International Space Station
Post-Assembly Accommodations and Resources

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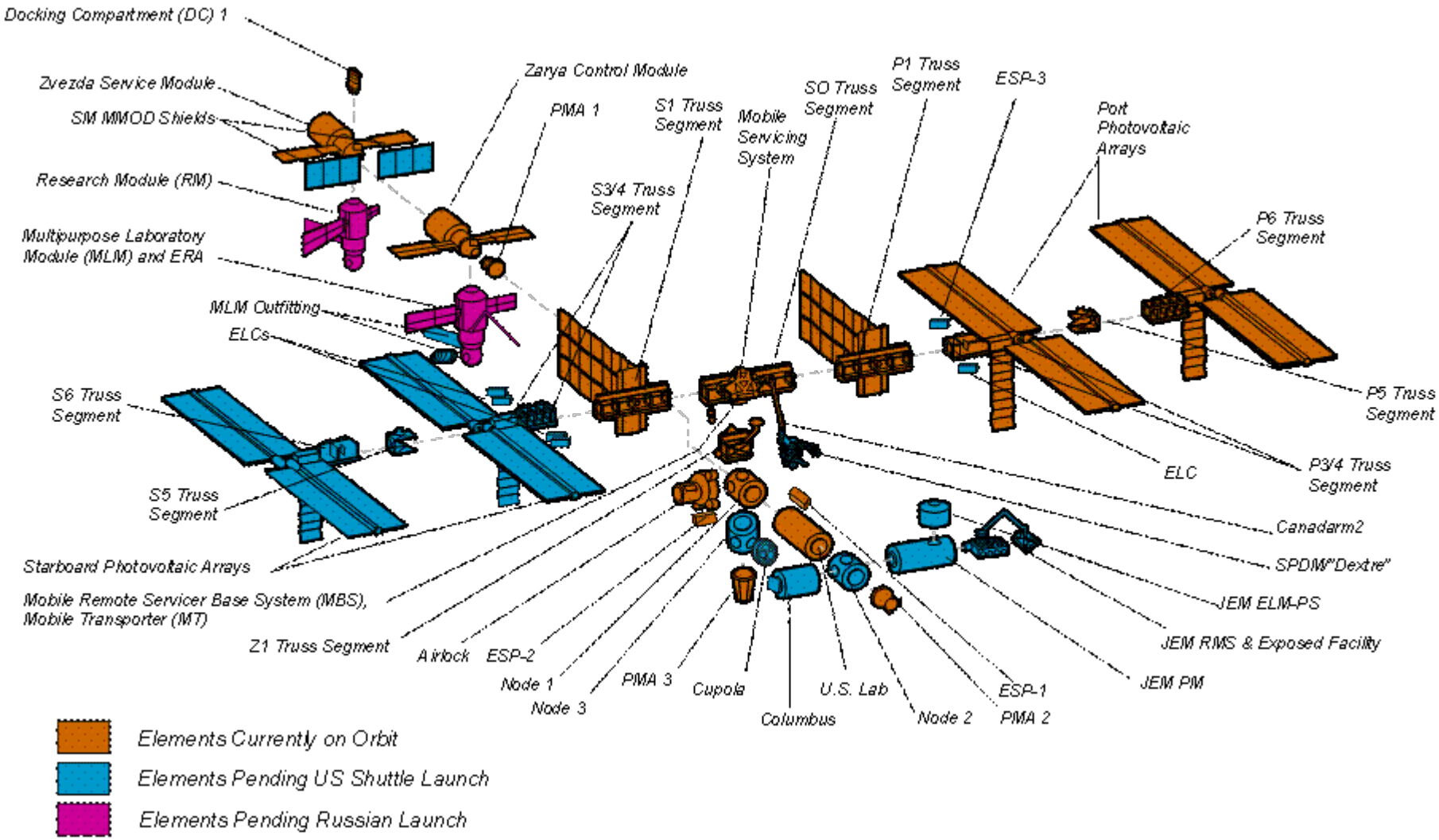
ISS Configuration



