

Kibō (ISS module)

The **Japanese Experiment Module (JEM)**, nicknamed *Kibō* (きぼう, *Kibō*, Hope), is a Japanese science module for the International Space Station (ISS) developed by JAXA. It is the largest single ISS module, and is attached to the *Harmony* module. The first two pieces of the module were launched on Space Shuttle missions STS-123 and STS-124. The third and final components were launched on STS-127.^[1]

Components

In initial configuration, *Kibō* consisted of six major elements:^[2]

- Pressurized Module (PM)
- Exposed Facility (EF)
- Experiment Logistics Module (ELM) Pressurized Section (ELM-PS)
- Experiment Logistics Module (ELM) Exposed Section (ELM-ES)
- Japanese Experiment Module remote manipulator system (JEMRMS)
- Inter-orbit communication system (ICS)^[3]

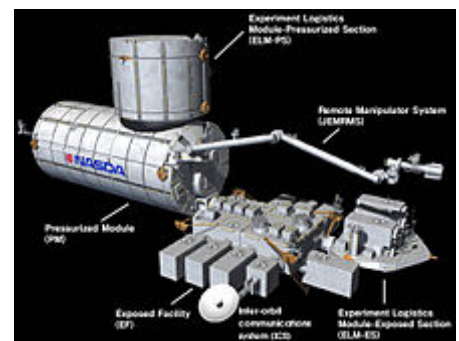
Pressurized Module

The Pressurized Module (PM) is the core component connected to the port hatch of *Harmony*. It is cylindrical in shape and contains twenty-three International Standard Payload Racks (ISPRs), ten of which are dedicated to science experiments while the remaining thirteen are dedicated to *Kibō*'s systems and storage.^[4] The racks are placed in a 6-6-6-5 format along the four walls of the module. The end of the PM has an airlock and two window hatches. The exposed facility, experiment logistics module, and remote manipulator system all connect to the PM. It is the location for many of the press conferences that take place on board the station.

Exposed facility



Japanese Experiment Module



NASDA-era graphic



Interior of the pressurized module

The Exposed Facility (EF), also known as "Terrace", is located outside the port cone of the PM (which is equipped with an airlock). The EF has twelve Exposed Facility Unit (EFU) ports which attach to Payload Interface Unit (PIU) connectors on EF-equipment exchange units (EF-EEUs). All experiment payloads are fully exposed to the space environment. For proper functioning of these experiments, the payload requires an orbital replacement unit (ORU), consisting of the electrical power system (EPS), communications and tracking (CT), and the thermal control system (TCS). Of the twelve ORUs, eight are replaceable by the JEMRMS while the other four are EVA-replaceable.



Exposed facility

Logistics module

The experiment logistics module (ELM) includes two sections:

- The pressurized section (ELM-PS), also called the JLP (Japanese logistics pressurized), is a pressurized addition to the PM. It is used as a storage facility, providing storage space for experiment payloads, samples and spare items.^[5]
- The unpressurized (external) section (ELM-ES) serves as a storage and transportation module. It was used to transfer external experiments with the Space Shuttle. It is not used after the retirement of the shuttle.^{[6][7]}



Experiment logistics module, pressurized section

Remote manipulator system

The JEM remote manipulator system (JEMRMS) is a 10 m (33 ft) robotic arm, mounted at the port cone of the PM. It is used for servicing the EF and for moving equipment to and from the ELM. The JEMRMS control console was launched while inside the ELM-PS, and the main arm was launched with the PM. The small fine arm, which is 2 m (6 ft 7 in) long and attaches to the end effector of the main arm, was launched aboard HTV-1 on the maiden flight of the HTV spacecraft. Once HTV had docked, the small fine arm was assembled by the crew and deployed outside the airlock to test it. The JEMRMS grappled the arm and unfolded it to flex the joints before stowing it onto the EF.^[8] The free end of the JEMRMS is able to use the same type of grapple fixtures that the Canadarm2 uses.^[9]

Inter-orbit Communication System

Inter-orbit Communication System (ICS) consists of a rack of communication module in the Pressurized Module (ICS-PM) and the antenna module to be attached on the Exposed Facility (ICS-EF).^[10] It was used to communicate with the ground station via JAXA's communication technology demonstration satellite DRTS "Kodama". After the decommissioning of DRTS in August 2017, *Kibō* relies on the ISS's Ku band communication through NASA's TDRSS. ICS-EF was disposed by jettisoning into orbit in February 2020^[11] and reentered on March 17, 2023^[12] over Sacramento, California.^[13]

Launch sequence



The EF and ELM-ES arriving at the Kennedy Space Center



Technicians working on the remote manipulator system at KSC

NASA launched the JEM complex over three flights using the Space Shuttle. The shuttle had a large payload bay which carried the modules into orbit along with the crew. This is in contrast to the Russian modules, which are launched into orbit on multistage Proton rockets and then rendezvous and dock with the station automatically.

