



# 4<sup>TH</sup> KIBO ROBOT PROGRAMMING CHALLENGE GUIDANCE SESSION #2

26 April 2023

Kibo-RPC Secretariat

# AGENDA

- 1. 4<sup>th</sup> Kibo Robot Programming Challenge  
(Kibo- RPC) overview**
- 2. About the program creation**
- 3. About the preliminary round**
- 4. About the final round**
- 5. Q&A**

# AGENDA

- 1. 4<sup>th</sup> Kibo Robot Programming Challenge  
(Kibo- RPC) overview**
2. About the program creation
3. About the preliminary round
4. About the final round
5. Q&A

# 4TH KIBO- RPC OVERVIEW

- The Kibo Robot Programming Challenge is a robot programming competition for students, in which students compete to complete a given mission using a robot on the International Space Station (ISS) with the actions students have programmed.
- This program is open to graduate students and undergraduate students <sup>\*2</sup> from around the world <sup>\*1</sup>, with a focus on the Asia-Pacific region.

<sup>\*1</sup>Exceptions may apply so please check with the person in charge

<sup>\*2</sup>Regions that are members of the United Nations

- You can learn about the following:
  - Scientific, technical and mathematical skills and technical knowledge
  - The necessity of estimating the position/attitude and adjusting operations for space robots, and its implementation method



# 4TH KIBO- RPC OVERVIEW

Outline of the 3rd Kibo Robot Programming Challenge.

**351 teams and 1431\* students from 12 countries/regions participated.**

\*Includes teams from outside the Kibo-RPC participating countries/regions that participated by forming a joint team with a team from a Kibo-RPC participating country/region (World Wide Team).



Rank	Country/Region	Team name
1	Taiwan	KIBO la na tsu bu KIBO / Robology Awesome Aliens
2	Indonesia	Bondowoso 3 / Prime
3	Japan	Space Lark



# 4TH KIBO- RPC OVERVIEW

## Game Story

The air leak caused by the space debris impact was repaired by a talented student programmer, and peace returned to the ISS.

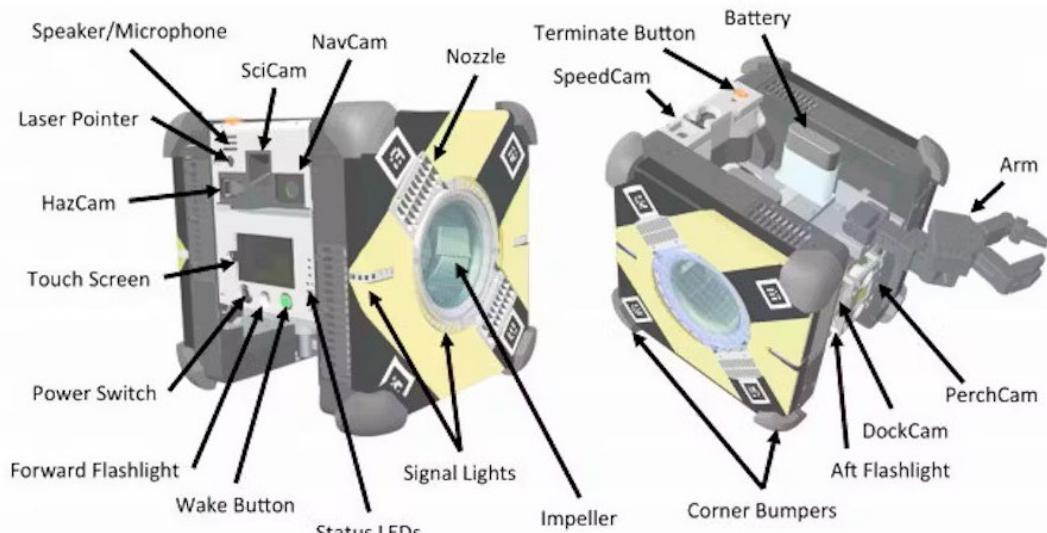
However, in 2023, an alert was confirmed from Kibo's control unit that ammonia, which is used as a refrigerant for the external control system was suspected to have leaked into the ISS.

The number of leakage points increased randomly over time due to increased pressure in the coolant piping.

*Repair the leakage points by laser irradiation of Astrobee!*

Note: This is a fictional story.

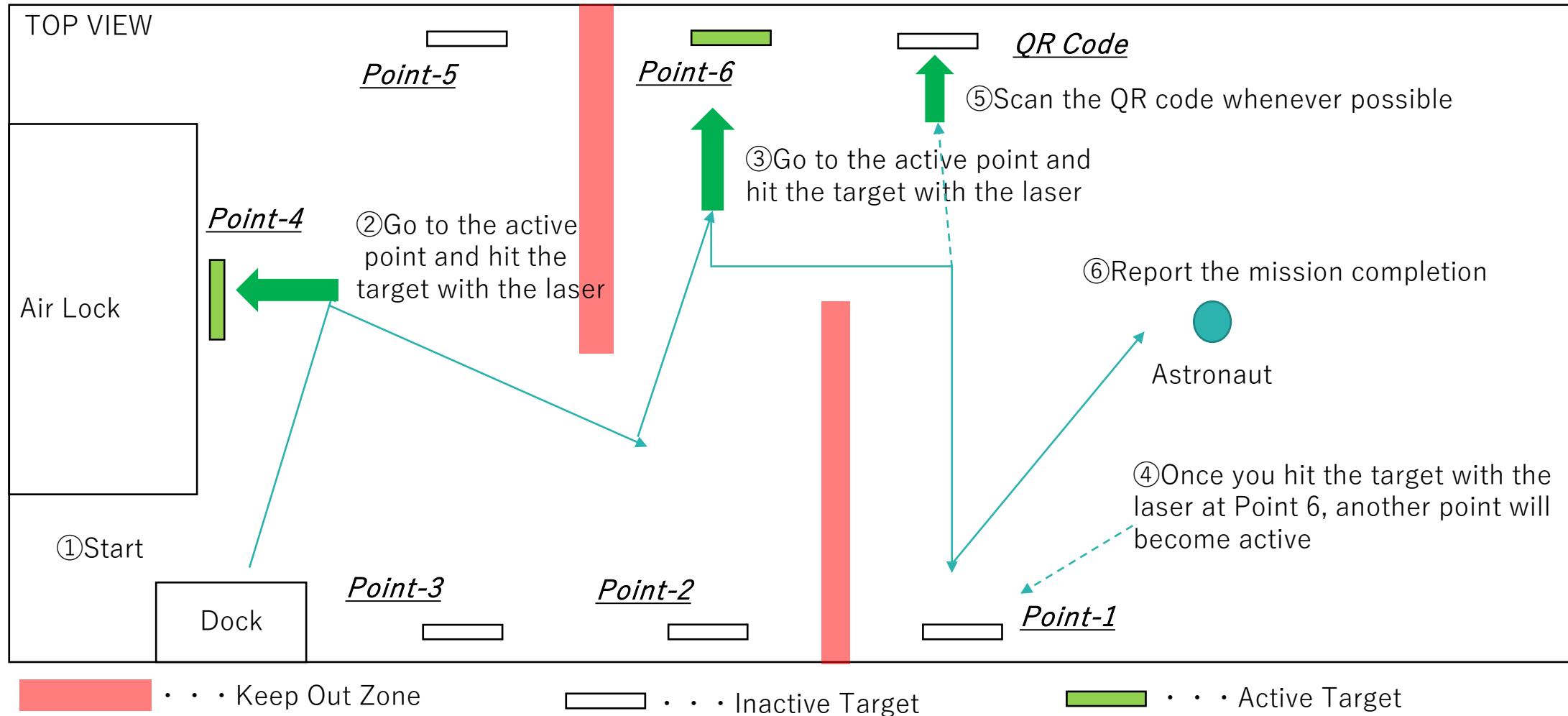
## Astrobee (NASA)



- SciCam : Streaming camera
- HazCam : Obstacle detection camera
- NavCam : Image processing camera
- LaserPointer : Laser irradiation of targets
- Arm : Robot arm to grasp objects
- Signal Lights : Light to report the mission completion

