6th Kibo Robot Programming Challenge
Guidebook
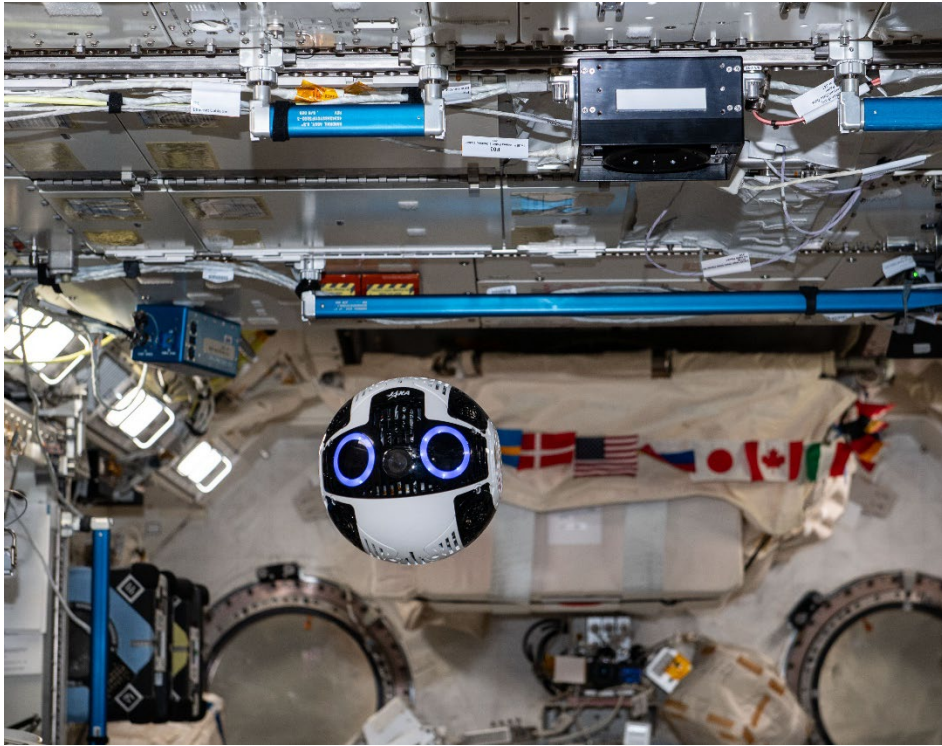
Version 1.0 (February 17, 2025)

Japan Aerospace Exploration Agency (JAXA)

Revision History

Details regarding changes made to the document are shown below.

Revision Date	Version	Paragraph(s)	Revision Location
February 17, 2025	1.0	All	-

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1. Introduction

1.1. Kibo-RPC

The Kibo Robot Programming Challenge (Kibo-RPC) is an educational program in which students will solve various problems by moving free-frying robots (Astrobee and Int-Ball) using their programming skills in a simulation environment and, in the final, in the Japanese Experiment Module (Kibo*) aboard the International Space Station (ISS).

Through interaction with experts in the field of space and the opportunity to observe their work firsthand, students will be able to deepen their understanding and acquire specialized scientific knowledge.

Through this educational program, it is our hope students will take the initiative to learn the techniques and methods involved in programming and robotics, while honing their STEM (science, technology, engineering and mathematics) skills.

This program is hosted by the Japan Aerospace Exploration Agency (JAXA) in cooperation with the National Aeronautics and Space Administration (NASA).

*Kibo is pronounced "key-bow" and means "hope" in Japanese.

1.2. Educational Objectives

In this program, by moving actual robots in the ISS based on hypotheses simulated in advance, students will learn about the importance of bridging the gap between simulation and reality when programming.

Students will learn to create programs that are robust enough to handle uncertainties and errors that cannot be easily simulated, such as external disturbances, and which work well in the real world. Through simulations, they will learn the need for multiple program revisions, attitude control for free-flying robots, and how to conduct missions within the ISS.

In the 6th Kibo-RPC, the focus is on image processing, and you will need to program your program for more accurate image processing. In addition, route design and team strategy will be more important than in the past, as there are additional factors that will be scored depending on Astrobee's route.

1.3. ISS Robots

The ISS is equipped with Astrobee free-flying robots and Int-Ball[*1], a spherical camera drone. In the Kibo-RPC, students will create a program to move an Astrobee to designated locations within Kibo.

