3rd Space Exploration Conference
50 Years of Space Exploration: Taking the Next Giant Leap

International Collaboration and Global Exploration

a brief update on what JAXA is planning in both science and exploration collaboration
to share views on the role of international collaboration
in the sustainability of space exploration

February 27th, 2008

Prof. Junichiro Kawaguchi, Program Director
Dr. Fuyuto Terui, Associate Senior researcher, R&D Office
JSPEC (JAXA Space Exploration Center)/JAXA

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JAXA Organizational Structure

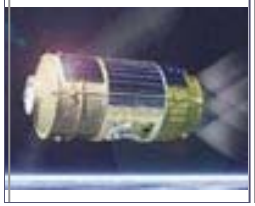
Total personnels : 1,649 (Apr . 2007)

Total Budget FY 2007 : \183.8B (US$1.52B)

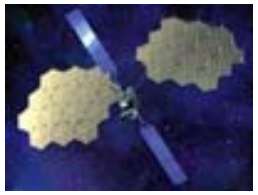
President

Vice-President

- Policy Coordination
- Admin. Management
- Technical Management
- Office of Space Flight & Operations



- Office of Space Applications

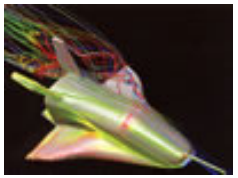


- Inst. of Space & Astro. Science

- Space Exploration Center (JSPEC)

- Human Space System & Utilization Prg. Group

- Aeronautical Program Group



- Inst. of Space tech. & Aeronautics.

Scope of work for JSPEC

- Elaborate strategies of science and technology, program planning and promotion of Space Exploration activities through domestic and international collaborations.
- Specific R&D activities for engineering and science
- Development, operation and other related activities for spacecraft
- Research and analysis of scientific and technical aspects for future missions

International activity by JSPEC

- **Global Exploration Strategy (GES)** framework document was agreed among 14 space agencies in Kyoto WS in March 2007.
- **International Space Exploration Coordination Group (ISECG)** started its implementation activities with 12 space agencies from November 2007 at Berlin WS.

Principle & Objectives for Space Exploration JAXA thinks

Principle for Space Exploration

Achieve lofty themes such as expansion of human activities and contribute to evolution of civilization.

While GES-FD states 5 Principles for the Space Exploration.

(1) Strategic & Political Objectives:

- To contribute and sustain the nation's economy and industry growth commensurate with its position in science & technology,
- To expand human activities as a stepping stone to Mars and beyond,
- To foster human resources of next generation for science and technologies in future.
- To contribute and formulate international collaboration and framework,

(2) Objectives from Technology and Innovation Point of View:

- To develop fundamental systems engineering skills such as landing, return, mobility, etc enabling autonomous and perfectly controllable missions.
- To induce technological innovation and to promote spin-offs so as to bring welfare and evolution to society through the challenges.

(3) Objectives from Science and knowledge point of view :

- To lead the top science, and to obtain new knowledge, and to contribute for the creation of new culture,
- To investigate the environment for full scale manned exploration to the moon and beyond.

JAXA's Lunar Exploration Strategy

- **Lunar Exploration Program :**
  leading International Cooperation, Discovery and Innovation
- **Robotic Lunar Missions:**
  Until the middle of 2010s, in-depth scientific measurements and utilization.
- **Human Lunar Missions:**
  ***Autonomous missions with its own objectives, making use of human related technologies.**
  ***Pursuing the Japanese astronaut on the moon as early as possible in international activity commensurate with its international status.**
  ***Lunar Surface activity by Japan's own space systems awaits for the governmental decision in the middle of 2010s.**

