The International Perspectives
- Looking Back/Looking Ahead -

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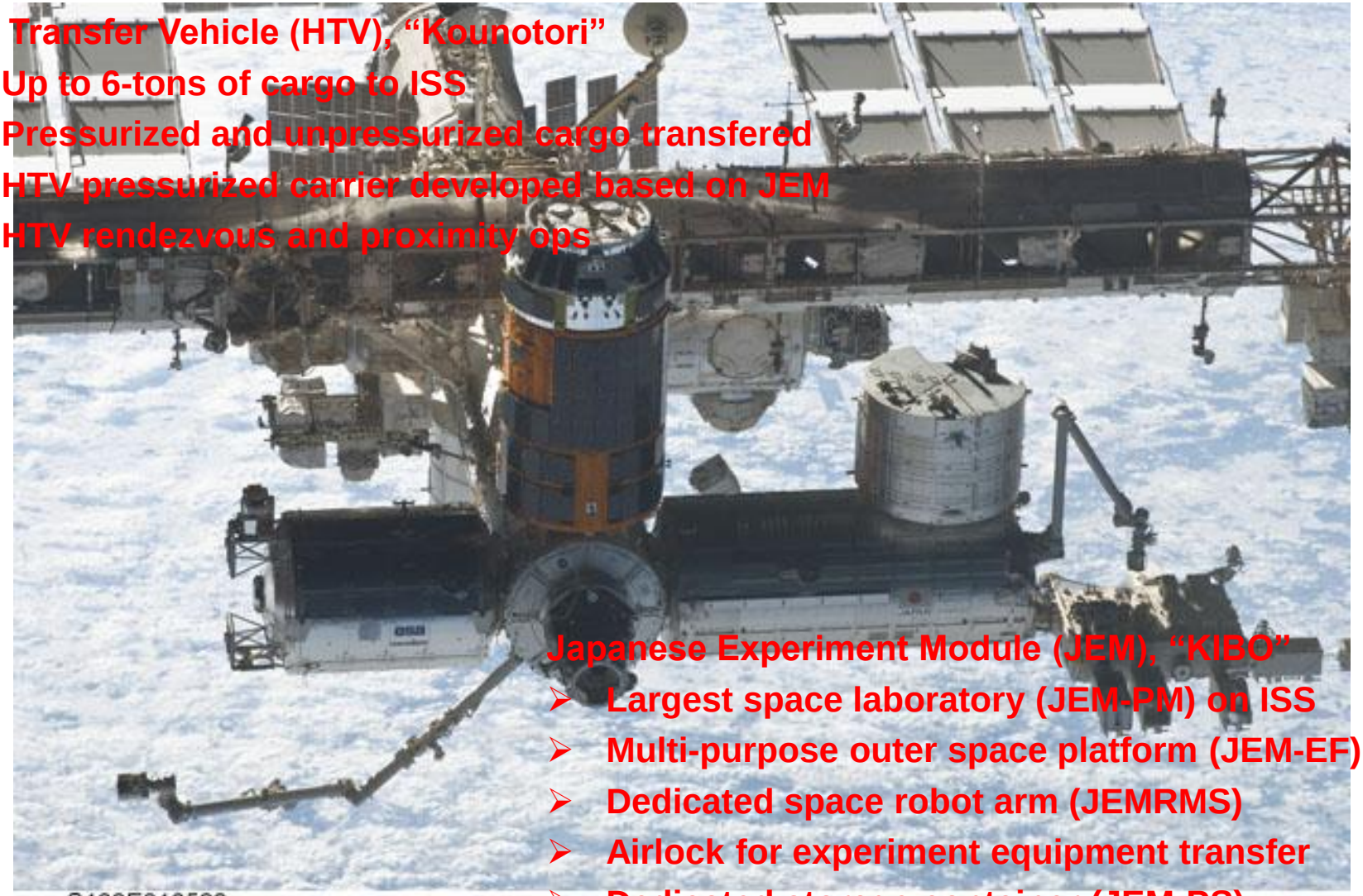
Shinobu Doi
JEM Mission Operations and Engineering Center
Japan Aerospace Exploration Agency

S133E010447

Japan's Major Contribution to ISS

H-II Transfer Vehicle (HTV), "Kounotori"

- Up to 6-tons of cargo to ISS
- Pressurized and unpressurized cargo transfered
- HTV pressurized carrier developed based on JEM
- HTV rendezvous and proximity ops