[*1] Int-Ball will not be used in the competition this time, but will watch in the competition.

Astrobee	**Int-Ball**

Figure 1.3-1 Astrobee

Figure 1.3-2 Int-Ball

Astrobee is NASA's new free-flying robotic system that will help astronauts reduce the time they spend on routine duties, leaving them to focus more on the things that only humans can do.

Working autonomously or via remote control by astronauts, flight controllers, or researchers on the ground, the robots can perform tasks such as taking inventory, documenting experiments, or moving small items or cargo throughout the station. (https://www.nasa.gov/astrobee)
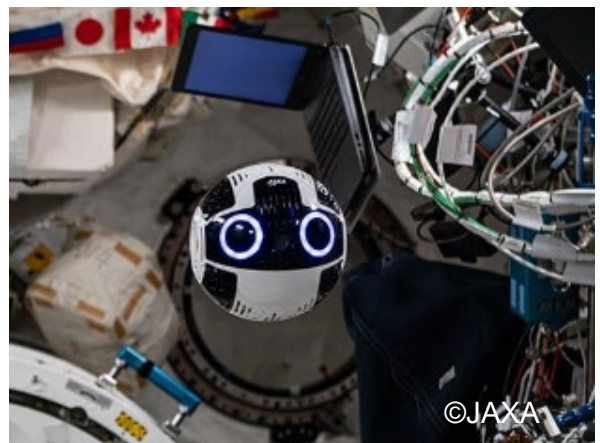
Int-Ball is a free-flying camera drone designed to ultimately eliminate the need for crew members to capture routine video footage aboard the ISS/Kibo.

Similar to current consumer-grade cameras, Int-Ball is used by on board crew to provide flexible views for ground operators.

Int-Ball is perhaps the first human-friendly camera robot in space.

Testing is underway for full-scale operations in the future.

(https://fanfun.jaxa.jp/topics/detail/10536.html)