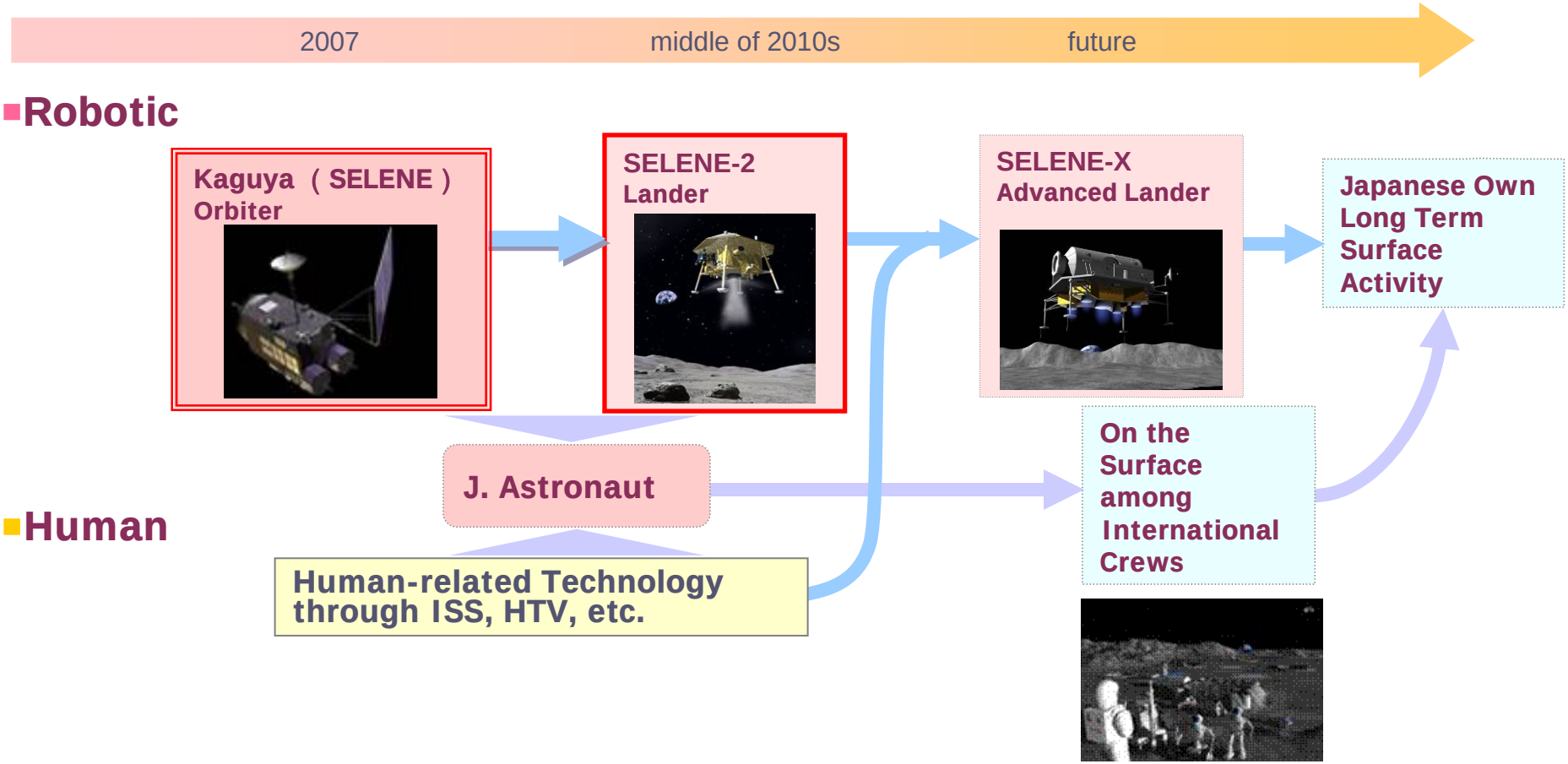
Robotic Lunar Missions concentrate:
- New Missions as SELENE follow-on
- Establish Technology Capabilities to contribute international efforts.

Human Lunar Missions concentrate:
- The Japanese astronaut on the surface for human in-situ operations, to acquire experience for further destinations.

