Kibo Utilization Strategy

Toward maximized outcome of Kibo utilization

Agenda 2025

The third edition

March 2020
JEM "Kibo" Utilization Center
Human Spaceflight Technology Directorate

CONTENTS

[Reference] Abbreviations

Abbreviation	English	Japanese
AI	Artificial Intelligence	人工知能
APRSAF	Asia-Pacific Regional Space Agency Forum	アジア・太平洋地域宇宙機関会議
BBM	Bread Board Model	試験試作用モデル
CALET	CALorimetric Electron Telescope	高エネルギー電子・ガンマ線観測装置
CBEF	Cell Biology Experiment Facility Centrifuge-equipped Biological Experiment Facility	細胞培養装置 遠心機付き生物実験装置
ExHAM	Exposed Experiment Handrail Attachment Mechanism	簡易曝露実験装置
EM	Engineering Model	エンジニアリングモデル
EML	Electromagnetic Levitator	電磁浮遊炉
ESA	European Space Agency	欧州宇宙機関
HISUI	Hyperspectral Imager SUIte	宇宙実証用ハイパースペクトルセンサー
HTV-X	H-II Transfer Vehicle-X	新型宇宙ステーション補給機
IMAP/GLIMS	Ionosphere, Mesosphere, upper Atmosphere, and Plasmasphere/Global Lightning and Sprite Measurement Mission	地球超高層大気撮像観測/スプライトおよび雷放電の高速測光撮像ミッション
i-SEEP	IVA-replaceable Small Exposed Experiment Platform	中型曝露実験アダプター

Abbreviation	English	Japanese
ISS	International Space Station	国際宇宙ステーション
JAXA	Japan Aerospace Exploration Agency	宇宙航空研究開発機構
JP-US OP3	Japan-United States Open Platform Partnership Program	日米オープン・プラットフォーム・パートナーシップ・プログラム
J-SPARC	JAXA Space Innovation through Partnership and Co-creation	宇宙イノベーションパートナーシップ
LEO	Low Earth Orbit	地球低軌道
MAXI	Monitor of All-sky X-ray Image	全天X線監視装置
NASA	National Aeronautics and Space Administration	アメリカ航空宇宙局
NICER	Neutron star Interior Composition Explorer	中性子星内部組成観測装置
PDCA	Plan-Do-Check-Act	計画-実行-評価-改善
R-ORU	Robotics-compatible Orbital Replacement Unit	軌道上交換ユニット
SDGs	Sustainable Development Goals	持続可能な開発目標
SEDA-AP	Space Environment Data Acquisition equipment - Attached Payload	宇宙環境計測ミッション装置
SMILES	Superconducting Submillimeter-Wave Limb-Emission Sounder	JEM搭載超伝導サブミリ波リム放射サウンダ
ToMMo	Tohoku Medical Megabank Organization	東北メディカル・メガバンク機構
UNOOSA	United Nations Office for Outer Space Affairs	国際連合宇宙局

Introduction

Introduction

The environment surrounding the JEM Kibo is greatly changing as seen at the recent events such as the Japanese government's recent changing of its space policies, the reorganization of JAXA as a National Research and Development Agency and Japan's declaration to participate in the international space exploration. Through the utilization the JEM Kibo, JAXA has been trying to bridge between its R&D outcomes, which directly associated with possible social contributions, and the growth of Japanese R&D and commercial activities, aiming at maximizing outcomes of R&D activities of Japan. In order to continue utilization of space environment even after the ISS retires, private sector's demand for and investment in low Earth orbit (LEO) should be stimulated and private sector's activities in this field should be expanded so that LEO becomes an economic segment by the private sector initiative.

- Enhance considerably the quality, quantity and diversity of the experimental technologies installed and developed on the Kibo at the expense of the national budget according to the needs, allow these technologies to be used by a wide range of users from industries, academies and governments and contribute to Japanese sciences and technologies and the national integrated innovation strategy.
- Prioritize activities on creation of Kibo's unique outcomes and promote space experiments whose values of investment have been recognized as means required for private sector's R&D activities (business operations for which investment has been decided).
- Take full advantage of Kibo as an R&D basis, which is constantly creating useful outcomes for human life on Earth and respond to public expectations.

About this document

- The objective of The Kibo Utilization Strategy is to summarize the Goals of Kibo utilization around 2030, the objectives, and specific activities until 2024, and to show guidelines for expansion/promotion of Kibo utilization aimed at maximized outcomes, requirements for experiment devices/equipment development, and public offering policies for Kibo utilization, according to JAXA's management and business policies and plans on the supposition that the ISS operations will be extended beyond 2024, which is the current the government decided year to continue its operation.
- The Strategy is to be revised timely as needed according to the changes of the environment surrounding Kibo utilization and the progress during its operational period to ensure a steady PDCA cycle for the activities concerned.

Revision Notes of the Third Edition

The Kibo Utilization Strategy is revised because of a progress of the Kibo utilization, and situational changes related to LEO activities and human space exploration plan. The main points of the revision will be shown as follows:

① Clarification of the direction of activities after ISS's retirement (in and after 2028/2030) supposing that the current space environment utilization activities is continued

② Clarification of the vision/roadmap in a perspective of the situation of LEO around 2030:
- Make the best use of the remaining term of the ISS operations, conduct space exploration activities and make active preparations for securing a utilization continuity the after the ISS's retirement.
  - National research promoted by the government (Kibo utilization as a public R&D basis)
  - Open innovation with business use (Kibo utilization as a commercial activity platform)
  - Acquisition of technologies for longer duration human exploration beyond LEO (Kibo utilization as JAXA's R&D activities)

③ Update of activities until 2024 (responding to a progress of the activities)

④ Update of prioritized areas (Platforms) for maximized outcomes
- Change of terms: from "Aging Research Supporting Platform" to "Health and Longevity Research Supporting Platform"
- Additional description of "**Innovative Material Research Supporting Platform**" (ELF utilization) as a new platform and "Biomedical and Developmental Cell Science Platform" as proposed as a candidate platform for the next revision
- Shift of space demonstration of a new material using ExHAM to i-SEEP

⑤ Specific activities handled as appendix to be reviewed in consideration of their progress and the changing situation (so that such activities can be updated flexibly).

