INTERNATIONAL SPACE STATION

Summary of Platform Specifications

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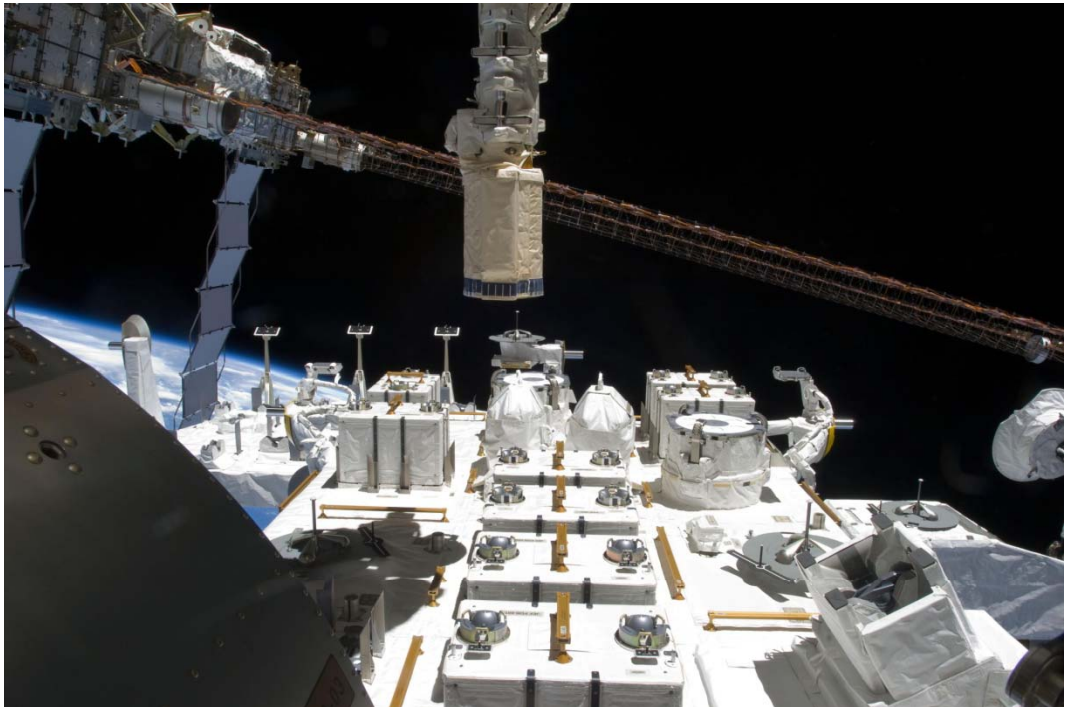
Nov. 12, 2009

The research described in this presentation was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

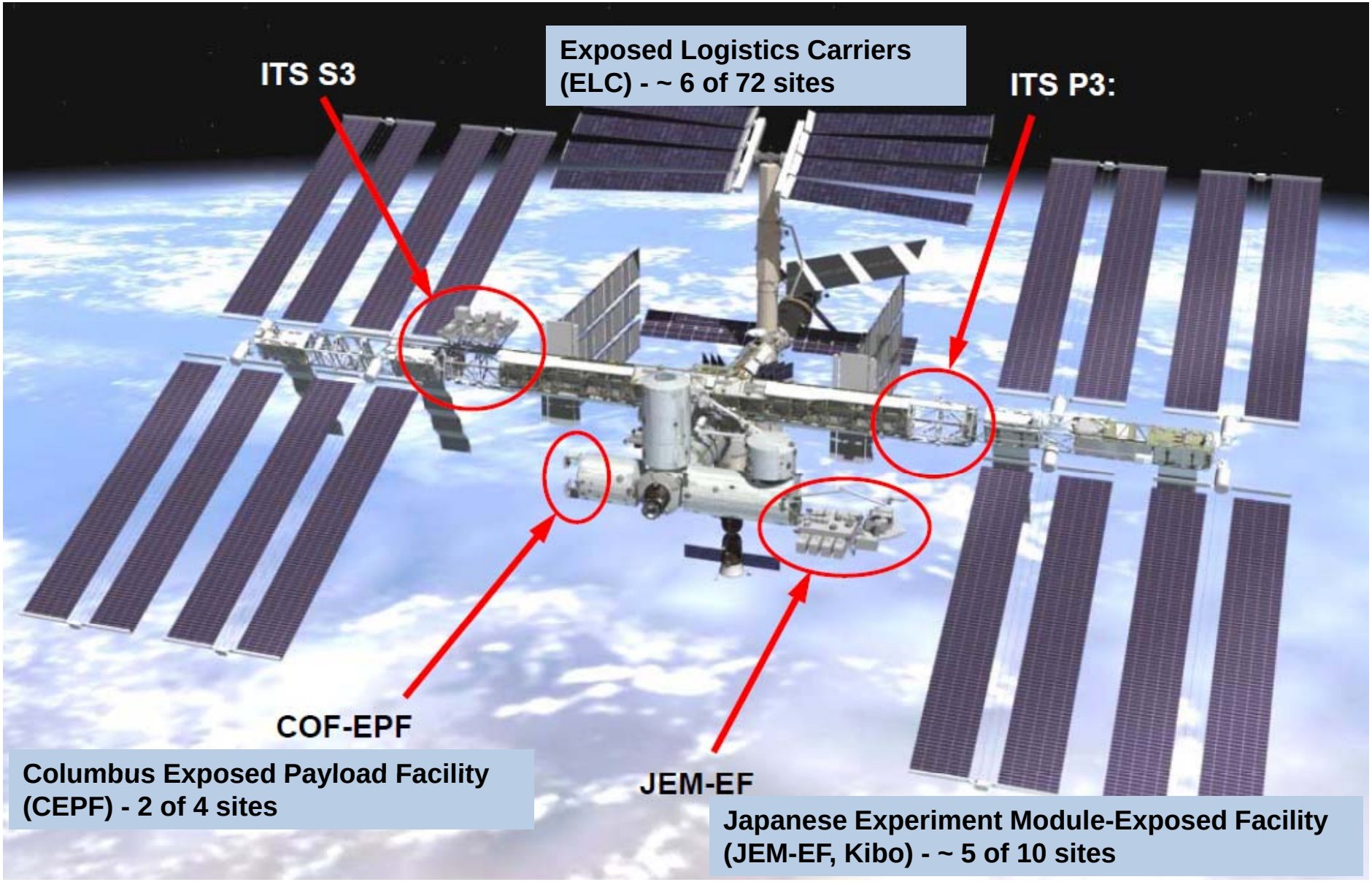
This document does not contain export-controlled information.

Topics

- **ISS Overview**
- **General Features**
- **Specific Locations**
- **Environments**
  - **Natural**
  - **Programmatic**

