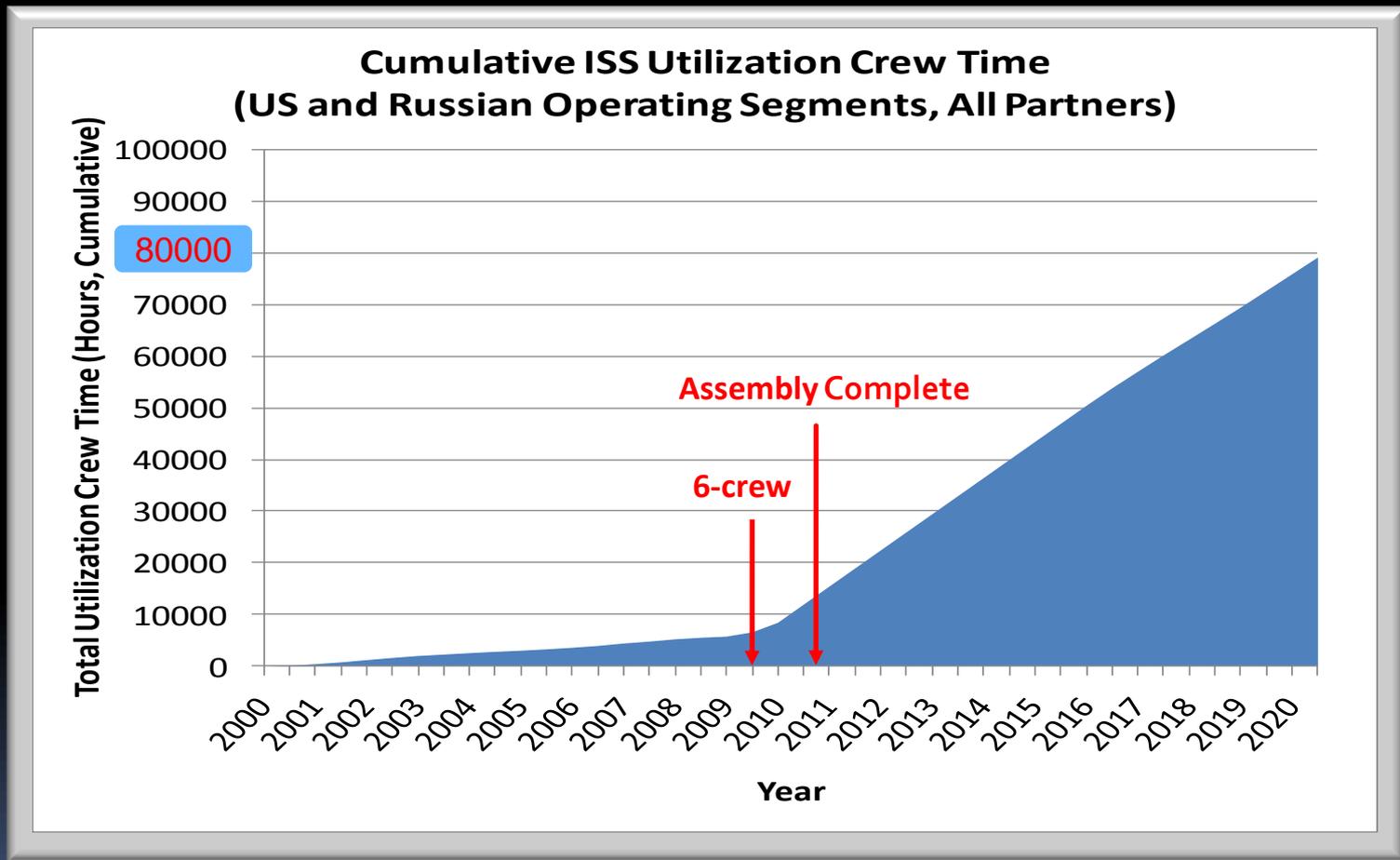


*Biology and Biotechnology, Earth and Space Science,
Educational Activities, Human Research,
Physical & Material Sciences, Technology Demonstration*

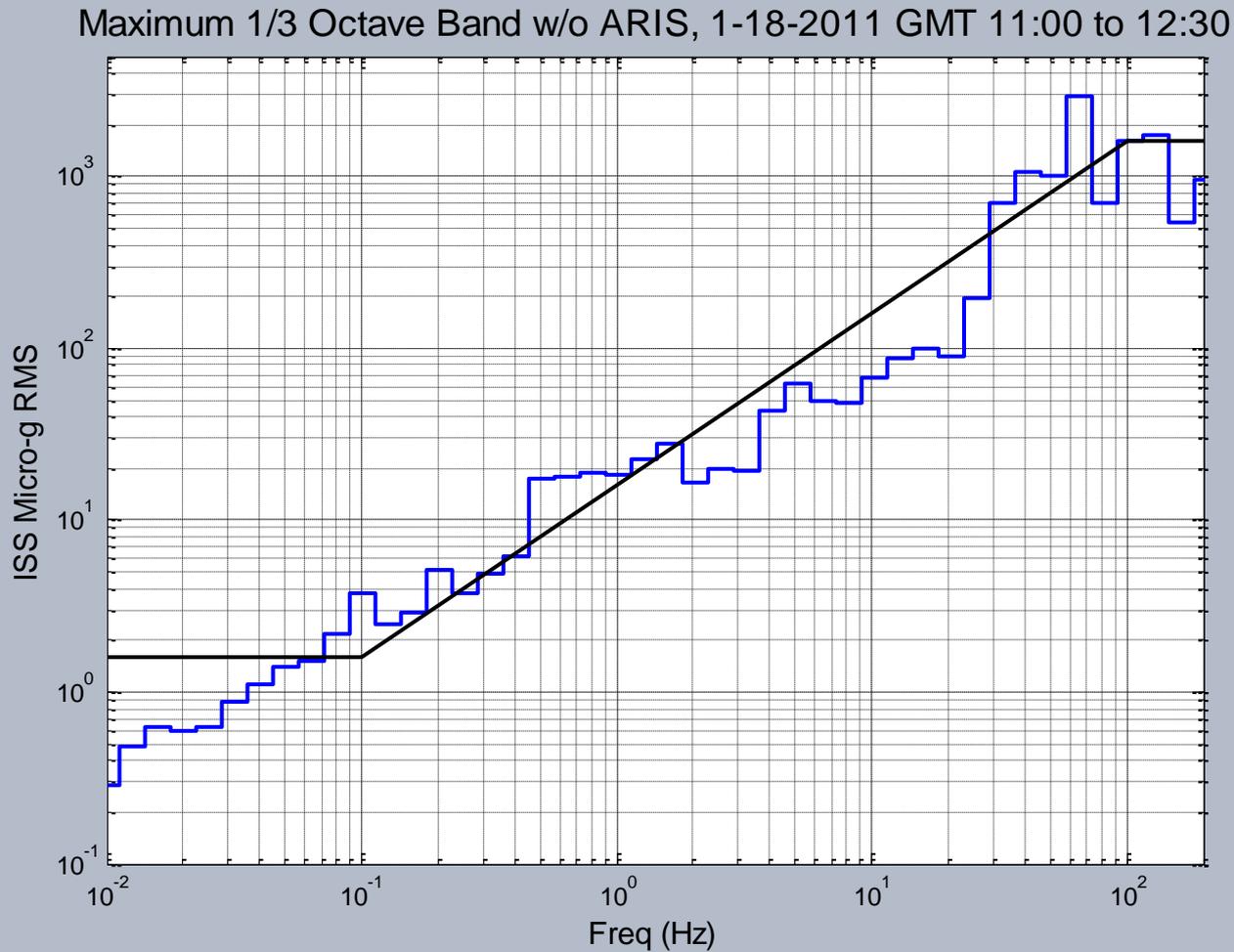
On Orbit Payload Resources

Power	30kw average
Air to Ground Data	~37.5 Mbps of video (3 lines of video at 12.5 Mbps each)
	~8 Mbps of MRDL data (Science return)
	~5 Mbps for payload still imagery downlink
	~20 Mbps utilized for payload data recorded over LOS
Internal Payload Racks	13 NASA Lab
	11 ESA Lab
	10 JAXA Lab
External Sites	8 NASA Truss ELC Platform Sites
	10 JAXA Platform Sites
	4 ESA Platform Sites
Crew time	35 hrs per week (average)

Human Operated Research



Internal Microgravity Environment

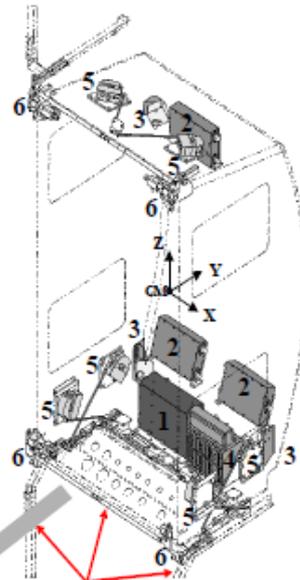


*On-board sensors monitor perturbations to the microgravity state
Maximum over 1.5 hours, SARJ Rotating, 6 crew*

Microgravity Environment

Active Rack Isolation System

- 1 → Dual Processor
- 2 → 3 Sensor Electronic Units
- 3 → Accelerometer Heads
- 4 → 8 Actuator Drivers
- 5 → 8 Actuators
- 5 → 8 Position Sensors
- 6 → Hard stop Bumpers



STATION UMBILICAL
STANDOFF STRUCTURE



ARIS Umbilical Set

- ARIS is the primary rack-level ISS vibration isolation system.
- ARIS umbilical system allows Station resources (power, low temperature water etc.) to be passed to the rack.
- Three triaxial accelerometer heads sense rack acceleration.
- Eight voice coil actuator driven pushrods used for actuation.
- Eight position sensors integrated in actuator housing.

ARIS Active Isolation Mode Control Architecture

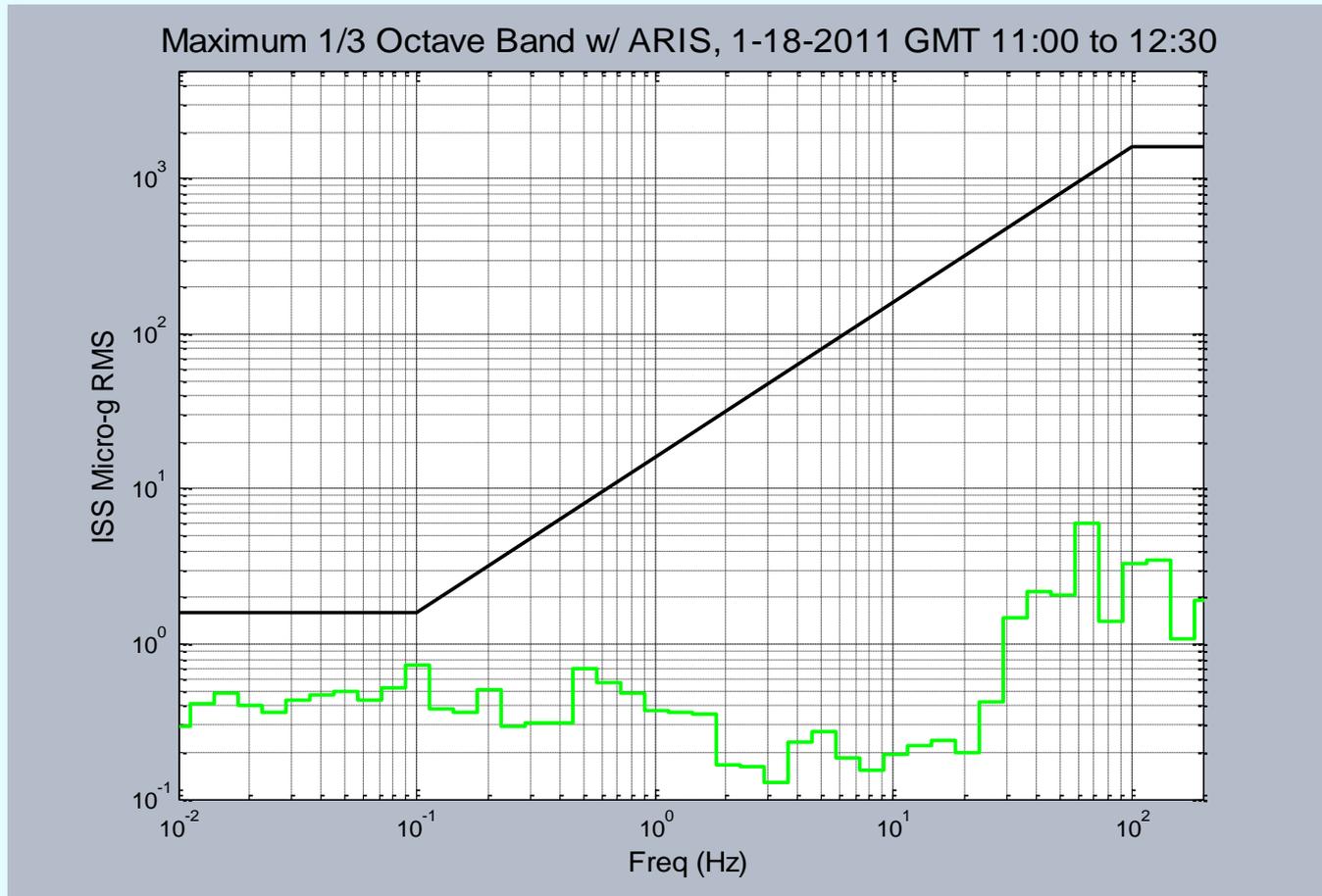
- **Low Bandwidth Position Loop (< 0.01 Hz):**
 - Rack Centering
- **Higher Frequency Acceleration Loop (< 7 Hz):**
 - Active Vibration Isolation
- **Antibump Outer Loop:**
 - Accelerate/Decelerate rack if bumping is imminent.