Goals of Kibo Utilization around 2030

Space environment utilization in LEO becomes a part of human social and economic activities through Kibo utilization

- Continue to make effective use of the JEM Kibo as a "technical demonstration/technical accumulation platform," an "academic/scientific research platform" and a "commercial activity platform."
- Aim the situation which the private sector bear the responsibility to operate and utilize space environment and provide in-orbit service. Expand space environment utilization by combining private sectors utilization by themselves and JAXA's utilization by procuring their service as the means for continuous utilization of space environment
- Several options shown on the right are supposed for schemes of space environment utilization after the ISS's retirement.
- Assume Continuous utilization of space environment of LEO (including ISS), because of tremendous benefits to human being of outcomes of stable long-duration R&D/scientific research activities in microgravity and the availability of Kibo as a platform for technical demonstration for JAXA's exploration.
- Aim Expanded/developed space environment utilization by JAXA and industries in which in-orbit services established through Kibo operation/utilization have been handed over for post-ISS space environment utilization.

Options	Scheme of space environment utilization
Option 1	small scale experiment service Opt. 1-1 platform with human stay Opt. 1-2 unmanned experiment system
Option 2	Joint utilization of foreign country's platform
Option 3	Service procurement from US entities.

Visions for Achieving Goals of Kibo Utilization

① Contribution of national research promoted by the government (public utilization)

- Expand space environment utilization that can contribute to resolving national problems and enhancing the capabilities of basic sciences and technologies, by making use of Kibo's unique environment, and prioritize/screen the research areas

② Promotion of open innovation with business uses (for commercial utilization)

- Transfer space environment utilization technologies to private-sector commercial service providers as they become matured and establish a business scheme where private companies are independently engaged in their own service business for end users while JAXA, as a customer, procures necessary services.
- Undertake active preparations for constructing an ecosystem for space environment utilization after the ISS's retirement.

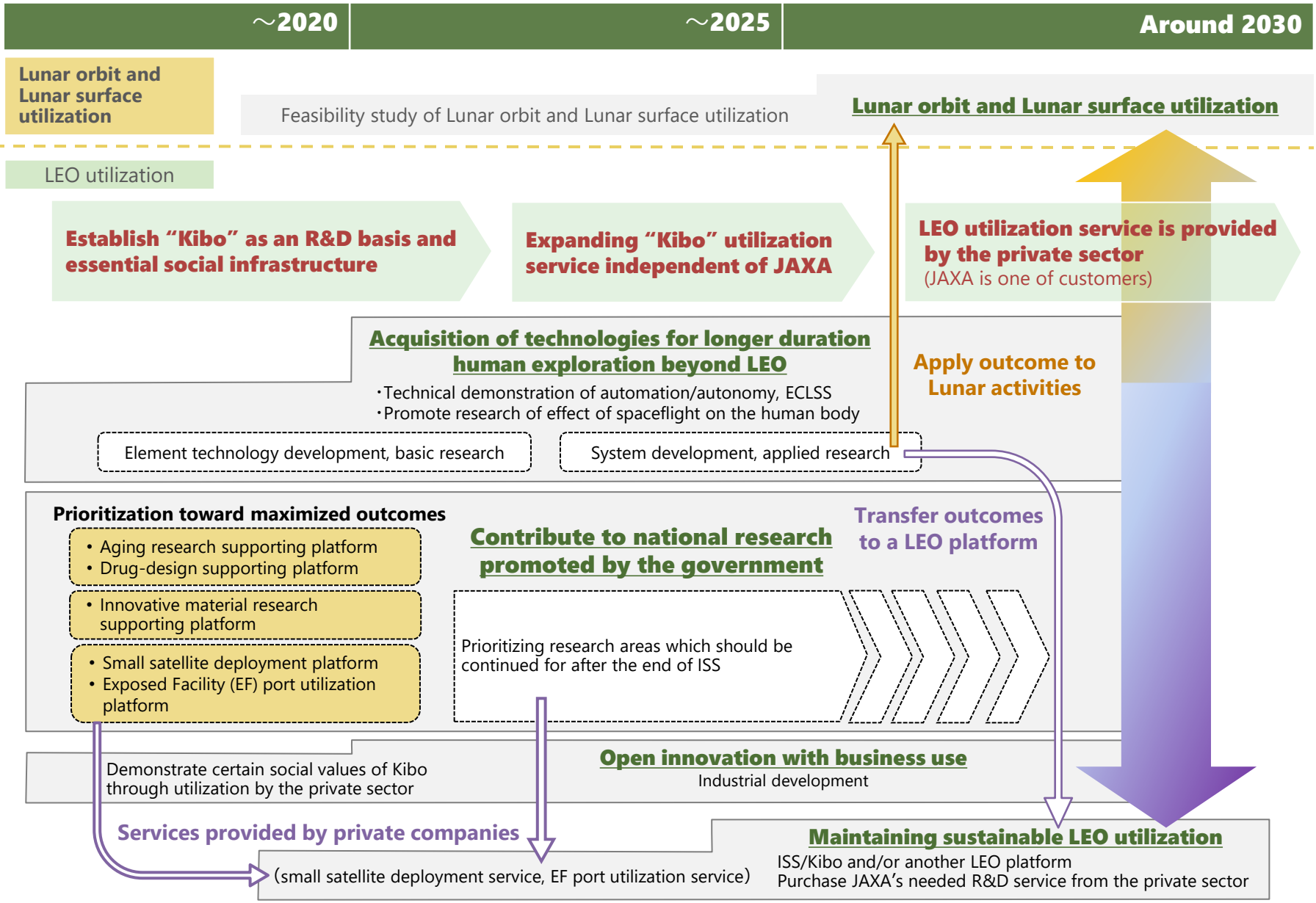
③ Promotion acquisition of technologies for longer duration human exploration beyond LEO (JAXA's R&D utilization)

- Acquire technologies and knowledge required for very long human stay in space (identification of effects of space environment on human body) for the possibility that more people can stay or live-in space for a long duration.
- Promote technology accumulation and technical demonstrations for lunar orbit, lunar surface exploration and space environment utilization and connect research outcomes of Kibo utilization seamlessly with the Gateway utilization.

