Japan's Contributions to the International Space Station (ISS)

June, 2013
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Space Vehicle Technology Center
Japan Aerospace Exploration Agency (JAXA)

Congratulations on 50th Anniversary

50

5

1963.6.16

2008.3.11 The fist part of Japanese Experiment Module was launched

International Space Station

- 1984: US President Ronald Reagan proposed developing a permanently-occupied space station
- 1988: Governments of Canada, ESA member countries, US and Japan signed the Intergovernmental Agreement on a cooperative framework for the space station
- 1993: Russia joined the program
- 1998: Beginning of on-orbit station assembly
- 2000: Beginning of continuous stay of the astronauts
- 2008: Beginning of assembly of Japanese Experiment Module
- 2011: Completion of station assembly
- Present: In the utilization phase

International Partners

ISS is truly an International space collaboration effort, with the participation of many countries.

(C) NASA

The First Piece of ISS

ISS assembly sequence started in 1998 with the Russian module, Zarya (sunrise), launched by a Russian Proton rocket vehicle.

Zarya provides battery power, fuel storage and rendezvous and docking capability for Soyuz and Progress space vehicles.

Nov. 20, 1998

ISS Under Construction...(1998-2011)

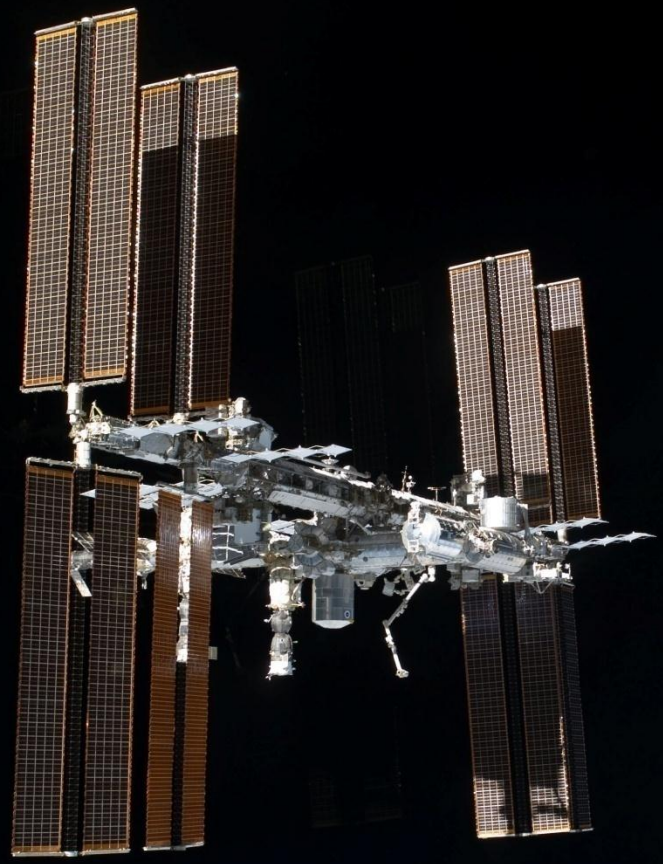
Dec. 1998

Dec. 2000

Dec. 1998

Dec. 2006

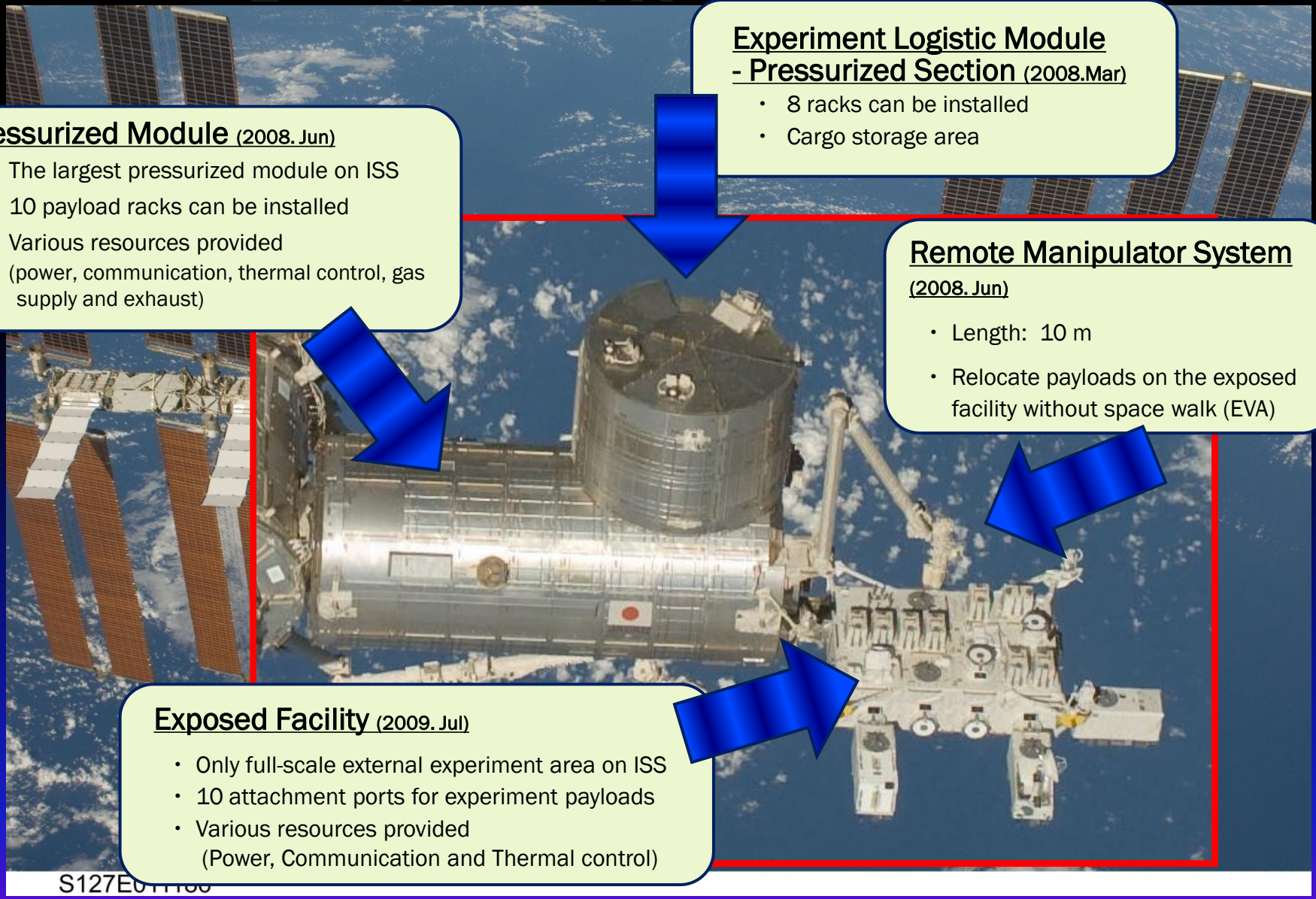
ISS Assembly Completion



July 2011, Space shuttle Atlantis, on its final spaceflight of the Space Shuttle Program, carried the Raffaello multipurpose logistics module.

2011.7@STS-135

Japanese Experimental Module (JEM) - Kibo



Pressurized Module (2008. Jun)

- The largest pressurized module on ISS
- 10 payload racks can be installed
- Various resources provided
  (power, communication, thermal control, gas supply and exhaust)

Experiment Logistic Module - Pressurized Section (2008.Mar)

- 8 racks can be installed
- Cargo storage area

Remote Manipulator System (2008. Jun)

- Length: 10 m
- Relocate payloads on the exposed facility without space walk (EVA)

Exposed Facility (2009. Jul)

- Only full-scale external experiment area on ISS
- 10 attachment ports for experiment payloads
- Various resources provided
  (Power, Communication and Thermal control)

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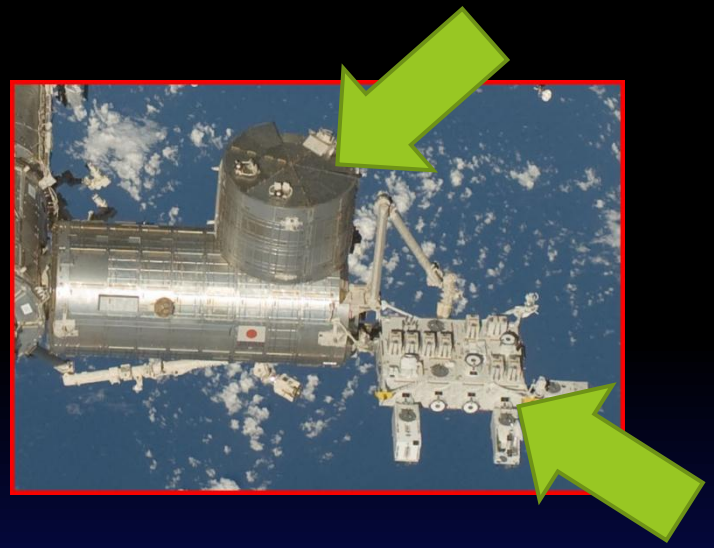
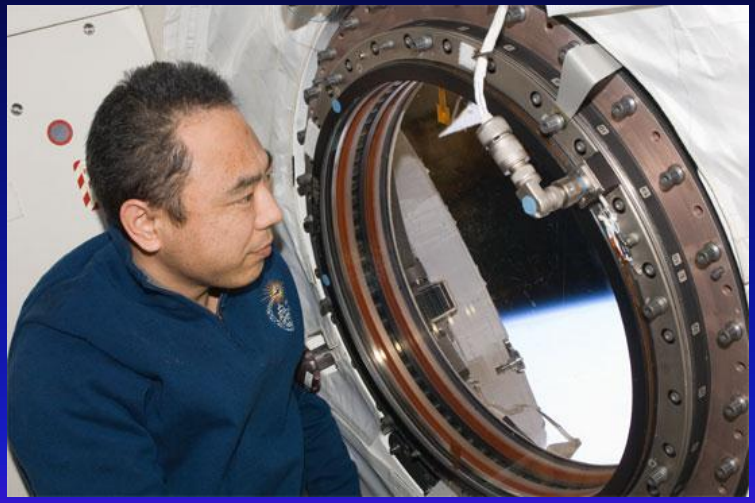
Inside of Kibo
Astronaut Furukawa playing yo-yo in zero gravity

Japanese Style...



