Kibo Utilization Workshop
5 Dec. 2023, Sydney Australia

Overview of Kibo Utilization

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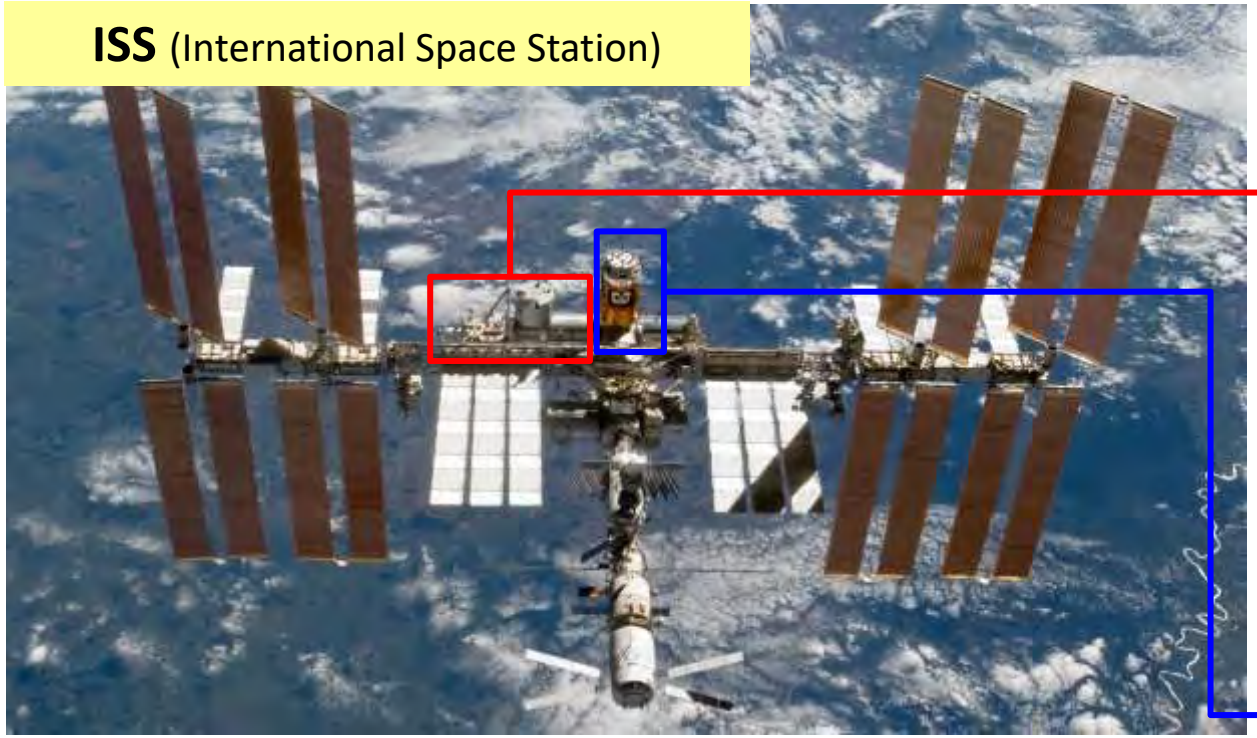
International Space Station/Japanese Experiment Module:Kibo

ISS (International Space Station)



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Kibo
(Japanese Experiment Module)

HTV
(H-II Transfer Vehicle)

H-IIB
Japanese
Launch Vehicle

- **The ISS is a huge manned construction located about 400km above the Earth.**
- **JAXA has contributed to the ISS program by developing and operating the Kibo module and HTV.**
- **Japan is the only country participating in the ISS program in the Asia-Pacific region. JAXA has collaborated with many countries in the region.**

Memorandum of Cooperation between ASA and JAXA

Signed on July 7, 2020

APRSAF : Asia-Pacific Regional Space Agency Forum

APRSAF
ASIA-PACIFIC REGIONAL SPACE AGENCY FORUM

APRSAF was established in 1993 to enhance space activities in the Asia-Pacific region.
APRSAF is the largest space-related conference in the Asia-Pacific region with participation of over 40 countries.
It currently consists of five working groups:

- **Space Frontier WG**
- Satellite Applications for Societal Benefit WG
- Enhancement of Space Capability WG
- Space Education for All WG
- Space Policy and Law WG

Under the Space Frontier Working Group, the Kibo-ABC collaborative initiative was established in 2012
to promote "Kibo" utilization in the Asia-Pacific region and
to share and build on the outcomes of "Kibo" utilization.

Kibo-ABC: Asian Beneficial Collaboration through Kibo Utilization

Kibo-ABC Members

https://www.aprsaf.org/initiatives/kibo_abc/

- 19 organizations
- 14 countries/region

As of Nov. 2023

New Zealand
*NZSA
*NZAN

Philippines
*PhilSA
*DOST-SEI

Rep.of Korea
*KARI

Nepal
*NESARC

Singapore
*SSTL

Malaysia
*MYSA

Taiwan
*TASA

Japan
*JAXA

Thailand
*GISTDA
*NSTDA

Indonesia
*BRIN

Bangladesh
*NMST

Australia
*ASA
*ANU

Vietnam
*VAST-STI

UAE
*UAESA
*MBRSC

KIBO-ABC
Asian Beneficial Collaboration through Kibo Utilization

Goal and Activity of Kibo-ABC

Goal — **Sharing the Benefits of ISS/Kibo**

Step 1 — **Multilateral programs** among member agencies

- Education and capacity building (for space agencies and students)
- Understanding of space environment utilization

Step 2 — **Bilateral missions** between JAXA and a member agency

- Bringing innovative ideas
- Creation of bilateral missions (new space experiment missions)

SUSTAINABLE DEVELOPMENT GOALS

Education Innovation

Good health Education Economic growth Innovation

Kibo-ABC Multilateral Education Programs

Space Seeds for Asian Future program (Asian Herb in Space)

■Small plant experiment

Asian Try Zero-G program

■ Scientific experiment ideas is proposed from Asian youth. ISS crew performs the selected ideas.

Kibo Robot Programming Challenge program

■ Programming competition for students to have interest in future space technology development

These programs are igniting the passion of the next generation in the Asia-Pacific region.

e.g.
Many Australian students (more than 250,000) have participated in "Asian Herb in Space" program.

Multilateral education programs

Kibo-ABC Establishment

・・・2006 2008 2010 2012 2014 2016 2018 2020 2022 2024

①Student Parabolic Experiment (2006-2013)

②Space Seeds for Asian Future (2010-)

③Asian Try Zero-G (2011-)

④Kibo Robot Programming Challenge (2020-)

Bilateral projects

Kibo-ABC Establishment

・・・ 2010 2012 2014 2016 2018 2020 2022 2024

Kibo Utilization Workshop ▲Indonesia2015 ▲UAE2020 ▲Malaysia2016 △Australia 2023 ▲Thailand2017

2009 – 2012
Protein crystal growth (PCG) experiment (Malaysia)

2019 – 2020
PCG experiment (Thailand)

2023 – 2024
PCG experiment (UAE)

2013
CubeSat deployment (Vietnam)

2019 – 2021
Space radiation measurement (Malaysia)

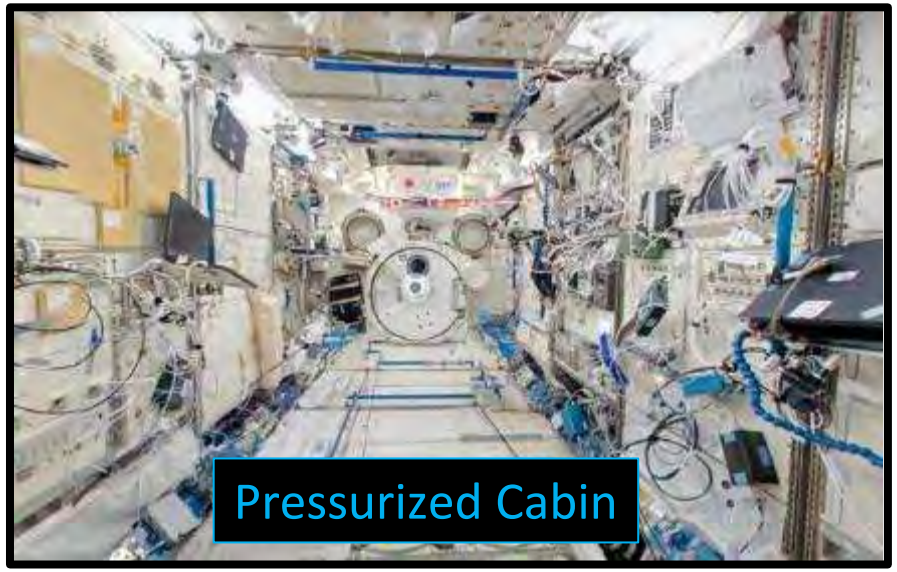
2018
CubeSat deployment (Singapore)

2019
Space education mission (UAE)

2023
Rodent sample share (Thailand)

International Space Station/Japanese Experiment Module:Kibo

In the International Space Station, a broad range of research, experiments, and observations has been conducted in numerous fields, such as life science, space medicine, material science, fluid science, the Earth and planetary science, as well as the cultivation of human resources.



- **Life science** for supporting a long-lived healthy society
- **Material science** for improving technologies for manufacturing
- **Technology development** for a prosperous, safe, and secure life

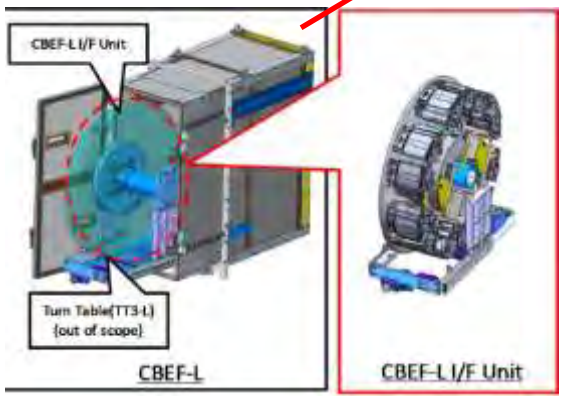
- **Small satellite deployment** through the airlock
- New **material exposure experiment**
- **Space technology development** such as the Earth observation sensor
- **Astronomical X-ray observations**

Kibo Pressurized (internal) Utilization Facilities

SAIBO Rack

CBEF (Cell Biology Experiment Facility)

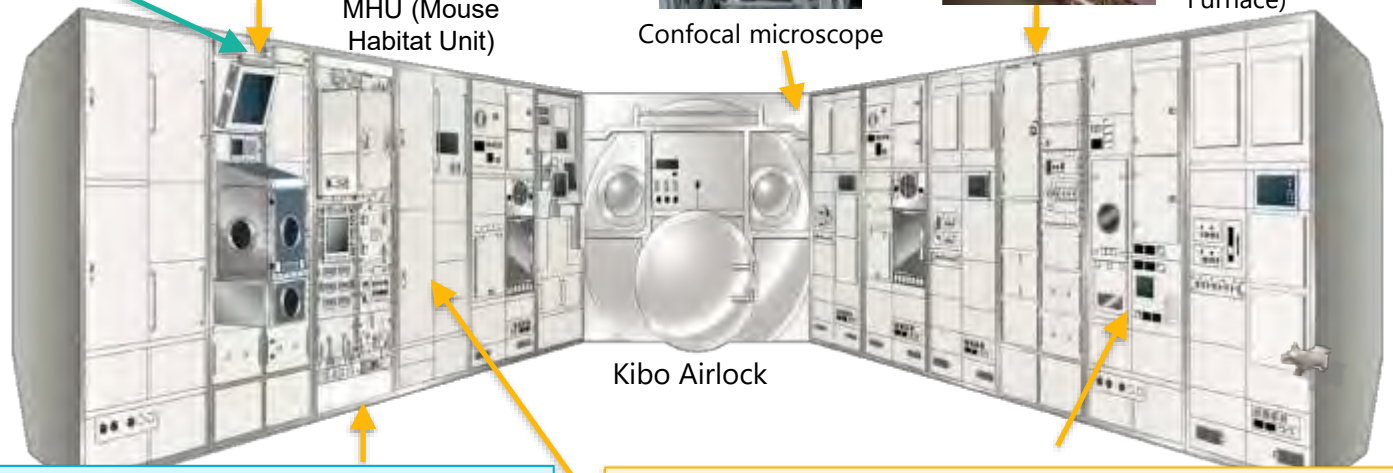
MHU (Mouse Habitat Unit)



Confocal microscope

GHF (Gradient Heating Furnace)

KOBAIRO Rack

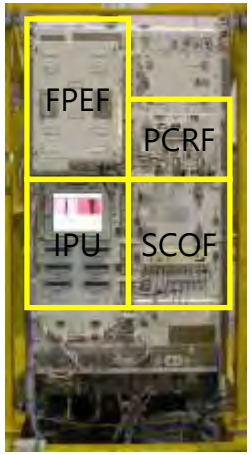


Kibo Airlock

FROST (On-board Refrigerator)

Fluorescence Microscope

RYUTAI Rack



FPEF (Fluid Physics Experiment Facility)

IPU (Image Processing Unit)

SCOF (Solution Crystallization Observation Facility)

PCRF (Protein Crystallization Research Facility)

Multi-purpose Small Payload Rack 1,2

MSPR #1, #2

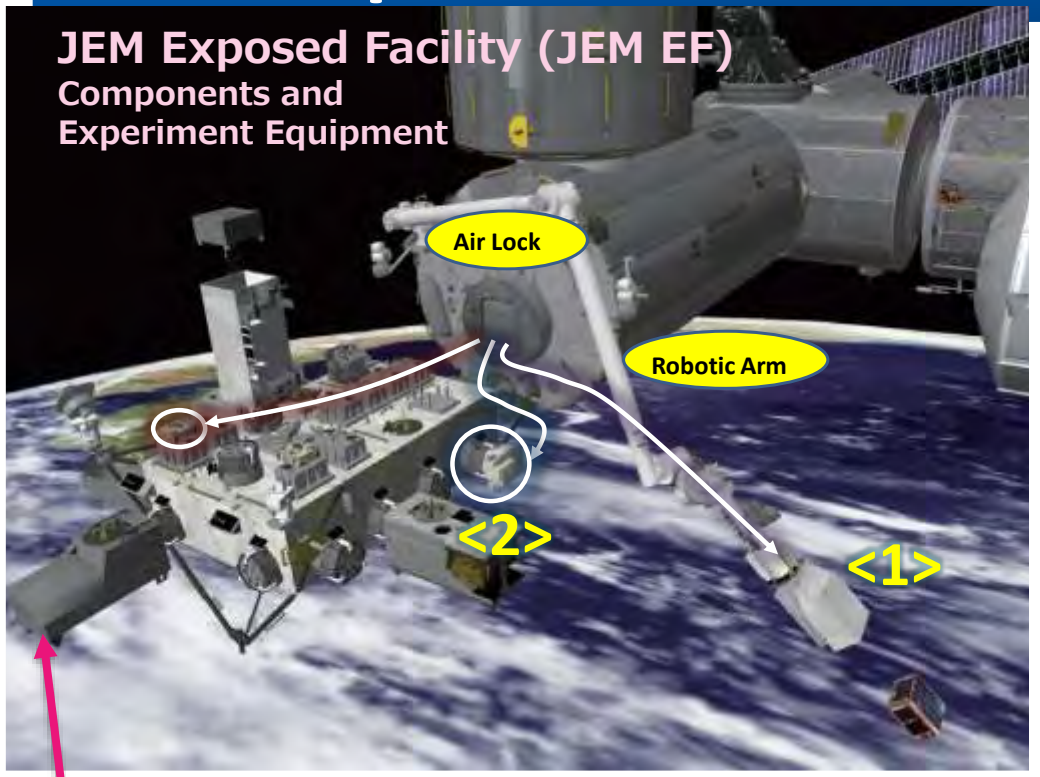
CCE (Chamber for Combustion Experiment)

ELF (Electrostatic Levitation Furnace)

SCEM (Solid Combustion Experiment Module)

JWRS (JEM Water Recovery System)

Kibo Exposed Facilities



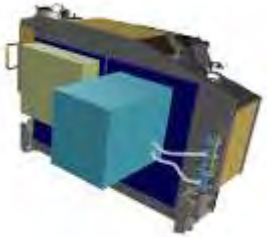
<1> JEM Small Satellite Orbital Deployer (J-SSOD)

- Commercial service provides: Space BD Inc. and Mitsui Bussan Aerospace Co., Ltd.

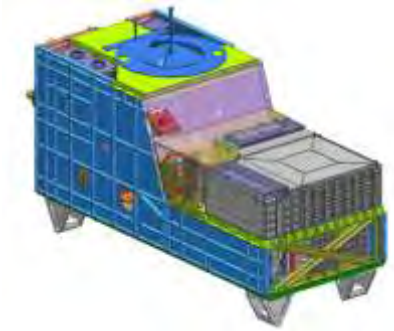
© JAXA

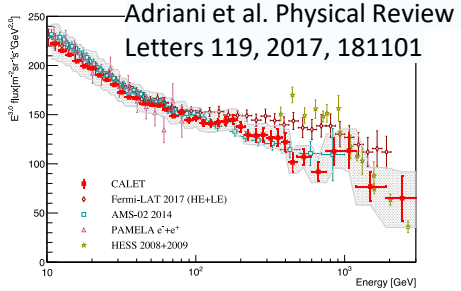
<2> IVA-replaceable Small Exposed Experiment Platform (i-SEEP)

- Space BD Inc. is a service provider.



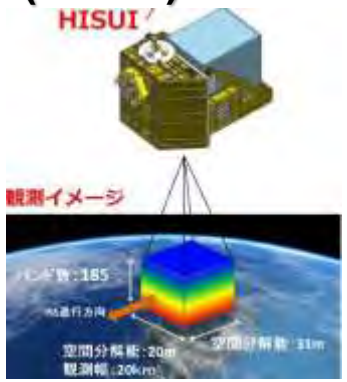
CALorimetric Electron Telescope: CALET





Monitor of All-sky X-ray Image: MAXI

Hyperspectral Imager SUIte (HISUI)



Data is available at https://www.tellusxdp.com/contents/data/hisui/

Expansion of Kibo utilization

Pressurized Module utilization

Science/ Environment/ Resource/ Health

Higher impact research

Expanding human activity

Healthy life expectancy

ECLSS

Human space exploration

On-orbit sample collection

Rodent

Datasets

Remote-ops

AI

Electrostatic Levitation Furnace (ELF)

Advanced material

Aquatic habitat

Solid combustion

Combustion

Carbon neutral

Fluid physics/crystallization

3D organ culture

Regenerative medicine

Cell

C.Elegans

Radiation effects

Micrograv ity science

Plant

Fundamental research

Food production

Drug design

Advancing technology

Protein crystallization

High-quality protein crystallization

Commercial partner

2009 explore prioritize 2015 Platforms 2020 Commercial use 2024 Further expansion 2030

All sky X-ray map

Collaboration w/ NASA

Science observation

Ozone layer

Environ. monitor

CALorimetric Electron Telescope

New tech demo

Global problem solving

Hyperspectral Imager

Cutting-edge/ business demo

Small-sat deployment

Service providers

Exposed Facility utilization

Exposed experiments

Material exposure

i-SEEP (Mid-size payload attachment)

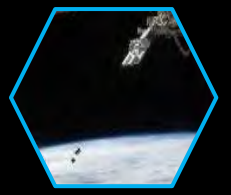
Service provider

Optical comm tech

Kibo Utilization Platforms to support R&D in space

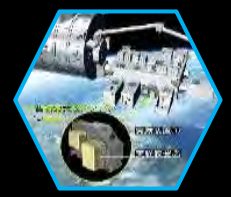
Health and Longevity
- Rodent missions

Small satellites deployment



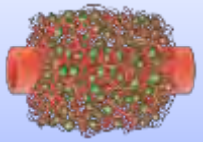
Drug design - Protein crystallization missions

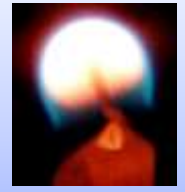
Exposed facility port utilization



Innovative Material
- Electrostatic Levitation Furnace

New platform candidates





Prioritized by:

- A certain number of demands / users
- Unique Capability on ISS
- Scheduled, Frequent Opportunities
- Standardized Process

“Bottom-up”, fundamental research

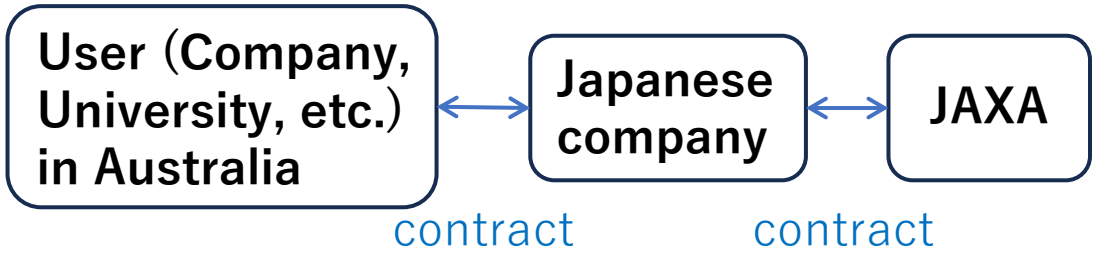
Kibo Utilization Scheme

◆ **Please contact these Japanese companies, if you are interested in Kibo utilization.**

Utilization fields	J-SSOD	i-SEEP/ SPySE/ ExBAS	Protein Crystal Growth (PCG)	Other utilization fields
Point of contact	***MBA** (Mitsui Bussan Aerospace) ***Space BD**	***Space BD**	***Space BD**	***Digital Blast** ***JAMSS** ***Kanematsu** ***MBA** ***Space BD** ***Other Japanese companies**
	Service providers selected by JAXA			

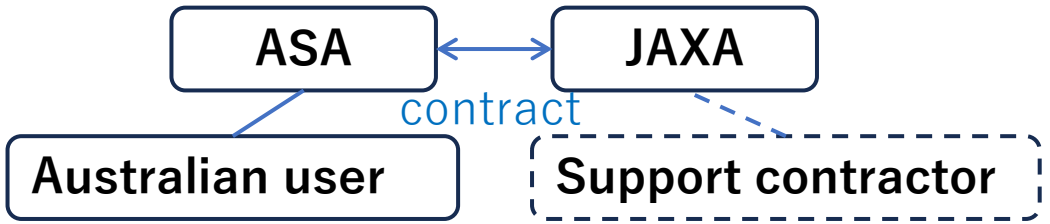
◆ **Scheme of contract**

Case A *(for all utilization fields)*



Optional case B *(for PCG and other fields)*

If ASA has a budget as a national project, JAXA can make a contract with ASA.



Back up

Recent Activities in Japan

1. Japan's participation in the extension of the ISS utilization and operation until 2030 was announced in November 2022.
2. New Basic Plan on Space Policy was approved by the Cabinet in June 2023.
3. Astronaut Furukawa launched on August 26, 2023 (JST)
   - Docked to ISS on August 27 and will stay for a half year
4. New astronaut candidate selection
   - Mr. Makoto SUWA and Ms. Ayu YONEDA were selected in February 2023 out of 4,127 appliants.

Furukawa entered ISS in August 2023

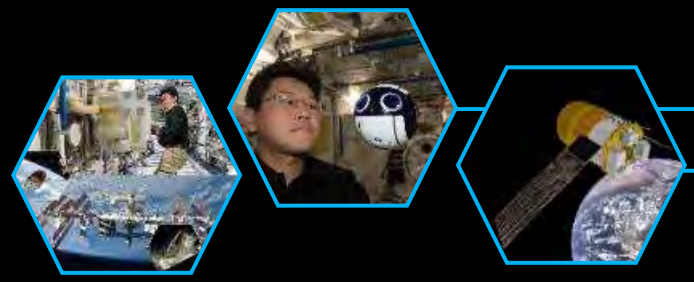
Suwa and Yoneda visited Prime Minister Kishida on July 3, 2023

Kibo Utilization Strategy - Long-Term Vision

Space Exploration



Lunar orbit and lunar surface utilization



Acquire technologies for longer duration human exploration beyond LEO

Small satellite Deployment service

External Platform Utilization

Protein Crystal Growth Experiment Service

Health and Longevity Research Support

Innovative Material Research Support

R&D

Tech Demo

Commercialization

Various R&D, non-R&D Activities

Private Sectors

lead LEO to a Marketplace

Government

sustains R&D capabilities

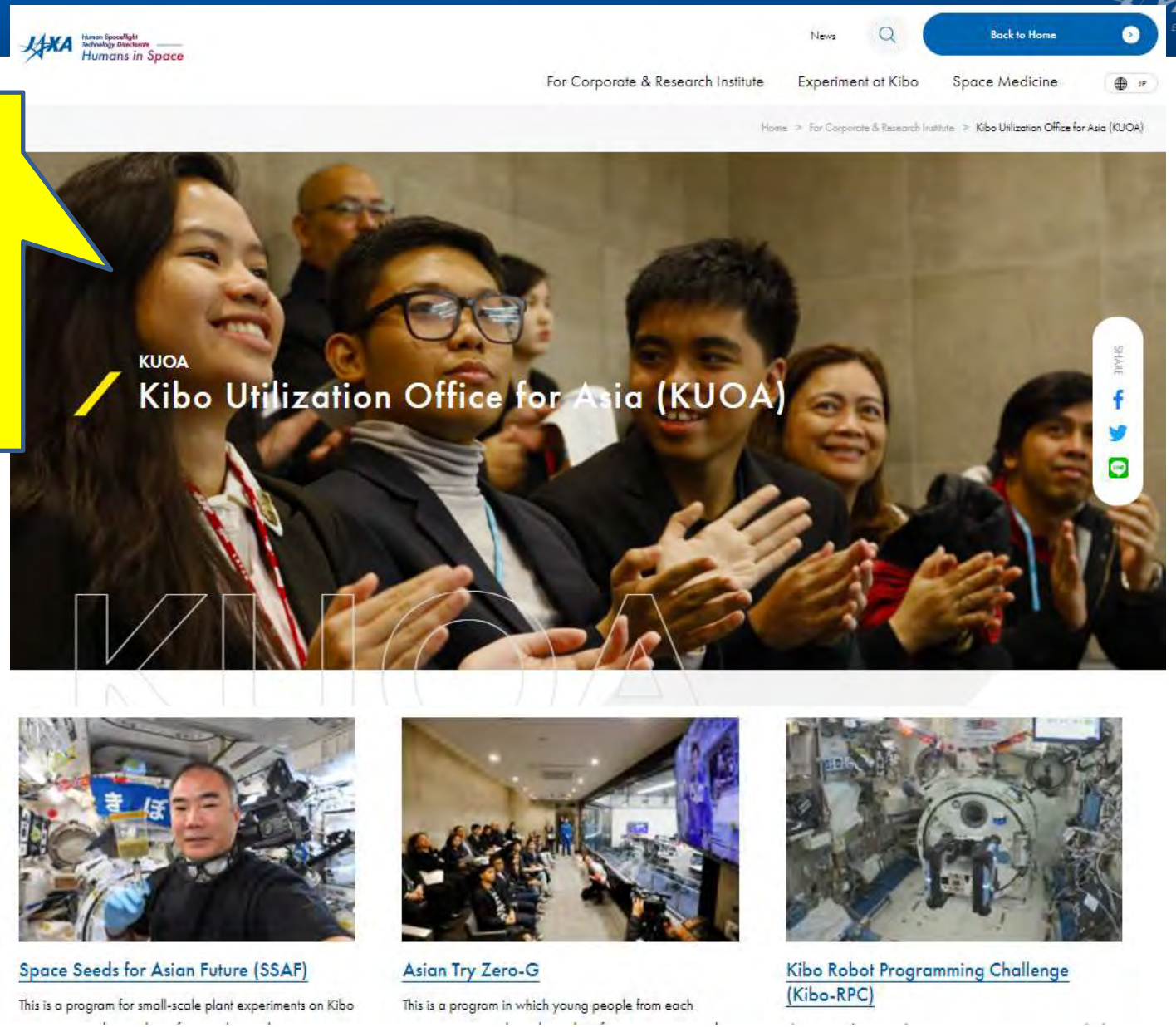
Continuing LEO utilization

For More Information

You can get more information about Kibo utilization activity in the Asia-Pacific region on the website.

Portal site:
https://humans-in-space.jaxa.jp/en/biz-lab/kuoa/

Search
"KUOA JAXA" !



Thank you for partnership!

KIBO UTILIZATION WORKSHOP

KIBO-ABC AND ART AND CULTURAL ACTIVITIES ONBOARD IN JAPAN

Japan Aerospace Exploration Agency

KIBO-ABC
Asian Beneficial Collaboration through Kibo Utilization

Dec. 5, 2023 @Sydney, Australia

Kyoichi Arakane, JAXA, Japan

All photo credits are JAXA and/or NASA unless otherwise specified,

Kibo-ABC Multilateral Education Programs

Space Seeds for Asian Future program

■Small plant experiment on Kibo

Asian Try Zero-G program

■ Scientific experiment ideas is proposed from Asian youth. ISS crew performs the selected ideas.

Kibo Robot Programming Challenge program

■ Programming competition for students to have interest in future space technology development

- *These programs are igniting the passion of the next generation in the Asia-Pacific region.*
- *They also engage and influence students to pursue careers in scientific and technology fields.*

Asian Herb in Space (AHiS)

(The third project of the Space Seeds for Asian Future)

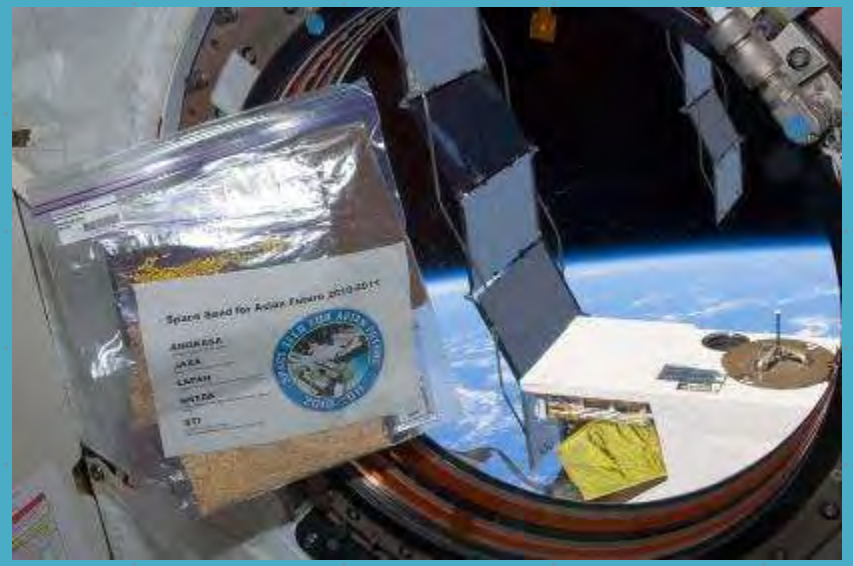
https://humans-in-space.jaxa.jp/en/biz-lab/kuoa/ssaf/

AHiS Mission 1

AHiS Mission 2

AHiS Asian Herb in Space SSAF

Project Overview



2011

- The purpose of AHiS is to provide students and young researchers in the Asia-Pacific region with an **opportunity to learn about space biology**.
- AHiS also aims to promote **understanding and gain experience** regarding the utilization of Kibo by participating organizations.