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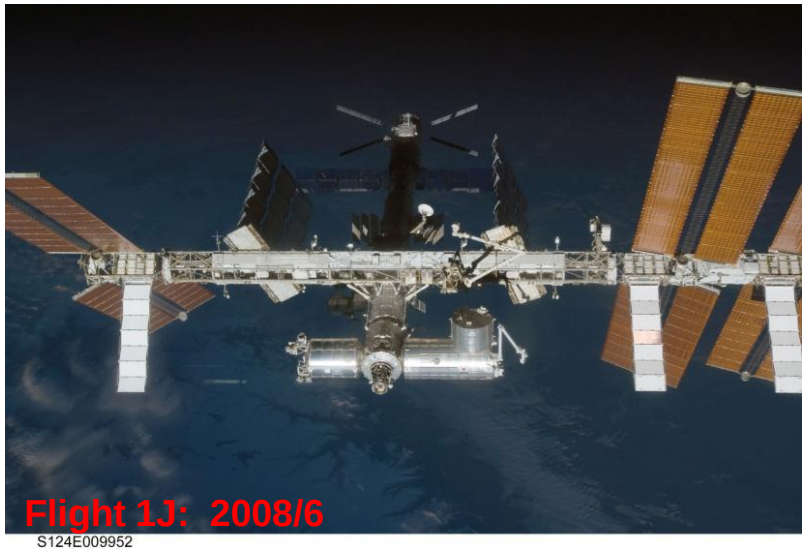
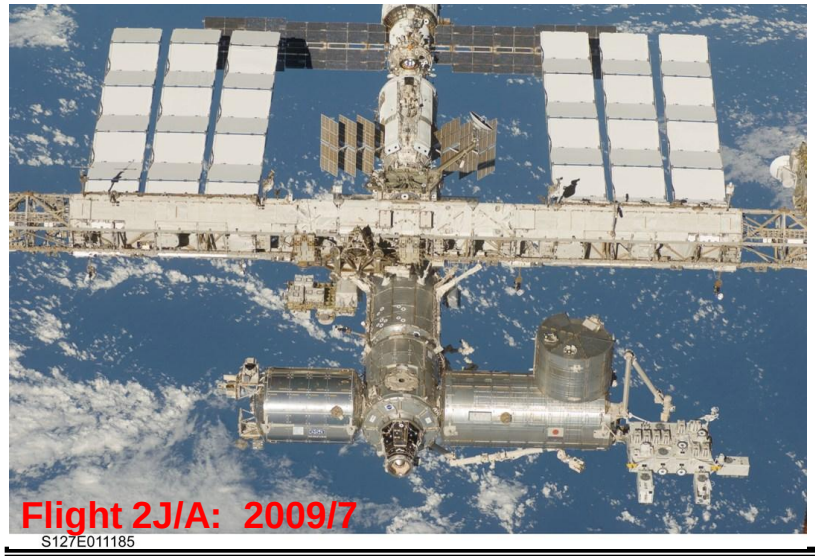
Japanese Experiment Module (JEM), "KIBO"

- Largest space laboratory (JEM-PM) on ISS
- Multi-purpose outer space platform (JEM-EF)
- Dedicated space robot arm (JEMRMS)
- Airlock for experiment equipment transfer
- Dedicated storage container (JEM-PS)