- Compact, efficient, clean
- Built-in storage
- Windows with healing views
- Beautiful balcony

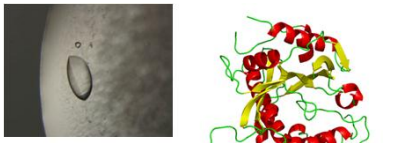


The great music studio in space

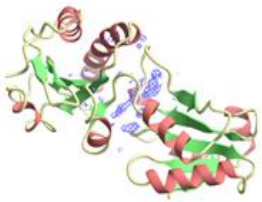
KIBO Utilization Outcomes

Example 1
Contribution to New Medicine Development

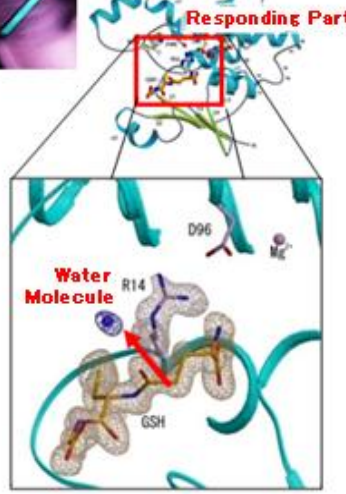
- A high-quality protein crystal was generated in space, and then minute three-dimensional structure data was acquired on the ground.
- Discovery of unknown protein structure which causes illness helps effective selection of appropriate medicine candidate.



Development of remedies for all types of influenza virus



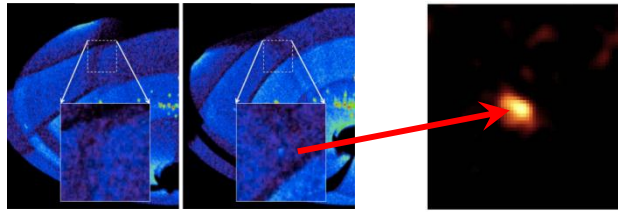
Clarifying the onset mechanism of Alzheimer's disease



Development of a remedy for muscular dystrophy (a rare illness)

Example 2
24-Hour Monitoring of Space and the Earth

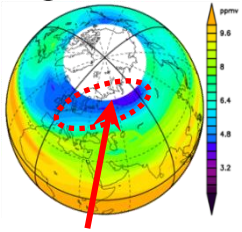
- **MAXI (Monitor of All-sky X-ray Image)**
  In cooperation with the U.S. satellite (Swift), new discoveries regarding a black hole have been observed. The related thesis was published in "*Nature*" *magazine*.



Observation of the moment when a huge black hole was absorbing stars

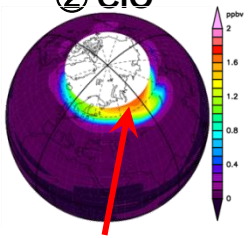
- **SMILES (Superconducting Submillimeter-Wave Limb-Emission Sounder)**
  Simultaneous high accuracy observation on atmospheric trace components (nearly 10 kinds including ozone (O3))

① Ozone



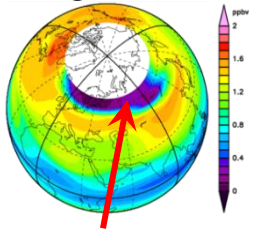
Stratospheric ozone decreased above Europe and Russia.

② ClO



Plenty of chlorine compounds generated in the process of ozone destruction are observed.

③ HCl



The decrease of hydrogen chloride indirectly suggests an increase of ClO.

Another outcome...

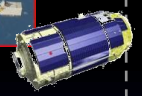
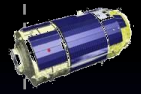
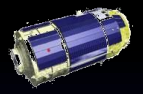
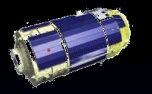
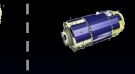
JAXA has a certification system for space food and provides Japanese food to crew members onboard. They are appreciated not only by Japanese astronauts but also crew members from other countries.

JAXA Astronauts

2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 ～

2008.3 ▲ 2008.6 ▲ 2009.7 (JEM Assembly Complete)

2009.9 (HTV#1) 2011.1 (HTV#2) 2012.7 (HTV#3) 2012.8 (HTV#4)





Wakata
Exp. 18,19,20
(2009.3-7)

Noguchi
Exp. 22,23
(2009.12-
2010.6)

Furukawa
Exp. 28,29
(2011.6-11)

Hoshide
Exp. 32,33
(2012.7-11)

Wakata
Exp. 38,39
(2013.11-)

Doi
STS-123
(2008.3)

Hoshide
STS-124
(2008.6)

Yamazaki
STS-131
(2010.4)