ARIS Modeling

- Rack Mass and Umbilical Stiffness Modeling
- Actuator Dynamics Modeling
- Umbilical Dynamics Modeling
- Rack Structural Dynamic Modeling
- Bumper Models

Internal Microgravity Environment

Rack with ARIS active



Active Rack Isolation System is effective even during crew exercise

Internal Research Accommodations

Architecture based on **Modular** racks

Modularity = maintainable, reconfigurable,
interchangeable between ESA, JAXA, NASA



ISS Fly through from the JAXA module to the Russian Service Module



Research Facilities and Capabilities

Multi Purpose Research Facilities

Physical & Material Sciences

Biology and Biotechnology

Human Research

Earth and Space Science

Technology Test Beds

Robotics

Communication and Ground Control

Transportation



Minus Eighty-degree Laboratory Freezer for ISS

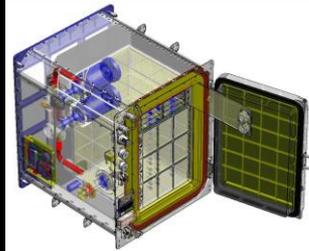
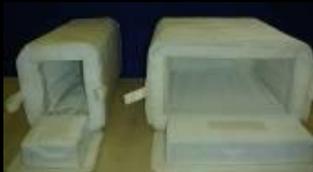
(MELFI)



*Provides thermal conditioning at
+4°C, -26°C and -80°C for sample (blood, urine,
tissue, etc) preservation
3 Units on-orbit*

Cold Stowage Accommodations



	MELFI 	MERLIN 	GLACIER 	Single and Double Cold bag with ICEPAC's 
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

Material Science Glove Box



Provides a safe environment for research with liquids, combustion, and hazardous materials

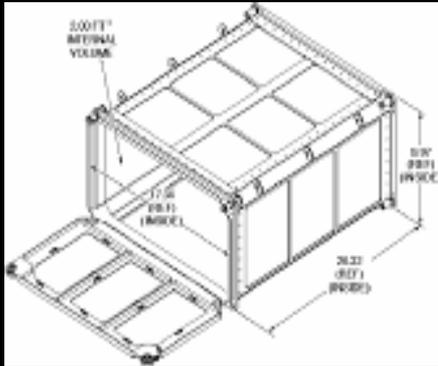
Being modified to support Biology and Bio-technology

ExPRESS Racks



(Expedite the Processing of Experiments for Space Station)

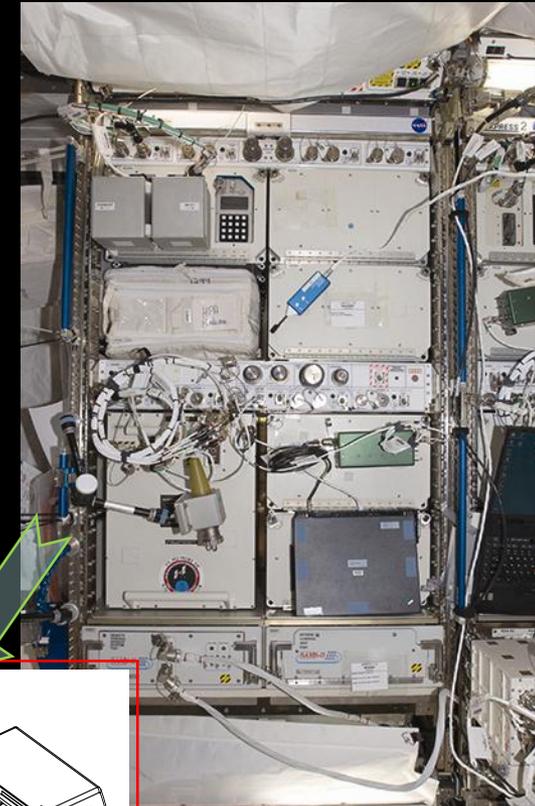
Middeck Locker



Features

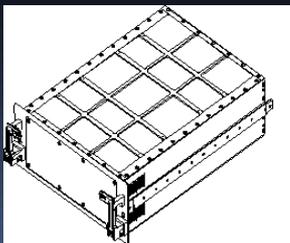
- 4 rear captive fastener attachments
- Friction hinge
- Dual door locks
- Installation tool guides on 4 corners
- Weight – 12 lbs

Sub Rack size payload capability with standard utilities such as power, data, cooling and gases



ExPRESS Rack

International Sub rack Interface Standard Drawer



Features

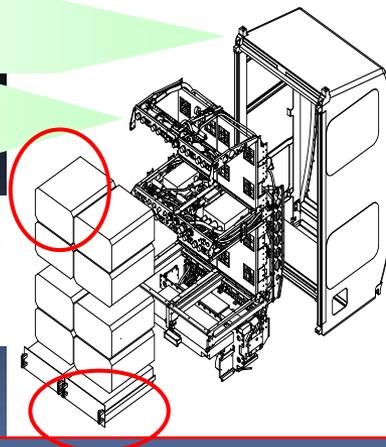
- 4 PU (Panel Unit)
- Blind Connectors
- Locking Handles
- Weight – 27 lbs
- Rated to at least 37

EXPRESS 8/2 Configuration

International Standard Payload Rack

Secondary Structure & Subsystems

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

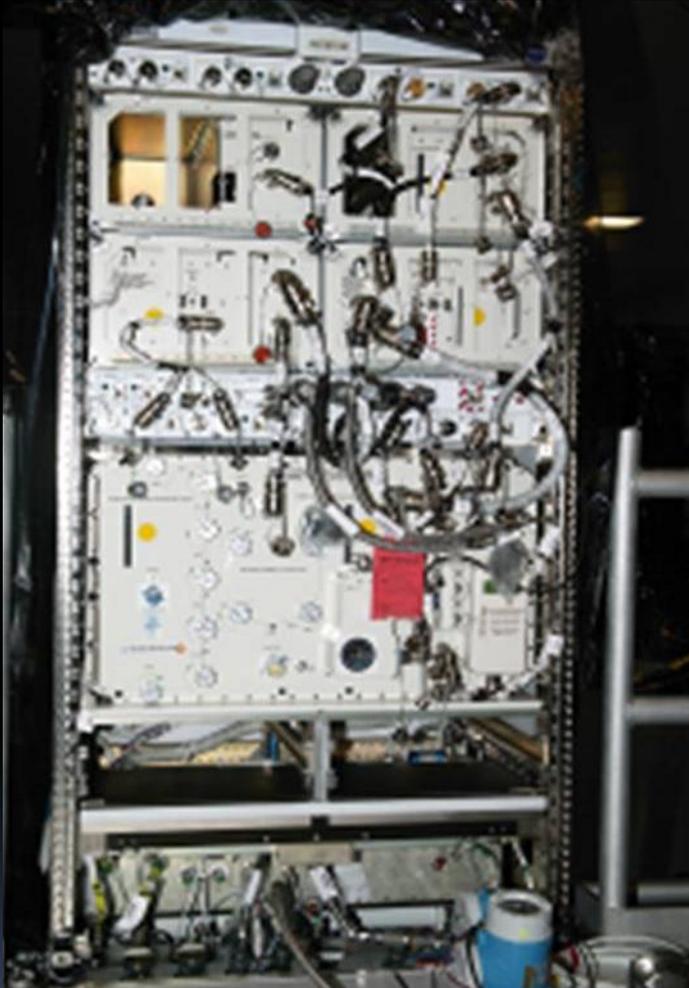


EXPRESS Rack Resources

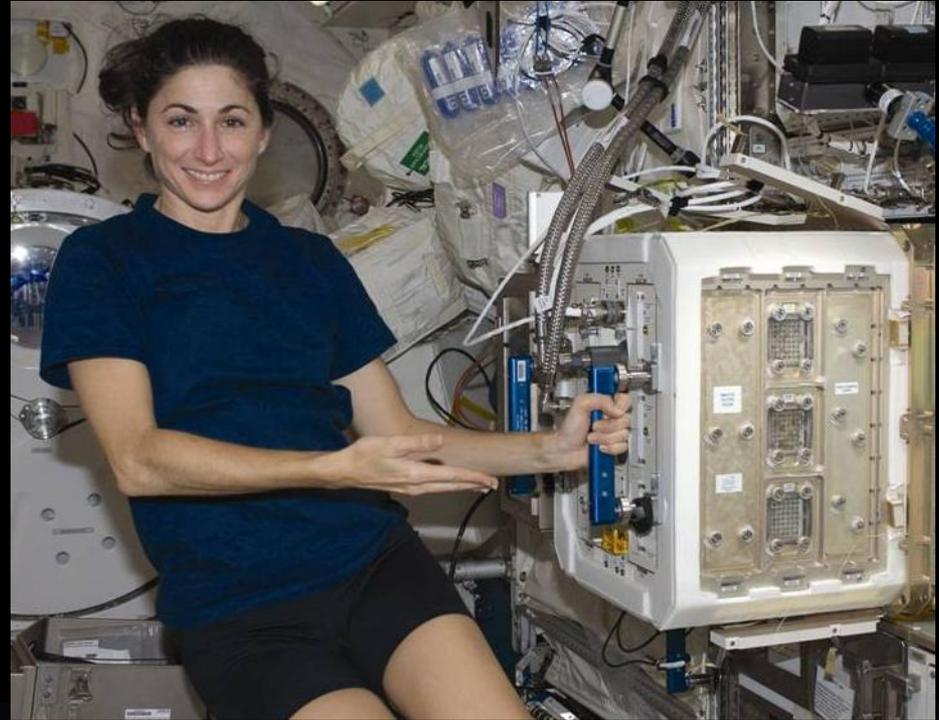
(Expedite the Processing of Experiments for Space Station)

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

ExPRESS Sub Rack Payloads



**Space Dynamically Responding
Ultrasound Matrix System
(SpaceDRUMS)**



ASI Mouse Drawer System (MDS)
Supported 6 mice on orbit for 90 days

ExPRESS Sub Rack Payloads



ABRS
*Advanced Biological
Research System*



Two growth chambers; each chamber is a closed system capable of independently controlling temperature, illumination, and atmospheric composition to grow a variety of biological organisms.

Cube Lab Sub-locker Payload

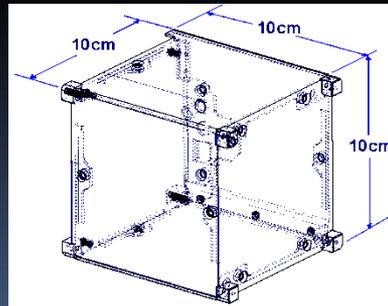
SCIENCE TEAM: NANORACKS, LLC

RESEARCH OBJECTIVES:

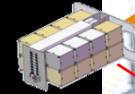
Cube Lab is a multipurpose research facility consisting of CubeSat platform experiment modules (Cube Lab Modules) and Cube Lab Frames. Three Cube Lab Frames are being installed as EXPRESS Rack inserts to supply power and USB data transfer capability for Cube Lab Modules on ISS. The Frames are made to house up to 16 standard-sized Cube Lab Modules (1 CU size = 10cmx10cmx10cm).

Each Cube Lab Module has different educational or industrial researcher(s). Each Module plugged into a Frame can provide USB data file transfer capability if an experiment requires it. The transfer is conducted with the Module plugged-into a Frame and use of a temporary Cube Lab Data Cable connection between the FRAME and an EXPRESS Laptop Computer. The Modules also come in multiples of the 1CU size: 4 CU = 40cmx10cmx10cm and 8 CU= 40cmx10cmx20cm.

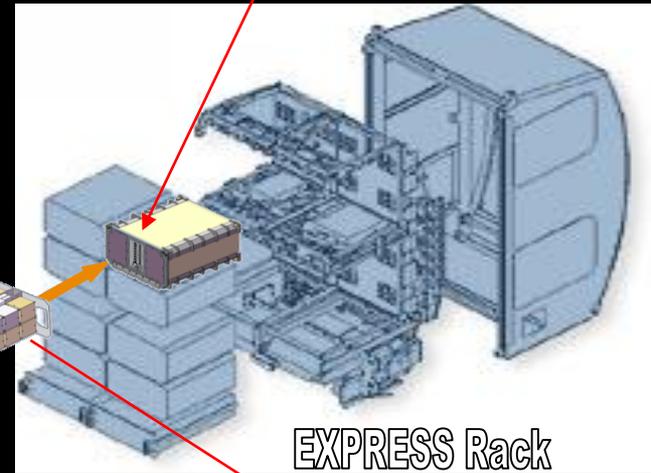
Cube Lab Module



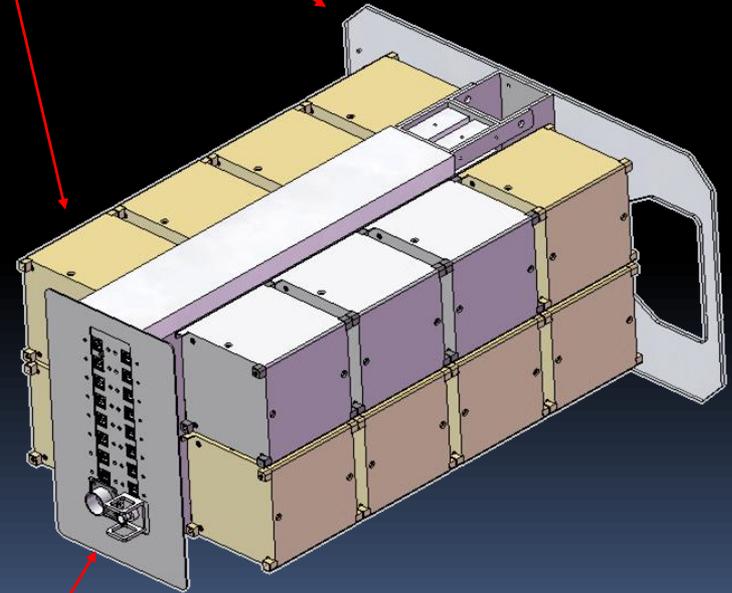
Cube Lab
Frame with
16 Cube Lab
Modules



EXPRESS Rack
Locker



EXPRESS Rack



Cube Lab Frame

ExPRESS Racks



ExPRESS 1
US Lab



ExPRESS 2
US Lab



ExPRESS 3
Columbus



ExPRESS 4
JEM



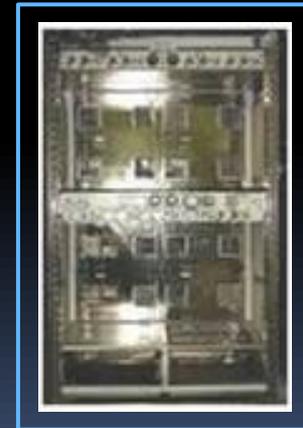
ExPRESS 5
JEM



ExPRESS 6
US Lab



ExPRESS 7
US Lab



ExPRESS 8
US Lab
Launching on ULF-5

European Drawer Rack (EDR)

A multidiscipline facility to support up to seven experiment modules. Each module has its own cooling, power, data, communications, vacuum, venting and nitrogen supply.