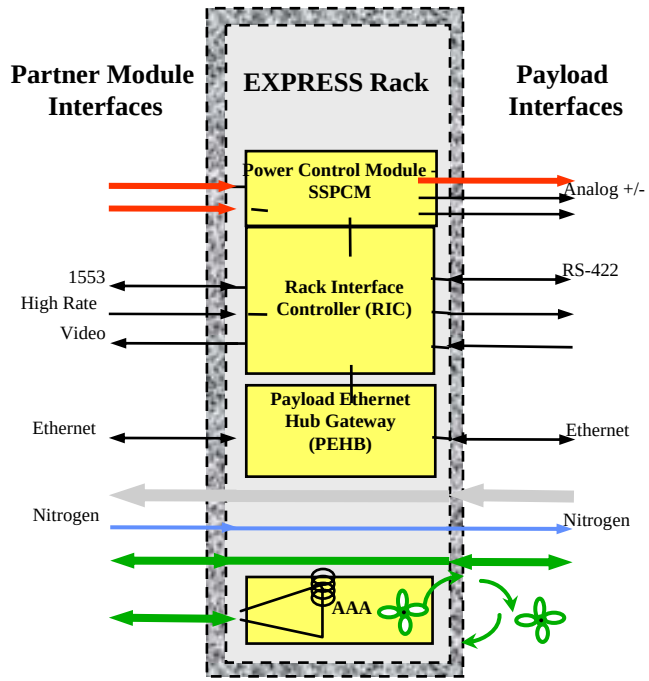
ISS Payload Racks

International Standard Payload Rack (ISPR) interfaces

Power:	3, 6, or 12 KW, 114.5-126 VDC
Low Rate Data:	1Mbps, MIL-STD- 1553 bus
High Rate Data:	100 Mbps
Local Area Network:	Ethernet 10 Mbps (802.4)
Video:	NTSC
Gases:	Nitrogen, Argon, Carbon Dioxide, Helium
Moderate Temp Loop:	16.1 C - 18.3 C; Flow rate=0-45.36 kg/hr
Low Temp Loop:	3.3 C - 5.6 C; Flow rate=233 kg/hr
Venting:	10-3 torr in less than 2 hours
Vacuum:	10-3 torr

Expedite the Processing of Payloads for Space Station (EXPRESS) Rack interfaces

Mass Capacity:	72 lbs
Power:	Up to 20 Amps @ 29 VDC
Data:	
Video:	NTSC
Gases:	1 Nitrogen (shared)
Thermal:	Avionics Air @ 15 scfm
Vacuum:	1 (shared)
Water	Up to 500 W



Destiny Facilities Today

ER2A

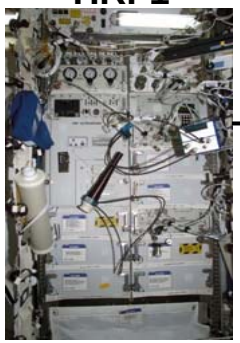
ER1

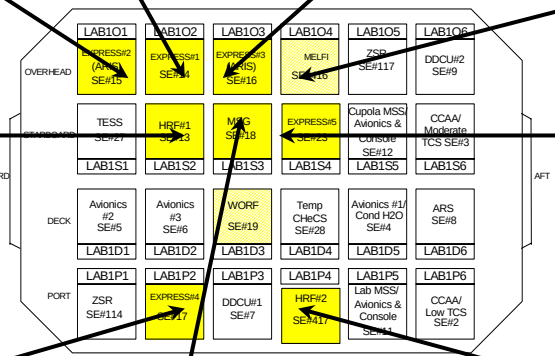
ER3A

EMCS

MELFI

HRF1





ER5

ER4

MSG

HRF2

Nine NASA Research Racks On Orbit

- **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
- **5 Multi-User (EXPRESS) Racks**
  - Middeck locker scale instruments in various research disciplines such as biotechnology and plant research
- **Microgravity Sciences Glovebox (MSG)**
  - Principally materials and fluid physics experiments to date
- **Minus Eighty-degree Laboratory Freezer for ISS (MELFI)**
  - Provides thermal conditioning at +4°C, -26°C and -80°C

Expedition 2 crewmember Susan Helms activating the HRF 1 rack

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

Expedition 3 crewmember Frank Culbertson conducting cell culture experiment in CBOSS in EXPRESS Rack 4

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

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

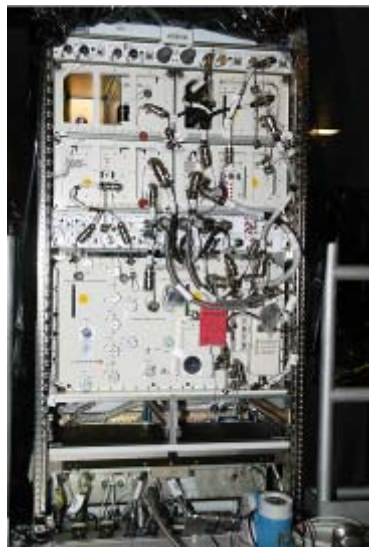
Planned NASA Research Facilities

NASA pressurized payload rack facilities awaiting launch

- **Combustion Integrated Rack (CIR) (2008)**
  - Facility dedicated to research in combustion science
- **Microgravity Science Research Rack (MSRR) (2008)**
  - Facility to support ESA Microgravity Science Lab furnace
- **Space Dynamically Responding Ultrasound Matrix System (SpaceDRUMS) (2008)**
  - EXPRESS-based containerless (ultrasound) processing facility
- **Window Observation Research Facility (WORF) (2008)**
  - Facility to support visual and multispectral remote sensing using Lab Optical Window

