JAXA'S ISS/KIBO UTILIZATION PROGRAM

At the Expert Meeting in Malaysia

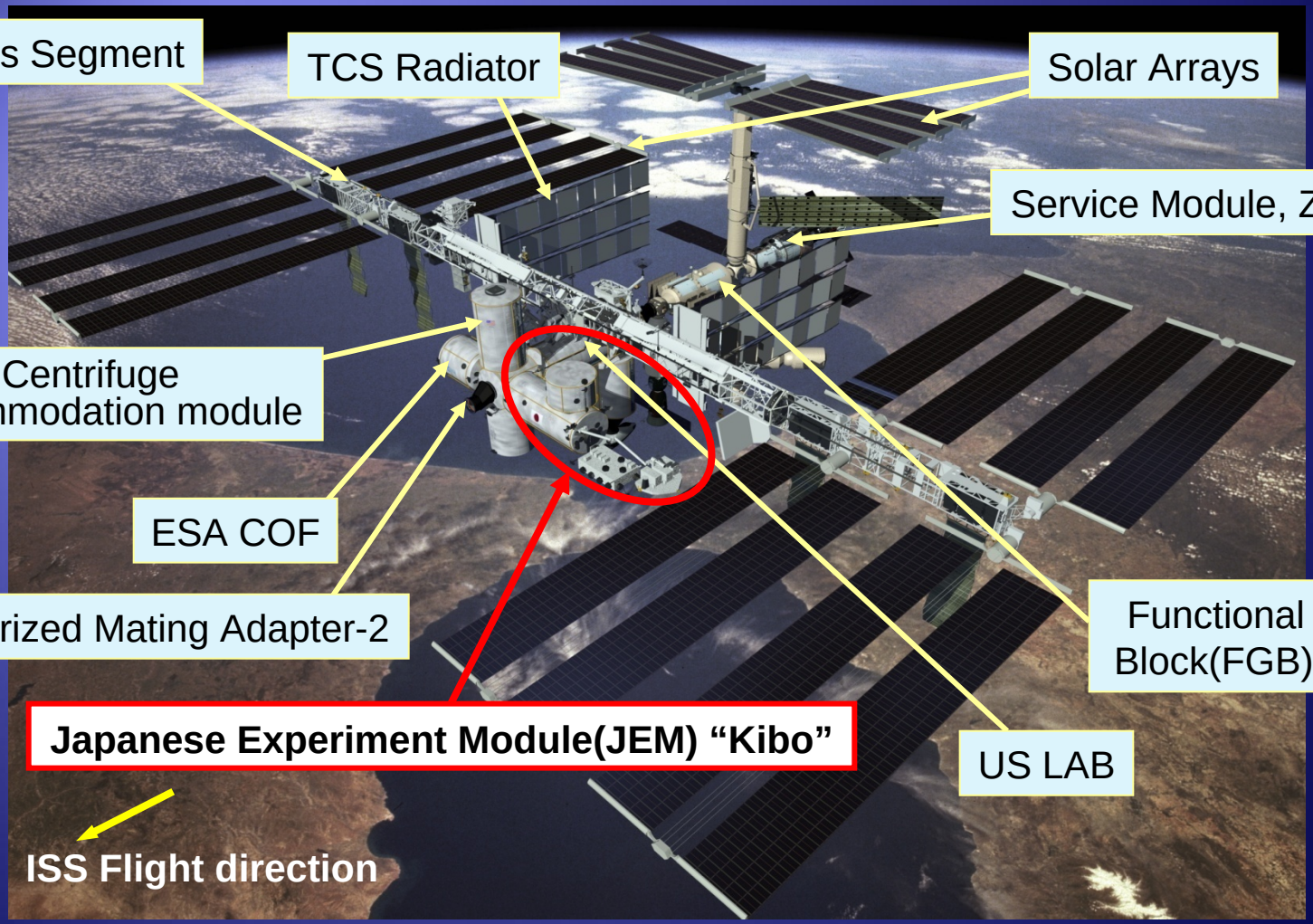
15th November, 2011

TAI NAKAMURA/ TOMOMI SUZUKI

Human Space Systems and Utilization Mission Directorate

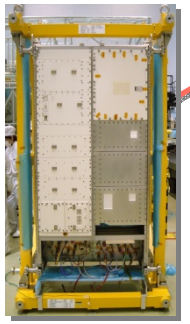
JAXA

INTERNATIONAL SPACE STATION(ISS)

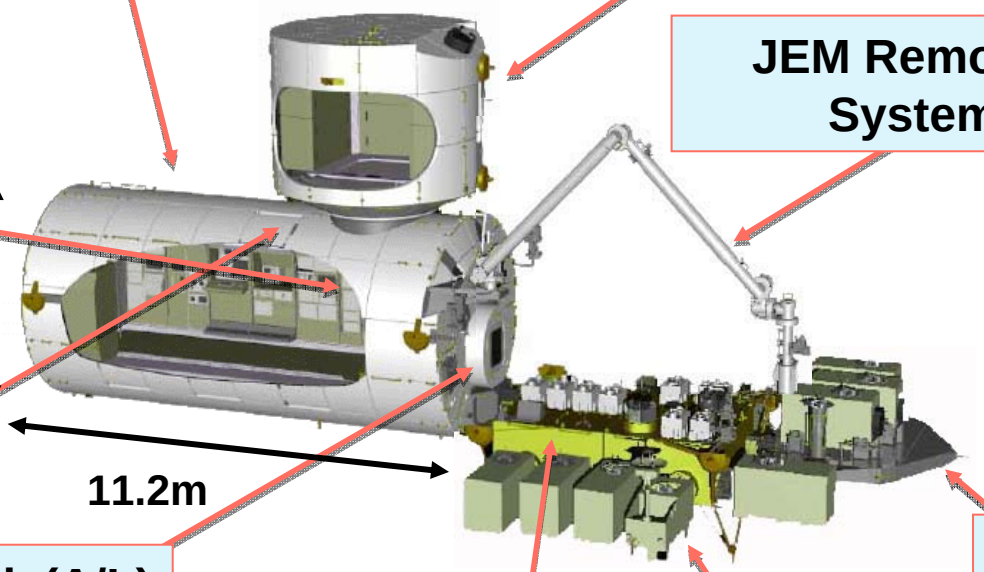


JAPANESE EXPERIMENT MODULE (JEM) "KIBO"

RMS Control Panel



Inter-orbit Communication System Rack (including HTV PROX)



Pressurized Module (PM)

Experiment Logistics Module -Pressurized Section (ELM-PS)

JEM Remote Manipulator System (JEMRMS)