2. Event Information
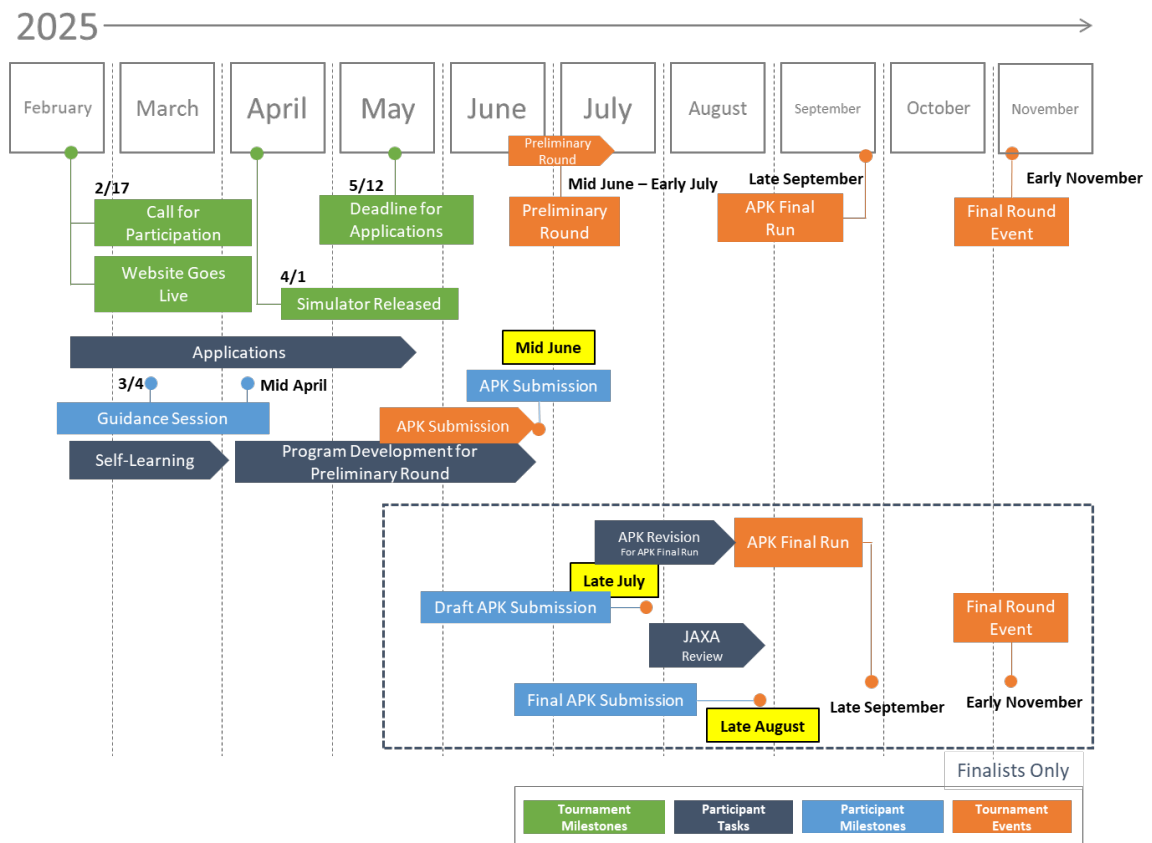
2.1. Event Schedule

Figure 2.1-1 Entire Event Schedule

Table 2.1-1 Event Explanation *Dates are subject to change.

Category	Explanation
Call for Participation	**February 17 – May 12, 2025** · A Kibo-RPC briefing session will be held during this period.

Self-Learning	**February – April 2025**
	· Participants may access the Github repository provided by NASA to learn how to program Astrobee.
	  ➢ GitHub-1 (https://github.com/nasa/astrobee)
	  ➢ GitHub-2 (https://github.com/nasa/astrobee_android)
	  ➢ Astrobee Website (https://www.nasa.gov/astrobee)
	· Program development tutorials for beginners are also available on the website.

	· Since the programming language is Java, learning Java will be helpful in developing programs for the preliminary round.
Program Development	**April – June 2025** · Using the web-based simulator, which is scheduled for release in early April, participants will develop their programs for the preliminary round. · A rule book containing detailed game rules will be released at the same time as the simulator.
Preliminary Round	**Late-June – Early-July 2025** · **Please participate in the preliminary round hosted by the designated agency in your country/region.** · Please develop and upload your Android Package Kit (APK) **through the web-based simulator by the submission deadline.** · The winning team (finalists) from each country/region will advance to the APK Final Run, which will take place aboard the ISS. ➢ Please note that there may be further restrictions on the number of teams that can participate in the APK Final Run on the ISS. The number of teams and the selection method will depend on astronaut schedules and will be announced at a later date. · The competition will be judged by the space agency in each country/region based on scoring elements, game rules, and individual evaluation criteria set by JAXA. · Details such as location and schedule will be announced by each country/region's space agency.
APK Revisions （Finalists Only）	**Mid-July to late August 2025** · Finalists in the APK Final Run **must revise their programs** before installing them on Astrobee. · The APK Final Run Simulator is scheduled to be released in July. · Teams must submit a draft of their program **in late July**. JAXA will conduct a review of the program content from a safety perspective during the draft stage. **If there are any problems, the representative's team will have to modify their program according to JAXA's instructions.** Please note that the schedule is tight. · The deadline for submitting the final version of the program is **the end of August.** (Don't be late. More information will be released later.)
APK Final Run	**Late September 2025** · Finalists' programs will be installed on ISS Astrobee for the competition. Only the runs of your own team will be **available for online viewing** and at this point there will be no announcements regarding scores or ranking.
Final Round Event	**Early November 2025**

	· **The results and ranking of each finalist's games in the APK Final Run will be announced.**
	· The competition will be judged based on the scoring elements and game rules set by JAXA.

2.2. Website and simulation release date

The web-based simulation environment will be prepared in phases.