On 12 March 2007, the *Experiment Logistics Module-Pressurized Section*

(ELM-PS), the main laboratory, arrived at the Kennedy Space Center (KSC) from Japan.^[14] It was stored in the Space Station Processing Facility (SSPF) until launched into orbit aboard Endeavour on 11 March 2008 as part of the STS-123 mission.^[15]

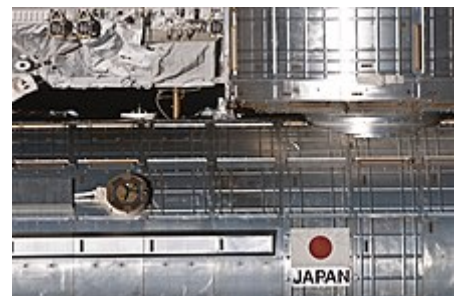
On 30 May 2003, the *Pressurized Module* (PM) arrived at KSC from Japan.^[16] It was stored at the SSPF until launched into orbit aboard Discovery on 31 May 2008 as part of the STS-124 mission.^[17] On 3 June 2008, the PM was attached to the *Harmony* module. At first the ELM-PS, the small cargo bay, was connected to a temporary location on *Harmony* and later, on 6 June 2008, was moved to its final berthing location on top (zenith) of the main laboratory.

The *Exposed Facility* (EF) and *Experiment Logistics Module-External Section* (ELM-ES) arrived at KSC on 24 September 2008.^[18] The two elements were launched on Endeavour on 15 July 2009 as part of the STS-127 mission.^[19] The ELM-ES was brought back to Earth at the end of the mission. The assembly of the EF was completed during the fifth spacewalk of the mission.^[20]

Specifications

Kibō is the largest single ISS module:

- *Pressurized module*^[22]
 - Length: 11.19 metres (36.7 ft)
 - Diameter: 4.39 metres (14.4 ft)
 - Mass: 15,900 kilograms (35,100 lb)
 - Launch Date: 31 May 2008
- *Experiment logistics module - Pressurized Section*^[23]
 - Length: 4.21 metres (13.8 ft)
 - Diameter: 4.39 metres (14.4 ft)
 - Mass: 8,386 kilograms (18,488 lb)
 - Launch Date: 11 March 2008
- *Exposed Facility*^[24]
 - Length: 4 metres (13 ft)
 - Diameter: 5.6 metres (18 ft)
 - Height: 5 metres (16 ft)
 - Mass: 4,000.685 kilograms (8,820.00 lb)

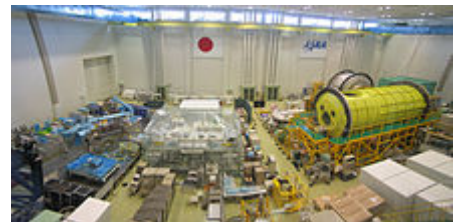


Close view of the exterior panels of the Pressurized Module and Logistics Module, during STS-132

- Launch Date: 15 July 2009
- *Robotic Arm*^{[24][25]}
 - Main Arm (MA)
 - Length: 10 metres (33 ft)
 - Mass: 780 kilograms (1,720 lb)
 - Handling Capacity: Max. 7000kg(Payload size: 1.85m x 1.0m x 0.8m / weight: less than 500kg)
 - Small Fine Arm (SFA)
 - Length: 2.2 metres (7 ft 3 in)
 - Mass: 190 kilograms (420 lb)
 - Handling Capacity: Max. 80kg with Compliance Control Mode, Max. 300kg without Compliance Control Mode(ORU size: 0.62 x 0.42 x 0.41m / weight: 80kg max)



A prototype for the Small Fine Arm was tested during the STS-85 space shuttle mission in 1997.^[21]



The JEM being manufactured

The module and all its integrated accessories were manufactured at the Tsukuba Space Center in Japan. It is made from stainless steel, titanium, and aluminum.