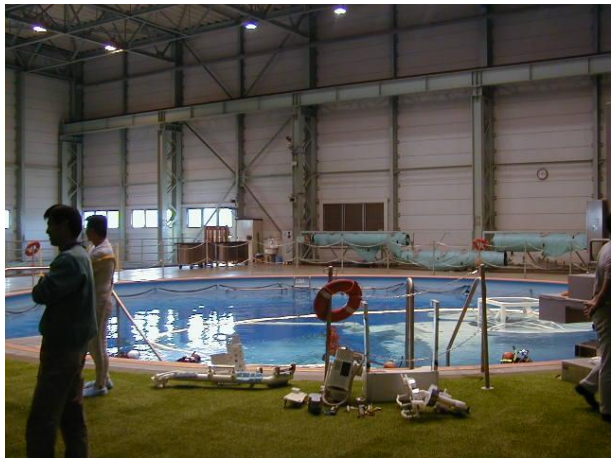
Successful JEM Assembly



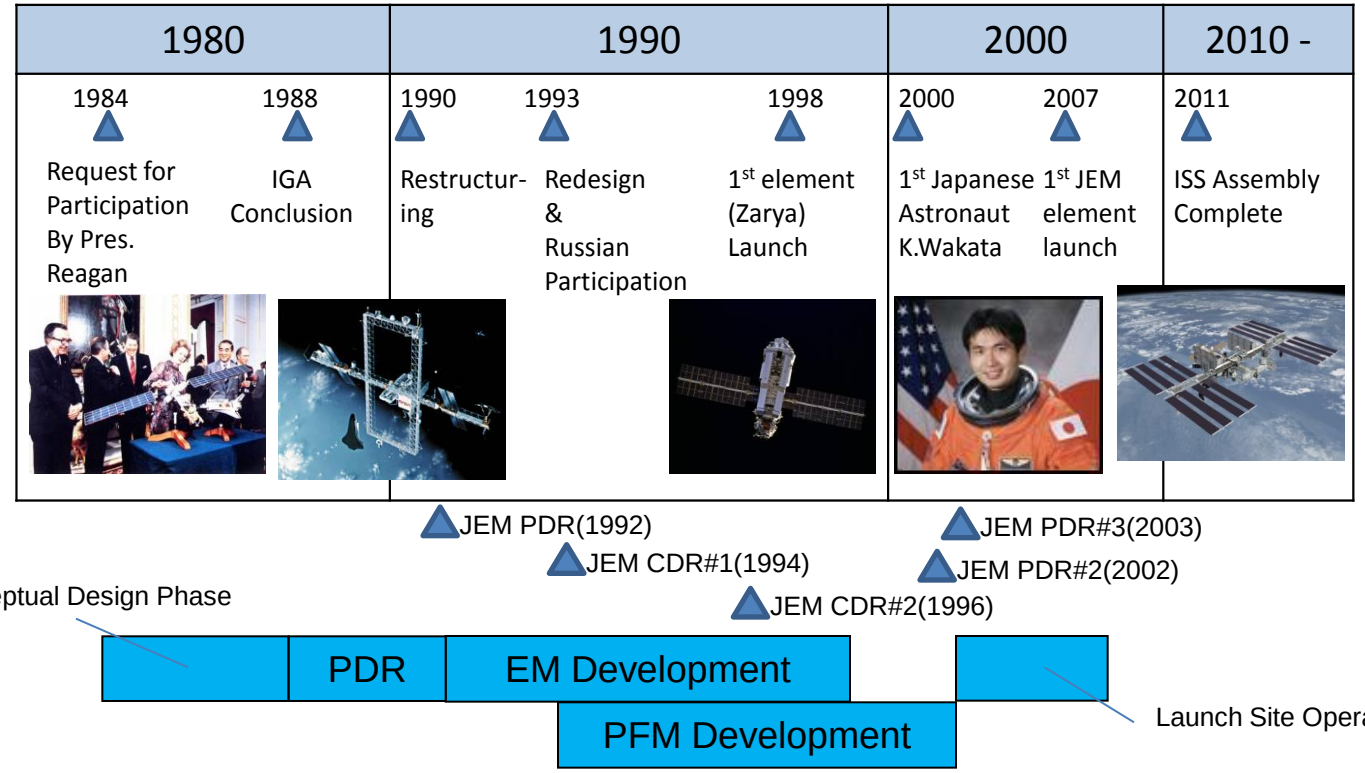


Looking Back (1/3)
- Gained Human Space Technology -

- Development human-space modules
  - Experiment Module, “KIBO”
  - Unmanned Logistics Transporter, “Konotori”
- Integration skills
  - Program management,
  - Systems Engineering, Systems Integration
  - Safety Assurance for manned system
- Operations and controls of the human-space crafts
- Flight crew related capabilities
  - JAXA’s astronauts : 5 flown to ISS, 3 candidates
  - Trainings and simulations



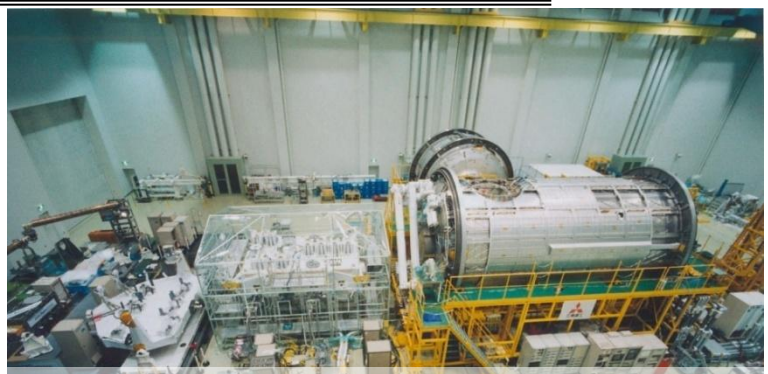
Looking Back (2/3)
- Prolonged Development Schedule -



