INTERNATIONAL CONTRIBUTION THROUGH THE UTILIZATION OF JAPANESE EXPERIMENTAL MODULE ON ISS

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ISS (International Space Station)

- ISS is a huge manned construction located about 400km above the Earth.
- 15 countries participate in the ISS program
- Japan strives to make concrete international contributions through extensive utilization of Kibo and HTV.
“Kibo” is Unique! – Exposed Facility

Small Satellite Deployment platform using J-SSOD

“Kibo” (JEM) Exposed Facility

Airlock

Robotic Arm
(JEM-Remote Manipulator System)

J-SSOD (JEM Small Satellite Orbital Deployer)
Unique system to deploy the satellite and inject the orbit from Kibo by using One and Only function on the ISS

Credit: JAXA
## Specification for J-SSOD platform

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite Size</td>
<td>CubeSat: 1U, 2U, 3U or 6U (*1) 50 kg class satellite: 55×35×55 cm</td>
</tr>
<tr>
<td>Satellite mass</td>
<td>CubeSat: 1.33 kg or less per 1U 50 kg class satellite: 50 kg or less</td>
</tr>
<tr>
<td>Orbital altitude</td>
<td>approximately 380 - 420 km (*2)</td>
</tr>
<tr>
<td>Inclination</td>
<td>51.6°</td>
</tr>
<tr>
<td>Deployment direction</td>
<td>Nadir-aft 45° from the ISS nadir side</td>
</tr>
<tr>
<td>Deployment velocity</td>
<td>CubeSat: 1.1 - 1.7 m/sec 50 kg Microsat: 0.4 m/sec</td>
</tr>
<tr>
<td>Ballistic coefficient</td>
<td>100kg/m² or less (*3)</td>
</tr>
</tbody>
</table>

*1) CubeSat specification:
   - For 1U, 2U and 3U: 10cm(W) × 10cm(D) Height: 1U: 10cm, 2U: 20cm, 3U: 30cm
   - For 6U: 10cm(W) × 20cm(D) × 30cm(H)

*2) Depends on ISS altitude.

*3) Depends on ballistic coefficient, altitude at release, solar activity, etc.

**Lower vibration environment** are provided since Small Satellites are stowed in a soft bag and carried to the ISS together with other cargo.
MicroSat (20～100kg)  NanoSat (1kg～20kg)  PicoSat (less than 1kg)

Extremely Low-cost
(more than 200 M$ → less than 5 M$)
- New players are welcome to join (enterprises, local governments, developing countries etc.)
- Great opportunity for education tools and challenging missions

Short Turn Around Life Cycle
(more than 5 years → less than 1-2 years)
- College students can experience whole development cycle
- Curriculum can be standardized as sustainable program
- Quick return on your business investments, technology demonstration

Cost-Effective Method for Various Missions
- Practical remote sensing data can be obtained from small satellites

Ref: Prof. Nakasuka, Tokyo Univ. (2017.6.12) (modified by JAXA)

Snapshot of Banana farm, Mindanao, the Philippines
(provided by PHL-MICROSAT, DIWATA-1)
At present, satellite deployers other than J-SSOD that use Kibo include the NanoRacks CubeSat Deployer (NRCSD) and Cyclops (Space Station Integrated Kinetic Launcher for Orbital Payload Systems).

## Nanosatellites by launch years

<table>
<thead>
<tr>
<th>Year</th>
<th>Launched Satellites</th>
<th>Deployed from Kibo</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>2013</td>
<td>88</td>
<td>4</td>
</tr>
<tr>
<td>2014</td>
<td>141</td>
<td>46</td>
</tr>
<tr>
<td>2015</td>
<td>129</td>
<td>49</td>
</tr>
<tr>
<td>2016</td>
<td>88</td>
<td>44</td>
</tr>
<tr>
<td>2017</td>
<td>295</td>
<td>57</td>
</tr>
</tbody>
</table>
Small Satellite Deployment from Kibo

As of Today, more than **200** satellites have been successfully deployed from Kibo. JAXA operates the innovative launch opportunity by using one and only function on Kibo/ISS

From JAXA Tsukuba Space Center (TKSC) in JAPAN

Credit: JAXA/NASA

Flight Control Team and Engineering Team
Launch Opportunities for Small Satellite from Kibo/ISS
UNOOSA-JAXA Cooperation “KiboCUBE”

Collaboration between UNOOSA and JAXA to offer small satellite deployment opportunities from Kibo in order to facilitate improved space technologies in developing countries.

◆ UNOOSA and JAXA have selected a team from the University of Nairobi to be the first to benefit from the KiboCUBE programme.

◆ As for 2nd round opportunity, we have selected a team from the Universidad del Valle de Guatemala to be the second to benefit from the KiboCUBE programme.

◆ As for 3rd round opportunity, we have selected a team from the Mauritius Research Council and Surya University to be the third and fourth to benefit from the KiboCUBE programme.

◆ The 4th Round….coming Soon!! Duedate is January 31, 2019

Credit: JAXA
Launch Opportunities for Small Satellite from Kibo/ISS
UNOOSA-JAXA Cooperation “KiboCUBE”

**Entity located in developing country**
- Design, develop, operate the CubeSat
- Submit necessary documents for safety and interface review by JAXA
- Hand over the CubeSat to JAXA e.t.c...