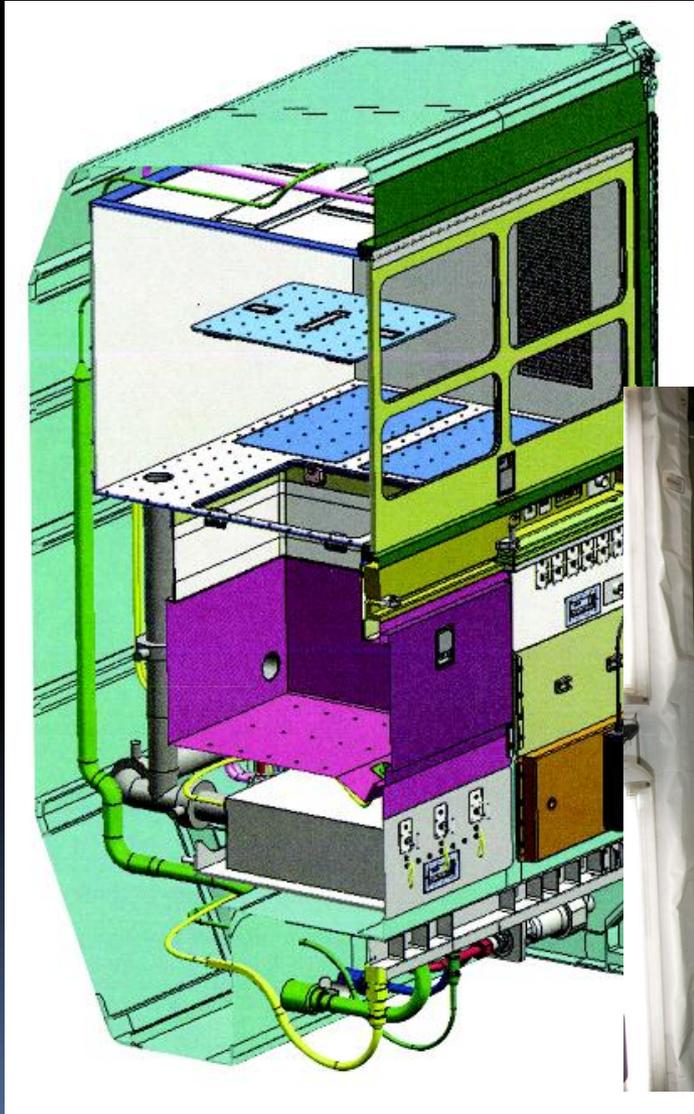


Multipurpose Small Payload Rack

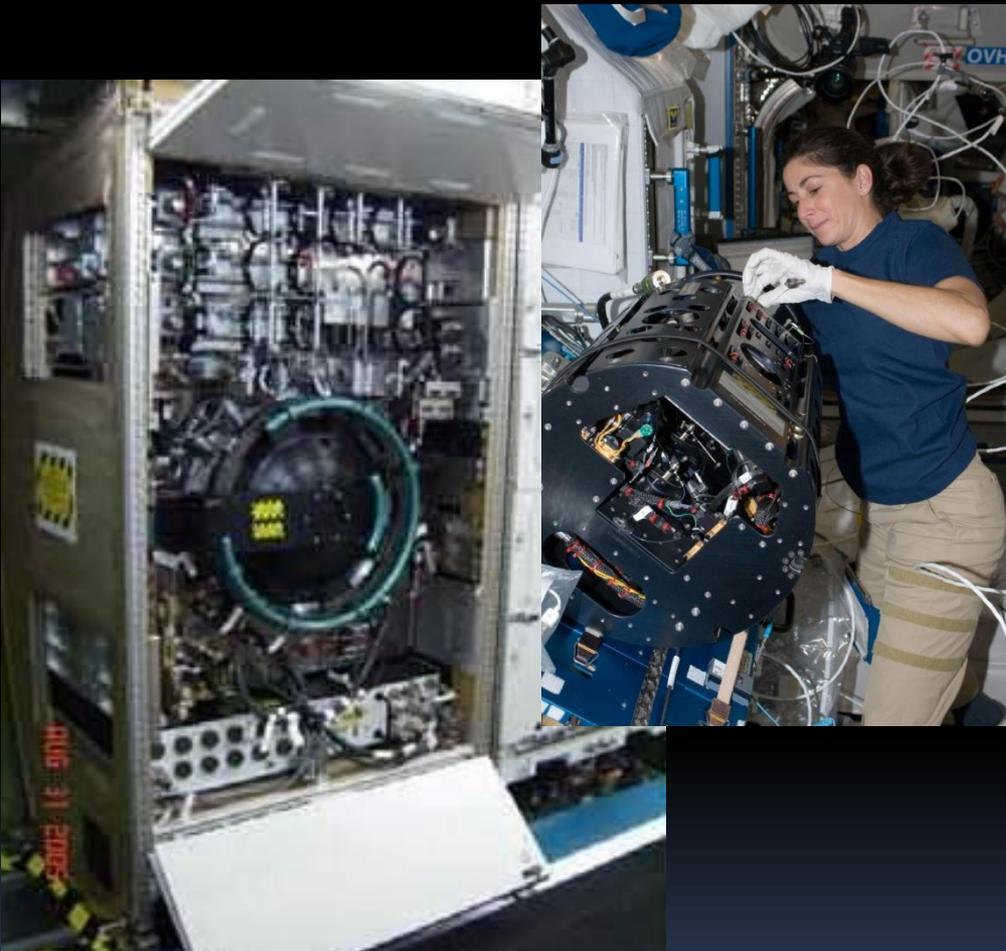


(MSPR)

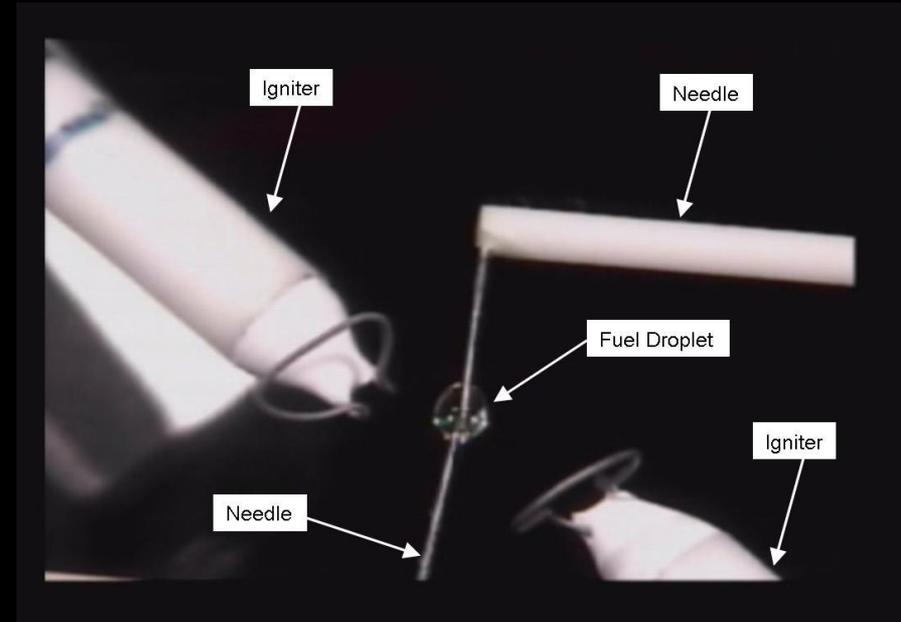
A multidiscipline facility that provides two workspaces and one work bench and can hold equipment, supplies power and enables communication and video. MSPR just arrived on orbit aboard HTV2. A second rack is planned for HTV5.



Combustion Integrated Rack (CIR)



Facility used to perform sustained, systematic combustion experiments in microgravity



Sample during combustion

Materials Science Research Rack-1

(MSRR-1)



ESA Provides the
furnace 's and
sample cartridges



NASA Provides the
rack and on-orbit
space



*Solidification and Quenching Furnace in the
ESA Material Science Laboratory (MSL)*

*MICAST = Microstructure Formation in
Casting of Technical Alloys under Diffusive
and Magnetically Controlled Convective
Conditions
Studies formation of microstructures during
casting of technical alloys*

Investigations selected from both agencies

Ryutai Fluids Experiment Rack



A multipurpose rack system that supports various fluid physics experiments. It consists of four sub rack facilities:

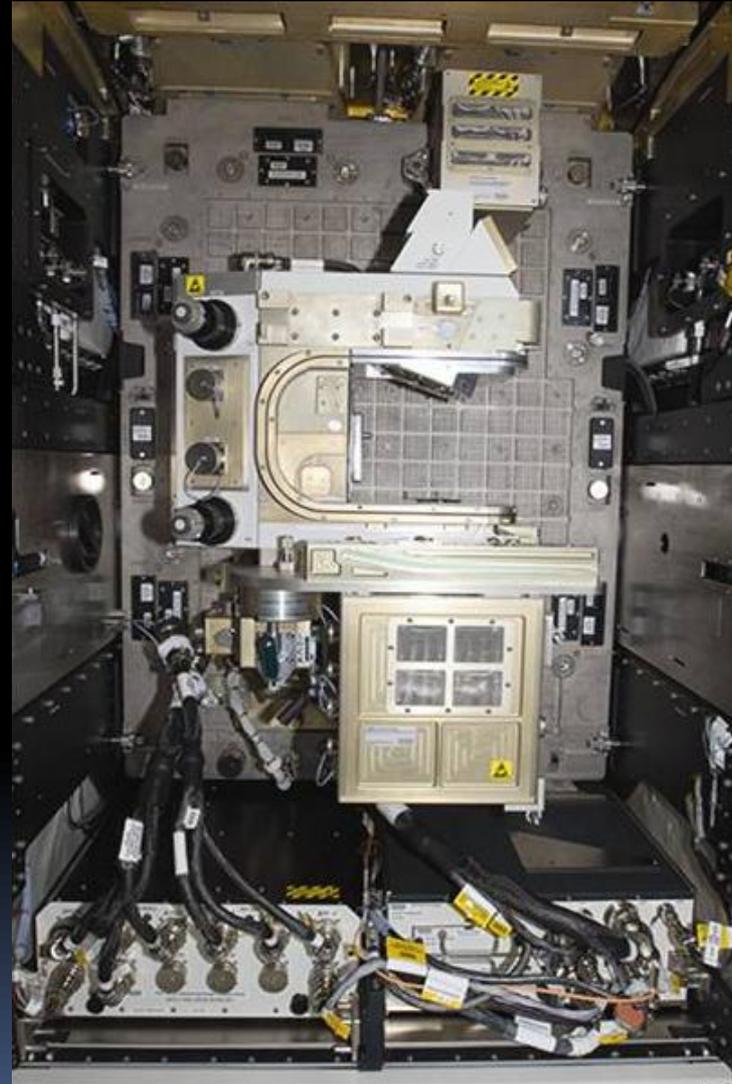
- Fluid Physics Experiment*
- Solution Crystallization Observation*
- Protein Crystallization Research*
- Image Processing Unit*



Fluids Integrated Rack (FIR)



A fluid physics research facility designed to accommodate a wide variety of microgravity experiments dedicated to fluid physics research, with Light Microscope Module

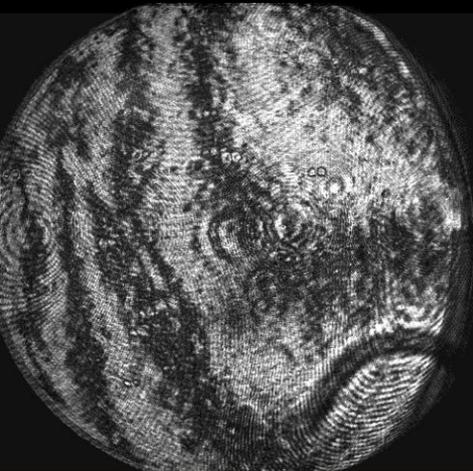
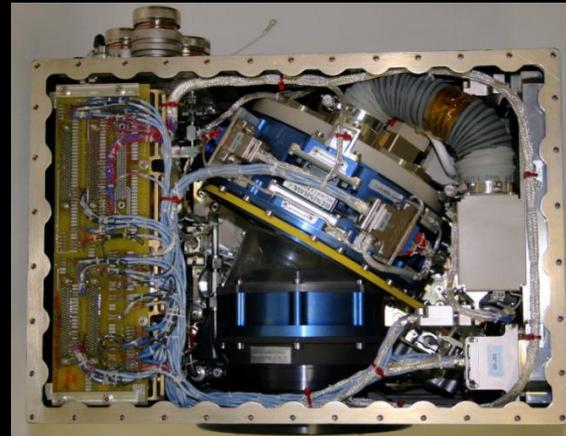


Fluid Science Laboratory (FSL)



Multi user facility for conducting fluid physics research in microgravity

Geoflow
Simulation of Geophysical Fluid Flow Under Microgravity



This interferogram is used to calculate the temperature field analyzing the "bulls-eye" (fringe) patterns. Geoflow studies thermally driven rotating fluids which can be used in modeling the convection of the Earth. Image courtesy of ESA