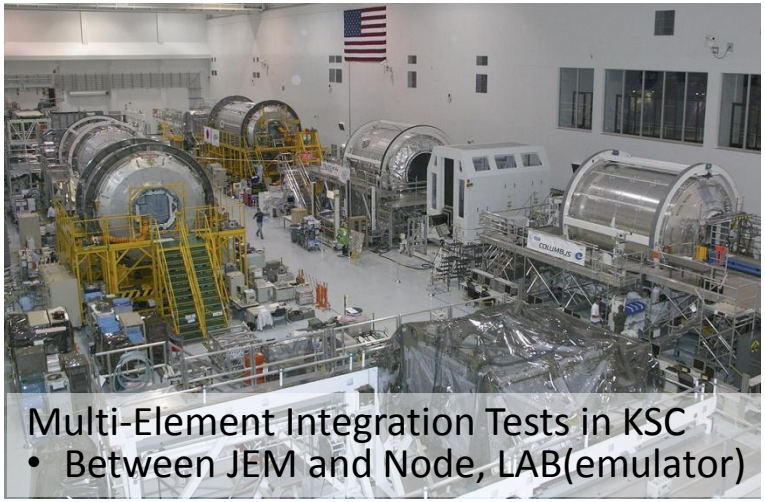
- **Frequent program changes resulted in design and interface changes, and caused a complicated development process.**

Looking Back (2/3)
- Integration and End-to-End Test-

- "Integration" is a crucial part for huge systems.
  - JEM system level led by JAXA, 8 main contractors at maximum
  - ISS system level led by NASA
- "End-to-End test" is also crucial for "Integrated system" verification.
  - End-to-end tests start with "Interface tests"
  - The scope of "end-to-end" varies depending on disciplines but should be widened as much as possible.
  - End-to-end tests should include the operational demonstrations as well.
- In order to compensate the gap of the development phase of each hardware, stepwise tests were considered for the risk mitigation.
  - NASA-JAXA Joint Test for EPS and C&DH were performed in four steps from the EM phase.



JEM System level E-t-E test in Japan
- Between JEM elements
- Between JEM elements and payloads
- Between Ground system and JEM/Payloads