CIR

MSRR



SpaceDRUMS

WORF

Planned NASA Research Facilities

NASA pressurized payload rack facilities awaiting launch

- **EXPRESS Rack 6 (2008)**
  - Multipurpose payload facility, may also house ISS Galley elements
- **Fluids Integrated Rack (FIR) (2009)**
  - Facility dedicated to fluid physics research, with Light Microscope Module
- **Muscle Atrophy Research Exercise System (MARES) (2009)**
  - Facility for musculoskeletal, biomechanical, neuromuscular and neurological physiology measurements

EXPRESS 6

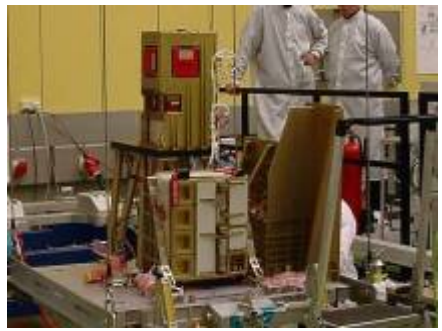
FIR

MARES

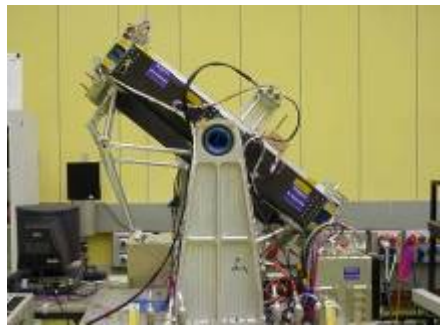
Columbus

***Columbus* Module at KSC**

1E November 2007



EUTEF



SOLAR

Biolab

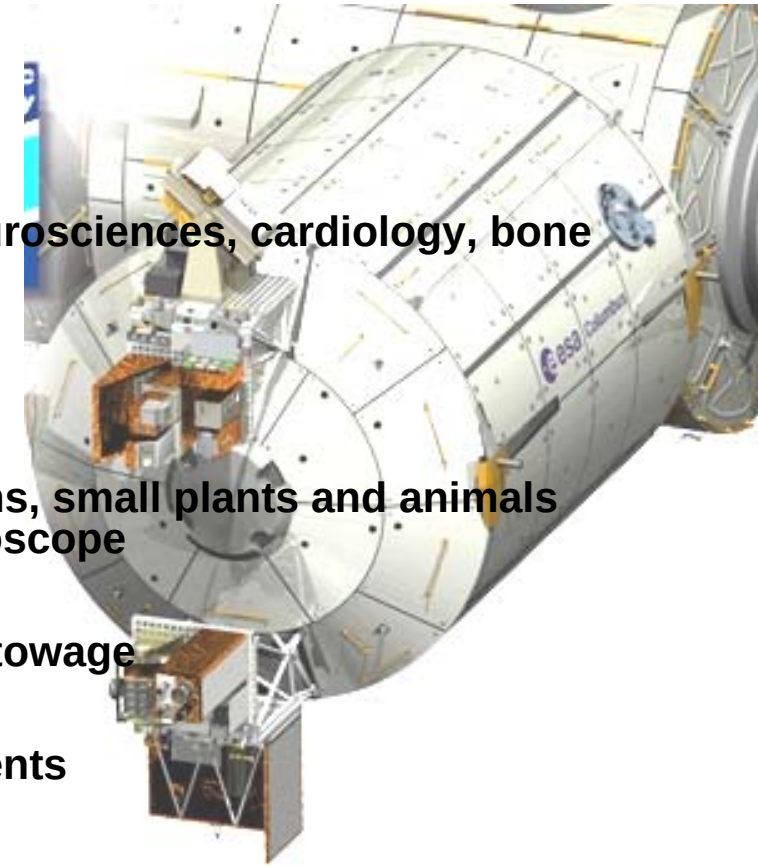
European Drawer Rack

European Physiology Module

European Transport Carrier

Fluid Science Lab

Columbus



European Space Agency (ESA)

Research racks launched in Columbus

- **European Physiology Module**
  - **Facility for human physiology research in neurosciences, cardiology, bone and muscle metabolism**
- **Fluid Science Lab**
  - **Multi-user facility for fluid physics research**
- **Biolab**
  - **Facility for cell culture, tissue, microorganisms, small plants and animals research, includes glovebox, incubator, microscope**
- **European Drawer Rack**
  - **Provide for middeck-class experiments and stowage**
- **European Transport Carrier**
  - **Stowage and transportation rack for experiments**