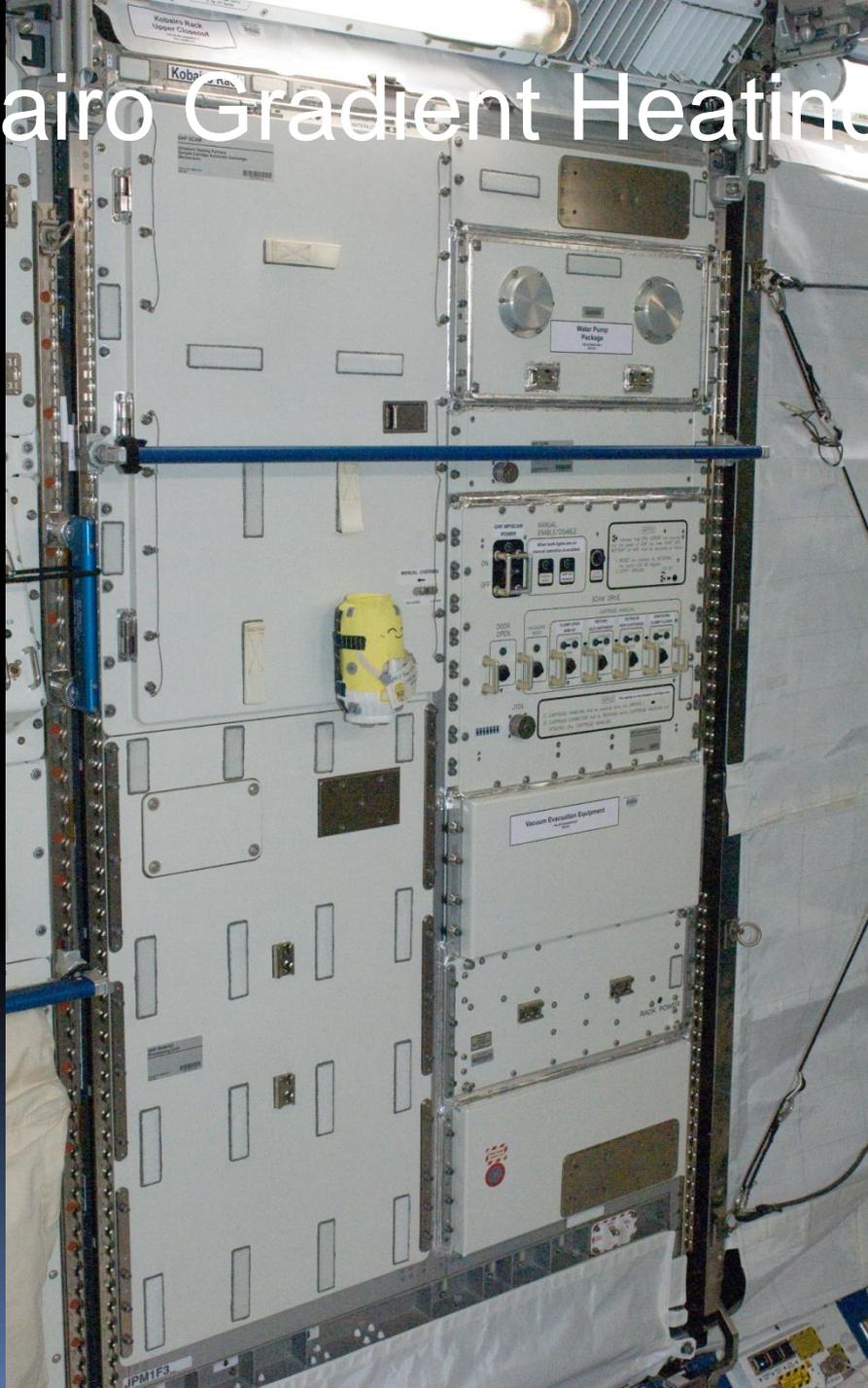
Saibo Experiment Rack



*A multipurpose
Biological Research
payload rack system that
sustains life science
experiment units and supplies
resources to them.
It contains a clean bench,
glove box with microscope
incubators
and centrifuge.*



Kobairo Gradient Heating Furnace



An electrical furnace used for generating high-quality crystals from melting material. It consists of a vacuum chamber and three independently movable heaters. Kobairo just arrived on orbit aboard HTV2.

Biological Experiment Laboratory (BioLab)



Used to perform space biology experiments on microorganisms, cells, tissue cultures, small plants, and small invertebrates. It includes a incubator with microscope, spectrophotometer, and two centrifuges, glove box and two cooler/freezer units.



Human Research Facility (HRF)



HRF-1 Rack



HRF-2 Rack



Ultrasound

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

European Physiology Module *(EPM)*



Designed for investigating the effects of microgravity on short-term and long-duration space flights on the human body and includes equipment for studies in neuroscience, cardiovascular, bone, muscle physiology and metabolic processes.



Exercise Device's

Russian Treadmill



CEVIS
Cycle Ergometer with
Vibration Isolation System

COLBERT
Combined Operational
Load Bearing Exercise
Treadmill

Russian
Cycle Ergometer

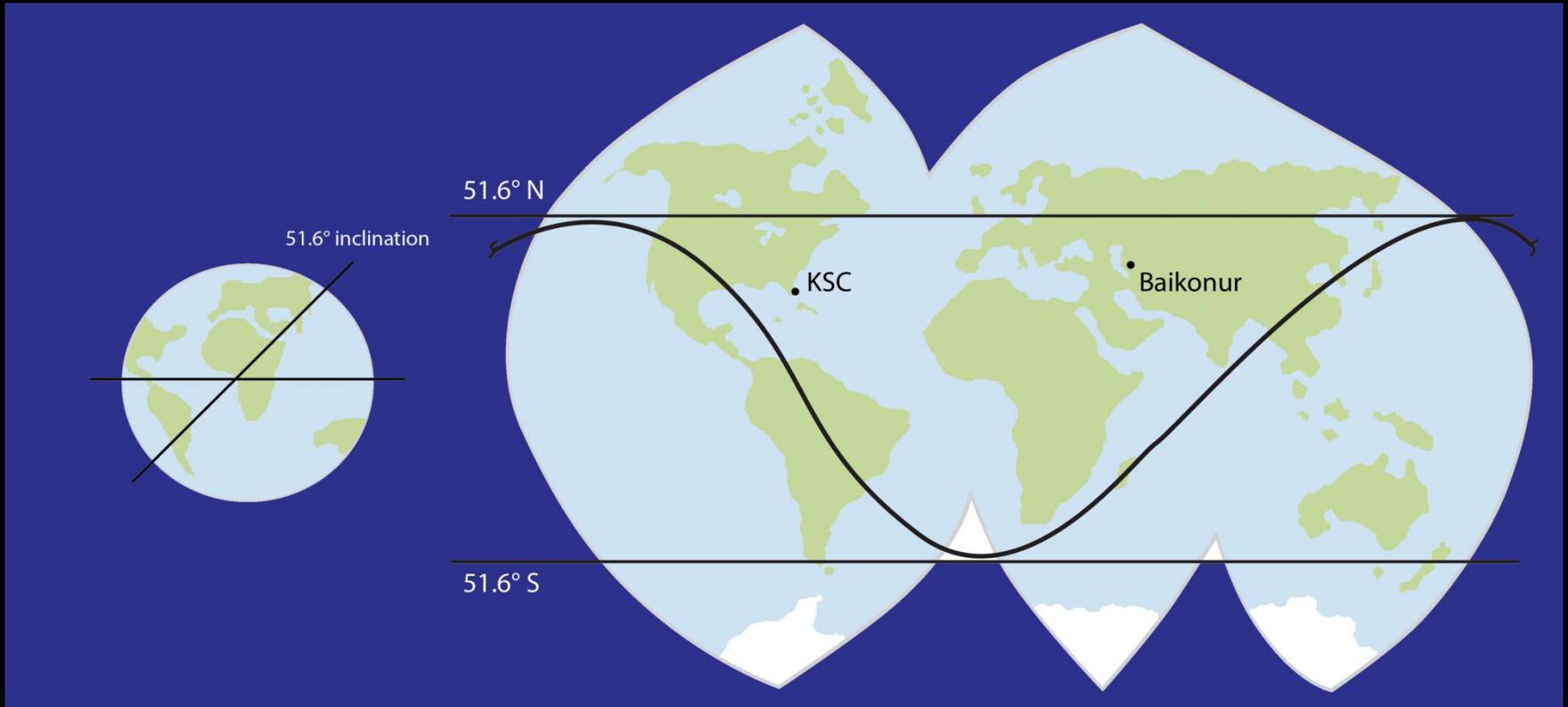
ARED
Advanced Resistance
Exercise Device

Earth and Space Science



- Space, Earth surface and Limb views
- External and Internal Payload sites
- Observation of transient atmospheric phenomena
- Planetary science sensor test beds

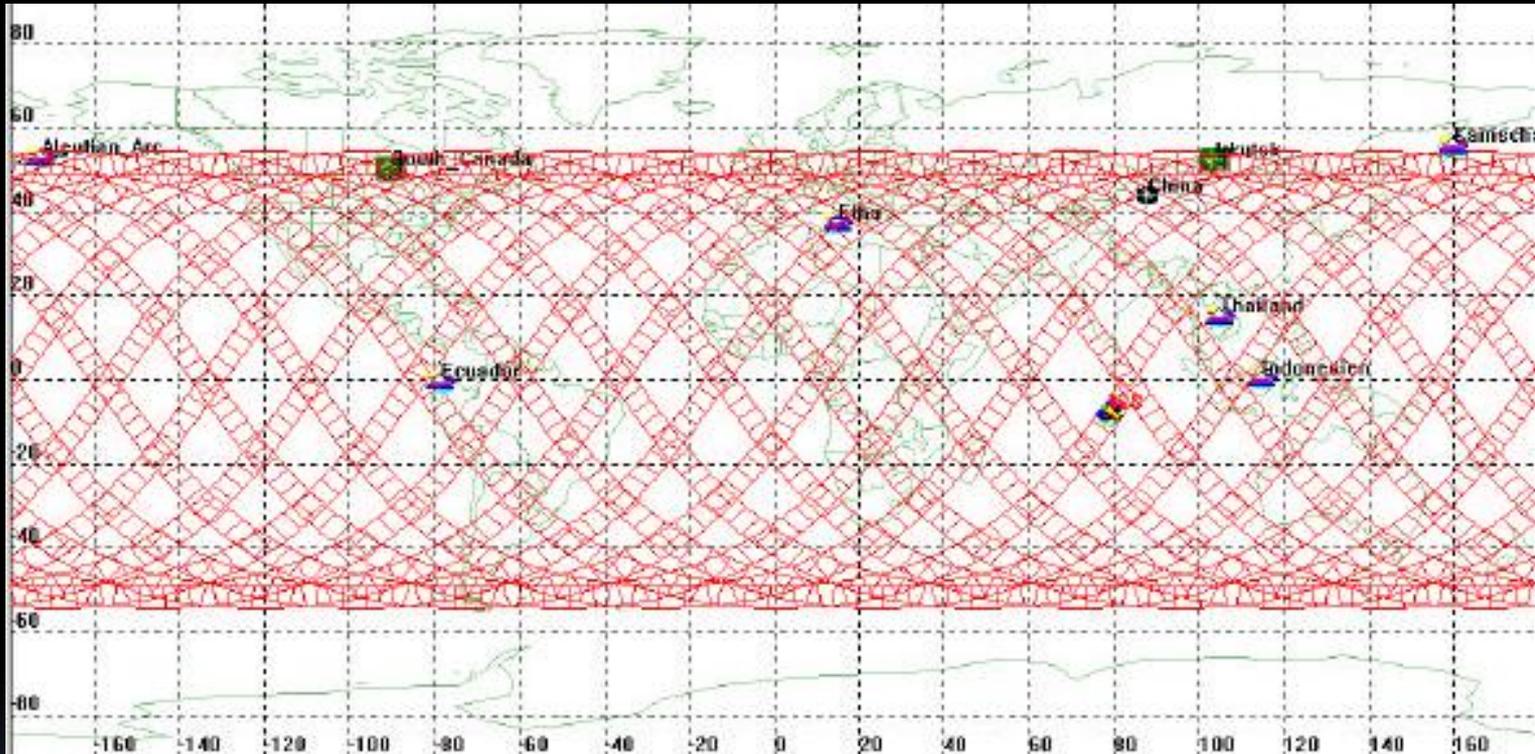
ISS as a Platform for Earth Science



All geographic locations between 51.6 North and South latitude
can be observed NADIR pointing

Provides coverage of 85% of the Earth's surface and 95% of the
world's populated landmass every 1-3 days

ISS as a Platform for Earth Science



ISS coverage in 24 hrs for a 70°-swath optical payload. (Courtesy of ESA)

Processing lighting (changes with subsequent passes)

Well-suited for test bed concepts with hardware
change out and upgrades

ISS as a Observation Platform

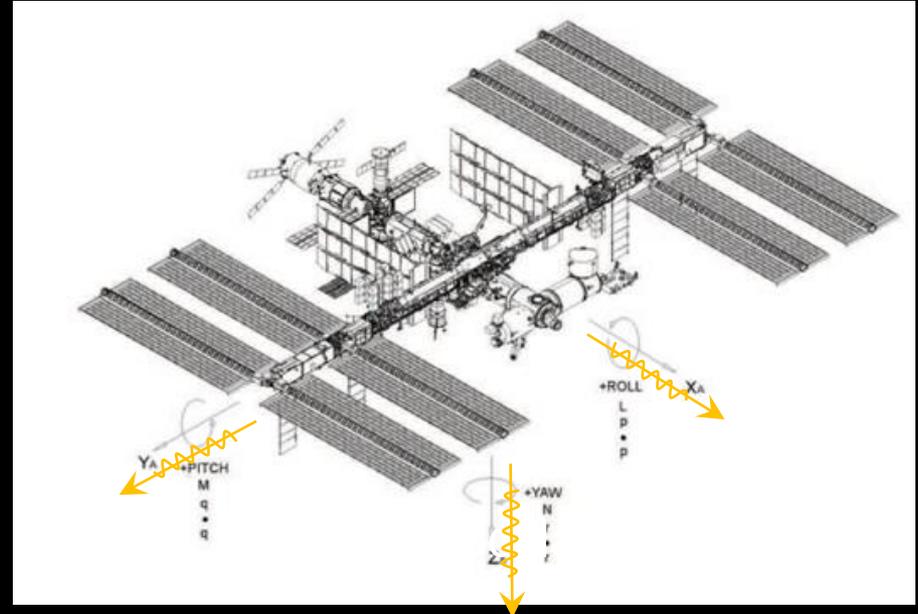
Torque Equilibrium Attitude (TEA) and Wobble Oscillation Description

For Stage configurations in the foreseeable future, the predicted TEA ranges are:

Roll: $-1.0 \sim +3.0$ deg

Pitch: $-7.0 \sim +2.0$ deg

Yaw: $-15 \sim +15$ deg.