Mission 1

Mission-1; Space growth experiment mission

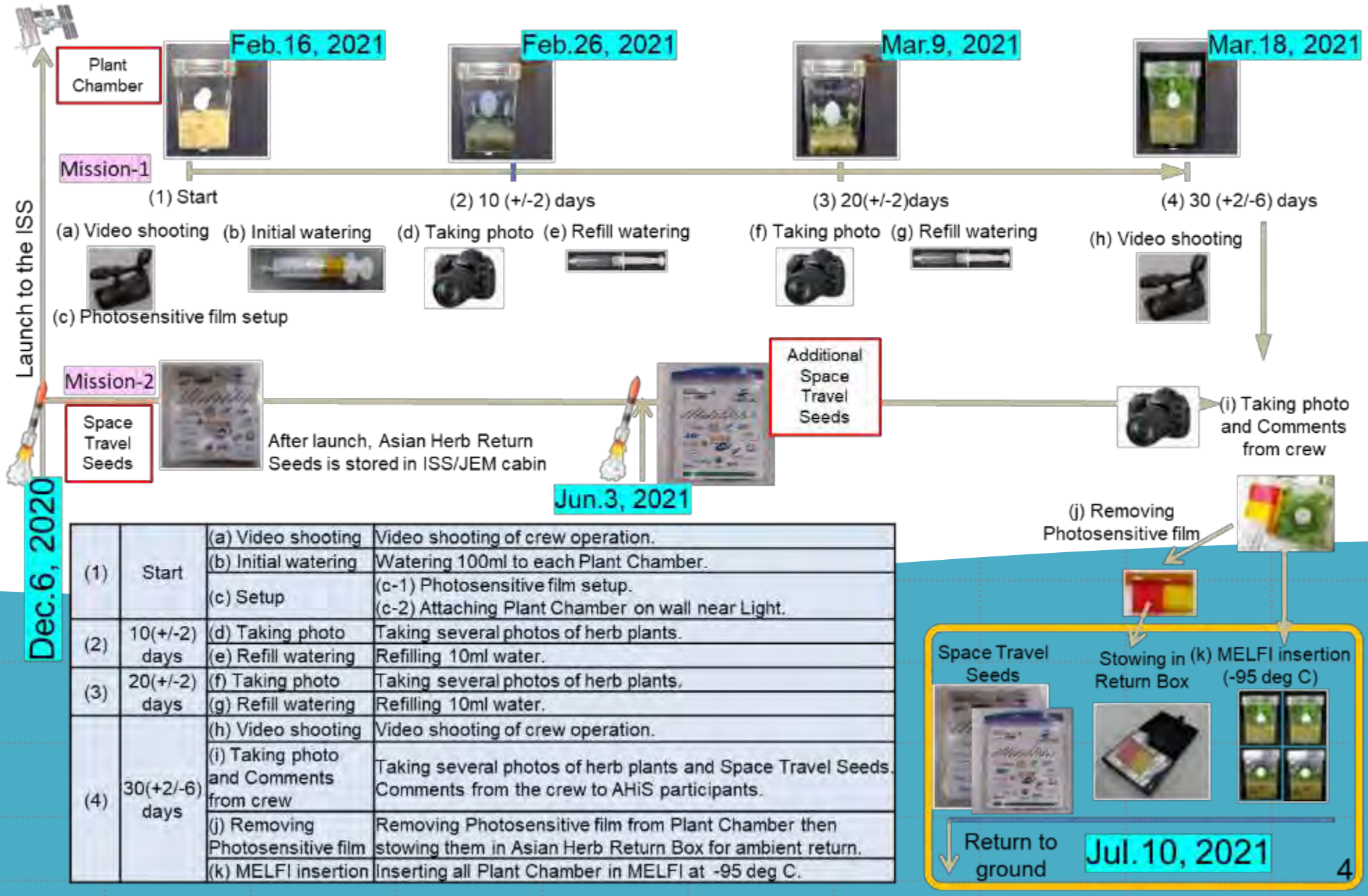
- **Basil seeds grew in the Kibo module and returned for analysis by Japanese and Malaysian researchers.** Participating organizations will give students and young researchers an opportunity to conduct a ground control experiment using the basil seeds provided by JAXA.

JAXA Sweet Basil

MYSA Holy Basil

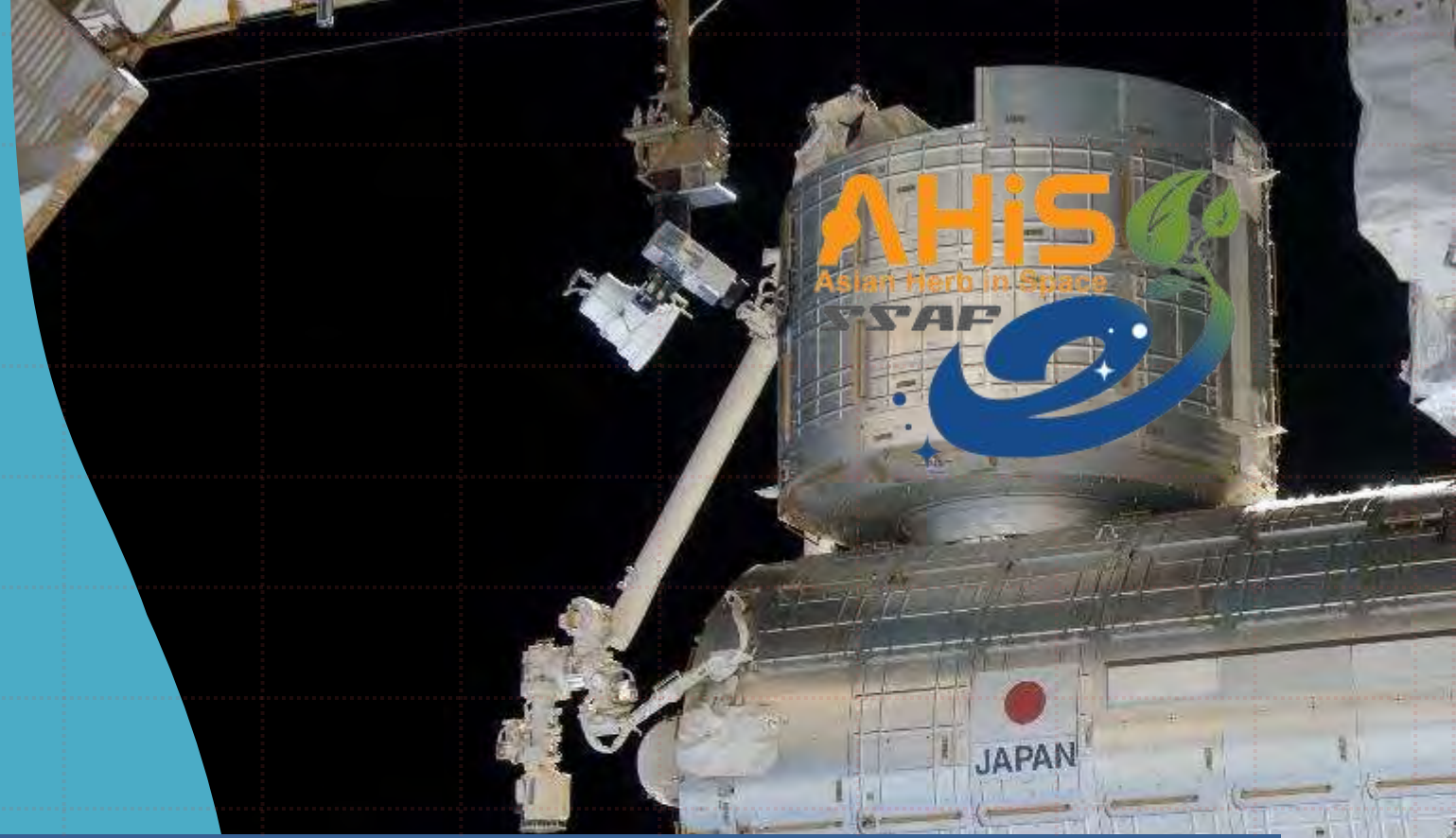
AHiS experimental flow on the ISS

Mission 1



(1)	Start	(a) Video shooting	Video shooting of crew operation.
		(b) Initial watering	Watering 100ml to each Plant Chamber.
		(c) Setup	(c-1) Photosensitive film setup. (c-2) Attaching Plant Chamber on wall near Light.
(2)	10(+/-2) days	(d) Taking photo	Taking several photos of herb plants.
		(e) Refill watering	Refilling 10ml water.
(3)	20(+/-2) days	(f) Taking photo	Taking several photos of herb plants.
		(g) Refill watering	Refilling 10ml water.
(4)	30(+2/-6) days	(h) Video shooting	Video shooting of crew operation.
		(i) Taking photo and Comments from crew	Taking several photos of herb plants and Space Travel Seeds. Comments from the crew to AHiS participants.
		(j) Removing Photosensitive film	Removing Photosensitive film from Plant Chamber then stowing them in Asian Herb Return Box for ambient return.
		(k) MELFI insertion	Inserting all Plant Chamber in MELFI at -95 deg C.

Mission 2



Mission-2; Space travel seed mission

- Herb seeds provided by participating organizations are stored in the Kibo module then returned to the participating organizations for research and education purposes.

Mission 2: Space Travel Seeds from Kibo-ABC countries and regions (Launched by SpX-21)

Country/Region	Common name
Japan	Sweet basil
Thailand	Golden shower tree
Indonesia	Celery
	Onion
New Zealand	Pohutukawa
Australia	Golden wattle
Taiwan	Red quinoa
	Bell (Sweet) pepper
	Sunflower
	Orchid
United Arab Emirates	Ghaf
	Port royal senna
	Ben tree
	Sweet basil
Nepal	Holy basil
Extra	Spearmint, Coriander

Mission 2: Space Travel Seeds from Kibo-ABC countries and regions (Launched by SpX-22)

Country/Region	Common name
Bangladesh	Coriander
Singapore	Coriander
	Butterhead lettuce
Vietnam	Impatiens eberhardtii Tard
	Codonopsis javanica (Bl.) Hook. F.et Thomas
	Diplocyclos palmatus (L.) Jeffrey
	Cosmos bipinnatus Cav.
	Celosia cristata

Asian Try Zero-G (ATZG)

A Gateway to Access the Experiments in Space for Asian Students

https://humans-in-space.jaxa.jp/en/biz-lab/kuoa/tryzerog/

What is Asian Try Zero-G?

Aim

Spread the usage of the Japanese experiment module Kibo among the Asia-Pacific regions for the benefit of humanity

Design

Support STEM education in Asia-Pacific regions contributing to the 4th goal of SDGs, quality education.

Value

Asian Try Zero-G is valuable because it is more than a mere outreach program, it is an international collaboration, giving access to outer space to any student, and providing the learning process of a small space mission.

Cooperation

Since Japan is the only Asian country participating in the ISS program, Japan cooperate with other Asian countries/region to have low earth orbit experiences in science.

History

- Started from 2011
- Participating countries/regions:
  3 → 8 countries & regions (2022 edition)
- Conducted: 7 times

Asian Try Zero-G 2023

9 countries and regions

Same as before

– Category A

- Simple physics experiments, that can be visible to confirm physical phenomena.

New Category

– Category B

- On-board exercises for astronauts

≪Tips to Category B≫
・A unique body movements can't be done on the ground but can be done in space
・Body movement and postures can be an exercise under microgravity, yet easily done on Earth.

Proposal Categories

Selection Process

Preliminary Selection

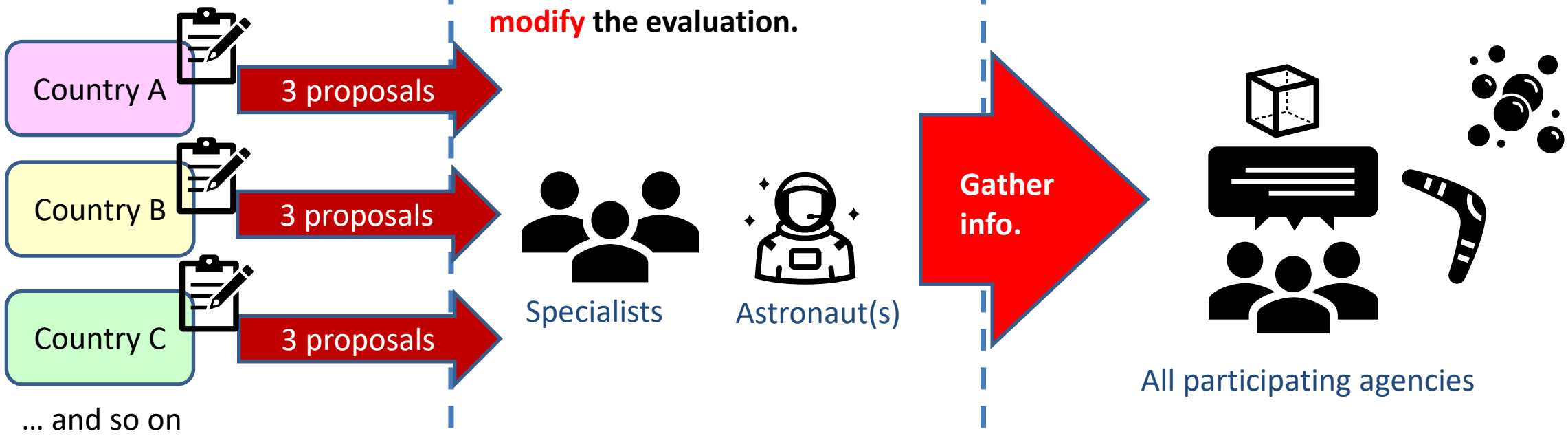
1) Each participating agency calls for student experiment proposals
2) Evaluate the proposals using universal evaluation sheet
3) Select 3 best proposals for each category and submit them to the secretariat.

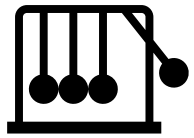
Feasibility Check by JAXA Specialists and Astronauts

1) Secretariat compiles all the experiment proposals and evaluation sheets.
2) Ask JAXA specialists/ astronauts to check feasibility in space.
3) Check the evaluation sheet if any misunderstanding occurs and modify the evaluation.

Final Selection

1) All participating agencies gather and discuss the proposals with the feasibility check to narrow it down to 6 to 8 experiment proposals.
2) Combine any similar proposals for letting more students be involved and save crew time.





Preliminary Selection by each country/region

From June 1 to June 26

Countries/ Regions	Category A			Category B		
	Selected Proposals Max: 3	All Proposals	Participants	Selected Proposals Max: 3	All Proposals	Participants
Australia	1	1	1	1	1	1
Bangladesh	2	2	2	0	0	0
Indonesia	2	2	4	0	0	0
Japan	2	11	28	3	13	29
Nepal	0	0	0	0	0	0
Philippines	3	26	76	3	11	40
Singapore	3	3	5	1	1	3
Taiwan	3	19	38	2	3	5
Thailand	3	107	221	3	45	117
Total	19	171	375	13	74	195

Total Proposals

245

Total Participants

570

- Held on July 11, 2023
- Online
- Participation from Kibo ABC member countries/regions
- 16 themes were selected.

Final Selection

Category A

	Country/Region	Theme
1	Australia	Twist Athlete Robot Experiment
2	Bangladesh	Finding the shape of Magnetic Field Lines
3	Indonesia	Try a total elastic collision in space using the Lato-Lato game
4	Indonesia	Lato-lato motion trials in zero gravity
5	Japan	Acceleration of liquid surface in capillary action in microgravity
6	Philippines	Oloid's Movement in Microgravity
7	Singapore	Magnus Glider Looping Phase in Microgravity
8	Singapore	Zero-G Siphon
9	Taiwan	Behaviors of the magnus effect in zero-gravity
10	Thailand	Water Spheres and Electrostatic Force
11	Thailand	Stranger things two ball on string

Category B

	Country/Region	Theme
1	Japan	Rubber gymnastics on air chair
2	Japan	Flexibility exercises with rope
3	Philippines	The Effectivity of Elastic Resistance Band Exercise When Performed in Zero-Gravity
4	Taiwan	Let us blow
5	Thailand	Starfish exercise for Microgravity

ISS on-orbit Experiment

- Duration: About 90 min+.
- Date: Feb 13, 2024 (TBD)
- Venue: Tsukuba Space Center

Kibo-Robot Programming Challenge (Kibo-RPC)

https://humans-in-space.jaxa.jp/en/biz-lab/kuoa/kibo-rpc/

Background

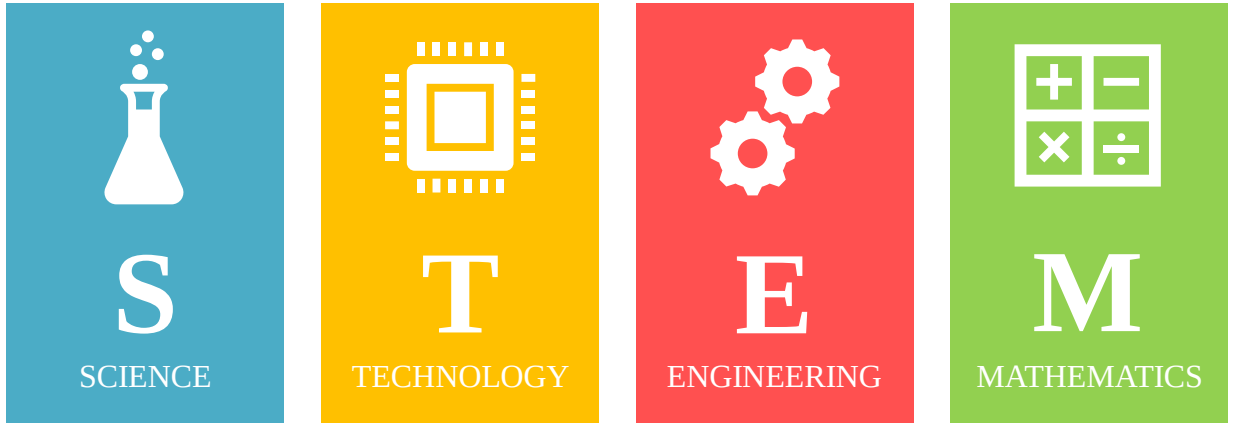
- **Japan-U.S. Open Platform Partnership Programs (JP-US OP3)**
  - On December 22, 2015, the Japanese and U.S. governments agreed on a new cooperation framework for the ISS Program.
    - Japan decided to extend its participation in the ISS operations until 2024.
    - An outline of JP-US OP3 is as follows:

1. **Promotion of mutual use of experiment facilities**
2. **Increased cooperation in the Asia-Pacific region**
3. **Promotion of new uses for the ISS: technology demonstration, and use of HTV and HTV-X**
4. **Promotion of use of effective and efficient space-related technologies**

JAXA and NASA are pursuing implementation of JP-US OP3.
Kibo-RPC is based on JP-US OP3.

Background

- **About the Kibo Robot Programming Challenge**
  - The Kibo Robot Programming Challenge is **an educational program.**
    - Students solve various problems by **programming free-flying robots (Astrobee and Int-Ball) in the International Space Station (ISS).**
  - Participants will have the chance to learn cutting-edge methodologies and **to hone their skills in science, technology, engineering and mathematics (STEM).**
  - **Expand international exchange by encouraging students** to interact with other participants from around the world.
  - **To expand Kibo utilization in the Asia-Pacific region**, an educational program for operating robots and computer programming is being offered to students in Japan and the Asia-Pacific region.



Background

- **Educational objectives of the Kibo Robot Programming Challenge are to learn :**
  - The techniques for creating simulation programs that **perform well in the real world despite uncertainties and within margins of error**.
  - The necessity of **controlling and correcting positions and orientation** of a free-flying robot.
  - **How to perform assigned tasks in the onboard environment** through simulation trials.

Automation and autonomy technologies are essential for future human space activities in low Earth orbit, and we aim to develop human resources with these skills (STEM education) through this program.

Robots in ISS

- Robots such as Astrobee and Int-Ball are on the ISS.
  - NASA's free-flying robot "Astrobee" is a programmable robot. Students create their own programs to control Astrobee and aim to accomplish the mission in the Kibo-RPC.
  - JAXA's Int-Ball is a free-flying camera robot.

4th Kibo-RPC

Astrobee

Int-Ball

Preliminary Round / Final Round

- Preliminary Round
  - Held in each country/region using simulator.
  - Program **stability** and **robustness** are important
  - The winning teams will advance to the Final Round as the representatives of their own countries/regions.

- Final Round
  - Held in the ISS/Kibo module.
  - Finalists' programs will be installed on Astrobee on-board and run on the day of the Final Round.

Participation Results of 4th Kibo-RPC

- Number of participants
  - – **30 countries/region** have been participating.
    - includes participation from 19 countries through the UNOOSA international slot.
  - – A total of **over 1,685 students on 421 teams** entered.
    - 3rd Kibo-RPC：1,431 students / 351 teams

Country / Region	Teams
Australia	3
Bangladesh	74
Japan	27
Malaysia	12
Nepal	1
Singapore	6

Country / Region	Teams
Taiwan	29
Thailand	182
United Arab Emirates	8
Vietnam	1
The United States	28
UNOOSA	50

Education Payload Observation Pilot Mission (2010~2014)　　18 themes in total

Space Poem Chain

The Space Poem Chain is an activity by which participants consider space, Earth, and life across the borders of nations, cultures, generations, specialties, and roles; their words are spun into a poem chain.Words spun in this way are launched to and stored aboard Kibo, the Japanese experiment module attached to the ISS, which can be seen as a bright shining star from all countries in the world.

The Poem Chain is a technique of dialog that Shin Ohoka, a Japanese poet, developed from Renga and Renku, which are fields of Japanese traditional culture. We are compiling a Space Poem Chain by combining the poems publicly solicited via the Internet and contributions by poets and men of culture under the supervision by Shin Ohoka. Both Japanese and English poems are compiled without discrimination so that people worldwide can participate.

The Japan Aerospace Exploration Agency (JAXA) began a trial compilation of a Space Poem Chain in fiscal 2003 and, has proceeded with full-scale compilation of the Space Poem Chain since 2007, as an application of Kibo. We are accepting contributions from people of ages ranging from the second year of elementary school to 98 years, regardless of nationality, specialty, or role.The wonder, splendor, and possibility of being born on Earth and living in space are spun with words.The work can be seen at the web site indicated below.

JAXA is also seeking to develop and distribute the Space Poem Chains.JAXA is compiling space poem chains characteristic of each region and school, in cooperation with other institutes, including the Japan Planetarium Association, regional planetarium associations, the Japan International Cooperation Agency (JICA), and schools (Japanese language lessons in elementary schools and high schools). Anyone who is interested in participating should consult the person in charge of Space Poem Chains via the web site below. JAXA will continue to develop and distribute the Space Poem Chains, in an effort to share the preciousness of life and the pleasure of living via Kibo.

<Flow of the Space Poem Chain Activity>

2003
The first space poem chain "Life on the Earth" was compiled as a collaborative effort. English space poem chains were then compiled at the International Space University Support in order to compile space poem chains characteristic of each region and to compile school space poem chains characteristic of each school from the planning stage was started in cooperation with local planetariums and science museums.

2006
Full-scale compilation of space poem chains was started as an initial mission for Kibo. They were recorded on a DVD, together with space poem chains compiled by regional planetariums and science museums, for storage on Kibo.

2007
Compilation of the space poem chain "Volume of the Stars" was started.

2008
Plans included launching the space poem chains compiled in 2006 to Kibo in March and storing them there, as part of the 1JA mission. After the "Volume of the Stars" is completed, it will be recorded on a DVD, along with the space poem chains compiled by local planetariums and science museums, including the Yamanashi version of the space poem chain "Star Spinning Song," which was compiled mainly by the Yamanashi Prefectural Science Museum, and the space poem chains compiled by Keio Women's High School, Kofu Municipal Yamasho Elementary School, and Junior high schools in Uganda, Africa (in cooperation with the Japan International Cooperation Agency (JICA)), and will be launched on Kibo in the latter half of 2008.

●To persons who wish to participate in Space Poem Chains:
People throughout the world, of ages ranging from the second year of elementary school to 98 years, have thus far contributed to the Space Poem Chains.We are awaiting additional contributions.We will continue to operate the consultation desk on the JAXA Space Poem Chain website; those who are interested in the development and distribution of Space Poem Chains are invited to contact the desk.

JAXA Space Poem Chain website : http://iss.jaxa.jp/utiliz/renshi/index.html

Sample Return Mission – Life in the Universe

On Kibo, plans include proceeding with studies of life sciences by utilizing a special environment that is available only in the experimental module floating in space (e.g., microgravity and cosmic rays).JAXA initiated the Sample Return Mission primarily to support educational activities concerning life sciences for teachers in schools and local science museums.In the 1JA mission in March 2008, some life forms that are familiar to us (e.g., eggs of water fleas and seeds of plants) were launched aboard Kibo, stored there for half a year, and then returned to Earth. Samples with their soundness confirmed will be distributed to teachers who want to use them in their educational activities.Details will be made available later.

Astronaut Doi and plant seeds

Japan Aerospace Exploration Agency
Human Space Systems and Utilization Mission Directorate
Tsukuba Space Center (TKSC)
2-1-1 Sengen, Tsukuba-shi, Ibaraki-ken 305-8505 Japan
TEL.+81-29-868-3074
FAX.+81-29-868-3956
■Utilization in space ··· http://iss.jaxa.jp/utiliz/index.html

Space Experiments on Kibo
Utilization for Education, Culture/Humanities and Social Sciences
EPO: Education Payload Observation

The picture of Earth was taken in 2007 with a high-definition television camera on KAGUYA (SELENE), a Japanese satellite orbiting the Moon. Its fantastic beauty reminds us, nearly 40 years after the landing of Apollo on the Moon's surface, that the Earth is a matchless place for human beings to live. Individuals who have been launched into space have gained a new perspective of Earth and space; they have offered various descriptions, such as "The Earth was blue" and "You cannot see national borders on the Earth." The purpose of Education Payload Observation, or EPO, is to make new discoveries through artistic expression in the space environment, in addition to utilizing it for scientific experiments. EPO will help pursue the development of global citizenry, expanding the future of mankind, and creating new values through educational activities and cultural and humanistic trials, using Kibo, the Japanese Experiment Module attached to the International Space Station (ISS). We believe that trying artistic expression in space, with a focus on the future, necessary for human beings to learn that they can lead productive lives in space.

Logo mark of the JAXA EPO Mission
(Designed by Prof. Noriyasu Fukushima)

Pilot Missions of Utilization for Culture/Humanities and Social Sciences – First Ever Attempts at Space Art

Human beings have looked up at the starry sky, been moved by it, and achieved evolution driven by curiosity since our earliest days. Even in modern society, where we have extended the range of our activities to space, many space-related areas remain uncovered. One of the objectives of the ISS is to introduce impressions that human beings have never experienced and to expand the wisdom of human beings by exploring the space environment. JAXA has long considered the significance of space exploration in the fields of culture/humanities and social sciences. At last, the opportunity has arisen to try related activities aboard Kibo, the Japanese Experiment Module. Thus, we solicited proposals for utilizing Kibo for culture/humanities and social sciences in order to try artistic activities in the space environment governed by microgravity and subsequently selected ten themes. These themes consist of artistic expressions that utilize viewpoints from space and the microgravity environment, and lead to the creation of social values on the ISS.

Selected ten cultural and humanistic experiments

Artistic Experiments Using a Water Sphere
Takao Fujiwara
Kyoto City University of Arts

Marbling painting on a water ball
Takuro Osaka
University of Tsukuba

Sparkling Neurons
Hitoshi Nomura
Kyoto City University of Arts

Space Clothes Experiment
Michiyo Miyanaga
Tokyo National University of Fine Arts and Music

Modeling Clay in Space
Yuichi Yonebayashi
Tokyo National University of Fine Arts and Music

'moon' score : ISS Astronaut
Hitoshi Nomura
Kyoto City University of Arts

Spiral Top
Takuro Osaka
University of Tsukuba

Hiten
Setsuko Ishiguro
Ochanomizu University

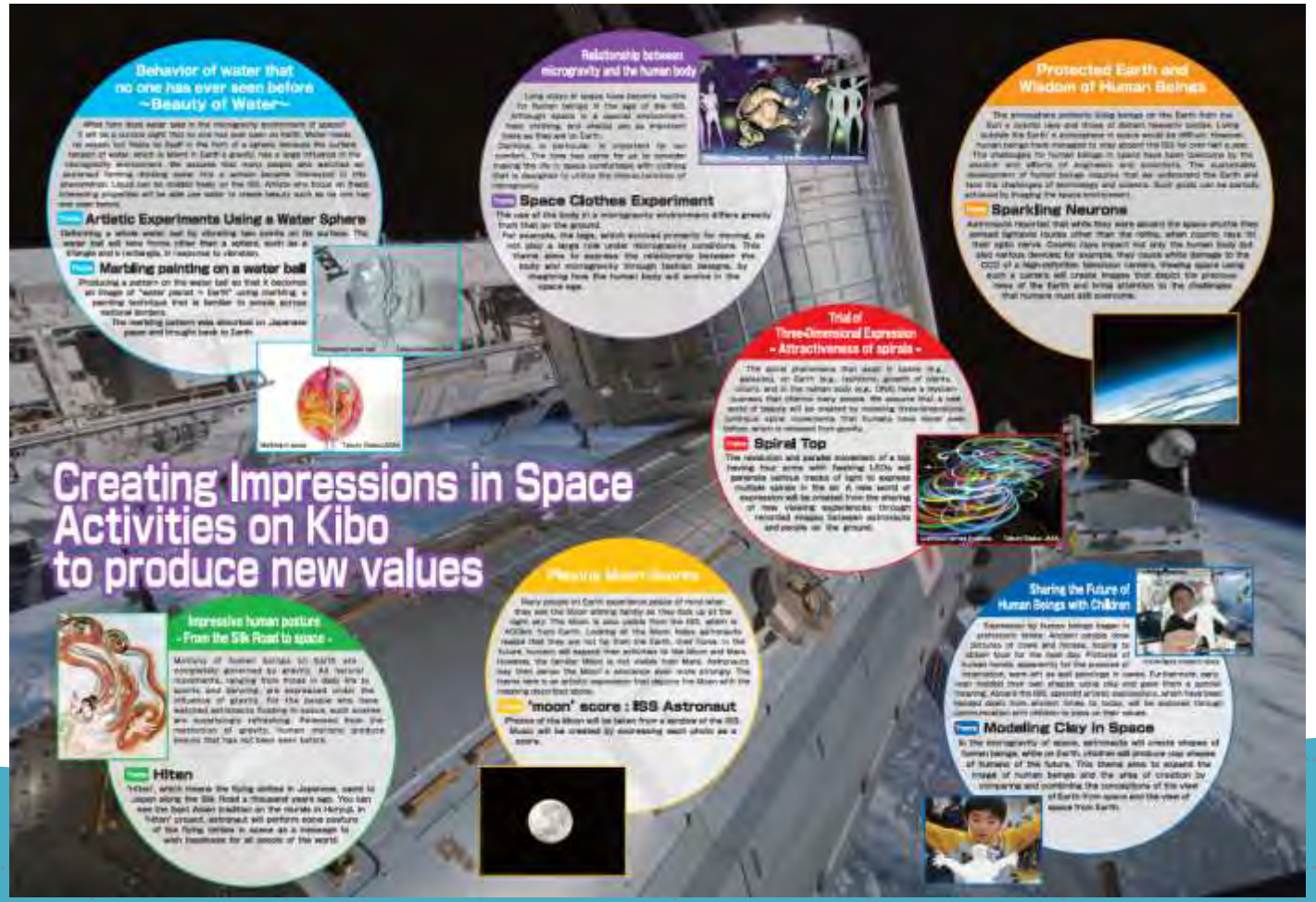
Dewey's Forest*
Shiro Matsui
Kyoto City University of Arts

Message in a Bottle*
Shiro Matsui
Kyoto City University of Arts

* "Dewey's Forest" and "Message in a bottle" are under feasibility study phase.