④ Basic technologies supporting the three Kibo utilization forms ① to ③

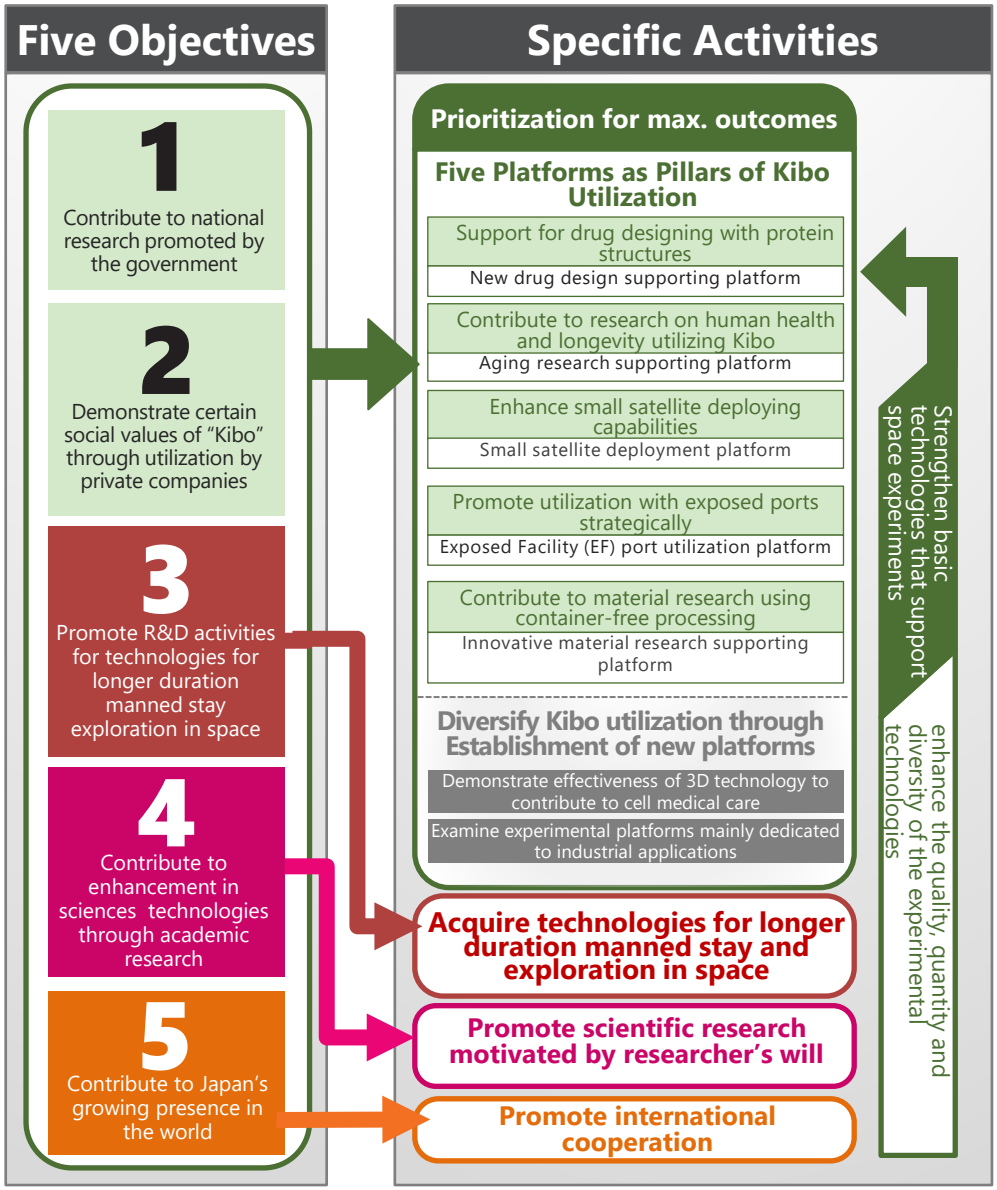
- Promote R&D activities for acquiring automation and remote-control technologies for utilization/operation of space environment so that operations implementable without human intervention can be performed autonomously.

Overview of JAXA's Utilization of Space Environment
(as the basis for this Strategy)



Activities for Achieving Goals of Kibo Utilization and Realizing the Visions

Current five objectives for Goals and visions



■ Activities until 2024

- Secure continuity of space environment utilization and develop technologies for longer duration human stay in space and deep space exploration.
  - ◆ Establish utilization/operation technologies to secure continuity of space environment utilization related to the areas to be continued for Japan, taking the best advantage of the robotics and remote control and AI technologies.
  - ◆ Conduct research focusing on technologies required for long duration human stay in space and effects of space environment on human body.
- Increase users and transfer utilization services to private companies.
  - ◆ Establish additional Platforms and construct organizations dedicated to promotion of utilization of R&D like the ISS National Lab of the US.
  - ◆ Cultivate commercial service providers and transfer the service to them stepwise.
  - ◆ Decrease the entry barrier of Kibo utilization by simplifying the procedures/processes and cooperate with J-SPARC activities.
  - ◆ Designate strategic partners.

■ Activities in and after 2025

- Utilize the ISS as long as it is in operation as a site for technical development for securing availability for utilization after the ISS's retirement and technical demonstration for long duration human stay in space and deep space exploration.
- Continue to use space environment by procuring utilization services from commercial service providers to establish a scheme of private-sector independent LEO activities and examine the possibility to utilize space environment for the Lunar Orbital Platform-Gateway ("Gateway") .

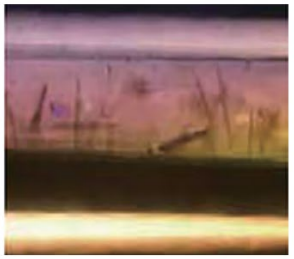
Drug-design Supporting Platform

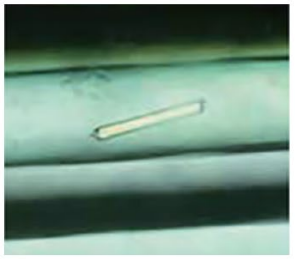
○ **Objectives**
- Transfer JAXA's accumulated globally advantageous technologies and know-how to commercial service providers stepwise.
- Promote Kibo utilization on themes having strong academic/industrial impact and difficult for crystallization to maximize outcomes of national project-based and scientific research and support the drug development aimed by the national government's health and medical care strategies on the aspect of structural analysis in order to contribute to realizing a society of health and longevity.
- Optimize the experiment opportunities to meet various demands.

○ **Required experimental technologies/techniques**
- Opportunities are provided for crystallization experiments at 4°C and 20°C (2018~). Large-protein crystallization technology for neutron diffraction is under development. A protein crystallization technique was demonstrated and its applicability to space environment was examined.
- A crystallization container in which crystallization conditions on the ground can be applied is being developed.