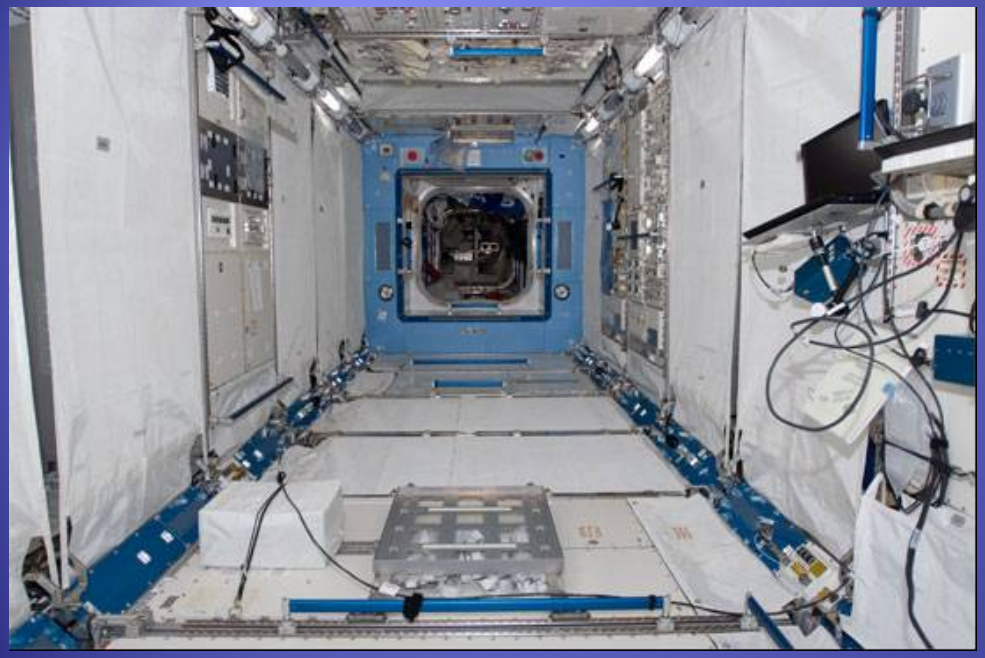
Airlock (A/L)

Exposed Facility (EF)

Experiment Logistics Module Exposed Section (ELM-ES)

Inter-orbit Communication System (ICS)

"KIBO" PRESSURIZED MODULE(PM)



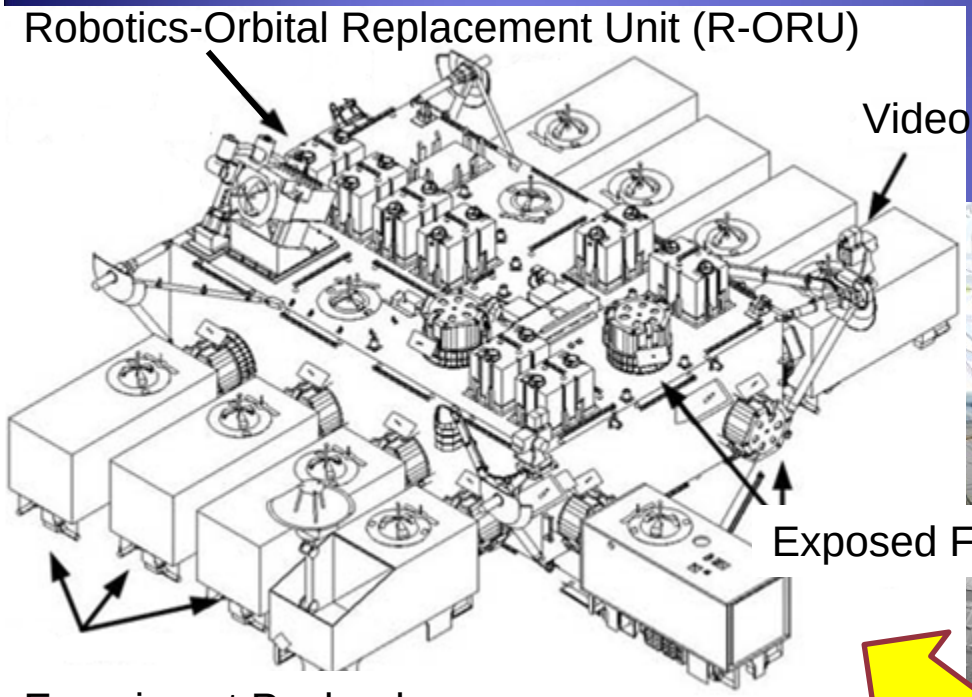
Pressurized Module

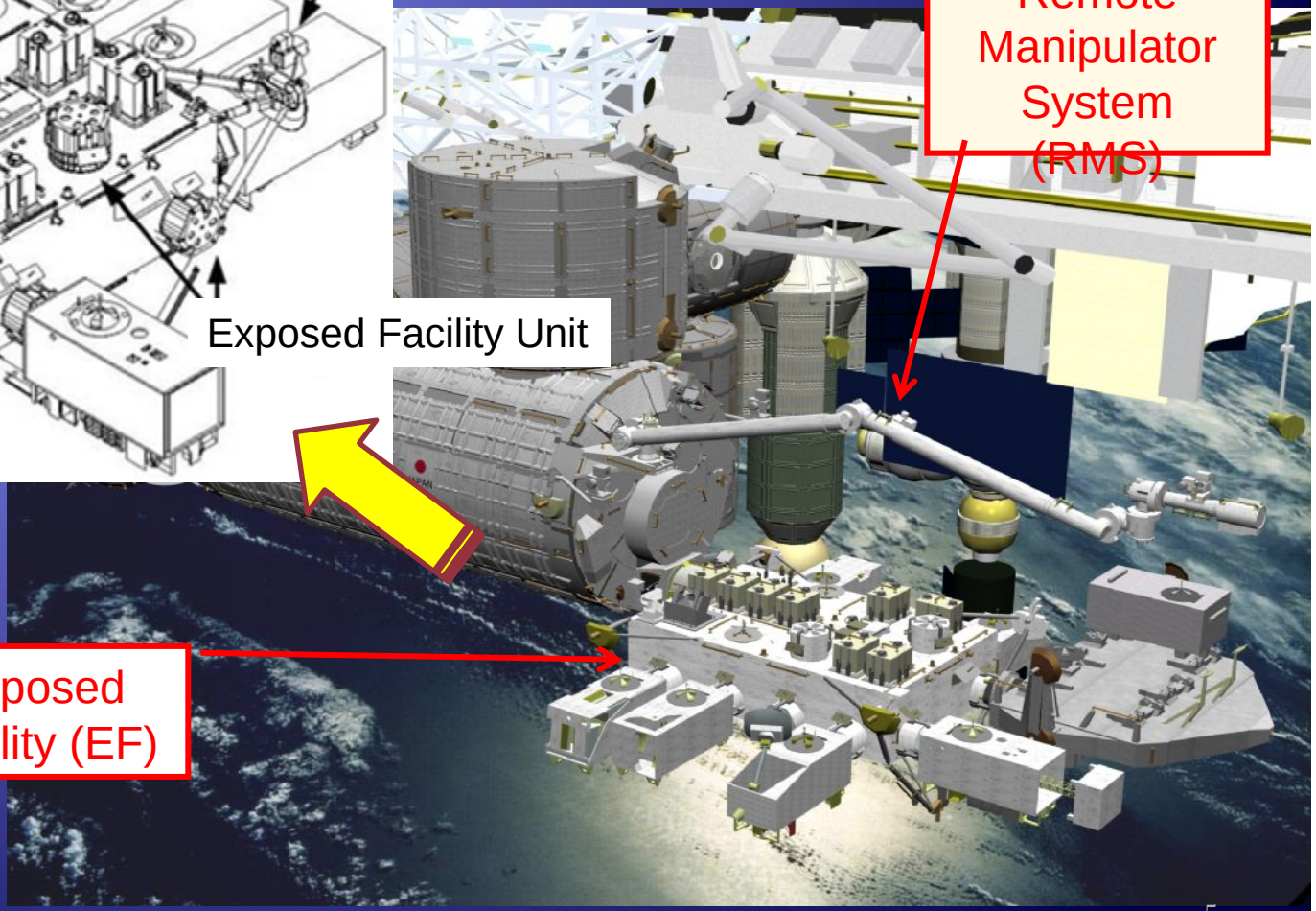
Japanese experiment facility in zero gravity. Various resources can be supplied (power, environment control, network, gas and vacuum).

Airlock (A/L)

Hatch to outer space for experiment equipment or Replacement.