Art and Culture

Education Payload Observation Pilot Mission (2010~2014) 18 themes in total



Art and Culture

Art and Culture

Spiral Top

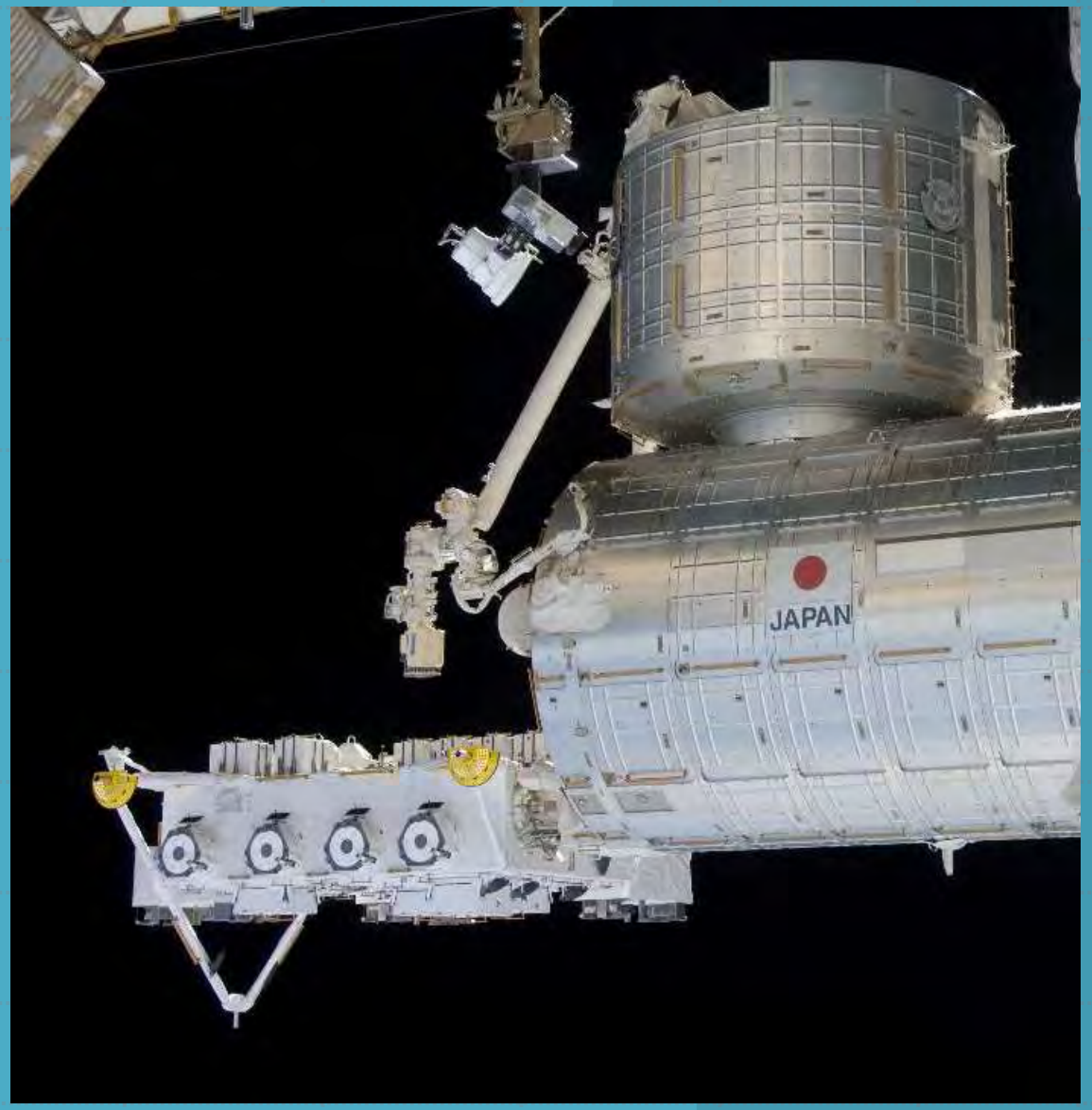
https://youtu.be/bNttXiblt0E?si=_--4kNZV3bbyTuGG

Credit: JAXA/Takuro Osaka

Thank you!

Kyoichi Arakane
Associate Senior Engineer
JEM (Kibo) Utilization Center
Human Spaceflight Technology Directorate

Contact: kibo-utilization-asia@ml.jaxa.jp
Phone: +81-70-1170-2723



Mitsui Bussan Aerospace Co.,Ltd.

CONFIDENTIAL

Introduction of Mitsui Bussan Aerospace Activities on “Kibo”

December 2023

Tsuyoshi Tenda
Mitsui Bussan Aerospace(MBA)

1 About Us

① About US (Mitsui)

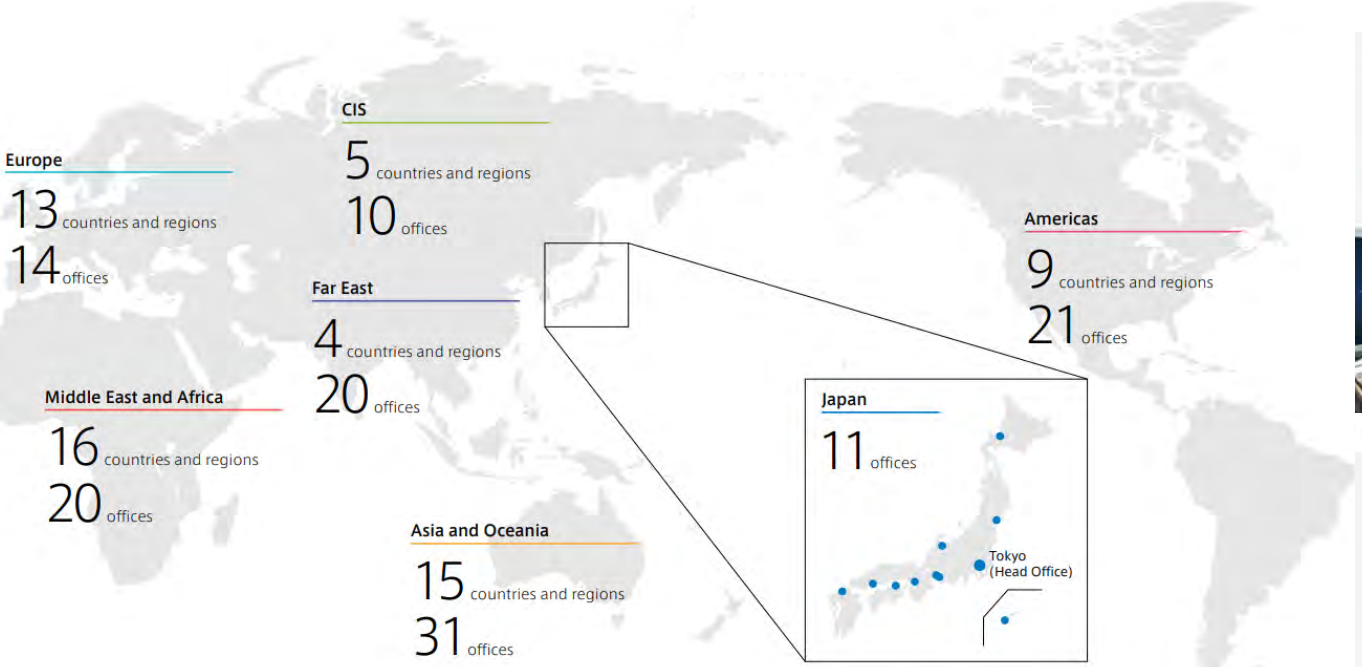
MITSUI&CO.

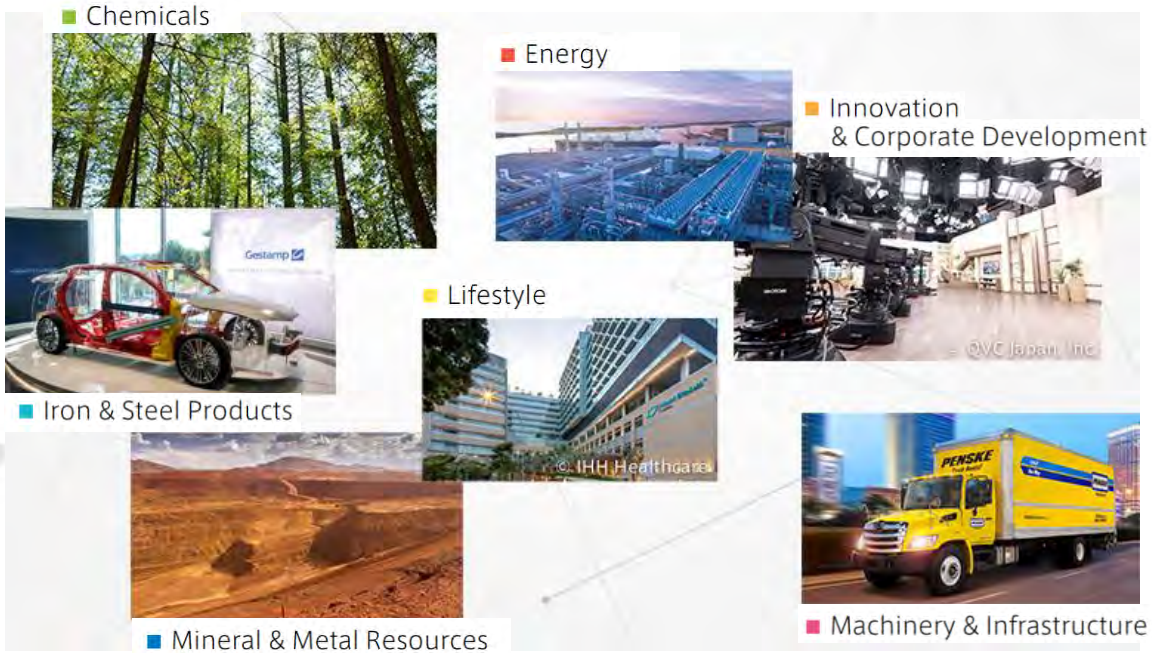
Established in 1947

Sales 26.4 tri Yen (FY2022/3)

Number of Offices 127 offices 63 countries/regions

# of Employee 44,000





① About US (MBA)

Mitsui Bussan Aerospace Co.,Ltd.

Established in 1982

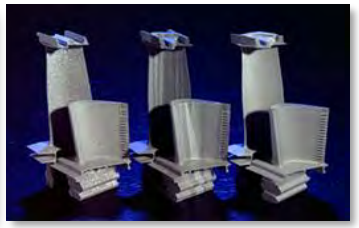
Sales 26.4 Bil Yen (FY2022/3)

100% Owned by Mitsui & Co

# of Employee 124

LEONARDO

DASSAULT AVIATION

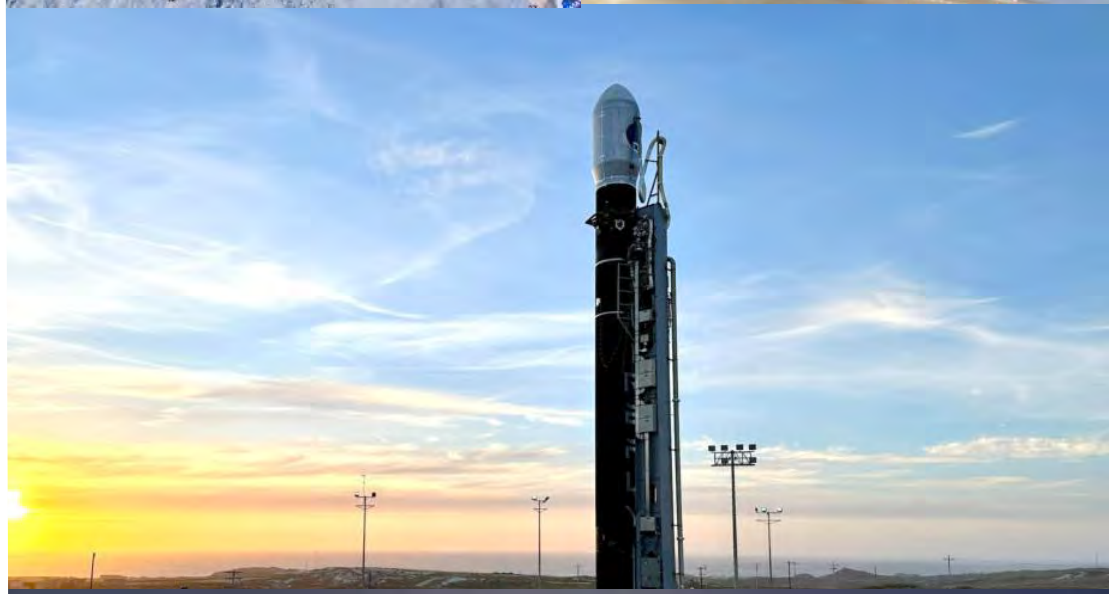


LOCKHEED MARTIN

FLIR

HQ Location : 8-2, Marunouch 1-Chome, Chiyoda-ku, Tokyo
Overseas Offices : Dallas, Milan
Business Outline : Import/Export of Aerospace & Defence Product/Service
e.g. Helicopter, Business Jet, Security Camera, Engine Blade, etc.
Space Business Department was launched in July 2019.

2 Our Activities



② MBA – what is our "One Stop Shop"

Full coverage on value chain of space utilization

Platform Procurement	Safety Review	Integration	Transportation to Space	Post-launch Services
● Provision of CubeSat Solution as One Stop Service ● Component Procurement ● Environment Testing ● ISS utilization	● Safety Review Support	● Ground Handling ● logistics	● Rocket Rideshare Service (J-SSOD/ Launch Vehicle)	● Satellite Operation with Partner ● Ground Station Service with Swedish Space Corporation ● Ground Station Procurement ● ISS utilization operation

Highlighted Achievements

✓ We can introduce wide varieties of platform for space

② MBA – what is our "One Stop Shop"

J-SSOD Satellite Deployment Service

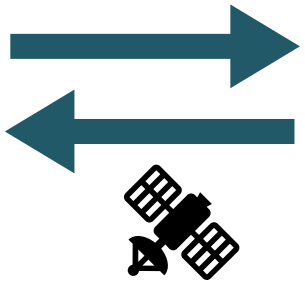
➢ J-SSOD Service by Mitsui Bussan Aerospace

We were selected by JAXA as an official service provider for the CubeSat deployment service from KIBO the Japanese experiment module on ISS from 2019.

JAXA

- Safety Review
- Transportation to launch site
- Launch and Deployment

Selected as a service provider



Hand over Satellite

Mitsui Bussan Aerospace Co.,Ltd.

- Procuring launch opportunity
- Supporting safety review
- Performing Integration

Contract

Customer

- Satellite Development

Achievement

- ✓ 8 Satellites Deployed
- ✓ First operational 6U
- ✓ Deployment service for Kibo CUBE/J-CUBE program on 2021,2022

➢ SORA-HAIBIN Space Logistics Service by J-SSOD

A service that can deliver anything that can go into space.
What would you like to send to space?
（Letter, Memorabilia, product for Advertisement）

飛ぶはずのないものを宇宙へ。

それは、入るものならなんでも宇宙にお届けできるサービス。
宇宙に行ったことがないであろうあれやこれ。
何を打ち上げるにしても、たぶん世界初。
あなたは何を宇宙に送りますか?
ただいま、集荷中です。

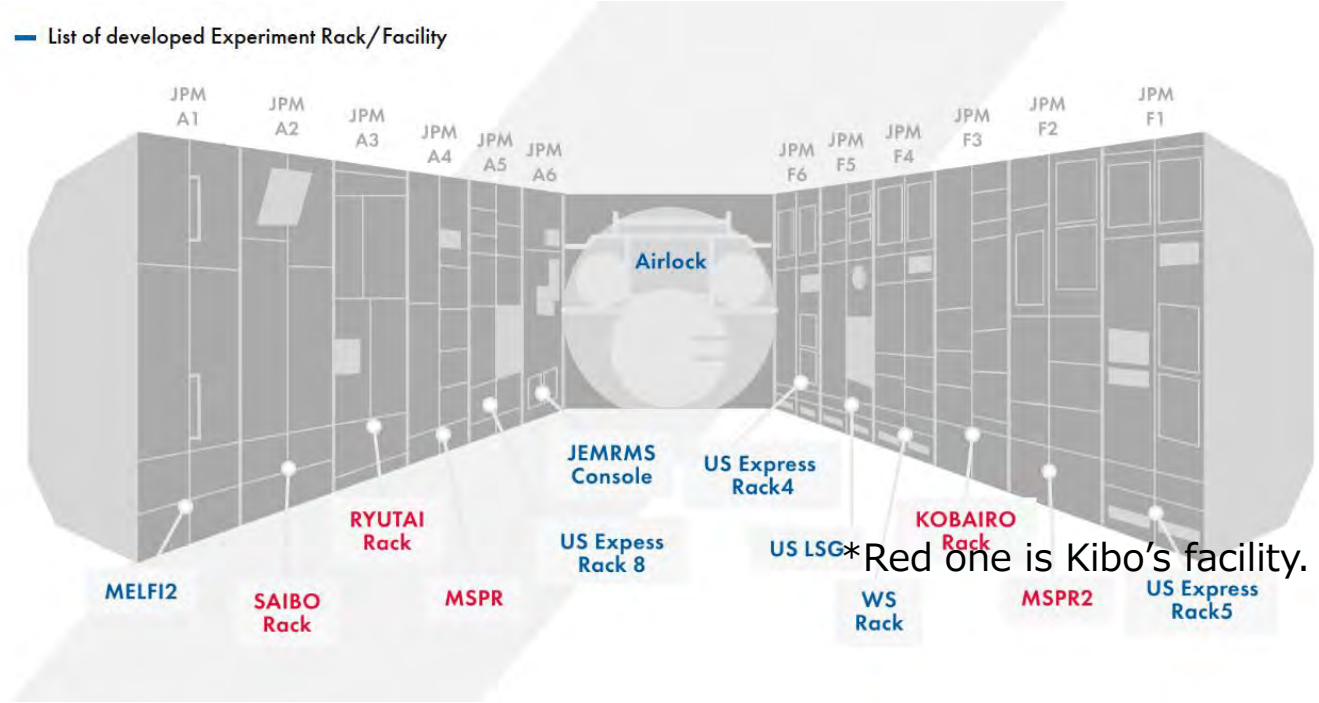
宙配便
SORA-HAIBIN

spacebiz@mb-aero.co.jp

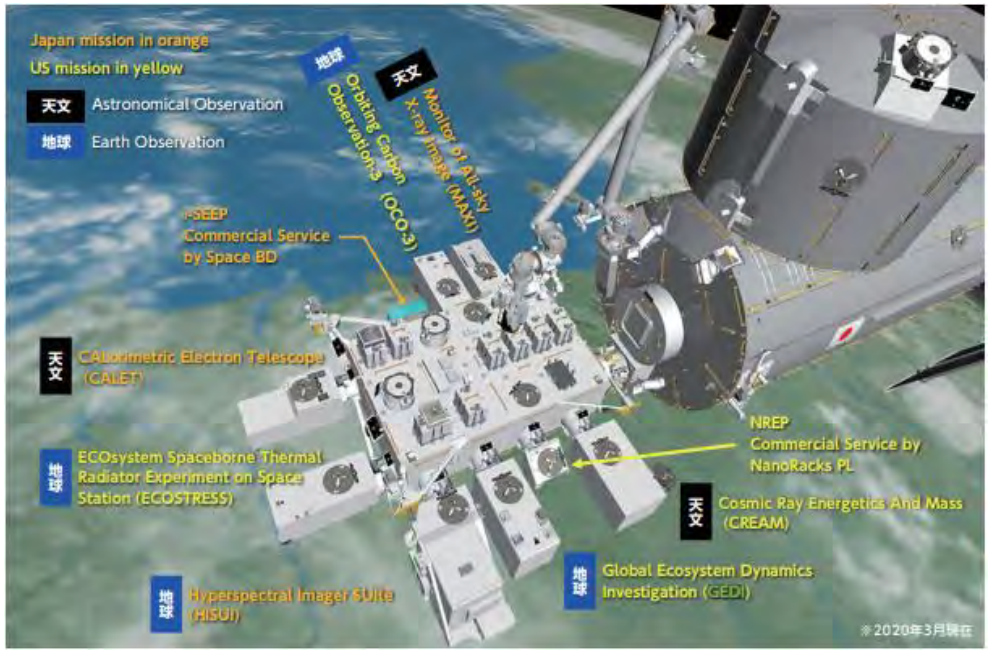
Introducing JAXA Kibo's facilities

➢ JAXA Kibo's facilities

- We can introduce Kibo's facilities for the customer's several purposes including commercial uses.

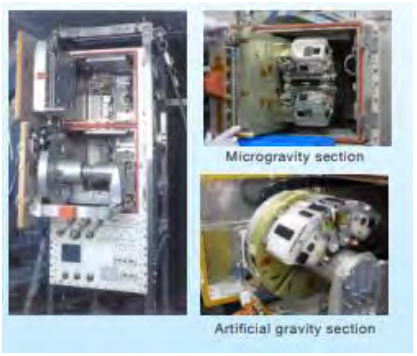


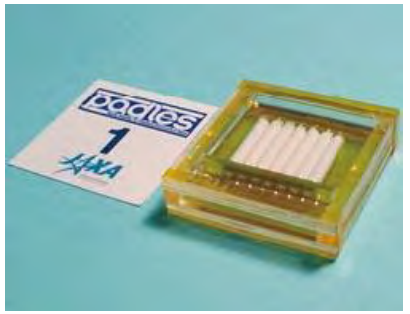
*Red one is Kibo's facility.



Introducing JAXA Kibo's facilities

Name of equipment	Electrostatic Levitation Furnace: ELF	Cell Biology Experiment Facility: CBEF	Mouse Habitat Unit: MHU	Passive Dosimeter for Lifescience Experiments in Space: PADLES
Category	Physical chemistry	Biomedical	Biomedical	Common equipment
Summary	Melt substances and conducting material experiments.	Cultivate cells, microorganisms, small plants, etc.	Breed mince under microgravity and artificial gravity with CBEF.	Space radiation dosimeter.





✓ We can introduce a suitable facility based on a customer requirement.
※ These experimental equipments are just an example.

Mitsui Bussan Aerospace Co., Ltd.

spacebiz@mb-aero.co.jp

Speaker

Mitsui Bussan Aerospace Co.,Ltd.

Tsuyoshi Tenda(Manager /Space Business Dept.)

Tsuyoshi Tenda has worked for many years as an engineer specializing in spacecraft environmental testing. He has contributed to environmental testing for more than 20 spacecrafts. He was also involved in the development of experimental equipment for the ISS. In his current position, he is responsible for supervising the technical field of the J-SSOD (JEM Small Satellite Orbital Deployer) service, supporting safety reviews, and rocket launch projects.

spacebiz@mb-aero.co.jp

HQ Location : 8-2, Marunouch 1-Chome, Chiyoda-ku, Tokyo
Overseas Offices : Dallas, Milan
Business Outline : Import/Export of Aerospace & Defence Product/Service
e.g. Helicopter, Business Jet, Security Camera, Engine Blade, etc.
Space Business Department was launched in July 2019.

Launch Service/ ISS Kibo external platform

J-SODD, i-SEEP(ExBAS)

Shuji Yamazaki

Shuji Yamazaki

Head of ISS Platform Business Unit

Since joining in April 2022, he has been in charge of sales of "Protein Crystal Growth (PCG)” experiment as a private partner of JAXA. Currently, he is developing business of space x life science and in charge of PostISS studies. Prior to this, he had worked as a researcher at a major Japanese manufacturer for 10 years. He proposed new business in the life science field and experienced a wide range of operations including research and development, manufacturing, and sales through business promotion. After that, he became the head of business and engaged in project management. His areas of expertise are material science and liquid biopsy.

s.yamazaki@space-bd.com

COMPANY PROFILE & TEAM

Masa Nagasaki
Co-founder & CEO

DRIVE YOUR BUSINESS INTO SPACE

Founded: September, 2017

Office: Tokyo, Belgium (Europe Rep)

Number of employee: 50

Investors

INCUBATEFUND

AOKI GROUP

Pavilion Capital

MIZUHO Mizuho Capital

SMBC SMBC VENTURE CAPITAL

Total equity raised : JPY2.1B (=15.6M US$)

Partnership with JAXA

JAXA

Space BD

Space BD has been selected five times in a row through RFPs to be the official service provider

H3 and HTV-X are under development in JAXA

18′/5 #1 **Satellite deployment from ISS * Kibo module**

19′/3 #2 **External facility utilization of ISS * Kibo module**

19′/12 #3 **“Rideshare launch” on H3 rocket**

20′/10 #4 **Satellite deployment from ISS refueling vehicle HTV-X1**

21′/3 #5 **Protein crystal growth experiment service on * Kibo module**

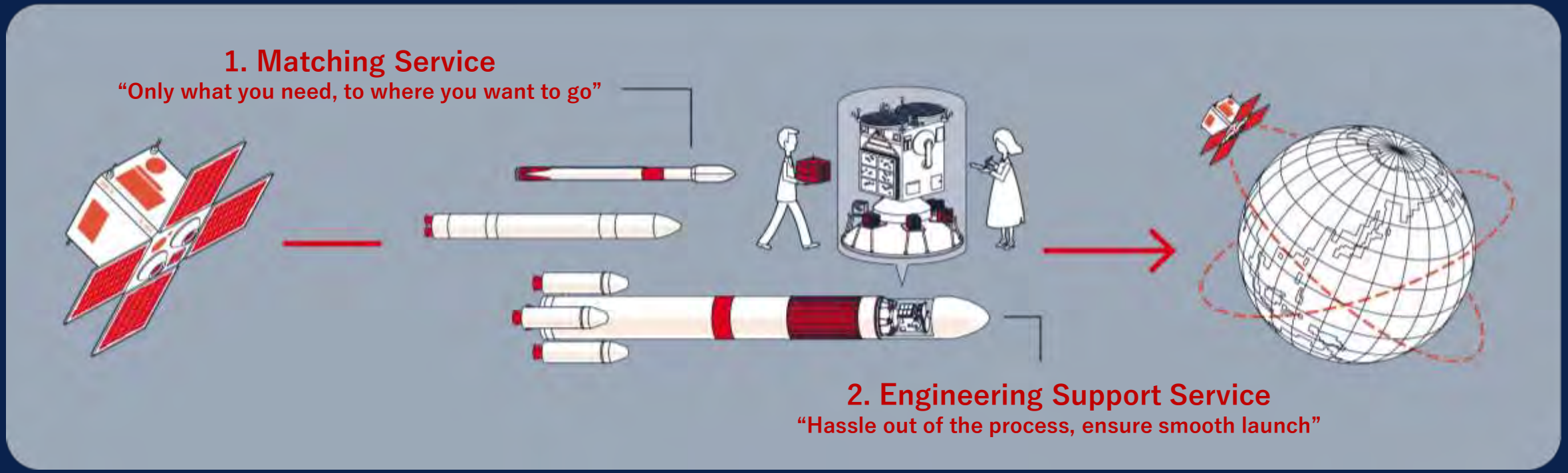
#1
The right is shared with Mitsui & Co.

#2-#5
Exclusive rights

*Kibo is one part of the ISS, developed by Japan.

Space BD's Core Business – More than just a launch service

Transportation business to deliver cargo (e.g. small satellites) into space. The Unique value we provide is in the procurement of transportation means (flexibility) and technical support.



Launch services

Satellite deployment from *Kibo Module

Approx. **50**

Promoting and managing projects as JAXA's service provider since May 2018

12/50 are successfully launched and deployed (success rate: 100%)

Rideshare launch on SpaceX's Falcon 9

Approx. **20**

Organizations are successfully deployed, including the UK company. Expanding the global launch options to meet a wide variety of global demand

*Kibo is one part of the ISS, developed by Japan.