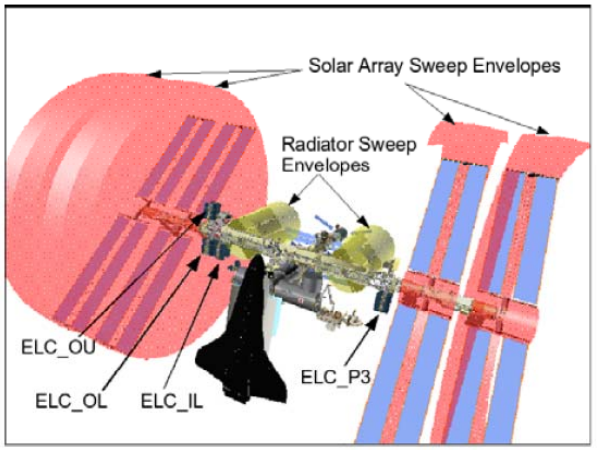


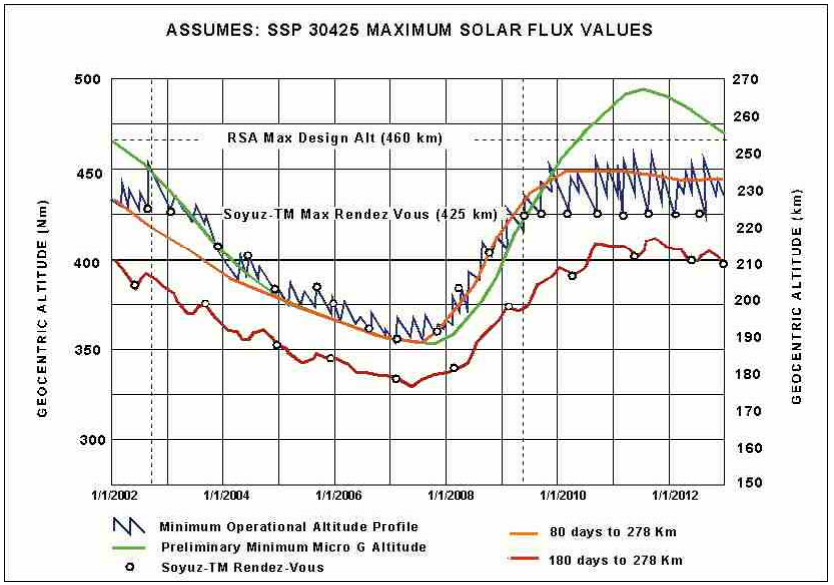
ISS Overview



General Features

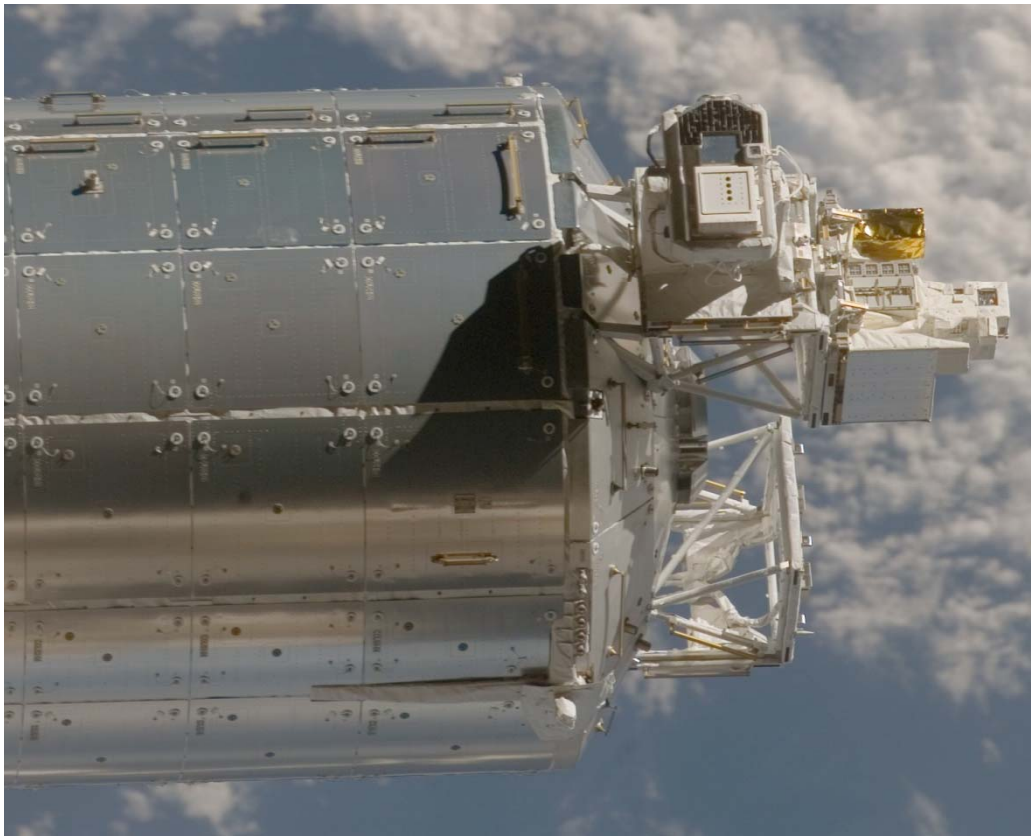
- 51.6° orbit, 91-minute period
- 340 – 440 km altitude
- Oriented for orbital stability
  - Station oriented to Earth mostly
  - Solar Panels/Radiators pointed to/away from the Sun
- Pointing Accuracy
  - ±0.08° for roll & pitch and +0.23°/-0.02° yaw (bending of truss)
- Communications with Earth
  - via TDRSS, : ~ 90%

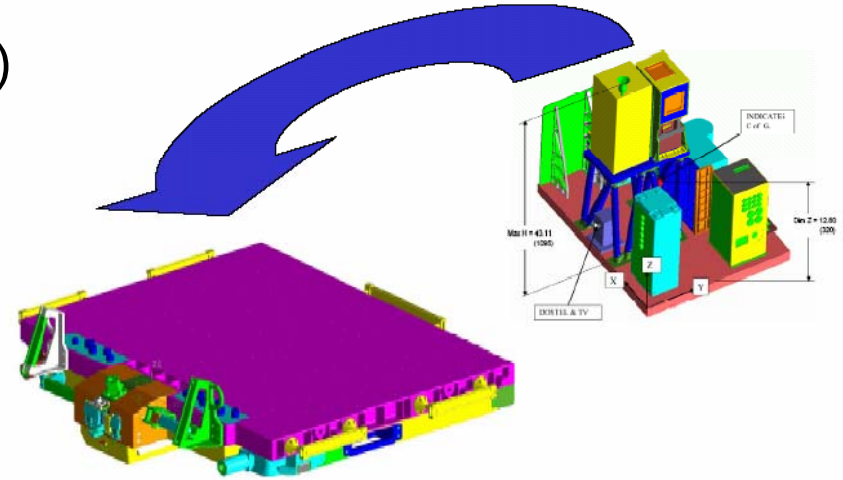




Columbus External Payload Facility (CEPF)

- 4 external sites (2 available to NASA)
- 0.86m x 1.2m baseplate x 1.2m tall
- Mass < 227 kg