"KIBO" EXPOSED FACILITY (EF)

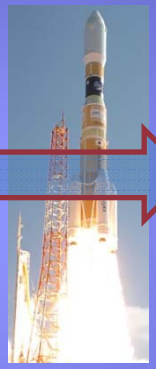




UNIQUE USAGE of the JEMRMS

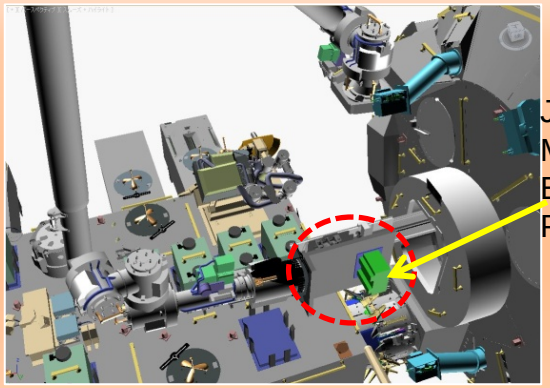
-SATELLITE DEPLOYMENT MISSION OVERVIEW-

② Satellite Install Case are installed in a soft bag.

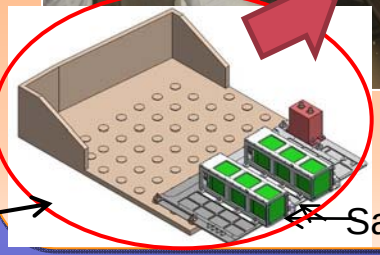


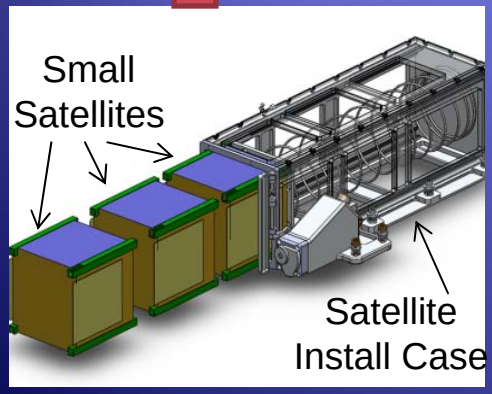
Launch !

③



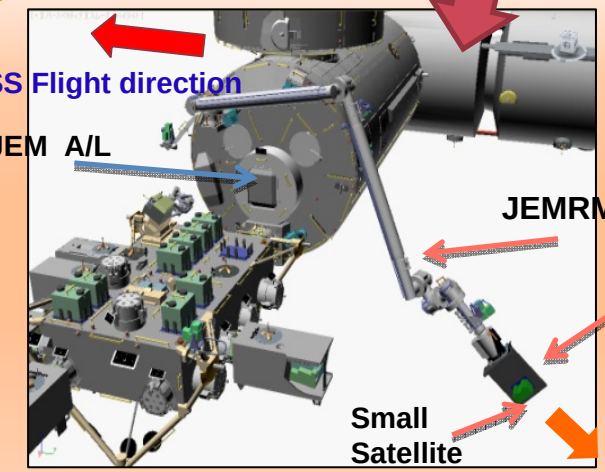
④The JEM A/L slide table will be extended to outside.





①Small satellites with Satellite Install Case.

⑤The JEMRMS will grapple and detach the adapter from the JEM A/L .
The JEMRMS will release the small satellite.
Small satellite will go into low orbit.



Go into low orbit !

LAUNCH SCHEDULE OF EXPERIMENT FACILITIES

JFY 2008 | JFY 2009 | JFY 2010 | JFY2011 | JFY2012 | JFY2013

March, 2008 ELM-PS

June, 2008 JPM

July 2009 EF & ELM-EF

Nov. 2009 HTV#1 launch

HTV#2 launch

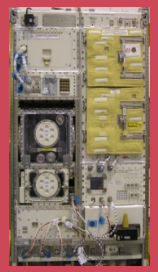
HTV#3 launch

HTV#4 launch

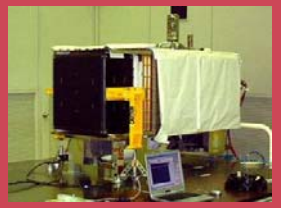
HTV#5 launch

Ryutai Rack

Saibo Rack



SEDA-AP



MAXI

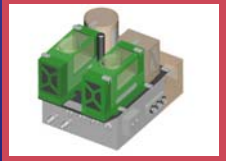
SMILES

Kobairo Rack

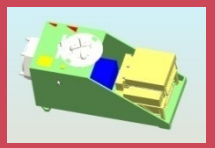
Multi-Purpose Small payload Rack

Multi Mission Consolidated Equipment

Aquatic Habitat



CALET



Electrostatic Levitation Furnace

PAYLOADS ACCOMODATION INSIDE KIBO

SAIBO Rack

On-board

Clean Bench (CB)

Treatment of Life sample, micro scope observation

Cell Biology Experiment Facility (CBEF)

Cell culture, incubation

High Definition TV System

On-board

HDV camera

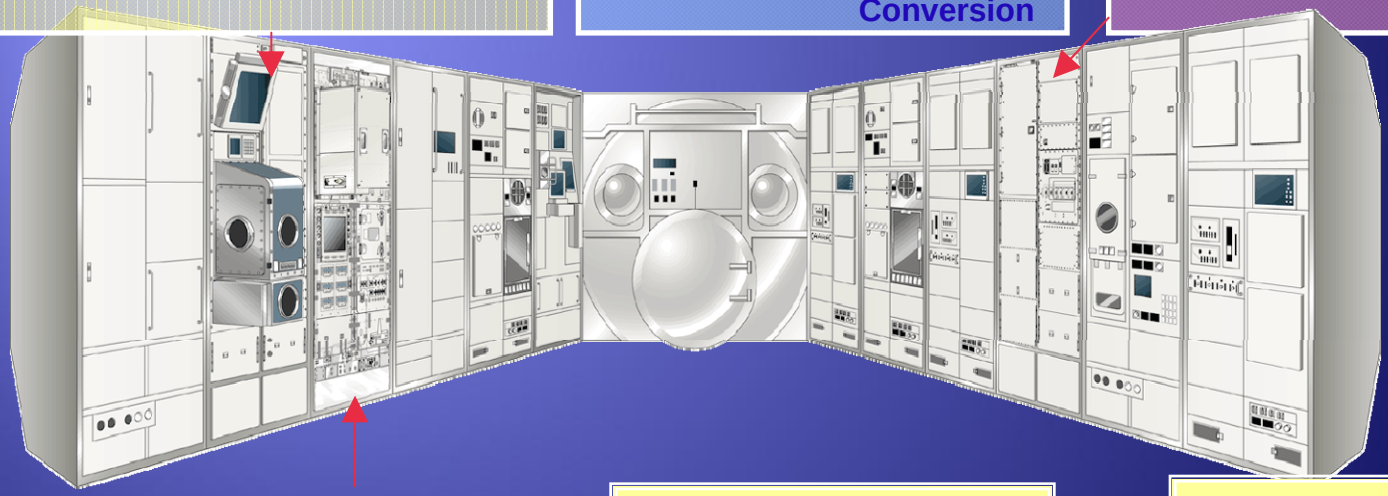
Multi Protocol Conversion

KOBAIRO Rack

on-board

Gradient Heating Furnace (GHF)

Material processing



RYUTAI Rack

On-board

Fluid Physics Experiment Facility (FPEF)

Image Processing Unit (IPU)

Solution Crystallization Observation Facility (SCOF)

Protein Crystallization Research Facility (PCRF)

