The 27th Session of the Asia-Pacific Regional Space Agency Forum (APRSAF-27)

Space Frontier Working Group (SFWG) Concept Note

SFWG: https://www.aprsaf.org/working_groups/sf/

1. Scope and Objectives
The Space Frontier Working Group (SFWG) aims to explore new space frontiers, taking into account the trends of international space community engaged in space exploration activities. This working group discusses the utilization of the Japanese Experiment Module “Kibo” of the International Space Station (ISS), not only for scientific experiment but also for technology demonstration for future space exploration missions, while also engaging in topics related to space exploration beyond the ISS. By using Kibo as the steppingstone for future space exploration, this working group aims to contribute to the expansion of space activities in the Asia-Pacific region towards the moon and beyond.

Kibo is a manned space facility that provides unique research capabilities in the International Space Station (ISS). Kibo consists of a Pressurized Module, an Exposed Facility, a Logistics Module, and a Remote Manipulator System. Various scientific and engineering research activities are conducted onboard Kibo, taking advantage of the unique environment of the low Earth orbit. Research is currently being conducted aboard Kibo in the fields of life science, medical science, materials science, space environment monitoring, Earth observation, and demonstrations of advanced technology.

The SFWG promotes the utilization of Kibo in the Asia-Pacific region in the aforementioned fields, as well as for other areas and topics, through information exchange and discussion at WG sessions among participants. In addition to promoting the use of Kibo, the SFWG aims to create multilateral cooperative programs for its utilization among participating countries by using the framework of the Asian Beneficial Collaboration through Kibo utilization (Kibo-ABC) initiative. Furthermore, SFWG will organize a new session on International Space Exploration, where participants can share the latest on their studies and plans for the moon and beyond.

2. Activities and Discussion Points
On November 30 and December 1, 2021, a SFWG meeting will be held online prior to the APRSAF-27 plenary sessions.

Through discussion among participating nations, the SFWG aims to contribute to building cooperative projects for Kibo utilization to provide a broad range of benefits for the Asia-Pacific region. Participants can also share updates on both the global, national, and private sectors’ efforts toward expanding robotic and human exploration to the Moon and beyond.

- **Microgravity science experiments using Kibo’s Pressurized Module and other opportunities**
  Proposals for Kibo utilization from Asian countries were limited in number for a long time in the past. However, significant progress has been observed recently. Indonesia, Malaysia, and Thailand have developed plans for space experiments using Kibo’s Pressurized Module and Exposed Facility. The below are some of the highlights:
  - New radiation dosimeters were installed inside and outside of Kibo to measure the radiation in 2019-2021. The data analysis is ongoing in Malaysia.
  - Protein crystal growth experiments for anti-malaria drug design were conducted twice in 2019 and 2020. They were Thailand’s first space experiment on Kibo.
  - An Emirati astronaut performed an education mission on Kibo under collaboration between United Arab Emirates (UAE) and Japan in 2019.
  - UAE Space Agency and JAXA held the Kibo Utilization Symposium online in 2020 in order to share information on Kibo’s wide range capability.
Reports on the latest activities and any experiment proposals for Kibo’s Pressurized Module are welcome and open for discussion at this WG session. Information on microgravity science experiments using a small rocket, parabolic flight, and a drop tower will also be shared in order to further expand the opportunities for these experiments.

**Opportunities for launch and deployment of microsatellites from Kibo/J-SSOD**

*J-SSOD: JEM Small Satellite Orbital Deployer*

The demand from Asia-Pacific nations for microsatellite deployment has been increasing. Many satellites from Asian countries (such as Bangladesh, Bhutan, Israel, Malaysia, Mongolia, Myanmar, Nepal, the Philippines, Singapore, Sri Lanka, Turkey, and Vietnam) have been deployed from Kibo, and the deployment system/J-SSOD attracts global attention as a new transportation system for satellites.

Concurrently with these microsatellite deployments, KiboCUBE collaboration between JAXA and the United Nations Office for Outer Space Affairs (UNOOSA) has been in progress to provide opportunities for educational and research institutions of developing countries to deploy one unit (1U) CubeSat from Kibo. The SuryaSat Project of Indonesia was selected for the third round of KiboCUBE.

JAXA selected two private companies as providers of microsatellite deployment services from Kibo to promote commercial activities using the Kibo module. The number of domestic and overseas users working with these two providers are increasing, contributing to the expansion of space activities in the region.

The microsatellites project teams will be invited to introduce their activities and future plans at the WG session, and the participants will be informed of the future opportunities to utilize J-SSOD as well as the latest information on KiboCUBE.

**Experimental equipment on Kibo’s Exposed Facility**

The Exposed Facility has unique functions to realize frequent, easy, and diverse space experiments. For example, the IVA-replaceable Small Exposed Experiment Platform (i-SEEP) provides the resources, such as power and communications, for multiple pieces of equipment to be installed, making it easier to perform technical demonstration, earth observation, and space observation.

Malaysia and Turkey have conducted material exposure experiments on Kibo’s Exposed Facility. The experiment service provider selected by JAXA is actively promoting the utilization of i-SEEP in the Asia-Pacific region.

These unique capabilities of Kibo’s Exposed Facility and examples of experimental missions will be presented in this session. There will also be a discussion about the opportunities for using the Exposed Facility.

**Kibo-ABC activities for STEM education and SDGs contribution in the Asia-Pacific region**

The Kibo-Robot Programming Challenge (Kibo-RPC) is an educational competition, designed mainly for university students, in which they are challenged to solve various problems by operating real robots in Kibo. JAXA began Kibo-RPC with the cooperation of NASA in 2020. Kibo-ABC has also launched the Asian Herb in Space (AHiS) program in 2020 to provide students and young researchers with an opportunity to learn about space biology. These programs contribute to human resource development and capacity building for Kibo utilization.

The activities of the 2nd Kibo-RPC and AHiS will be discussed at the Kibo-ABC Workshop organized by Kibo-ABC members on November 29, 2021, one day before the SFWG session.

During this SFWG session, JAXA and participating agencies will explain the activities of Kibo-RPC and AHiS to SFWG participants as well as informing non-participating countries of this educational opportunity. Furthermore, the Asian Try Zero-G program, to be conducted in the near future, will be introduced to participants.

**ISS as a technical demonstration platform for Lunar and Mars exploration missions**

NASA and the international partners including JAXA are taking steps to begin the next era of exploration to the Moon and Mars, and the ISS/Kibo will be utilized as a technical demonstration platform for these future missions.
Participants are welcome to share their mission ideas and future plans for Kibo utilization in this field.

- **Special session: “Status of International Space Exploration”**
  This session invites presentations from each country/agency to share their activities and plans for space exploration endeavours. In addition, the latest activities of International Space Exploration Coordination Group (ISECG) including its global space exploration roadmap will be presented. ISECG developed the Global Exploration Roadmap (GER) in 2011 and have updated it in 2013 and 2018. In addition, ISECG issued the supplement of GER which focuses on Lunar Surface Exploration Scenario in 2020.