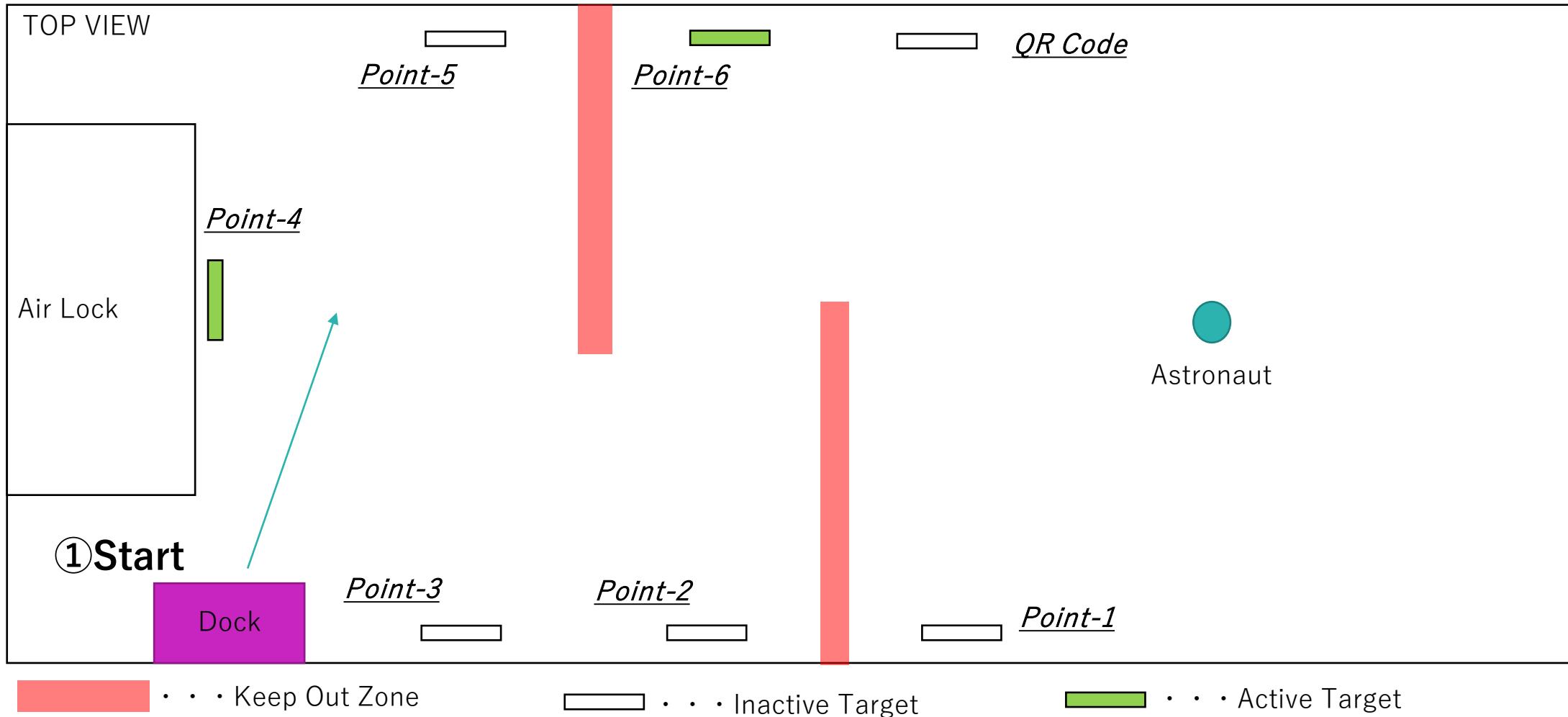
# 4TH KIBO- RPC OVERVIEW

## Mission details



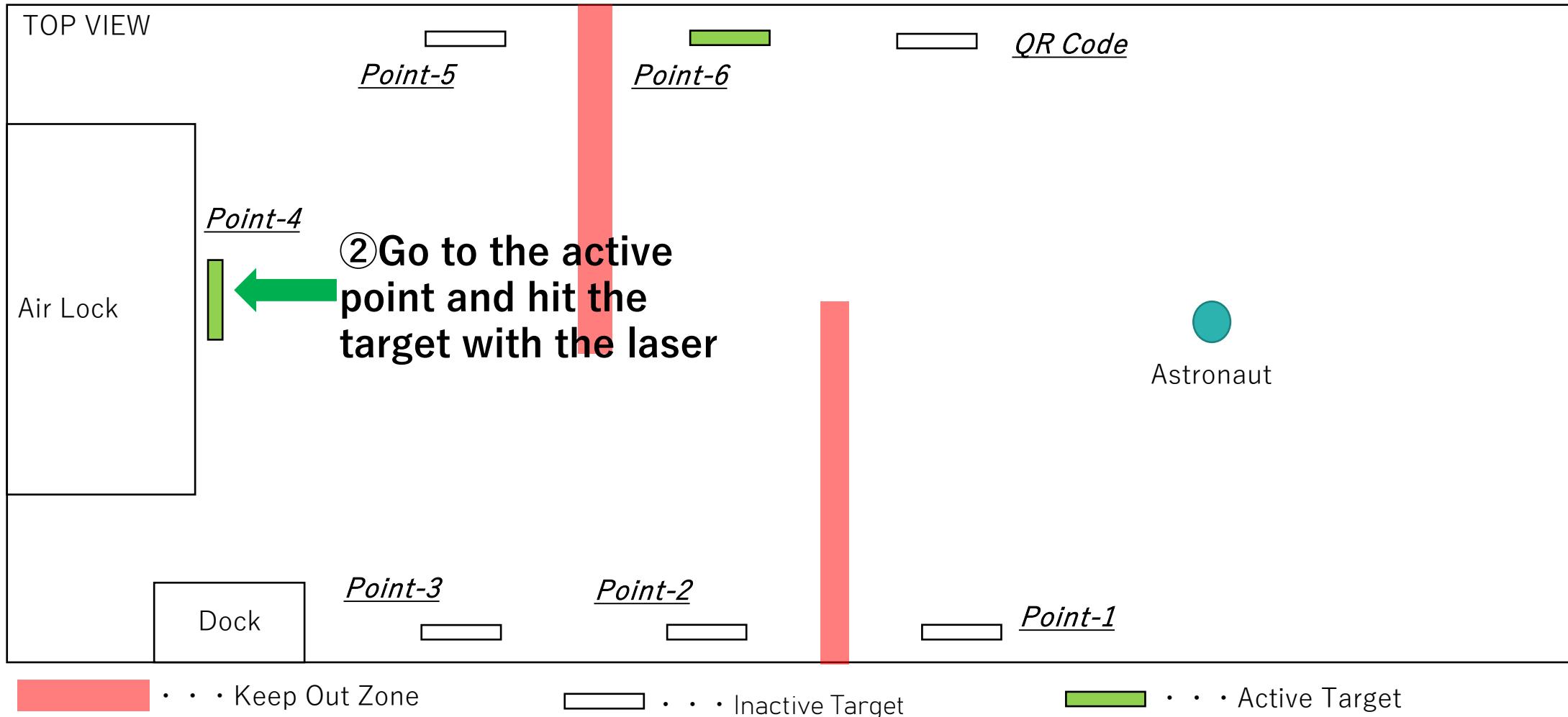
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## Mission details