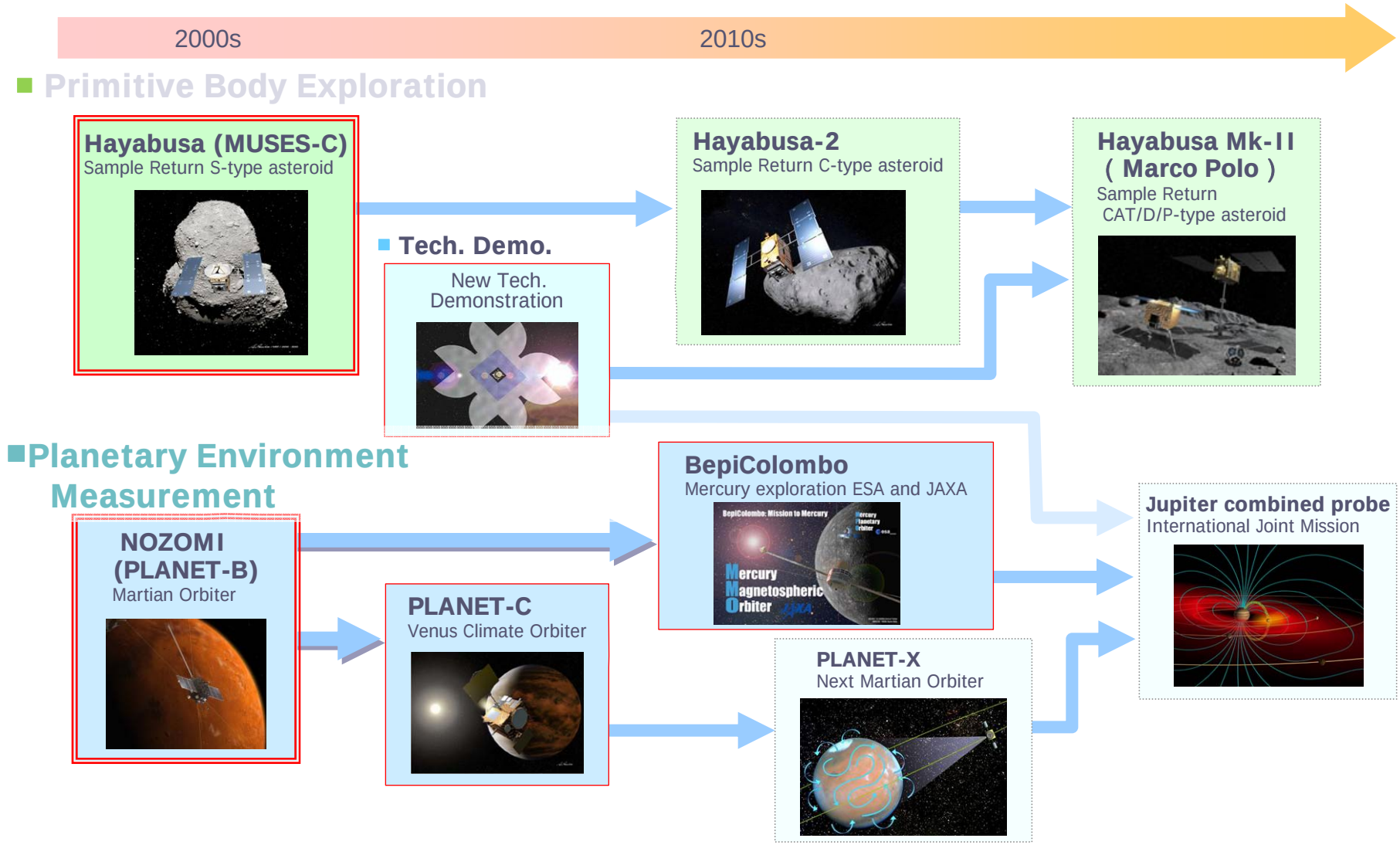
Robotic Lander for Surface Exploration

Japanese Astronaut on the Surface among International Crews

JAXA's Lunar Exploration Road Map



JAXA's Solar System Exploration Road Map



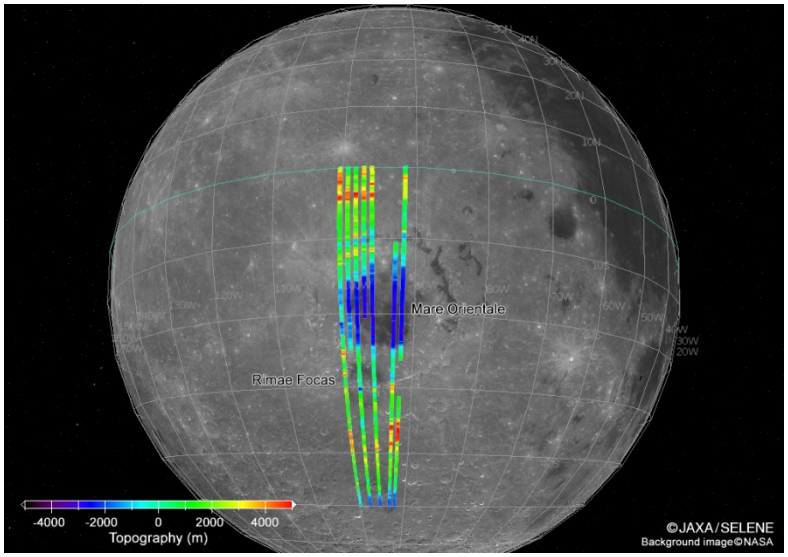
"Kaguya" Selenological and Engineering Explorer (SELENE)

- Launched by the H-IIA on September 14, 2007 (JST) from Tanegashima Space Center.
- The major objectives
  - **obtain scientific data** of the lunar origin and evolution
  - **develop the technology** for the future lunar exploration.