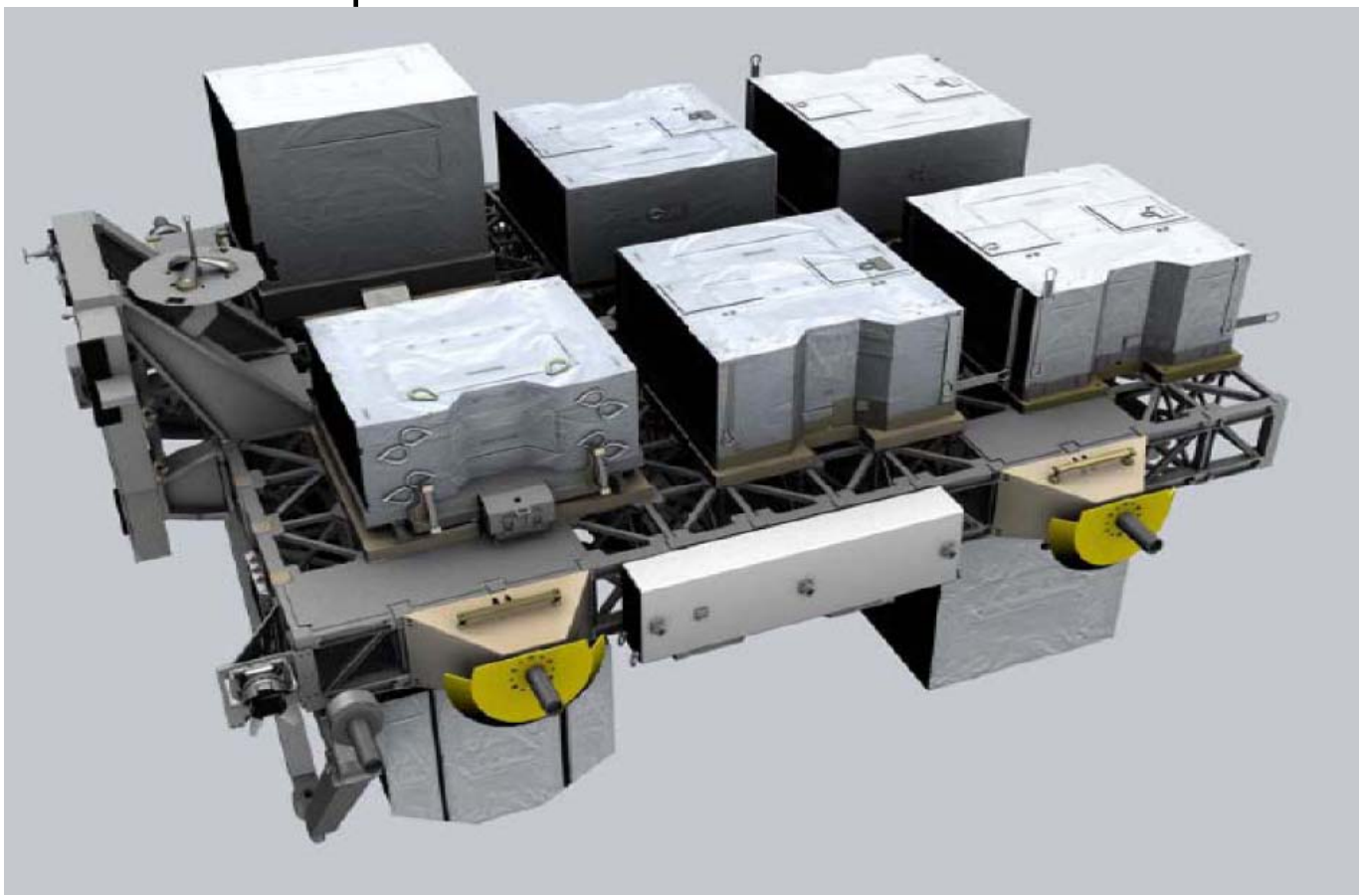


- Standard attachment mechanism
  - Actuatable by crew or robotic tools

- 120Vdc, 1,250W
- MIL-STD-1553B, 10Mbps Ethernet

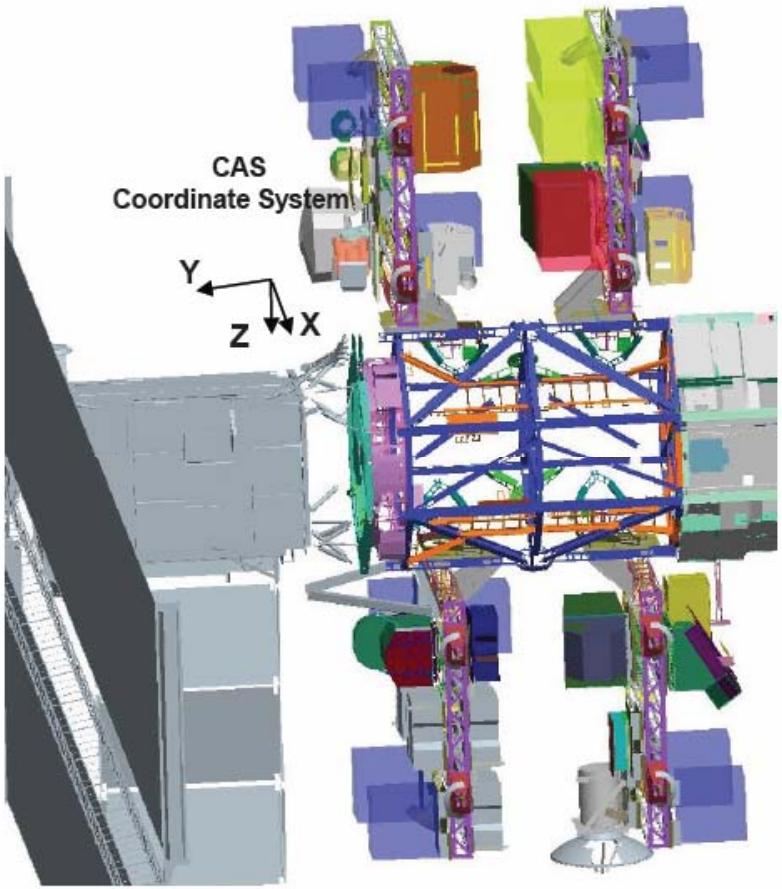
ExPRESS Logistics Carrier

- 6 ELC sites, 2 Science Payloads/ELC
- Same envelope, mass, services as CEPF
- ELC were integrated on the ground
- Payloads can be removed & replaced on orbit