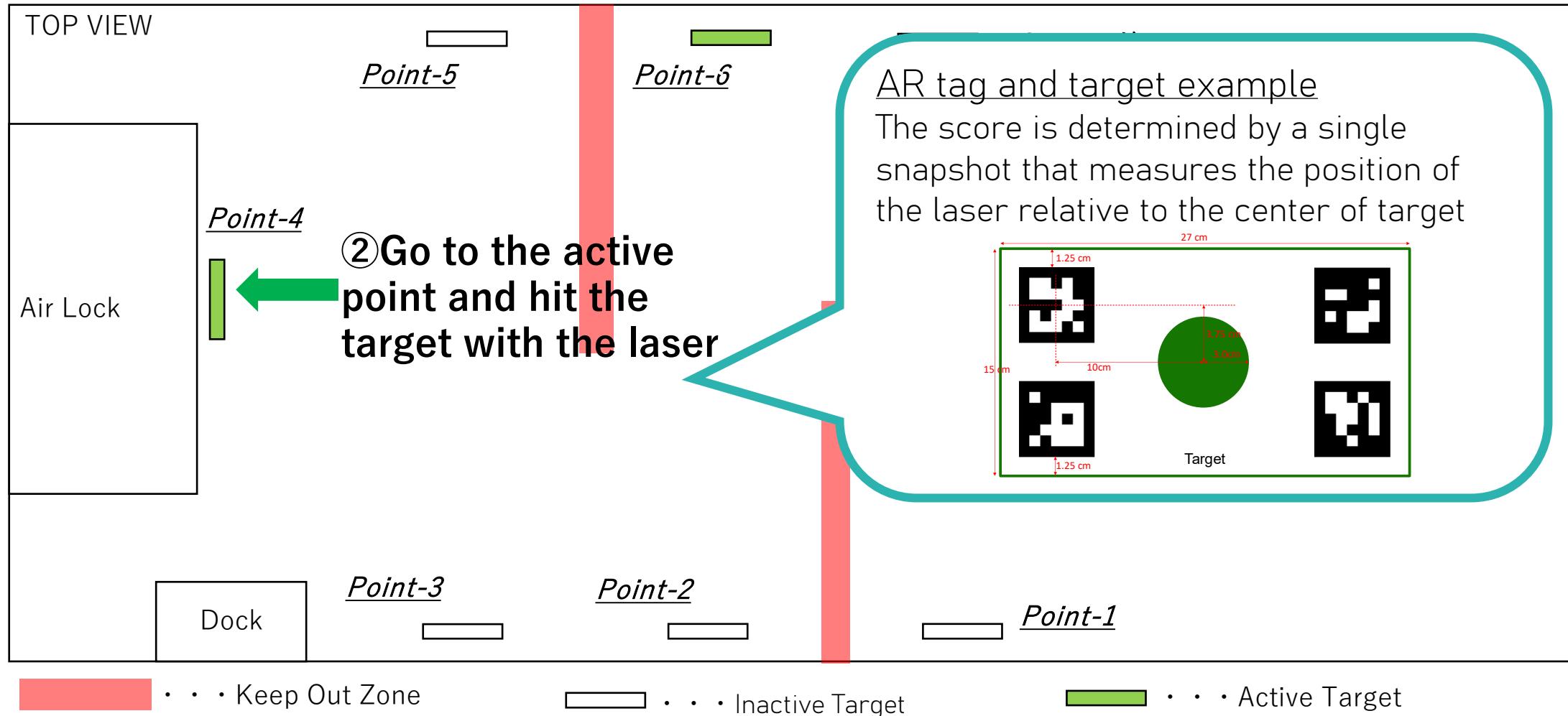
# 4TH KIBO- RPC OVERVIEW

## Mission details



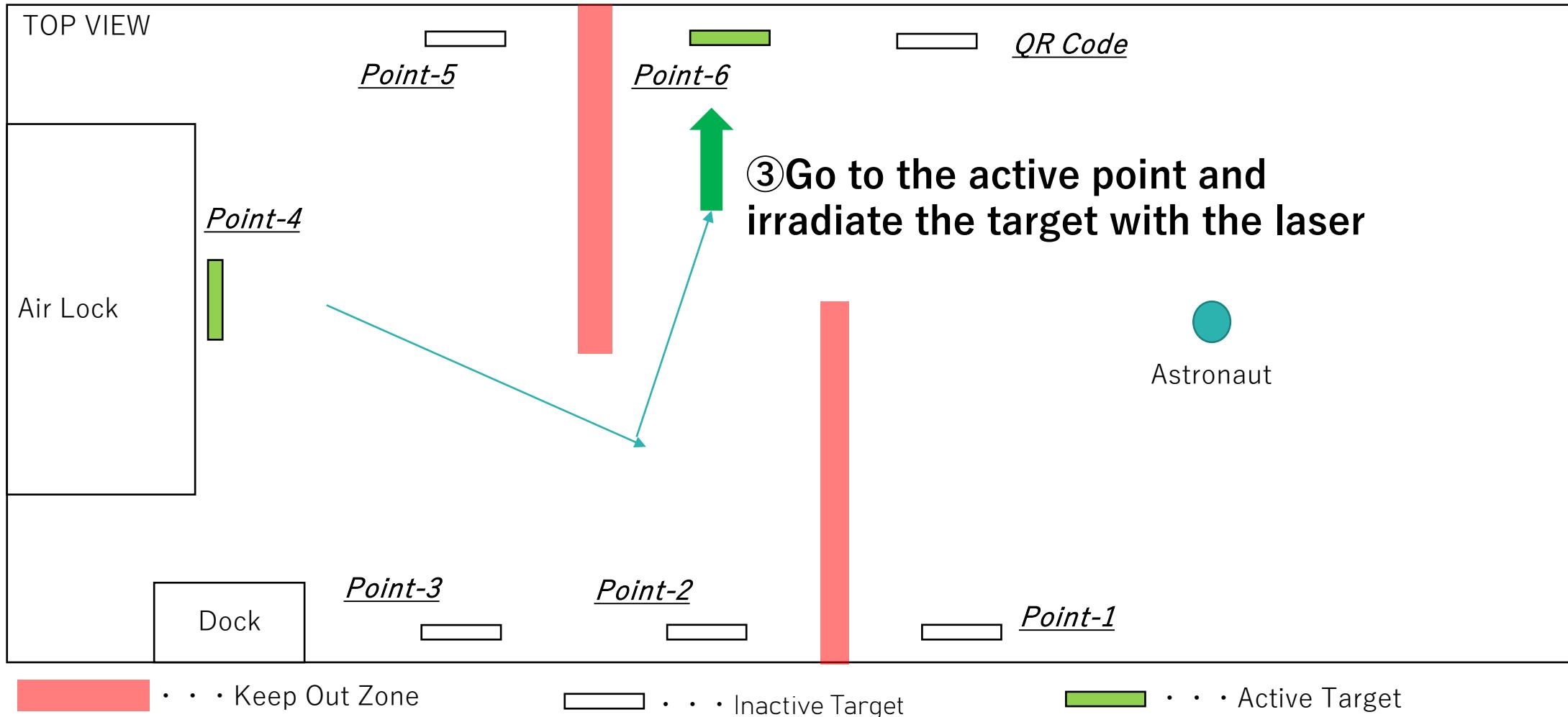
# 4TH KIBO- RPC OVERVIEW

## Mission details



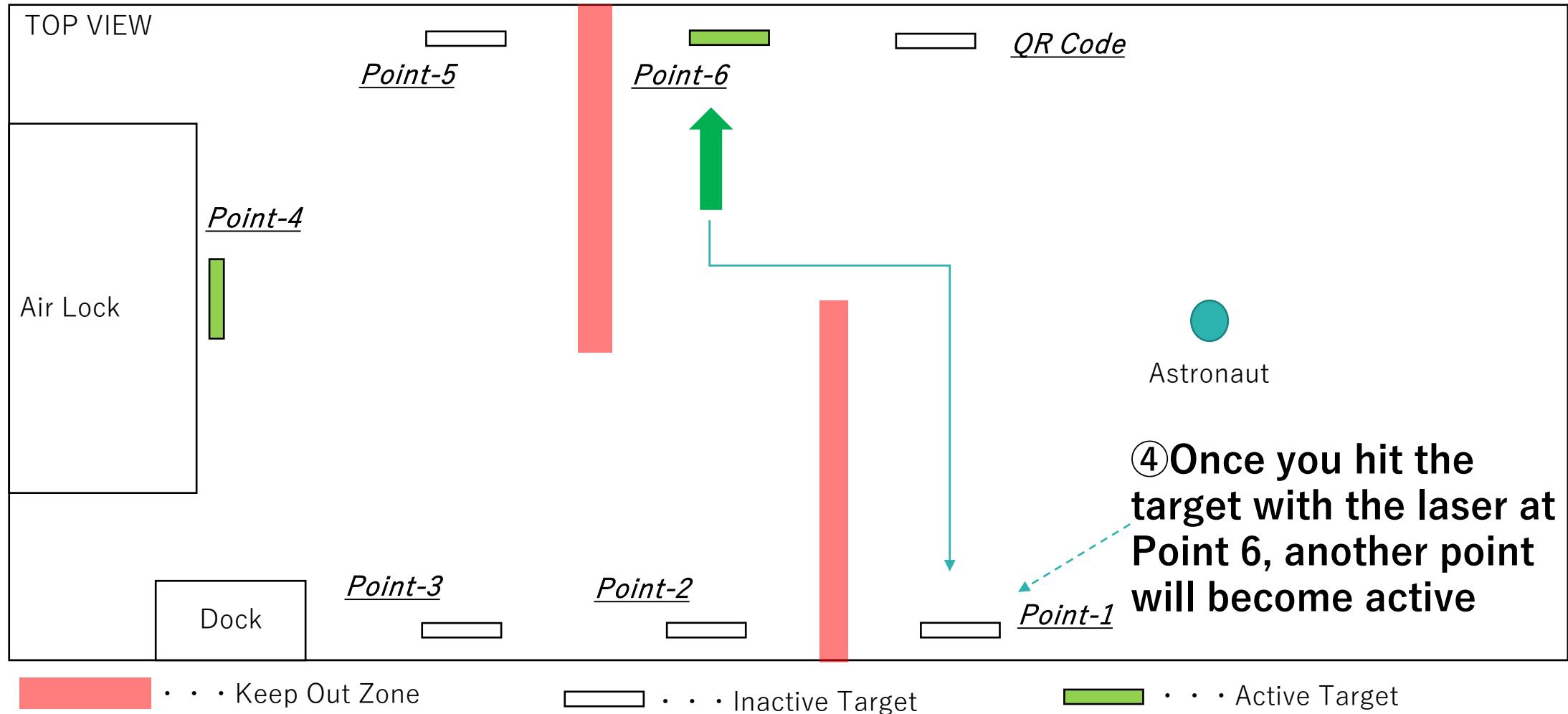
# 4TH KIBO- RPC OVERVIEW

## Mission details



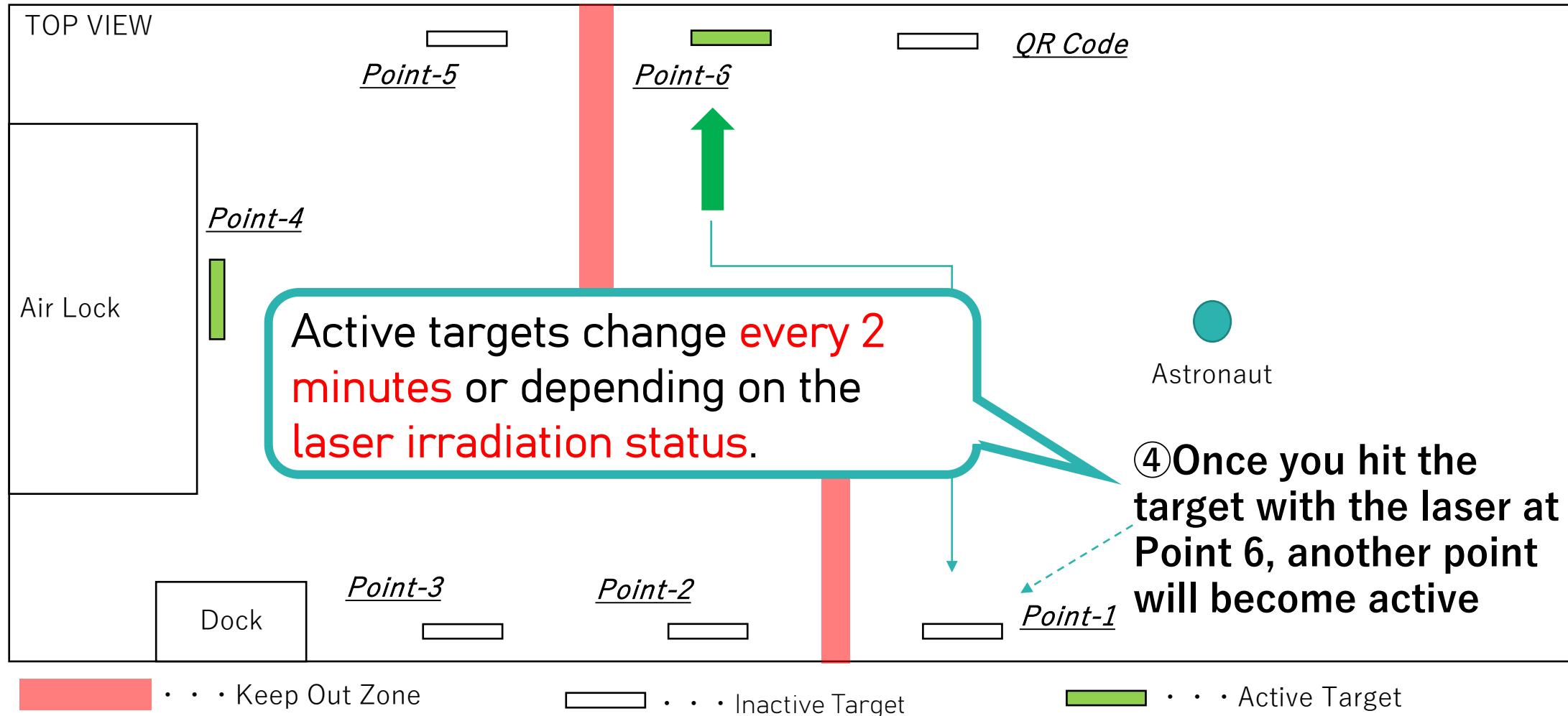
# 4TH KIBO- RPC OVERVIEW

## Mission details



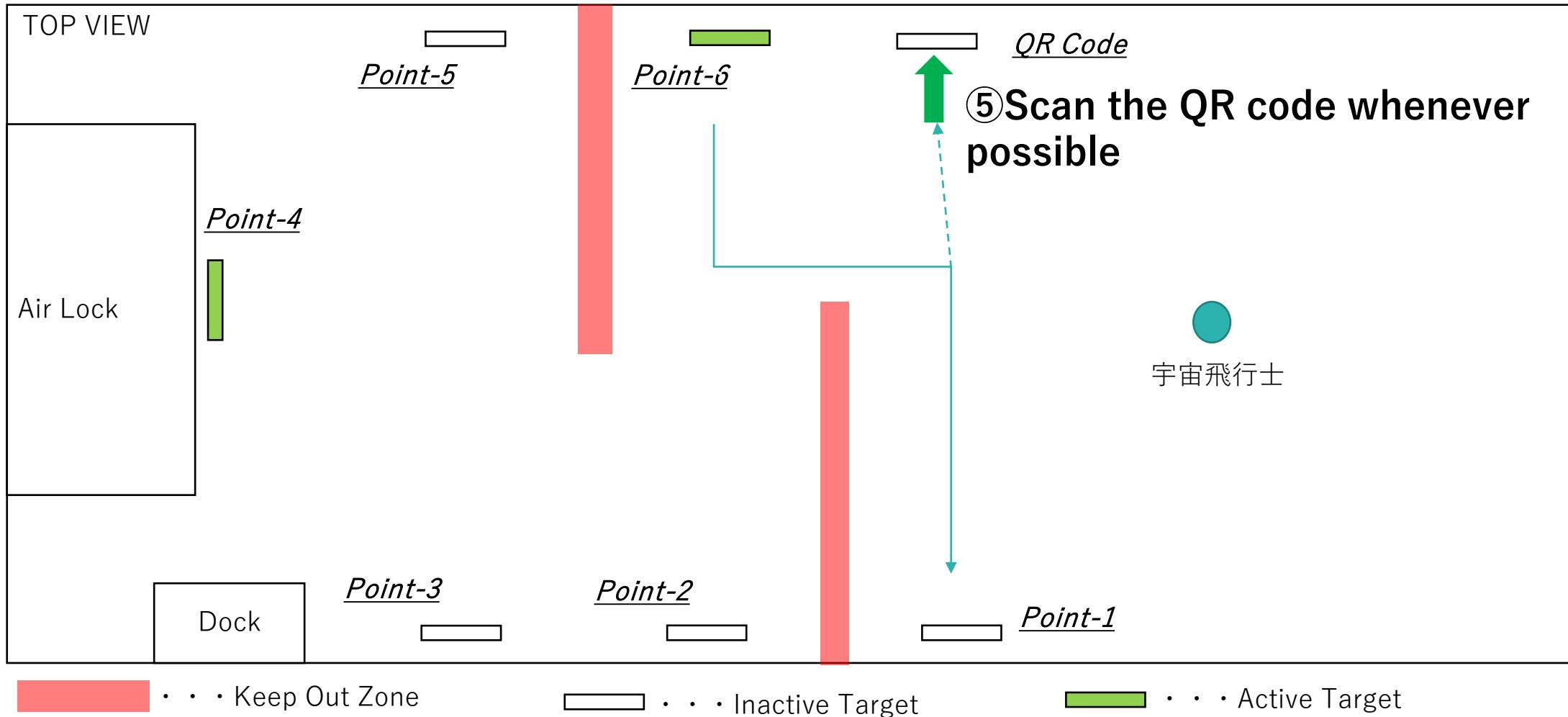
# 4TH KIBO- RPC OVERVIEW

## Mission details



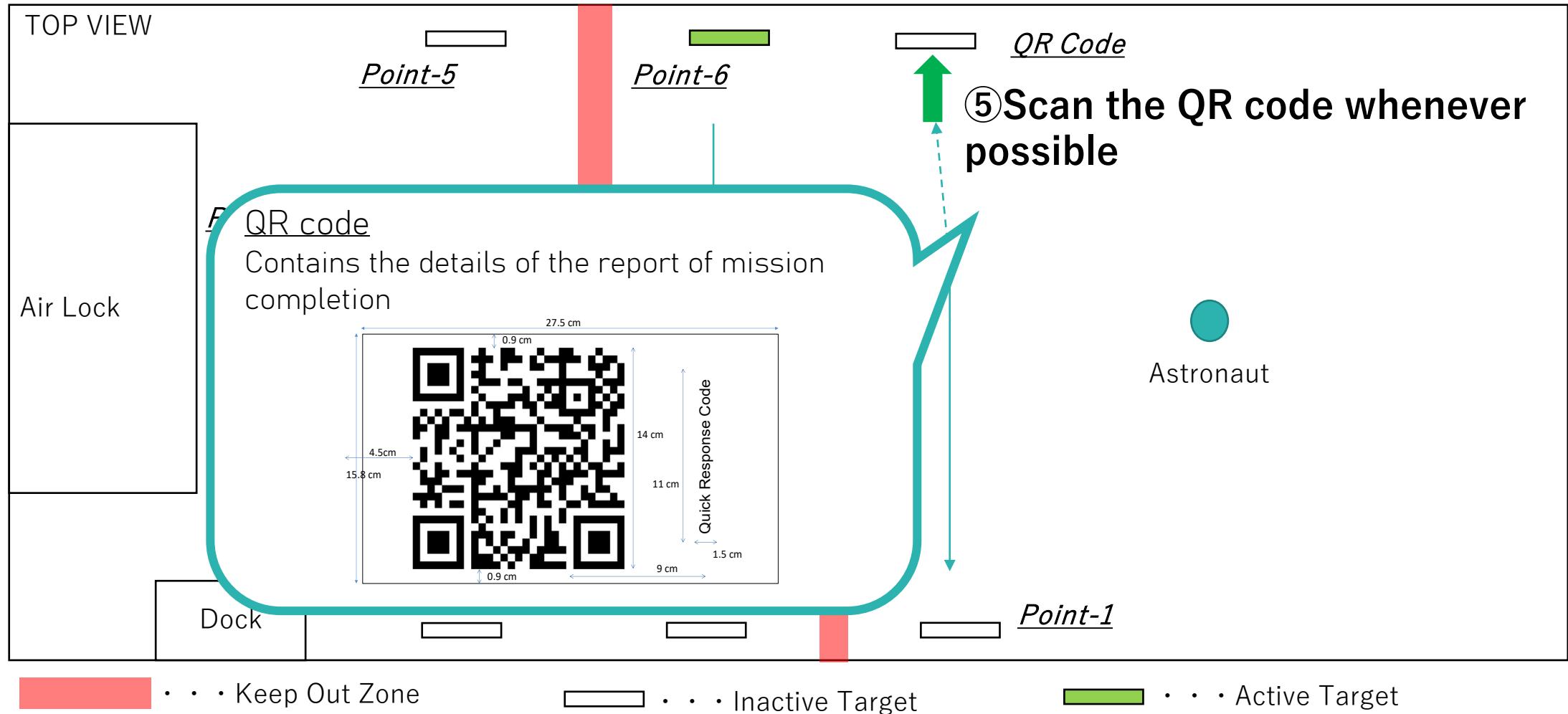
# 4TH KIBO- RPC OVERVIEW

## Mission details



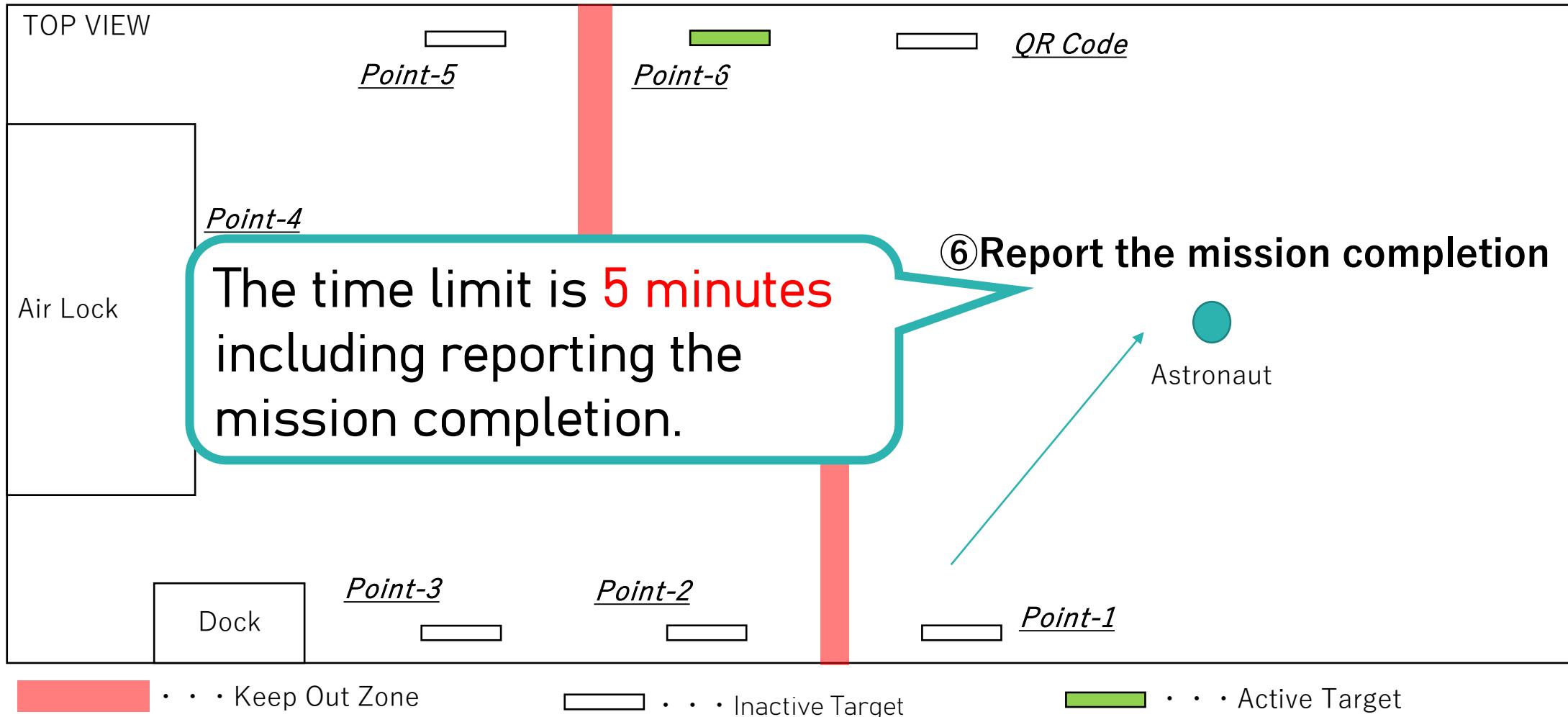
# 4TH KIBO- RPC CONFERENCE OVERVIEW

## Mission details



# 4TH KIBO- RPC OVERVIEW

## Mission details



# SCHEDULE

## Participation application



By 23:59 14 May 2023

Simulator login account distribution



## APK submission

29 May to 25 June 2023



## Program revision

Until the first half of August 2023

Finalists will modify the APK for the Run on the ISS

Programming by using simulators and preparing APKs



## Program creation

Until 25 June 2023



## Preliminary round period

26 June to 9 July 2023

September to October 2023



- **APK Final Run**  
*on ISS*
- **Final Round Event**  
*on ground*

# PARTICIPATION METHOD

1. Read 'How to Enter the Kibo-RPC' in Kibo-RPC Website.

<Entry Qualification>

1. Students up to graduate school in a Kibo-RPC participating countries/region  
(regardless the nationality)
2. Teams of three or more (participation in more than one team is prohibited)
3. Each team must have a team leader  
(a member of the team can become a team leader)
4. Agree to the attention the terms and conditions in the application form

2. Click on the "Application Form" of your country, fill the information in and send.

If modifications are required, please email the Secretariat with the name of the team and the details of the modification.

**Deadline for applications is 23:59 on 14 May 2023**

3. After submitting the application, a registration completion email will be sent.