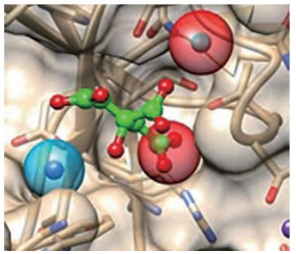
○ **Measures for promoting Kibo utilization**
- Promotion to the universities and research institutes which have steadily been engaged in national strategic research (45%); cooperative activities with strategic partners including PeptiDream Inc., the National Institute of Advanced Industrial Science and Technology (AIST) and Tohoku University Tohoku Medical Megabank Organization (5%); private-sector utilization (30%); and JAXA's technical demonstrations (20%).

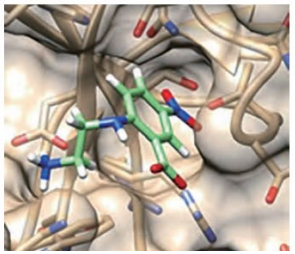
Astronaut Onishi retrieving protein crystallization experiment samples from the Protein Crystallization Research Facility (PCRF)

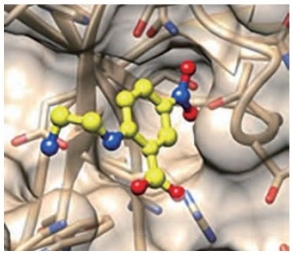




Crystallization of a complex of the enzyme "dipeptidyl aminopeptidase (DPP) 11" crucial for growth of periodontal disease-causing bacteria and the compound "SH-5" having an antimicrobial effect and selectively acting on periodontal disease bacteria; crystal produced on Earth (left) and crystal produced in space (right) (source: Iwate Medical University/JAXA)







Each research process used data acquired in space. Left: Chemical information of a compound that can be combined with DPP 11 was refined using the 3D structure of high-quality crystals of DPP 11 produced in Kibo; center: An example of search for inhibitors and bonding manner analysis on PC using commercially available database; right: High-quality crystals of a complex of DPP 11 and hit compound SH-5 were successfully produced in space and their bonding manners were identified (source: Iwate Medical University/Showa University).

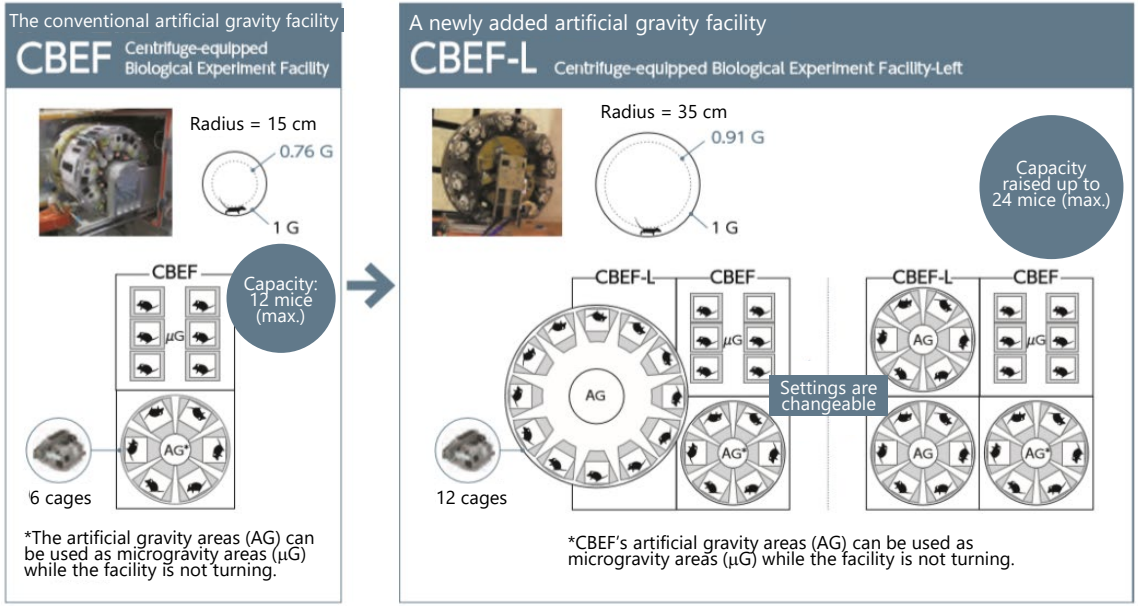
Aging Research Supporting Platform

○ **Objectives**
- Continue experiments using small animals to contribute to elucidating the mechanism of biotransformation associated with human aging and developing related-disease control.
- Develop an automated/autonomous system capable of accomplishing mouse missions in a compact manner without astronaut's support so that mouse rearing missions can be continued even after the ISS's retirement.

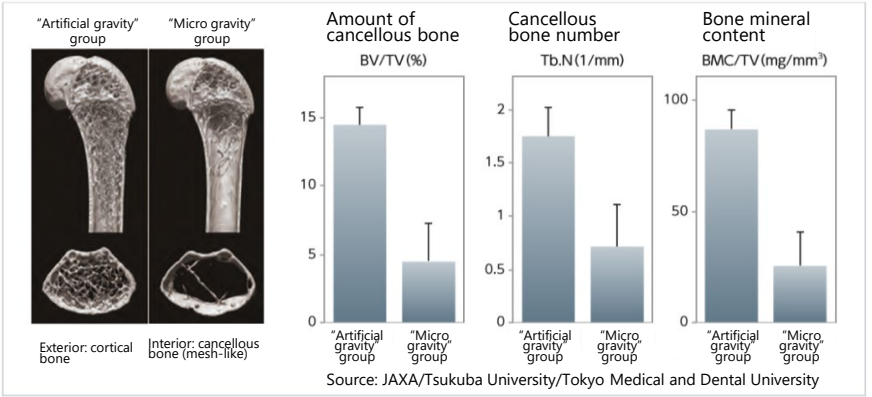
○ **Required experimental technologies/techniques**
- Establish a system capable of monitoring the behavior of living intracorporal genes with an optical marker and an automated sample freezing technique (by 2022).
- Develop an automated mouse rearing/rearing device maintenance system, a remote anatomization system and an automated sample freezing system (by 2024).