Our achievements: satellite launch & deployment

Academia

Binar-1 / CUAVA-1
- Launched first satellite in West Australia

Private company

IHI-SAT
- Support company's in-orbit demonstration

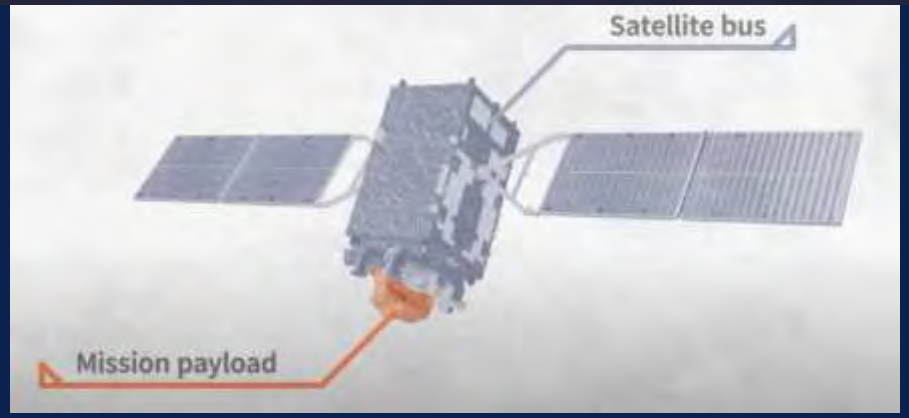
Education Program

Clark Sat Program
- Apply satellite development as an education program for students

ISS Kibo external platform utilization

IVA-replaceable Small Exposed Experiment Platform: i-SEEP

- Utilize the infrastructure resources (electricity, communication, etc.) directly from the ISS
- Developers can save time and financial costs to focus in developing mission payload
- Sample return option is available



Past project: i-SEEP

SATLANTIS (Spain) i-SIM Project

- Feb 2019 – Jan 2021
- IOD of the earth observation camera developed by SATLANTIS

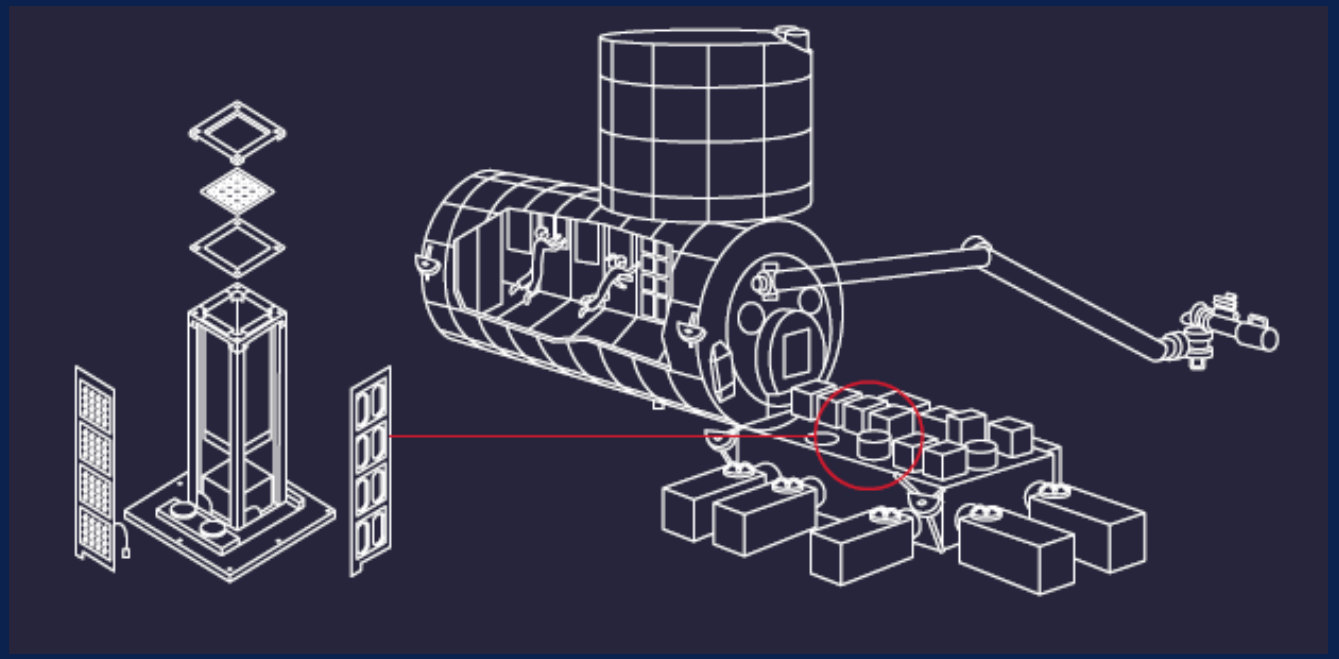
Sony(Japan) ELTRES™ Project

- IOD of wireless testing devices compatible with ELTRES™, Sony's low-power wide-area wireless communication standard

ISS Kibo external platform utilization

Exposed Experiment Bracket Attached on i-SEEP: ExBAS

- A bracket attached on i-SEEP which Space BD developed with JAXA
- Space BD has launched *Space Delivery Project* since 2021
- Able to approach diverse purposes such as research, marketing, corporate branding, education, art, etc.



Panasonic
INDUSTRY

Thank you

Please stop by our booth tomorrow

s.yamazaki@space-bd.com
https://space-bd.com

Our business area

Space BD provides a one-stop service in satellite launch supply chain(ISS as a means of launch). Also expanding “non-satellite” products and after-launch value creation in commercial manner.

2. Sourcing components

3. Testing services

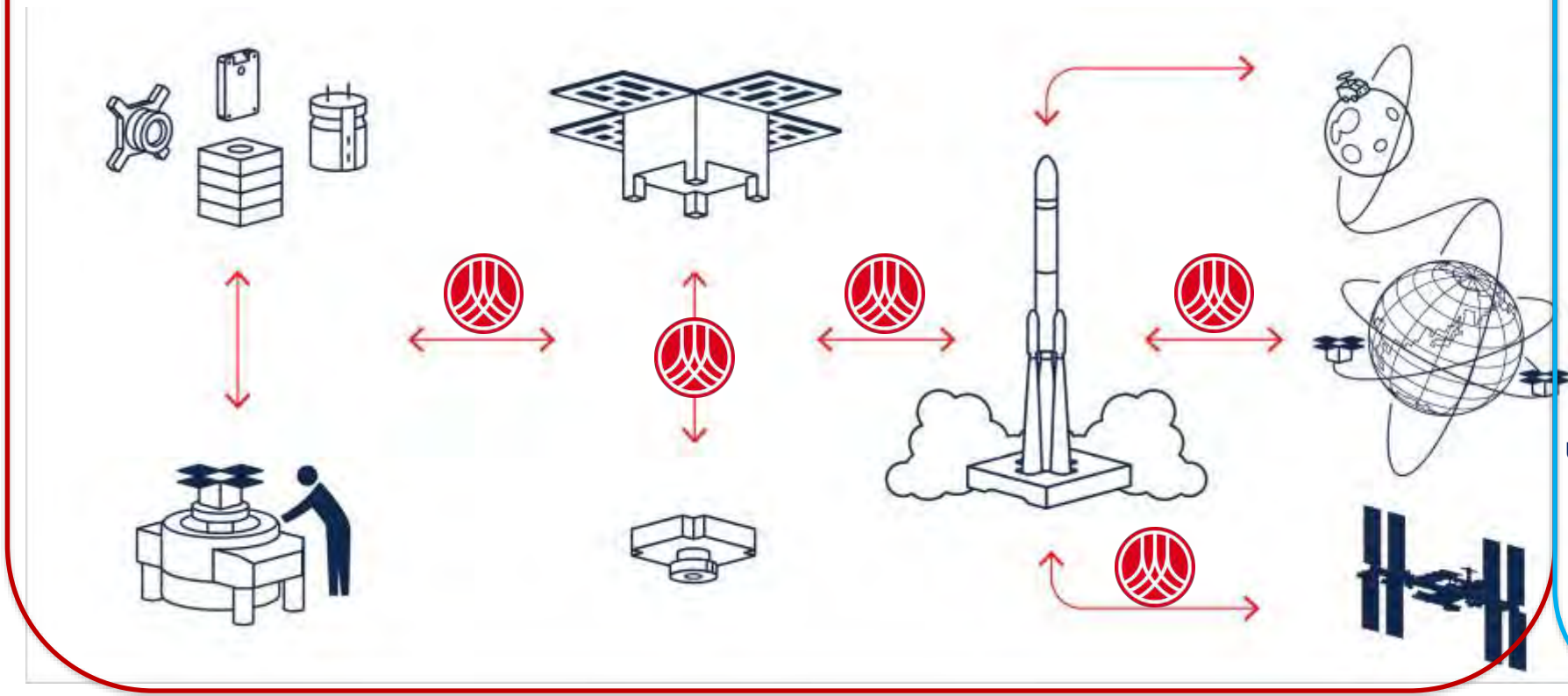
4. Satellite System integration

1. Launch services

5. Commercial utilization of space
- Life Science Services, Entertainment, Education etc.

Satellite launch services through one-stop service with practical added value

Manufacturing | Launch | Operation



Realization of a wide variety of business using current and upcoming space technology

Finding new applications

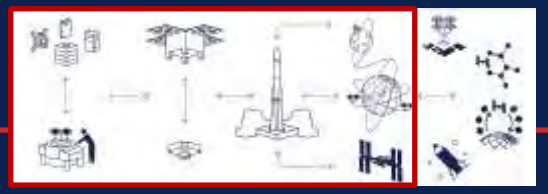
5-1 Marketing, Branding Exploitation

5-2 Life Science services

Use of Satellite Data

5-3 Education

Added value for satellite launch services



Full service line-up from pre-launch phase to satellite deployment

One Stop Service

Launch method research & proposal → Sourcing components → Official permits & procedures → Safety reviews → Testing Pre-launch preparation → Launch & deployment → Operation

Support for sourcing components
We can procure the parts needed for your development from sources in Japan and overseas

Testing services
From planning to execution, we can help you complete all necessary safety review testing, saving you time and money

Re-flight guarantees
Choose the re-flight guarantee option (fee applies) for total peace of mind in the case of a cancelation

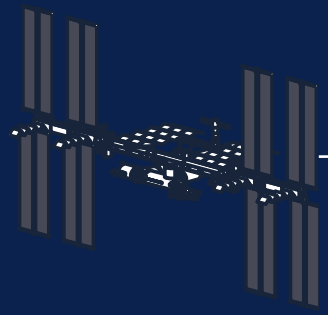
Options for Micro/Nano satellites

Space BD is the Japanese leading company in the field. Using almost every options in diversified way to space.

Heavy-lift
Launch Vehicle
Rideshare

SpaceBD
SpaceBD

International
Space Station
(ISS)



Satellite
deployment
Service from ISS

SpaceBD

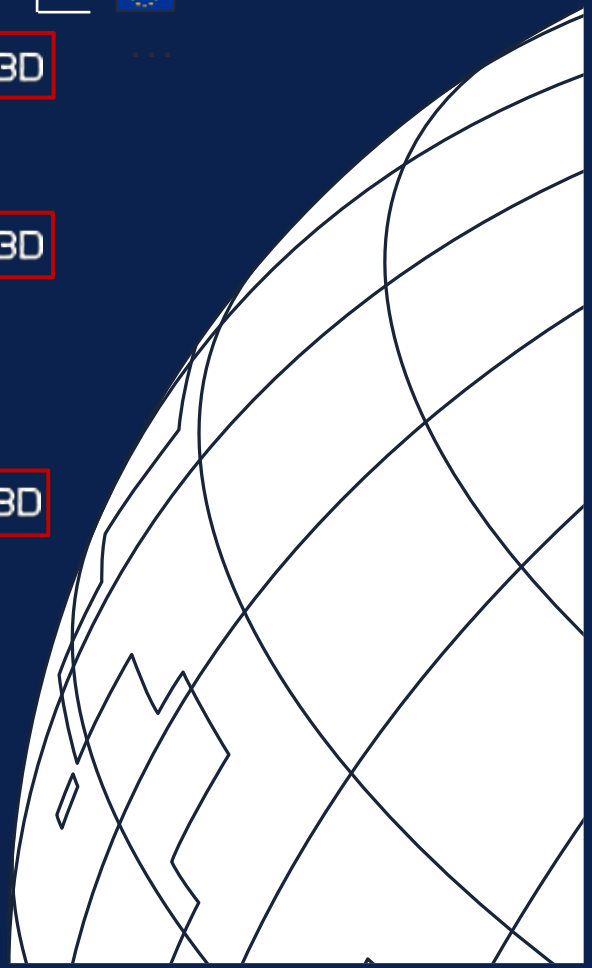
External Platform
Utilization service
On ISS

SpaceBD

Satellite
deployment service
from HTV-X

SpaceBD

Small-lift
Launch Vehicle
Rideshare



JAXA's cell culture experiments and standardized cell culture system

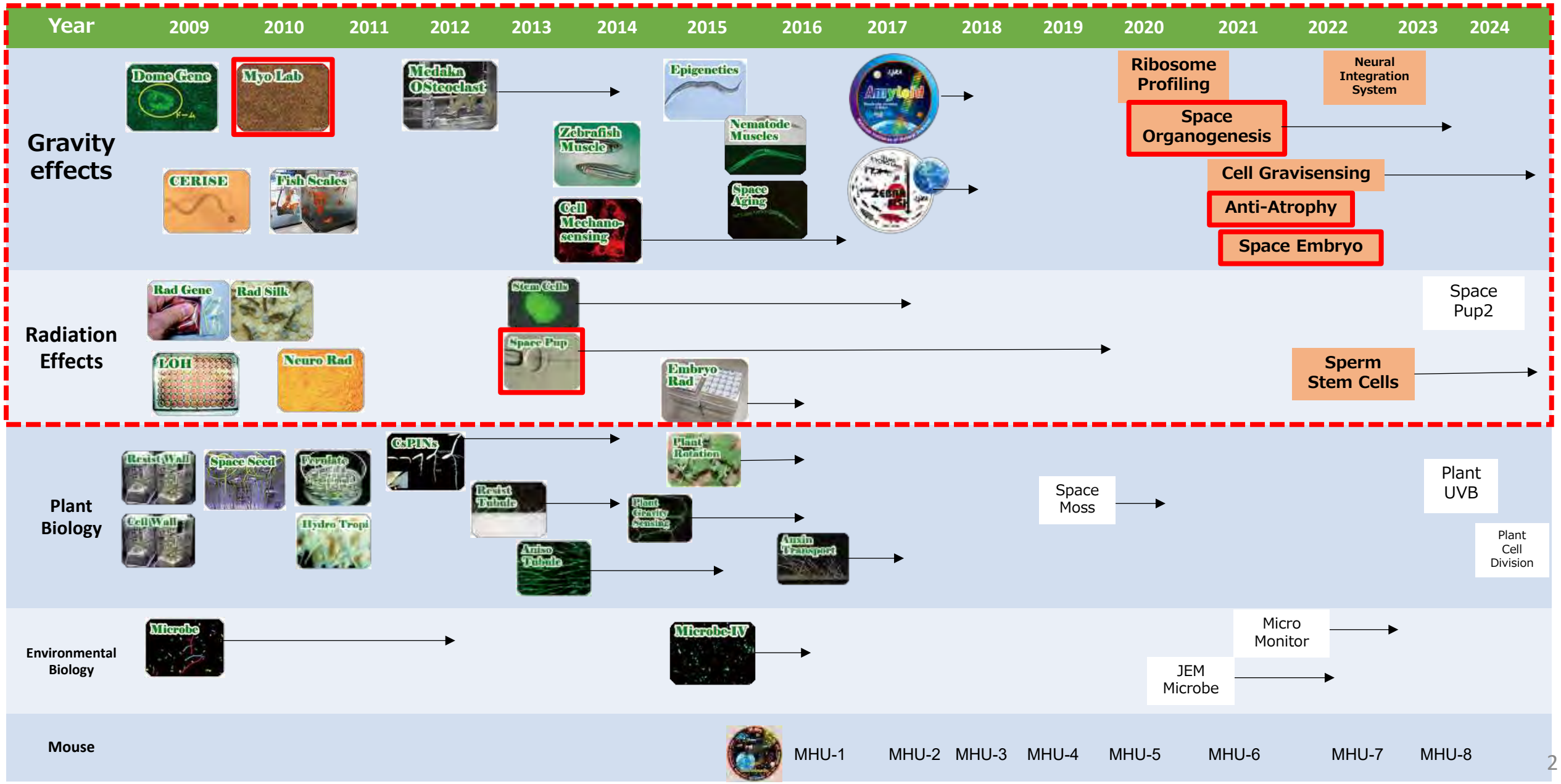
UMEMURA Sayaka
Japan Aerospace Exploration Agency
December 5, 2023
Kibo-utilization-asia@ml.jaxa.jp

Objectives

To introduce

- Cell culture experiments in Kibo
- Standardized Cell Culture System

1. Life science experiment in Kibo (2009-2024)



2. Purpose of the cell experiment

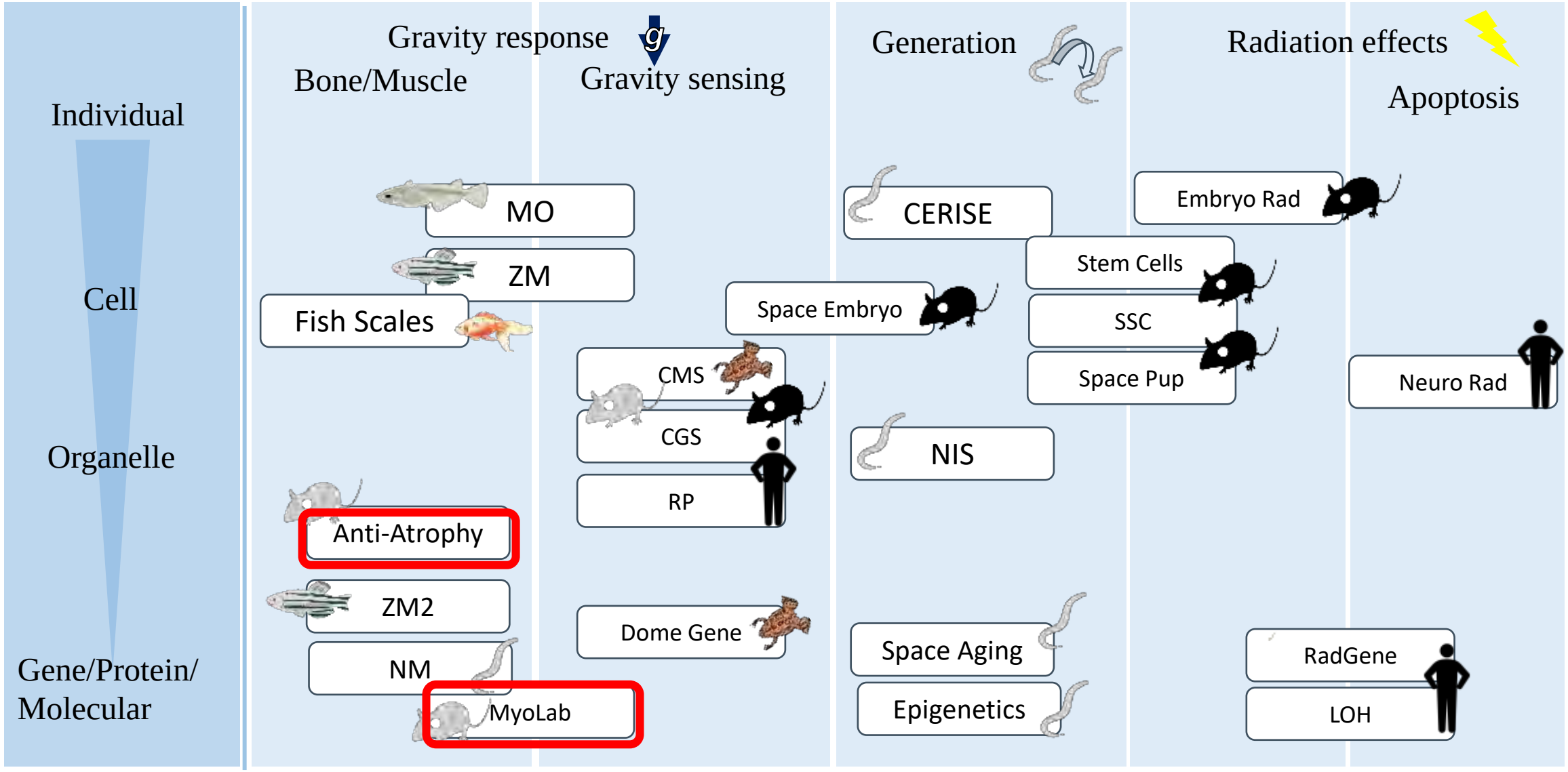
- **Expansion of human space activities is expected in both low Earth orbit (LEO), and deep space.**

■Cell experiments can contribute on;

1. **Understanding the biological response** against space environment (stresses of microbiology and space radiation) and possible adaptation,
   - ① **Gravity response**; Cell Gravity sensing, Ribosome Profiling, Space Embryo and Anti-Atrophy
   - ② **Radiation effects**: Space Pup, Sperm Stem Cells

2. **Regenerative medicine**; static microgravity environment in space is believed to offer distinct advantages for generating functional three-dimensional cultures of tissues and organs.
   - ① **Develop innovative three-dimensional culture technologies**: Space Organogenesis

3. Understanding the biological response



MO: Medaka Osteoclast, ZM: Zebrafish Muscle, SSC：Sperm Stem Cells, CMS: Cell Mechanosensing, CGS: Cell Gravisensing,
RP: Ribosome Profiling, NM: Nematode Muscle, NIS: Neural Integration System LOH: Loss of Heterozygosity

Mouse Rat
Human cell

3. Understanding the biological response; Gravity response

Muscle Atrophy analysis and prevention

NEUROLAB 1998
Baldwin KM

Discovered that only a special protein degradation pathway was activated in rat skeletal muscle after a 16-day flight

The ubiquitin proteasome pathway is characterized by ubiquitinating proteins to be degraded.

MyoLab 2010
Nikawa, Tokushima Univ.

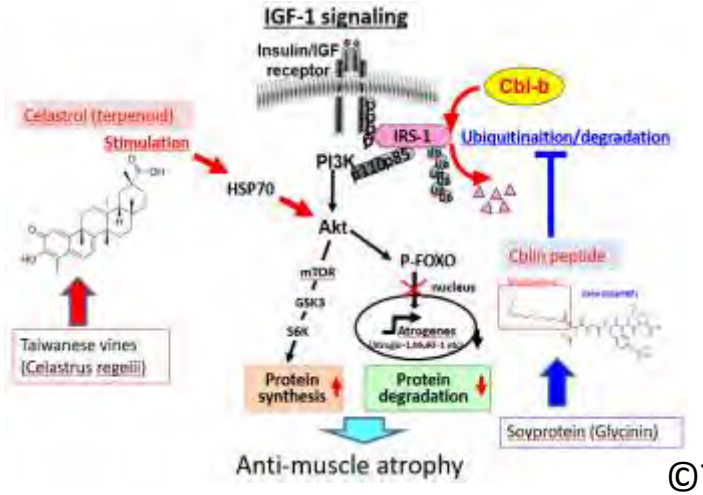
Ubiquitin ligase Cbl-b interferes with IGF-1 signaling, a signal for skeletal muscle hypertrophy

- ✓ Cbl-b in rat myoblasts was approximately 10 times higher than on the ground.
- ✓ Cbl-b induces muscle atrophy with impairment of IGF-1 signaling through ubiquitination and degradation of IRS-1.

Anti-Atrophy 2021
Nikawa, Tokushima Univ.

Research on inhibitory effects of novel concept biomaterials, a HSP inducer and ubiquitin ligase inhibitor, on microgravity-induced muscle atrophy

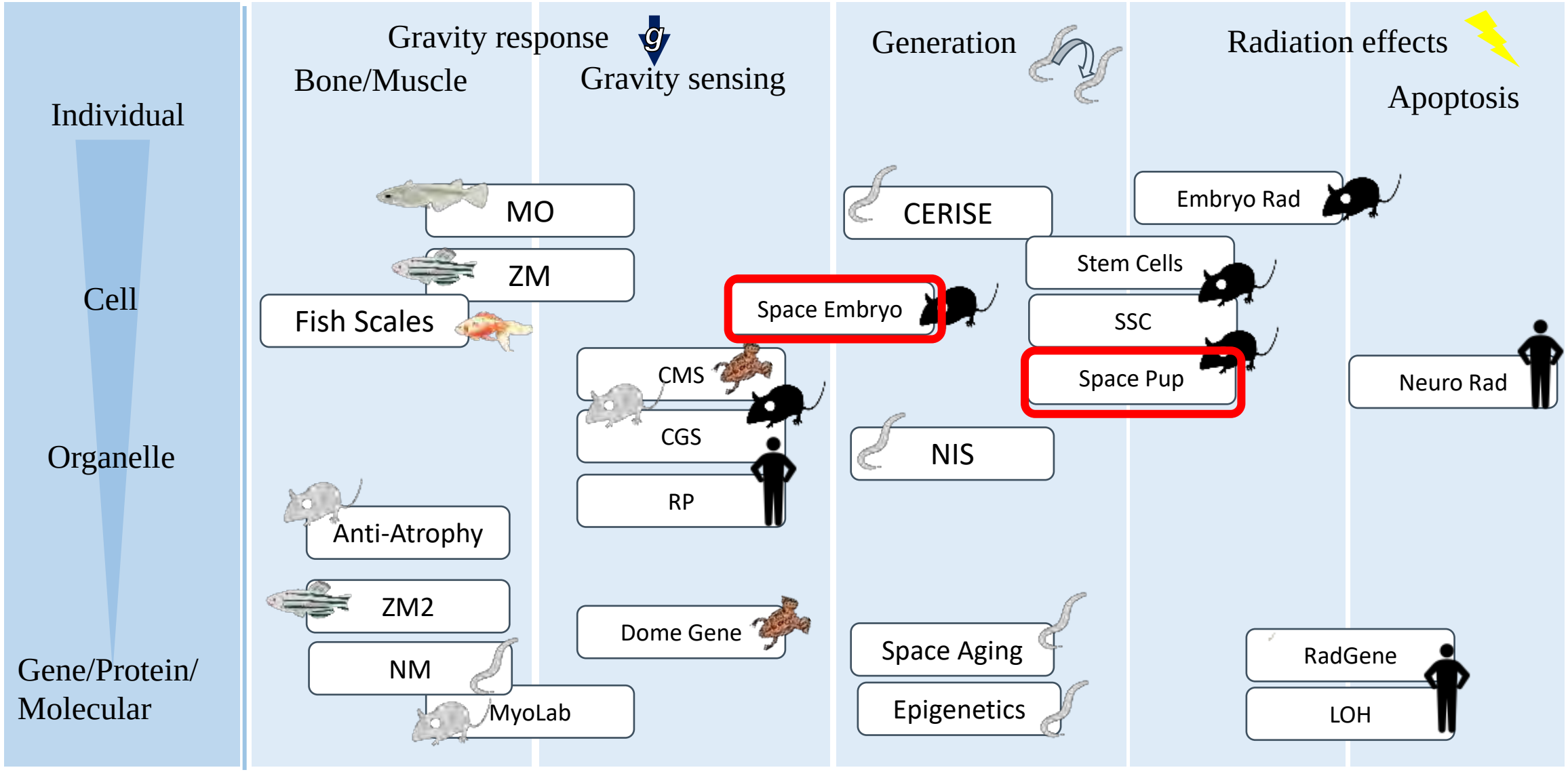
Set-up samples for the Anti-Atrophy experiment



©Tokushima Univ.

Mechanism of Action of 2 Biomaterials on Muscle Atrophy

3. Understanding the biological response



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Mouse Rat

Human cell

3. Understanding the biological response; Generation

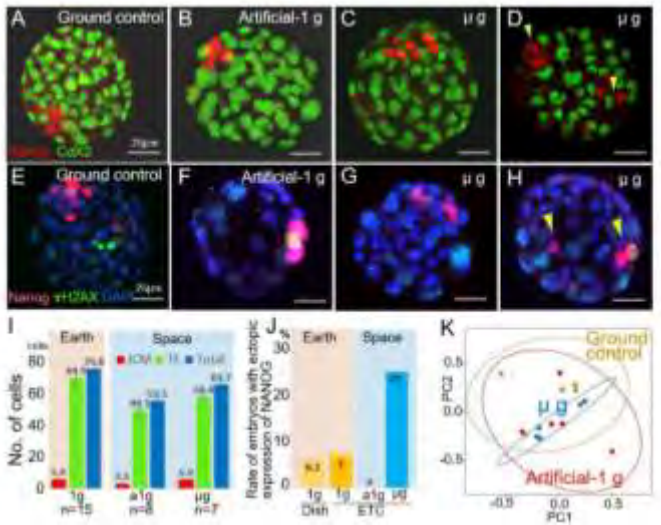
Possibility of Reproduction in Space

Space Pup **2013-2019**

- Succeeded in fertilization with freeze-dried mouse sperm stored for 5 years and 10 months on the ISS.
- Mice are normal and no effect on the next generation, showed the possibility of storage in space for over 200 years.