The email contains your ID, so please keep it.

The ID must not be divulged to anyone outside the team.

 Kibo-RPC point of contact (POC)

[BGD](#) [JPN](#) [MYS](#) [NPL](#) [SGP](#) [TWN](#) [THA](#) [UAE](#) [USA](#) [VNM](#) [UN](#)

Australia



[Australian Space Agency \(ASA\)](#)  
[One Giant Leap Australia Foundation \(OGL\)](#)

[Learn more](#) 

Bob Carpenter and Jackie Carpenter  
[onegiantleap@bigpond.com](mailto:onegiantleap@bigpond.com)

[Application Form](#) 

# FLOW AFTER THE APPLICATION

## Preparation

*\*See the Programming Manual for details.*

### 1. Check the required PC specifications

- 64-bit processor
- 4GB RAM(8 GB RAM recommended)
- Ubuntu20.04 (TBD) or Windows10 (64-bit version)

Environment : Android Studio  
Language : Java

General PC specifications are fine.

### 2. Install Android Studio

Install Android Studio from the developer site

Installation of 【openJDK8】 , 【ADB (AndroidDebugBridge)】 , 【Gradle】 needed  
for Ubuntu

### 3. Download additional components of Android Studio

Additional components are needed to build programs.

Note: APK (Android Application Package) is an Android app ; Astrobee programmes will be created under this format.

### 4. Download Template APK from Kibo-RPC website

Template APK is a pre-prepared program that cannot be created by the participants.

# FLOW AFTER THE APPLICATION

## After the preliminary preparations

### 1. PC set up

- Installation of Android studio/**Template APK** download
- If necessary, local environment building

The simulator will not work without the Template APK.

### 2. Creation of the program, simulation trial, debugging/improvement

Let's watch the development procedure guide video!

- A tutorial video on how to log in to the site and create a program is available on the Kibo-RPC website.
- If you are new to programming, we strongly recommend you to watch it from the beginning