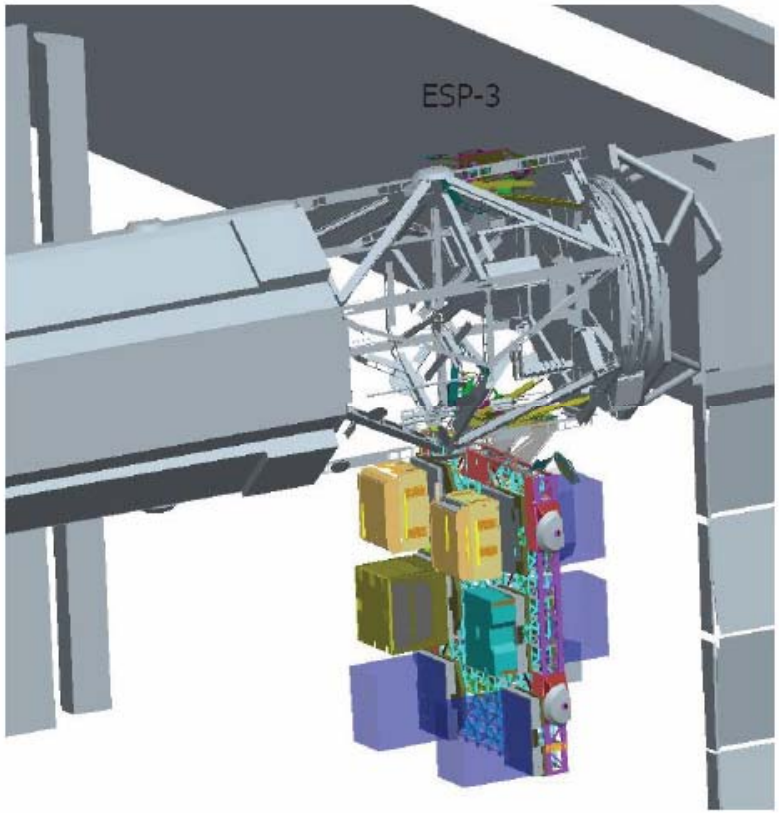


ExPRESS Logistics Carrier

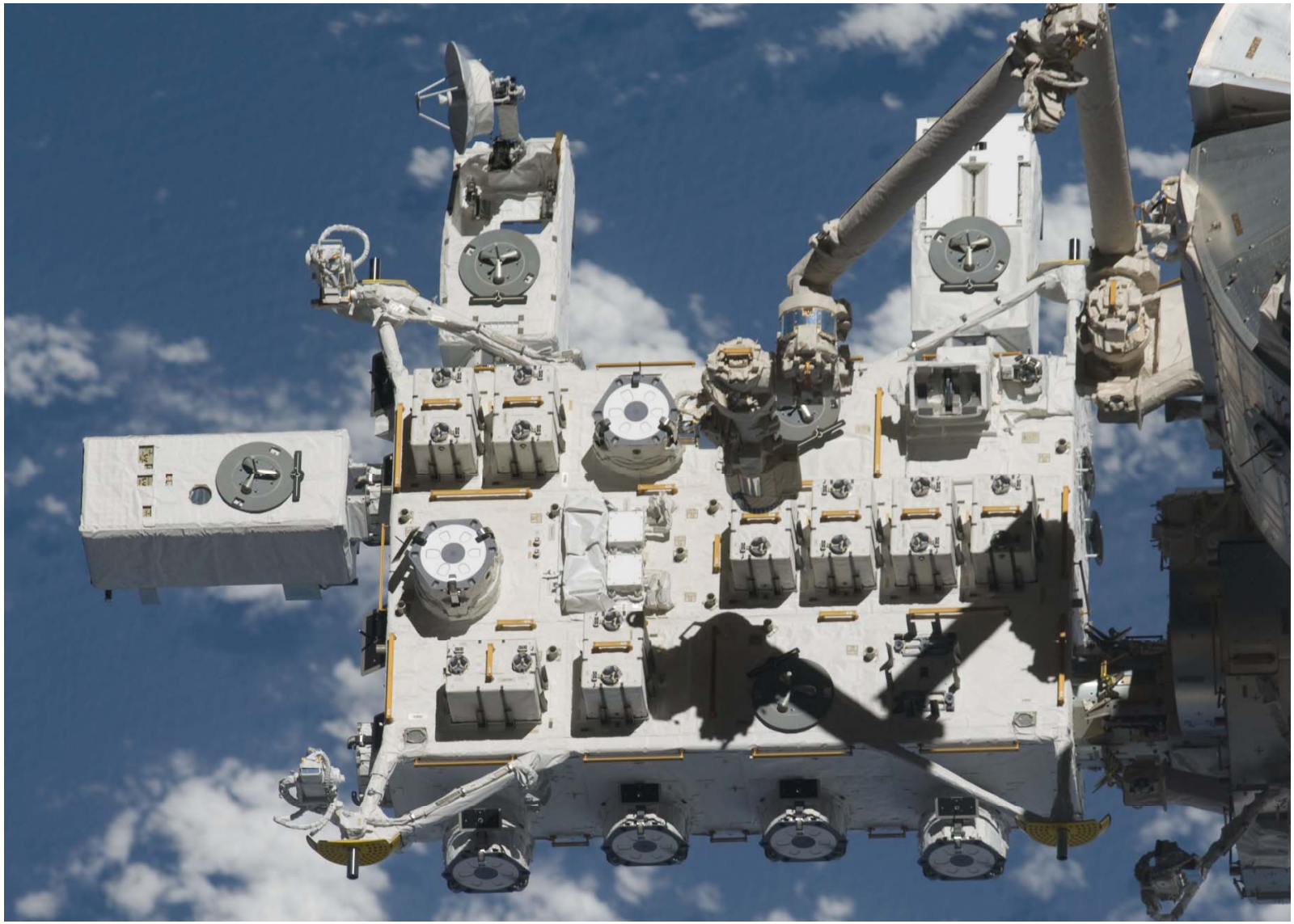
S3



P3

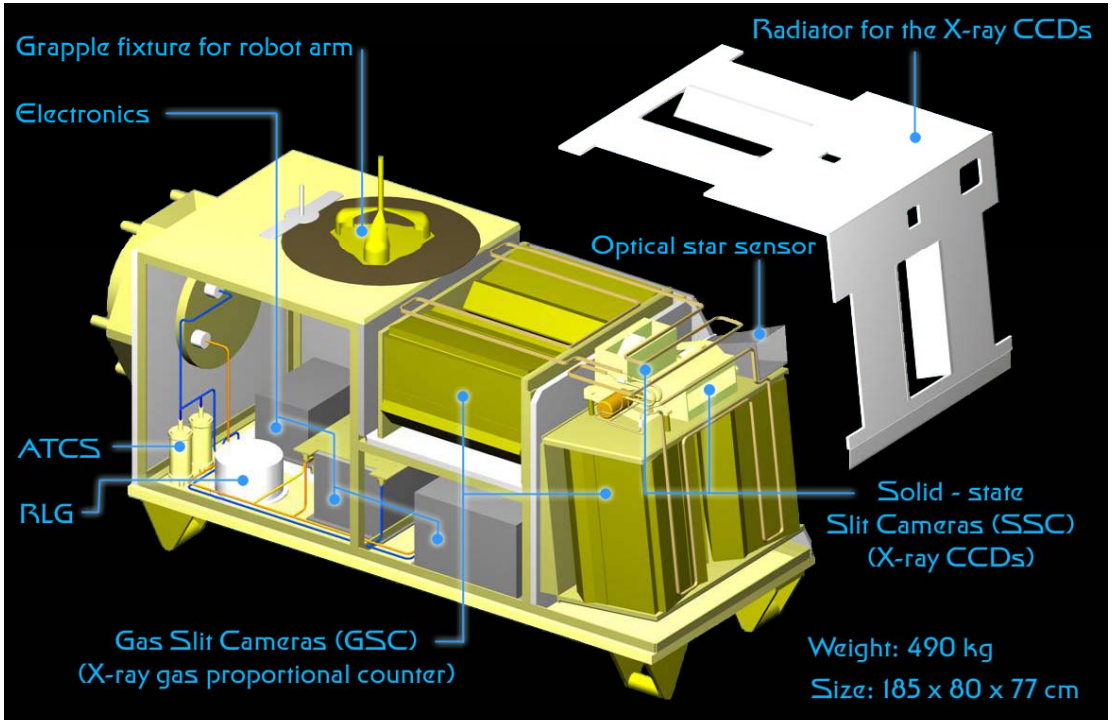


Kibo: Japanese Experiment Module – Exposed Facility



JEM-EF Payload

- **Unique interfaces**
  - **To JEM-EF (Payload Interface Unit)**
  - **To launch vehicle (Payload Attachment Mechanism)**
  - **To ISS Arm (Grapple Fixture)**
- **Mass**
  - **Nominal: 500 kg**
  - **Heavy: 2,500 kg (2 sites)**
- **120 Vdc; 3,000W**



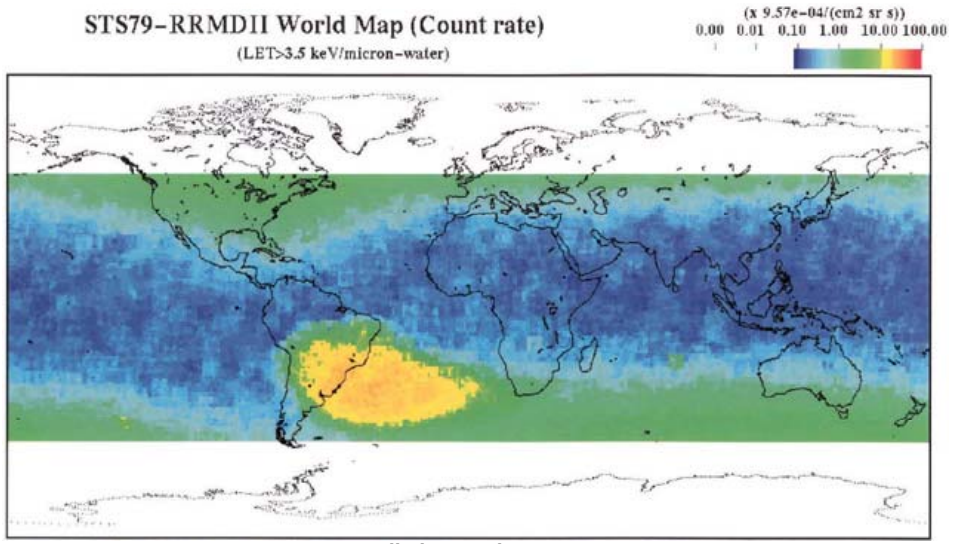
MAXI – JEM-EF Payload

ISS Locations: Summary

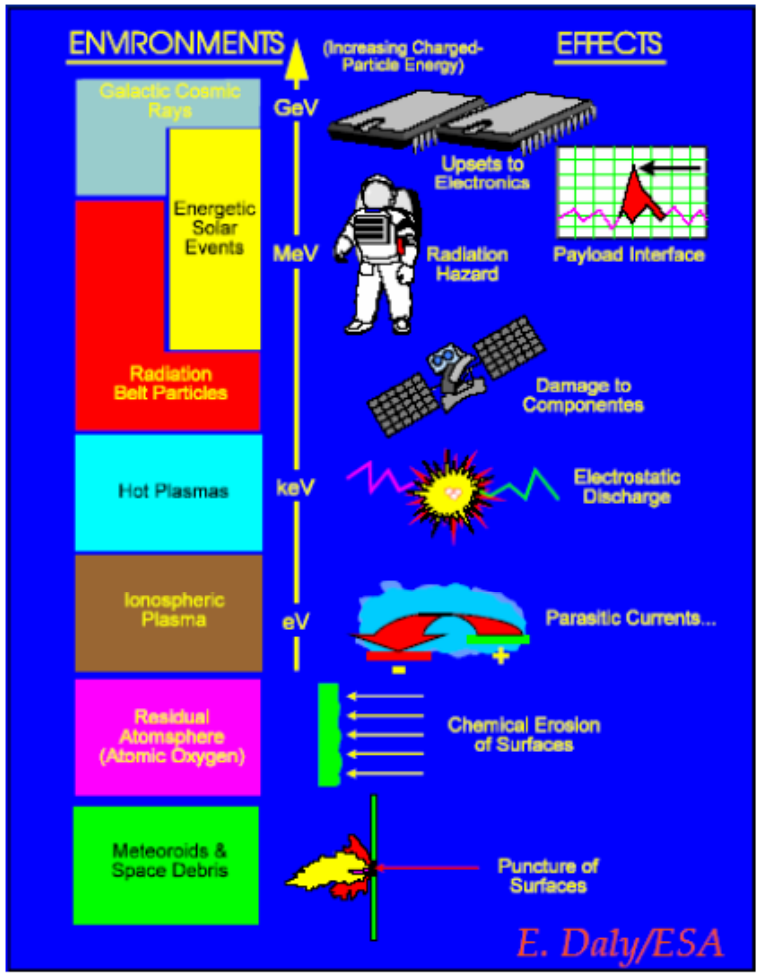
ISS Location	Mass (kg)	Volume (m^3)	Dimensions (m)	Voltage (VDC)	Power (W)	MIL-STS-1553B	Ethernet (10 Mbs)	Hi Rate (100 Mbps)
Columbus	227	1.2	0.8 x 1.2 x 1.2	120	1250	√	√	
Kibo (JEM-EF)	500	1.5	1.85 x 1.0 x 0.8	120	3000	√	√	√
ELC	227	1.2	0.8 x 1.2 x 1.2	28	750	√	√	

Environment

- Thermal
  - 3K sink, 1420 W/m^2
- Contamination
  - < 1 μg/cm/year
- Radiation
  - trapped protons, Galactic Cosmic Rays
- Orbital debris & meteroids



JAXA, STS-91 Space Radiation Environment Measurement Program



Barth J., "The Radiation Environment", NASA/GSFC Presentation.