○ **Measures for promoting Kibo utilization**
- Integrate and analyze data acquired in mouse rearing missions and Big Data accumulated on Earth and construct the data setting and the data sharing schemes.
- Continue 100% assignment of the resources to publicly offered research themes and those in cooperation with national public research institutes. On the other hand, continue aiming at creating private-sector utilizations, The resources are assigned to any demand for utilization when the private sector requires.

▼**A different artificial gravity environment generated in Kibo**



▼**Change of osseous tissues of a mouse reared for a long period in Kibo**

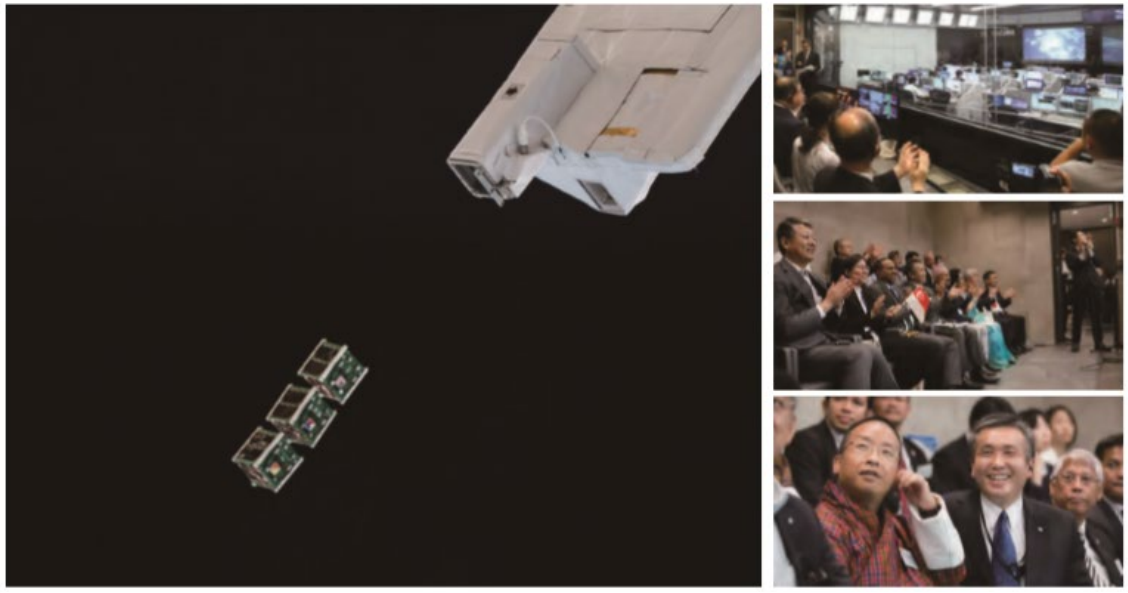


Small Satellite Deployment Platform

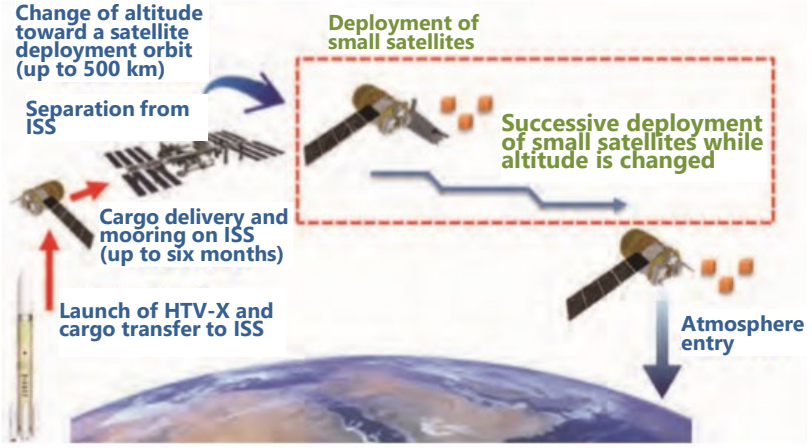
○ **Objectives**
- Complete transfer of JAXA's technical know-how so that the small satellite development service providers can independently complete the entire series of operations from acceptance of orders to launches without JAXA's assistance (within FY2020).
- Progress the satellite deployment technologies/techniques so that deployed satellites can be operated longer and be applied to practical utilization missions in view of the continuation of the small satellite deployment business after the ISS's retirement.

○ **Required experimental technologies/techniques**
- Increase stepwise the capability of the small satellite deployment functions so that it can become possible to deploy 48U satellites by the end of FY2022, considering customer acquisition situation and the market trend related to satellite size.
- Examine the feasibility of transporting a satellite by free flyers based on Kibo into a high orbit for longer lifetime of small satellites and achieve practical applicability of this launch scheme by 2024.

○ **Measures for promoting Kibo utilization**
- Promote contributions to SDGs and capacity building for emerging space nations in cooperation with strategic partners.
- Keep Kibo utilization percentages at 70% for commercial service providers and 30% for international cooperation/JAXA's technical development until the end of fiscal year 2021 (in terms of number of satellites), and then raise the percentage for commercial service providers stepwise up to 100% until the end of FY2024.



Small satellites being deployed from Kibo (left) and the officials concerned witnessing with delight a deployment of their nation's small satellite, from Bangladesh and Nigeria (upper right), from Singapore (middle right) and from Bhutan, Philippines and Malaysia (bottom right).