Table 2.2-1 Release Schedule

Event	Date
Programming Manual	April 1, 2025
Rule Book	April 1, 2025
JAXA Web-based Simulation Environment	April 1, 2025
Simulation Update for APK Final Run	July 2025

The website of the previous Kibo-Robot Programming Challenge

1st: https://humans-in-space.jaxa.jp/krpc/1st/index.html

2nd: https://humans-in-space.jaxa.jp/krpc/2nd/index.html

3rd: https://humans-in-space.jaxa.jp/krpc/3rd/index.html

4th: https://humans-in-space.jaxa.jp/krpc/4th/index.html

5th: https://humans-in-space.jaxa.jp/krpc/5th/

3. Kibo-RPC Entry Application

> **Some countries/regions participating in Kibo-RPC may differ in terms of requirements such as nationality, number of persons in a team limit, and age limit for participation, etc. Please check with the space agency in the relevant country/region for details.**

3.1. Entry Requirements

Students who live in one of the Kibo-ABC member countries/regions[*1] or the US and who are enrolled in a school up to graduate school in a country/region[*2] participating in Kibo-RPC (including foreign students) are qualified to enter. Exceptions may be made in cases such as those shown below if approved by the Point of Contact (space agency) (POC) of the country/region participating in the Kibo-RPC in which they reside. If you think that applies to you, please contact your POC.

Special Cases:

1. Non-students may be eligible to compete, as long as they are not professional programmers.

2. Students studying outside their country may be allowed to form a team representing their country in the place in which they are studying.

*1 Kibo-ABC Member Countries/Regions (in alphabetical order)

   Australia, Bangladesh, Indonesia, Japan, Malaysia, Nepal, New Zealand, Republic of the Philippines, Republic of Korea, Singapore, Taiwan, Thailand, United Arab Emirates, Vietnam

   Kibo-ABC URL: https://humans-in-space.jaxa.jp/biz-lab/kuoa/kibo-abc/

*2 Countries/Regions Participating in the 6th Kibo-RPC (as of Feb 2025)

   Australia, Bangladesh, Indonesia, Japan, Malaysia, Nepal, Republic of the Philippines, Singapore, Taiwan, Thailand, United States, Vietnam

   *Other Kibo-ABC member countries/regions are also being considered for participation.

In the 6th Kibo-RPC, **an additional slot has been established to expand the competition internationally and allow students from developing economies and economies in transition that are United Nations Member States which are not "Countries/regions participating in the 6th Kibo-RPC" in [*2] above.**
This slot was realized in cooperation with the United Nations Office for Outer Space

Affairs (UNOOSA). For details of this slot, please refer to the UNOOSA Website for detailed entry requirements.

- UNOOSA Website (To be updated)

  https://www.unoosa.org/oosa/en/ourwork/access2space4all/Kibo-RPC/kibo-rpc_5th_round.html

See Table 3.1 to see which countries you can apply to participate.

Table 3.1 Team Categories

Case	Nationality of participants	Location of their School	Means of Participation[1]
1	Kibo-RPC Participating Countries/Region	Kibo-RPC Participating Countries/Region	Apply from the preliminary round of the country/region the team members are from or where the school is located.
2	Kibo-RPC Participating Countries/Region	Kibo-RPC non-participating countries/region	Apply from the preliminary round of the country/region the team members are from.
3	Kibo-RPC non-participating countries/region	Kibo-RPC Participating Countries/Region	Apply from the preliminary round of the country/region where the school is located.
4	Kibo-RPC non-participating countries/region from developing economies and economies in transition[2]	Kibo-RPC non-participating countries/region from developing economies and economies in transition[2]	Apply from the preliminary round through the UNOOSA international slot.
5	Kibo-RPC non-participating countries/region from developing economies and economies in transition[2]	Kibo-RPC non-participating countries/region from developed economies [2]	Apply from the preliminary round through the UNOOSA international slot.
6	Kibo-RPC non-participating countries/region from developed economies [2]	Kibo-RPC non-participating countries/region from developing economies and economies in transition[2]	Apply from the preliminary round through the UNOOSA international slot.

*1 Multiple entries in various preliminary rounds in different countries/region are not allowed.

*2 For country/region classifications, see the World Economic and Situation Prospects 2025 published by United Nations Department of Economic and Social Affairs and other related organizations.

3.2. Team Formation Rules

(1) Team Structure

- A Team must consist of at least 3 and no more than 8 members (Guardians are not counted in the number of team members).
    - ✓ Some participating countries/region may have a maximum number of team members. For details, please check the application guidelines for each country/region.