The first Japanese ISS Commander

Under training aiming at future ISS mission



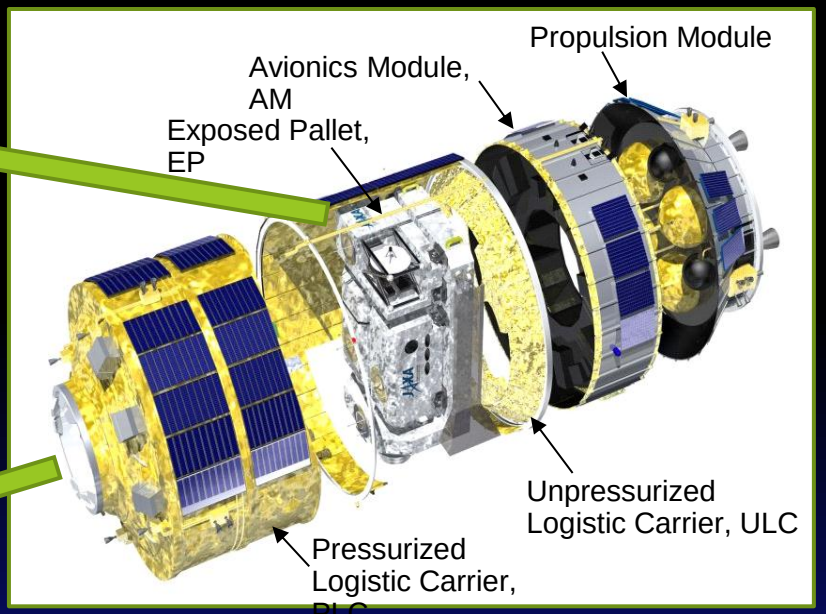
Yui
Exp. 44,45

Onishi

Kanai

H-II Transfer Vehicle (HTV) - Kounotori

EP with unpressurized cargo transferred by SSRMS



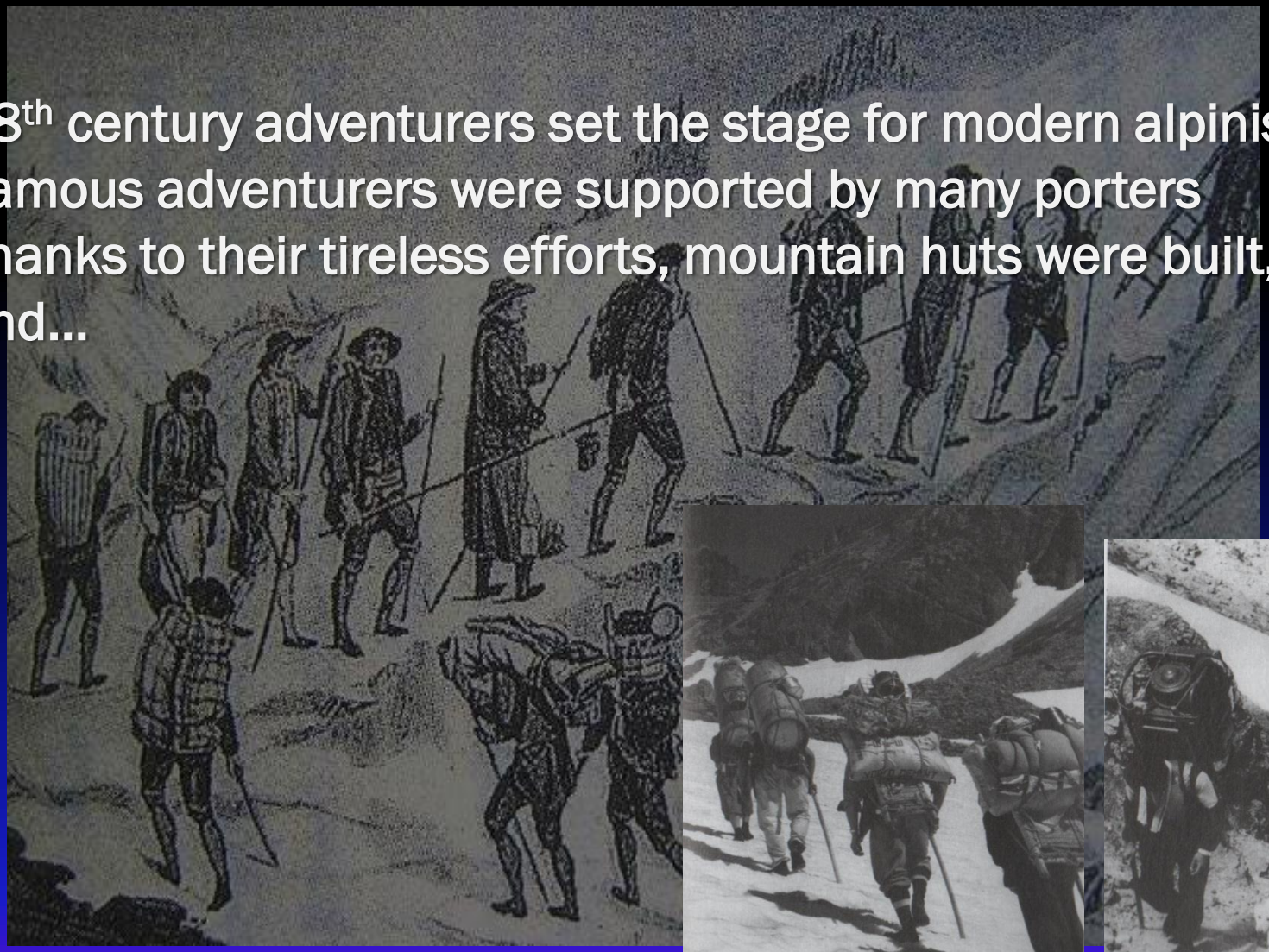
PLC internal view (Cargo and Rack)

Launched by H-IIB from Tanegashima S.C.