Observation of physical phenomenon under microgravity

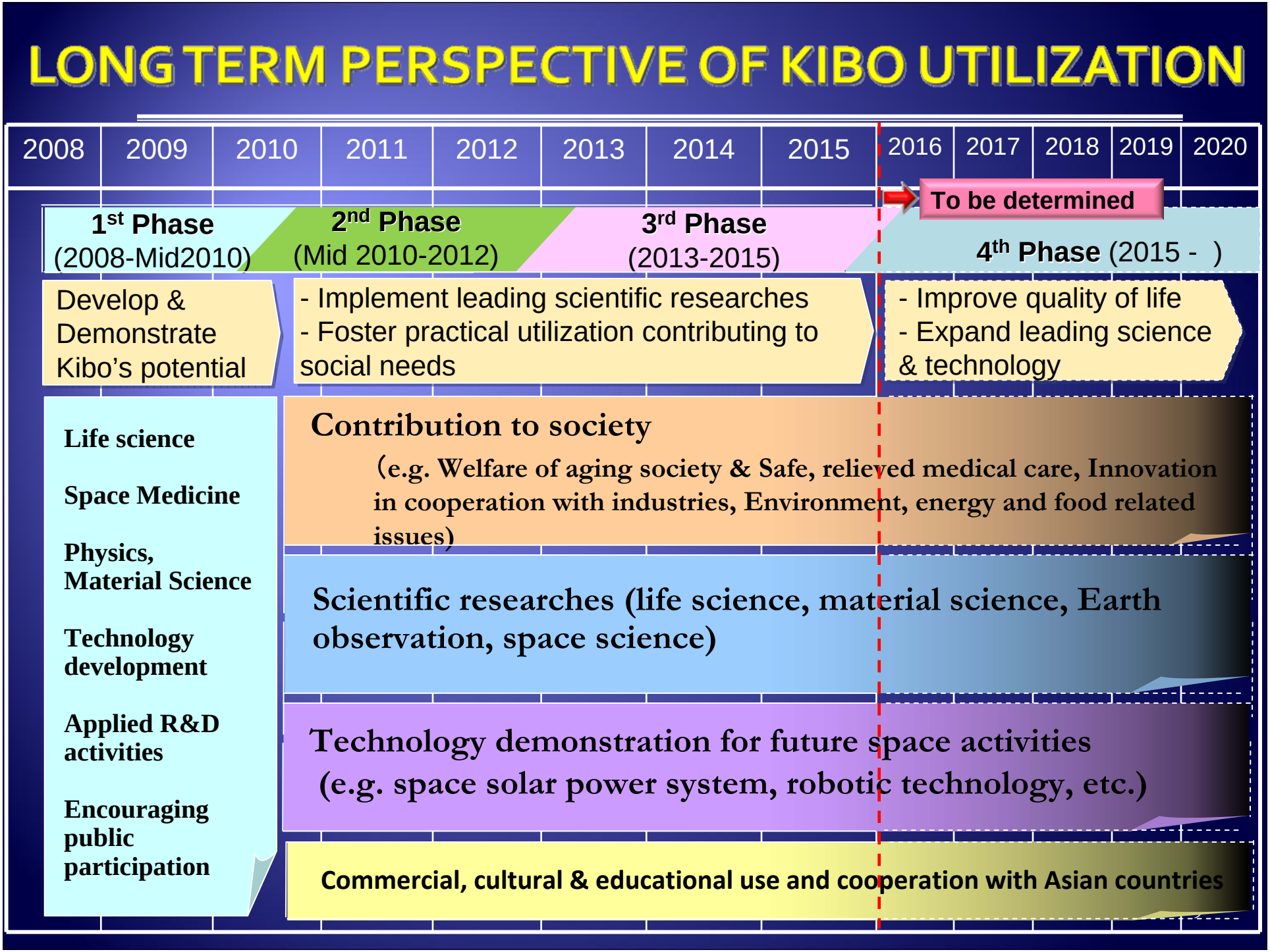
Multi-Purpose Small payload Rack

On-board

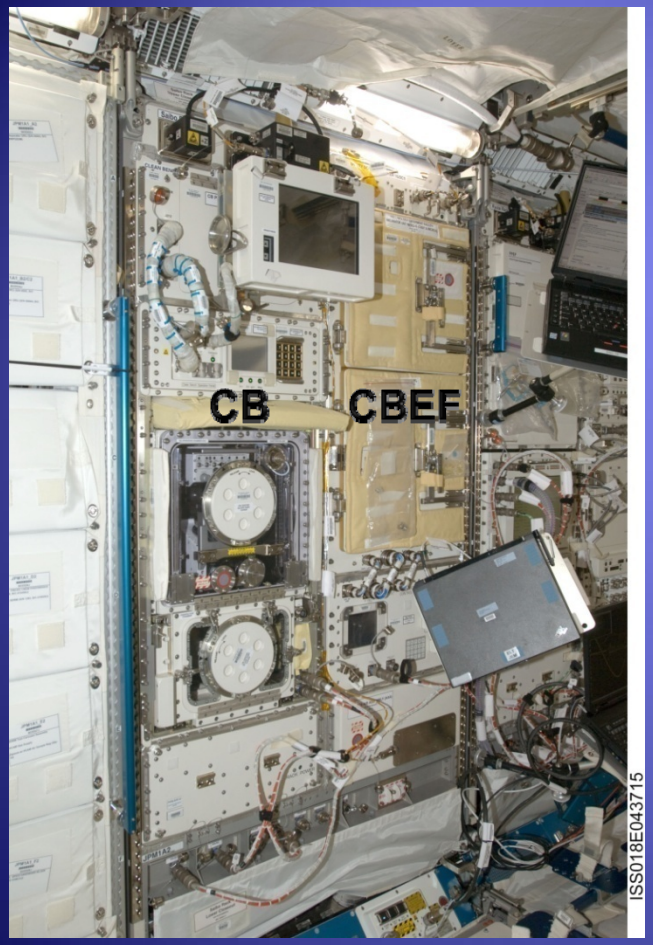
Electrostatic Levitation Furnace

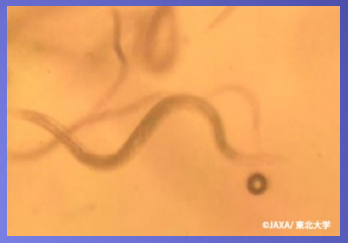
2014 ~

LONG TERM PERSPECTIVE OF KIBO UTILIZATION

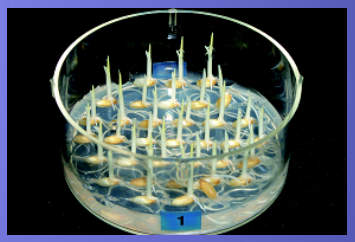


LIFE SCIENCE EXPERIMENTS IN SAIBO RACK

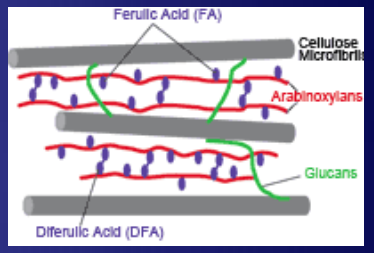




CERIES in-flight experiment successfully completed. Post-flight analysis will be performed for examining effectiveness of RNA interference (RNAi) and changes and differences in gene and protein activities

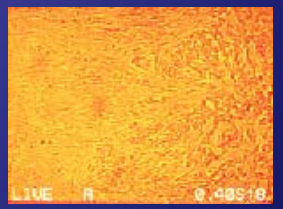


Cell wall structure of rice shoots under microgravity conditions in space. Regulation by gravity of ferulate formation in cell walls of rice seedlings