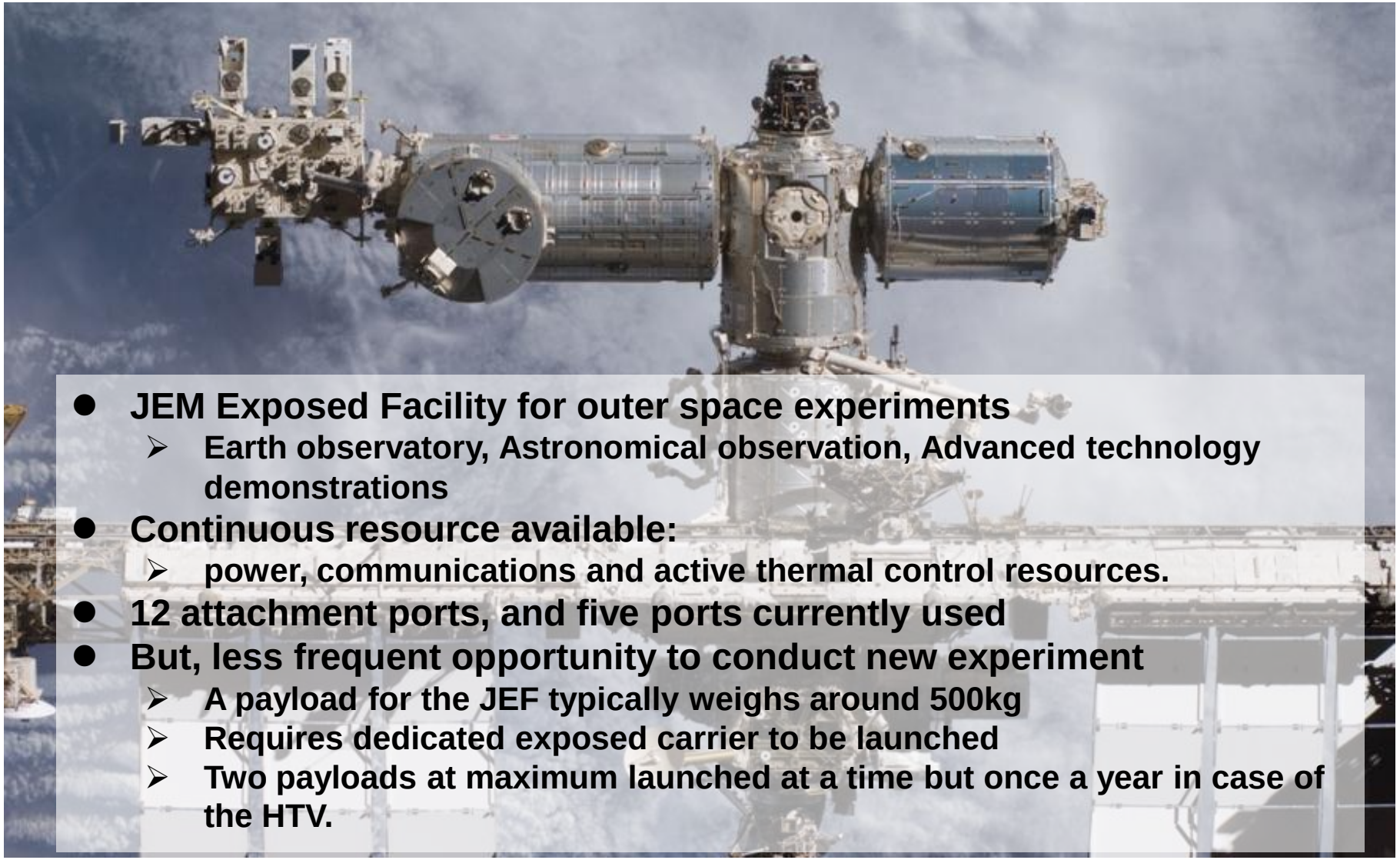
Multi-Element Integration Tests in KSC
- Between JEM and Node, LAB(emulator)

Looking Ahead

- Key technologies and knowledge of manned space systems obtained through ISS
- JEM and HTV demonstrated to the world Japan's high technology competence and reliable development management
- Maximize use of JEM and HTV in light of ISS operations beyond 2016 and use of JEM as a test bed for future manned space explorations

- Enhance Utilization
- Test beds for future human space exploration

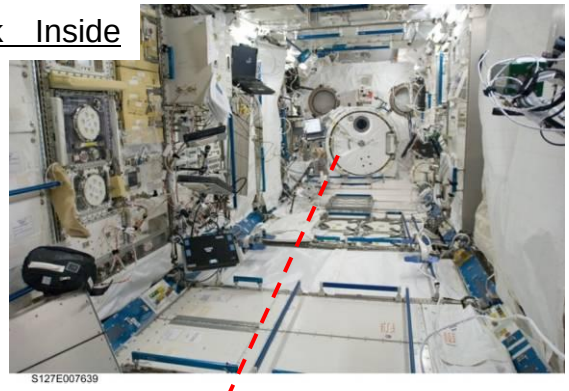
Enhance Utilization



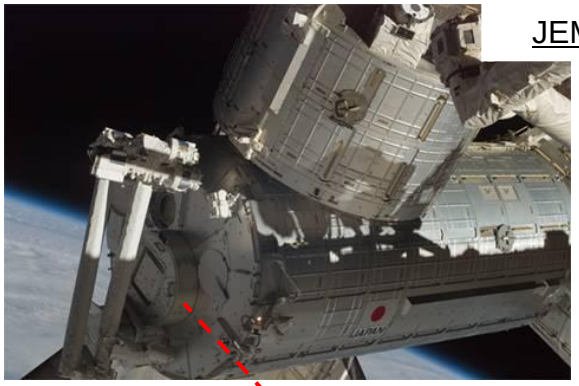
- JEM Exposed Facility for outer space experiments
  - Earth observatory, Astronomical observation, Advanced technology demonstrations
- Continuous resource available:
  - power, communications and active thermal control resources.
- 12 attachment ports, and five ports currently used
- But, less frequent opportunity to conduct new experiment
  - A payload for the JEF typically weighs around 500kg
  - Requires dedicated exposed carrier to be launched
  - Two payloads at maximum launched at a time but once a year in case of the HTV.