External payloads launched with Columbus

- **European Technology Exposure Facility (EuTEF)**
  - **Provides a platform for investigators to gather science data on the ISS space environment**
- **SOLAR**
  - **A platform with coarse pointing capability for three science instruments to monitor the solar flux in different wavelenghts**

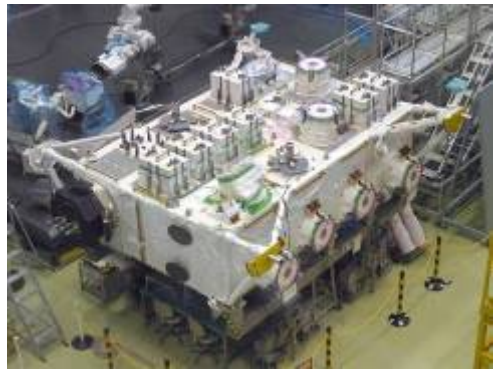
Kibo

***Kibo* Pressurized Module at KSC**

1J/A January 2008

1J February 2008

2J/A October 2008



JEM-EF at TkSC

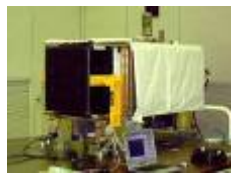
1J/A January 2008

Ryutai

Saibo

HTV1 July 2009

Kobairo

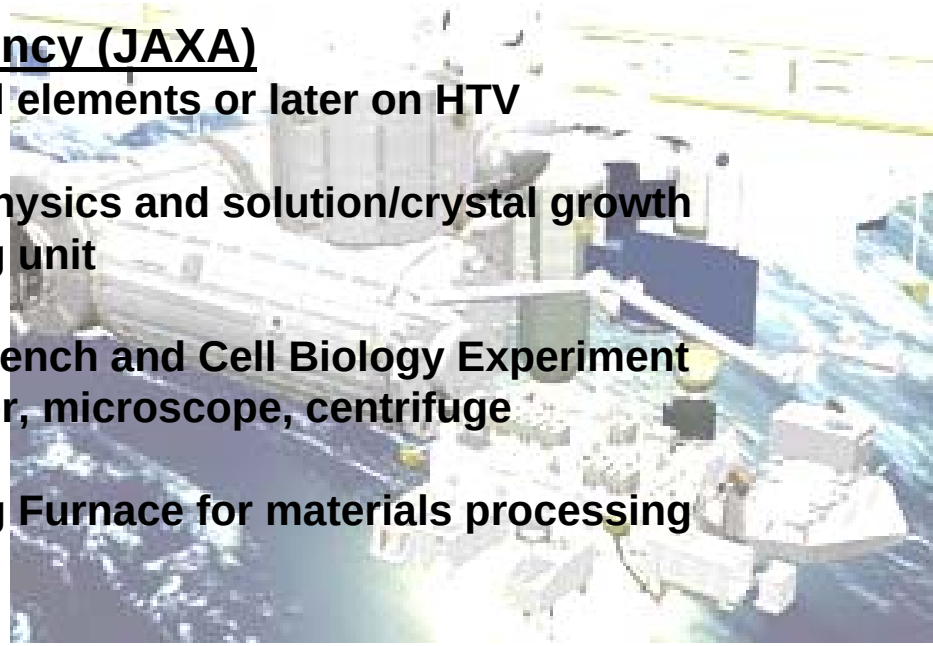


SEDA

MAXI

SMILES

Kibo



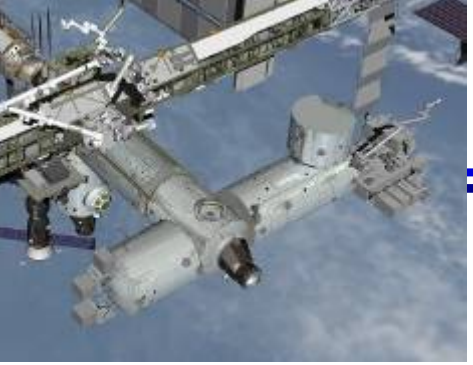
Japanese Aerospace Exploration Agency (JAXA)

Research racks launched with pressurized elements or later on HTV

- **Ryutai (2008)**
  - **Contains four experiments for fluid physics and solution/crystal growth research, including image processing unit**
- **Saibo (2008)**
  - **Cell biology facility, contains Clean Bench and Cell Biology Experiment Facility, including glovebox, incubator, microscope, centrifuge**
- **Kobairo (2009)**
  - **Facility contains the Gradient Heating Furnace for materials processing research**