- Deliver a total of 6 tons of pressurized and unpressurized cargo to ISS
- Provide unique cargo transfer capability essential for ISS operations after the shuttle retirement.
  - ✓ Large unpressurized cargo
  - ✓ Pressurized cargo, including the experiment payload racks

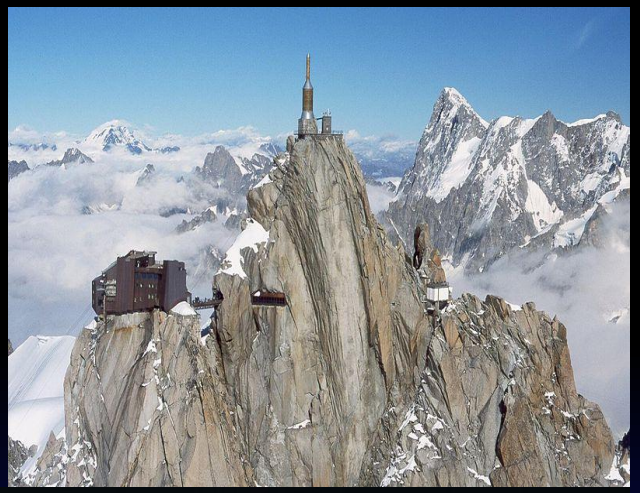
Roles of Kounotori

- 18th century adventurers set the stage for modern alpinism
- Famous adventurers were supported by many porters
- Thanks to their tireless efforts, mountain huts were built, and…

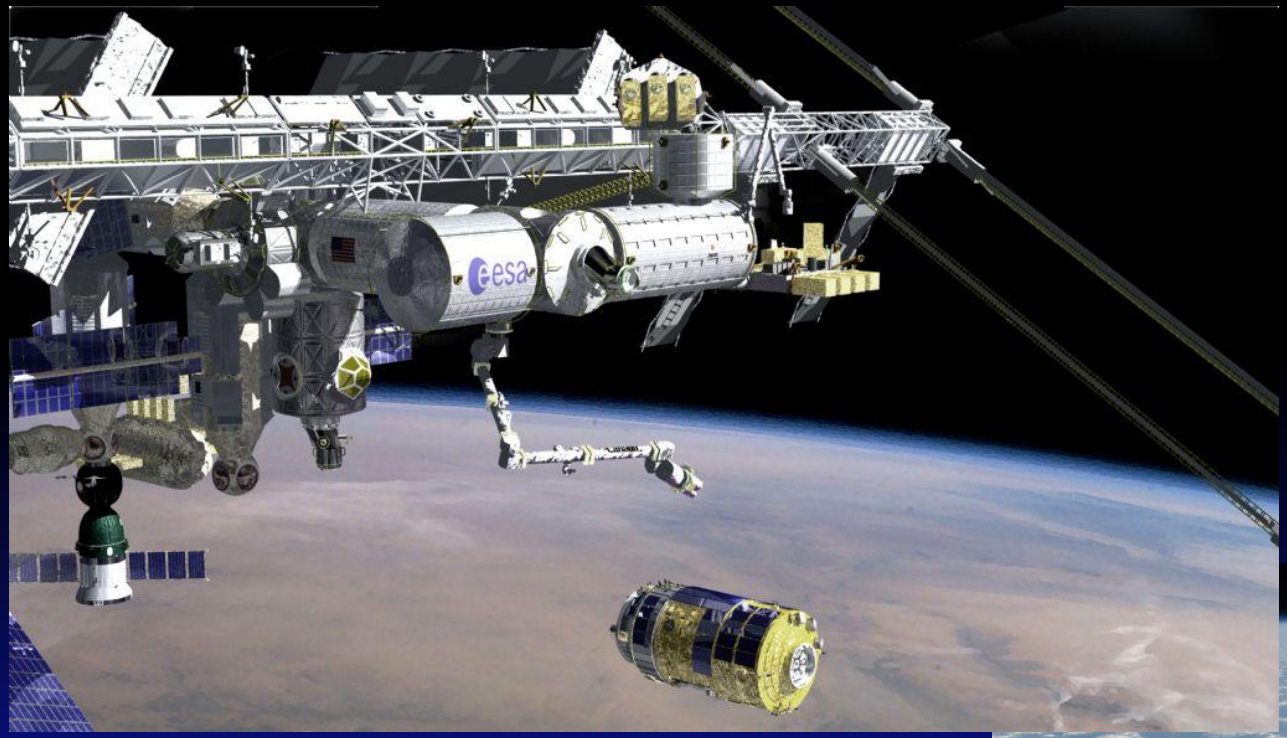


Roles of Kounotori

200 years later, access to the top of the mountains is a lot easier

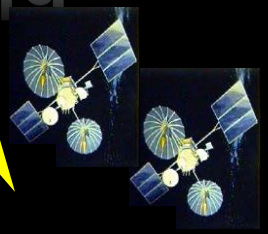


Roles of Kounotori Is Space Porter...