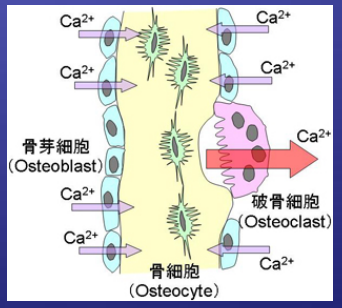


Cbl-Mediated Protein Ubiquitination down regulates the response of skeletal muscle cells to growth factors in Space (Myo Lab)

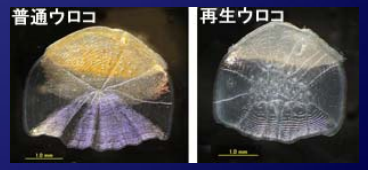
Biological effects of space radiation and microgravity on mammalian cells (Neuro Rad)



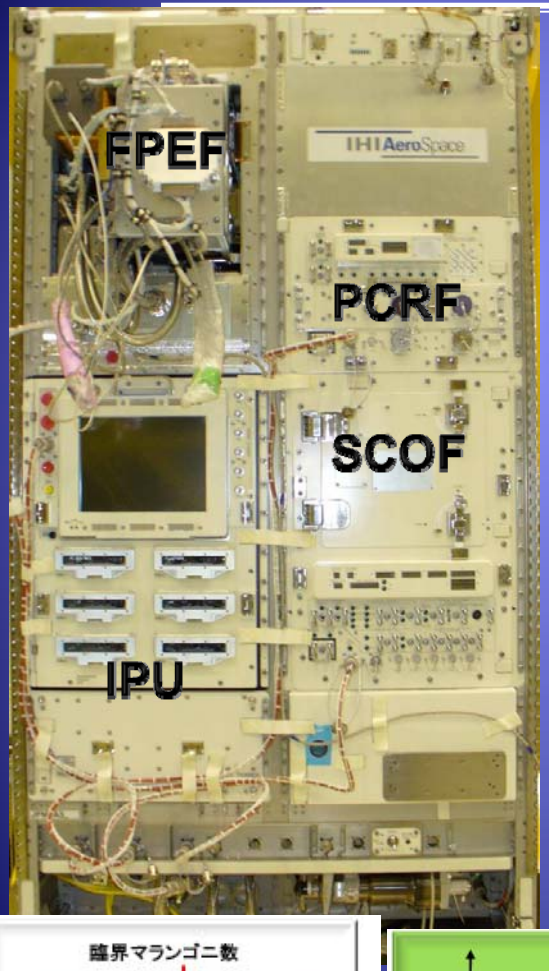
Maintenance of Rotating table in the centrifuge



Regulation of bone metabolism in space: analysis by an in vitro assay system using goldfish scale as a model of bone

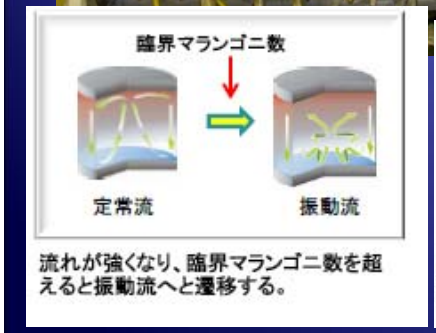


MICROGRAVITY EXPERIMENTS IN RYUTAI RACK

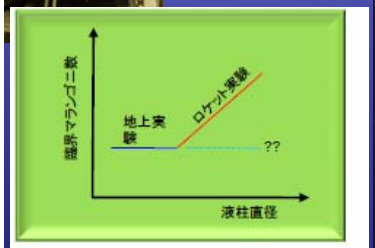


- Marangoni experiment series have been conducting in the FPEF.
- FACET and Ice Crystal experiments have been done in the SCOF.
- High Quality Protein Crystal Growth is conducted in the PCRF.
- Image Processing Unit (IPU) supports most of the experiments.

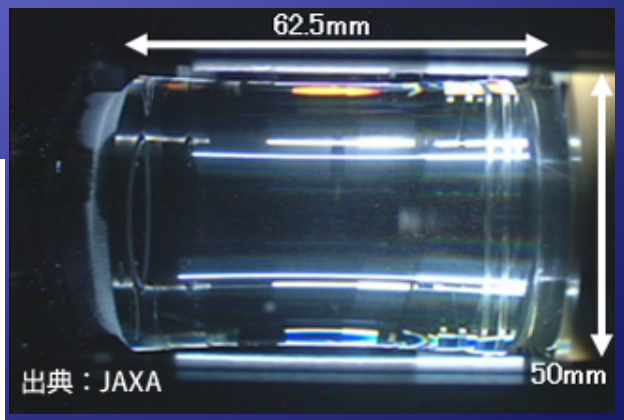
On board maintenance by astronaut Soichi NOGUCHI to fix the sealing of experiment cartridge.

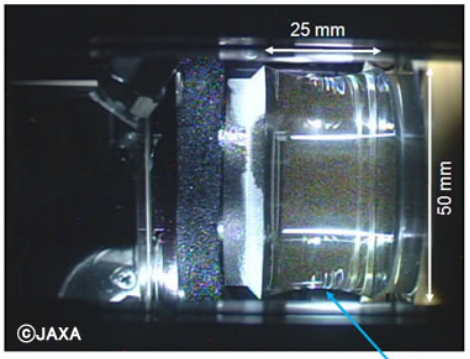


流れが強くなり、臨界マランゴニ数を超えると振動流へと遷移する。



過去のロケット実験では液柱サイズ依存性が見れられたが、流体力学では説明できなかった。



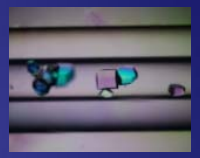


INDUSTRIAL APPLICATIONS

Obtain high quality protein crystals under microgravity in order to bring more precise protein 3D structures, which are useful for new drug/chemical design.