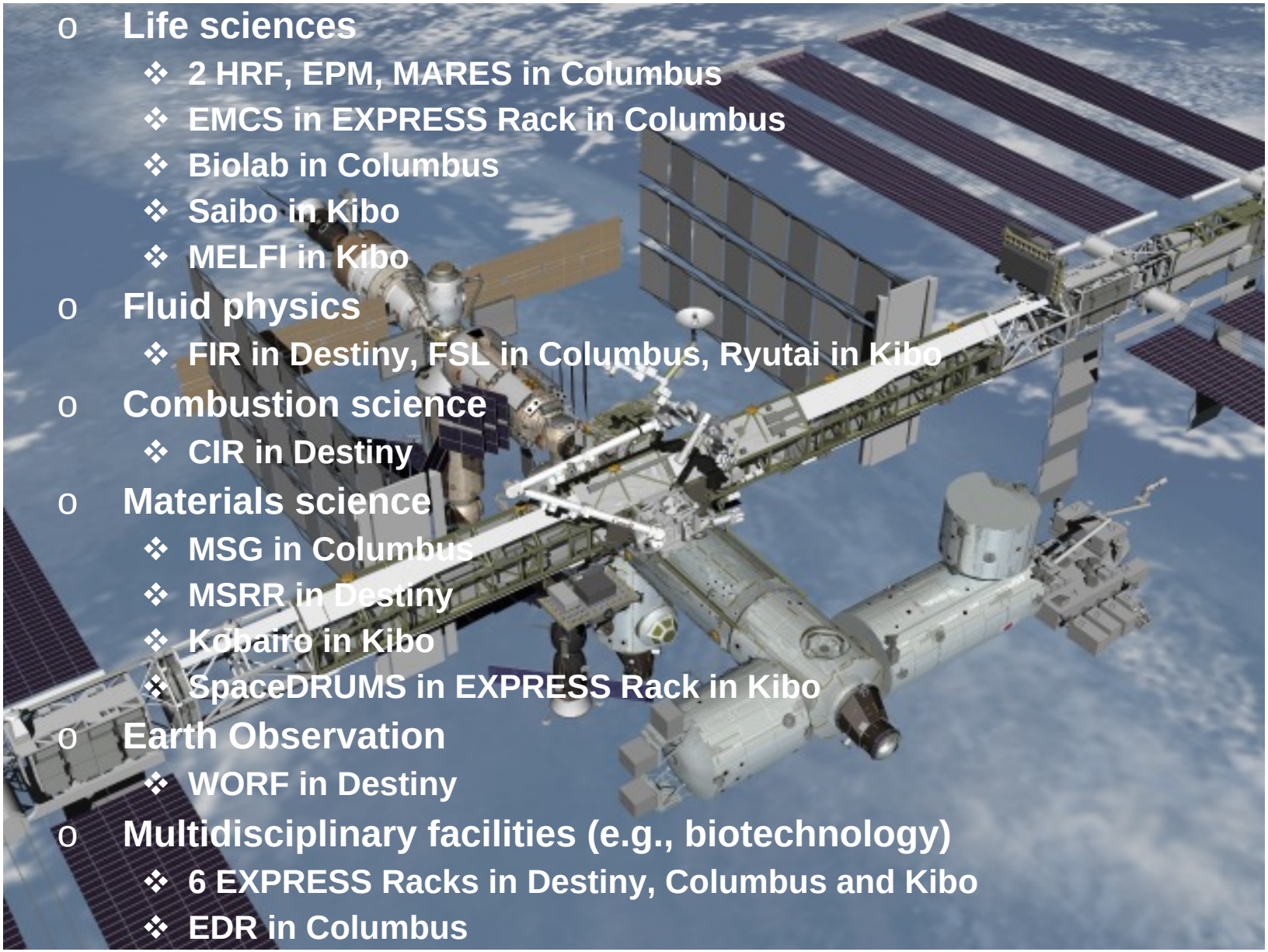
External payloads launched with JEM-EF or later on HTV

- **Space Environment Data Acquisition (SEDA) (2008)**
  - **Monitor neutron, plasma, atomic oxygen, and heavy ions**
- **Monitor All-sky X-ray Image (MAXI) (2008)**
  - **Observe X-ray bursts by Gas Slit Camera and X-ray CCD Slit Camera**
- **Superconducting Sub millimeter-wave Limb-Emission Sounder (SMILES) (2009)**
  - **Demonstrate sub-millimeter sensor technology and conduct sub-millimeter limb-emission sounding of the atmosphere and perform global observation of trace gases in the Stratosphere**