- Kounotori is the Japanese word for stork
- It brings tons of cargo, including experiment equipment, spares, crew's clothes, foods, anything the astronauts might need for their space life in...like a porter
- Eventually, anyone will be able to go up there...like a mountain huts in the future...perhaps?

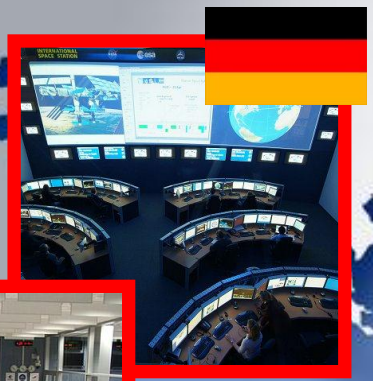
Mission Control Centers of the World



Moscow, TsUP

Tsukuba, JEM MCR

Huntsville, POIC



Munich, COL-CC

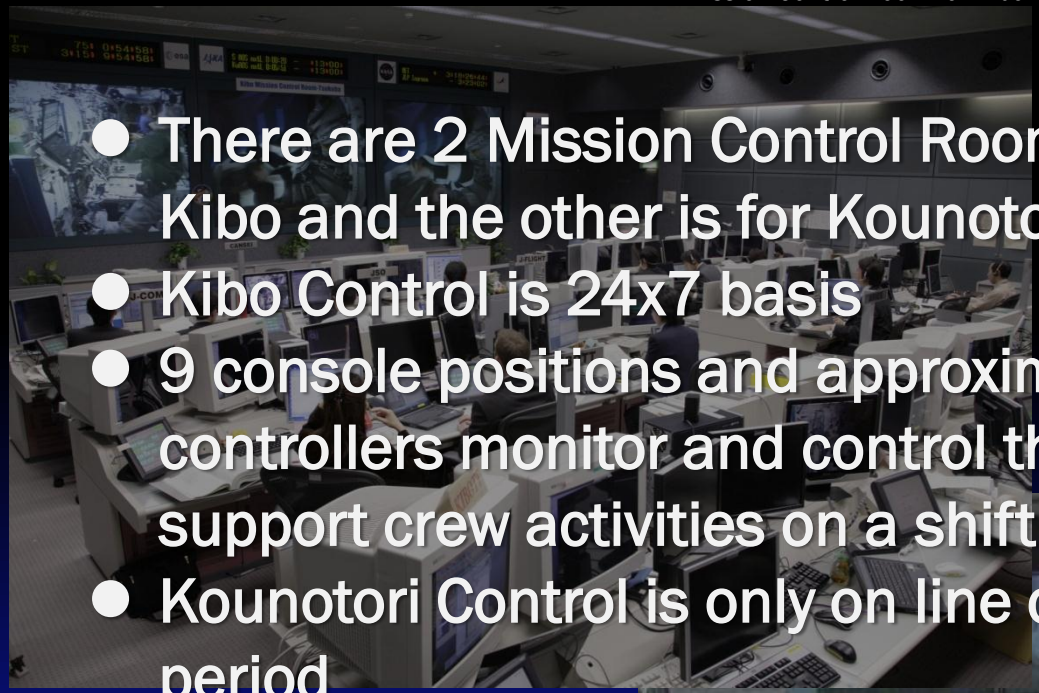
Toulouse, ATV-CC

Tsukuba, HTV MCR

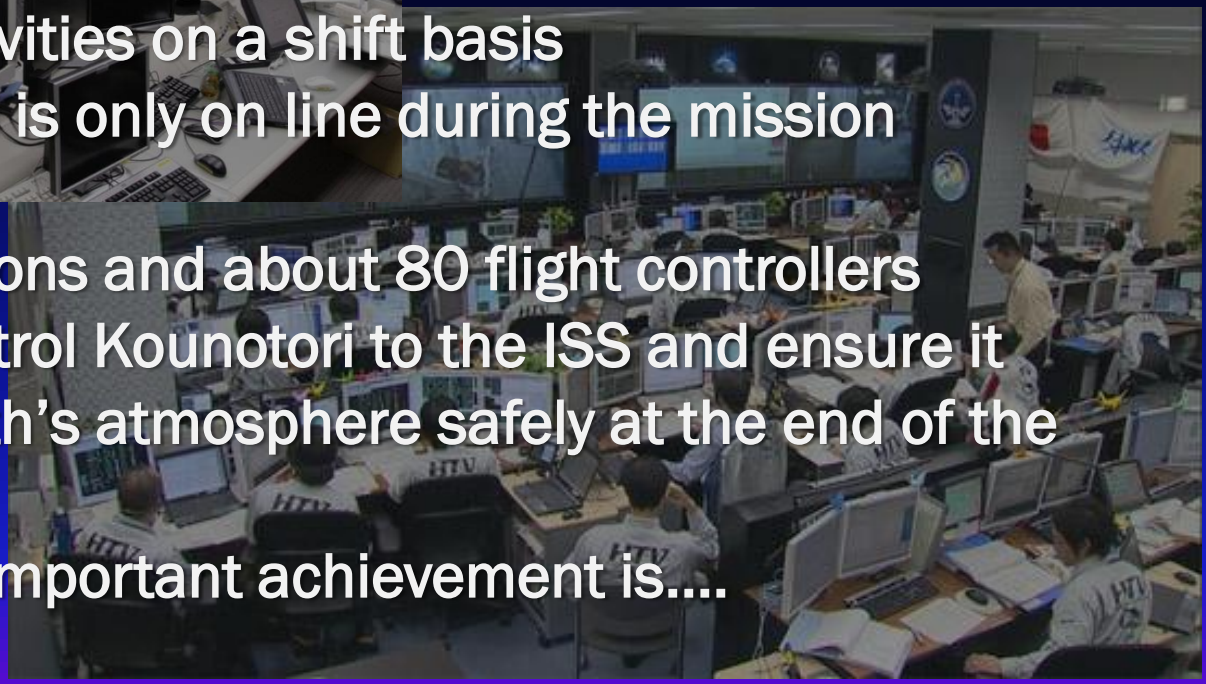
Houston, MCC-H

Mission Control Rooms in Tsukuba Space Center

Mission Control Room for Kibo



- There are 2 Mission Control Rooms in TKSC, one is for Kibo and the other is for Kounotori
- Kibo Control is 24x7 basis
- 9 console positions and approximately 80 flight controllers monitor and control the Kibo system and support crew activities on a shift basis
- Kounotori Control is only on line during the mission period
- 15 console positions and about 80 flight controllers navigate and control Kounotori to the ISS and ensure it re-enters the earth's atmosphere safely at the end of the mission
- One of our most important achievement is....



Mission Control Room for Kounotori

Team Work!