It consists of

- a main **orbiting satellite** at about 100km altitude
- **two small satellites** (Relay Satellite and VRAD Satellite) in polar orbit.

The orbiters will carry instruments for scientific investigation of the Moon, on the Moon, and from the Moon.



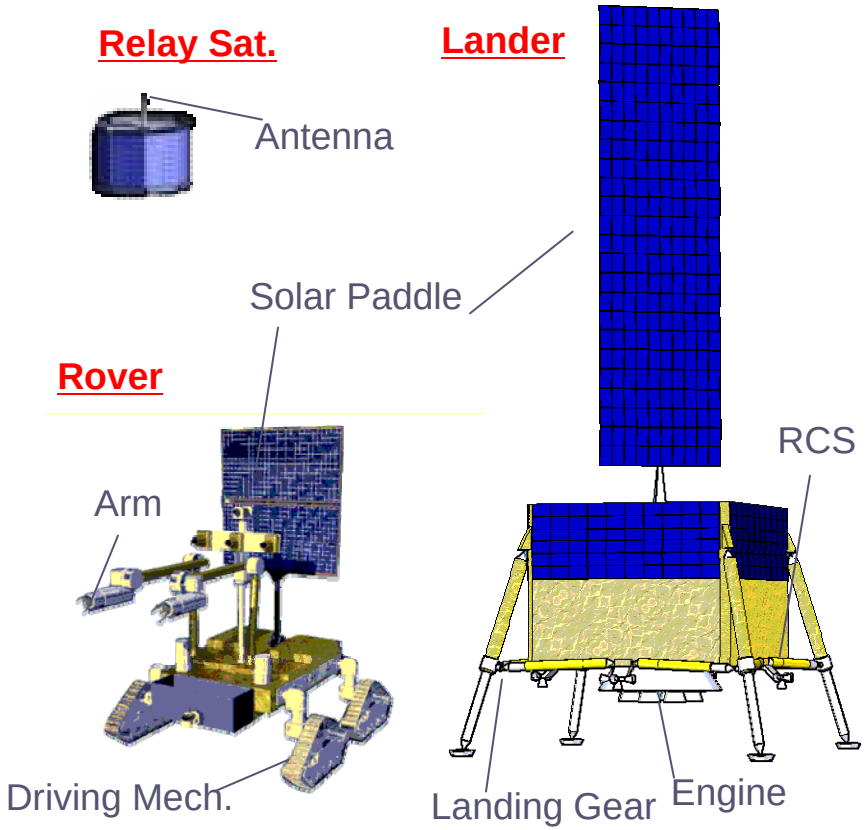
SELENE-2: Landing Observation

The landing area anticipated is at such as **Quasi- eternal sun-lit area** either in polar region or some other locations, and the mission life for the Lander shall last **one month** at least.