Experiments on *Kibō*

Current external experiments

- **MAXI** – X-ray astronomy from 0.5 to 30 keV.^[26] Exposed Facility Slot 1.
- **STP Houston 8 Payload-COWVR** and **TEMPEST**^[27] Launched on SpaceX CRS-24 in 2021. Exposed Facility Slot 7 port originally held **ICS-EF** and **CREAM** which was moved back to Slot 2 to make room for STP Houston 9.
- **OCO-3** – Monitoring of carbon dioxide in the Earth's atmosphere using a flight spare from OCO-2.^[28] Exposed Facility Slot 3 port originally held **SMILES**.
- **NREP** – Nanoracks External Platform. NREP-2 is the current mission on this pallet. Exposed Facility Slot 4.
- **i-SEEP** – IVA-replaceable Small Exposed Experiment Platform (JAXA). Mounted to Exposed Facility Slot 5.^[29] It is a platform to support small-to-medium (less than 200 kg) payloads. Experiments on the i-SEEP platform are HDTV-EF2 (since 2017), GPSR/Wheel,^[30] and SOLISS (since 2019).^[31]
- **GED** – Global Ecosystem Dynamics Investigation on ISS Exposed Facility Slot 6 port originally held **HREP**.
- **CREAM** – Cosmic Ray Energetics and Mass Experiment. Launched on SpaceX CRS-12 in 2017. Initially at Exposed Facility Slot 2. Moved to Slot 7 in 2021^[32] and back to Slot 2 in 2023 to make room for STP Houston 9.



Looking forward at *Kibō*



Looking alongside

- **HISUI** – Hyperspectral Imager Suite (METI) replacement for **HREP** which ended its mission in 2017.^[33] Exposed Facility Slot 8 port originally held **MCE**.
- **CALET** – CALorimetric Electron Telescope (JAXA), observation for high energy cosmic rays. Launched aboard Kounotori 5 (HTV-5).^[34] Mass: 2500 kg.^[35] Exposed Facility Slot 9 port originally held **SEDA-AP**.
- **ExHAM 1 and 2** – External Facility Handrail Attach Mechanism (JAXA).^[36] Mounted to the deck on handrails in the forward and aft locations next to slots 7 and 10.
- **ECOSTRESS** – Ecosystem Spaceborne Thermal Radiometer Experiment on Space Station.^[37] Exposed Facility Slot 10 port originally held the ELM-ES and the HTV Transfer Pallet.
- **STP-H9-SWELL** (Space Wireless Energy Laser Link), A test payload for Laser Communications a follow on to OPALS, **Electric Propulsion Electrostatic Analyzer**, A test device that will demonstrate re-boost using Ion Propulsion, **Neutron Radiation Detection Instrument** from NRL, **Variable Voltage Ion Protection Experiment** from NRL, **ECLIPSE** (Experiment for Characterizing the Lower Ionosphere and Production of Sporadic-E), **Glowbug**, cosmic ray detector built in conjunction with NASA, an experiment that will study cosmic rays for two years, **SpaceCube Edge Node Intelligent Collaboration**, an experiment built by NASA Goddard that will study microchips and artificial intelligence exposed to the vacuum of space, and **SOHIP**, a hyperspectral imager built by Livermore Labs that will study the atmosphere for two years. Exposed Facility slot 11 port originally held **ICS-EF**, **i-SEEP2**, and temporary held **CREAM** until it was relocated back to Slot 2.^[38]

Former external experiments

Deorbited with Kounotori 5 (HTV-5):

- **SMILES** – Observes and monitors very weak sub-millimeter wave emission lines of trace gas molecules in the stratosphere.^[39]
- **MCE** – Multi-mission Consolidated Equipment (NASA).

Deorbited with SpaceX CRS-15:

- **HREP** – Hyperspectral Imager for the Coastal Ocean (HICO) and Remote Atmospheric and Ionospheric Detection System (RAIDS) experimental payload.^[40]

Deorbited with SpaceX CRS-17:

- **CATS** – Cloud-Aerosol Transport System (LiDAR, NASA).^[41] Originally held in Slot 5, will be replaced by **MOLI**.