1998, the moment when Kibo was just installed in the ISS

Team Work!

2013, 5th anniversary ceremony of Kibo

Team Work!

2012, right after HTV3 mission complete

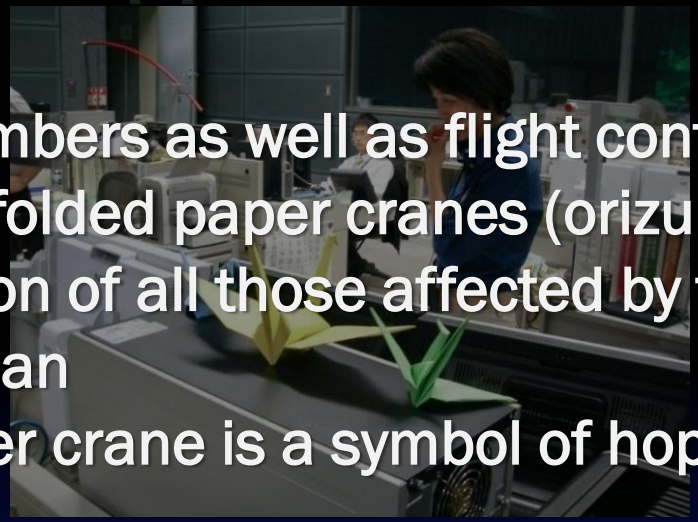
And Team Work

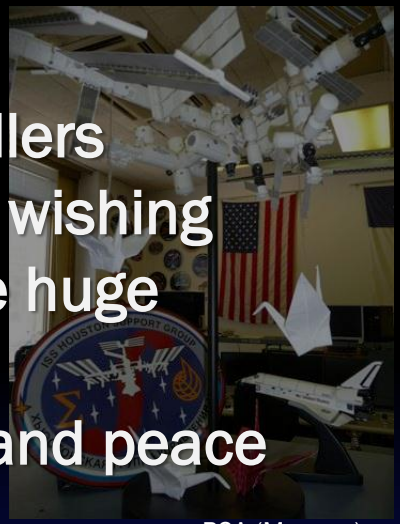
- In March 2011, there was a huge earthquake in Japan
- Fortunately there were no injuries to staff in TKSC, however several buildings, including the one where the Mission Control Rooms are located, incurred severe damage
- As a result, we were unable to continue operations there
- NASA volunteered to monitor Kibo and Kounotori for us and provided us with facilities in Houston to continue our operations
- Thanks to their support , we were able to continue our operations and our control room capability was back in 2 weeks or so
- Sometime later, to cheer up flight controllers as well as all the people in Japan, NASA and other international partners gave us a great present....

Priceless Partnership

- The ISS crew members as well as flight controllers around the world folded paper cranes (orizuru) wishing for the recuperation of all those affected by the huge earthquake in Japan
- In Japan, the paper crane is a symbol of hope and peace


JAXA (Tsukuba/Kounotori)


JAXA (Tsukuba/Kibo)