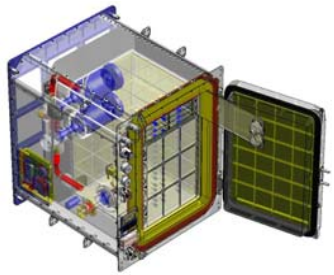
Node 3
NOD3F5 WRS1 SE#315
NOD3S5 OGS SE#313
NOD3A5 Avionics #1 SE#311
NOD3P5 TVIS-II SE#45
NOD3E4 WRS2 SE#316
NOD3S4 ARS SE#314
NOD3A4 Avionics #2 SE#312
NOD3P4 HC SE#317
Cupola SE#309
forward starboard aft port
forward starboard aft port
JLP1F2 AVCO
JLP1S2 AVCO
JLP1A2 AVCO
JLP1P2 AVCO
JLP1F1 AVCO
JLP1S1 AVCO
JLP1A1 AVCO
JLP1P1 AVCO
JEM ELM-PS
NASA Payload Rack
IP Payload Rack
overhead
aft
deck
forward
J E M
Radial Port
JPM1O5 DMS-1 SE#351
JPM1O4 JEM/ICS SE#360
JPM1O3 AVCO
JPM1O2 AVCO
JPM1O1 DMS-2 SE#352
JPM1A6 RMS SE#355
JPM1A5 ZSR SE#122
JPM1A4 ZSR SE#123
JPM1A3 RYUTA1 SE#364
JPM1A2 SAIBO SE#365
JPM1A1 ZSR SE#125
JPM1D6 TCS-2 SE#357
JPM1D5 EPS-2 SE#359
JPM1D4 MELFI SE#25
JPM1D3 JRSR SE#353
JPM1D2 EPS-1 SE#358
JPM1D1 TCS-1 SE#356
JPM1F6 EXPR #4 SE#17
JPM1F5 AVCO
JPM1F4 W/S SE#362
JPM1F3 KOBAIRO SE#366
JPM1F2 ZSR SE#124
JPM1F1 EXPR #5 SE#23
FGB
overhead
port
deck
starboard
N o d e 1
NOD1O4 ZSR SE#110
NOD1P4 ZSR SE#111
NOD1D4 RSR SE#381
NOD1S4 ZSR SE#116
Z1 Truss
Airlock
L a b
LAB1O6 DDCU #2 SE#9
LAB1O5 CHeCS 2 SE#55
LAB1O4 Galley (ER#6) SE#53
LAB1O3 MSRR#1 (ARIS) SE#22
LAB1O2 EXPR #1 SE#14
LAB1O1 EXPR #2 (ARIS) SE#15
LAB1P6 TCS SE#2
LAB1P5 MSS/AV SE#11
LAB1P4 AVCO
LAB1P3 DDCU #1 SE#7
LAB1P2 AVCO
LAB1P1 AVCO
LAB1D6 ARS SE#8
LAB1D5 Avionics #1 SE#4
LAB1D4 CHeCS 1 SE#28
LAB1D3 WORF SE#19
LAB1D2 Avionics #3 SE#6
LAB1D1 Avionics #2 SE#5
LAB1S6 TCS SE#3
LAB1S5 MSS/AV SE#12
LAB1S4 AVCO
LAB1S3 FIR (ARIS) SE#370
LAB1S2 CIR (PaRIS) SE#21
LAB1S1 TeSS SE#27
N o d e 2
NOD2O5 ZSR SE#118
NOD2O4 DDCU SE#301
NOD2P5 Crew Qtrs SE#60
NOD2P4 DDCU SE#304
NOD2D5 Crew Qtrs SE#62
NOD2D4 DDCU SE#303
NOD2S5 Crew Qtrs SE#63
NOD2S4 DDCU SE#302
CAM
JEM
MPL M
APM
overhead
port
deck
starboard
A i r l o c k
AIR1O1 Stowage SE#191
AIR1A1 Avionics SE#194
AIR1D1 Stowage SE#192
AIR1F1 CA Equip SE#193
overhead
port
deck
starboard
C o l u m b u s
COL1O4 ZSR SE#121
COL1O3 ZSR SE#120
COL1O2 ZSR SE#117
COL1O1 FSL SE#412
COL1A4 HRF#2 SE#417
COL1A3 EPM SE#413
COL1A2 Bio Lab SE#414
COL1A1 EXPR #3 (ARIS) SE#16
COL1D4 ESR SE#415
COL1D3 System SE#400
COL1D2 System SE#400
COL1D1 System SE#400
COL1F4 HRF#1
COL1F3 MARES SE#419
COL1F2 MSG SE#18
COL1F1 EDR SE#411
overhead
port
deck
starboard SE#13
Subsystem
Stowage