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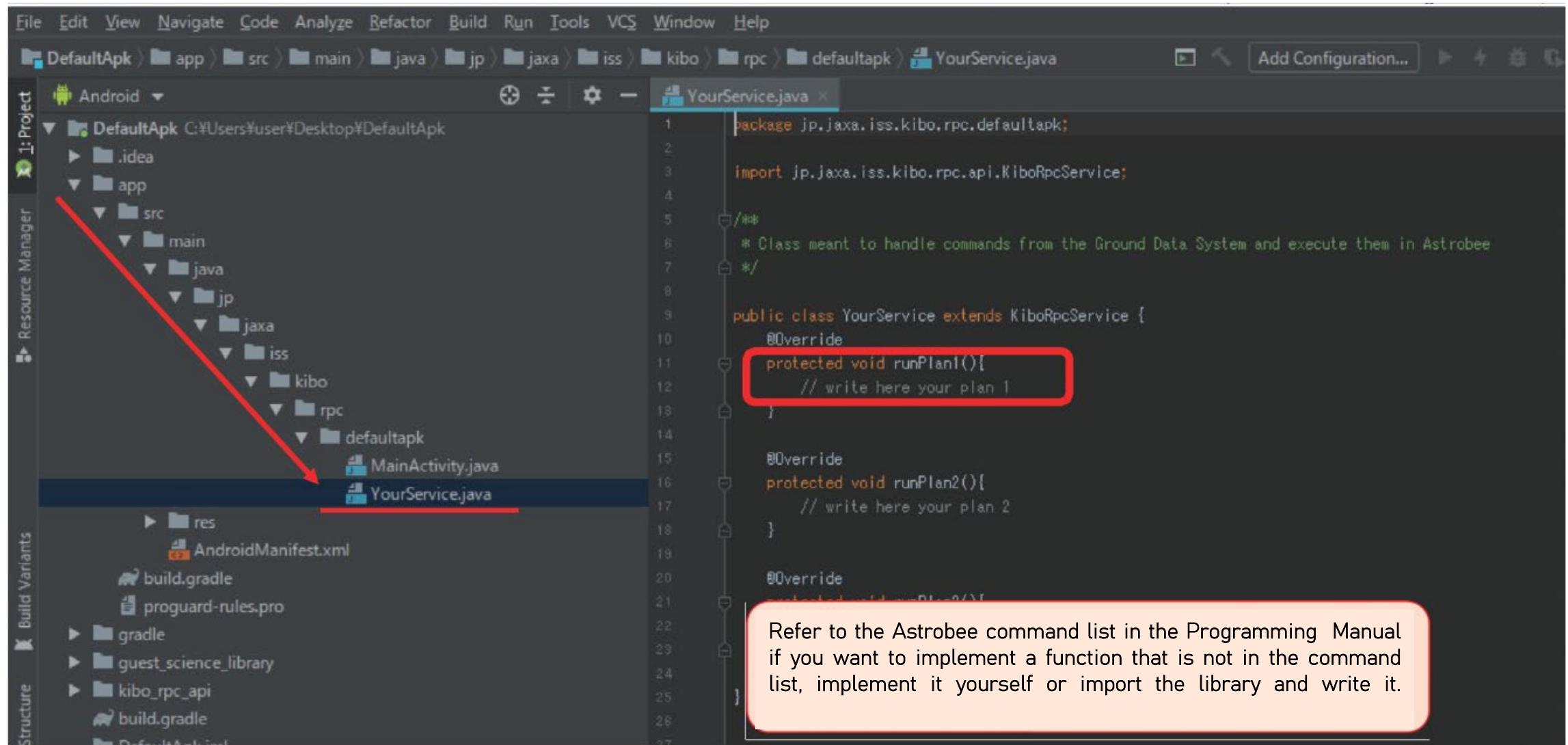
# PROGRAM CREATION FLOW

## 1. Program creation



Create your program on your own PC  
(java language)

# PROGRAM CREATION FLOW

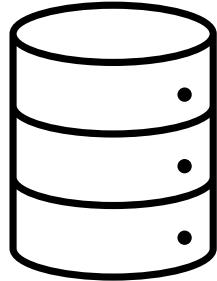
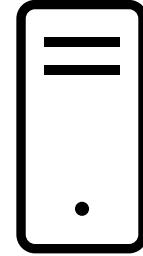


# PROGRAM CREATION FLOW

1. Program creation



2. Upload APK into JAXA's server



Create your program on your own PC  
(java language)

# PROGRAM CREATION FLOW

The screenshot shows the homepage of the Kibo-RPC website. At the top, there is a navigation bar with the Kibo-RPC logo, a home icon labeled "ホーム", a question mark icon labeled "よくある質問", a download icon labeled "ダウンロード", a lock icon labeled "ログイン", and language options "EN" and "JA". A red dashed circle highlights the "ログイン" button. Below the navigation bar, the title "Kibo Robot Programming Challenge" is displayed, along with three images: a view of the International Space Station from space, a white spherical robot with blue glowing eyes inside the ISS, and a close-up of a robotic arm. At the bottom of the page, there is a banner with Japanese text: "宇宙×ロボット×プログラミング" (Space × Robot × Programming), "キミも参加してみよう!" (Let's participate too!), and "第4回 Kibo-RPC" (4th Kibo-RPC). Another banner at the very bottom says "プログラム開発手順ガイド動画公開予定!!" (Program development procedure guide video to be released!!).

# PROGRAM CREATION FLOW

## Homepage

The screenshot shows the Kibo-RPC homepage with a dark blue header bar. The header contains the logo "Kibo-RPC" and the subtext "Kibo Robot Programming Challenge". To the right are navigation links: HOME (highlighted in green), SIMULATION, EVENT, BULLETIN BOARD, CHANGE PASSWORD, and LOGOUT.

The main content area is divided into three sections:

- Simulator Issues:** A box containing the text "There are no issues." with a decorative yellow dashed line below it.
- Simulator Releases:** A box containing a table with three columns: Date, Version, and Note. The table shows one entry: April 03, 2023, 1.0, and "1st release of Web Simulator for Preliminary Trial".
- Preliminary Round Info:** A box containing the text "Coming soon..." with a decorative yellow dashed line below it.

# PROGRAM CREATION FLOW

## SIMULATION PAGE

The screenshot shows the Kibo-RPC simulation page. At the top, there is a navigation bar with links for HOME, SIMULATION (which is highlighted with a red dashed circle), EVENT, BULLETIN BOARD, CHANGE PASSWORD, and LOGOUT. Below the navigation bar, there are three main buttons: SIMULATION, RESULTS, and RANKING. The SIMULATION button is highlighted with a blue border.

The main content area features two slots for program submission. Slot #1 is labeled "Available" and contains fields for "Program" (with a dashed box for file upload), "Simulator Version" (set to 1.0), and "Memo". It includes three buttons: "START SIMULATION", "TERMINATE SIMULATION", and "VIEW RESULT". To the right of Slot #1, there are icons for cloud storage, a progress bar, and a rocket ship. A note says "Target Pattern  Random  Customized".

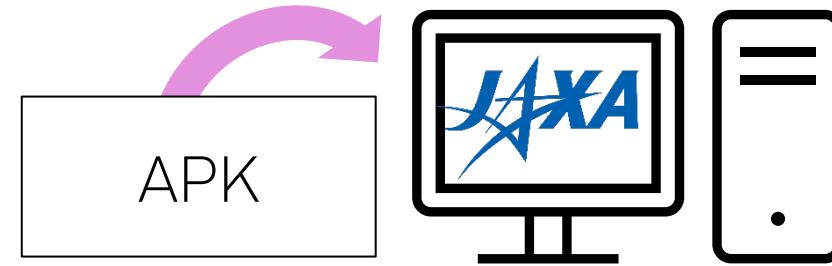
Slot #2 is also labeled "Available" and has a similar structure, though its details are partially cut off at the bottom of the screen.

# PROGRAM CREATION FLOW

## 1. Program creation

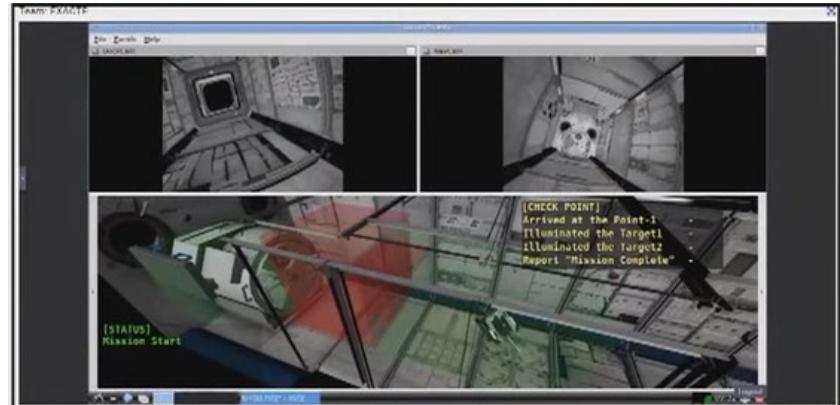


## 2. Upload APK into JAXA's server



Create your program on your own PC  
(java language)

## 3. Program execution



# PROGRAM CREATION FLOW

## SIMULATION PAGE

The screenshot shows the Kibo-RPC Simulation Page. At the top, there is a navigation bar with links for HOME, SIMULATION (which is currently selected), BULLETIN BOARD, CHANGE PASSWORD, and LOGOUT. Below the navigation bar, there are two main buttons: "SIMULATION" (highlighted with a blue border) and "RESULTS".

The main content area is titled "Slot #1 Available". It displays a file named "SampleApk.apk" which is 0.1 GB in size. There are upload, download, and delete icons above the file. Below the file, there are dropdown menus for "Target Position" (set to "Random"), "Simulator Version" (set to "1.0"), and "KOZ Patten" (set to "Random"). A "Memo" input field is also present.

At the bottom of the slot card, there are three buttons: "START SIMULATION" (highlighted with a red arrow pointing to it), "TERMINATE SIMULATION", and "VIEW RESULT".

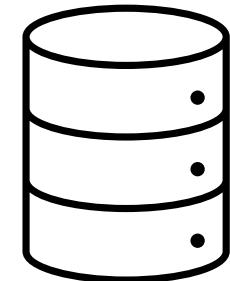
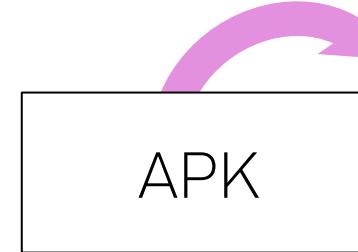
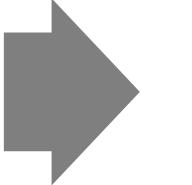
# PROGRAM CREATION FLOW

## 1. Program creation

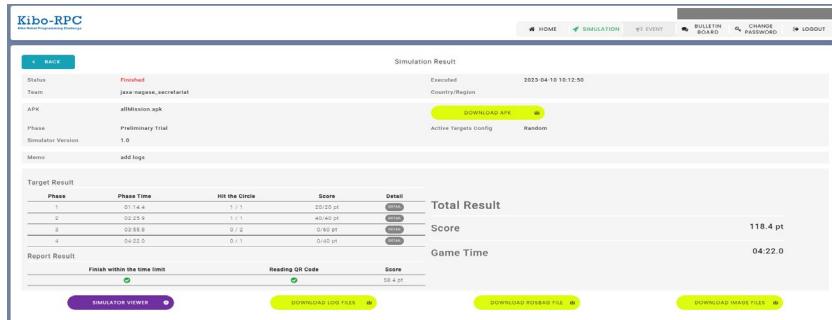


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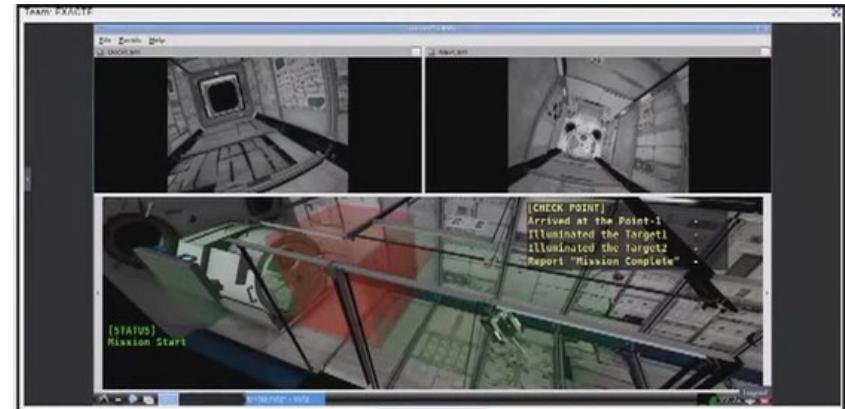
## 2. Upload APK into JAXA's server