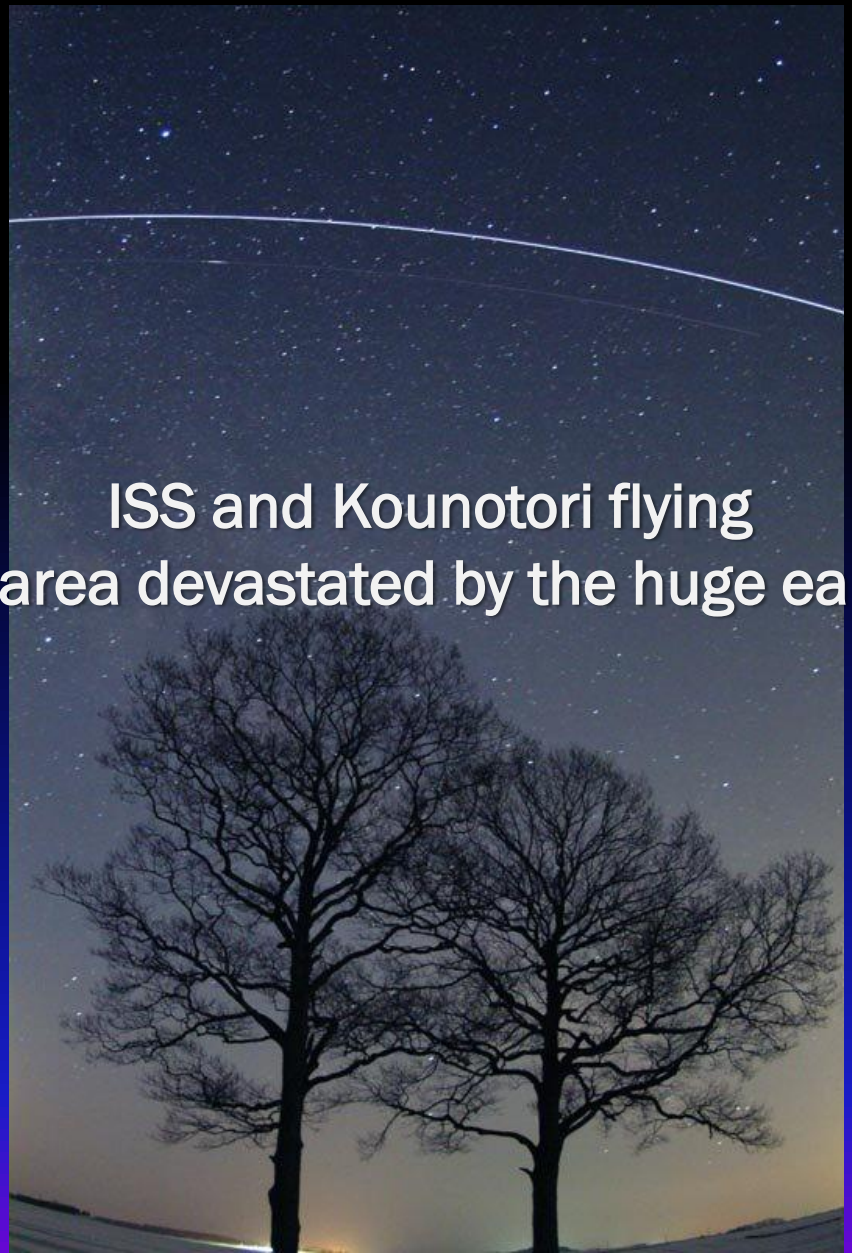

RSA (Moscow)

NASA (Houston)


At HTV hatch area on-board

ESA (Munich)

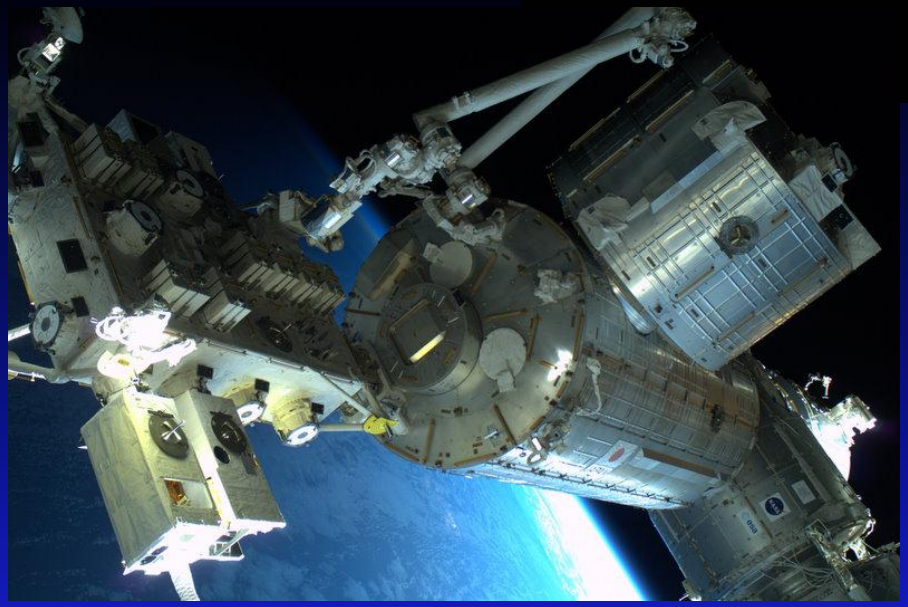

Cranes over the HTV hatch window



ISS and Kounotori flying
over the area devastated by the huge earthquake

My Friends – Female Flight Directors

NASA(Houston) Flight Directors, ESA (Columbus/ATV) Flight Directors, Russian Flight Director, JAXA (JEM/HTV) Flight Directors



THANK YOU