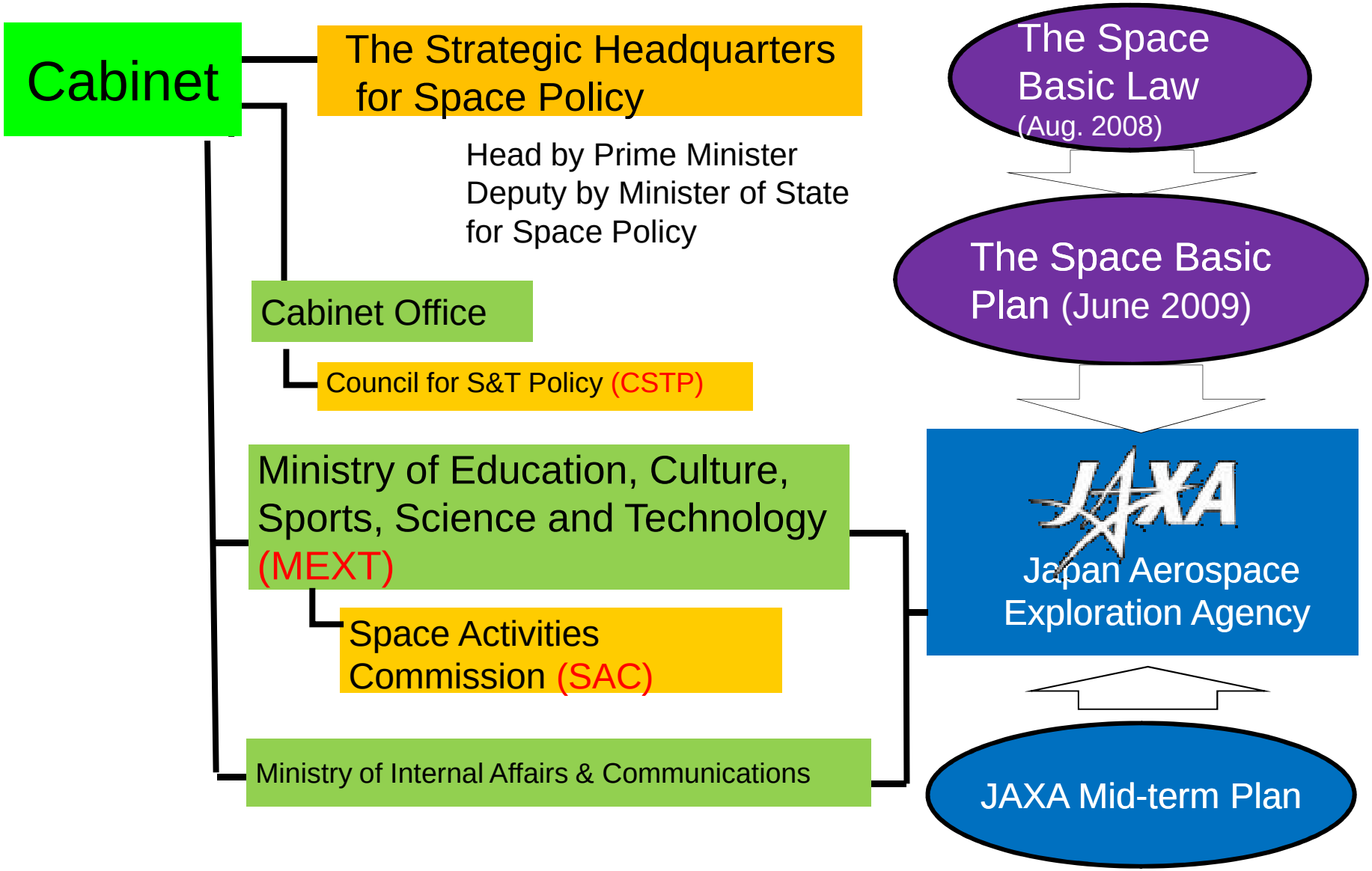
JAXA Status of Exploration and Human Space Program