**UNOOSA**
- issue the AO and compile all applications received.
- Establish a selection board with JAXA
- Notify the entity that it has been selected e.t.c...

**JAXA**
- Provide technical interface/safety requirement
- Technical interface/safety review
- Launch the CubeSat to the ISS/Kibo
- Deploy the CubeSat from ISS/Kibo e.t.c...
Launch Opportunities for Small Satellite from Kibo/ISS
UNOOSA-JAXA Cooperation “KiboCUBE”

May 11th, 2018

1KUNS-PF
Launch and Deploy: 2018

Investigator:
University of Nairobi (Kenya)

Size: 1U

Credit: University of Nairobi/IKUNS-PF Team
Credit: JAXA/NASA
Credit: JAXA
Partner to promote J-SSOD programme

<table>
<thead>
<tr>
<th>Partner</th>
<th>Target</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNITED NATIONS Office for Outer Space Affairs (KiboCUBE)</td>
<td>Educational or research institutions from developing countries of United Nations member states</td>
<td>Provide developing countries with the opportunity to deploy CubeSat</td>
</tr>
<tr>
<td>Kyushu Institute of Technology (Strategic Partner)</td>
<td>Especially University’s Students for developing country</td>
<td>Capacity building through developing the CubeSat called BIRDS project and other projects</td>
</tr>
<tr>
<td>Hokkaido and Tohoku University (Strategic Partner)</td>
<td>Especially University’s Students for Asian region</td>
<td>Capacity building through developing the Microsat (50kg)</td>
</tr>
<tr>
<td>Tokyo University (Strategic Partner)</td>
<td>Especially Africa region and developing country</td>
<td>Utilization of Small Satellite technology to contribute to social problems such as water quality management</td>
</tr>
</tbody>
</table>

On February 23, 2018, JAXA made an announcement to the private sector that it would compare proposals and select service providers capable of providing small satellite deployment services from Kibo. And after carefully evaluating the proposals, JAXA has selected Space BD Inc. and MITSUI & CO., LTD. as the service providers.

Other international cooperation

With countries in the Asia-Pacific region

- Promote Kibo utilization in the Asia-Pacific region in order to build and share outcomes.
- The fee-based service of space environment utilization is available. 
  *e.g. J-SSOD, ExHAM, i-SEEP, Protein crystal growth, Electrostatic levitation furnace, etc*

- **Singapore** made a cooperation agreement with JAXA in 2017. 
  The SpooQy-1 cubesat project using J-SSOD (SSTA/NUS)

- **Malaysia** made a cooperation agreement with JAXA in 2018. 
  The SOFPADS dosimetry experiment using ExHAM/PADLES (ANGKASA/UPM)

- **Indonesia and Thailand** have conducted a feasibility study with JAXA respectively.

Preparation of Singaporean CubeSat ©National University of Singapore

Handover of the samples from UPM to JAXA at JAXA on Nov.2 2018
JAXA developed the unique Exposed Experiment Handrail Attachment Mechanism (ExHAM) system to expose samples in space.
Material exposure experiment platform using ExHAM

Samples can be loaded on the Exposed Experiment Handrail Attachment Mechanism (ExHAM), subjected to long-term exposure to space, and then returned to Earth for evaluation of the technology demonstration in space and to capture samples of cosmic dust, etc.

ExHAM provides easier and more frequent opportunities for small-sized experiments.

ExHAM has the area for 20 units of Type 1.
Material exposure experiment platform using ExHAM

Scenario for ExHAM mission

1) Launch
   - Mission Samples
   - H-IIB
   - HTV*
   *Dragon and Cygnus are also available.

2) Installation on ExHAM
   - Airlock
   - Airlock Table

3) Installation on handrail by JEMRMS

4) Exposure experiment (Nominal: 1 year)

5) Retrieval into Kibo pressurized section

6) Return to the ground

7) Analysis

*Dragon and Cygnus are also available.
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 from over 40 countries. It currently organizes four working groups:

- Space Environment Utilization WG
- Space Technology WG
- Space Applications WG
- Space Education WG

Under Space Environment Utilization WG (SEUWG), a new collaborative initiative “KIBO-ABC” was established to promote “Kibo” utilization in the Asia-Pacific region and to share and build outcomes.

Utilizing and Sharing the Outcomes of ISS/Kibo

1st Step
Terms of reference (TOR) among member countries

2nd Step
Bilateral Agreement between JAXA and a proposed country

- Understanding of Bilateral Projects
- Capacity building
- Bringing innovative ideas

Multilateral projects

- Creation of Bilateral Projects
- New space experiment missions

Bilateral projects
Kibo-ABC Multilateral Projects
(Kibo-ABC; Asian Beneficial Collaboration through “Kibo” Utilization)

SSAF/ Space Seeds for Asian Future program
■ Small space experiment on Kibo

Asian Try Zero-G program
■ Scientific experiment ideas is proposed from Asian youth. ISS crew performs the selected ideas.

1/2sec-μG program
■ Micro-G experiment by Mini drop tower demonstration.
Learning about micro-G.

Parabolic Flight Experiment program
■ Asian young researchers perform micro-G experiment by using the parabolic flight.
Thank you for your kind attention!!

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