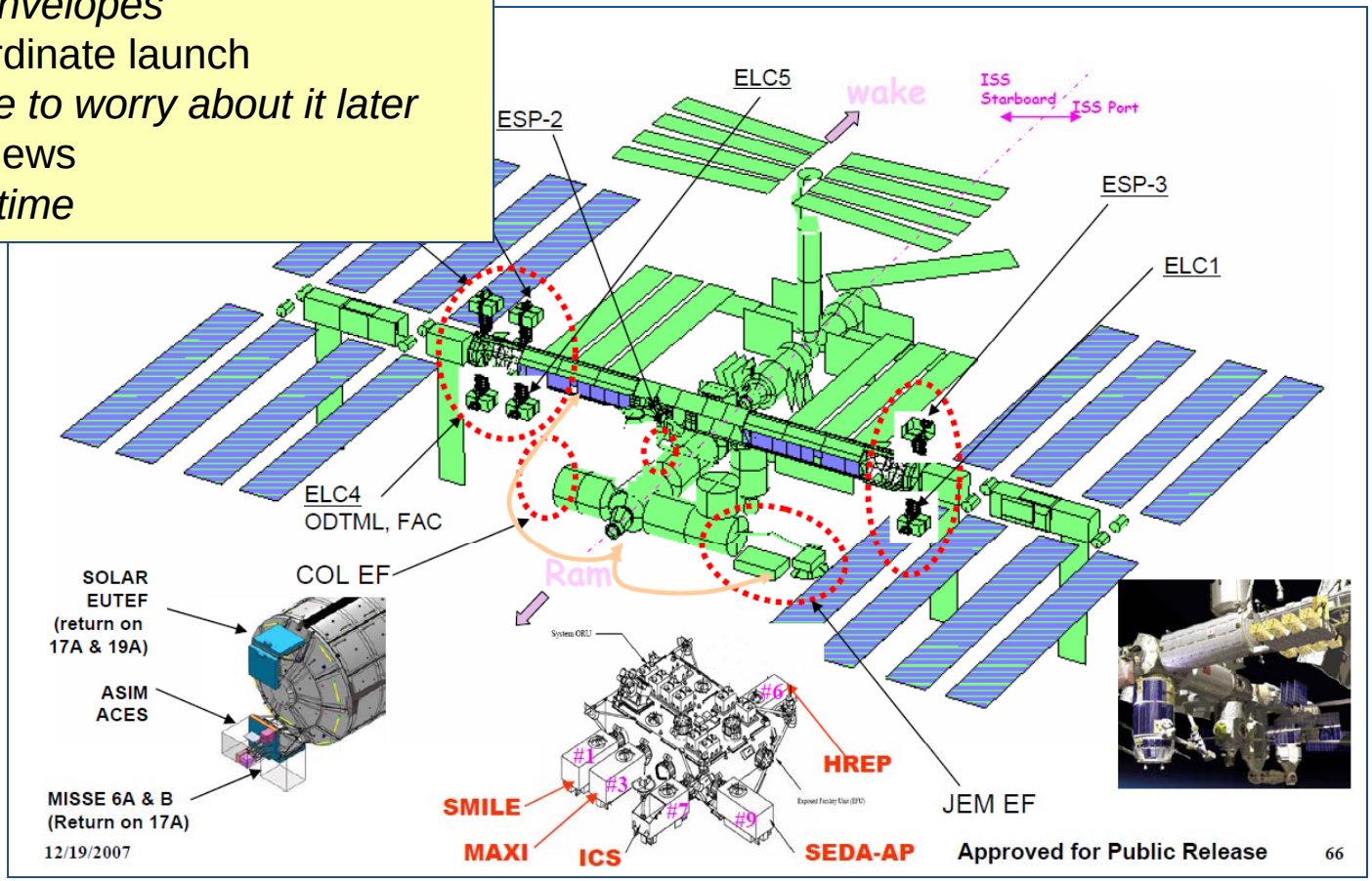
Programmatic Environment

Payload Integration (ISS Payloads Office, Code OZ)

- Formal “3-year” development process
- Safety Process
  - Driven by launch vehicle
  - Generic & unique hazards (pressure vessels, lasers, batteries)
- Launch Services
  - At no cost to Payload Developer
- Analytic Integration

Summary

Above the atmosphere
but ISS carries its own
Long-duration mission
in 30-minute snips
Mass is not at a premium
only small envelopes
You don't have to coordinate launch
but you have to worry about it later
Unobstructed zenith views
most of the time



Acknowledgement

- Much of this presentation was derived from a presentation by Gene Cook (ISS Payloads Office) in December 2007 titled “ISS Unpressurized Payload Accommodations” *<www.nasa.gov/pdf/206852main_SMEX_Presentations_website.pdf>*
- Some information was obtained from the NASA Science and Technical Information Program Office document, “Overview of Attached Payload Accommodations and Environments on the International Space Station” (Nov 2007) , *<http://www.nasa.gov/pdf/190373main_TP-2007-214768.pdf>*
- The photographs were obtained from the Web

- Additional information can be obtained
  - For Columbus Exposed Payload Facility from:

    *www.spaceflight.**esa**.int/users/downloads/userguides/colaccom.pdf*

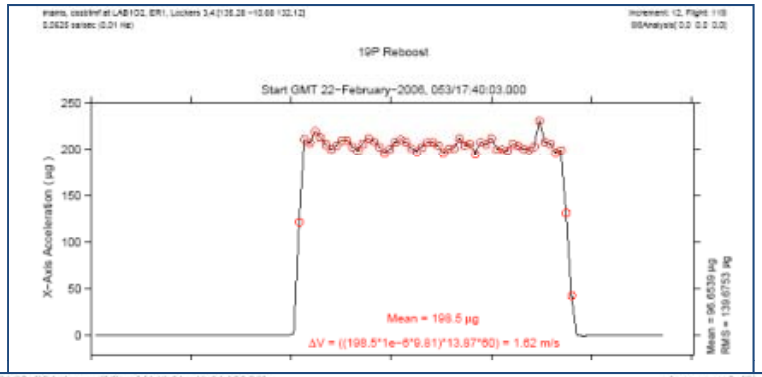
  - For JEM Exposed Facility from:

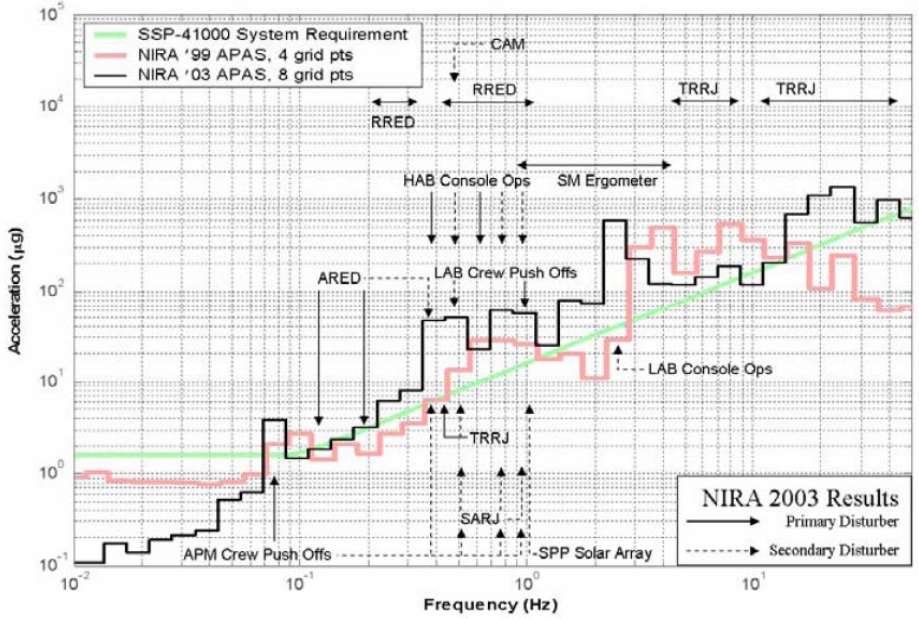
    http://idb.exst.jaxa.jp/edata/02110/199810K02110040/199810K02110040.html