Table 3.2 Number of Team Members (as of Feb 2025)

Participating Countries/Region	Number of Team Members
Australia	3-8
Bangladesh	3-8
Indonesia	3-**5**
Japan	3-8
Malaysia	3-**5**
Nepal	3-8
Republic of the Philippines	3-8
Singapore	3-**6**
Taiwan	3-**5**
Thailand	3-**4**
USA	3-**6**
Vietnam	**5**-8
UNOOSA	3-**6**

- At least one of the team members must be eligible for one of the cases in Table 3.1.
    - ✓ If the team is eligible for multiple cases, apply to the preliminary round of the case with a smaller number.

        Ex) If your team is eligible for both cases 1 and 3, you need to apply from case 1.
- No student may belong to multiple teams.
- After the preliminary round is over and a team has been selected, team members may not be changed.

(2) Team Leader

- Each team shall have a representative to manage the team as leader. A student or guardian (or teacher) on the team may be the team representative.
- The Team Representative is responsible for:
  - ✓ Managing the team's programming progress
  - ✓ Submitting the application forms
  - ✓ Submitting the programs
  - ✓ Communicating and sharing information with the POC in your country/region and secretariat (please make sure to check the correspondence from the POC and secretariat).

(3) Other Conditions

- The following skills and knowledge are preferred but not required*:
  - ✓ Android programming and image processing with Java
  - ✓ Knowledge of college-level physics and mathematics

  *These skills may be required to deliver results in the competition.
- When applying, please be sure to review the contents of the attached Kibo-RPC Entry Agreement and tick the consent confirmation box on the Application Form.

3.3. Application

(1) Select the URL for the preliminary round of the applicable country/region on the Kibo-RPC website (https://jaxa.krpc.jp/), fill in the form and submit it. Please note that the required items may differ depending on the POC of the preliminary round. The main common items are shown below. We recommend that you have the details ready before you start.
  - ✓ Team Name (English)
  - ✓ Team Leader: Name (English), age, nationality, affiliation, address, phone number, and email address)
  - ✓ Team Sub-leader (optional): Email address (backup contact information)
  - ✓ Gurdian and Teacher Information (only for teams consisting of high school students and younger): Name, phone number, email address
  - ✓ Team Members: Name, age, nationality, affiliation, history of past participation in Kibo-RPC

- ✓ How you learned about Kibo-RPC
- ✓ Team introduction and why you want to participate
- ✓ Consent to the Terms of Participation)

(2) After your application is accepted, you will receive an email containing your login ID and password to access JAXA's web-based simulator and the participants' page on the Kibo-RPC site.

Please allow 3 business days for registration to be completed。

Application deadline: May 12, 2025, at 23:59 (JST)

4. Game Explanation

4.1. Scenario

The space pirate IB-1 (Int-Ball the First) has hidden the space treasures he collected during his short life somewhere on the International Space Station "Kibo". The astronaut knows clues to find the real treasure hidden by IB-1, but the exact location is unknown. However, previous research has identified several possible sites where the treasure may be hidden, and landmarks have been found nearby.

Now, you will take control of the Astrobee and together we will search for IB-1's hidden treasure.

First, to find the treasure, the participants must command the Astrobee around the potential sites by following the landmarks. Be careful that fake treasures may be scattered among them. After visiting all the candidate sites, use the clues that the astronaut has to find the real treasure, return to the correct location and get the treasure! The path you take to the treasure is up to you.

Grab the treasure hidden by the Space Pirate IB-1 before your rivals find it!

Mission

Work with Astrobee to find the treasure left on the ISS by space pirates!

*Please note that this story is fiction.

4.2. Game Overview

Within a time limit, Astrobee will be moved from the starting position (dock station) to a candidate location in Kibo where the treasure is hidden, and all images will be read. Astrobee will then be moved to the astronauts' site, where it will read the images of the treasure and landmarks in the astronauts' possession to provide clues to locate the real treasure. After reading the images, the player moves to the location where the real treasure is hidden, takes a picture of the treasure, flashes the Signal Lights to signal that he/she has found the treasure, and tells the astronaut where the treasure is hidden to complete the mission.

4.3. Game Flow

1. Start from the docking station.
2. After starting, Astrobee will patrol several candidate sites aboard Kibo where treasures are hidden.
3. Each team may choose a route through the Oasis Zones[*1], where they receive points for passing through, and report what they find at each candidate location for hidden treasures.
4. Once all Astrobee has visited all of the sites, go to the astronaut and read the image of the real treasure and its nearby landmark. This will reveal the identity of the real treasure.
5. Go to the real treasure and take a picture.
6. After taking the photo, activate the Signal Lights to inform the astronaut of the treasure's location, and the mission is complete.