Space Embryo **2021**

- Mammalian embryos can develop to blastocysts even in microgravity
- Gravity does not affect the initial fate decision of the embryo
- First paper showing the possibility that mammals can thrive in space



Monitor the mission from Ground (Tsukuba Space Center)

”Evaluating the long-term effect of space radiation on the reproductive normality of mammalian sperm preserved on the Space Station.” Wakayama et al., Science Advances 2019

” Effect of microgravity on mammalian embryo development evaluated at the International Space Station” Wakayama et al., iScience 2023

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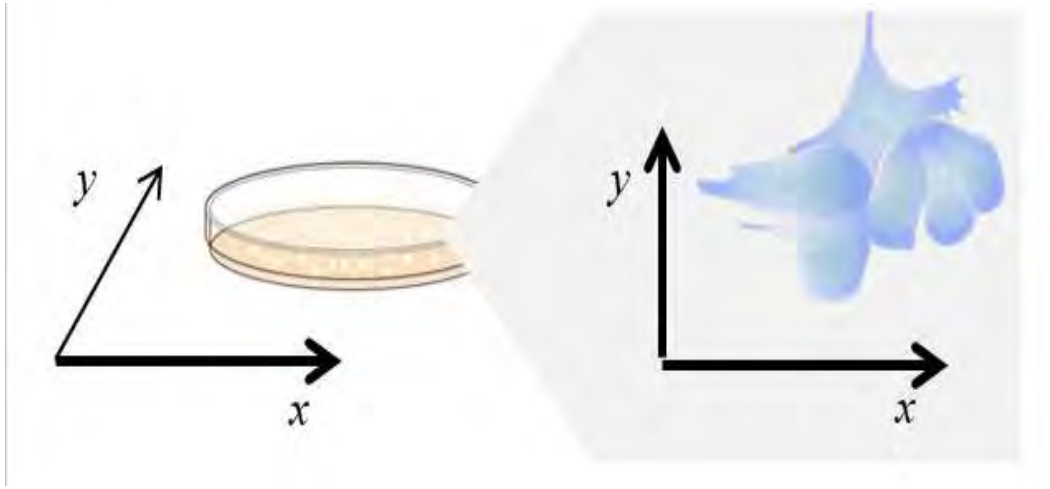
   - ① **Develop innovative three-dimensional culture technologies**: Space Organogenesis

4. Regenerative medicine

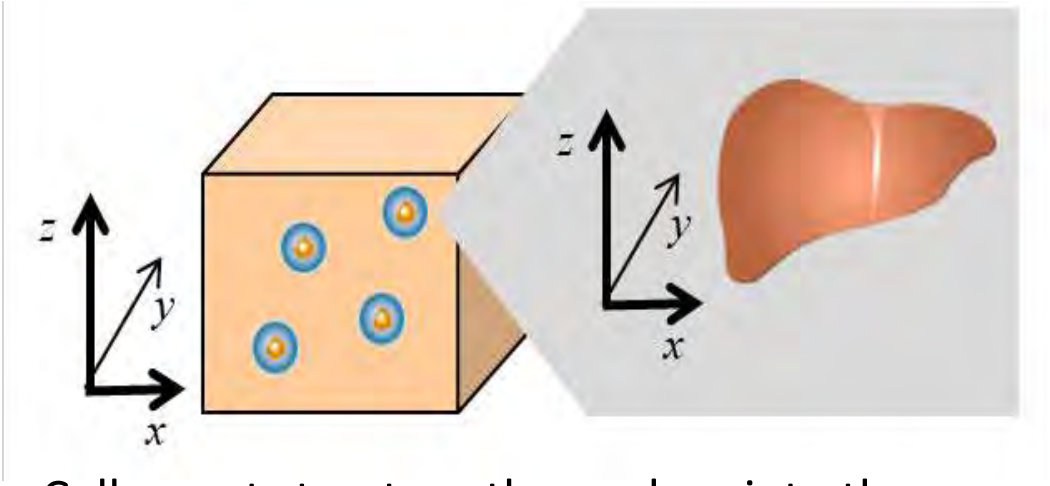
Advantage of microgravity

Cell culture on Earth



On Earth, Cell culturing is constrained by the effects of gravity, limiting the expansion to a two-dimensional monolayer structure.

Cell culture under microgravity



Cells must structure themselves into three-dimensional cell assemblies to fulfill their roles as functional tissues and organs.
Stable long-term microgravity has a great advantage in assembling cells in the three dimensions.

4. Regenerative medicine

Space Organogenesis 2020, 2024

■ **Purpose;**

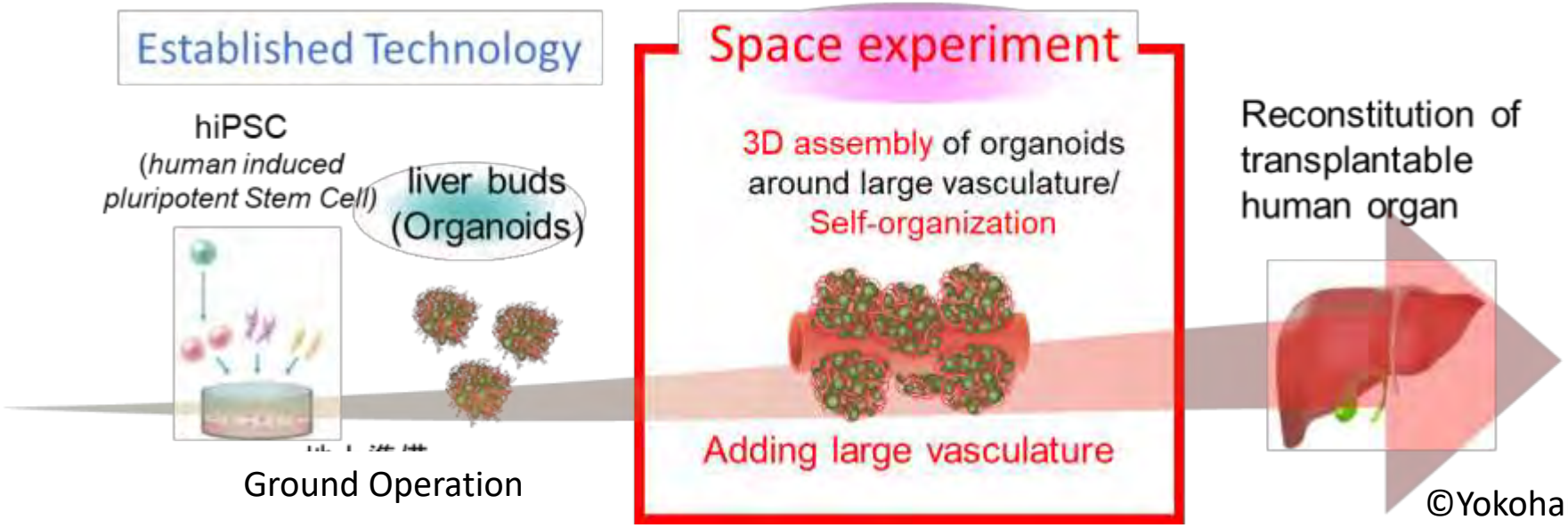
✓ Develop **innovative technology for generating three-dimensional organs using human iPS cells.**

✓ Reconstruct human organ with a large blood vessel applicable to medical transplantation.

■ **Status**

✓ 1st mission in 2020; 3D assembly of organoids around vasculature was confirmed.

✓ 2nd mission; Planned in March 2024.



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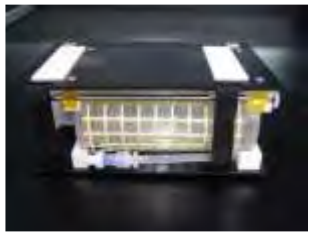
5. History of JAXA experimental systems

Previous experimental systems

Cell Experiment Unit (CEU)

Plant Experiment Unit (PEU)



Small Fish Container

Measurement Experiment Unit with camera (VMEU)

Measurement Experiment Unit (MEU)

DCC Case

Disposable Cultivation Chamber (DCC)

Challenges

- ✓ Prolonged development times
- ✓ high cost
- ✓ Limited experiment frequency
- ✓ Lack of versatility

Next strategy

Developing a standard, compact, efficient, automated cell culture system.

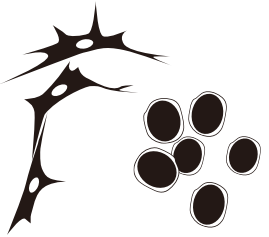
6. Standard Cell Culture System

ASTROCELL: Automated Space Tissue Regeneration, Organ and CELL cultivation equipment

Expected Function

Constant temperature and CO_2 concentration control

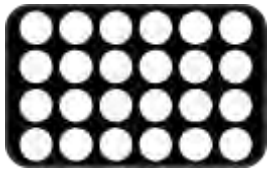
Temperature and humidity monitoring



Adherent and floating cell culture

Automatic medium exchange (perfusion and batch)

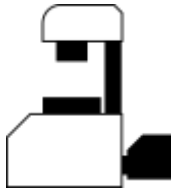
Monitoring of cell morphology per well



24-well plate standard sample vessels

Recovery of chemically fixed samples

Artificial gravity condition (microG and variableG comparison)



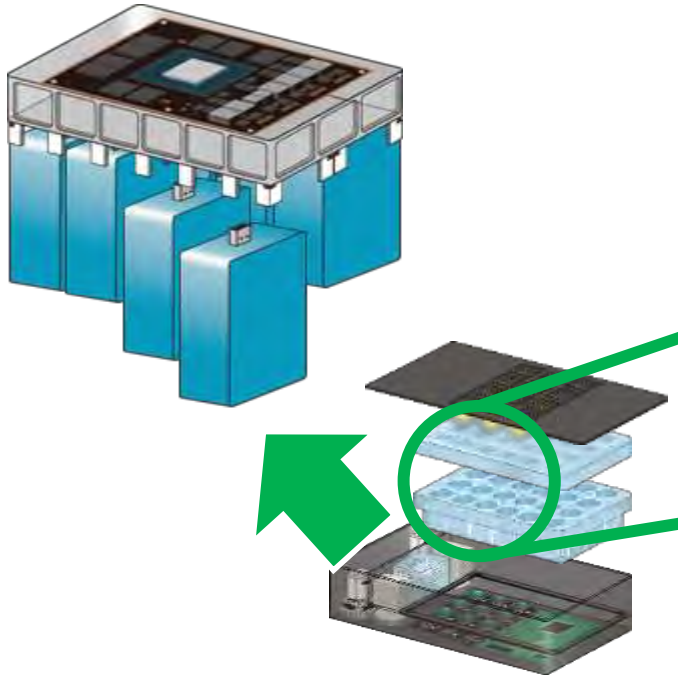
Observation with confocal microscope

6. Standardized Cell Culture System

Cell Biology Experiment Facility-Left (CBEF-L)

Incubator with
- ✓ Temperature/Humidity/ CO_2 concentration control
- ✓ Artificial gravity
- ✓ Power supply
- ✓ Communications from/to the ground

ASTROCELL



- ✓ Ground-On Orbit communication
- ✓ Pump drive motor control
- ✓ Automatic medium exchange (perfusion and batch)
- ✓ 24-well plate standard sample vessels
- ✓ Cell morphology monitoring

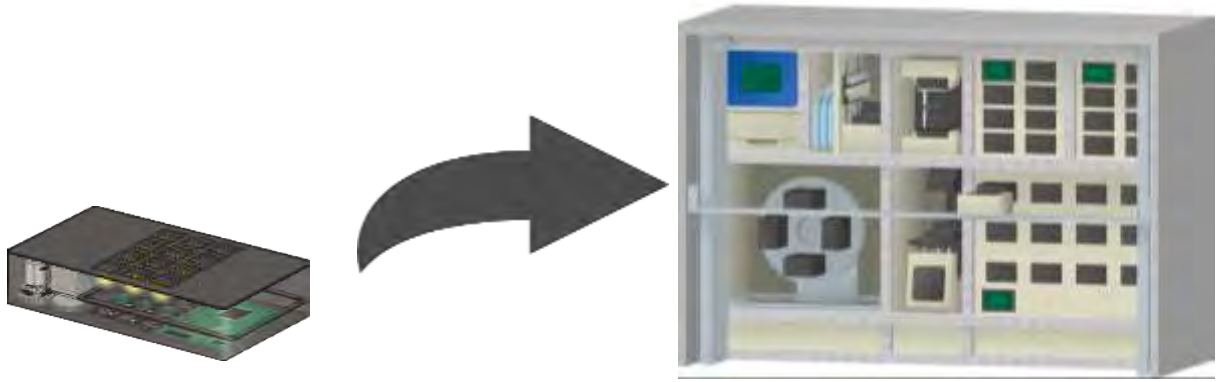
Confocal Space Microscopy (COSMIC)

Observation with confocal microscope
- ✓ Bright-field observation
- ✓ Confocal fluorescence observation
- ✓ Time-lapse imaging

6. Standardized Cell Culture System

Future plan

- ✓ The launch of ASTROCELL and the first technical demonstration experiment are targeted for 2026.
- ✓ Regular and user-friendly opportunity for a broader range of researchers, including both newcomers and existing users.
- ✓ Evolve the system for future research/commercial activities on the post-ISS platforms and space exploration around the Moon and beyond.



JAXA & ASA | Kibo Utilization Workshop

Space Exploration Research Opportunities on the Commercial Experiment Platform in Kibo

5th December, 2023

DigitalBlast

BIOGRAPHY

Presentator

- *Masanobu Oikawa is an Executive Officer and Director of Space Exploration division. With a background in business development, strategy consulting, he has expertise in growth strategies, market entry, alliances, new business development, and commercial due diligence, engaging with diverse client industries globally.*
- *His corporate experience spans corporate planning, international business development, and investments, including various overseas countries such as India and Brazil.*
- *Since joining DigitalBlast in 2021, he has been at the forefront of initiatives to drive business development focused on the sustainable utilization of low Earth orbit (LEO).*
- *In particular, he is leading the development of space experiment devices, such as 'AMAZ,' slated for installation on the International Space Station in the coming years.*

Masanobu Oikawa

Executive Officer, Director of Space Exploration Division

Who we are and what we will be

DigitalBlast

Who we are and Who we will be

Make Space Valuable

宇宙に価値を。

DigitalBlastは“宇宙に価値を”
提供するため常に挑戦し
宇宙産業の変革を実現していきます

DigitalBlast

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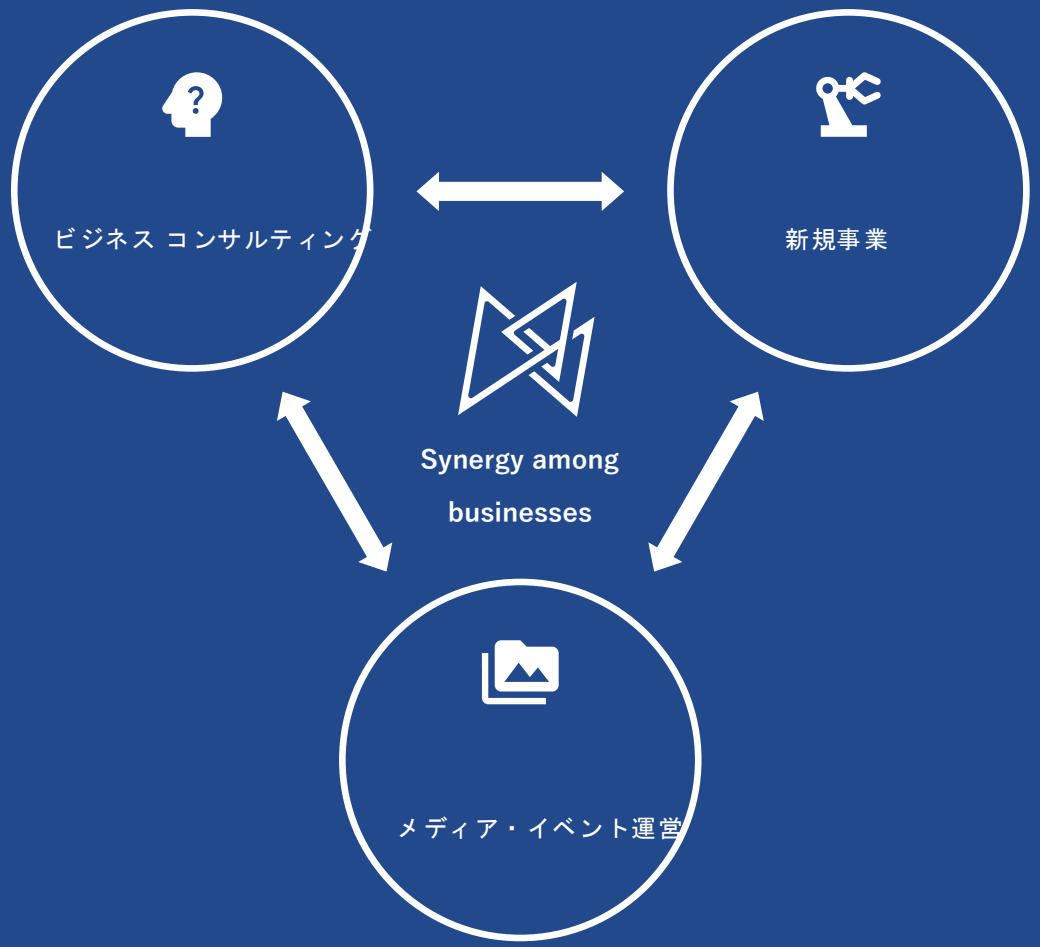
Space business platformer that makes space easy to understand and use.

”分かる“”使える“宇宙を創る
総合ビジネスプラットフォーマー



OUR BUSINESS
事業詳細説明

Consulting ビジネス コンサルティング

Our services focus on space-related business consulting and research projects for government agencies. We also focus on DX consulting, as we believe there is a high affinity between the digital industry and space.

Media & Event メディア・イベント運営

We operate a media focused on the space industry, named Space Media. It has a wide range of articles, from those that tickle intellectual curiosity to those that are more business-oriented and creates a point of contact between various people and space information.

Innovation Lab. 新規事業 R&D

R&D for space applications, mainly developing experimental equipment for use on the ISS and CSS. Today I will introduce you to this R&D experimental equipment and services in more deeply.

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Our Strategy and Approach

As a platform player, we will promote Space Exploration, Space Utilization,
and Space Market creation and development, leveraging synergies with our core businesses

Make Space Valuable

Space Exploration
Product & Service

Expand utilization areas by promoting the development of infrastructure and equipment/devices utilized on ISS

Space Utilization
User support & Integration service

Providing professional support to users for advancing the sustainable utilization of the microgravity environment in LEO

Nurturing Space Market
Space Consultancy & Media

Nurturing and creating markets by raising awareness of space utilization and attracting potential customers

Our professionals

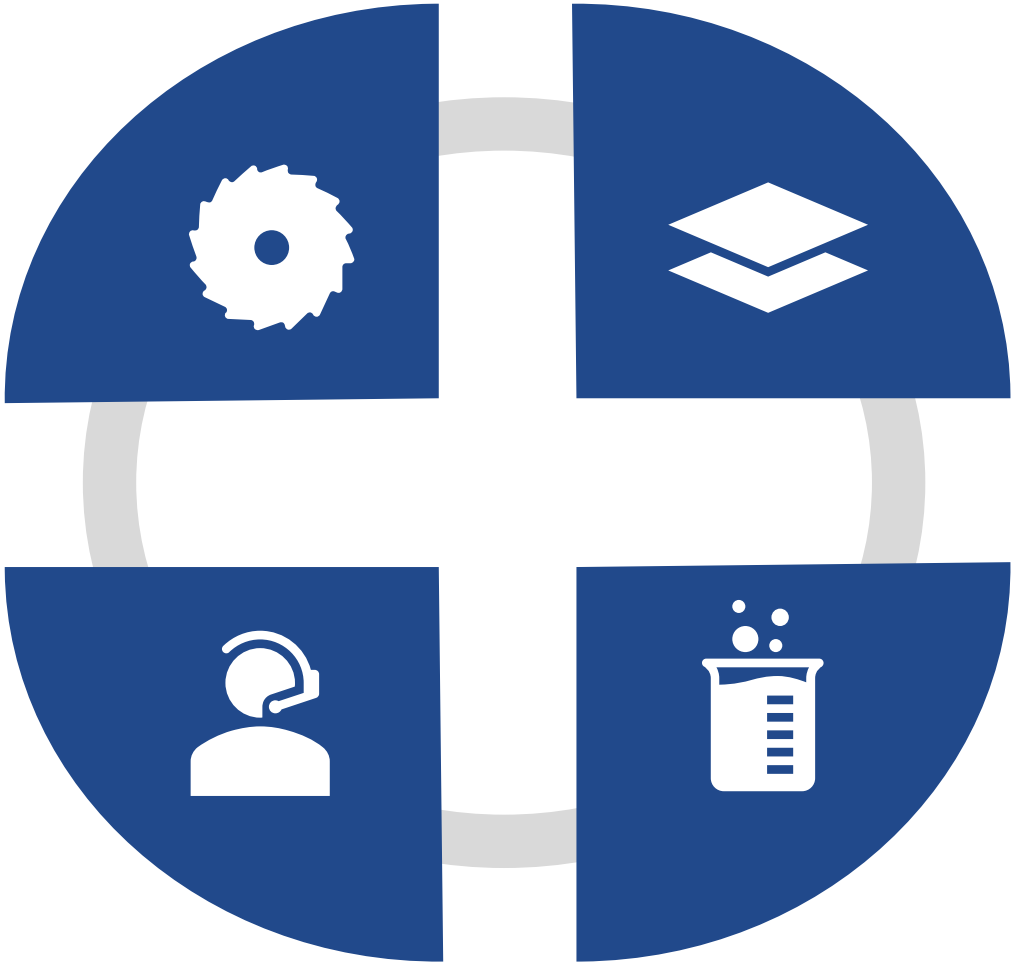
We are a team of experts with a wide range of expertise in the space domain, from engineers, operators, designers to user integrators, which enable us to give one-stop and seamless services

Space Engineers

Experts with experience in developing the various JEM infrastructures and payloads onboard the ISS

Space Designer

Hardware design of space experiment devices and satellites, and graphic design to attract the fascination of space



Space Operators

Experts with experience in system and operational control including space experiments on ISS/JEM

User Integrators

Experts with experience in supporting full-integration of space experiments for users of microgravity environments

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Space Research Opportunities on ISS/KIBO

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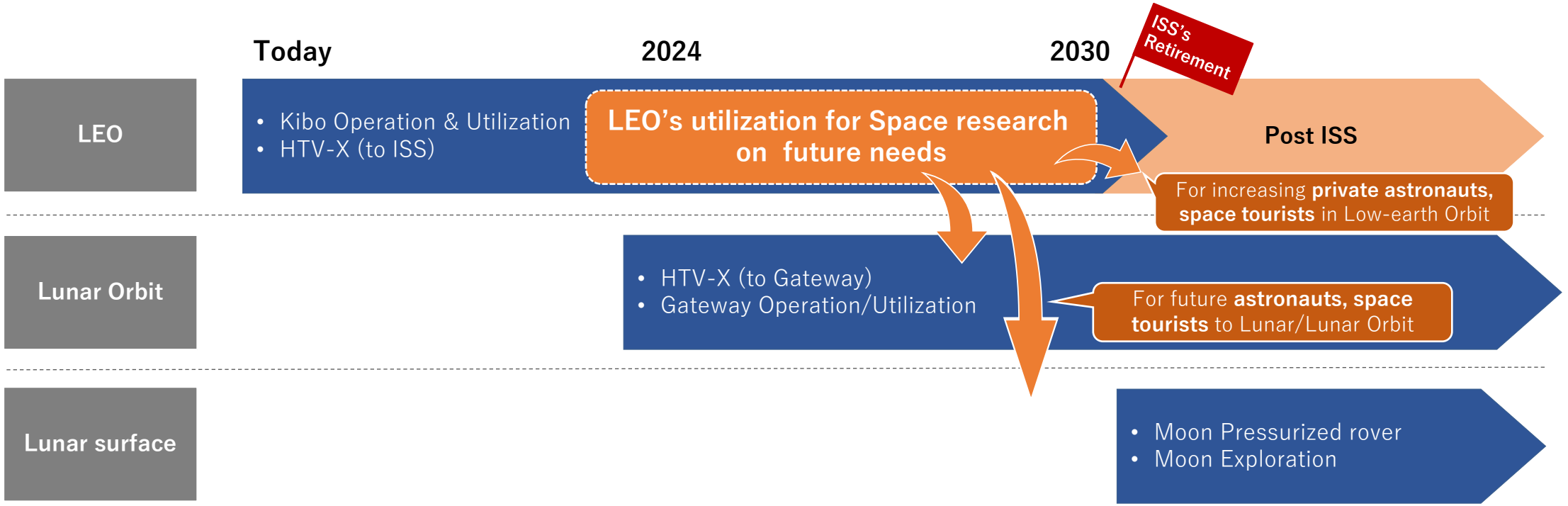
Kibo's Utilization as platform in space research and development

ISS/Kibo is the best platform for space research for **LEO utilization & the Lunar exploration**

Why ISS in LEO for space research ?

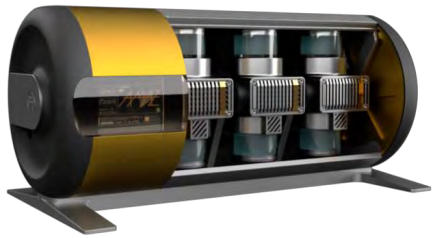
- ✓ Easier/cheaper/frequent access.
- ✓ Mature operability
- ✓ Wide variety of payloads



NOAH Project

NOAH project begins by providing opportunities for small plant experiments in LEO, expanding to larger plant experiments, which will address future space food needs in LEO and Moon

	AMAZ	TAMAKI	ATARI
Steps	• Obtain basic data on plant response to gravity through plant cultivation under various gravity conditions • Demonstrate that it is possible to grow plants in a controlled gravity environment in space and identify issues in plant cultivation • Identify needs and requirements for plant experiments on the ISS • To verify the needs and requirements for plant experiments on the ISS	• Confirmation of optimal environmental conditions for plant cultivation in a gravity environment simulating the surface of the moon • Challenge a variety of larger type of plants to provide the nutritional needs of humans. • Demonstrate efficient plant cultivation by recycling water and minimizing resources	• Efficient production of food for astronauts and space travelers in manned orbit and astronauts on the Moon.
Experimental subject	• **Moss（こけ）** • **Arabidopsis thaliana（シロイナズナ）** • **Mammalian cells（哺乳類細胞）**	• **Lettuce** • **Tomatoes** • **Strawberries** • **Potatoes**	• Various vegetables



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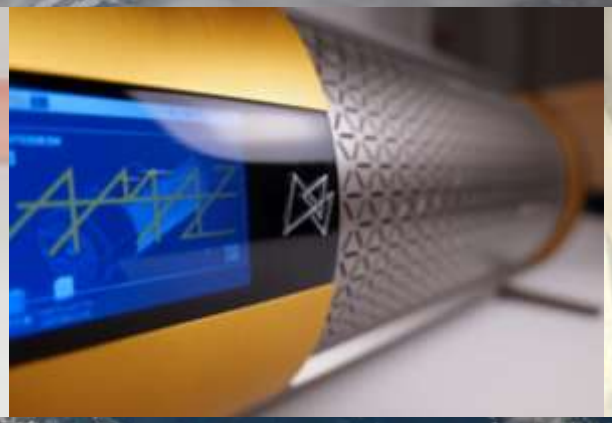
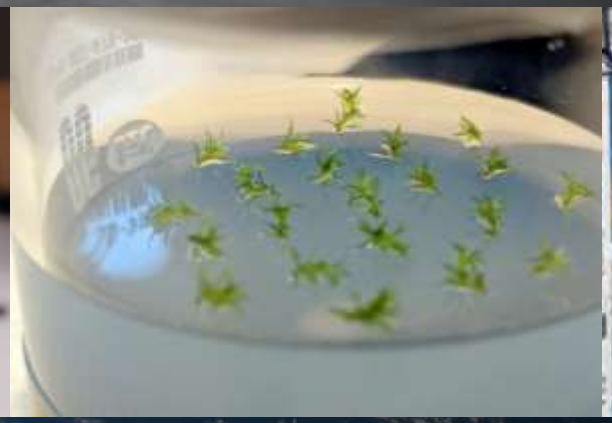
月面

宇宙での農業革命と生態循環維持システム構築

To construct an ecosystem on the Moon





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AMAZ's features and its competitiveness

Plant science research under microgravity with simultaneous experiments in μG, Partial-G, and 1G

Features

Installation	▪ International Space Station – Japan Experimental Module (JEM)
Start	▪ In the mid of 2020s
Size	▪ Approx φ200×400mm (Equipment) ▪ Approx φ50×50 (Chambers)
Gravity environment	▪ Flexible settings from μG～1G (2 options of gravity : 1 shall be μG)
Other functions	▪ LED、Observation camera、Humidity & temperature sensors

Comparison

	AMAZ	**CBEF-L (JAXA)**	**MVP (NASA)**
Gravitational environment	**3 types of gravity in maximum** **μG+2 controllable gravity** **(e.g. μG+1/6G+1G)**	**2 types in maximum** 2 controllable gravity (e.g. 1G+2G)	**2 types in maximum** 2 controllable gravity (e.g. 1G+2G)
Experimental Chambers	**6 units in maximum**	10 units in maximum	12 units in maximum
LED Light	**Built-in standard**	– (*1)	– (*1)
Observation camera	**Built-in standard**	– (*1)	– (*1)

*1: To be installed in the experimental chambers if needed

AMAZ with artificial gravity generator

Plant science research under microgravity with simultaneous experiments in μG, Partial-G, and 1G

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Use Case with AMAZ

AMAZ can be utilized for a wide range of small plant experiments

Space Moss（こけ）

Brewer’s Yeast（ビール酵母）

Arabidopsis thaliana（シロイナズナ）

Seed of pea plant（えんどう）

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Progress : AMAZ project

After completing the BBM (Bullet Board Model), we are in the process of manufacturing the Flight Model, with the aim of launching and installing it onboard the ISS in the mid-2020s

Completed

Ground model development (2022)

AMAZ BBM

In Progress

Flight model development & test (2022~)

AMAZ launch to the ISS and start Space research service

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Service Agreement with Axiom Space (US)

In addition to JAXA's Kibo utilization system, we have secured a channel to launch life-science research samples via the US, providing us **with broader options for Kibo utilization**

AXIOM SPACE

×

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AMAZ

Operational Streamline of Space Research with AMAZ

Space experiments necessitate meticulous ground preparation, arrangements for launch and astronaut resources, sample retrieval, as well as data analysis during and after the experiment

Operational streamline

1 to 1.5 years	A few weeks	A month	A few weeks	
Experiment preparation	Transportation and Launch	ISS installed and perform experiments	Sample Recovery to Earth	Analysis

Small Plants / Seeds

Observation of growth conditions on the ground

- Growth conditions
- Environmental data (Temperature, Humidity, etc.)