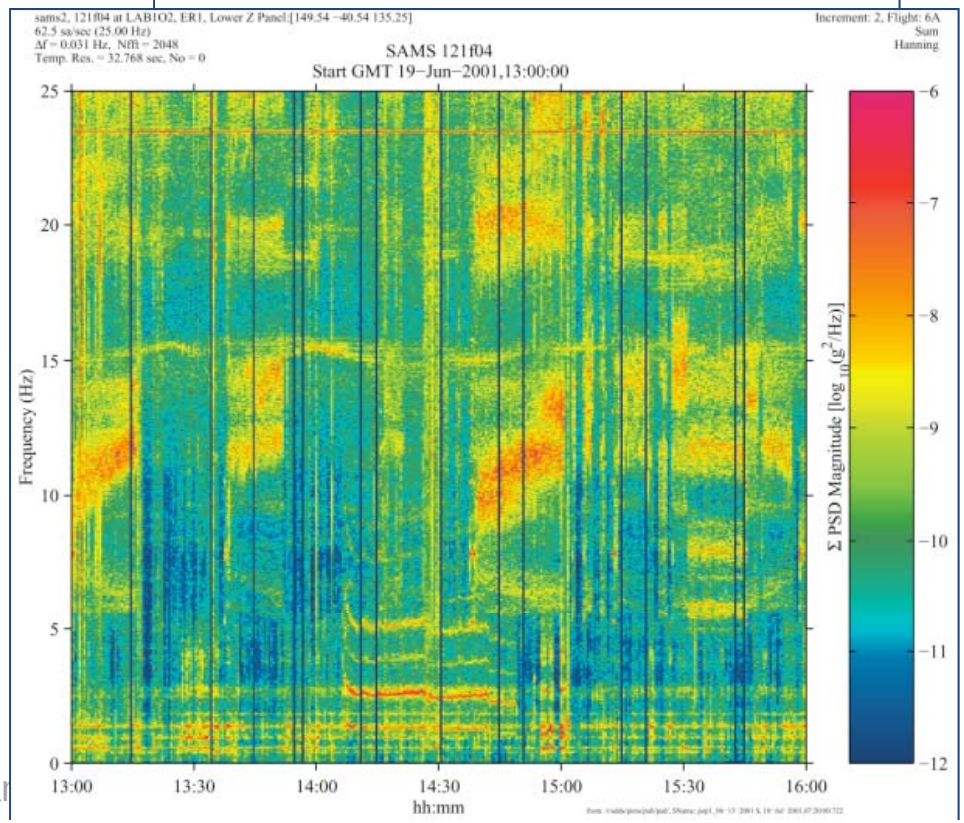
Backup Slides

Backup: Accelerations

- 0.2-g, 15-minute reboost
- 2 micro-g quasistatic acceleration
- Dynamic vibration environment

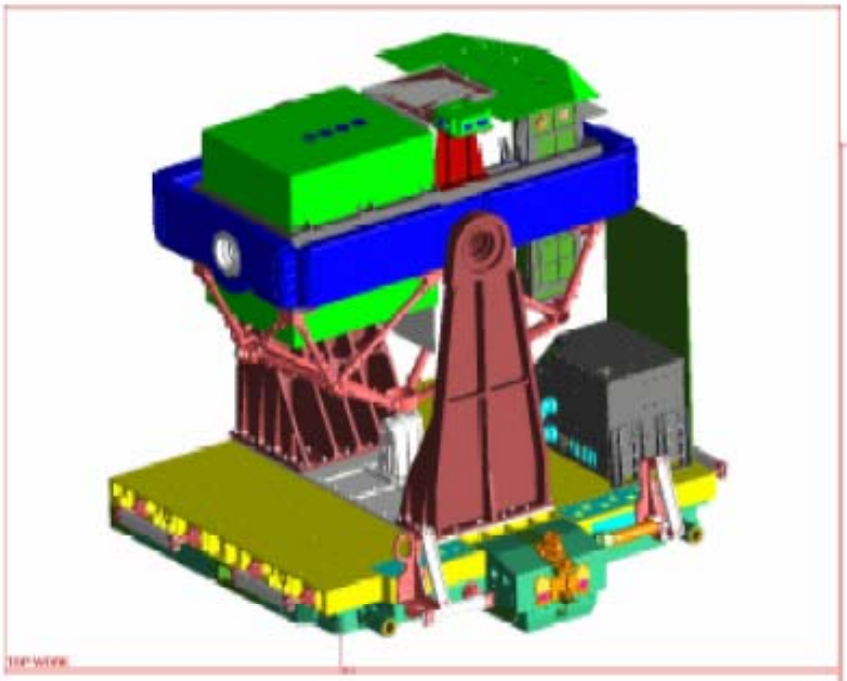






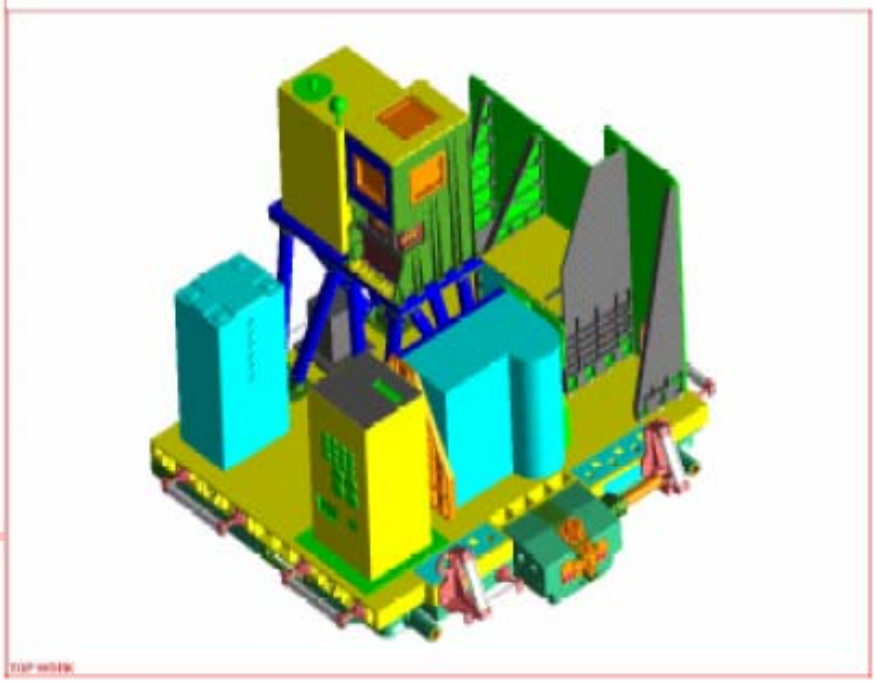
Backup: CEPF Payloads

SOLAR on CEPA



-SOLAR Payload with Integrated Carrier
(EVA mass = ~ 800 lbs)

EuTEF on CEPA



- EuTEF (European Technology Exposure Facility)
Payload with Integrated Carrier (EVA mass = ~ 752 lbs)