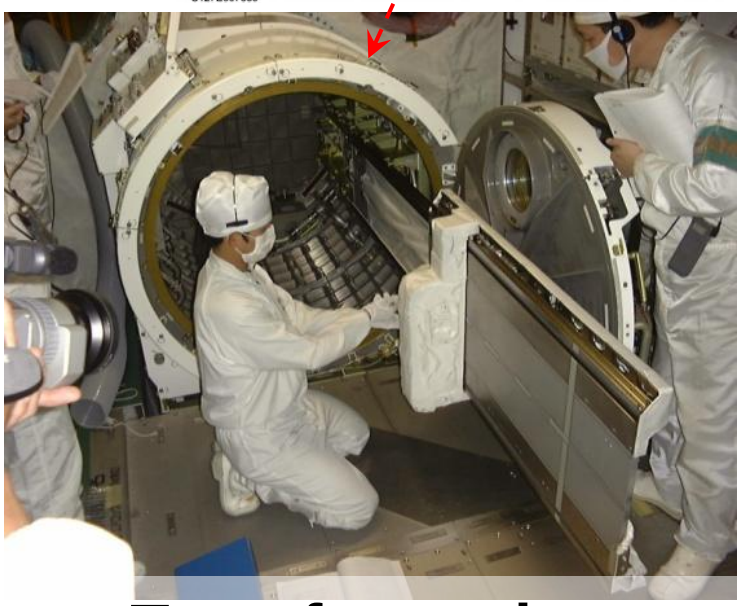
Enhance Utilization
- JEM Unique Capability; JEM Airlock -