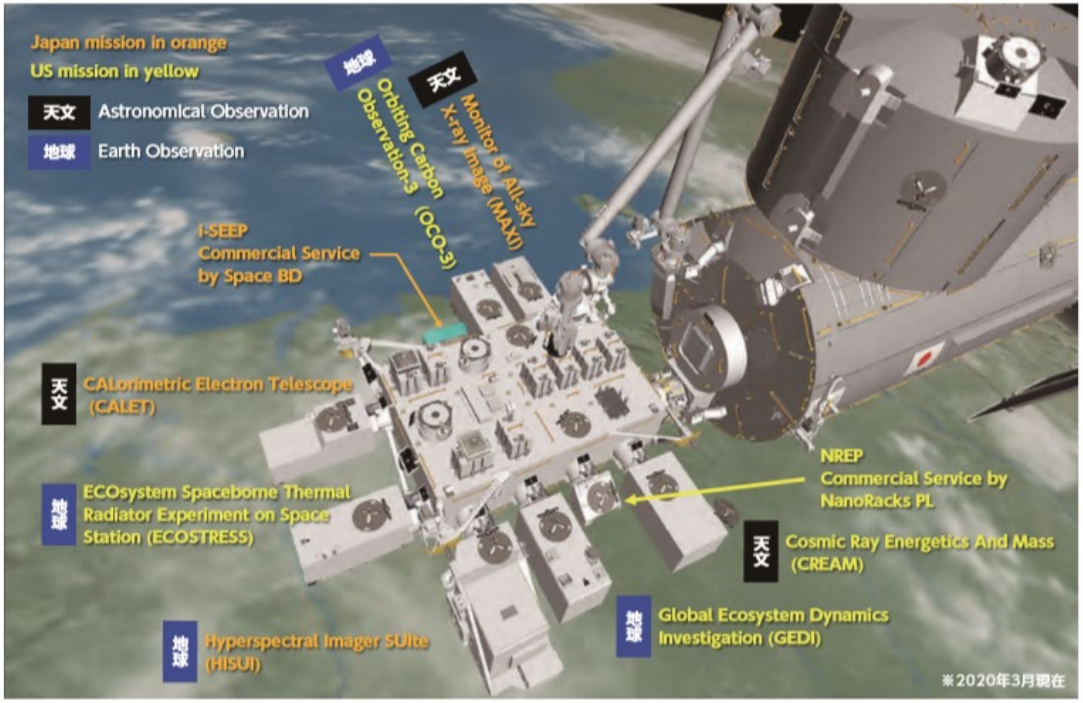
Deployment of small satellites with a new model of transfer vehicle (HTV-X)

Exposed Facility Port Utilization Platform

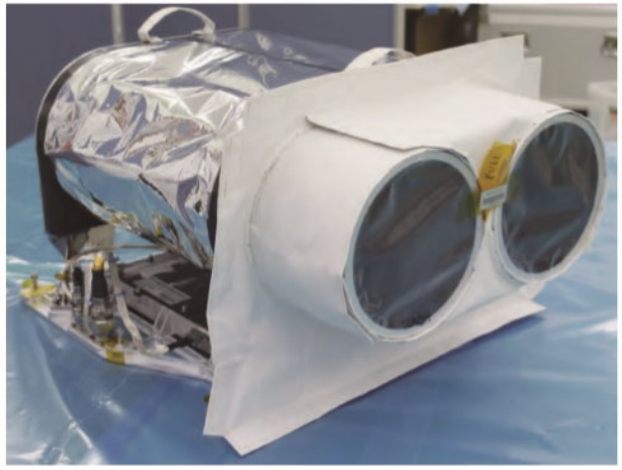
○ **Objectives**
- Complete transfer of JAXA's technical know-how so that the service providers using i-SEEP exposed ports can complete independently a series of operations from acceptance of orders to launches without JAXA's assistance (within FY2021).
- Develop a common payload support devices capable of accommodating eight sets of very small (3U-sized max.) payload and put it to practical application in order to be added values as an "Exposed Facility Port Utilization Platform."

○ **Required experimental technologies/techniques**
- Aim at starting a practical operation of the additional refrigerant feeding capability from i-SEEP to experiment devices, the increased speed (1 Gbps) of communication from i-SEEP to Kibo's pressurized section, and the added mechanism that works to joint exposed devices regardless of the air lock size within FY2023.

○ **Measures for promoting Kibo utilization**
- Make the best use of JAXA's advantages of the exposed ports in technical demonstrations and practical applications of future innovative technologies, service provision by commercial providers and entertainment utilization, and expand Kibo i-SEEP utilization in cooperation with the service providers, considering missions that only large-sized equipment can accomplish.



▼ **The integrated Standard Imager for Microsatellites (iSIM)**



The integrated Standard Imager for Microsatellites (iSIM) developed by Satlantis, a space venture company from Spain: Satlantis had commissioned JAXA via the company Space BD from Japan for compensation to conduct technical demonstration of the iSIM for extravehicular use outside Kibo.

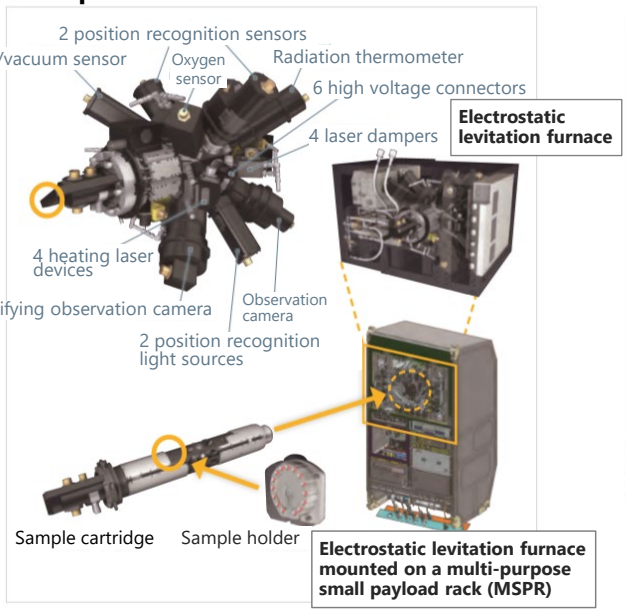
Innovative Material Research Supporting Platform

○ **Objectives**
- Publicize the advantages and effectiveness of the container-free processing techniques to stimulate data acquisition needs on various materials (including multi-element oxides) utilized in industries and demonstrate the social value of Kibo's Electrostatic Levitation Furnace (ELF).
- Utilize the fee-based utilization program and find companies who are willing to provide services using the Innovate Material Supporting Platform by 2024

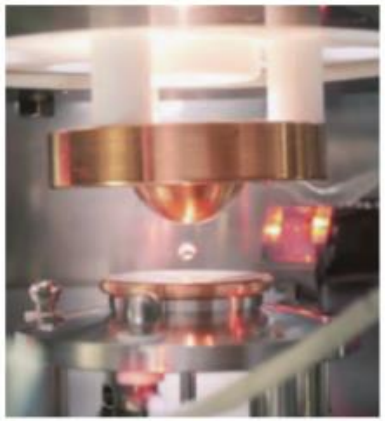
○ **Required experimental technologies/techniques**
- promote automatized/autonomous operations for more efficient experiments to expand Kibo utilization needs despite limited crew time and continue the thermophysical data acquisition using the Electrostatic Levitation techniques even after the ISS's retirement.
- Implement stepwise the additional capabilities of high sensitivity camera and CO_2 laser to expand utilization of ELF by FY2024 as a result of analyses of the demand of users including private companies handling high temperature materials.