Backup: CEPF Payload Fields of View

-Z: toward zenith

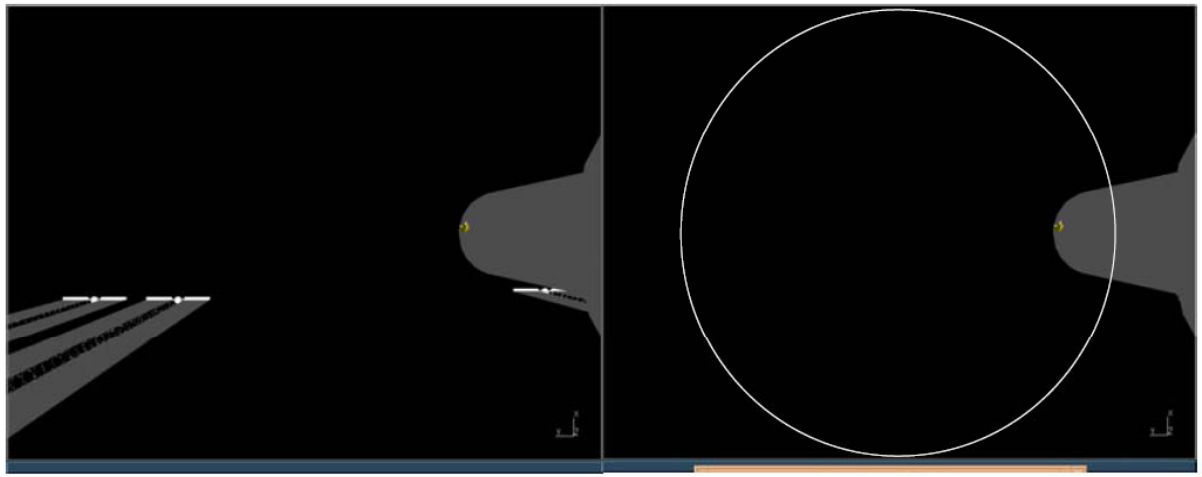


Figure 4.4-5: Columbus-EPF looking –Z, orbital sunrise (left), and orbital noon (right).

Figure 4.4-6: Columbus-EPF looking +Y, orbital sunrise (left), and orbital noon (right).

Backup: ELC Payload Fields of View

-Z: toward zenith

Figure 2.4-8: S3 upper truss, -Z, orbital sunrise (left), and orbital noon (right).

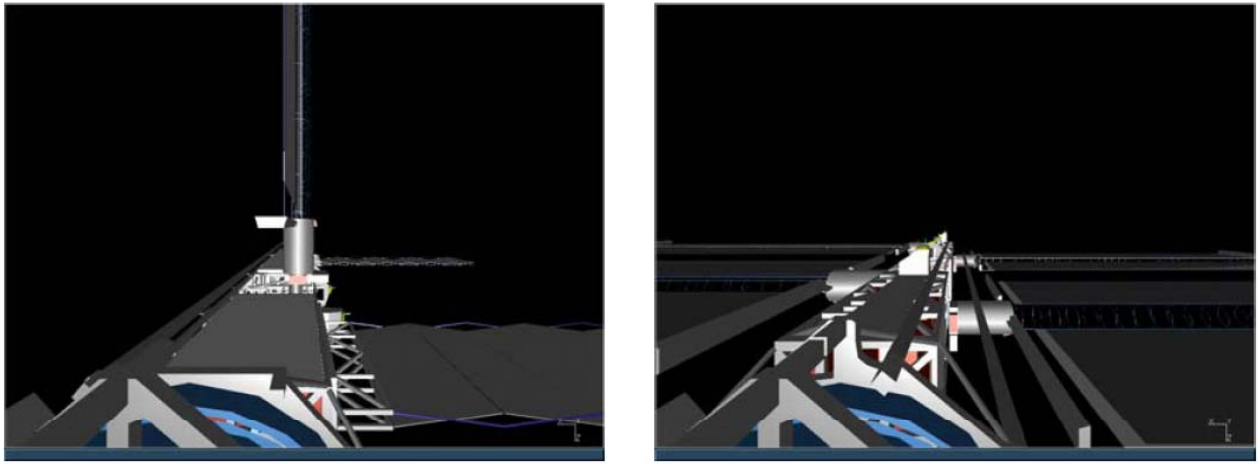
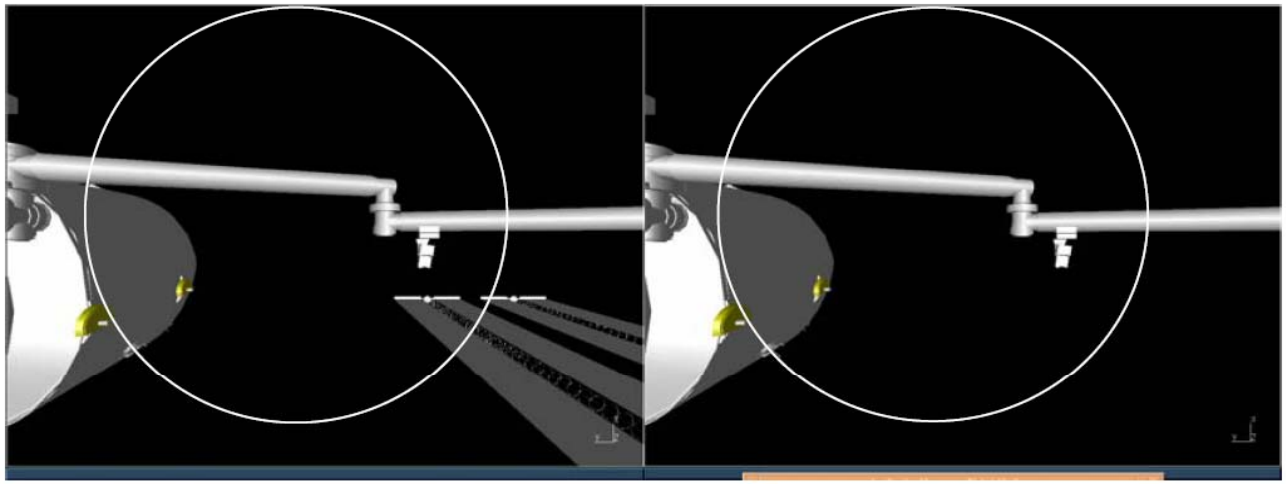


Figure 2.4-9: S3 upper truss, +Y, orbital sunrise (left), and orbital noon (right).

Backup: JEM-EF Payload Fields of View



-Z: toward zenith

Figure 3.4-5: JEM-EF, -Z, orbital sunrise (left), and orbital noon (right).

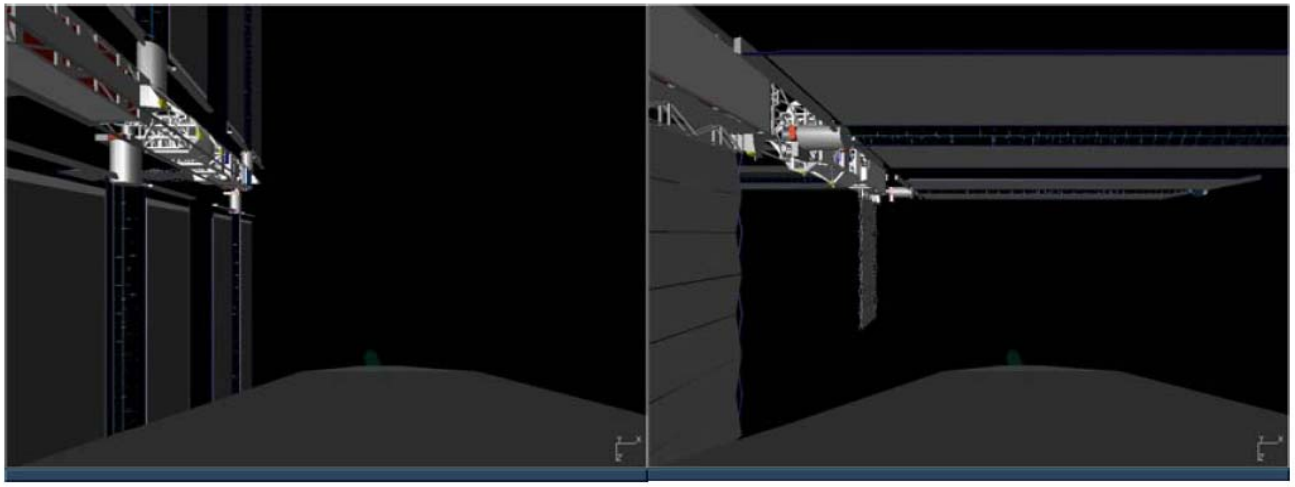
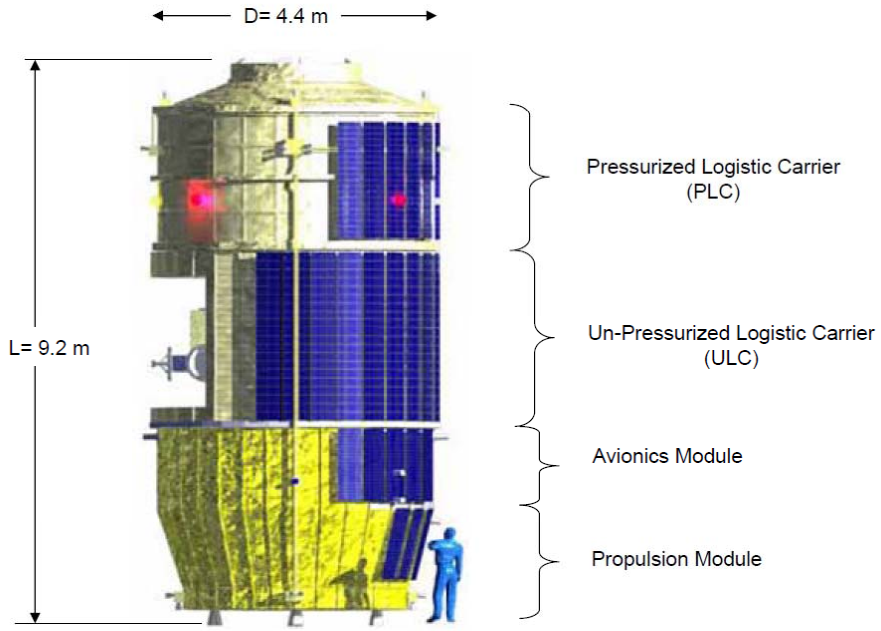