Post-Assembly Research Complement

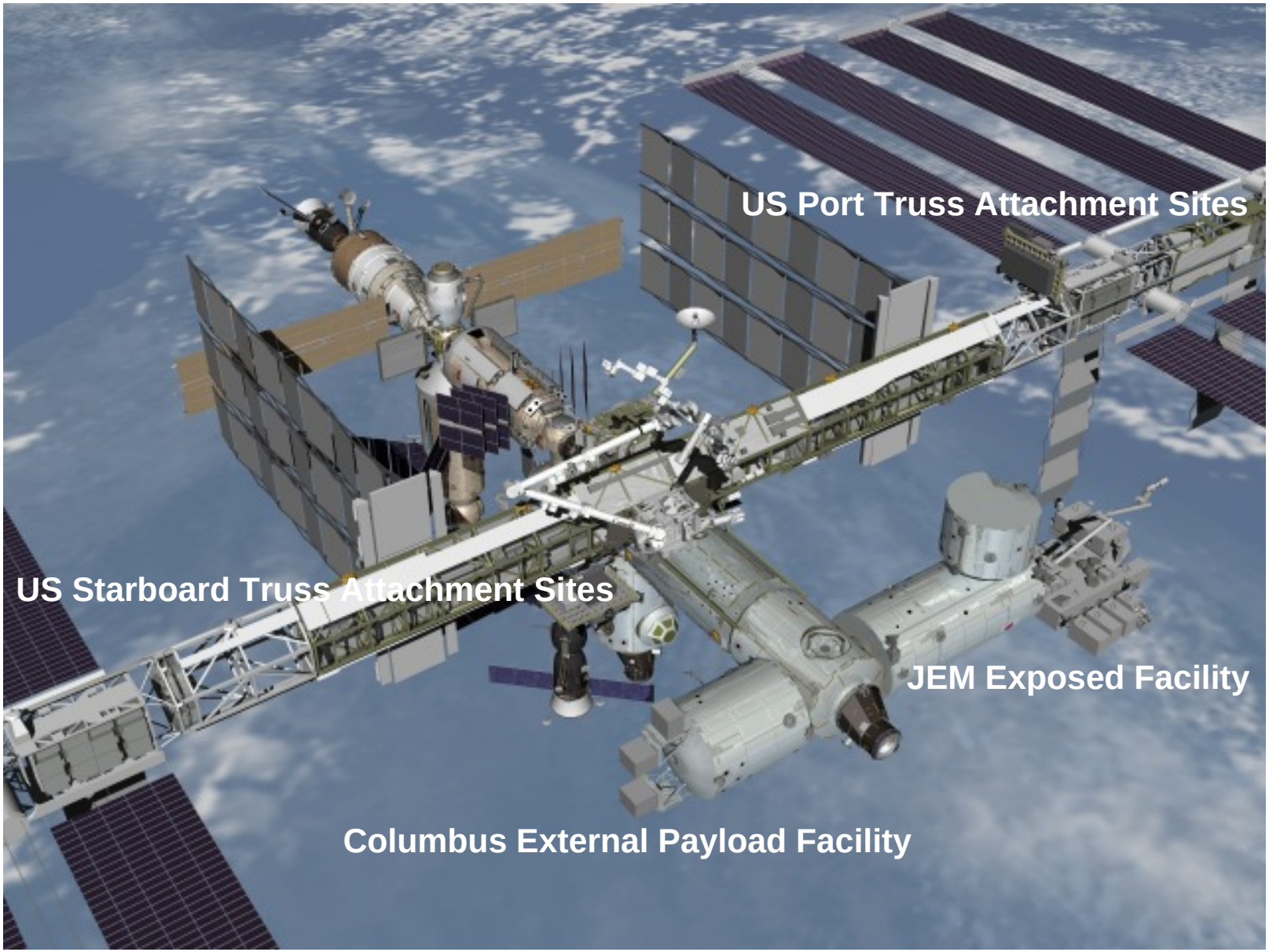


- Life sciences
  - 2 HRF, EPM, MARES in Columbus
  - EMCS in EXPRESS Rack in Columbus
  - Biolab in Columbus
  - Saibo in Kibo
  - MELFI in Kibo
- Fluid physics
  - FIR in Destiny, FSL in Columbus, Ryutai in Kibo
- Combustion science
  - CIR in Destiny
- Materials science
  - MSG in Columbus
  - MSRR in Destiny
  - Kobairo in Kibo
  - SpaceDRUMS in EXPRESS Rack in Kibo
- Earth Observation
  - WORF in Destiny
- Multidisciplinary facilities (e.g., biotechnology)
  - 6 EXPRESS Racks in Destiny, Columbus and Kibo
  - EDR in Columbus