Perform a variety of analyses

- Gene Expression Analysis
- Morphological Analysis
- Protein Analysis
- Photosynthetic Activity Analysis

AMAZ

Service Offerings

Our experts will support you throughout the entire process of your Space Experiment

1

Feasibility Study

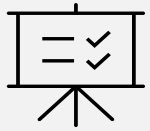
- *Professional support to materialize space experiments*
- *Feasibility study on safety criteria and other considerations for conducting space experiments*

2

Preliminary Experimental Study

- *Determination of conditions for experiments in space*
- *Preliminary experiments using ground-based equipment*

3



Sample Preparation

- *Sample Preparation for the space experiments*
- *Preparation of astronaut procedures and other required documents*

4

JAXA Kibo Utilization

- *Support for the application review process and necessary procedures for **Kibo utilization system** of JAXA*

5

Preparation Arrangement

- *Various arrangements for air or land transportations or laboratory required for preparation prior to launch*

6

Ground Operational Support

- *Ground control of space experiments conducted on ISS/KIBO*

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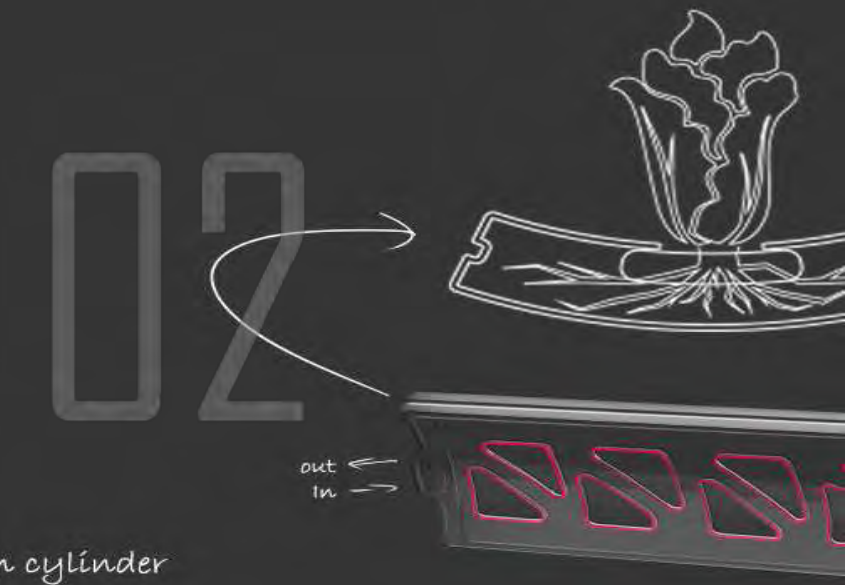
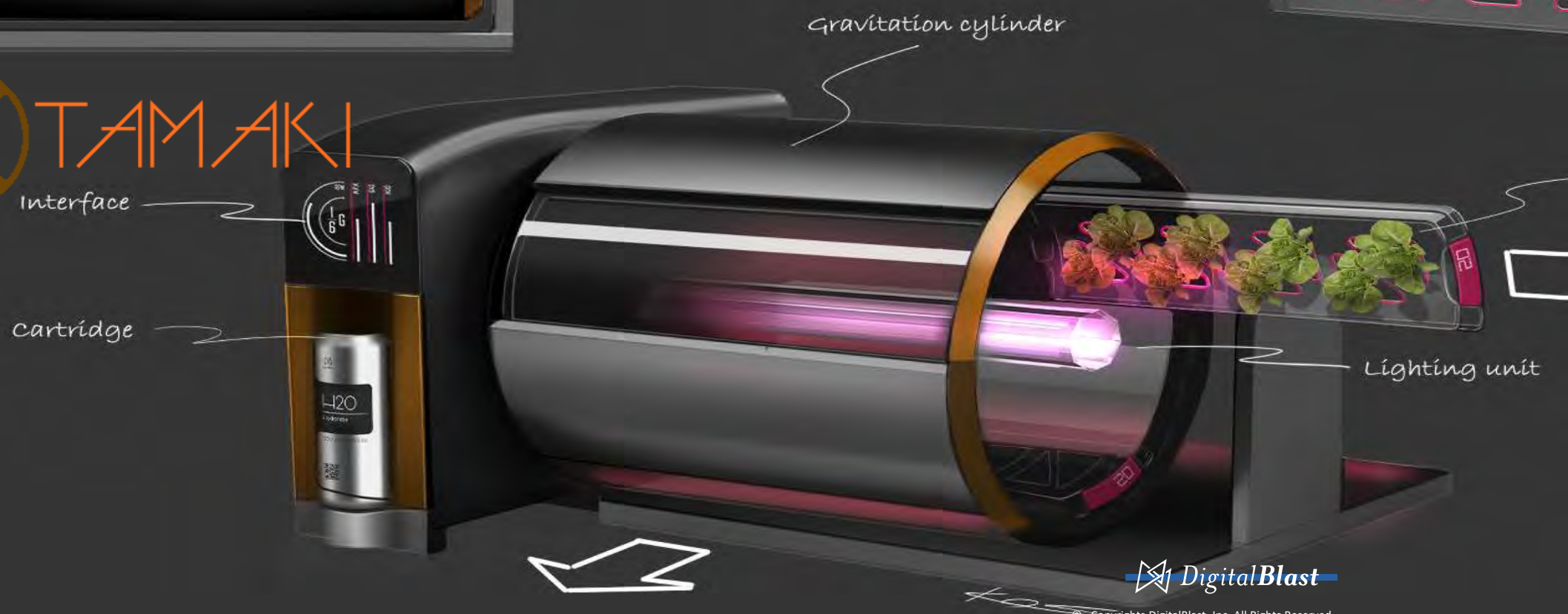


環 TAMAKI



環
TAMAKI

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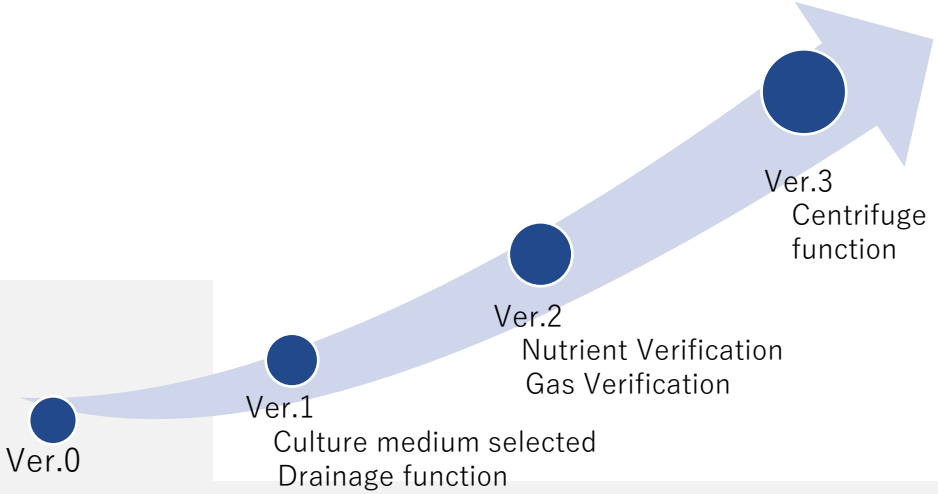
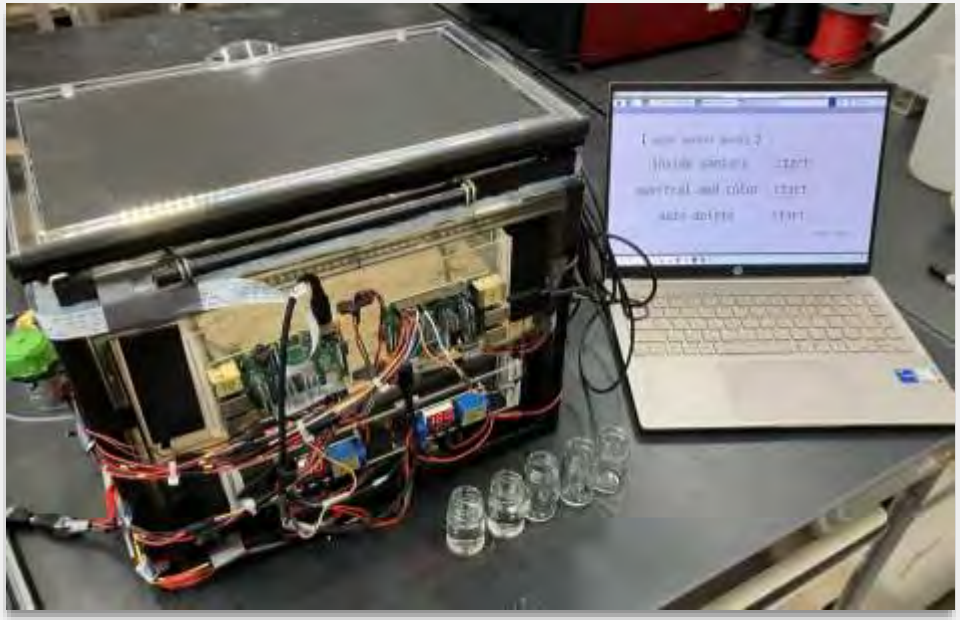
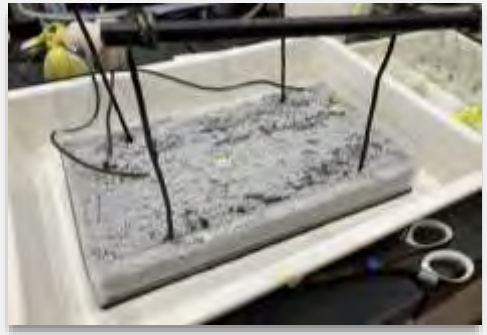
TAMAKI BBM ver.0

1st version of BBM（Bullet Board Model）is being progressing in collaboration with University of Meiji





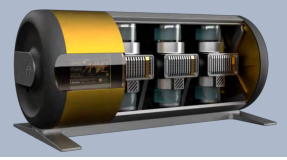
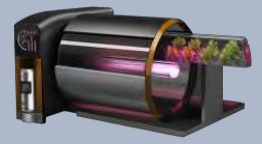
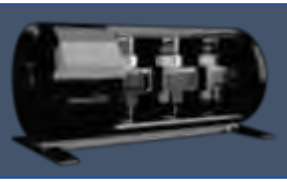


LIFE SCIENCE EXPERIMENT SERIES

Life Science Researches in the Space

We aim to expand our space experimental services from plant to cell, protein, and 3D culture in order to meet the evolving experimental needs in the post-ISS era

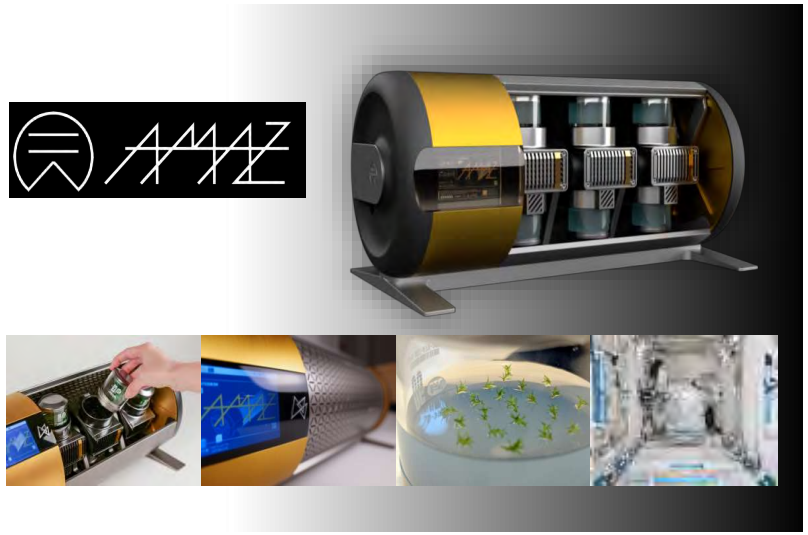
Space Experiments Needs

Plant science Experiment for Small organisms		**AMAZ**	Specialized in plant science experiment with simultaneous experiments in Micro-G, Partial-G, and 1G environments
Plant science Experiment for Large organisms		**TAMAKI**	Specialized in plant science experiment with simultaneous experiments in Micro-G, Partial-G, and 1G environments
Cell Biology Experiment		**AMAZ** Alpha	Specialized in cell culture with simultaneous experiments in Micro-G, Partial-G, and 1G environments
Protein Crystal Growth Expt.		**Incubators**	Experiment equipment for provision of the controlled environment in microgravity
3D CULTURE Space Organogenesis Experiment.		**AMAZ** Omega	Specialized in space organogenesis experiment with simultaneous experiments in Micro-G, Partial-G, and 1G environments
. . . . .		. . . . .	

LEO Service

Partnership

If you are a potential user, a partner, or any other company or organization interested in our space equipment, ***please contact us!***



- ✓ ***For Users :*** Universities, research institutions, and companies interested in expanding space food in LEO or lunar agriculture
- ✓ ***For Partners :*** Universities, research institutions, and companies that are interested in the development of space experiment device, both financially and technologically
- ✓ ***For Others :*** Any companies and organizations that are willing to cooperate with us in any way to create a new space industry, such as space development, promotion of space utilization, and creation of space needs

Please contact to

URL：https://en.digitalblast.co.jp/

Email：info@digitalblast.co.jp

DigitalBlast

- *DigitalBlast, with its mission to "bring value to space," stands at the forefront of catalyzing a paradigm shift in the space industry, steering it towards privatization and restructuring. In the midst of the ongoing transformation, where the space sector is progressively transitioning to be led by private enterprises rather than traditional government agencies, we are committed to pioneering business development initiatives.*

- *Aligned with our mission, DigitalBlast operates through three primary business pillars: Space & DX consulting, Media & Event businesses, and Space Explorations. These pillars are intricately connected, fostering synergies that span nurturing potential clients, guiding strategies for new space businesses, and leveraging space environments for clients' research and development, entertainment, and various other forms of space utilization.*

- *At the forefront of our endeavors is our flagship project, the groundbreaking small-scale life science experiment apparatus, "AMAZ." Serving as the foundational component for Project "NOAH," this initiative marks the initial step towards establishing an ecological cycle maintenance system for humanity's lunar exploration. With a vision to propel scientific development in the field of life sciences and create a habitable environment in outer space, "AMAZ" aims to conduct research on plant physiology in the lunar environment and lunar gravity, with the ultimate goal of installation and operation on the ISS.*

DigitalBlast

宇宙に価値を

Make Space Valuable

堀口 真吾　Shingo Horiguchi

株式会社DigitalBlast　DigitalBlast, Inc.

101-0051 東京都千代田区神田神保町1-105 神保町三井ビルディング19階

Jinbocho Mitsui Building 19F, 1-105 Kanda Jinbocho, Chiyoda-ku, Tokyo, 101-0051, Japan

ISS utilization business

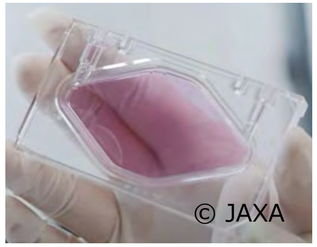
-Protein Crystal Growth-

Shuji Yamazaki

Life science activities conducted by JAXA

“Kibo”
ISS Japanese Experiment Module

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



- Drug Discovery
- Regenerative Medicine
- Aging Research
- Food production

We are the sole private partner of JAXA's "Protein Crystal Growth Project".

ISS “Kibo”
Protein Crystal Growth

2021/Mar.

JAXA → SpaceBD

Private partner

We delivered protein samples to ISS

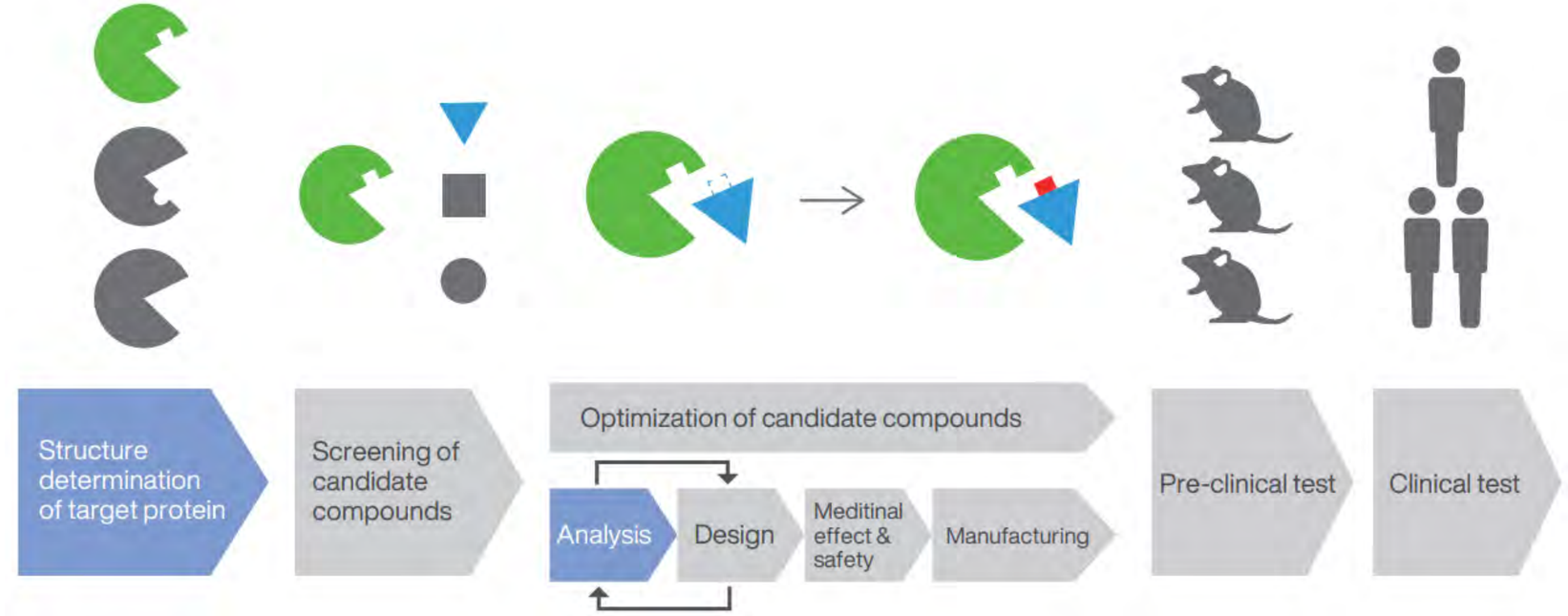
Launch : 10th November 10:28 @JST

Samples that we supported were launched with SpX-29.
(4th launch of our life science business)

Sample preparation
at the Kennedy Space Center.

Our contribution in drug discovery research

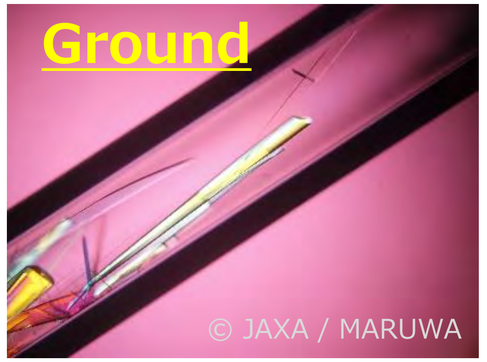
In drug discovery research, there is a method of looking at the shape of a “target” that causes a disease and creating a “drug” that matches that shape. Space experiments can provide detailed structural information about the "target".



(1) High-quality samples are important to obtain high-quality data.

(2) Under microgravity, higher quality crystals can be obtained than on the ground.

(3) More detailed structural information can be obtained by structural analysis of this.



Previous results of high-quality crystal in space

Determining the binding mode requires high resolution (1.5 Å or more), but there are many records of resolutions below 1.5 Å in space experiments.

***20+* years of operation & development**

More than *1,000* proteins launched to space

Users	Target protein	Resolution On the ground (Å)	Resolution In Space (Å)
Iwate Medical University	DPP11-N	3.50	1.49
Osaka Prefecture University	MAP2K7	2.10	1.30
Kagawa University	L-RhI	1.97	1.35
Kyoto University	ER-60	2.20	1.40
Kyoto Prefecture University	AM-1 peptidase	1.80	1.38
Kumamoto University	hMTH1	1.80	0.97
Tsukuba University	TcOYE-1	1.70	1.10
Tokyo University	PcCel6A	1.11	0.85
Tohoku University	PPL3B	1.80	1.20

Enzyme for growing multi-drug resistant bacteria and periodontal bacteria

Yasumitsu Sakamoto / Iwate medical University

4 Million compounds

① 

Various screening and computer docking simulations based on **the 3D structures obtained from 1st space experiment.**

13 drug candidates

② 

In vitro experiments

In 2nd space experiments, it was found to bind to the active site of the target.

Our delivery results

Academia public offering project：400 samples
Private project：31 samples

2021

National research center in Taiwan
Covid-19 research

Drug discovery research institute in Brazil
Covid-19 research

Agrichemical startup in Japan
Development of highly safe agrochemicals

2022

World’s first collaboration between AI drug discovery and commercial space experiment

Aiming to improve the accuracy of AI models using highly accurate structural data

2023

The challenge of developing a new diagnostic agent in collaboration with Sysmex (Japanese leading company)

sysmex

Education Program

High school students experience space experiments (SpX-26, 29)

Students experience the flow of actual drug discovery research. They filled the protein sample for space experiment by themselves. After launching the sample and crystallizing it in space, it was returned to the ground and analyzed.

① Exploring Crystallization condition

② Analysis On Ground

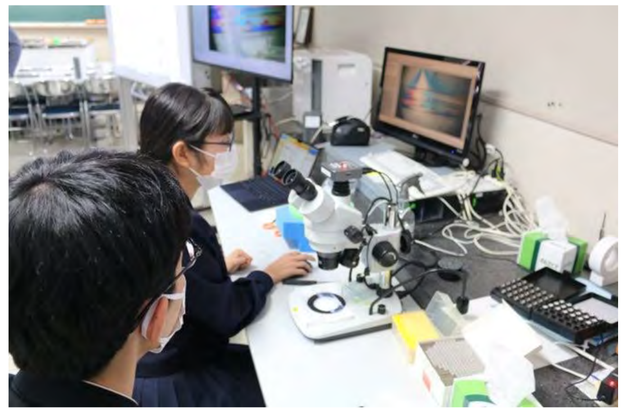
③ Sample filling For Space Expt.

④ Space Expt. (ISS)

⑤ Analysis of crystals

岩手県立花巻北高等学校
Iwate Prefectural Hanamaki Kita High School

Iwate Medical University

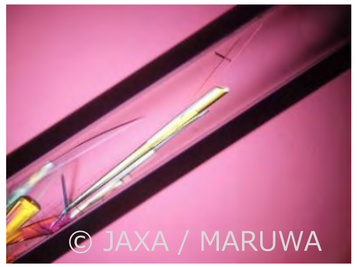


Space experiments / Life science

- Under microgravity, various phenomena different from those on the ground have been confirmed.
- In the life sciences, there are improvements in crystal quality/homogeneity, cell aggregation properties, increased growth factors, decreased muscle strength/bone density, and more.

Drug Discovery

Ground

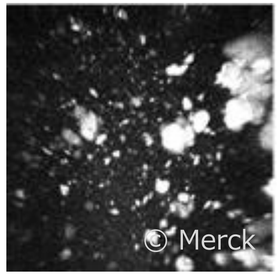


Space

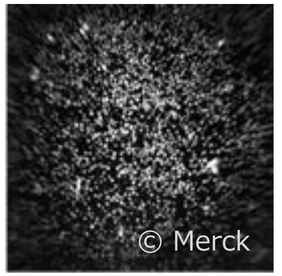
Structural analysis of proteins
Confirmation of interactions with drugs

Formulation

Ground



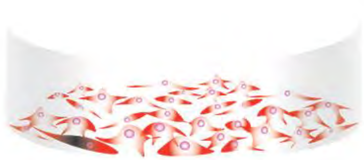
Space



Improved uniformity of drug crystals, Improved properties

Regenerative Medicine

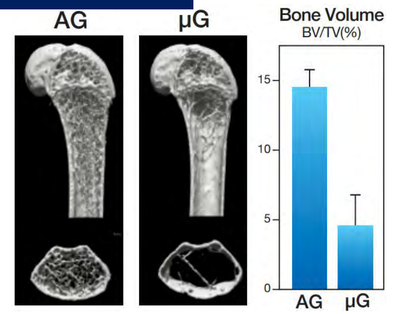
Ground



Space

3D cell culture, spheroid preparation

Aging research



*Reference

Biomarker for muscle/bone density reduction
Drug efficacy confirmation

*https://humans-in-space.jaxa.jp/kibouser/library/item/poster_en_MHU.pdf

Our support to utilize “Kibo”

We will take over the complicated rules of the space industry.

By standing between users and JAXA, we support smooth space utilization.

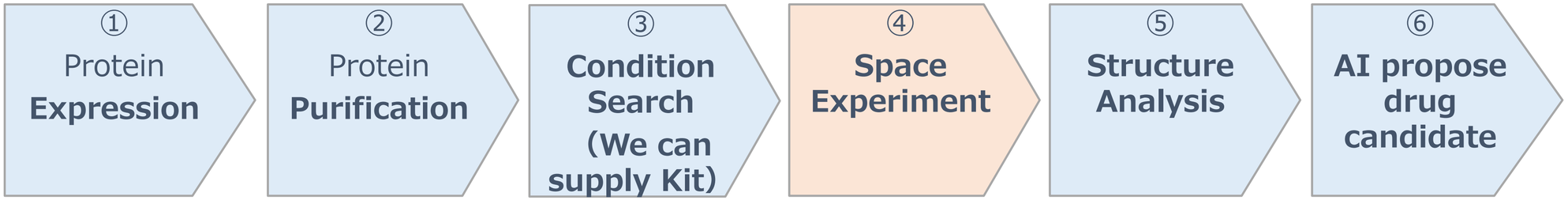
- Restrictions on usage limits and specifications
- ISS-specific contract rules
- High safety requirements (no harm to astronauts)
- Requirements such as impact resistance for products
- Restrictions on mission content
- etc ...

- Suggestion of optimal means of implementation based on user's wishes
- Design of space experiments and ground control experiments
- Support for space-specific procedures such as safety reviews

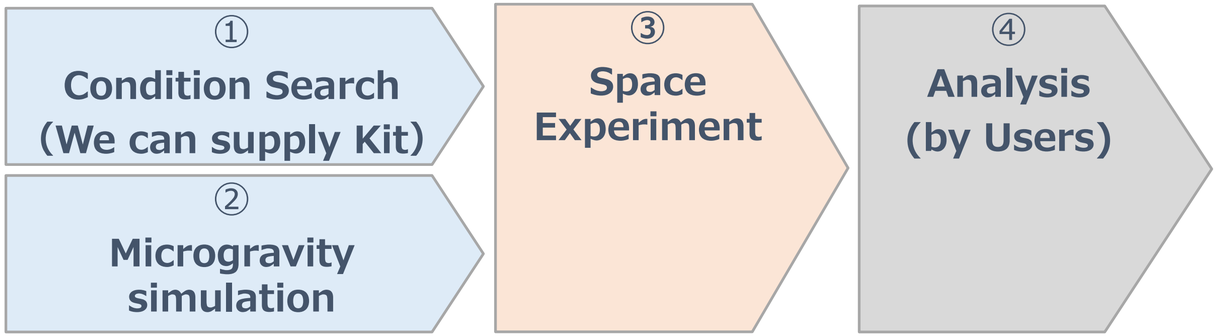
Our support to conduct lifescience experiment

- SpaceBD is capable of not only space experiments but also support on the ground.
- We have in-house life science researchers and external biotech partners.
- We offer ground experiments and space experiments separately, so you can start small.

Protein Crystal



Cell Culture



THANK YOU

Feel free to contact!

s.yamazaki@space-bd.com

Please stop by
our booth tomorrow

Utilization of the Electrostatic Levitation Furnace in the International Space Station (ISS-ELF)

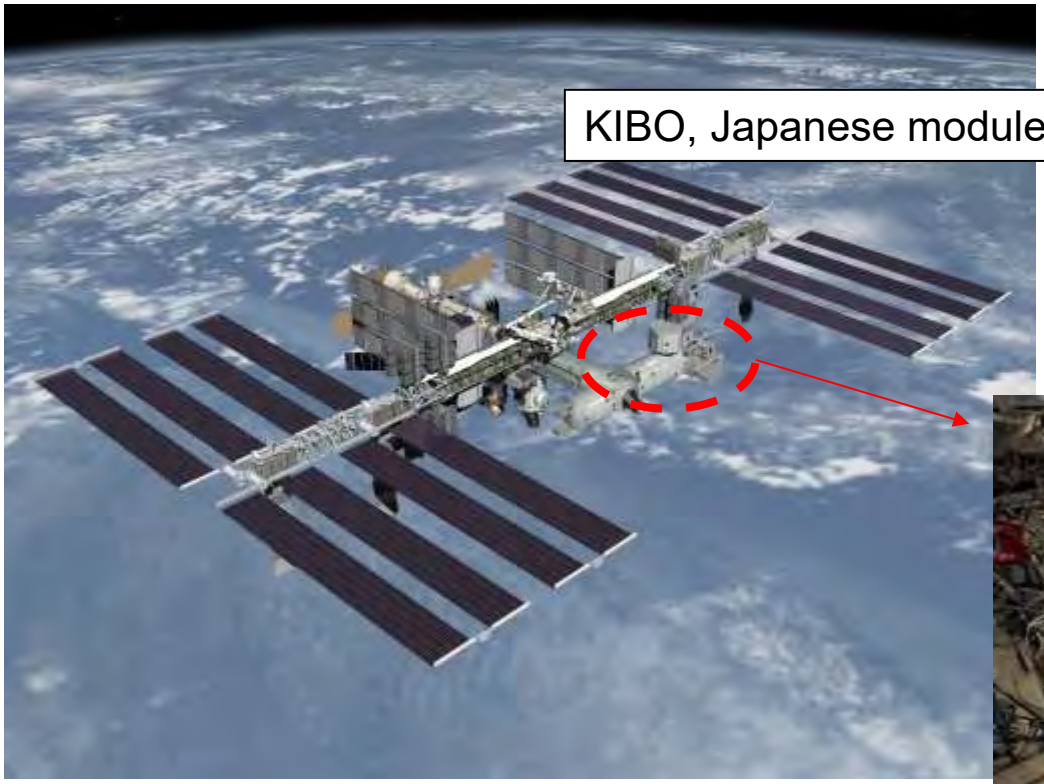
JAXA/ASA/ATSF Kibo Workshop
December 5, 2023
Australia

JAXA
JEM Utilization Center
Rina SHIMONISHI

What's the ELF?

The ELF (Electrostatic Levitation Furnace) is a device for material science.

While a sample is levitated and melted, thermophysical properties are measured by the ELF.

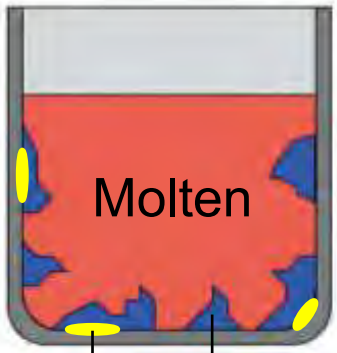


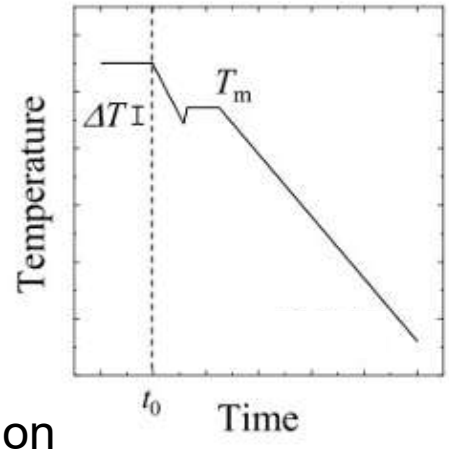
Astronaut installed the ELF into a rack in 2016.