○ **Measures for promoting Kibo utilization**
- Carry out promotion activities for academic societies and industrial associations related to material development/processing, welding, thermal spraying and semiconductor process and establish strategic partnership with the governmental material research organizations to expand Kibo utilization by research institutes and private companies. Resource (number of samples) will be assigned to strategic partners (40%) and fee-based utilization by private companies (30%).
- Meet the demands of the U.S., Russia and EU for utilization of ELF and expand utilization to Asian region to establish Japan's space utilization technology based on electrostatic levitation on the world market. 20% of Resource will be assigned to foreign users and the remaining 10% to technical demonstrations for enhancing the value of ELF.

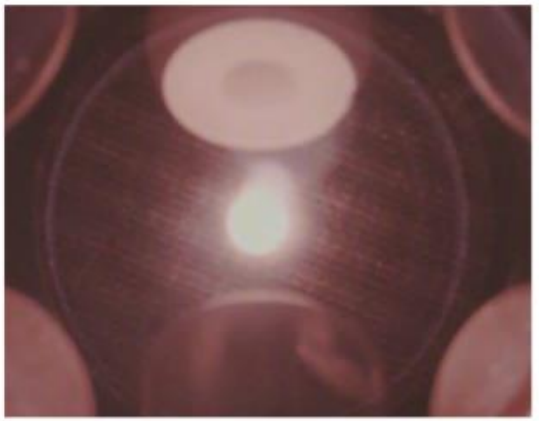
Composition of electrostatic levitation furnace



Levitation of an object in microgravity above the bowl



An experiment on the electrostatic levitation furnace on Earth: an electrically charged sample is levitating in electrostatic field generated by a voltage applied between the electrodes.



Molten aluminum oxide (central object) levitating between six electrodes (photo taken in July 2017)

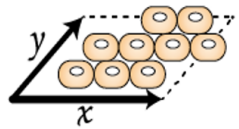
Specific activities:

Diversify Kibo Utilization through Establishment of New Platforms

Demonstrate effectiveness of 3D culture

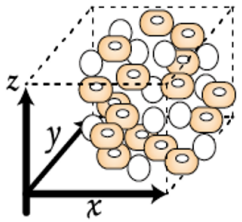
- Develop 3D culturing technology under the microgravity environment, conduct experiments related to cell medical care, and demonstrate the effectiveness of Kibo for expanding the organs to be regenerated and high-functionality.
- Once the technique is established and its effectiveness is demonstrated, set it one of strategic theme of experimental offering and make it a platform to enlarge the scope of applications toward researches on other 3D organ cultures.

Cell culture on Earth



Cell culture on the ground Earth is limited to two-dimensional expansion in a monolayer structure due to the effects of gravity

Cell culture on microgravity



It is expected that cell culture can be expanded into three-dimensionally in the microgravity environment of space

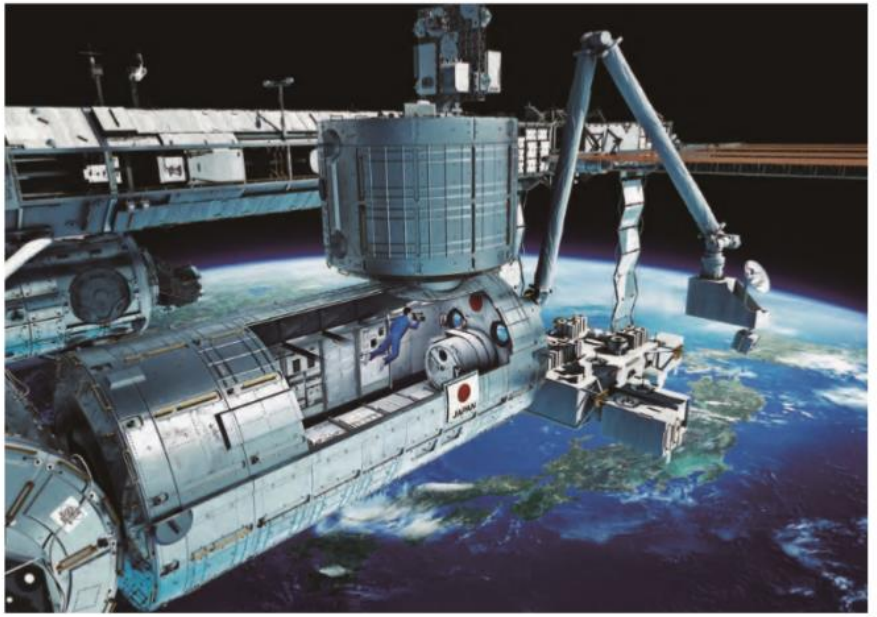
Expand commercial utilization based on new concepts

- Demonstrate the benefit of the space environment utilization in Kibo, leading other nations, to expand commercial utilization in LEOs (and on the ISS) in Japan.
- Expand Kibo utilization to continue space environment utilization mainly led by private sector after the ISS's retirement.
- Promote demonstration of the new concept business created in J-SPARC and the new technologies developed in the Space Exploration Innovation Hub using Kibo.
- Choose private companies who can coordinate Kibo utilization for each utilization area by FY2025 so that users can procure services from private service providers.
- Promote non-R&D utilization (e.g., production/distribution of video contents and additional services of short space trip) as well.
- Stimulate private sector's investment, expand the demand and utilization by private sector to activate economic activities and make LEOs (and the ISS) become more accessible sites for research and demonstration.

Contribute to improving reliability through orbital demonstration of new materials

- Contribute to the improved quality and reliability of new space materials at companies, universities and JAXA.
- Shift exposed experiments using ExHAM to those using i-SEEP in consideration of requests for power and communication resources for experiments within FY2020.

Exposed Experiment Handrail Attachment Mechanism (ExHAM)



Planned "Space Media Business" of the ISS (source: Bascule/SKY Perfect JSAT/JAXA)

Specific activities:

Technologies for Longer duration Human Exploration beyond LEO

(1) Technical development for lunar orbit and lunar surface utilization

- Promote technical development/demonstration for collecting detailed data on the reserves of water/ice and landing points on the Moon, making the best use of the JEM Kibo.
- Examine the possibility to utilize the space environment characteristic of stations in lunar orbits and on lunar surfaces that are different from that of LEOs to promote utilization of space environments at initial stages of lunar exploration.