Momentum Manager Controller Peak to Peak Attitude Wobble Oscillation

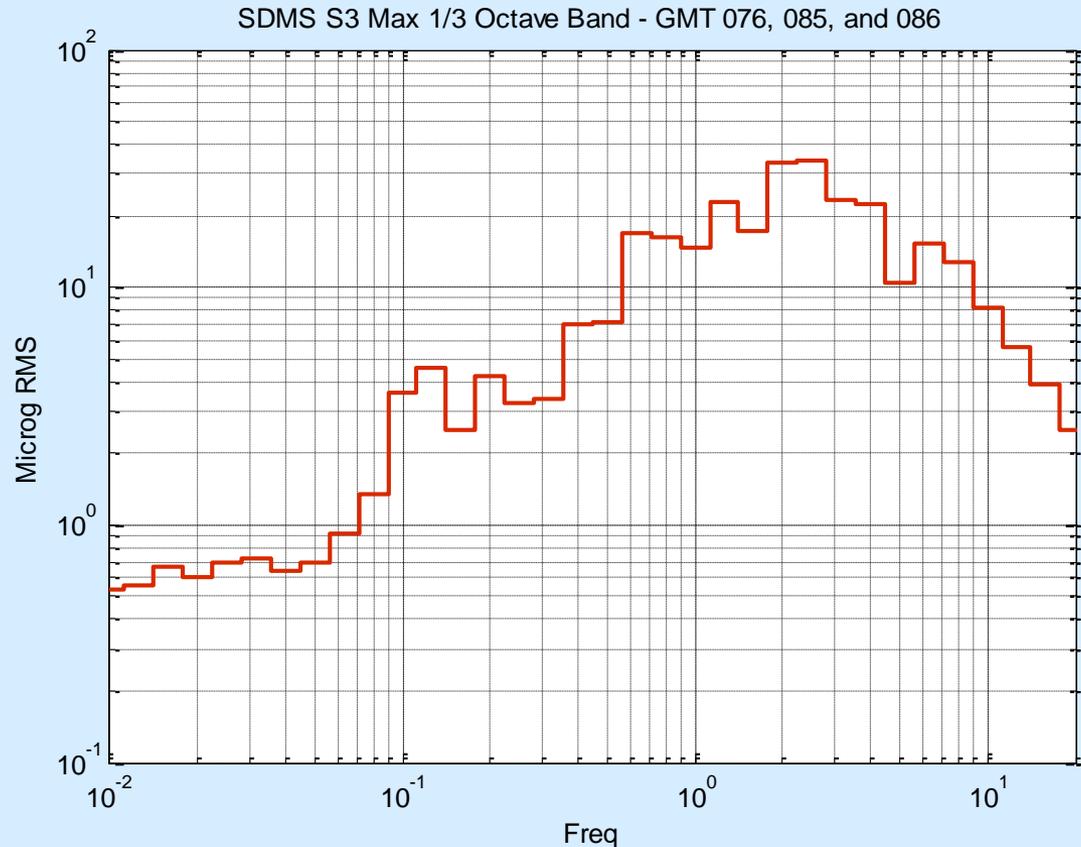
Performance Descriptions	Peak to Peak Attitude Oscillations Per Orbit			Peak Attitude Variation from Steady-State Orbit-Average Attitude		
	Roll (X) (deg)	Pitch (Y) (deg)	Yaw (Z) (deg)	Roll (X) (deg)	Pitch (Y) (deg)	Yaw (Z) (deg)
Non-Micro-Gravity (Assembly Stages) Non-Propulsive (Momentum Manager) Attitude Control Performance Requirement	10.0	10.0	10.0	+/- 5	+/- 5	+/- 5
Micro-Gravity (Assembly Complete) Non-Propulsive (Momentum Manager) Attitude Control Performance Requirement	7.0	7.0	7.0	+/- 3.5	+/- 3.5	+/- 3.5
Typical Steady-State Performance of Minimum CMG momentum oscillation Momentum Manager Controller	1.6	1.6	2.0	+/- 0.8	+/- 0.8	+/- 1
Typical Steady-State Performance of Minimum Attitude oscillation Momentum Manager Controller	1.6	0.4	0.2	+/- 0.8	+/- 0.2	+/- 0.1
Typical Steady-State Performance of Minimum CMG momentum & Attitude oscillation Blended Momentum Manager Controller	1.6	0.7	1.2	+/- 0.8	+/- 0.35	+/- 0.6

ISS External Vibratory Environment

for External Payload Pointing Instrument

Data measured on
ISS S3 truss

- ISS quiescent mode = No thruster firings, dockings, EVA, or robotics operations
- Typical response, not worst case
- Snapshot of 3 10-minute data takes
- All data taken on March 16, 26, and 27, Stbd SARJ Rotating, exercise, 3 crew.



Data provided by Boeing, June 2010

ULF-4 analysis concluded peak ELC rotations on the order of 0.03 degrees during quiescent mode

Windows on the Earth

Service Module Window
40-cm diameter
NADIR view



Window Observation Research Facility

(WORF)



US Laboratory Window
50-cm diameter
Telescope-quality optical glass
NADIR view



WORF Rack

Facility to support visual and multispectral remote sensing using Lab Optical Window

Crew Earth Observation



Targets of opportunity are uplinked each day to the crew based on that days orbital track

Human disasters

Gulf of Mexico Oil Spill, 4 May 2010, ISS023-E-32397

Crew Earth Observation

A photograph taken from the International Space Station (ISS) showing a volcanic eruption. A large, billowing plume of white ash and steam rises from a dark, rugged volcanic peak. The plume is dense and textured, with a bright white core. The surrounding landscape is dark and rocky, with some smaller peaks visible. The background is the deep blue of the Earth's atmosphere, with wispy white clouds scattered across the scene. The overall view is from a high altitude, looking down at the volcano.

Geologic phenomena

Sarychev Peak, Kuril Islands, ISS020-E-9048, 12 June 2009

Crew Earth Observation

(CEO)

*CEO: Houston at Night
Expedition 22*



CEO: Las Vegas at night. Visible are the Las Vegas Strip, seen in contrast with McCarran Airport. Frenchman Mountain and Nellis Air Force Base are dark against the rectilinear grid of the city.

Land use, agriculture studies and urban growth

Cupola



Bay window in space

80-cm diameter top
window

6 side windows



Cupola

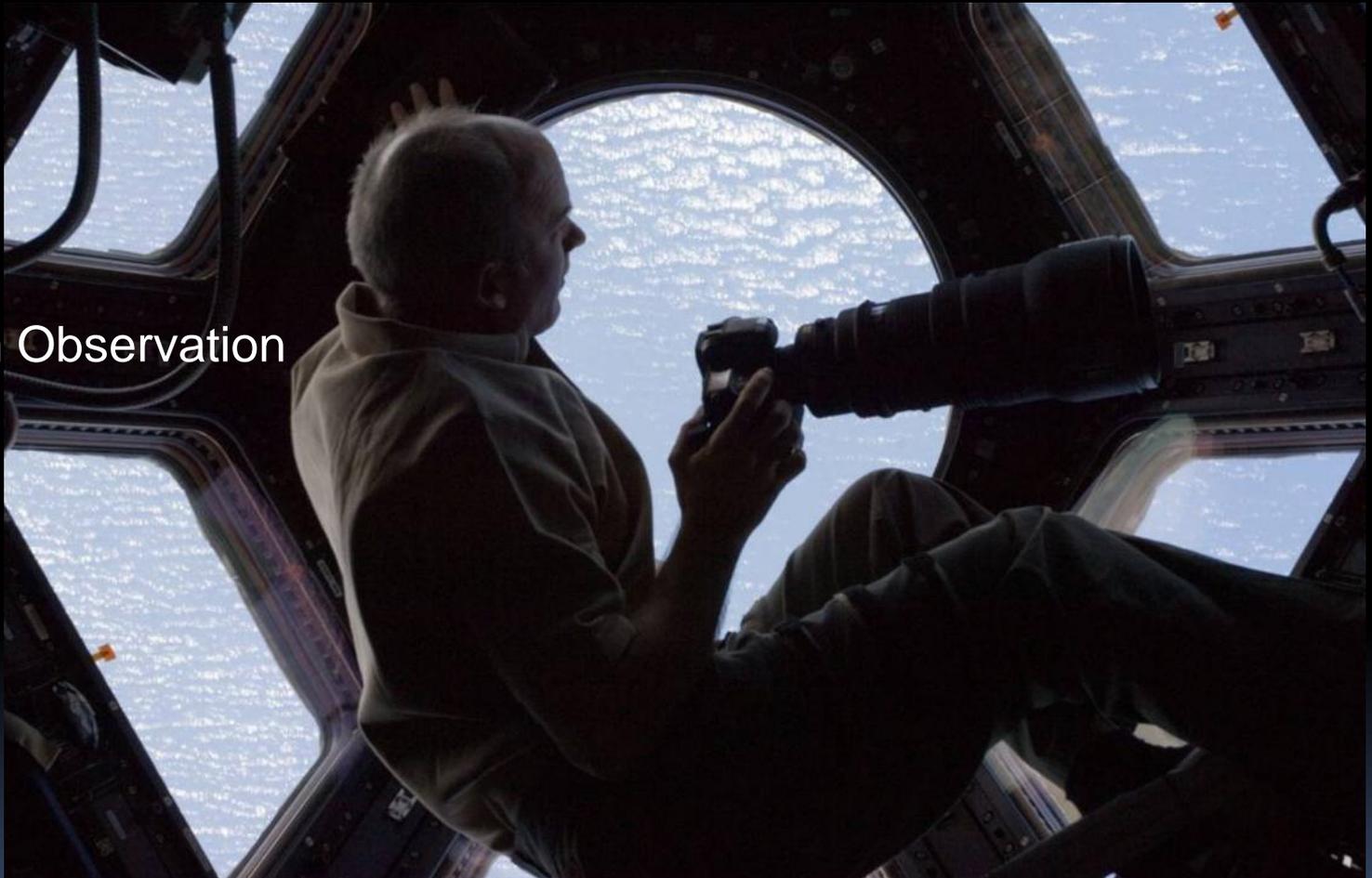
Situational Awareness
Inspection
Robotic work station





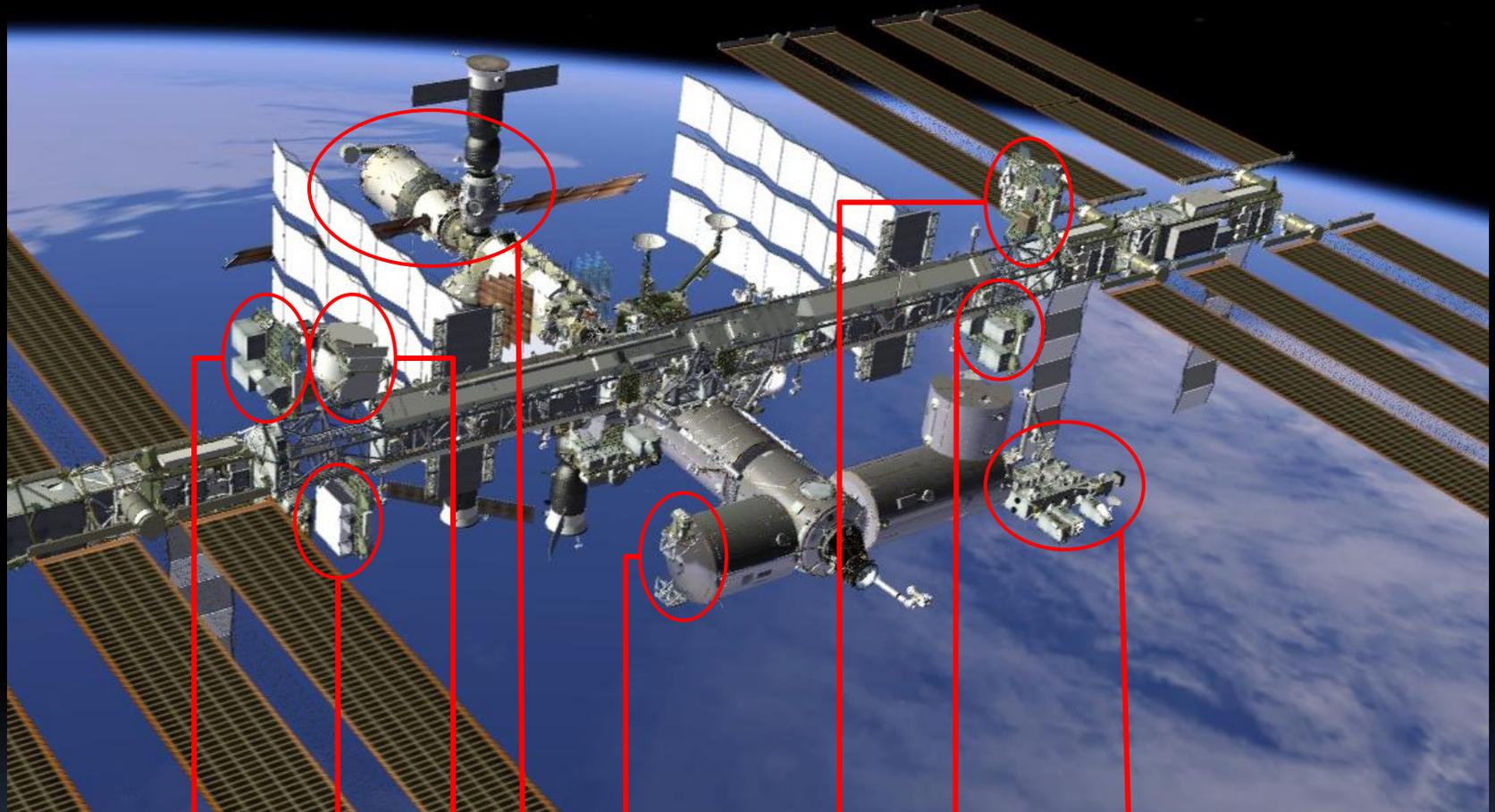
Cupola

Crew Earth Observation





External Payload Attach Site's



ELC-2

ELC-4

AMS

Columbus-EPF

ELC-3

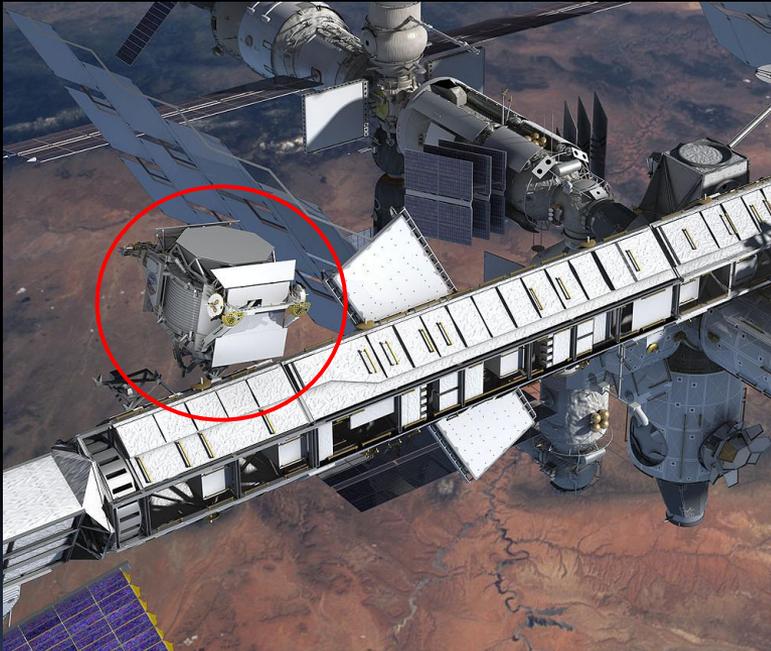
ELC-1

JEM-EF

External Workstations (9) on the Russian Service Module

Alpha Magnetic Spectrometer (AMS)