Jettisoned into orbit by ISS robotic arm:^{[42][43]}

- **SEDA-AP** – Space Environment Data Acquisition equipment-Attached Payload. Measures neutrons, plasma, heavy ions, and high-energy light particles in the station's orbit.
- **ICS-EF** – Inter-orbit Communication System-Exposed Facility, Japanese communication system. Originally at the Exposed Facility Slot 7.^[44]

Deorbited with SpaceX CRS-23:

- **i-SEEP2** - IVA-replaceable Small Exposed Experiment Platform 2^[45]

Current internal experiments

Japanese:

- **RYUTAI Rack** 流体 (りゅうたい, *ryūtai*, fluid) – Fluid Physics Experiment Facility (FPEF), Solution Crystallization Observation Facility (SCOF), Protein Crystallization Research Facility (PCRF), Image Processing Unit (IPU)
- **SAIBO Rack** 細胞 (さいぼう, *saibō*, cell) – Cell Biology Experiment Facility (CBEF), Clean Bench (CB)
- **KOBAIRO Rack** 勾配炉 (こうばいろ, *kōbairo*) – Gradient Heating Furnace (GHF)
- **MPSR-1** – Multi-Purpose Small payload Rack-1
- **MPSR-2** – Multi-Purpose Small payload Rack-2, housing Electrostatic Levitating Furnace (ELF)

American:

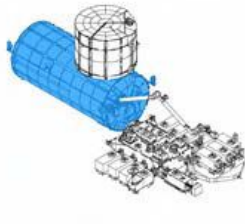
- **EXPRESS Rack 4** – Biotechnology Specimen Temperature Controller (BSTC), Gas Supply Module (GSM), Space Acceleration Measurement System-II (SAMS-II), Biotechnology Specimen Temperature Controller (BSTC), Nanoracks NanoLab
- **EXPRESS Rack 5**
- **MELFI-1** – two -80° freezer racks
- **Life Sciences Glovebox (LSG)**
- **Mochii** – Spectroscopic Scanning Electron Microscope (SEM) National Laboratory Facility^[46]

Planned experiments

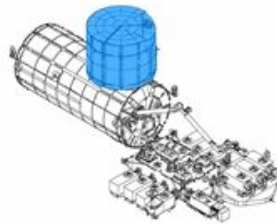
- **MOLI** – Multi-footprint Observation Lidar and Imager (JAXA) (external)

- JEM-EUSO (internal)

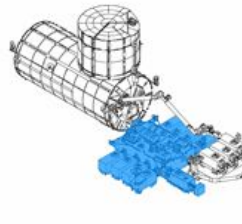
Parts



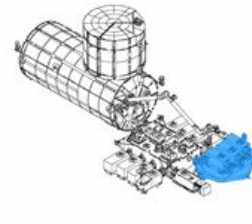
Pressurized
Module



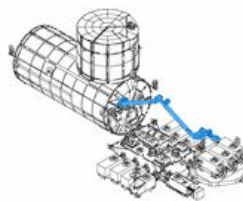
Experiment
Logistics Module-
Pressurized Section



Exposed Facility



Experiment
Logistics Module-
Exposed Section



Remote
Manipulator System

See also



Spaceflight portal

- Scientific research on the ISS
- Nanoracks CubeSat Deployer (NRCSD)

References

1. Kamiya, Setsuko (30 June 2009). "Japan a low-key player in space race" (<https://web.archive.org/web/20090803053741/http://search.japantimes.co.jp/cgi-bin/nn20090630i1.html>). *Japan Times*. p. 3. Archived from the original (<http://search.japantimes.co.jp/cgi-bin/nn20090630i1.html>) on 3 August 2009.
2. "Major Component" (<https://iss.jaxa.jp/en/kibo/about/kibo/>). JAXA. 29 August 2008. Retrieved 23 March 2021.
3. "About Kibo" (<https://web.archive.org/web/20090310171550/http://kibo.jaxa.jp/en/about/>). JAXA. 25 September 2008. Archived from the original (<http://kibo.jaxa.jp/en/about/>) on 10 March 2009. Retrieved 6 March 2009.
4. "Kibo Japanese Experiment Module" (http://www.nasa.gov/mission_pages/station/structure/elements/jem.html). NASA. Archived (https://web.archive.org/web/20081023071601/http://www.nasa.gov/mission_pages/station/structure/elements/jem.html) from the original on 23 October 2008. [Ⓔ] This article incorporates text from this source, which is in the public domain.