November 14, 2011

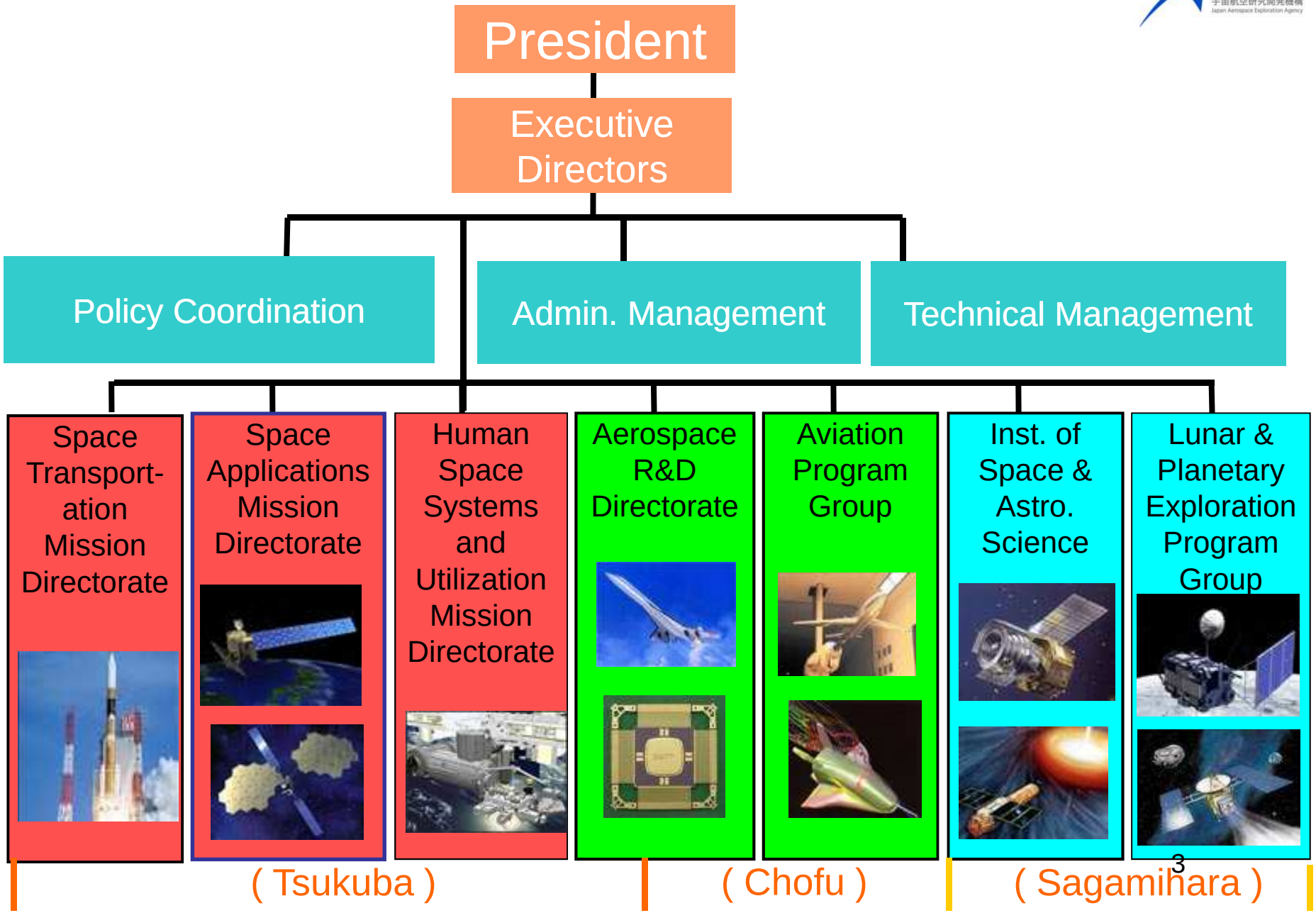
Japan Aerospace Exploration Agency
JAXA Space Exploration Center (JSPEC)

Naoki Sato

Outline of Japan's Space Policy and Organization



JAXA Organization and Activities



Space Basic Plan

[System] Satellite Applications System

- Land, Sea Observing Satellite contributing to Asian Region
- Earth Environment, Weather Observing Satellite
- Advanced Communication Satellite
- Positioning Satellite
- National Security Satellite