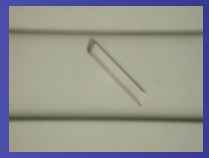
On the ground

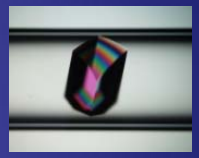

1.20Å


1.20Å

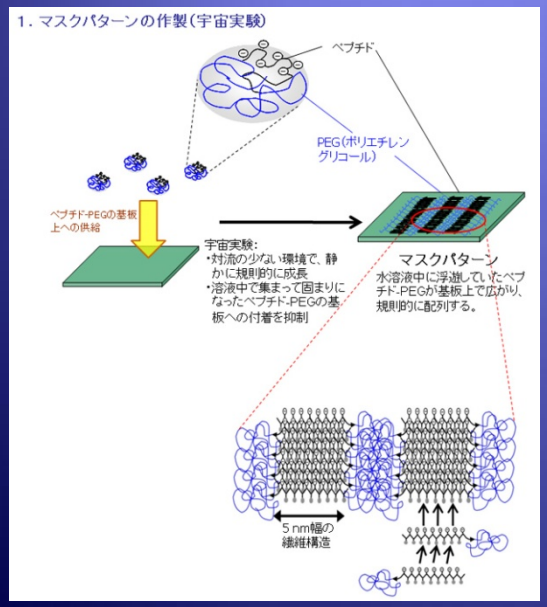

~4Å

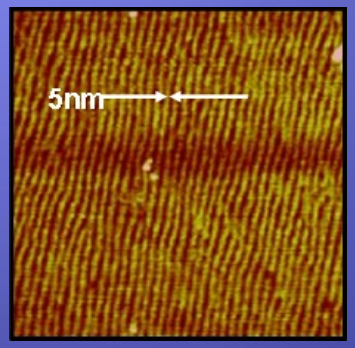
In space


0.89Å


0.9Å

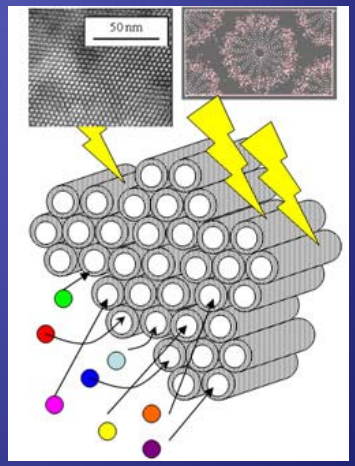

2.0Å





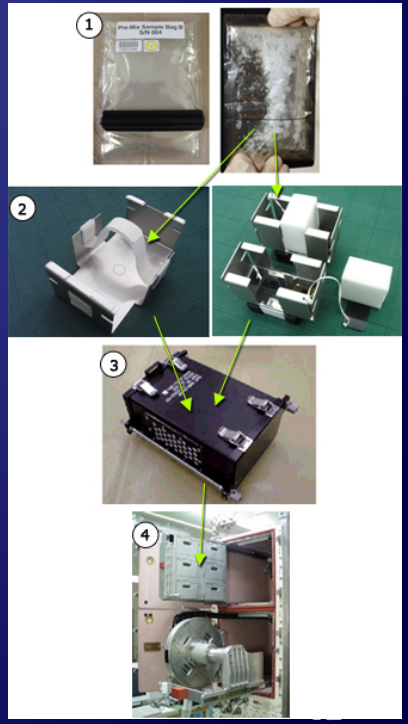
Nanotemplate

Produce two dimensional nano level mask pattern, which is expected to be used as a template for IC development.



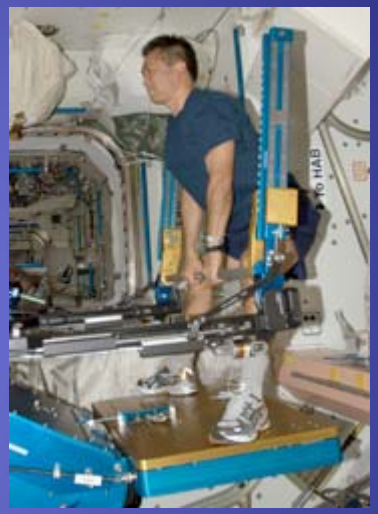
Nanoskelton

Analyze new porous structure in space for designing photocatalystic materials on the ground.



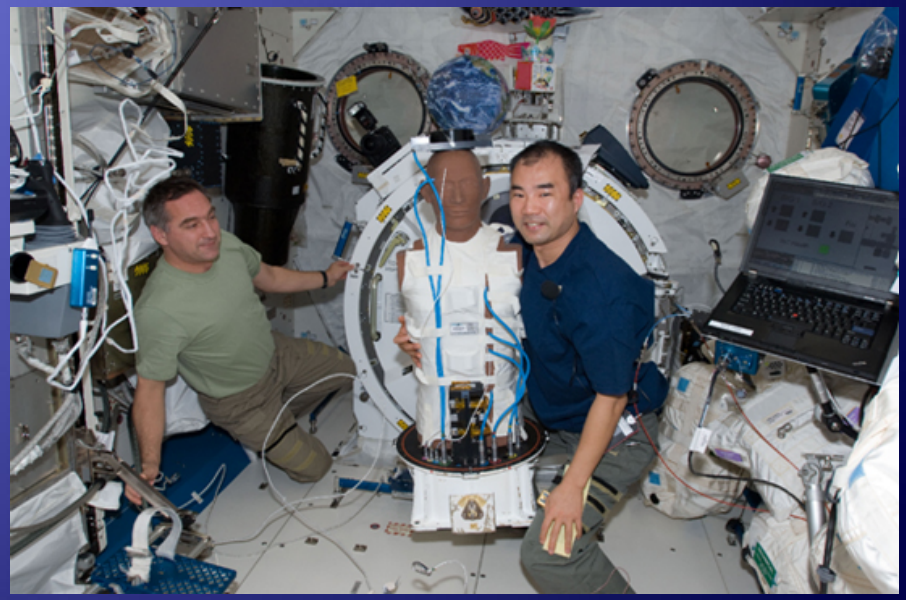
HUMAN RESEARCHES

Holter Electric Cardiogram to monitor crew Biorhythm in the ISS.



Excise and medicine which are useful for bone loss protection (NASA/JAXA)

Microbe sampling kits for Astronauts



Phantom torso “MATROSHIKA”

KIBO EXTERNAL PAYLOADS (1/3)

Monitor of All-sky X-ray Image (MAXI)

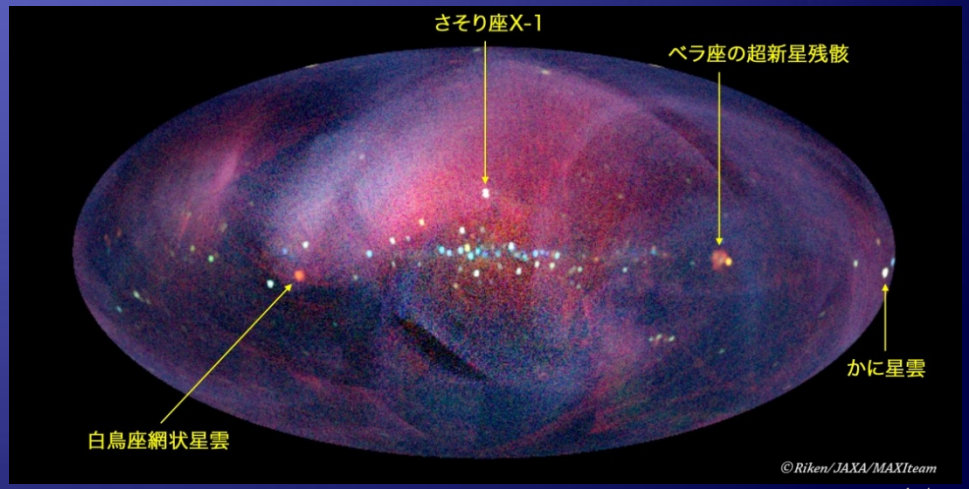
MAXI public data web site. http://maxi.riken.jp/top/

MAXI observes X-ray burst by Gas Slit Camera and X-ray CCD Slit Camera for real-time data acquisition and archiving.

NASA's Swift satellite and MAXI found a dormant black hole shredded and consumed a star.