5. "STS-123 MCC Status Report #11" (http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/sts123/news/STS-123-11.txt). NASA. 16 March 2008. Archived (https://web.archive.org/web/20100318232619/http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/sts123/news/STS-123-11.txt) from the original on 18 March 2010. © This article incorporates text from this source, which is in the public domain.
6. きぼう 船外実験プラットフォーム利用ハンドブック (<https://iss.jaxa.jp/kiboexp/participation/application/documents/ef02/handbook.pdf>) (PDF) (in Japanese). JAXA. October 2006. Retrieved 23 March 2021.
7. 船外パレット (https://iss.jaxa.jp/glossary/jp/se/elm_es.html) (in Japanese). JAXA. Retrieved 23 March 2021.
8. "Remote Manipulator System" (<https://web.archive.org/web/20080320035809/http://kibo.jaxa.jp/en/about/kibo/rms/>). JAXA. Archived from the original (<http://kibo.jaxa.jp/en/about/kibo/rms/>) on 20 March 2008.
9. "HTV-1 Mission Press Kit" (http://iss.jaxa.jp/en/htv/mission/htv-1/presskit/htv-1_presskit.pdf) (PDF). JAXA. 2 September 2009. p. 19. Archived (https://web.archive.org/web/20150402093403/http://iss.jaxa.jp/en/htv/mission/htv-1/presskit/htv-1_presskit.pdf) (PDF) from the original on 2 April 2015. Retrieved 31 January 2015.
10. Human Space Systems and Utilization Program Group (September 2007). "Kibo HANDBOOK" (https://iss.jaxa.jp/kibo/library/fact/data/kibo-handbook_en.pdf) (PDF). JAXA. Retrieved 24 March 2021.
11. Keeter, Bill (21 February 2020). "ISS Daily Summary Report – 2/21/2020" (<https://blogs.nasa.gov/stationreport/2020/02/21/iss-daily-summary-report-2212020/>). NASA. Retrieved 24 March 2021.
12. "ISS DEB (ICS-EF) (ID 45265)" (<https://aerospace.org/reentries/iss-deb-ics-ef-id-45265>). Aerospace. Retrieved 19 March 2023.
13. "The ICS-F was cataloged as object 45265, 1998-067RJ. It orbited the Earth as space junk for 3 years, and reentered at 0430 UTC (9.30pm PDT) over California, widely observed from the Sacramento area" (<https://web.archive.org/web/20230318081650/https://twitter.com/planet4589/status/1636956596482760704>). Archived from the original on 18 March 2023. Retrieved 19 March 2023.
14. "Shipping of the Kibō ELM-PS, Kibō RMS and Kibō experiment racks" (http://iss.jaxa.jp/iss/kibo/develop_status_51_e.html). JAXA. Archived (https://web.archive.org/web/20080505025525/http://iss.jaxa.jp/iss/kibo/develop_status_51_e.html) from the original on 5 May 2008.
15. "NASA's Shuttle Endeavour Begins Mission to the Space Station" (<http://www.nasa.gov/centers/kennedy/news/releases/2008/release-20080311.html>). NASA. Archived (<https://web.archive.org/web/20080318230737/http://www.nasa.gov/centers/kennedy/news/releases/2008/release-20080311.html>) from the original on 18 March 2008. © This article incorporates text from this source, which is in the public domain.
16. "Kibo PM arrival in USA" (http://iss.jaxa.jp/iss/kibo/develop_status_36_e.html). JAXA. Archived (https://web.archive.org/web/20070919031816/http://iss.jaxa.jp/iss/kibo/develop_status_36_e.html) from the original on 19 September 2007.
17. "NASA's Shuttle Discovery Launches With Japanese Laboratory" (<http://www.nasa.gov/centers/kennedy/news/releases/2008/release-20080531.html>). NASA. Archived (<https://web.archive.org/web/20081012020310/http://www.nasa.gov/centers/kennedy/news/releases/2008/release-20080531.html>) from the original on 12 October 2008. © This article incorporates text from this source, which is in the public domain.
18. "Kennedy Media Gallery;— Photo No: KSC-08PD-2924" (<https://web.archive.org/web/20110608081011/http://mediaarchive.ksc.nasa.gov/detail.cfm?mediaid=37693>). NASA. Archived from the original (<http://mediaarchive.ksc.nasa.gov/detail.cfm?mediaid=37693>) on 8 June 2011. © This article incorporates text from this source, which is in the public domain.