[Program] Research & Development Program

- Space Science Program
- Manned Program
- Space Solar Power System (SSPS) R&D Program
- Satellite Technology Demonstration Program

Calls for one year study of Japan's strategy for lunar exploration by robotic and possibly human

Overview of one year study of Japan's strategy for Lunar Exploration

- Objectives:
  - Clarify the exploration objectives and roadmap for technology development
  - Propose concrete plan for robotic lunar exploration for science and utilization, foreseeing manned lunar exploration afterward.
  - Establish the strategy for international cooperation
- Study group was organized under the Minister of state for Space Policy in August 2009 and completed the activities in July 2010.

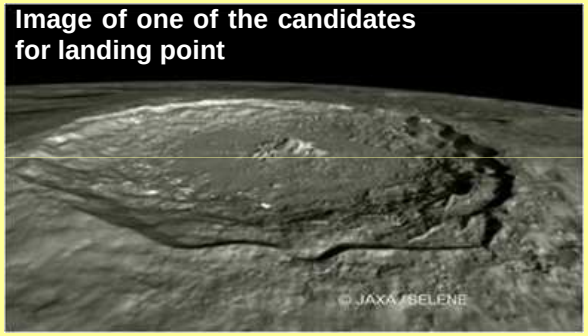
  Members: Reps.from industry, jurist, academy, astronaut, sociologist, etc
- A report was published and also was translated in English. (available upon request)
- Still need budget requests to implement the proposals in the report in the yearly budgetary cycle.

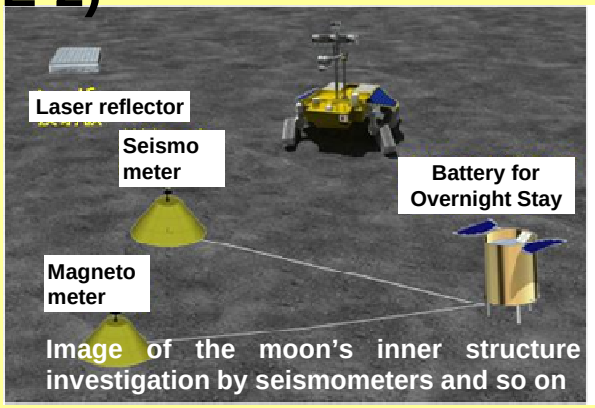
Robotic Exploration

Proposed Approaches :

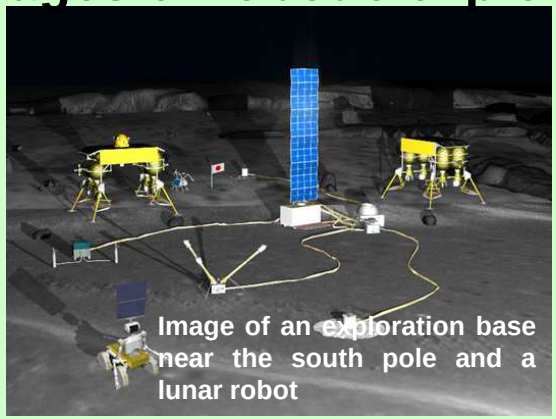
- 2015 : First lunar landing and short-term investigation
- 2020 : Assembly of the base, long-term investigation and sample return
- Demonstrate leadership in the international collaboration

Images of robotic exploration in 2015 (SELENE-2)





Images of robotic exploration in 2020 (SELENE-X)



Human Space Activity

Proposed Approaches :

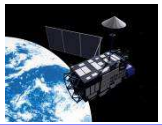
- Research and development of basic technologies for human transportation system by around 2020
  - Safety enhancement of rocket engine
  - Emergent escape technology
  - Human rated re-entry technology
  - Environment Control and Life Support technology
- Efficient technology development leveraging other space activities such as
  - Robotic lunar exploration
  - H-IIA/B launch operation
  - ISS utilization and operation for technology demonstration
- International cooperation is mandatory for human space exploration

JAXA's Roadmap and Current Project Status

JAXA's Roadmap for Space Exploration

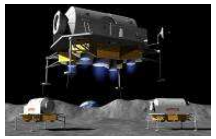
●Robotic Lunar Exploration Mission

2007～2009
KAGUYA (SELENE)
Orbiter

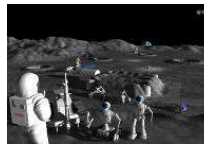


2016～
SELENE-2
Lander & Rover

2020～
SELENE-X
Advanced Lander for South Pole missions



Participation in international lunar exploration missions with Japanese crew



●Human Lunar Exploration Mission

Acquisition and Development of Human-related basic technology through the operation and utilization of ISS. HTV, etc.