[*1]Oasis Zone: Points will be added as long as Astrobee is moving through this area.
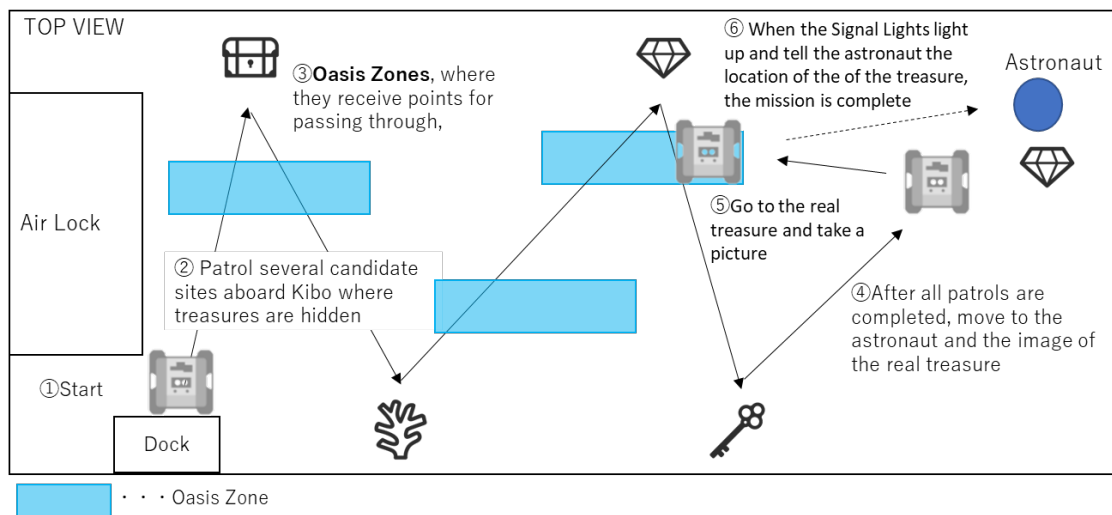

Figure 4.3-1 Game Flow

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	coin	fossil	shell
Landmarks Examples			
	crystal	diamond	emerald
Treasure Examples			

Figure 4.3-2 Examples of landmarks and treasures (see rule book for details)

4.4. Evaluation Criteria

We will evaluate whether you are able to quickly and accurately recognize what images were found in what area and whether you are able to properly search for real treasure.

In the preliminary round, simulations will be run in multiple patterns with different random elements (location of objects, real treasures), and the average of the scores will be the final score. For more details, please refer to the rulebook to be released in April.

4.5. Information to be released later

The following information will be available in the Kibo-RPC Rulebook in April 2025:

1. Starting position and orientation
2. Areas where each landmark/treasure is located
3. Coordinates and size of the oasis zone
4. Location of landmarks and treasures
5. Astronaut's position and orientation

5. FAQ

No.	Question	Answer
1	What if I want to add a member? Or I want to modify my registration details?	Additions can be made as long as they are within the maximum limit. Please contact the POC by email, including the following details. For revisions, please include the following information as well. ① Team Name ② Name of member to be added or changed (English) ③ Affiliation for additional member/member changes ④ Nationality for additional member/member changes ⑤ Age of additional member/changed member ⑥ Past competition experience for additional member/changed member
2	What should I do if I applied for participation, but was not issued an ID and password?	Please allow 3 business days for registration to be completed. If it takes longer than that, please contact the POC by e-mail.
3	When can I start developing my program?	Using the web simulator, which will be released in early April, students will develop programs in preparation for the preliminary round. Until then, participants can study Astrobee programming through Github, which NASA has made available to the public, as an independent study period. For details, please refer to 2. Event Information. Materials distributed up to last year can be downloaded from each Kibo-RPC site for your reference.
4	It says that knowledge of college-level physics and mathematics is required, but can elementary or junior high school	Although some of the content requires university-level knowledge, elementary and junior high school students can also

	students participate?	participate. In past competitions, some teams of only elementary school students have participated in preliminary round.
5	Can I contact members from other teams?	Please feel free to contact members through the forum set up in the simulation.
7	Can I use a Mac?	You are welcome to proceed with development on a Mac, but since it is not the recommended development environment for this program, the secretariat cannot provide support for it.
8	What should I do if I cannot create a local simulation?	Please proceed with the construction while referring to the programming manual to be released in early April. If you are unable to solve the problem, please provide us with the following information using the inquiry form. ① Operating environment ② Which command was executed (which step in the manual)? ③ What kind of errors were generated (output results and logs)?