Figure 3.4-6: JEM-EF, -Y, orbital sunrise (left), and orbital noon (right).

Backup: Launch Opportunities

- Space Shuttle
- HTV
- SpaceX/Falcon 9/Dragon

Dragon

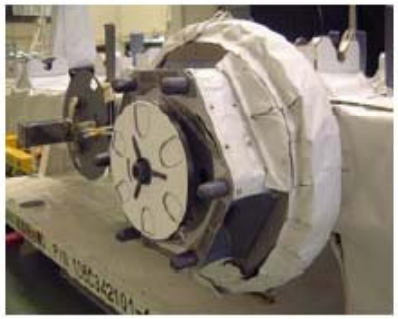


HII-A Transfer Vehicle

Backup: Accommodation Hardware

Mandatory Accommodation Hardware

- JEM EF payload
  1. Flight Releasable Grapple Fixture
  2. Payload Interface Unit
  3. HTV Cargo Attachment Mechanism (HCAM)
  4. HTV Connector Separation Mechanism (HCSM)



- FRAM payload (ExPA, CEPA)
  1. Flight Support Hardware
  2. Adapter plate
  3. ExPA or CEPA
  4. Passive FRAM
  5. PFRAM adapter plate

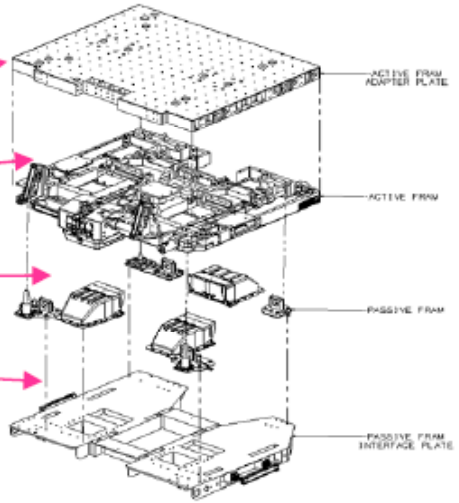


TABLE 3.5.1.2-1 HOT AND COLD NATURAL THERMAL ENVIRONMENTS

Case	Solar Constant (W/m^2)	Earth Albedo	Earth Outgoing Long Wave Radiation (W/m^2)
Cold	1321	0.2	206
Hot	1423	0.4	286

TABLE 3.5.1.2-2 INDUCED THERMAL ENVIRONMENTS

Induced Environment	Assumed Parameters
Beta Angle	+/− 75°
Altitude	150 nmi. to 270 nmi.
Attitude Envelope Without Orbiter (1)	Any combination of +/−15° Roll (about X axis) (2) +/−15° Yaw (about Z axis) (2) +15 to −20° Pitch (about Y axis) (2)
Attitude Envelope With Orbiter Docked to ISS (1)	Any combination of +/− 15° Roll +/− 15° Yaw 0 to 25° Pitch

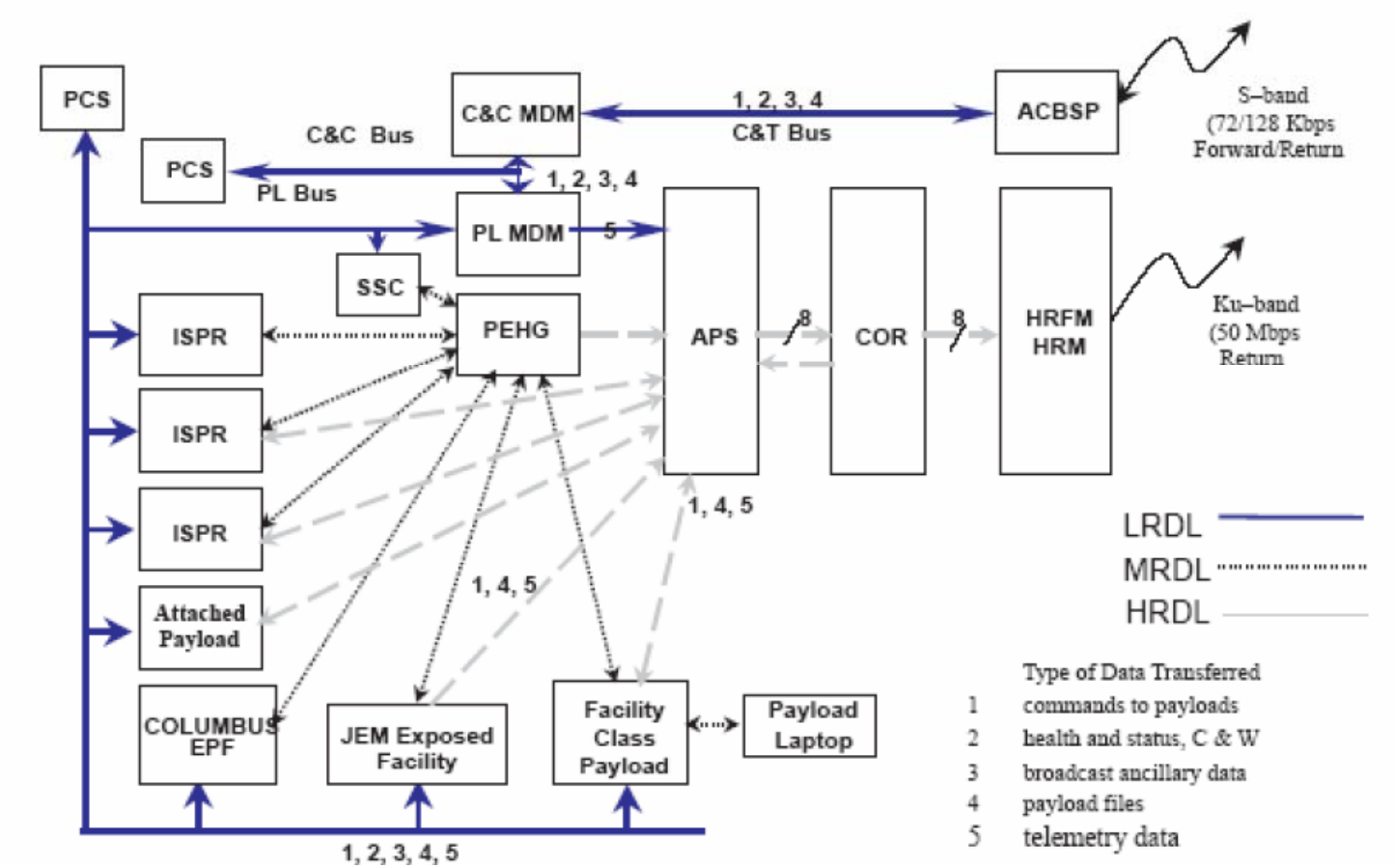
Note(s):

1 The attitude variations include variations in the Torque Equilibrium Attitude (TEA) as well as variations in the ISS attitude from the TEA attitude, both with Orbiter docked, and without Orbiter.

2 XYZ axes refer to ISS coordinate system orientation.

Backup: ISS Communications

- All NASA payloads use NASA communication resources
- Ground communications with Payload Operations are via Internet



Backup: Alpha Magnetic Spectrometer