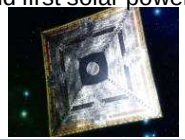
●Primitive Body Exploration

2003～2010
HAYABUSA (MUSES-C)
Sample return S-type asteroid

HAYABUSA-2
Sample return C-type asteroid

HAYABUSA-Mk2
Sample return D-type asteroid

2010
IKAROS
(Small Solar Power Sail)
World first solar power sail

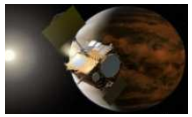


Jupiter and Torojan asteroids exploration
International Joint Mission

1998
NOZOMI (PLANET-B)
Japan first Mars explorer

BepiColombo
Mercury exploration ESA and JAXA

2010
PLANET-C
World first Venus Climate Orbiter

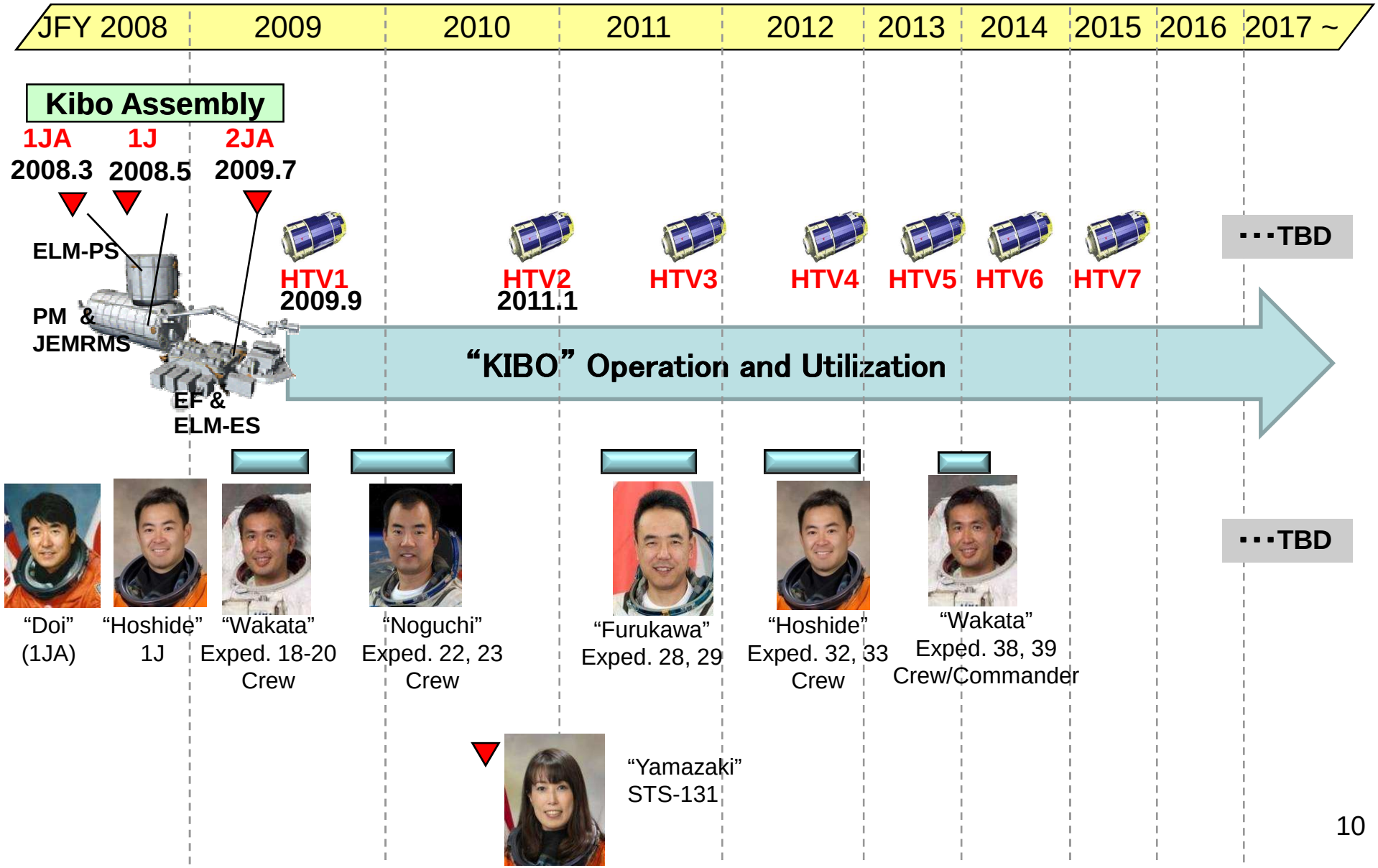


MELOS
Next Martian Orbiter

Robotics exploration for further expansion of frontier

Bold blue squares show the projects conducted.

ISS Japanese Elements and Astronauts' Flight Plan



SELENE (Kaguya)

Mission Objectives:

The major objectives of the KAGUYA mission are to obtain scientific data on lunar origins and evolution, and to develop the technology for future lunar exploration. The scientific data will be also used for exploring the possibility of future utilization of the Moon.

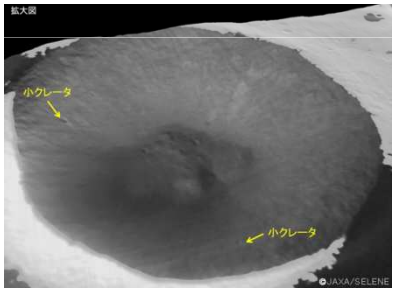
Mission Profile:

Launch: Sep. 2007

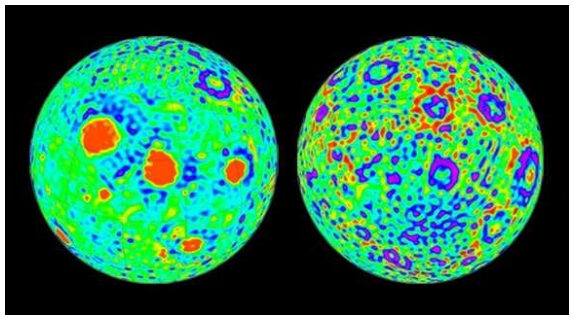
LOI to 100km: Oct. 2007

Landing (Hard): Jun. 2009

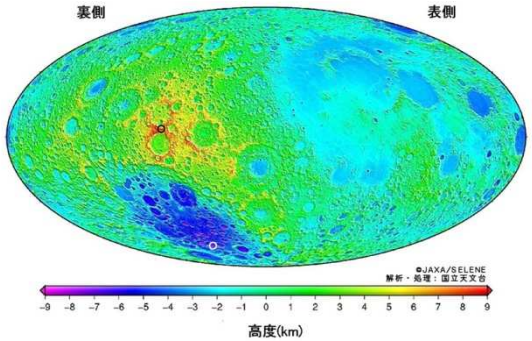
High Definition TV image



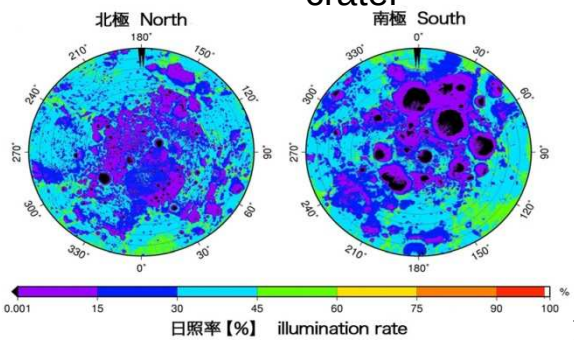
Internal view of Shackleton crater



Global gravity distribution



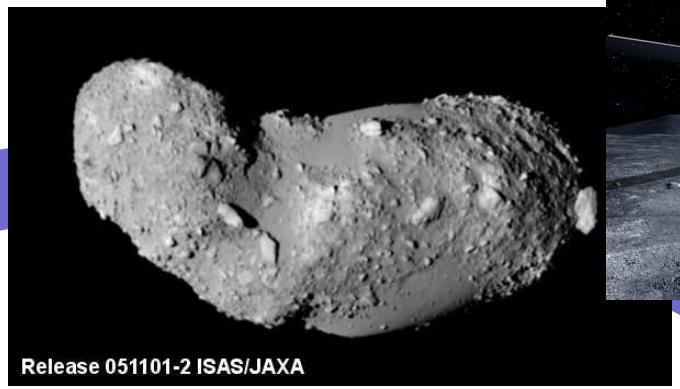
Global terrain map



Global illumination map

HAYABUSA

- World 1st Sample Return from Asteroid -



Arrival in 2005