(2) Promotion of robot application and experiment automation technologies in view of space utilization after ISS retirement

- Promote the R&D in cooperation with other organizations and companies for robot application technologies corresponding to the government's Integrated Innovation Strategy (incl. mutual application technologies between space and ground), technologies for space experiment automation (incl. 100% unmanned operation) and technologies for robot application technologies for replacing or assisting astronauts in microgravity (in Kibo) and in gravity on the Moon or a planet.

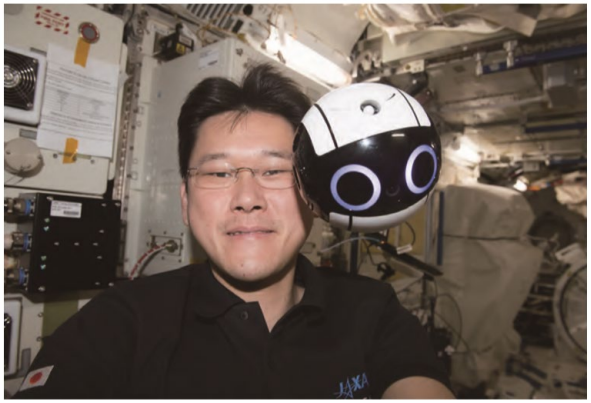
(3) Development of complete recycling environmental control and life support technologies capable of reducing mission costs

- Establish complete recycling environmental control and life support technologies, which is compact, energy-saving , highly reliable, and operable without water/oxygen replenishment and consumables, and provide such technologies for international human space exploration. Such technologies will contribute to the system's core portions as Japan, reduce mission costs through reduced quantities of cargoes and enhance Japan's presence.

(4) Radiation measurement and protection

- Improve the accuracy of astronaut's radiation dose determination so that radiation dose during a long-duration mission that tends to increase radiation dose can be evaluated on a real-time basis for determining emergency evacuation or return.
- Enhance radioprotection capability of both young astronauts whose lifetime radiation dose is small and experienced astronauts whose lifetime radiation dose is approaching the limit up to levels that allow them all to participate in human space explorations.

A mobility required for human exploration on lunar surfaces "Manned Pressurized Rover" (source: Toyota Motor Corporation)



Int-Ball and astronaut Kanai

This picture shows a demonstration model for the next-generation water regeneration system, ¼ in size compared with the current one.

Specific activities:

Promote Scientific Research Motivated by Researcher's Will

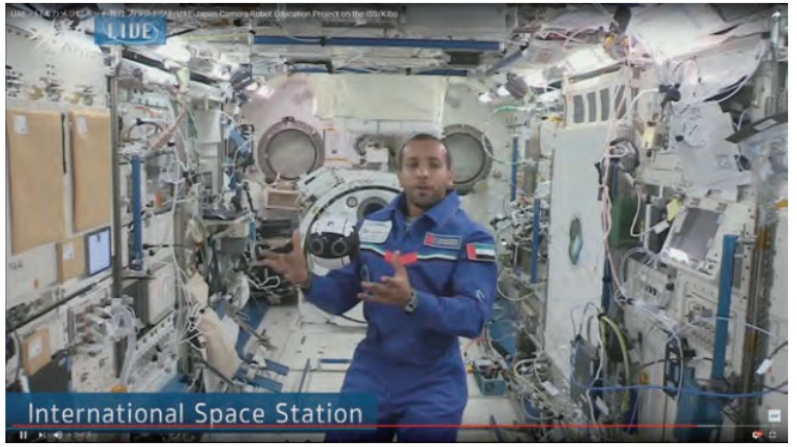
- Collect Kibo utilization themes periodically in order to create new interdisciplinary/field-fusion domains and innovation sources and studies in line with the government's Integrated Innovation Strategy. In the theme screening process, the usefulness of outcomes of Kibo utilization for progresses of the government's strategic research and sciences and technologies and their anticipated contributions to, and general vision of, industries and societies will be especially evaluated.
- Develop common and compatible experiment equipment/devices and technologies to be used for scientific studies for any study themes in different fields, considering the limited budget for Kibo utilization and use those experiment equipment, devices and technologies effectively.

Specific activities:

Promote International Cooperation

- Maximize the outcomes of Kibo/ISS utilization by holding for example a programming competition using an internal drone in the ISS, common use of the ELF and a joint mouse rearing mission under the JP-US OP3 framework, thus contributing to reinforce the Japan-U.S. cooperative relations in the strategic and diplomatic aspects.
- Promote the Kibo utilization opened to active participation of Asian nations wishing to space missions (incl. fee-based utilization) to contribute to enhancing Japan's international presence, being aware of a diplomatic importance of being the only nation participating in the ISS program.
- Promote active outreaching activities for UAE and African nations, regarded as potential users of Kibo and contribute with Kibo utilization to cooperation with governments of other nations and the United Nations.

Officials of the Selection Board of the 2nd and 3rd KiboCUBE on the podium of the IAC 2018 media briefing



Mr. Mr. Hazzaa Al Mansoor, the first astronaut from United Arab Emirates (UAE), held an educational event in Kibo, using the internal drone, Int-Ball, on September 30, 2019 (source: JAXA/NASA).

Specific activities:

Strengthening of Core Technologies for Space Experiments

- Promote development of experiment supporting equipment including sample observation system (microscope), automatic sample/image analyzing system and imaging system for visualizing biological structures to be able to handle space experiments that are being sophisticated.
- Improve the existing experiment devices (e.g., increase the size of the artificial gravity generator for a greater number of small animals) to be able to meet various utilization needs and enhance the performance of the common space experiment technologies/techniques including high-speed large experiment data transmission to support experiments in Kibo.
- Promote automated operation of experiment equipment and devices in view of the required development costs and periods and the reduced crew time to make effective use of crew time. Integrate new AI-based technologies and techniques into such automated equipment and devices because utilization of AI is likely to make progress in various fields in the perspective of realizing the "Society 5.0" (super-smart society), a new concept presented in the 5th Science and Technology Basic Plan.

If you have questions about this document or wish to make an inquiry into the JEM Kibo, send e-mail to:
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Kibo Utilization Strategy
https://humans-in-space.jaxa.jp/en/biz-lab/experiment/strategy/

Community activities
Kibo Utilization Network | https://humans-in-space.jaxa.jp/kibouser/community/
Official Twitter account | @JAXA_Kiboriyo