19. "STS-127 mission page" (http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/sts127/index.html). NASA. Archived (https://web.archive.org/web/20090716094058/http://www1.nasa.gov/mission_pages/shuttle/shuttlemissions/sts127/index.html) from the original on 16 July 2009. © This article incorporates text from this source, which is in the public domain.
20. Harwood, William (27 July 2009). "Endeavour crew completes fifth and final spacewalk" (<http://spaceflightnow.com/shuttle/sts127/090727fd13/index4.html>). *NASASpaceFlight.com*. Archived (<https://web.archive.org/web/20090731110002/http://www.spaceflightnow.com/shuttle/sts127/090727fd13/index4.html>) from the original on 31 July 2009. Retrieved 29 July 2009.
21. Garcia, Mark (19 July 2017). "About the Kibo Laboratory" (http://www.nasa.gov/mission_pages/station/structure/elements/kibo.html). NASA. Retrieved 8 January 2023.
22. "STS-124 Press Kit" (http://www.nasa.gov/pdf/228145main_sts124_presskit2.pdf) (PDF). NASA. Archived (https://web.archive.org/web/20101124164603/http://www.nasa.gov/pdf/228145main_sts124_presskit2.pdf) (PDF) from the original on 24 November 2010. © This article incorporates text from this source, which is in the public domain.
23. "STS-123 Press Kit" (http://www.nasa.gov/pdf/215905main_sts123_press_kit_b.pdf) (PDF). NASA. Archived (https://web.archive.org/web/20080624195809/http://www.nasa.gov/pdf/215905main_sts123_press_kit_b.pdf) (PDF) from the original on 24 June 2008. © This article incorporates text from this source, which is in the public domain.
24. Garcia, Mark (19 July 2017). "About the Kibo Laboratory" (http://www.nasa.gov/mission_pages/station/structure/elements/kibo.html). NASA. Retrieved 8 January 2023.
25. "Remote Manipulator System:About Kibo - International Space Station - JAXA" (<https://iss.jaxa.jp/en/kibo/about/kibo/rms/>). *iss.jaxa.jp*. Retrieved 8 January 2023.
26. "Monitor of All-sky X-ray Image: MAXI" (https://web.archive.org/web/20130521055336/http://iss.sfo.jaxa.jp/kibo/kibomefc/maxi_e.html). JAXA. Archived from the original (http://iss.sfo.jaxa.jp/kibo/kibomefc/maxi_e.html) on 21 May 2013.
27. Greicius, Tony (2 November 2021). "Small but Mighty NASA Weather Instruments Prepare for Launch" (<http://www.nasa.gov/feature/jpl/small-but-mighty-nasa-weather-instruments-prepare-for-launch>). NASA. Retrieved 17 January 2022.
28. "OCO-3" (<https://science.nasa.gov/missions/oco-3/>). NASA Science Mission Directorate. Archived (<https://web.archive.org/web/20180503224440/https://science.nasa.gov/missions/oco-3>) from the original on 3 May 2018. Retrieved 7 May 2018. © This article incorporates text from this source, which is in the public domain.
29. "IVA-replaceable Small Exposed Experiment Platform (i-SEEP)/Payload Interface Control Document" (http://iss.jaxa.jp/kiboexp/equipment/pdf/jmx-2017108_i-seep-icd_en.pdf) (PDF). JAXA. July 2017. Retrieved 25 February 2020.
30. "IVA-replaceable Small Exposed Experiment Platform (i-SEEP)" (<http://iss.jaxa.jp/en/kiboexp/ef/i-seep/>). JAXA. 31 October 2016. Retrieved 25 February 2020.
31. 宇宙探査イノベーションハブとリコー、THETAをベースに共同開発したカメラで360°全天球静止画・動画を撮影・公開 (http://www.ihub-tansa.jaxa.jp/theta_photo.html). JAXA. 17 October 2019. Retrieved 25 February 2020.
32. 利用状況と今後の予定 (<https://humans-in-space.jaxa.jp/kibouser/information/program/73119.html>) (in Japanese). JAXA. 22 December 2021. Retrieved 23 December 2021.
33. Japan Space Systems. "HISUI : Hyper-spectral Imager SUItE | Project | Japan Space Systems" (https://ssl.jspacesystems.or.jp/en/project_hisui/?doing_wp_cron=1577127094.6934249401092529296875). *ssl.jspacesystems.or.jp*. Retrieved 23 December 2019.
34. "About the cooperation of JAXA and ASI in the development of CALET" (http://iss.jaxa.jp/en/kiboexp/news/130610_calet.html). JAXA. 10 June 2013. Archived (https://web.archive.org/web/201401110093325/http://iss.jaxa.jp/en/kiboexp/news/130610_calet.html) from the original on 10 January 2014. Retrieved 10 January 2014.