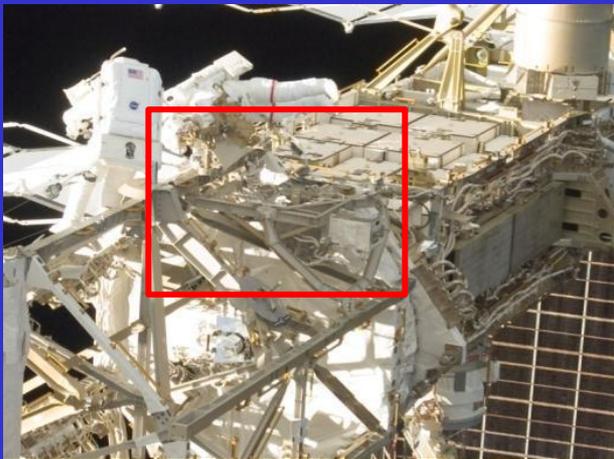
*Cosmic Ray detector
Collaboration of DOE and xxx
Truss mounted payload*



External Research Accommodations



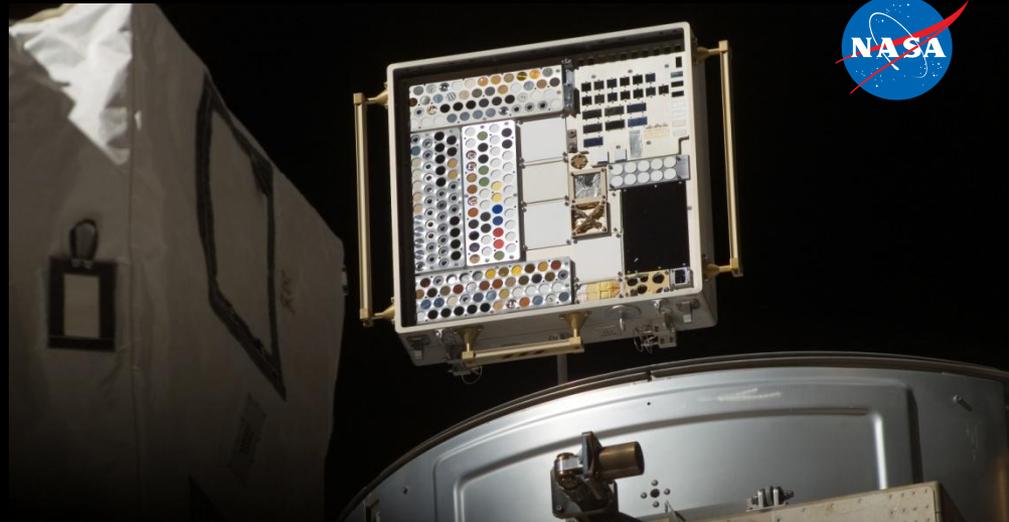
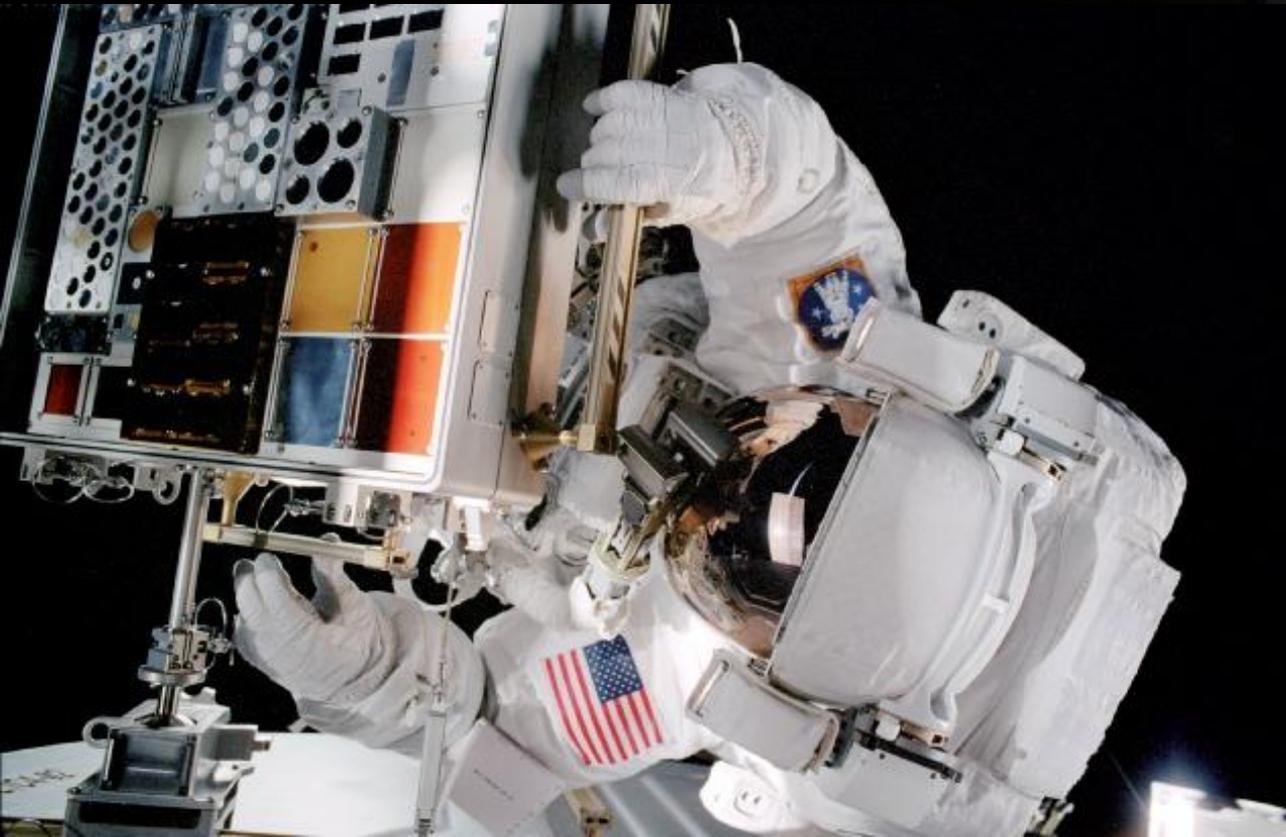
Common Attachment System (CAS) Site



Mass capacity	1360 - 8618 kg (3000 - 19000 lb)
Power	3 kW each on two lines (primary, auxiliary)
Thermal	Passive
Low-rate data	1 Mbps (MIL-STD-1553)
High-rate data	100 Mbps (shared)
Sites available to NASA	6 sites

Materials Research

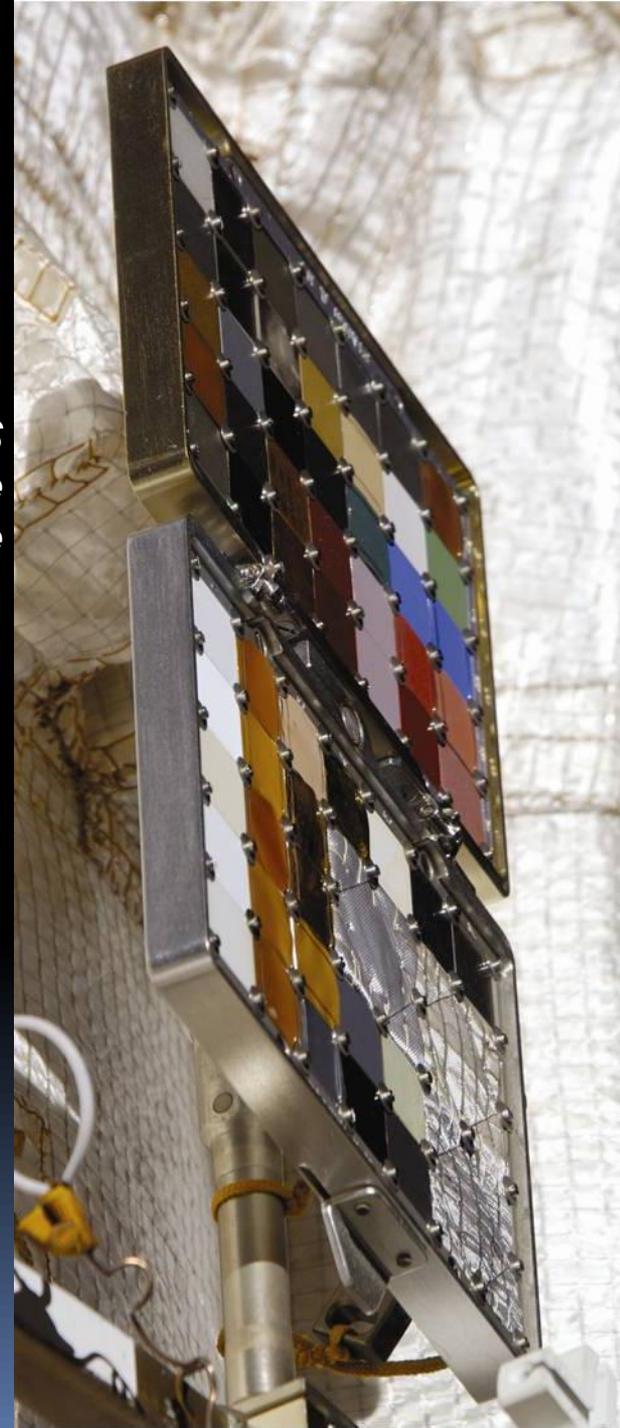
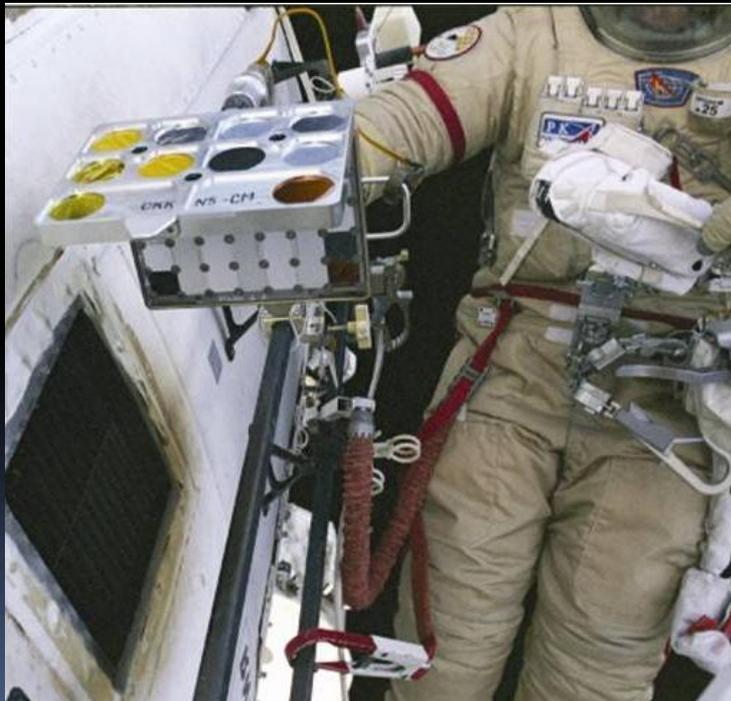
Materials International Space Station Experiment (MISSE)



Deployed outside it is a test bed for materials and coatings attached to the outside of the International Space Station being evaluated for the effects of atomic oxygen, ultraviolet, direct sunlight, radiation and extremes of heat and cold outside

Replaceable Cassette-Container (SKK or CKK)

*Mounted on the outside of the ISS
to test materials directly exposed to the
harsh environment of space*



Astro-Biology Research



Exposure Experiment Expose

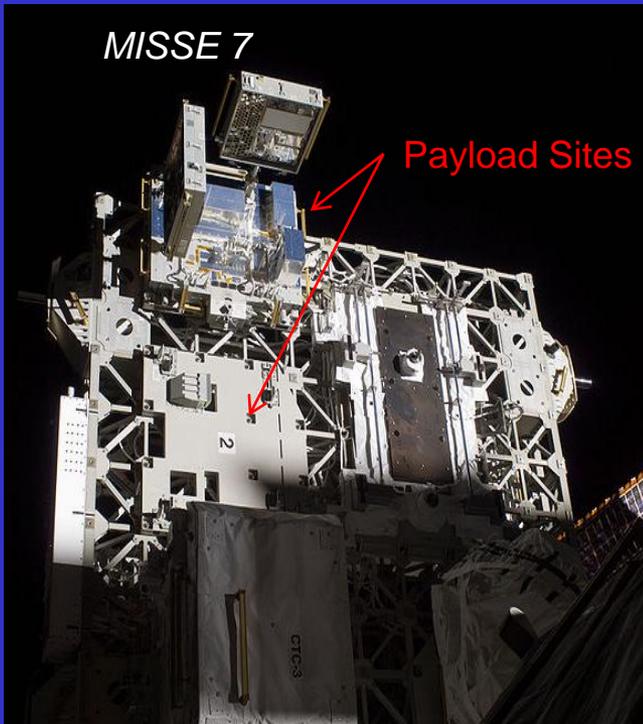


Deployed outside of the Zvezda service module it is multi user facility accommodating experiments in photo processing, photo-biology, exobiology and materials research