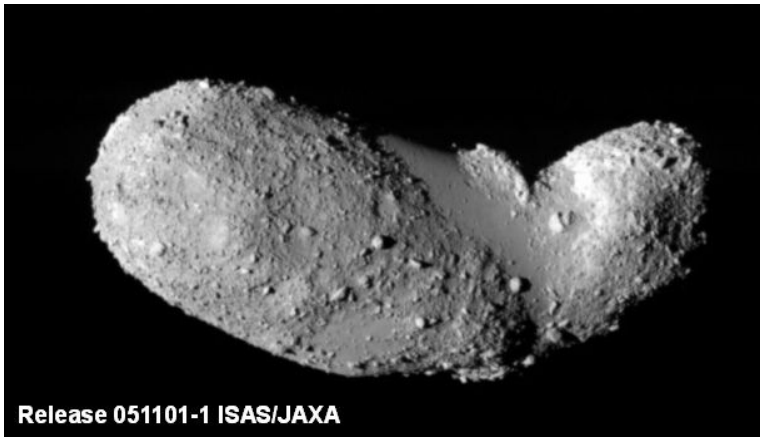
SELENE-2:

- Infrastructure for Exploration
  - **Lander**
    - Eternal light zone at polar
  - **Rover**
  - Moon night survival without RTG
- Lunar Science
  - Origin and evolution
- Environmental study for future utilization
- Int. collaboration and cooperation
- Launch: H-2A @ 2010s'
  - 1000kg (Dry)
  - 200 ~ 400kg Payload

Phase-A team started



Hayabusa: Sample Retune from Primitive Body



- Launched on 9th May, 2003
- Achieved its goal of arriving at the Type-S asteroid "**Itokawa"** and performing **scientific observations** and **touch down** in Nov., 2005.
- HAYABUSA is now on its **return trip to the Earth** in 2010

Hayabusa-2: Sample Retune from Primitive Body

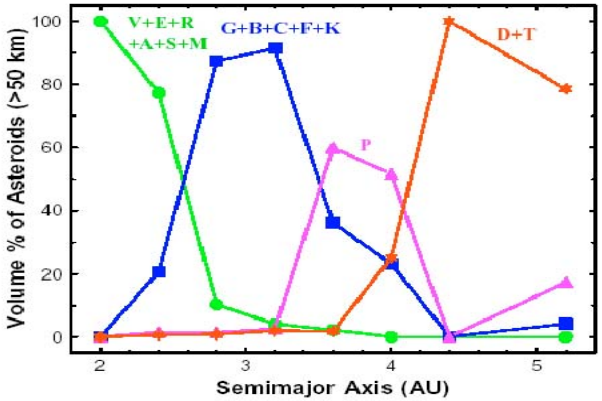
Hayabusa-2:

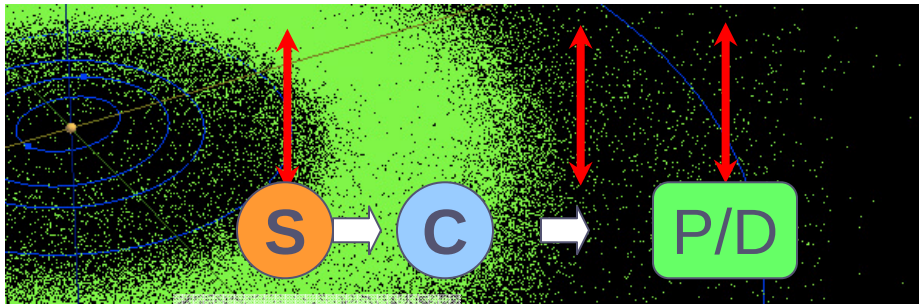
- Primitive body exploration
  - Programmatic **follow-on of Hayabusa**
  - from Type-S to **Type-C**
  - Hayabusa-Mk2 for Type-P,D
  - from asteroid belt
- Sample return
  - from type-C asteroid 1999 JU3
- Launch Window **2010-2012**