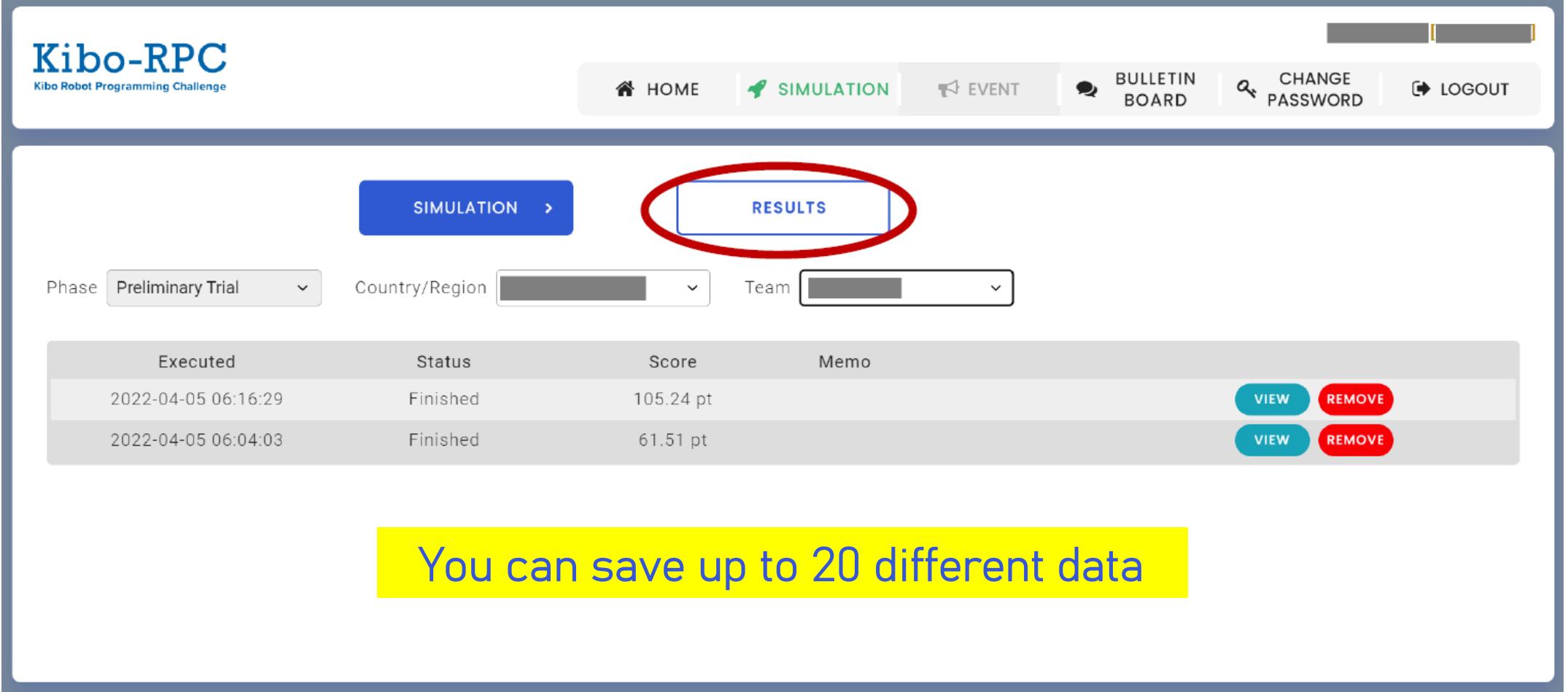
## 4. Verification of the results



## Program execution



# PROGRAM CREATION FLOW



The screenshot shows the Kibo-RPC software interface. At the top, there is a navigation bar with the following items: HOME, SIMULATION (which is highlighted in green), EVENT, BULLETIN BOARD, CHANGE PASSWORD, and LOGOUT. Below the navigation bar, there is a search bar with two dropdown menus for Phase (Preliminary Trial) and Team, and a dropdown menu for Country/Region. A large blue button labeled "SIMULATION >" is positioned to the left of the search bar. To the right of the search bar, a red oval highlights a blue button labeled "RESULTS". Below the search bar, there is a table displaying simulation results. The table has columns for Executed (date and time), Status, Score, and Memo. Each row contains two "VIEW" and "REMOVE" buttons. The data in the table is as follows:

Executed	Status	Score	Memo
2022-04-05 06:16:29	Finished	105.24 pt	<button>VIEW</button> <button>REMOVE</button>
2022-04-05 06:04:03	Finished	61.51 pt	<button>VIEW</button> <button>REMOVE</button>

At the bottom of the interface, there is a yellow banner with the text "You can save up to 20 different data".

# PROGRAM CREATION FLOW

The screenshot shows the Kibo-RPC interface for the "SIMULATION" section. At the top, there is a navigation bar with links for HOME, SIMULATION (which is active), EVENT, BULLETIN BOARD, CHANGE PASSWORD, and LOGOUT. Below the navigation bar, there are two buttons: "SIMULATION" and "RESULTS". The "SIMULATION" button is highlighted with a blue background and white text. The "RESULTS" button has a blue border and white text. Below these buttons, there are three dropdown menus: "Phase" set to "Preliminary Trial", "Country/Region" (with a dropdown arrow), and "Team" (with a dropdown arrow). A table below these filters displays two rows of simulation data:

Executed	Status	Score	Memo	
2022-04-05 06:16:29	Finished	105.24 pt		<a href="#">VIEW</a> <a href="#">REMOVE</a>
2022-04-05 06:04:03	Finished	61.51 pt		<a href="#">VIEW</a> <a href="#">REMOVE</a>

Below the table, a yellow banner contains the text: "You can save up to 20 different data".

# PROGRAM CREATION FLOW

Kibo-RPC  
Kibo Robot Programming Challenge

HOME SIMULATION EVENT BULLETIN BOARD CHANGE PASSWORD LOGOUT

[BACK](#)

### Simulation Result

Status	Finished	Executed	2023-04-10 10:12:50
Team	[REDACTED]	Country/Region	
APK	allMission.apk	DOWNLOAD APK	[REDACTED]
Phase	Preliminary Trial	Active Targets Config	Random
Simulator Version	1.0		
Memo	add logs		

### Target Result

Phase	Phase Time	Hit the Circle	Score	Detail
1	01:14.4	1 / 1	20/20 pt	[DETAIL]
2	02:25.9	1 / 1	40/40 pt	[DETAIL]
3	03:55.8	0 / 2	0/60 pt	[DETAIL]
4	04:22.0	0 / 1	0/40 pt	[DETAIL]

### Total Result

Score 118.4 pt

Game Time 04:22.0

### Report Result

Finish within the time limit	Reading QR Code	Score
✓	✓	58.4 pt

[SIMULATOR VIEWER](#) [DOWNLOAD LOG FILES](#) [DOWNLOAD ROSBAG FILE](#) [DOWNLOAD IMAGE FILES](#)

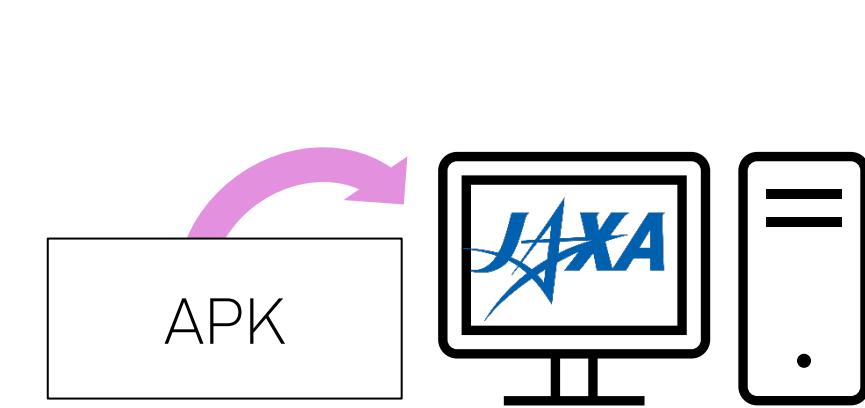
# PROGRAM CREATION FLOW

## 1. Program creation



Create your program on your own PC  
(java language)

## 2. Upload APK into JAXA's server



## 4. Result

A screenshot of the Kibo-RPC software interface. It shows a "Status" section with "Team" set to "jaxa-nagoya\_secretariat" and "apk" set to "allMission.apk". Below this is a "Target Result" table with four rows. The first row has "Score" 118.4 pt. At the bottom are buttons for "SIMULATOR VIEWER", "DOWNLOAD LOG FILE", and "DOWNLOAD REPORT FILE".

Phase	Phase Time	Hit the Circle	Score	Detail
1	00:14.4	1 / 1	20.00 pt	40.40 pt
2	00:25.9	1 / 1	40.40 pt	0.00 pt
3	00:36.8	0 / 2	0.00 pt	0.00 pt
4	00:42.0	0 / 1	0.00 pt	

Total Result: 118.4 pt

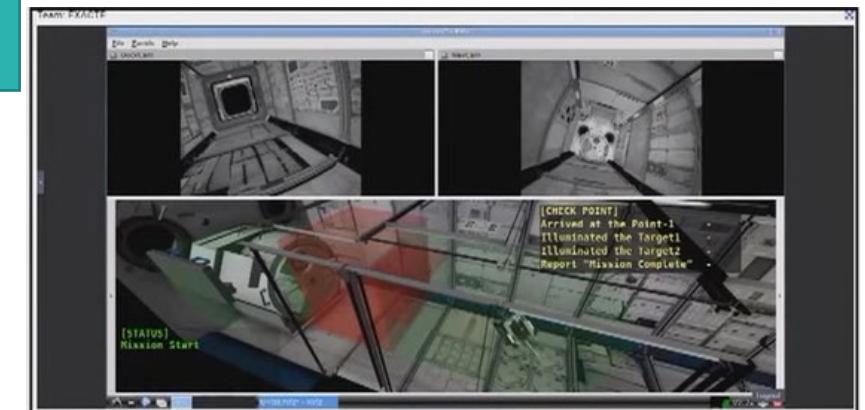
Report Result: 50.4 pt

Game Time: 04:22.0

Buttons: SIMULATOR VIEWER, DOWNLOAD LOG FILE, DOWNLOAD REPORT FILE

Feedbacks are important  
to improve the program

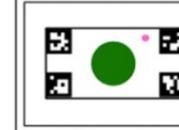
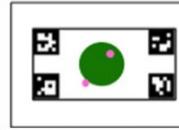
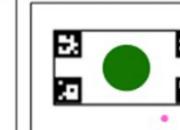
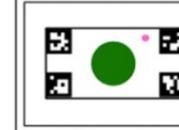
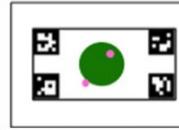
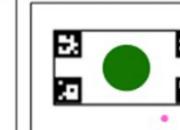
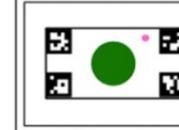
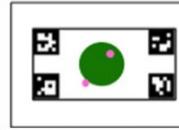
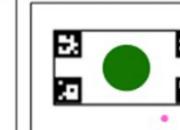
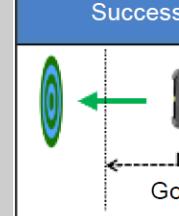
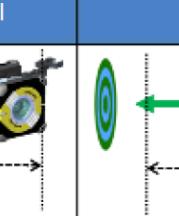
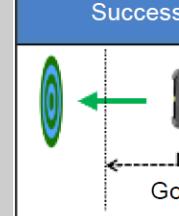
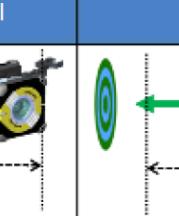
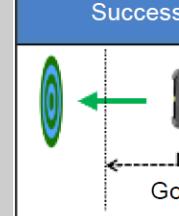
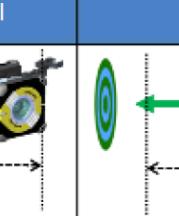
## 3. Execution



# ABOUT SCORING

## Scoring factors

\*The scoring formula will not be published.