External Research Accommodations



EXPRESS Logistics Carrier Payload Resources



Mass capacity each site	227 kg (500 lb)
Volume	1 m³
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



Columbus External Resources



Mass capacity

230 kg (500 lb)

Volume

1 m³

Power

**2.5 kW total to carrier
(shared)**

Thermal

Passive

Low-rate data

**1 Mbps (MIL-STD-
1553)**

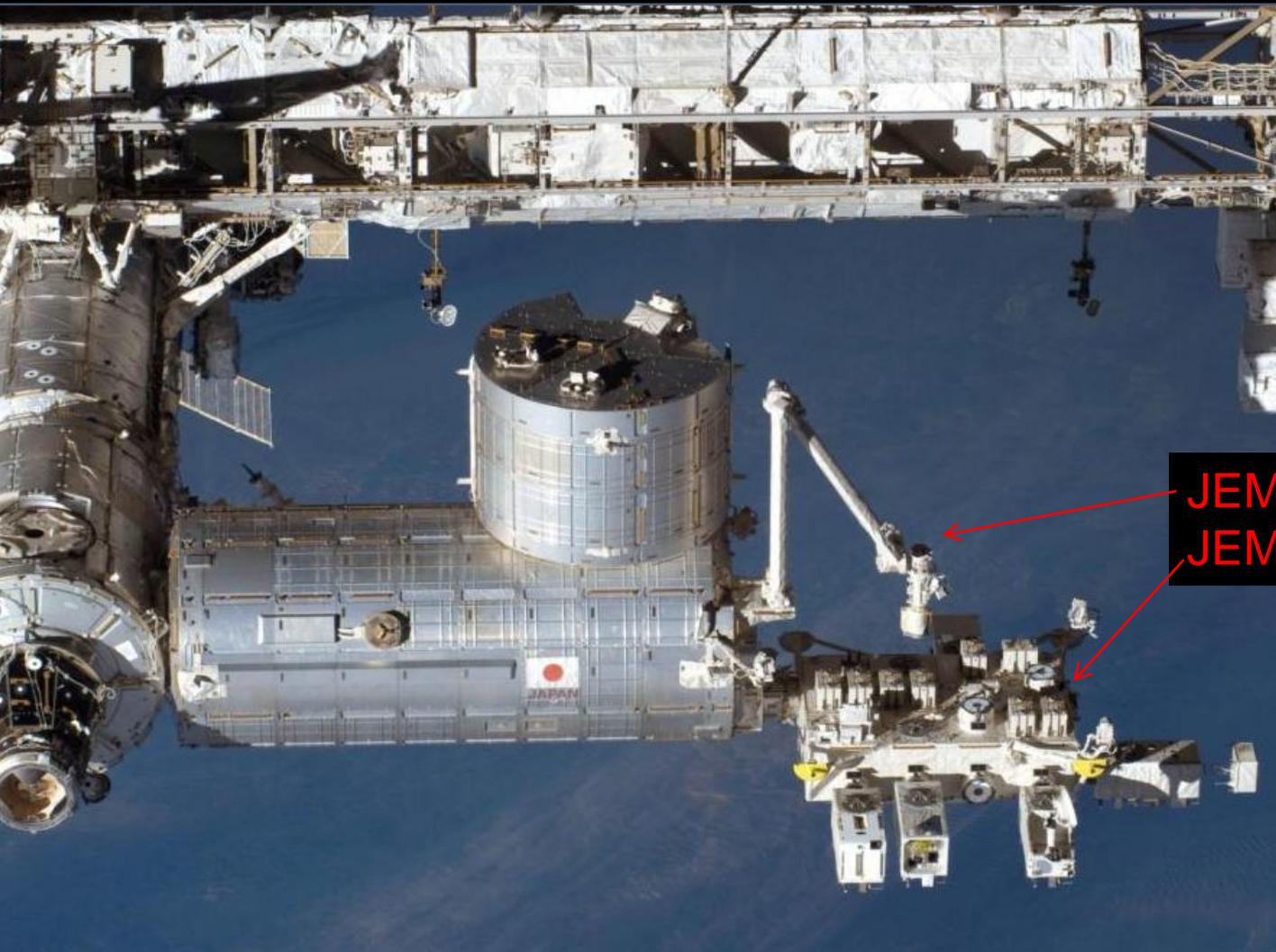
Medium-rate data

2 Mbps (shared)

Sites available

4 sites

Japanese Experiment Module - *Kibo*

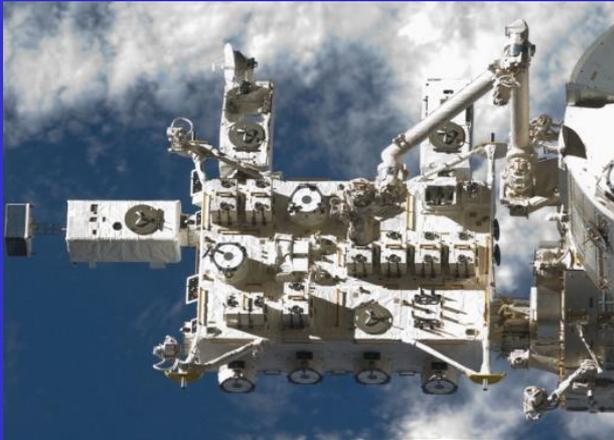


JEM ARM
JEM External Facility

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 m³
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	10 sites

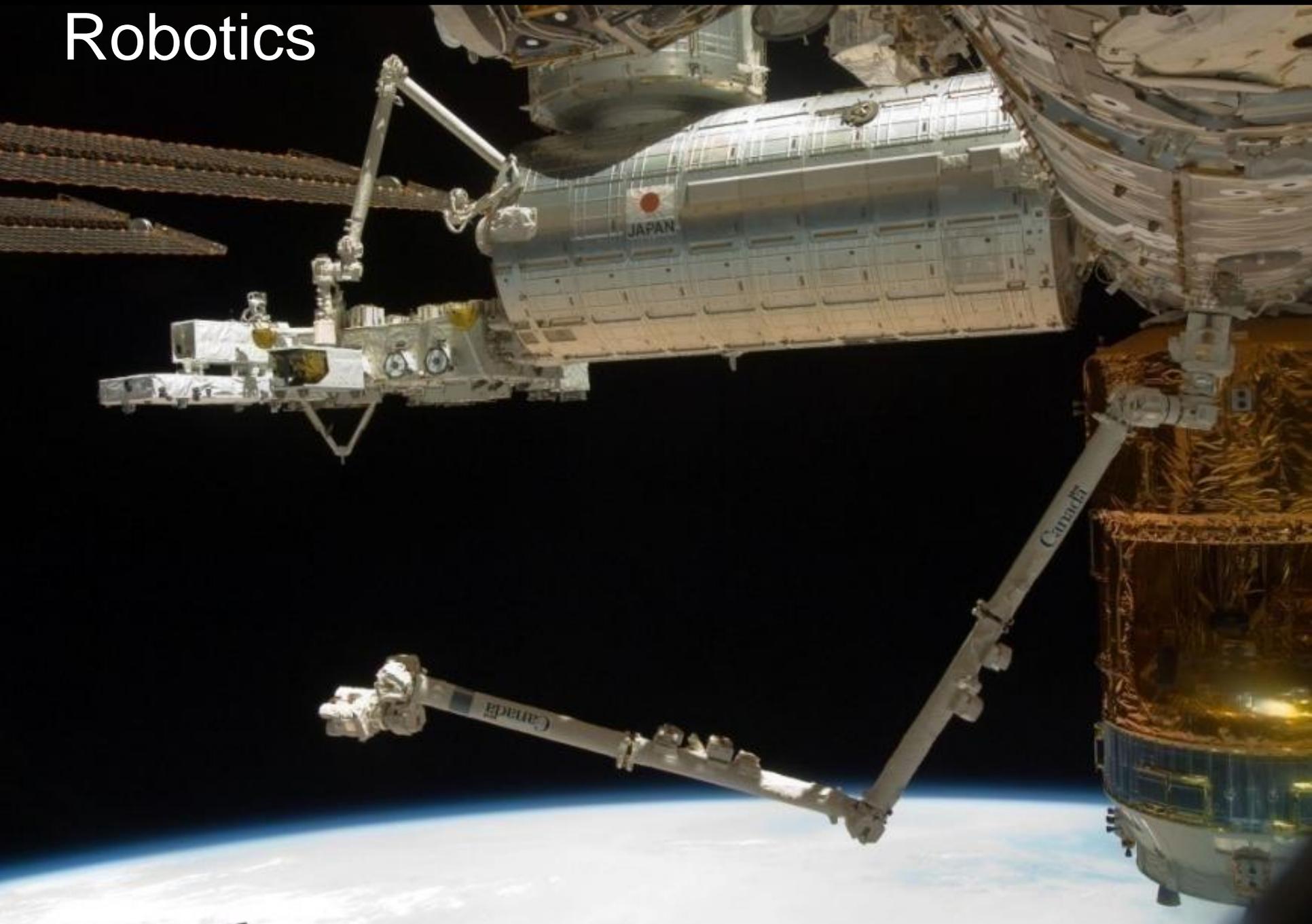
Station to Internal Resources

Power	3, 6, or 12 kW, 114.5 - 126 voltage, direct current (VDC)	
Data	Low Rate	MIL-STD-1553 bus 1 Mbps
	High Rate	100 Mbps
	Ethernet	10 Mbps
	Video	NTSC
Gases	Nitrogen	Flow= 0.1 kg/min minimum; 517-827 kPa, nominal; 1,379 kPa, maximum
	Argon, carbon dioxide, helium	517-768 kPa, nominal; 1,379 kPa, maximum
Cooling Loops	Moderate temperature	16.1 C – 18.3 C
	Flow rate	0 - 45.36 kg/h
	Low temperature	3.3 C – 5.6 C
	Flow rate	233 kg/h
Vacuum	Venting	10^{-3} torr in less than 2 h for single payload of 100 L
	Vacuum resource	10^{-3} torr

Upgrades In Work

Enhanced Processor and Integrated Communications (EPIC) Project	Phase A will upgrade the three Command and Control (C&C) MDMs and the two Guidance, Navigation, & Control (GN&C) MDMs.
	Phase B will upgrade the two Payload MDMs, and add Ethernet support for the C&C and Payload MDMs.
Air to Ground High Rate Communications System (HRCS) Project	Increase data rates internally and on the RF link 300 Mbps downlink, 7/25 Mbps uplink
	Combine audio and video on orbit
	Provide two way, high quality audio
	Open the door to internet protocol communications
	Open the forward link to multiple users
	Allow for the capability of transmitting & recording HDTV
On Orbit External Wireless High Rate	100 Mbps 2-way Ethernet capability
	1 Mbps 1553 capability
	Up to 4 antennas attached to EVA handrails on US Lab