- Possible Missions for
  - Science
  - Human exploration
  - Earth protection
  - In-situ resource utilization
- International collaboration based on JAXA's experience

Phase-A team started

Mission of unique & autonomy





Asteroid Belt

Marco Polo

Outline

Marco Polo is a **sample return mission** after Hayabusa. The target object is more primitive one, such as **D type asteroids or dormant comets**.

Japan is in charge of the mother ship, and **Europe** is in charge of the large lander and launcher. (The mission is M class in Cosmic Vision.)

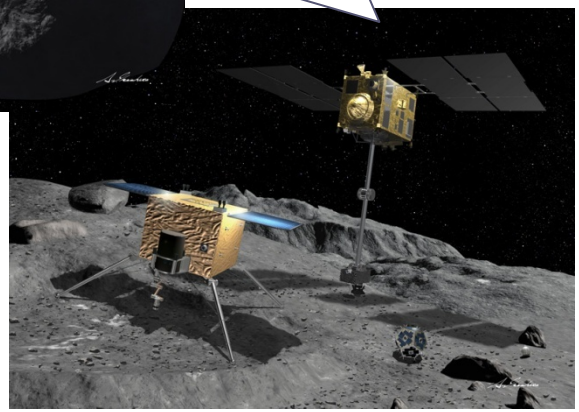
In situ observations by the mother ship, the lander, and the rover (optical, infrared, X-ray, radio) and sampling by two equipments will be performed.

The surface materials are brought back to the earth and they are analyzed in detail by using ground-based facilities.

Spacecraft approaching to the target

Initial state of Solar System

Exploration at the surface



One of the target objects:

Wilson-Harrington (dormant comet)

Mission Scenario

Launch	April 2018
Earth swingby	Oct. 2019
Arrival to target	Sept 2022
Departure	Jan 2023
Earth return	Oct. 2026

Other candidates:
2002 AT4, 2001 SG286, 1996 FG3, etc.