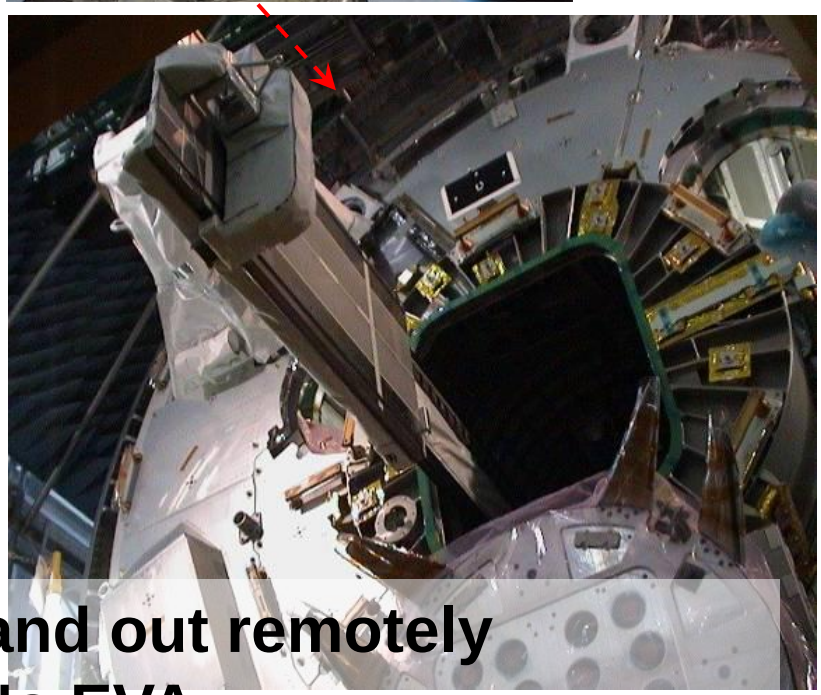
JEM Airlock Inside



JEM Airlock Outside



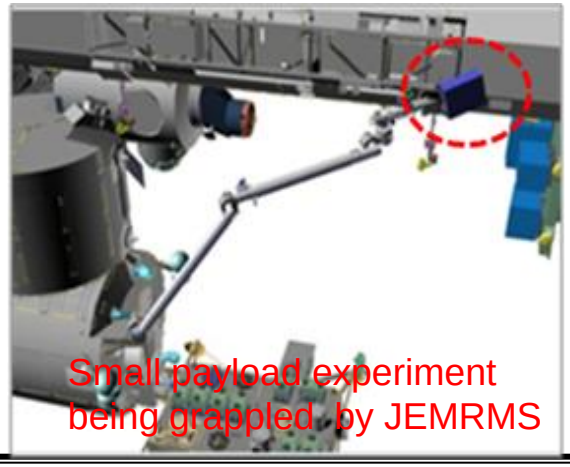




- **Transfer equipment in and out remotely**
- **Robotics Compatible, No EVA**

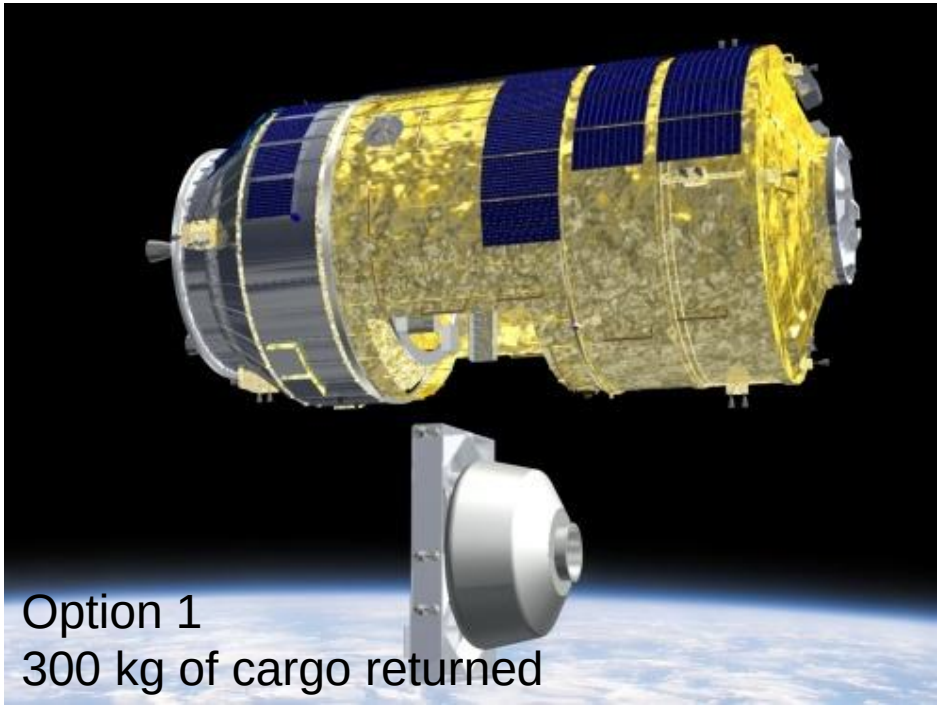
Enhance Utilization
- JEM Unique Capability; JEM Airlock -

- Alleviated launch environment (Soft bag is used for launch)
- More frequent launch opportunity
- Continuous experiment opportunity until the end of the ISS life
- Checkout and/or troubleshooting capability by crew in the pressurized section
- Return opportunity as necessary



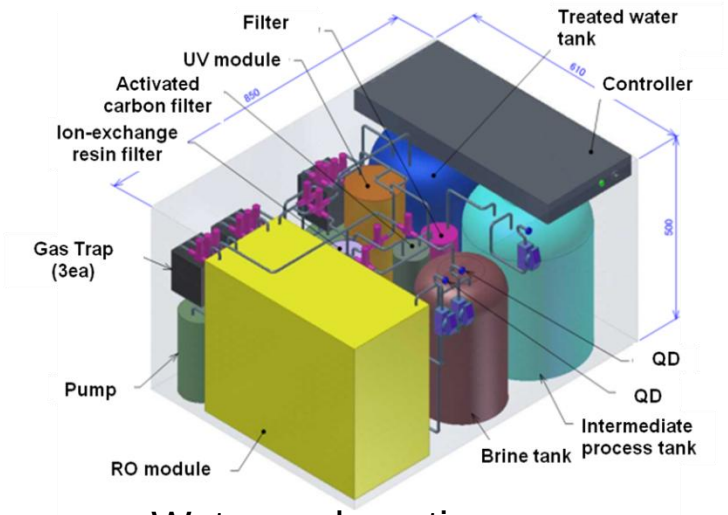
Maximize the use of HTV for future mission
- HTV Return Concept -

- Cargo return capability from ISS
- HTV-R demonstration flight in mid. 2010s
- Stepping stone in adding human capability to the HTV-R after 2020