Courtesy of NASA/GSFC

MAXI on the JEM EF



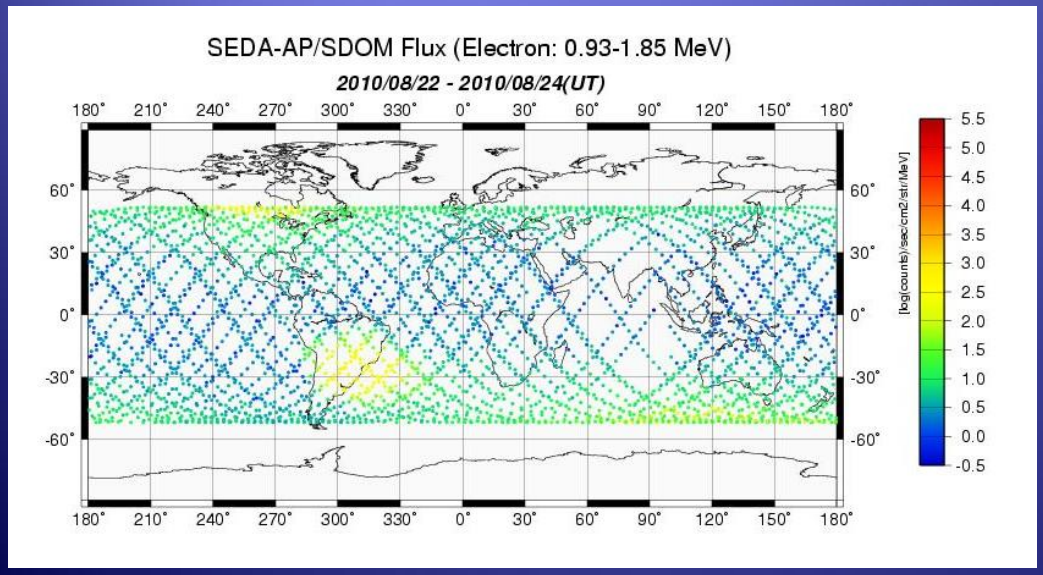
X ray CCD Camera Data

KIBO EXTERNAL PAYLOADS (2/ 3)

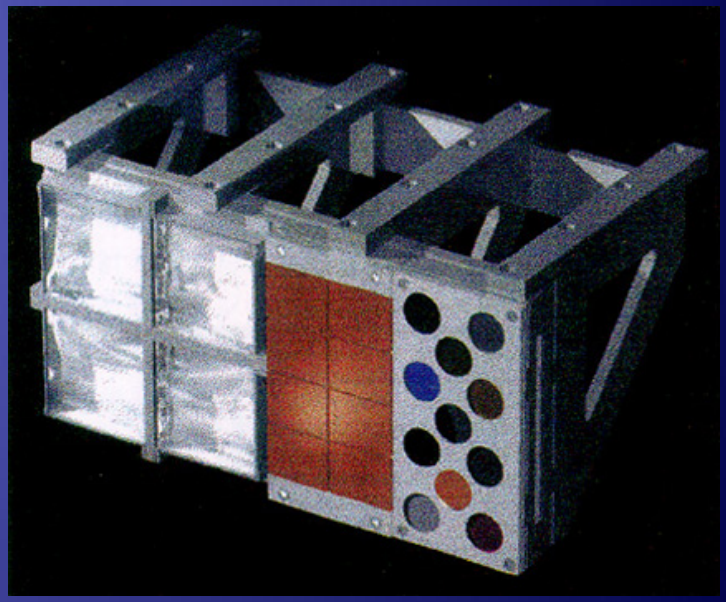
Space Environment Data Acquisition equipment-Attached Payload (SEDA-AP)

Data is available on the SEES web page.
http://sees.tksc.jaxa.jp/

SEDA-AP monitors Neutron, Plasma, Atomic Oxygen, captures Heavy Ion Micro-Particles, and Exposes Numerous Materials in Space Environment .



Electron Distribution



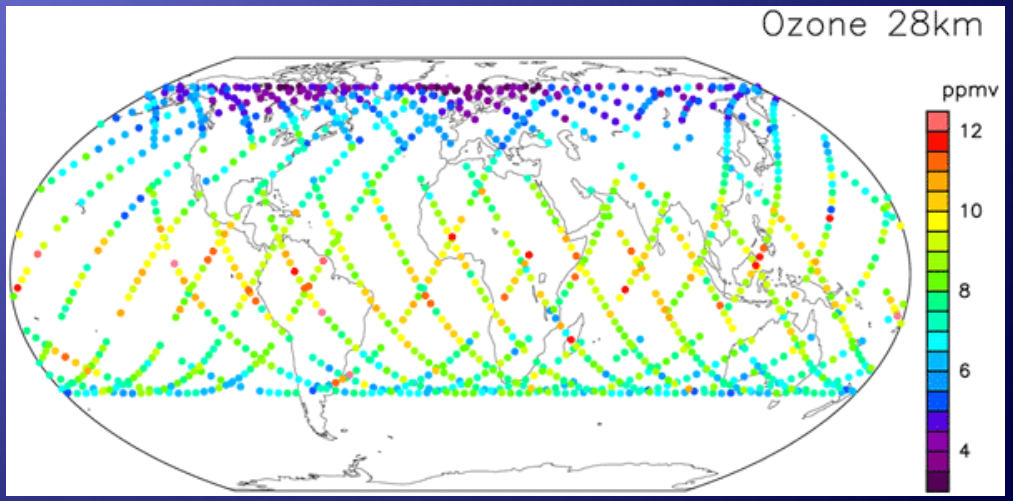
MPAC&SEED: Micro-Particles Capturer and Space Environment Exposure Device have been retreaved for analysis.

KIBO EXTERNAL PAYLOADS (3/ 3)

Superconducting Sub millimeter-wave Limb-Emission Sounder (SMILES)

Observation has finished.

- Monitor substance/molecules in the atmosphere which effect on earth environments such as ozone layer destruction, and global heating.
- Demonstrate Sub-millimeter Sensor Technology based on superconductive mixer and 4-Kelvin mechanical cooler sub-millimeter limb-emission sounding of the atmosphere
- Globaly observs of trace gases in the stratosphere

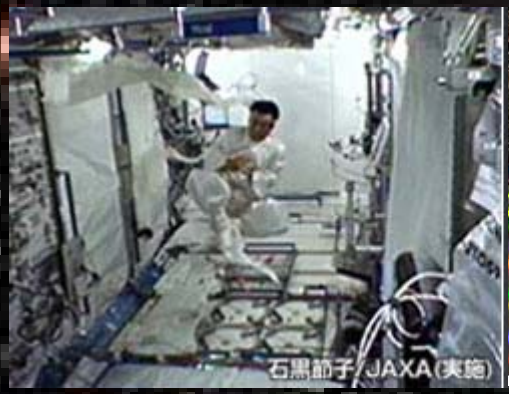


Ozone Distribution

EDUCATION AND ARTS

Moon Score

Space gardening

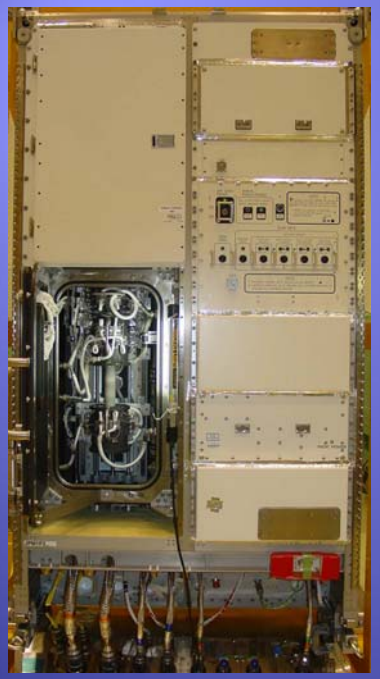


Space Dance “Hiten”

Spiral Top

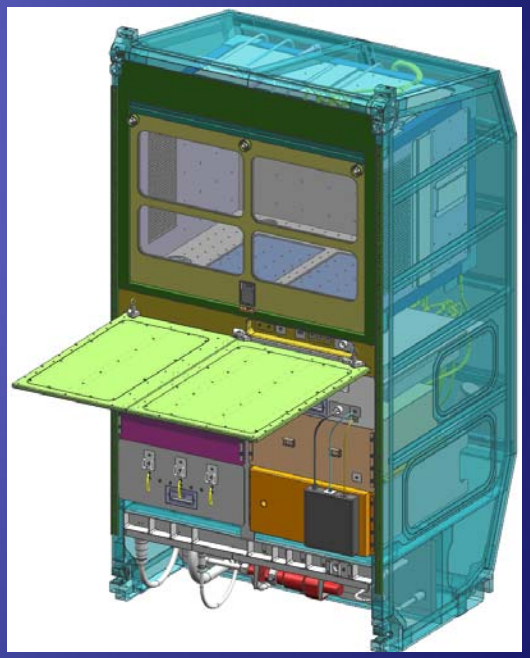
NEW EXPERIMENT Facilities (Launced by HTV#2)

Gradient Heating Furnace (GHF)



GHF is a electric furnace which generate temperature gradient on the sample to produce a single crystal alloy semi-conductor.