What is purpose of levitation?

Earth

Need a container

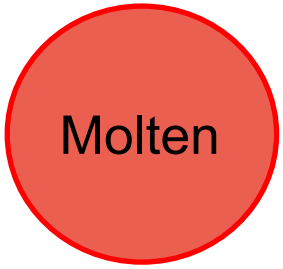


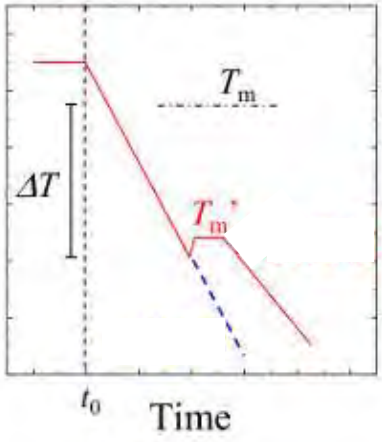


Molten sample reacts with the container and is contaminated.

Space

Container-less

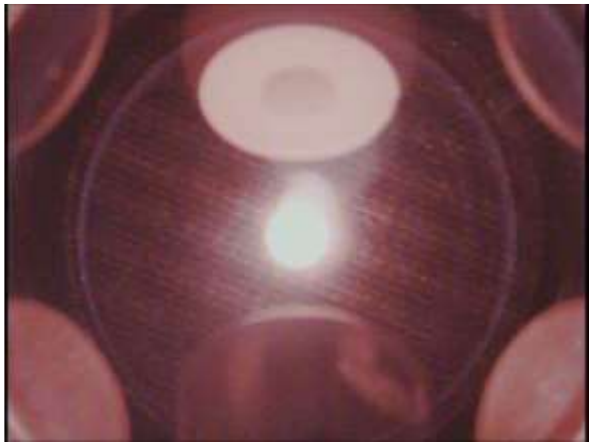




Measure thermophysical properties (above 2000 ºC) of pure sample.

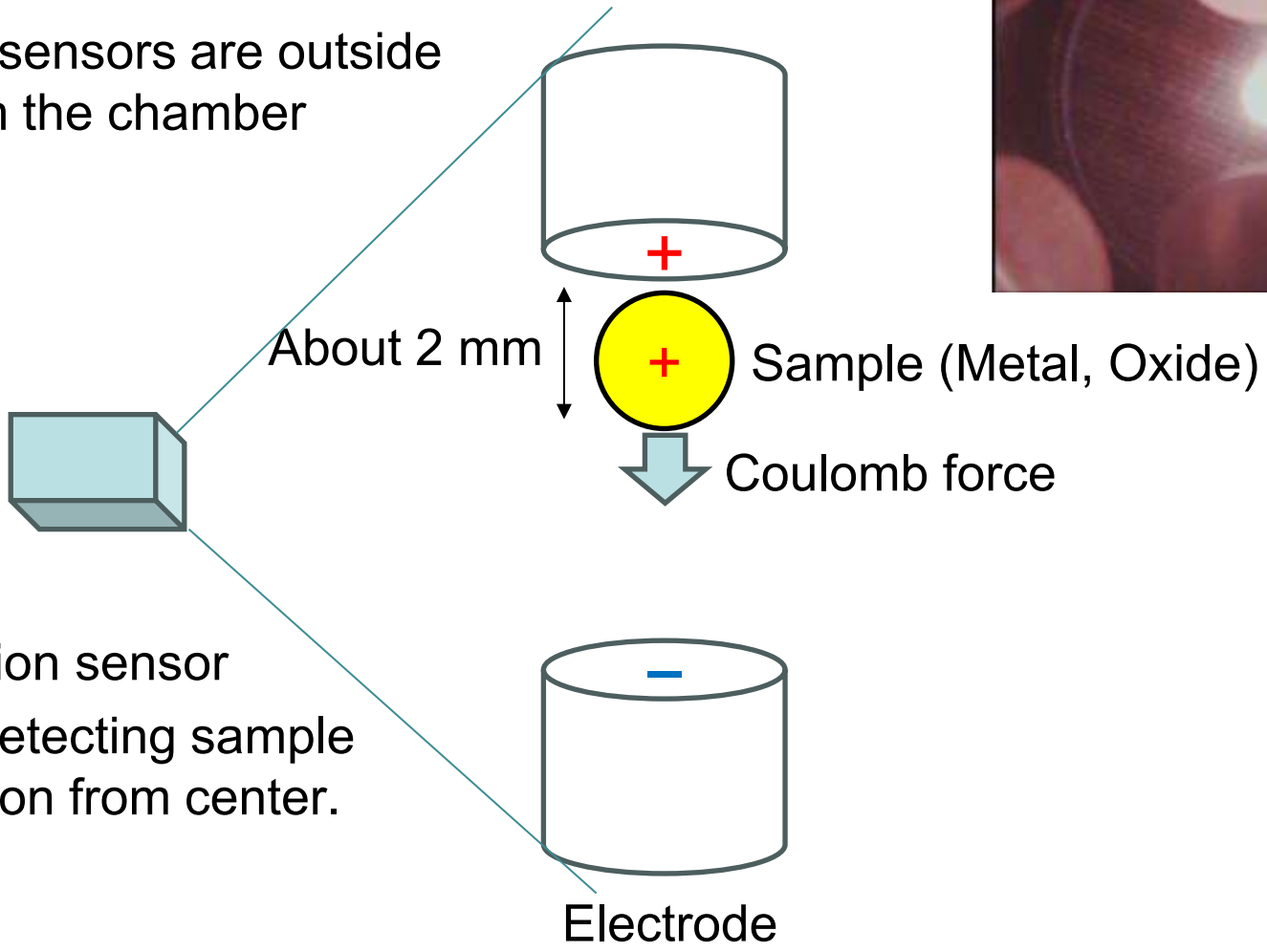
Produce unique glass because of supercooling.

How to levitate the sample



In ELF chamber

*All sensors are outside from the chamber

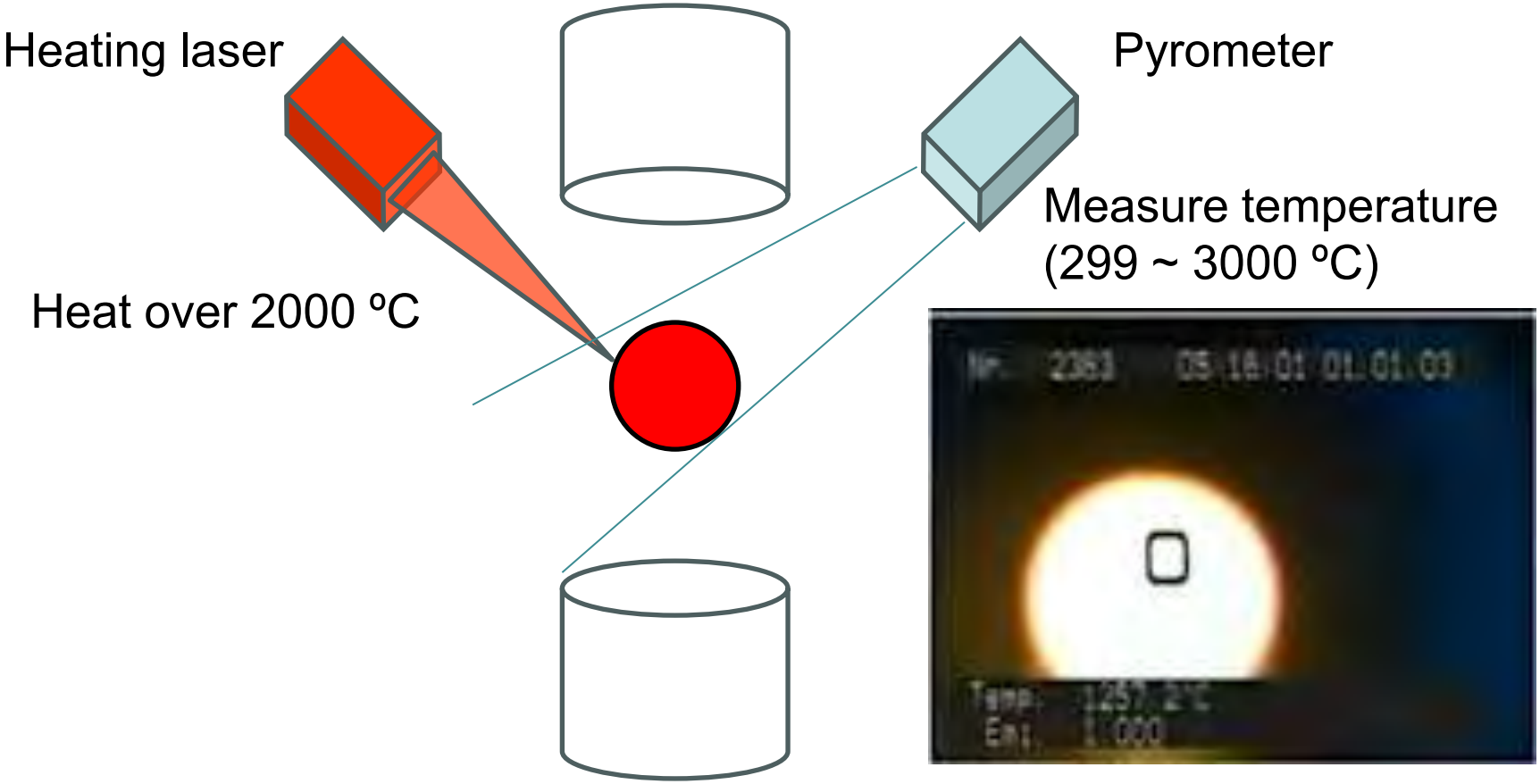


Position sensor

For detecting sample position from center.

How to heat the sample

In ELF chamber



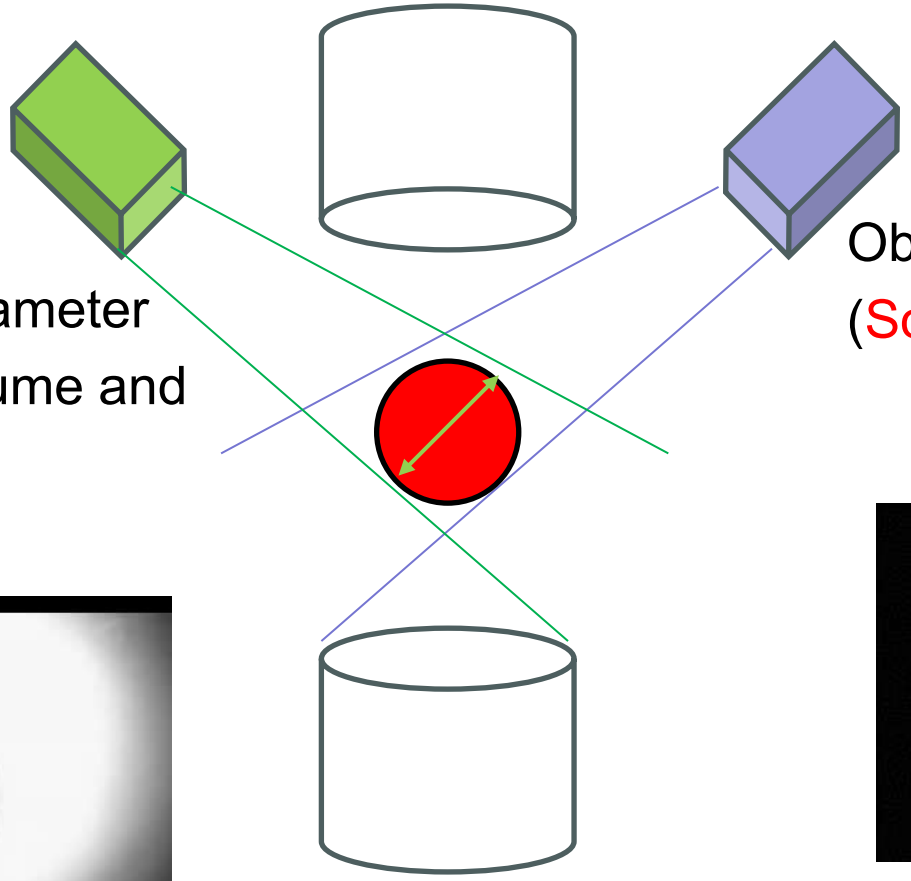
Courtesy of Prof. Kobatake, Principal Investigator of “Thermal storage” experiment.
https://humans-in-space.jaxa.jp/kibouser/pickout/73675.html

How to observe the sample

In ELF chamber

Camera

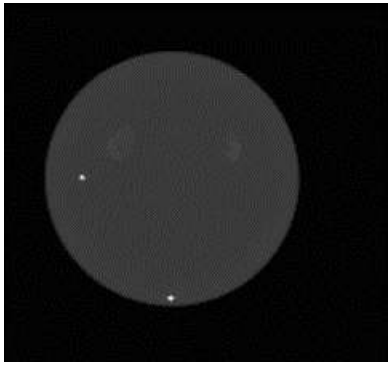
High-speed camera



- Measure a Diameter
- Calculate Volume and *Density*

Observe rapid phenomena

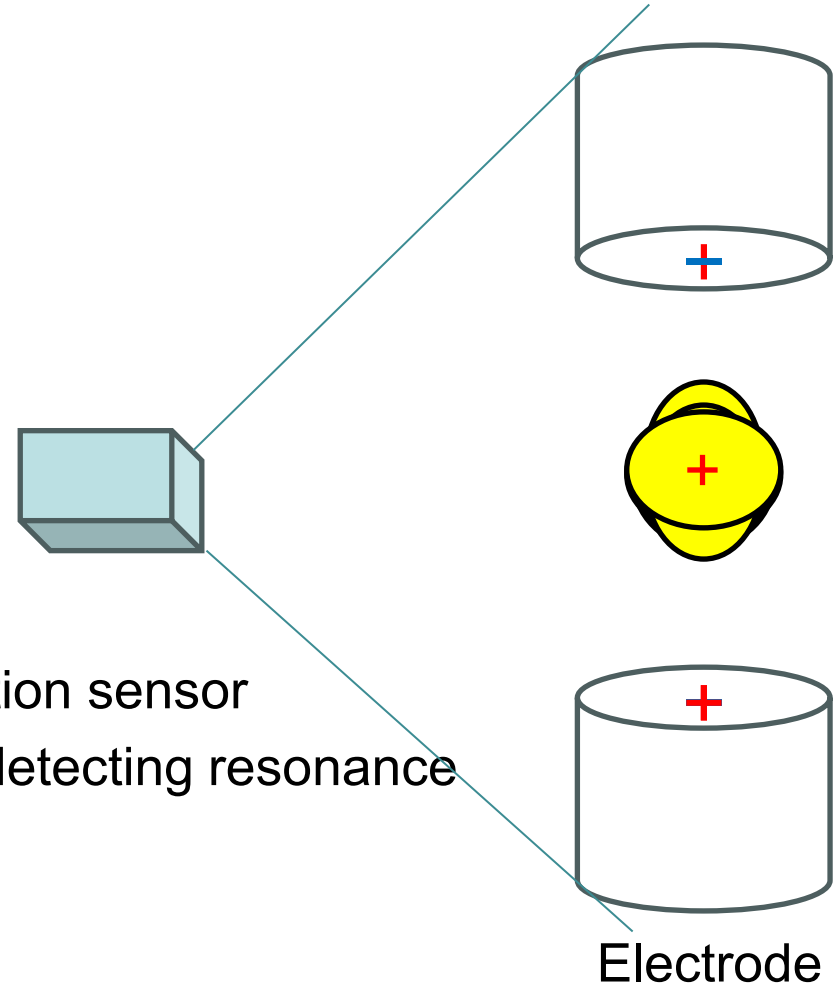
(Solidification process)



Courtesy of Prof. Suzuki, Principal Investigator of Hetero-3D experiment.
https://humans-in-space.jaxa.jp/kibouser/pickout/73599.html

How to oscillate the sample

In ELF chamber



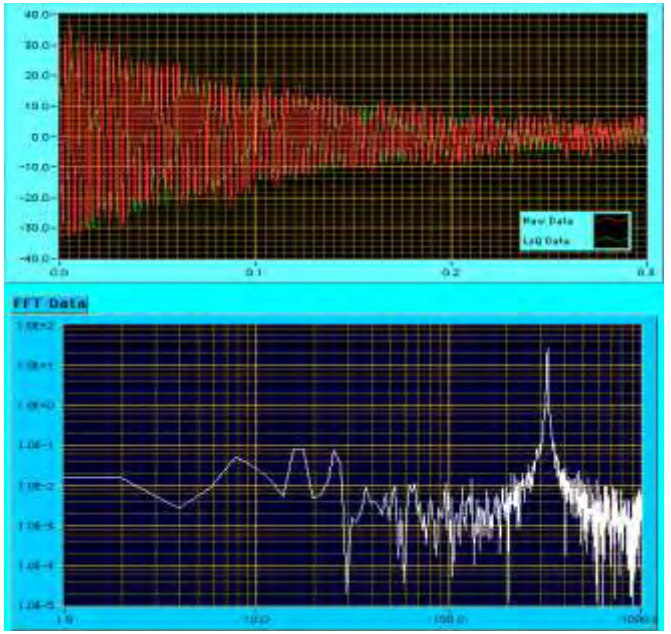
Position sensor

For detecting resonance

Electrode

Decay oscillation

→Measure *Viscosity*

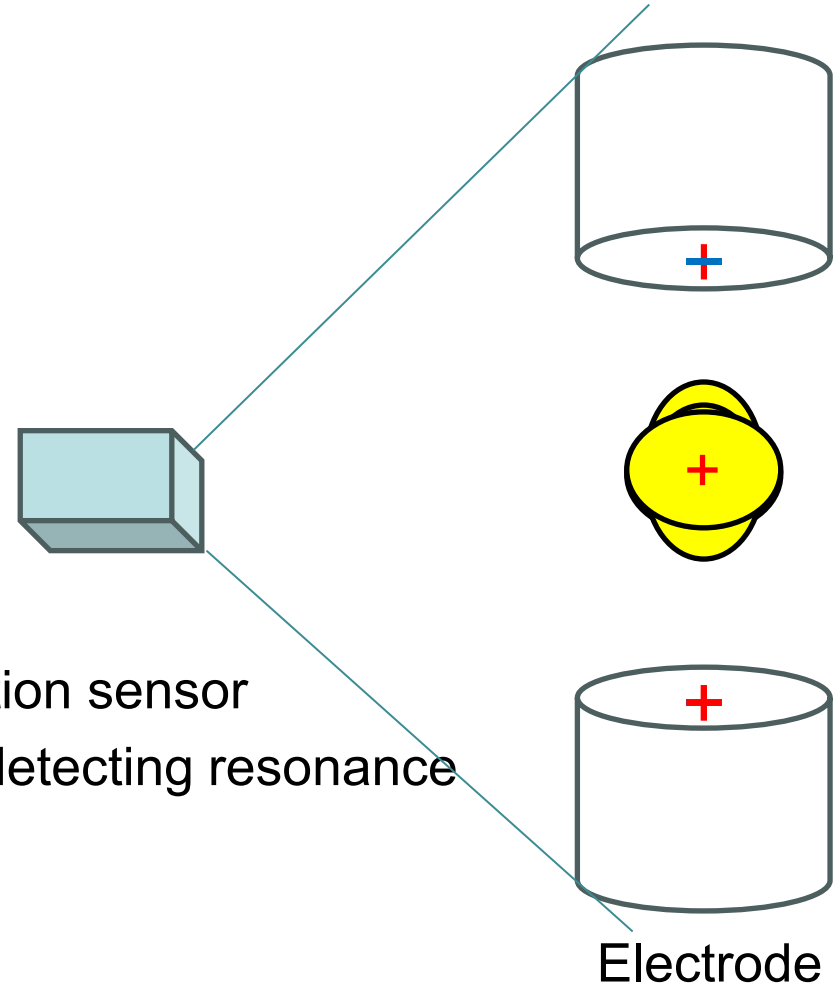


FFT data

→Measure Resonance frequency and *Surface tension*

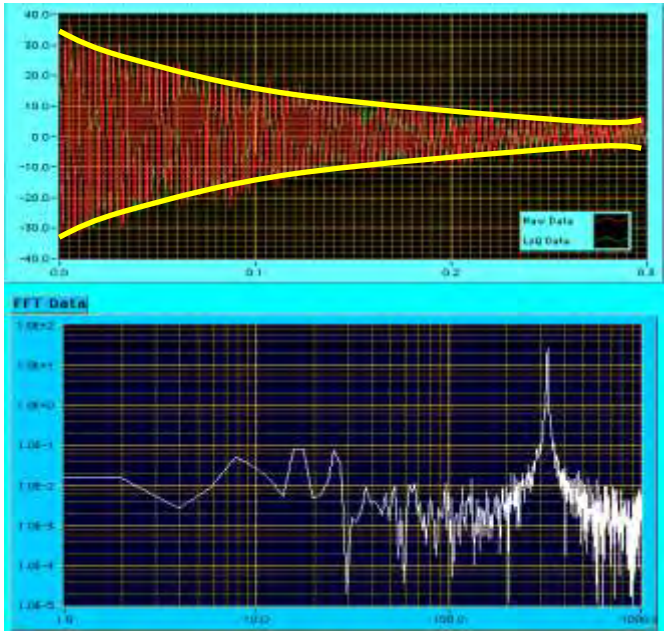
How to oscillate the sample

In ELF chamber



Decay oscillation

→Measure *Viscosity*

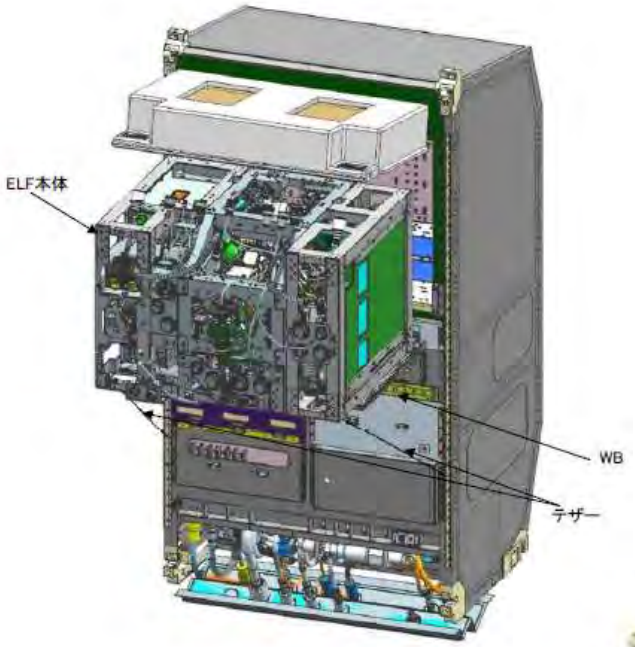


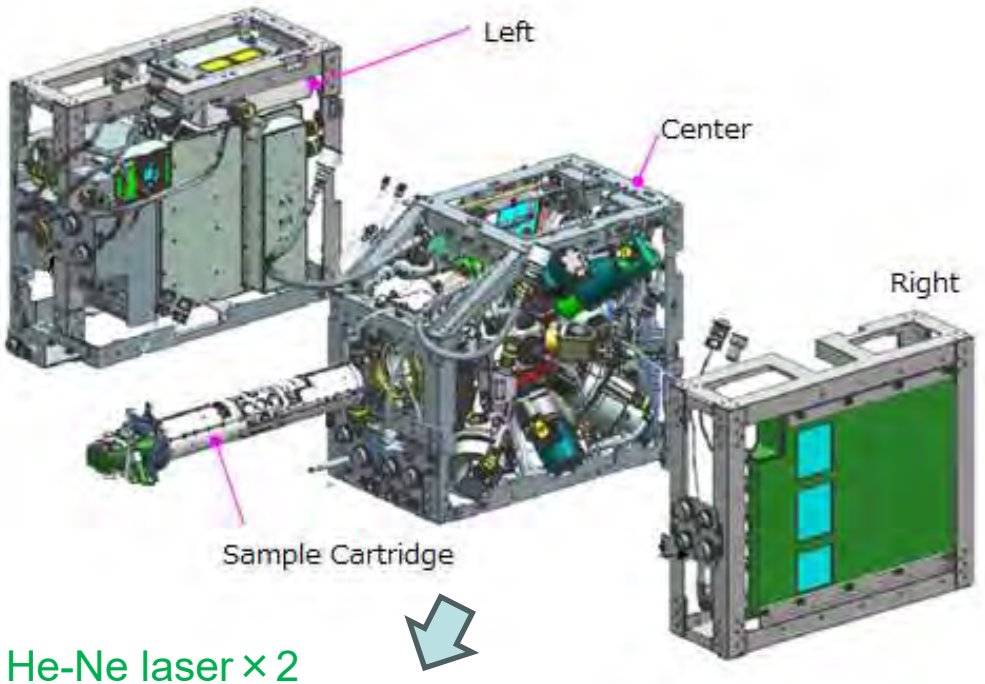
FFT data

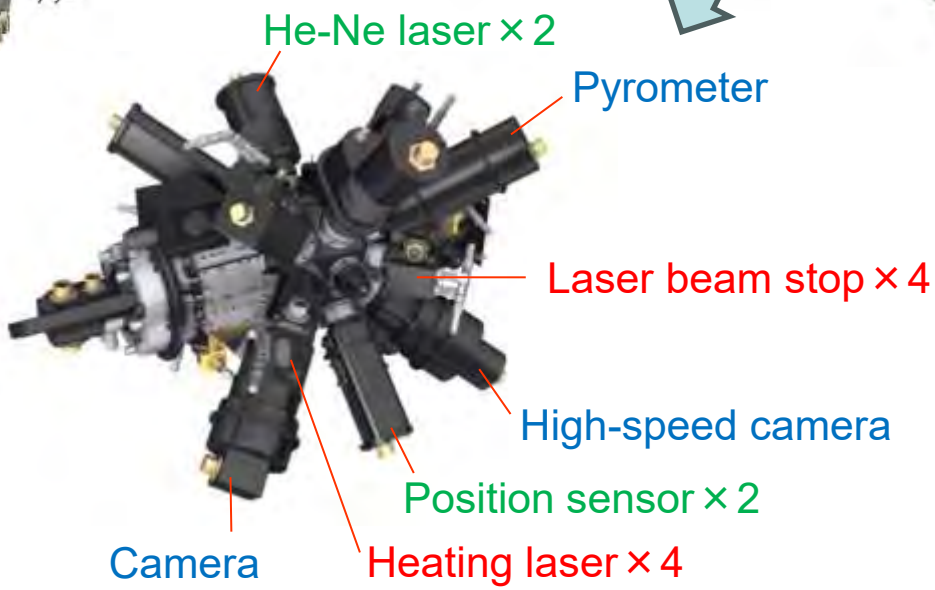
→Measure Resonance frequency and *Surface tension*

ELF component

Multi-purpose Small Payload Rack 2 in Kibo







Operation step for experiment

Space

ISS

Holder insertion by crew

Experiment

Holder retrieval by crew

Ground

Launch

Remote operations from Tsukuba, Japan

Return to the Earth

Size: 55 × 52 × 49 mm
Mass: 185 g

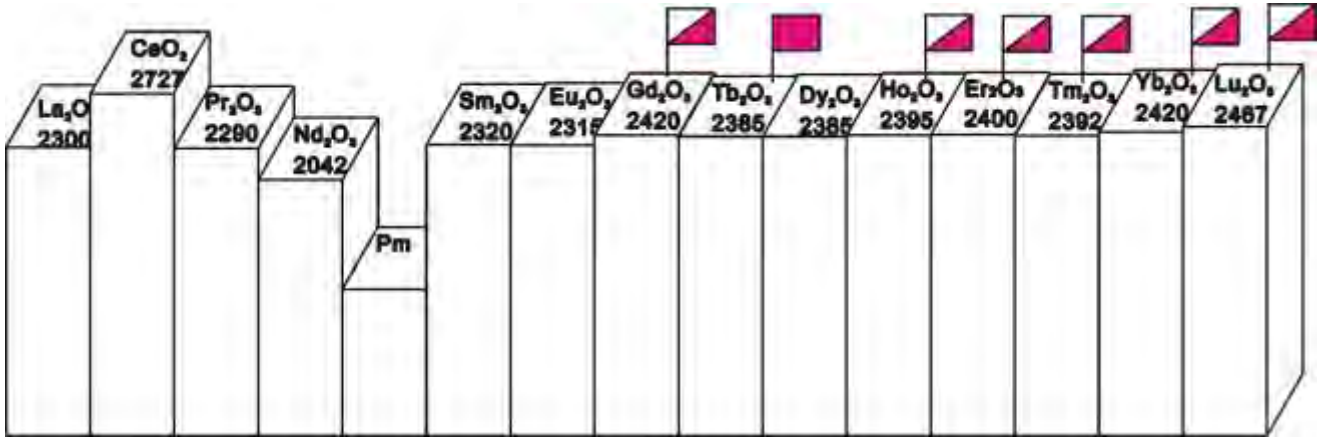
Load 20 samples into a holder

(Teams)

User at Tsukuba or online

Returned samples: weighted and sent back to User

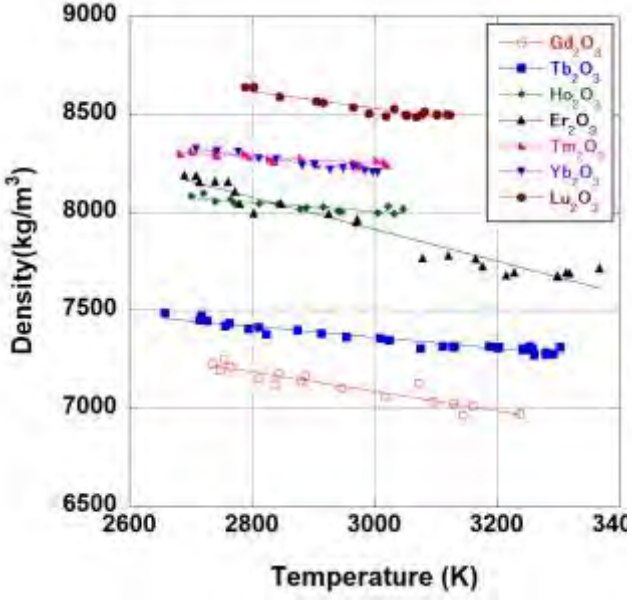
Measurement Data at High temperature

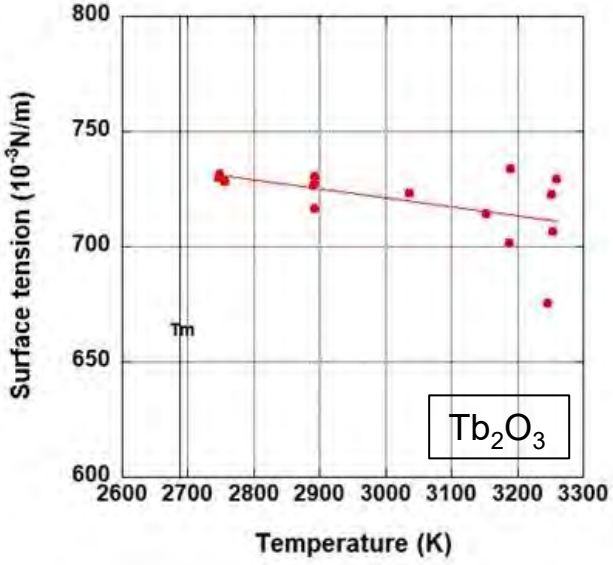


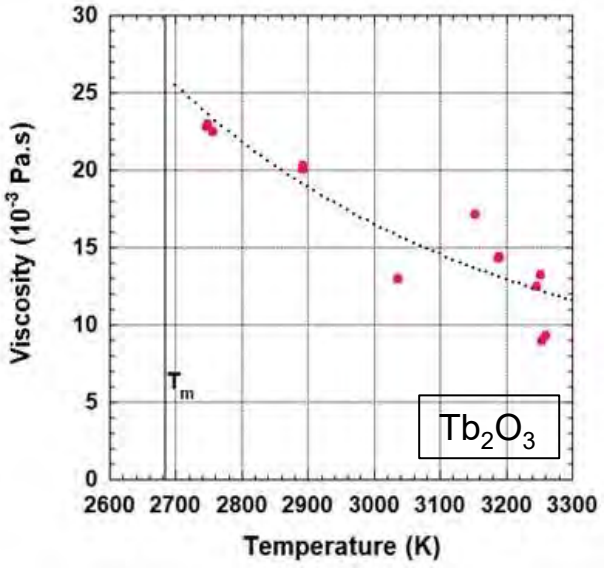
Density

Density, Surface tension, Viscosity

Measured thermophysical properties of lanthanoid sesquioxides over 2000 ºC.