1	Hitting the target with the laser	If the laser hits inside the specified area, basic points will be awarded. If the laser hits close to the center of the target, additional points will be awarded. The point hits by the laser will be determined from a single snapshot.	<table border="1"><thead><tr><th>Successful</th><th>Unsuccessful</th></tr></thead><tbody><tr><td> Basic Points</td><td> Additional Points</td></tr><tr><td></td><td></td></tr></tbody></table>	Successful	Unsuccessful	 Basic Points	 Additional Points		
Successful	Unsuccessful								
 Basic Points	 Additional Points								
									
2	Reaching the goal	Points will be awarded regarding the range of the designated coordinates.	<table border="1"><thead><tr><th>Successful</th><th>Unsuccessful</th></tr></thead><tbody><tr><td> Goal</td><td> Goal</td></tr></tbody></table>	Successful	Unsuccessful	 Goal	 Goal		
Successful	Unsuccessful								
 Goal	 Goal								
3	Mission completion report	Points will be awarded based on the content of the Mission Completion Report.							
4	Mission remaining time	When you have completed the mission, the remaining time will be converted into additional points and included in the total score. There is a limit to the additional points based on the remaining time. If you complete the mission with a certain amount of remaining time, you will receive an equivalent amounts of additional points.							

# AGENDA

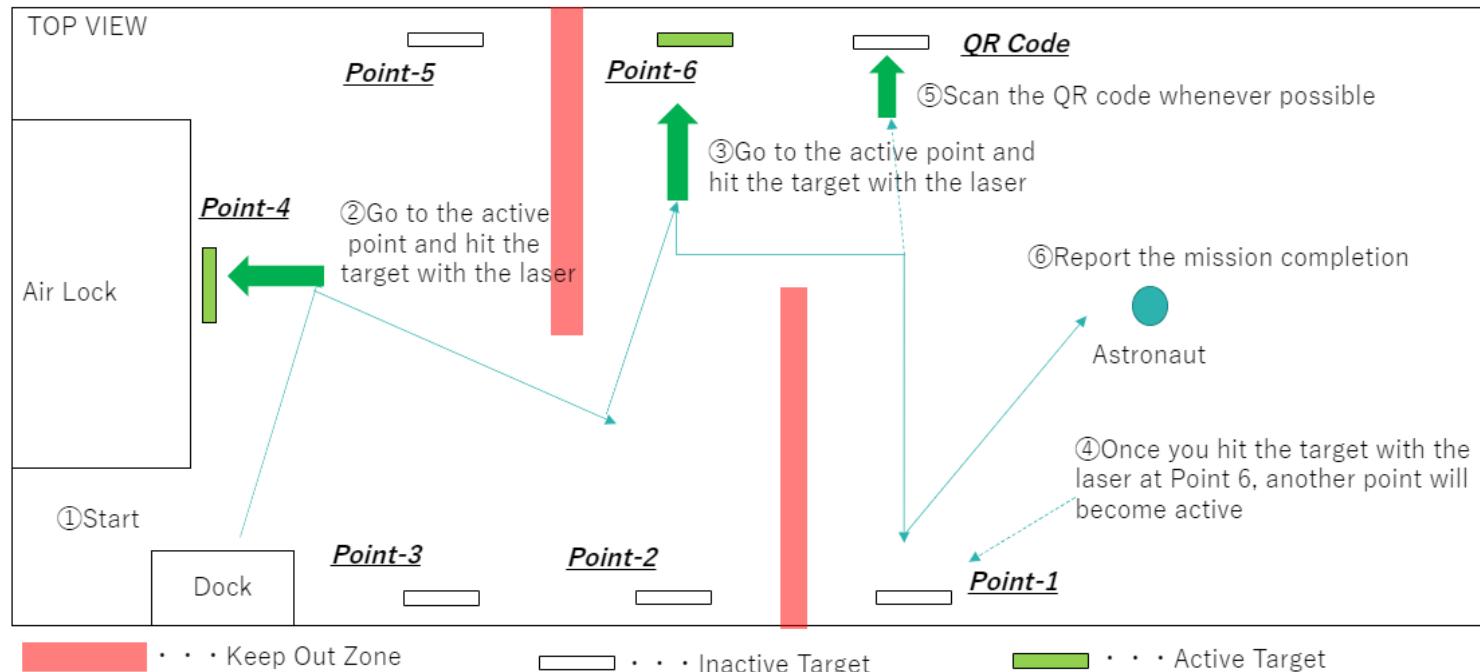
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- 5. Q&A**

# ABOUT THE PRELIMINARY ROUND

## Mission details

- In the preliminary round, the POC of each country/region runs the APKs submitted by the deadline using a simulator and the teams with the highest average score will go to the final round as finalists.

\*Depending on the country/region, factors other than the simulation score alone may also be included in the evaluation.



- Targets are in **6 locations**
- AR tags from 1 to 4 are placed next to the target and **randomly change**

# ABOUT THE PRELIMINARY ROUND

## Preliminary round rules

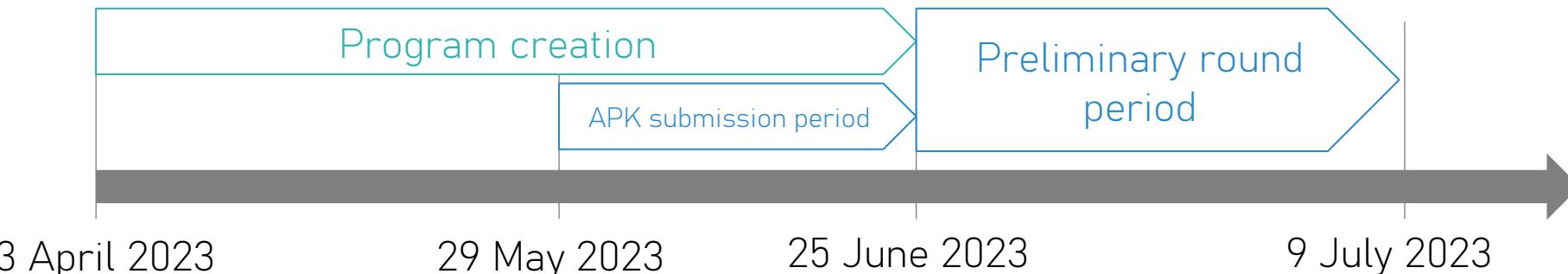
### 1. Eligibility

- Teams that have submitted their application form by 23:59 on 14 May 2023
- Teams that have submitted their APK by the submission deadline

**APK submission period 29 May to 25 June 2023**

### 2. Qualification period

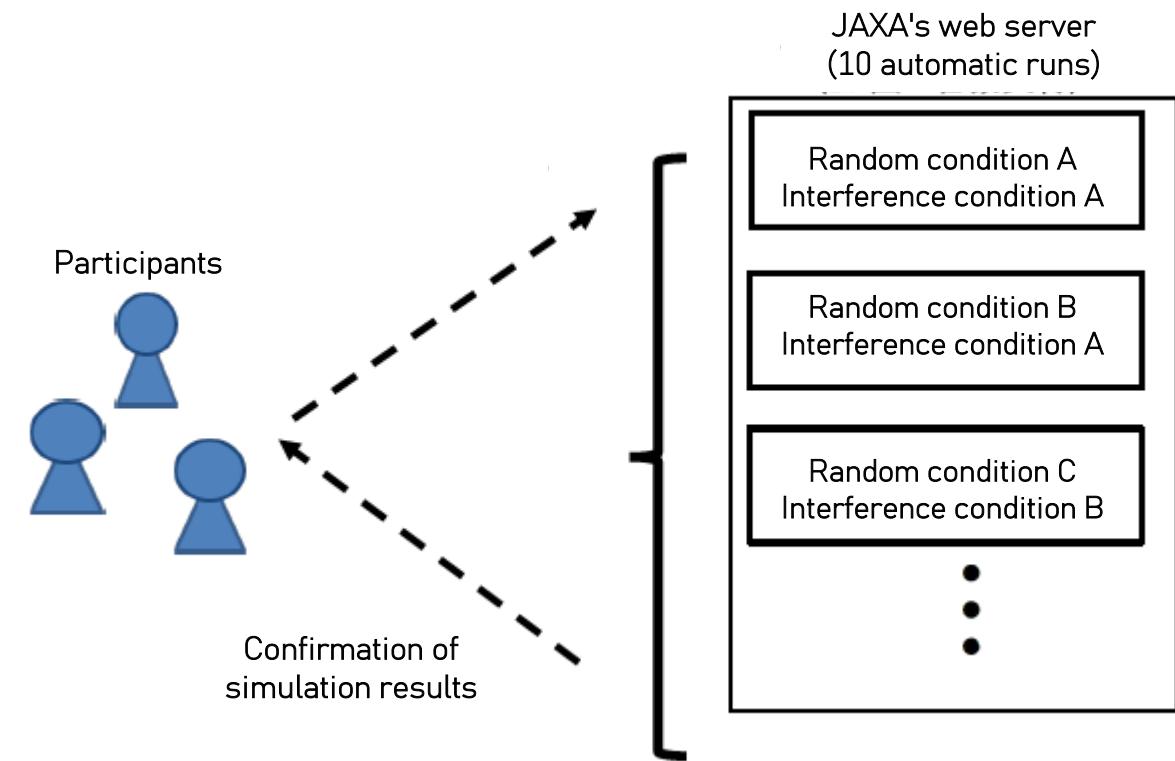
**Qualification period 26 June to 9 July 2023**



# ABOUT THE PRELIMINARY ROUND

## Preliminary round rules

3. Only one APK per team can be used
4. Each team runs 10 times in the preliminary round
  - All random factors are identical for all teams
  - Score is the average of the 10 runs