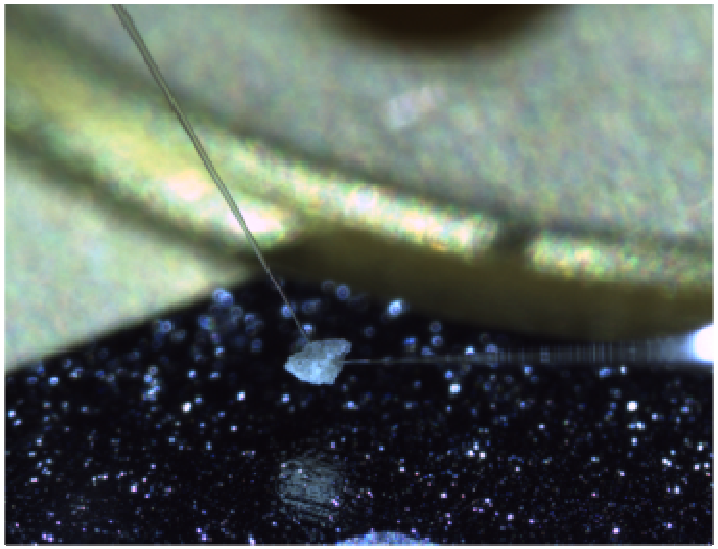
Launch in 2003

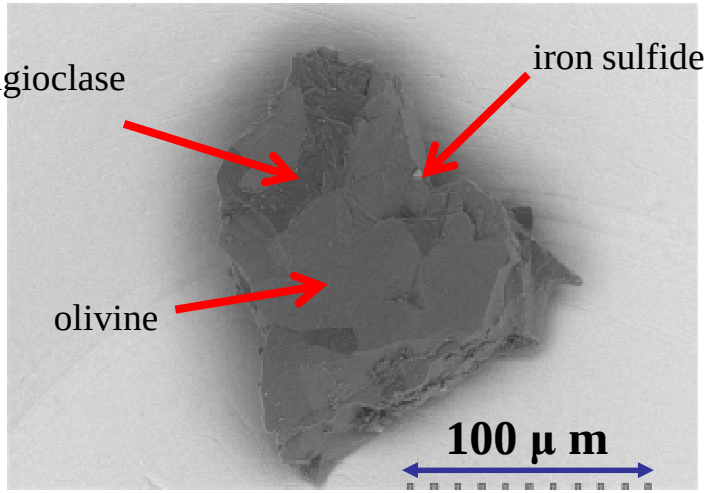
Return to Earth in 2010

HAYABUSA

- Current status of curation activity -

- Samples were collected by a special spatula in the Curation Facility in Sagamihara.
- Scanning Electron Microscope (SEM) observations and analyses (up to Nov. 2010)





- About 1,500 grains were identified as rocky particles.
- Most of them were judged to be of extraterrestrial origin (Asteroid Itokawa).