For more frequently asked questions, please visit the official Kibo-RPC website.

https://jaxa.krpc.jp/faq

Terms and Conditions

Applicants must agree to all of the terms below. If you live in the European Union, please agree to the

contents of the attached materials.

1. Privacy Policy

(1) Collected personal information will only be used for the operation of the Kibo-RPC, and possibly used for public relations of JAXA's events and taking surveys on career path.

(2) The videos and photos taken at this tournament will be made publicly available.

2. Responsibility of Applicant and Exemption Clause of JAXA

(1) JAXA will not be liable for any problems that may occur during program participation.Applicants need to take full responsibility for solving issues of this nature that may arise

(2) Applicants must guarantee that information on the application form and the program code do not violate any legal rights or obligations, such as intellectual property or export control,as applicable. If a legal problem related to the submitted information arises, the applicant will take full responsibility to solve the problem

(3) If there is a violation of these matters registration may be canceled, even after registration.

3. Notes

(1) Underage applicants must first obtain parental consent.

(2)   Do not use the simulator environment provided in the Kibo-RPC for any purpose other than the Kibo-RPC. Sign-on information for accessing the simulator environment will be made available only to the competition applicants. Do not disclose this information to anyone else.

(3) JAXA may use the program codes and results of the competition for the purpose of public relations and education.

Consent content based on EU GDPR

For the purposes of notification of competition information, Sending of prize certificates and commemorative gifts, provide information to POC in countries/regions other than Japan for the purpose of managing the event, JAXA needs to collect your personal data requested in the present form.

You may at any time object to the use of your data for this purpose by writing to the following address:

Z-KRPC@ml.jaxa.jp

You will find below all the detailed information concerning this processing of your personal data and a reminder of your rights, in application of the legislation in force.

JAXA, willing to respect the privacy and protection of personal data of its prospects and clients, complies with the legislation in force regarding the protection of personal data as data controller, and in particular Law no. 78-17 of 6 January 1978 (the "Data Protection Act") and, from 25 May 2018, Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of individuals with regard to the processing of personal data and the free movement of such data (the "GDPR").

PLEASE BE INFORMED THAT THE PERSONAL DATA WILL BE TRANSFERRED TO JAPAN AND POC AND TEAM OF THE PARTICIPATING COUNTRIES/REGIONS FOR THE PURPOSE AS DESCRIBED ABOVE.

You have, under the conditions defined by the Data Protection Act and the GDPR, unless otherwise provided:

(i) The right to withdraw at any time your consent to the processing implemented by JAXA based on such consent ;

(ii) The right to obtain from JAXA the confirmation that your personal data are or are not processed and, when they are, access to said personal data as well as to several information on the processing (processing purposes, categories of personal data concerned, recipients or categories of recipients to whom your personal data have been or will be communicated, the retention period of the personal data envisaged or, where this is not possible, the criteria used to determine this duration, etc.)

(iii) A right of access, rectification and/or erasure of your personal data;

(iv) The right to receive your personal data provided to JAXA, in a structured, commonly used, and legible format, and the right to transfer this data to another data controller without JAXA having to obstruct it;

(v) A right of opposition, for legitimate reasons, to the processing of your personal data and the right of opposition to the use of such personal data;

(vi) The right to request from JAXA the portability of your personal data in the event you wish to obtain the transfer of your personal data to the benefit of another data controller.

You can set, change and revoke at any time guidelines for the retention, erasure and communication of your personal data after your death. You have the right to appoint a third party to whom your data may be communicated after your death. You agree to inform this third party of your approach.

You may exercise the rights described above by writing to JAXA at the following email address:

Z-KRPC@ml.jaxa.jp