Objectives

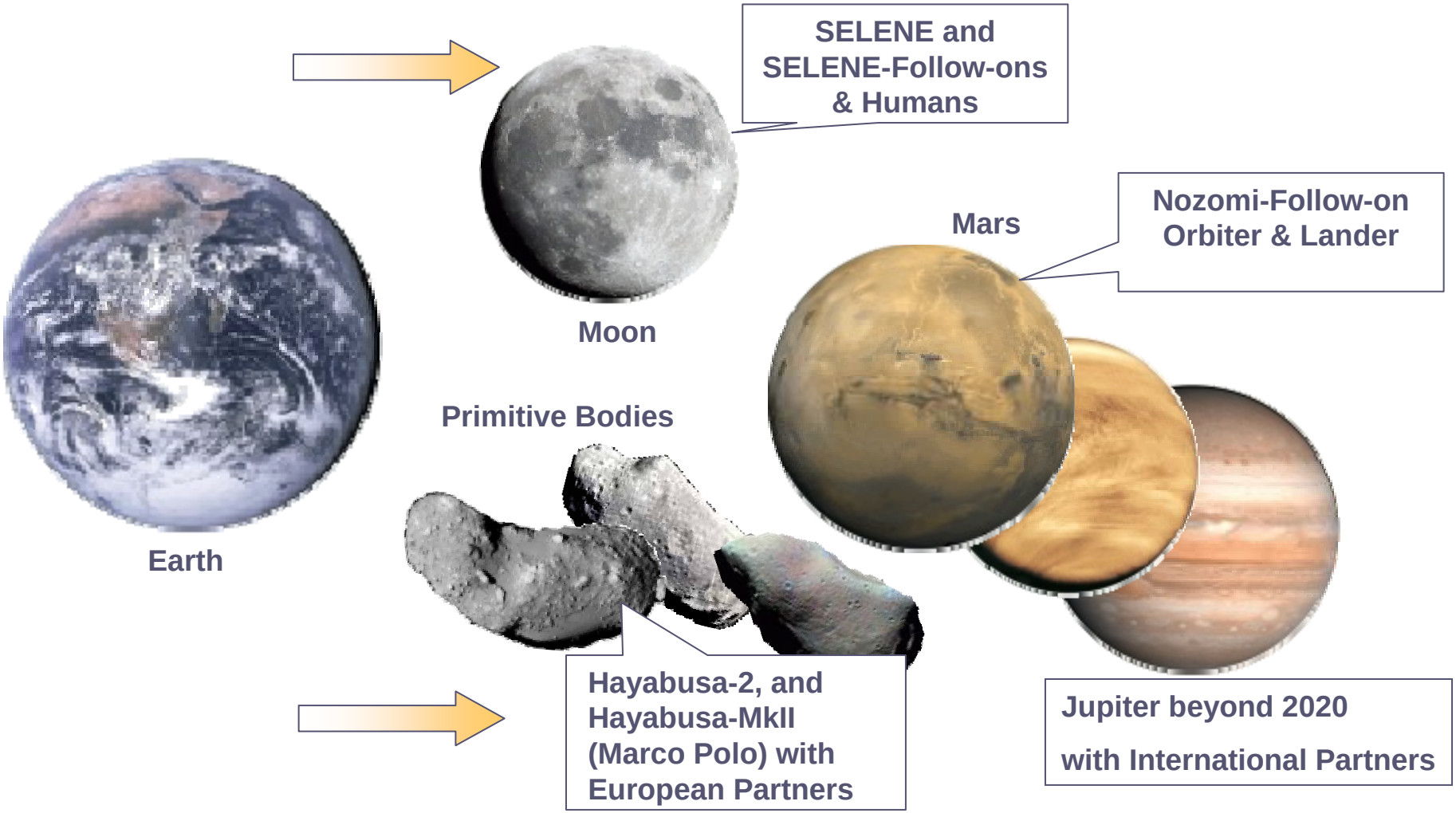
To understand the initial state and the evolution of the Solar System (primitive solar nebula and initial objects of the Solar System)

To understand the relationship between the primitive bodies of the Solar System and the life

To understand the material distribution in the Solar System

To develop higher level technology of explorations of Solar System bodies both for sample return and for in situ observations

JSPEC/JAXA Initiative for Solar System Exploration



JAXA's View for Science and Exploration

- Observation and Sample return by **lunar and primitive body unmanned mission** are for **expanding intellectual frontier**

: science

- Acquisition of **space robotics (unmanned) technology** is for **expanding territorial frontier for human activity**

: exploration

- Both are precursors for **unmanned solar system exploration of mars and beyond** and **human space exploration**
- Science mission pursues maximum result by small resources
- Exploration mission expects multidisciplinary and secondary effect comparable to the investment
- JSPEC/JAXA looks at **both Science and Exploration Missions** for Lunar & Planetary Destinations

JAXA's View
for International Cooperation and collaboration

- **Promote mutual reciprocity** across science and exploration field
- Realize common mission goal for mankind **gathering up participants' strength**
- Post ISS will be to go to the moon, mars and NEO. Multilateral cooperation and coordination are effective
- Standardization and data exchange will be coordinated by ISECG
- **Program of Programs** type cooperation is the key taking experiences from ISS into account

Conclusion

JAXA intends to contribute to the coordination **bridging between Exploration and Science** through ISECG-GES team activity among agencies with existing IMEWG, ILEWG, IPEWG and COSPAR....

Thank you