Cold Stowage Accommodations

	MELFI	MERLIN	GLACIER	Single and Double Coldbag w/ICEPAC's
				
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**

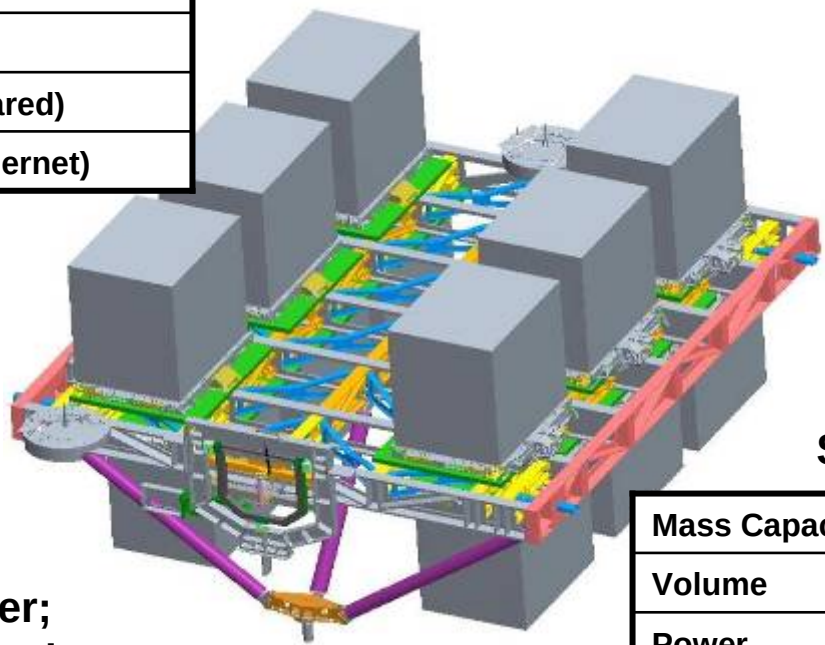
External Payload Accommodations



EXPRESS Logistics Carrier

5 EXPRESS Logistics Carriers (ELC) are planned for 2009-2010

Mass Capacity	3,636 kg
Volume	30 m^3
Power	3 kW, 113-126 VDC
Low Data Rate	1 Mbps
High Data Rate	6 Mbps (shared)
Local Area Network	6 Mbps (Ethernet)



12 sites per carrier;
2 sites with payload power and data services

Single Adapter Site

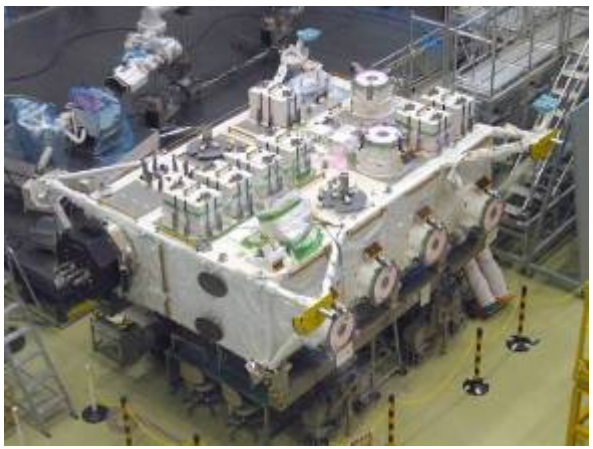
Mass Capacity	230 kg
Volume	1 m^3
Power	750 W, 113-126 VDC 500 W @ 28 VDC per adapter
Thermal	Passive
Low Data Rate	1 Mbps
Medium Data Rate	6 Mbps (shared)

IP External Platforms

Columbus External Payload Facility – 4 sites

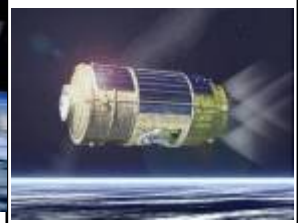
Mass Capacity	230 kg
Volume	1 m^3
Power	2.5 kW total to carrier (shared)
Thermal	Passive
Low Data Rate	1 Mbps
Medium Data Rate	2 Mbps (shared)

JEM Exposed Facility – 10 sites



Mass Capacity	500 kg standard site 2,500 kg large site
Volume	1.5 m^3
Power	3 kW, 113-126 VDC
Thermal	3 kW cooling
Low Data Rate	1 Mbps
Medium Data Rate	10 Mbps
High Data Rate	95 Mbps (shared)

Transportation Capabilities

	Soyuz	Progress	ATV	HTV	Orion	COTS
						
Up	**Crew, limited passive cargo**	**Passive cargo (limited capability for active cargo)**	**Passive pressurized cargo**	**Passive pressurized cargo and ISPR's, passive external cargo**	**Crew, passive and active cargo**	**Passive and active (?) cargo**
Down	**Crew, very limited passive cargo**	**N/A**	**N/A**	**N/A**	**Crew, passive and active cargo**	**Passive and active (?) cargo**

Summary

- ISS assembly and utilization to date have been relatively trouble-free
- A robust on-orbit research infrastructure already exists and has yielded a significant amount of valuable research
- This infrastructure will be significantly expanded in the next few years, enhancing pressurized and unpressurized research capabilities
- International collaboration will take on increasing importance
- A fleet of transportation vehicles will be available