Test beds for future human space exploration

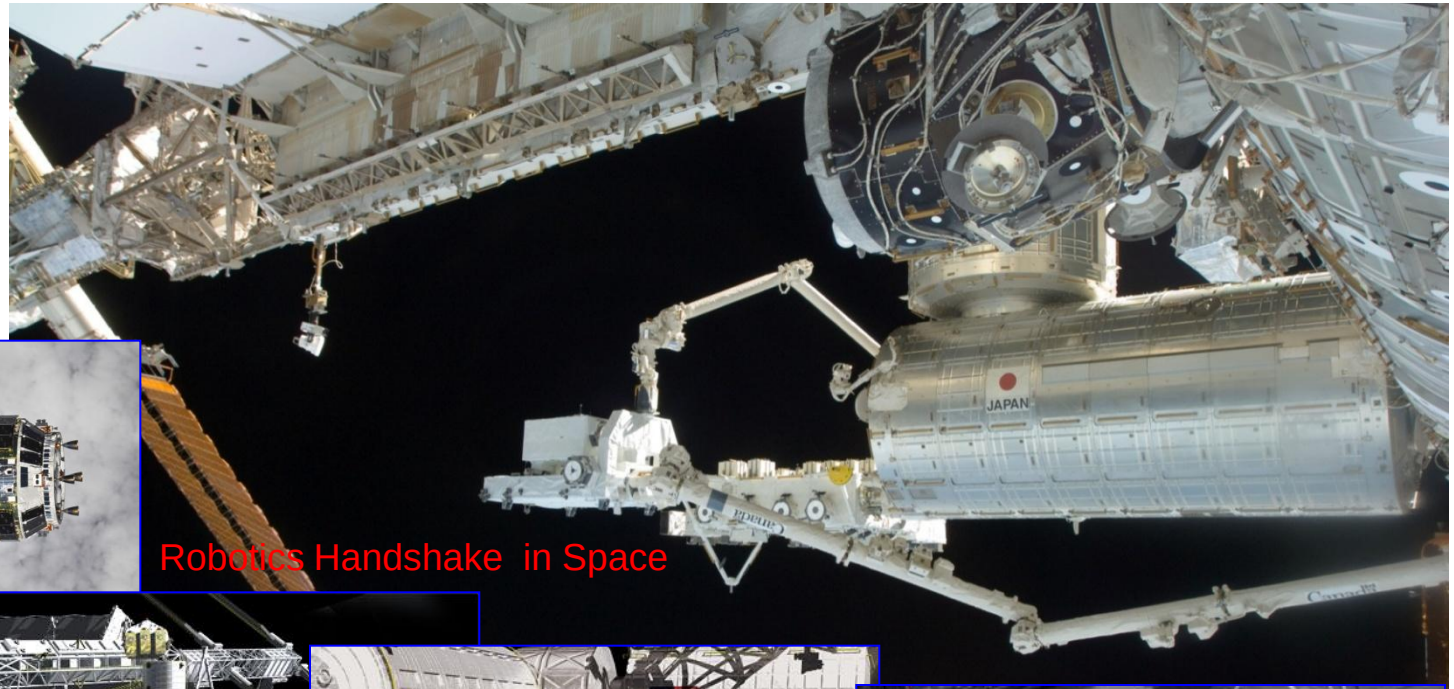
- JEM depends on the ISS for power generation, life support system.
- JAXA is proposing to develop and demonstrate these key technologies that will be essential for a long-duration manned mission. For example,
  - Water reclamation
  - Air reclamation
  - Revitalized fuel-cell (RFC)



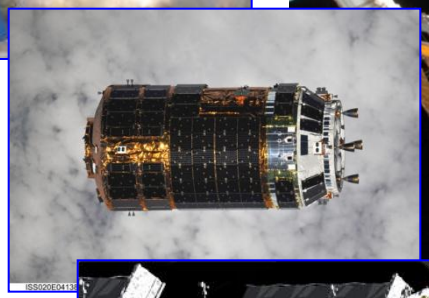
Water reclamation

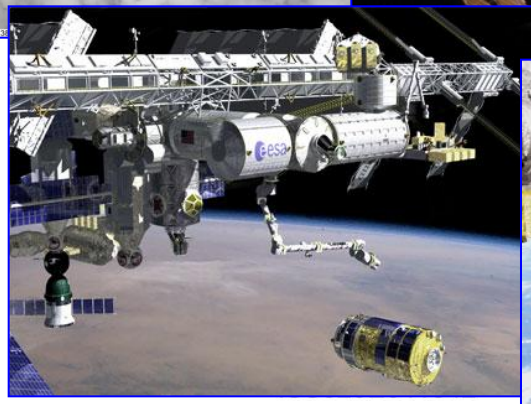
Revitalized fuel-cell (RFC)

Symbolic ISS Operations



Robotics Handshake in Space





Flt HTV1, September 2009

Thank you,