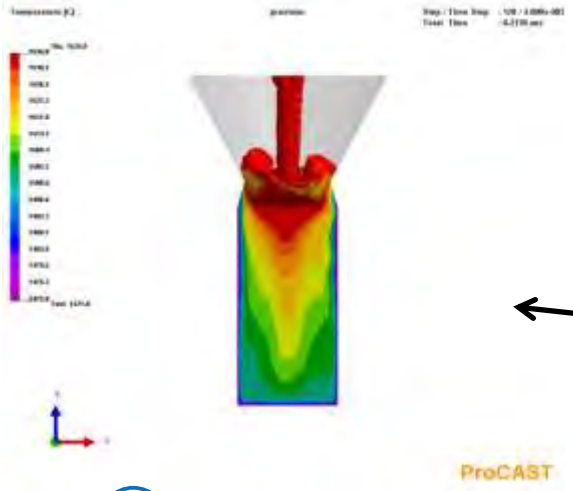


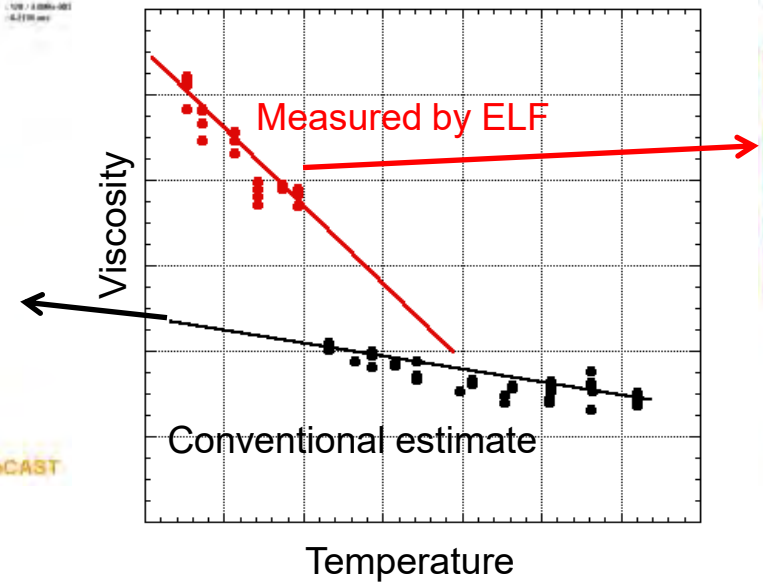
T. Ishikawa et al. *Metals*.**12** (2022), 1126.

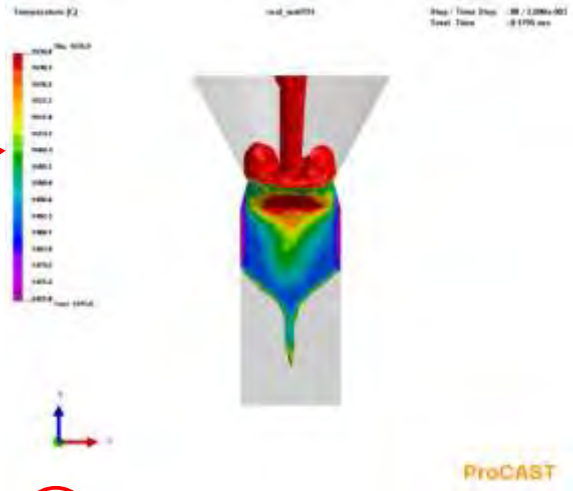
T. Ishikawa et al. *Int. J. Microgravity Sci. Appl.* **39** (2022), 390101.

Application for casting simulation

Coating material for turbine blades







☹ No shrinkage

☺ Shrink nest appears.
Flow changes greatly.

Data measured by ELF improved a casting simulation, which becomes similar to actual phenomenon.

⇒Found defects near shrink nest and contributed to countermeasures against the defects even before casting.

ELF utilization (1/5)

No.	Principal Investigator	Organization	Objective	Mission name	Status
1	Prof. Takehiko Ishikawa	JAXA	Technical demonstration of ELF onboard ISS and measurement of thermophysical properties of high temperature oxides	ELF Tech Demo	Space experiment ongoing
2	Prof. Masahito Watanabe	Gakushuin University	Interfacial phenomena and thermophysical properties of high-temperature liquids -Fundamental research of steel processing using electrostatic levitation-	Interfacial Energy	Space experiment ongoing
3	Dr. Shinji Kohara	National Institute for Materials Science	The origin of fragility in high-temperature oxide liquids - towards fabrication of novel non-equilibrium oxide materials	Fragility	Space experiment ongoing
4	Prof. Douglas Matson	Tufts University	Round Robin - Thermophysical Property Measurement	Round Robin	Space experiment completed

ELF utilization (2/5)

No.	Principal Investigator	Organization	Objective	Mission name	status
5	Dr. Richard Weber	MDI Inc.	Microgravity Investigation of Thermophysical Properties of Supercooled Molten Metal Oxides	Super glass 	Space experiment ongoing
6	Prof. Ranga Narayanan	Florida University	A Novel Way to Measure Interfacial Tension Using the Electrostatic Levitation Furnace	RIIST 	Space experiment ongoing
7	Dr. Hidemasa Yamano	Japan Atomic Energy Agency	Thermophysical property of eutecti c melting material of control rods f or severe accident analyses in fast reactors	B4C-SS eutectic 	Space experiment completed
8	Prof. Koichi Mori	Osaka Prefecture University	Research for debris removal technology by laser	Laser debris removal 	Space experiment completed

ELF utilization (3/5)

No.	Principal Investigator	Organization	Objective	Mission name	status
9	Prof. Hidekazu Kobatake	Doshisha University	Design of Thermal storage material from the aspect of nucleation and their thermophysical properties	Thermal Storage 	Space experiment completed
10	Prof. Tadahiko Masaki	Shibaura Institute of Technology	Study of liquid-liquid phase separation of undercooled liquid metals and forming process of multi shell sphere	Multi shell sphere 	Space experiment completed
11	Prof. Yoshio Kono	Ehime University	Measurement of Temperature Dependence of Viscosity and Density of Depolymerized Silicate Melts	Silicate melt 	Space experiment completed
12	Prof. Shinsuke Suzuki	Waseda University	Elucidation of solidification behavior of powder metals with heterogeneous nucleation site particles for 3D printer	Hetero-3D 	Space experiment completed

ELF utilization (4/5)

No.	Principal Investigator	Organization	Objective	Mission name	status
10	Prof. Masuno Atsunobu	Kyoto University	Investigation into the origin of functionalities emerged in functional densely packed oxide glasses by thermophysical properties measurements o n the melts	Unconventional Glass	In preparation
11	Prof. Nakamura Tomoki	Tohoku University	Reproduction experiment of chondrules formed at high temperature in the protoplanetary disk	Space Egg	In preparation
12	Prof. Ayahisa Okawa	Tohoku University	Measurement of Thermophysical Properties and Phase Transition Behavior of Rare-earth Silicates for Optimization of Thermal Spraying and Heat Treatment of Environmental Barrier Coating	Phase transition	In preparation

ELF utilization (5/5)

No.	Principal Investigator	Organization	Objective	Mission name	status
13	Dr. Ömür Can odabaş	TÜBİTAK MAM	Innovative Research on Novel Space Alloys	UYNA	In preparation Launch by Ax-3 (January 2024)
14~16	Undisclosed	Companies	Undisclosed	Undisclosed	Space experiment completed

Summary

- JAXA has developed the Electrostatic Levitation Furnace (ELF) and installed in the ISS-KIBO.
- The ELF enables to measure density, surface tension, and viscosity of high melting temperature materials over 2000 ºC.
- The measurement data has been utilized to improve the simulation for manufacturing.
- The ELF is utilized by many researchers and companies in Japan, US, and Turkey. The total experiments are 16.
  JAXA welcomes new ELF users ! Please contact us.
  E-mail: kibo-utilization-asia@ml.jaxa.jp

Acknowledgement

- ELF members, JAXA
- IHI aerospace Co. Ltd.
- ISS crew members
- Staffs for ground operations at Tsukuba Space Center
- Many ELF users (Universities and Companies in Japan, US, Turkey)

JMU-23Y073

Kibo Utilization Workshop
in Australia

JAMSS Experiences on Kibo Commercial Utilization

Dec 5, 2023

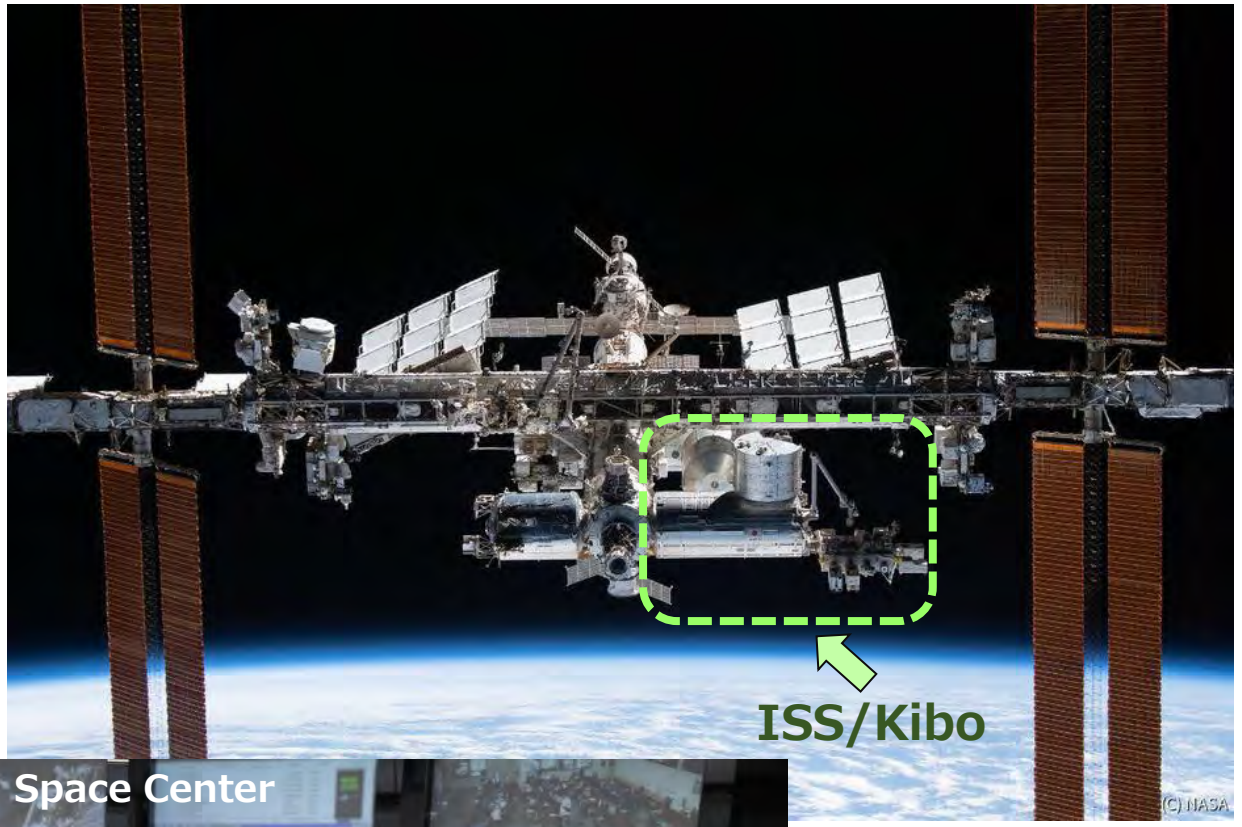
JAMSS
Kuniko OKADA

Company Overview

Name	JApan Manned Space Systems Corporation (JAMSS)
Established	May 14th, 1990
Capital	445 million yen
Sales	4.8 billion yen (in fiscal 2021)
Personnel	248 (as of Apr. 1,2023)
Business Activity	1. Operation and utilization support of JEM (Japanese Experiment Module "Kibo") at ISS 2. Education and Training 3. Safety and Product Assurance. 4. Independent verification of system safety (Software evaluation) 5. Utilization of satellites (such as earth observation, communication, and navigation satellites) 6. Promotion of space commercial utilization.

Company Overview

JAMSS has been supporting Japanese crewed space activities in the areas like:
- ISS/Kibo Ops & utilization
- Training
- Technical support
- Health management, and
- Safety & Mission assurance



Kibo Mission Control Room at Tsukuba Space Center

https://www.jamss.co.jp/mission/kibou/

Experiences on Kibo Commercial Utilization

Tosa Space Sake

JAMSS has been supporting the commercial utilization since before Kibo was launched in 2008.

JAMSS has supported the 1st Kibo commercial utilization “Lotte Xylitol Mission” in 2008.

Lotte Xylitol Mission

From JAMSS brochure

Experiences on Kibo Commercial Utilization

Service flow

From JAMSS brochure

- JAMSS have been supporting over 40 commercial utilization missions mainly for Kibo Commercial Utilization.
- JAMSS can support the customer's entire project, from project planning to hardware development (if required), transport, preparation of safety review, and operation requirement development.

Experiences on Kibo Commercial Utilization

Japan Manned Space Systems Corporation JAMSS

KIBO Studio (2020-)

Astronaut Noguchi in the Experiment Module "Kibo" holds face-to-face conversation with the cast on the ground (Los Angeles).

The rise of the sun on the New Year's day on Earth was filmed using NASA's ISS camera on external facility and was broadcasted live to the world from KIBO Studio.

JAMSS has been continuously supporting Bascule Inc. for "Kibo Studio" since 2020.

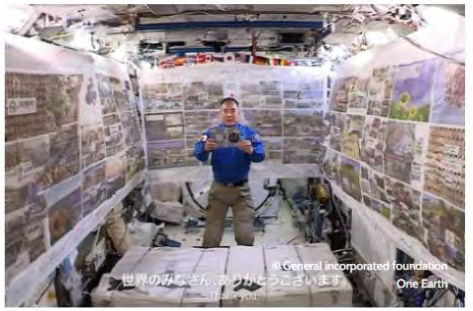
www.jamss.co.jp/en/space_utilization/join/

humans-in-space.jaxa.jp/kibouser/provide/more/73332.html

JAMSS has supported "Tohoku Reconstruction Space Mission 2021". (A social project to pray for the recovery of the tsunami-affected areas following the Great East Japan Earthquake including launch/return of memorial items, astronaut's message video recording on orbit)

www.jamss.co.jp/en/space_utilization/join/

Tohoku Reconstruction Mission 2021



Astronaut Noguchi in the Experiment Module "Kibo".

The Banner return ceremony (Otsuchi, Iwate)

JAMSS has provided some customized hardware items for several missions, in addition to the technical support.

Efforts toward Total Service Provider

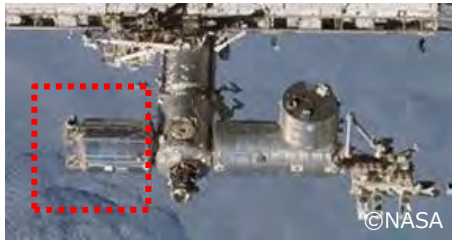
Kirara Service

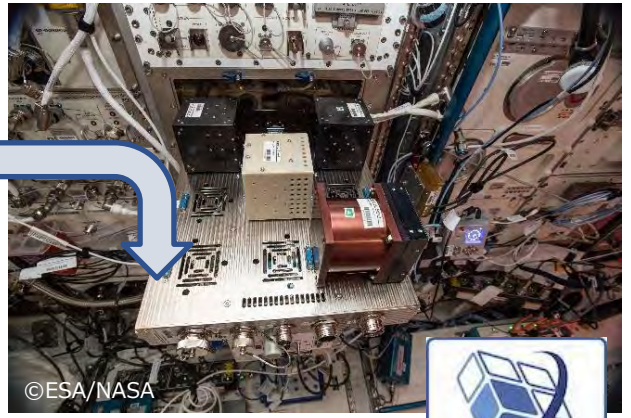
- Commercial business of protein crystallization to support drug discovery.
- All intellectual properties obtained from the results belong to clients.
- Our service is not only for Japanese but also for Asian, European and U.S. users.

We can feed back our Kirara's experience on our services for Kibo Commercial Utilization.

Kirara
Space-made Protein Crystal

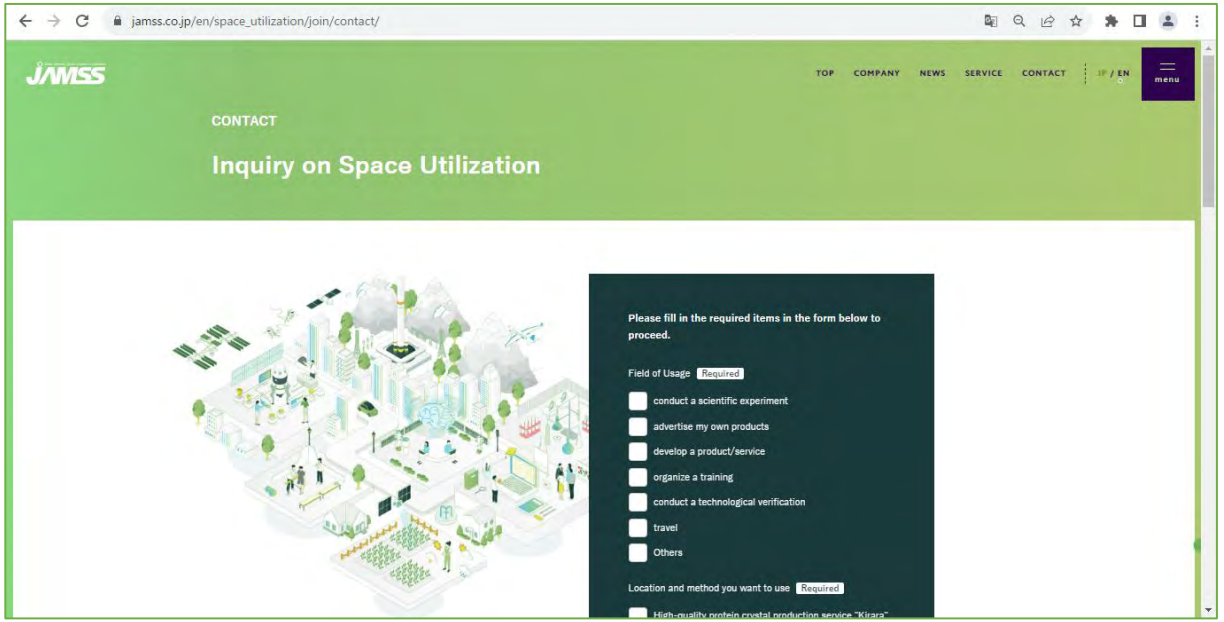
https://www.jamss.co.jp/en/kirara/





ICECUBES

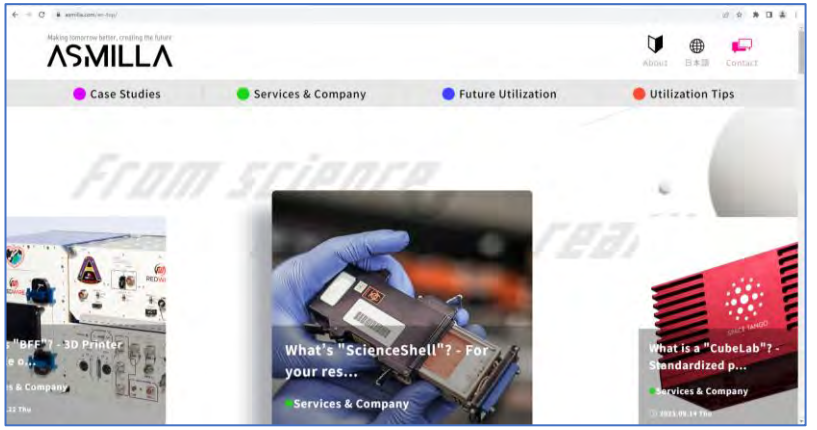
Contact



https://www.jamss.co.jp/en/space_utilization/join/contact/

Making tomorrow better, creating the future

ASMILLA




世界初を、兼松発に。
Shape the world, with Kanematsu.

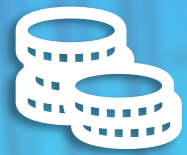
Kanematsu At A Glance

Est.
1889

Employee
7,296

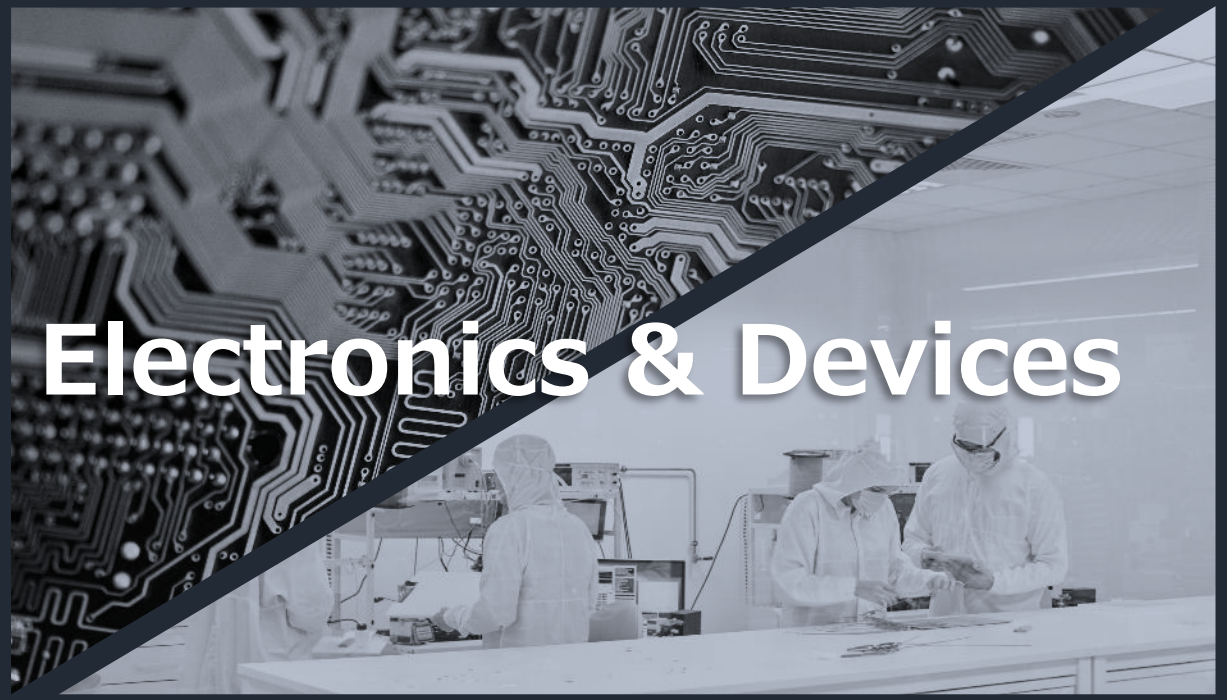
Group Companies
126

Overseas Offices
36 countries



Pre-tax Profit
$258M

Trading in various kinds of commercial products, production of traded goods, investment in businesses, provision of related services.


Electronics & Devices


Steel, Materials &
Plant


Aerospace
&
Motor Vehicles


Food, Meet & Grain

Kanematsu Space Business

From GEO satellites to Hi-Rel EEE semiconductors

Maintenance & development downrange systems for JAXA's H-IIA/B, H3 and Epsilon rockets.

Expanding LEO utilization working with Sierra Space

Strategic Investment in Sierra Space to Accelerate LEO Utilization

Strategic Agreement between Sierra Space Corporation, MUFG Bank, Kanematsu and Tokio Marine & Nichido Fire Insurance

SEPTEMBER 26, 2023 | NEWS

Sierra Space Increases Total Investment to a Record $1.7 Billion with $290M Series B Funding, Bringing Valuation to $5.3 Billion

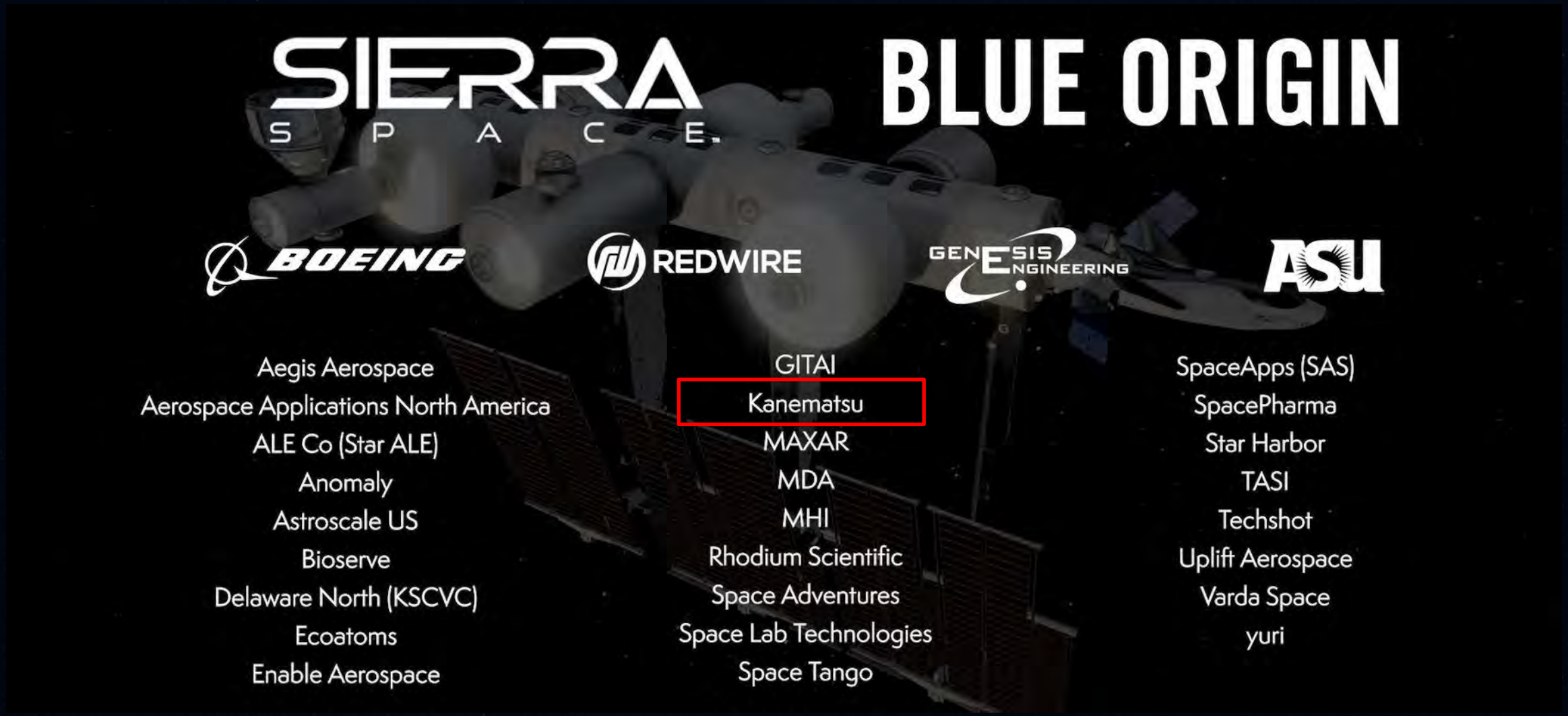
SEPTEMBER 26, 2023 | NEWS

SIERRA SPACE
DREAMS WORTH CHASING™

VISION

1. LEO becomes a new eco-system.
2. Creating a new eco-system in APAC by launching DC100/DC200 from Japan, conducting experiment and business in the space station, and coming back to APAC.

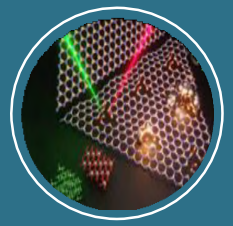
Expanding Team of Global Collaborators



Confidential

In-Space Commercial Market Segments

In-Space Bio Manufacturing



In-Space Manufacturing and Advanced Materials

Spaceflight Experiences

Entertainment Multi-Media Advertising

In-Space Services and Logistics

Market Segments Span All Kanemtasu Business Sectors

Orbital Age is coming. Kanematsu would like to investigate the joint LEO utilization projects together with Australian partners!