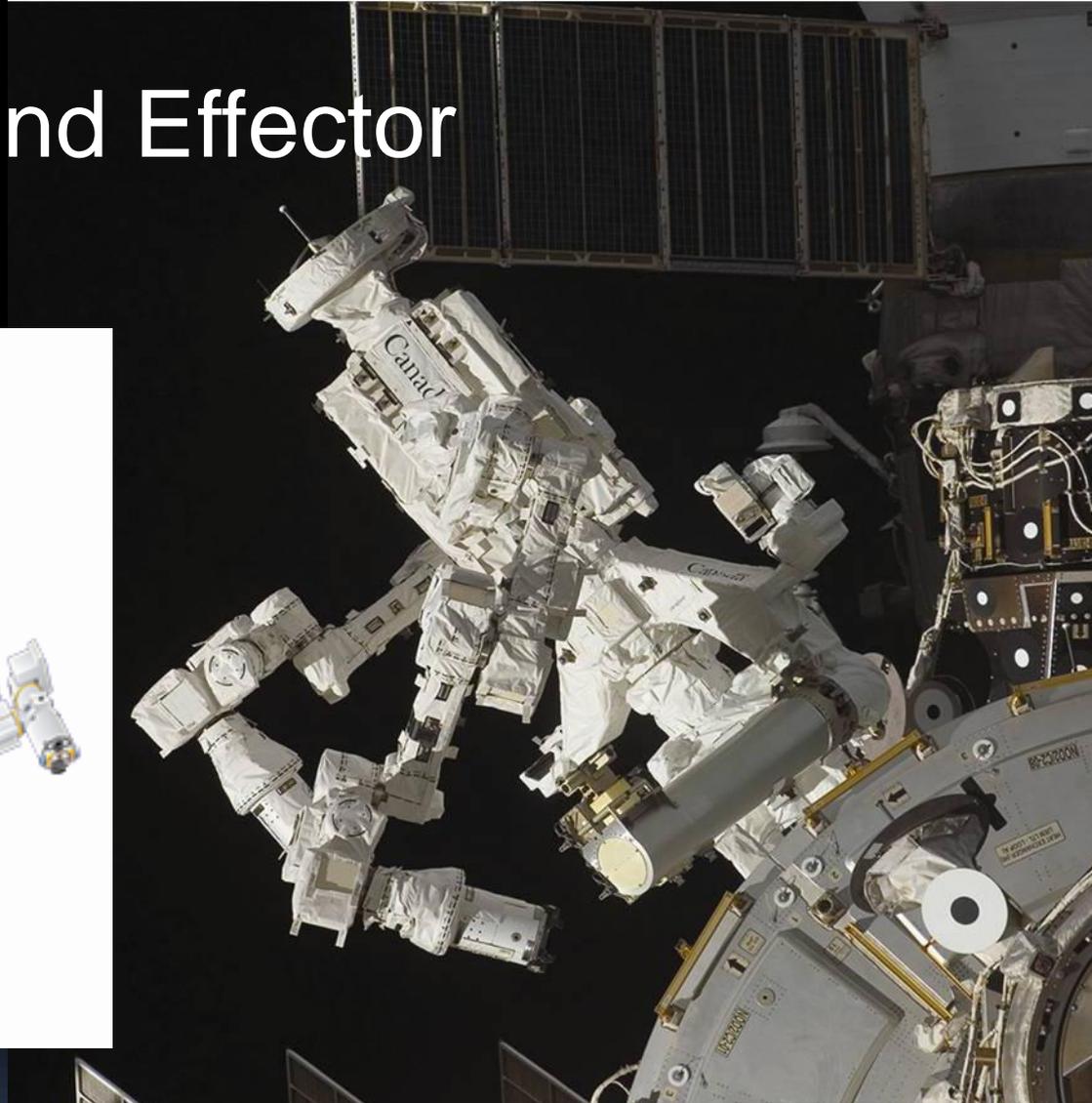
Robotics



Support Assembly and Maintenance



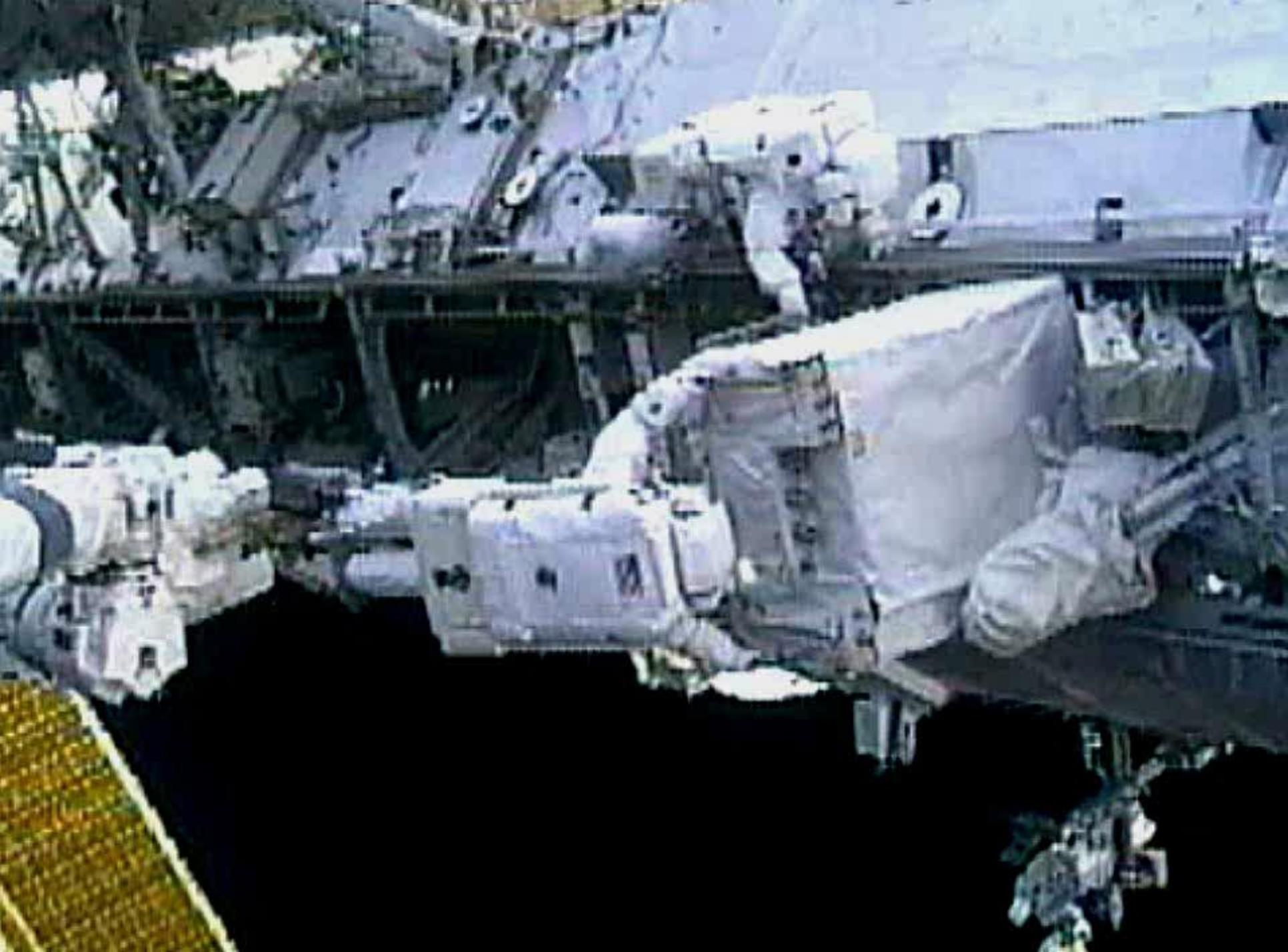
Dexterous End Effector



SSRMS attachment which the ground team or on-orbit crew can use robotically to install, remove and replace payloads and failed components

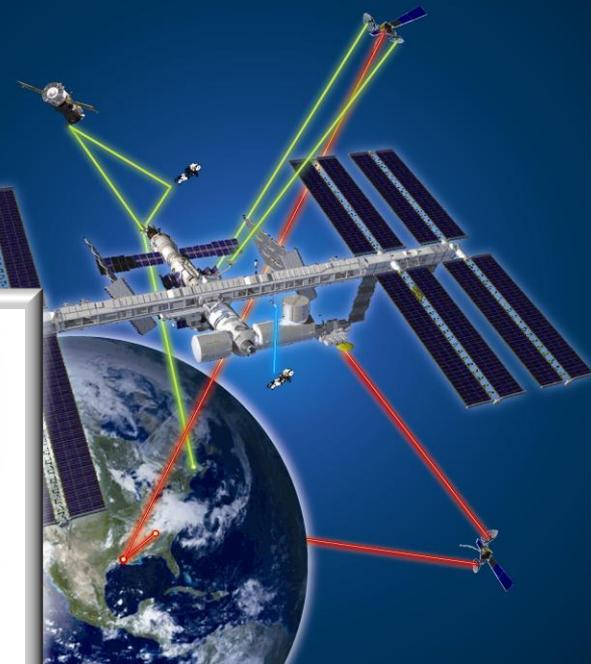
JEM ARM Payload Support







Communication and Control



ISS Control Centers



CSA - Payloads Telescience Operations Center (PTOC), St. Hubert, Quebec, Canada



Canadian Space Agency Mission Control Center (CSA-MCC), Longueuil, Quebec, Canada



NASA - Payload Operations and Integration Center (POIC), Huntsville, AL



NASA - Mission Control Center (MCC), Houston, TX



ESA ATV - Control Center, Toulouse, France



ESA-European User Support Operations Centers:
CADMOS, Toulouse, France
MARS, Naples Italy
MUSC, Cologne, Germany
B-USOC, Brussels, Belgium
E-USOC, Madrid, Spain
N-USOC, Trondheim, Norway
DAMEC, Odense, Denmark
BIOTESC, Zurich, Switzerland
ERASMUS, Noordwijk, The Netherlands



ESA - Columbus Control Center (Col-CC), Oberpfaffenhofen, Germany



HTV Control Center (HTVCC), Tsukuba-shi, Ibaraki, Japan



Japan Experiment Module Mission Control (JEMMC), Tsukuba-shi, Ibaraki, Japan



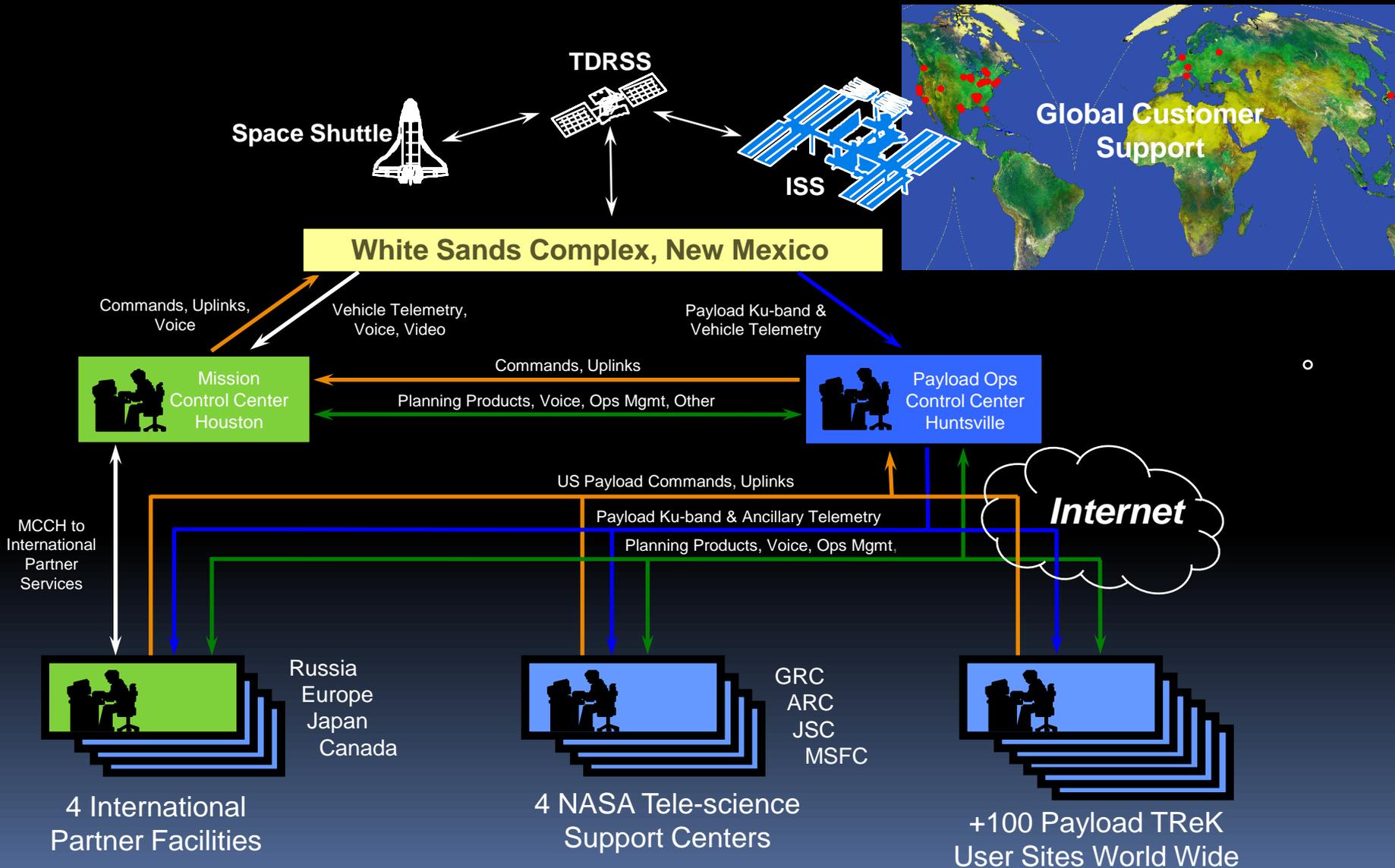
Roscosmos - Flight Control Center (TsUP), Korolyov, Russia



Roscosmos - Transport Vehicle Control Room, Korolyov, Russia

Near continuous air to ground communication

Payload Operations Integration Center Interfaces



Crew and Cargo Capability



Space Shuttle Cargo Capacity
5-7 crew
16,000 kg ascent



Soyuz
Cargo Capacity
3 crew
170 kg ascent

Cargo Capability

Proton
Progress

Ariane 5
ATV

HII
HTV

Falcon 9
Dragon

Taurus II
Cygnus



SpaceX

Orbital

An International fleet of space vehicles that delivers propellant, supplies and replenishes science experiments

ISS Cargo Vehicles

ATV (ESA)

Cargo Capacity
5,500 kg



Progress

Cargo Capacity
2,250 kg



Cygnus (Orbital)

Cargo Capacity
2,000 kg



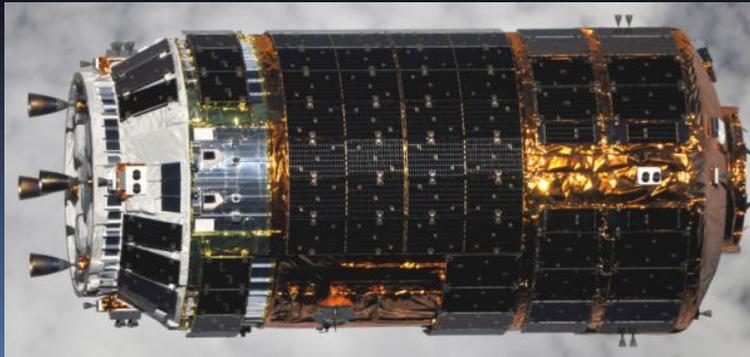
Dragon (SpaceX)

Cargo Capacity
3,100 kg ascent



HTV (JAXA)

Cargo Capacity
5,500 kg



Crew and Payload Return Capability



Space Shuttle

5-7 crew

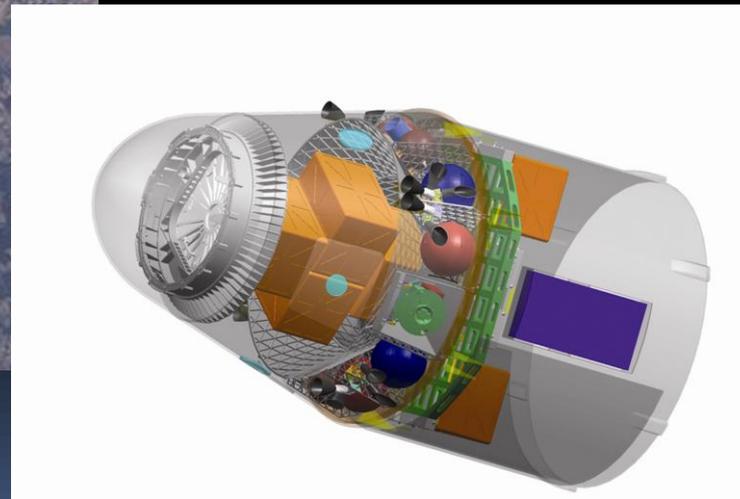
Cargo Capacity
16,000 kg descent



Soyuz

3 crew

Cargo Capacity 50 kg descent



Dragon (SpaceX)

Cargo Capacity
2,500 kg descent

Non-Partner Participation

In 2002, the ISS partnership developed a non-Partner Participation Policy, which governs how non-ISS Partners can participate in the International Space Station

Non-Partners team with one of the 5 ISS Partners (NASA, Roscosmos, the European Space Agency, the Japanese Aerospace Agency, the Canadian Space Agency)

The ISS partnership then reviews the bilateral cooperation for approval

Non-Partners are encouraged to review and contact one of the ISS Partners with their research proposals