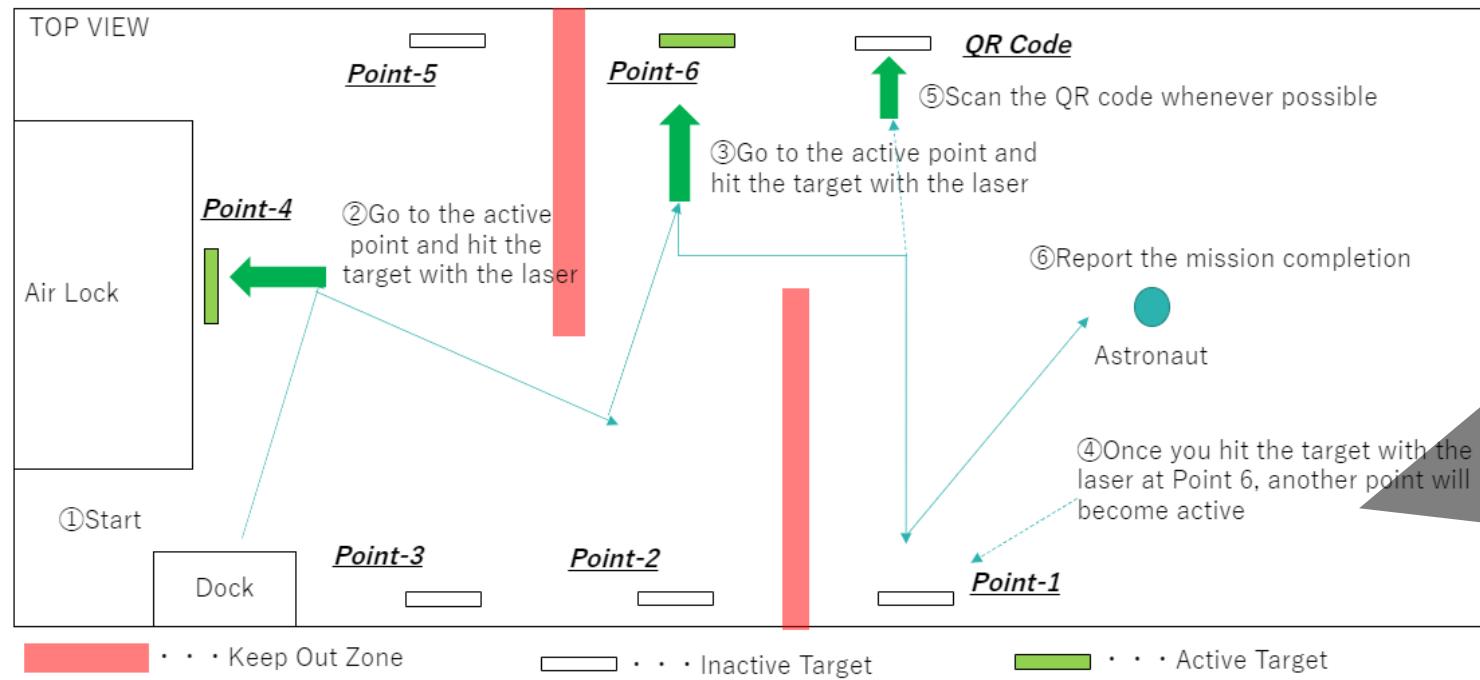
# AGENDA

- 1. 4th Kibo Robot Programming Challenge  
(Kibo- RPC) overview**
- 2. About the program creation**
- 3. About the preliminary round**
- 4. About the final round**
- 5. Q&A**

# ABOUT THE FINAL ROUND

## Mission details

- The final round is carried out by uplinking (installing) the program to the Astrobee in orbit.
- Programs for the final round are submitted in advance (expected late July/early August).
- Details of the Final round and the program submission date will be provided to finalists at a later date.



- Targets are in **4 locations**
- **AR tags from 1 to 4** are placed next to the target and **randomly change**
- In the final round only, Astrobee's Signal Lights light up according to the mission completion report

# ABOUT THE FINAL ROUND

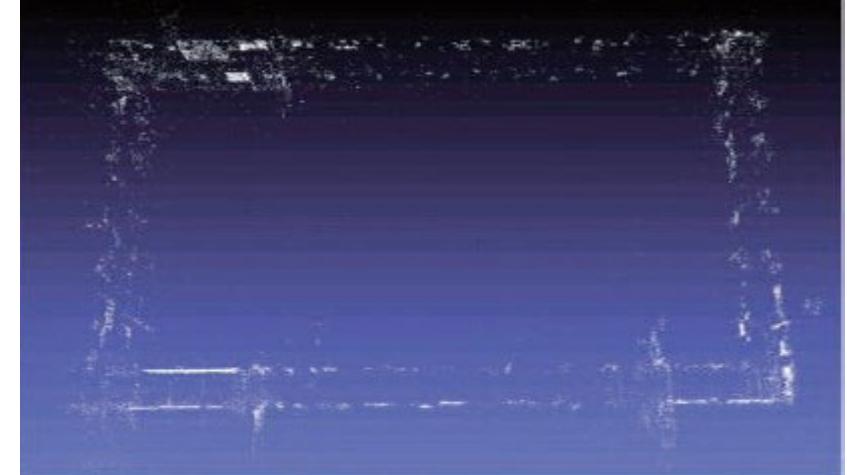
Difference between simulated and real environment

## Sparse Mapping

- ① Collect images of the Kibo interior in advance and create a Map
- ② Estimate self-location by comparing the image taken by the camera during the flight with the map.



Cannot estimate self-location  
if features are too small.

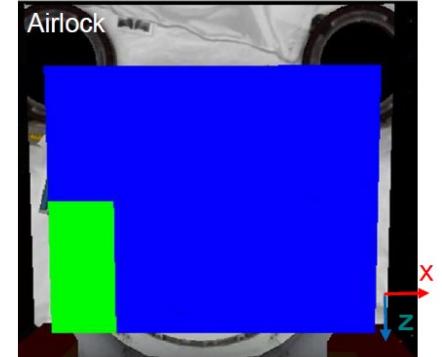
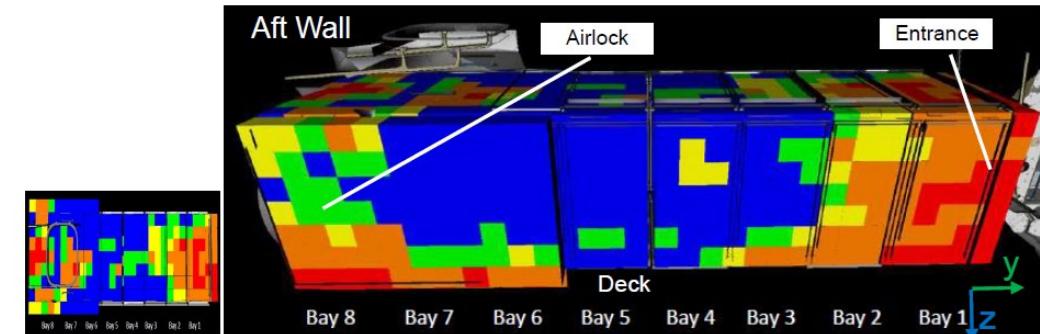
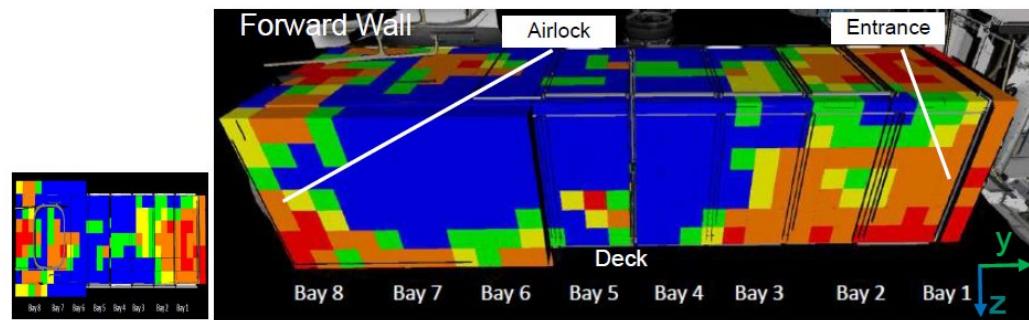
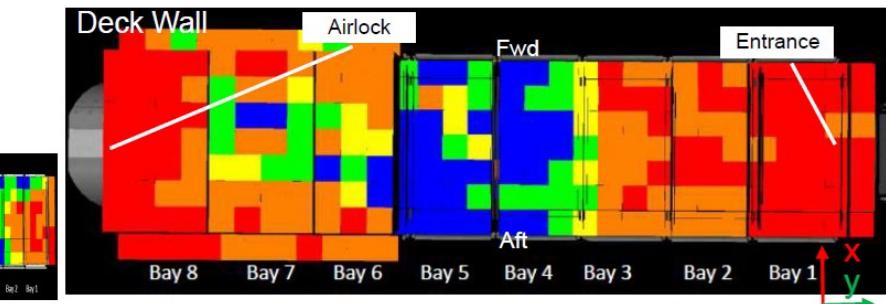
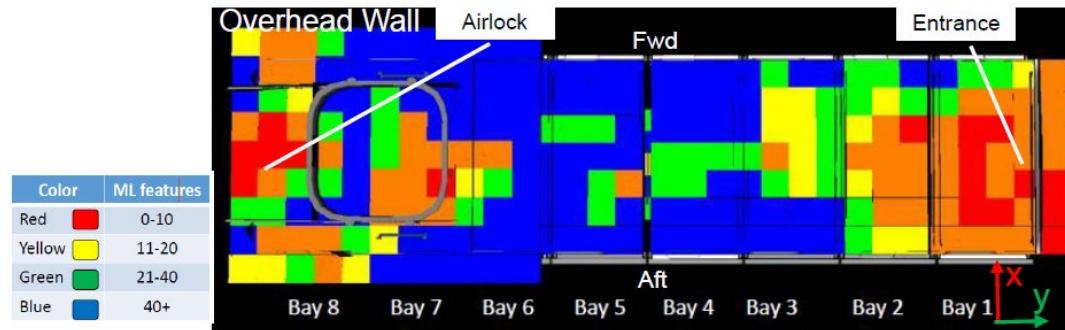


<https://www.nasa.gov/sites/default/files/atoms/files/coltin2016localization.pdf>

# ABOUT THE FINAL ROUND

Difference between simulation environment and real environment

## Mapped Landmark(ML) in Kibo



プログラミングマニュアルより

# ABOUT THE FINAL ROUND

ISS Run and Event will take place on different days

APK Final Run: mid-September 2023

Final Round Event: mid-October 2023

## Final Round Event details

Event opening/ Rules explanation

Presentation of the participant teams/ Results of the ISS Run

Announcement of rankings/award ceremony/interview with winning team

Kibo-RPC workshop (Lectures and networking events)

\*Details from 3rd Kibo-RPC

The event can be watched on YouTube

[3rd Kibo Robot Programming Challenge \(Kibo-RPC\), Final Round on-orbit competition](#)



# 4<sup>TH</sup> KIBO ROBOT PROGRAMMING CHALLENGE GUIDANCE SESSION#2

Thank you for your attention!

Please fill out the survey via this QR code

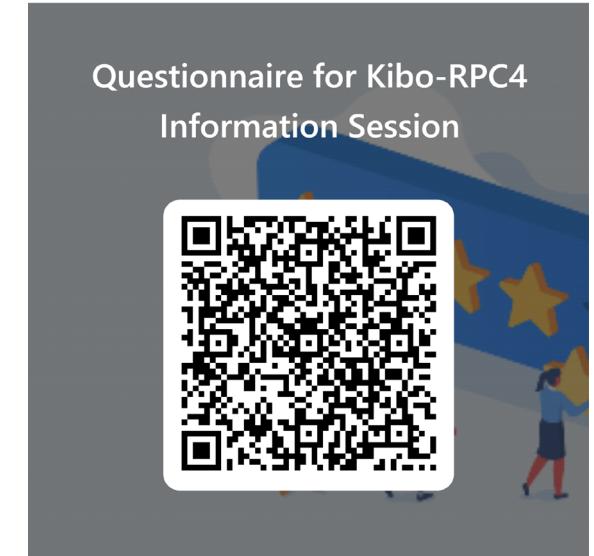
The time required is about 3 minutes.

Questionnaire for Kibo-RPC4  
Information Session



# Q & A

- If you have any questions, please write it in chat(QA).  
\*Questions that require confirmation will be answered by e-mail at a later date.



4th Kibo-RPC Competition's URL : <https://jaxa.krpc.jp/>  
JAXA KUOA URL : <https://humans-in-space.jaxa.jp/biz-lab/kuoa/>  
Kibo-RPC Secretariat : [Z-KRPC@ml.jaxa.jp](mailto:Z-KRPC@ml.jaxa.jp)