35. Torii, Shoji (24 February 2006). "The CALET Project for Investigating High Energy Universe" (<https://web.archive.org/web/20070616153729/http://www.icrr.u-tokyo.ac.jp/icrr-study/CALET-EBHU06.pdf>) (PDF). Waseda University, Advanced Research Institute for Science and Engineering; University of Tokyo, Institute for Cosmic Ray Research. Archived from the original (<http://www.icrr.u-tokyo.ac.jp/icrr-study/CALET-EBHU06.pdf>) (PDF) on 16 June 2007.
36. "ExHAM : Experiment - International Space Station - JAXA" (<https://iss.jaxa.jp/en/kiboexp/ef/exham/>). *iss.jaxa.jp*. Retrieved 6 March 2020.
37. Keeter, Bill (5 July 2018). "ISS Daily Summary Report – 7/05/2018" (<https://blogs.nasa.gov/stationreport/2018/07/05/iss-daily-summary-report-7052018/>). NASA.  This article incorporates text from this source, which is in the public domain.
38. "STP-H9" (https://space.skyrocket.de/doc_sdat/stp-h9.htm). *Gunter's Space Page*. Retrieved 26 April 2023.
39. "Superconducting Submillimeter-wave Limb-emission Sounder: SMILES" (https://web.archive.org/web/20060928051843/http://iss.sfo.jaxa.jp/kibo/kibomefc/smiles_e.html). JAXA. Archived from the original (http://iss.sfo.jaxa.jp/kibo/kibomefc/smiles_e.html) on 28 September 2006.
40. Keeter, Bill (11 July 2018). "ISS Daily Summary Report – 7/11/2018" (<https://blogs.nasa.gov/stationreport/2018/07/11/iss-daily-summary-report-7112018/>). NASA.  This article incorporates text from this source, which is in the public domain.
41. "Robotics and Space Biology Today as Cosmonauts Look to Next Spacewalk – Space Station" (<https://blogs.nasa.gov/spacestation/2019/05/13/robotics-and-space-biology-today-as-cosmonauts-look-to-next-spacewalk/>). *blogs.nasa.gov*. Retrieved 14 May 2019.  This article incorporates text from this source, which is in the public domain.
42. きぼう 船外設置の宇宙環境計測ミッション装置（SEDA-AP）をISSから廃棄しました (http://iss.jaxa.jp/kiboexp/equipment/ef/seda_ap/seda-ap_disposal.html) (in Japanese). JAXA. 21 December 2018. Retrieved 21 December 2018.
43. 衛星間通信システム船外部（ICS-EF）をISSから廃棄しました (<http://iss.jaxa.jp/kiboexp/news/200225.html>) (in Japanese). JAXA. 25 February 2020. Retrieved 25 February 2020.
44. "At 12:50 CT today, robotics ground controllers commanded an SSRMS disposal jettison of the retired JEM ICS-EF" (<https://blogs.nasa.gov/stationreport/2020/02/21/iss-daily-summary-report-2212020/>).
45. 利用状況と今後の予定 | 「きぼう」利用のご案内 | JAXA 有人宇宙技術部門 (<https://humans-in-space.jaxa.jp/kibouser/information/program/73189.html>) (in Japanese). JAXA. 9 March 2022. Retrieved 12 March 2022.
46. "Facility Details" (https://www.nasa.gov/mission_pages/station/research/experiments/explorer/Facility.html?id=7657). *www.nasa.gov*. Retrieved 22 May 2023.

External links

- [Japanese Experiment Module \(*Kibō*\)](https://humans-in-space.jaxa.jp/en/kibo/) (<https://humans-in-space.jaxa.jp/en/kibo/>) at JAXA.jp
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