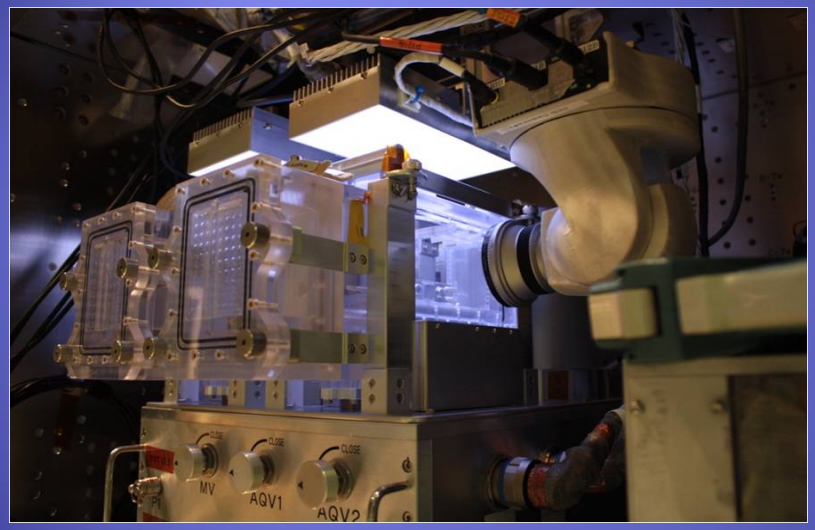
Multi-Purpose Small payload Rack (MPSR)



MSPR is a versatile payload rack which provides experiment space, working table, and resources such as electric power and communications for small experiment equipment.

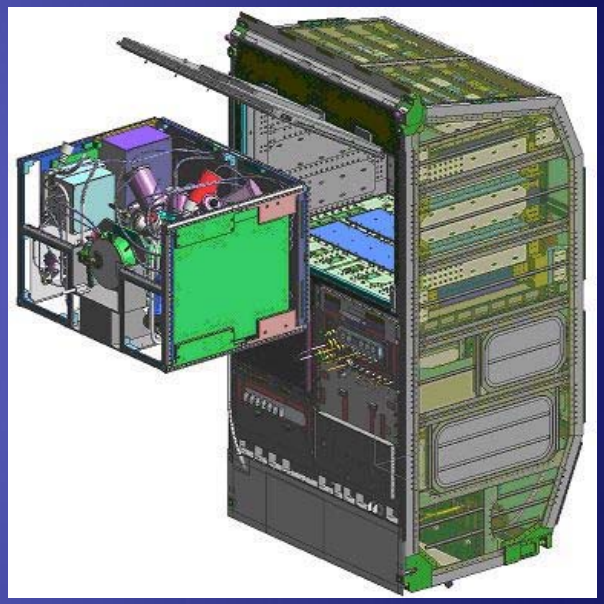
SUBRACK PAYLOADS USING MSPR

Aquatic Habitat (AQH)



AQH provides log-term life support for small fish to study the effects of microgravity and space radiation on them. It enables multi-generations experiments in space with Medaka and Zebra fish, which are the model vertebrate animals for life science research.

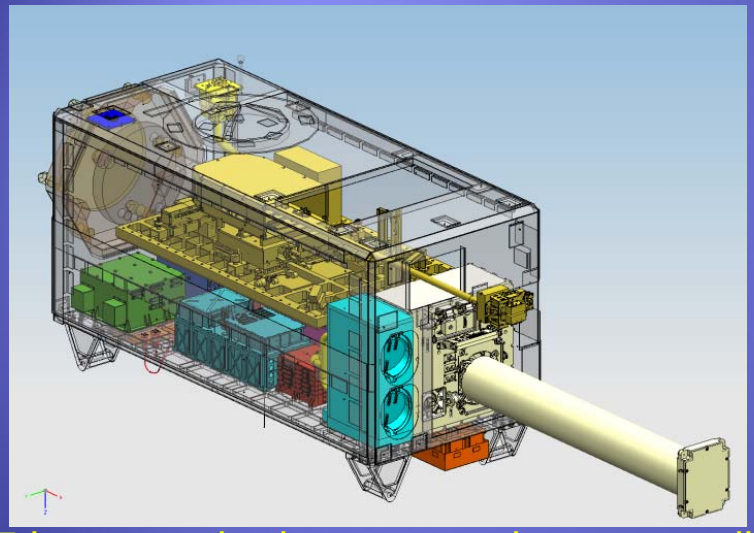
Electrostatic Levitation Furnace (ELF)



ELF measures the thermo-physical properties of fused materials such as metals and oxides. It levitates materials using electrostatic force and melt them with laser heaters to enable containerless processing in microgravity.

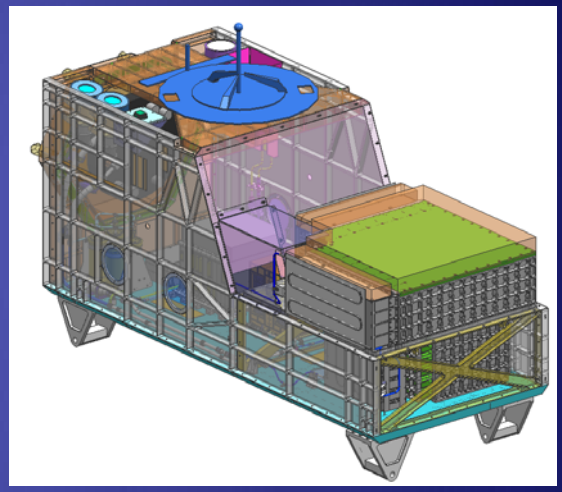
EXTERNAL PAYLOADS UNDER DEVELOPMENT

Muti Mission Consolidated Equipment (MCE)



MCE is a port-sharing type equipment to utilize a external location of Kibo efficiently.
- On-Orbit Demonstration of Space Inflatable Structure
- ISS Ionosphere, Mesosphere, upper Atmosphere, and Plasmasphere mapper
- Global Lightning and Sprite Measurement
- Robot Experiment on JEM
- Commercial Off-The Shelf High Definition Television Camera System for JEM Exposed Facility

Calorimetric Electron Telescope (CALET)



CALET will be used to search for the origin of cosmic rays and the dark matter by observing electron and gamma-ray.
It is equipped with Imaging Calorimeter, Total Absorption Calorimeter, Charge Detector, and Gamma-ray Burst Monitor.

COOPERATION ACTIVITIES IN ASIAN-PACIFIC REGION

- A report issued by Space Activity Commission of Japan in June 2009 noted the importance of Japanese role as “the gateway to ISS in Asia”, considering that Japan is the only country participating ISS program in Asia.
- JAXA has established a new office, “Kibo Utilization Office for Asia (KUOA)” last year.
- JAXA promotes ISS/Kibo utilization cooperative activities with Asia-Pacific countries through the Asia-Pacific Regional Space Agency Forum (APRSAF).
- A task force under the Space Environment Utilization Working Group of APRSAF has been working to plan joint Kibo utilization missions with Asian countries.

Parabolic Flight Experiment by Student

16th APRSAF Jan. 26-29, 2010 in Thailand