IKAROS

(Interplanetary Kite-craft Accelerated by Radiation Of Sun)

- Solar sailing (thrust by photon) demonstration - COMPLETED
- Demonstration of attitude control by LCD reflection ratio change - COMPLETD

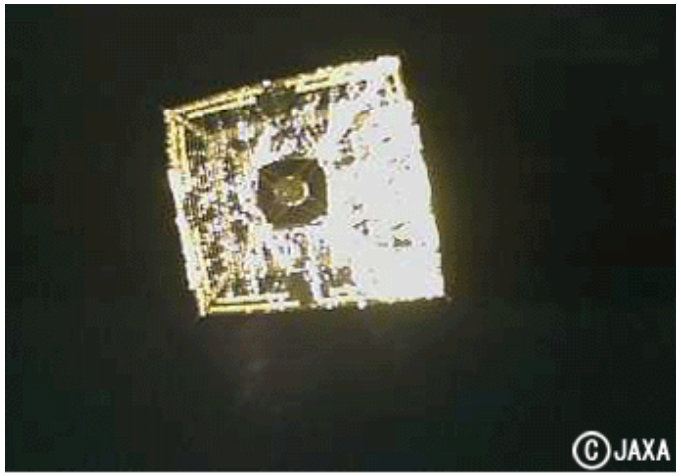
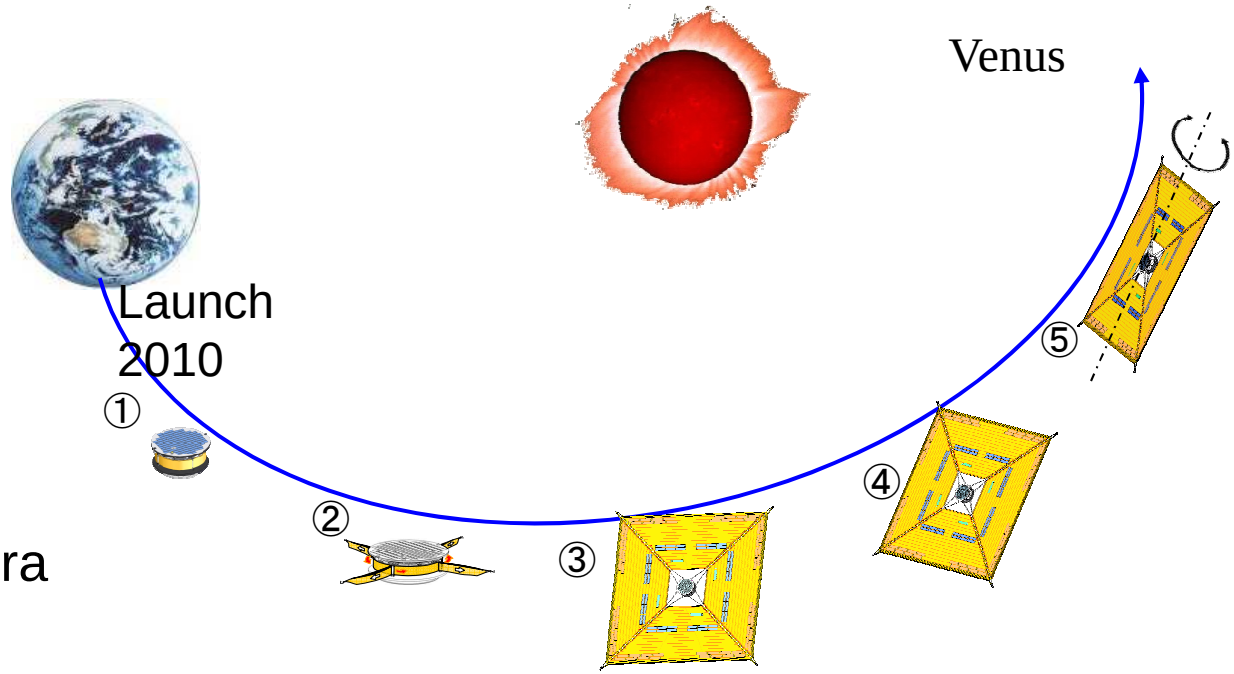


Image from deployed camera



HAYABUSA-2

Target: 1999JU3 (C type)
Launch: Jul. 2014
Arrival: Jun. 2018
Earth Return: Dec. 2020

New Experiment

Create Crater

Sample analysis

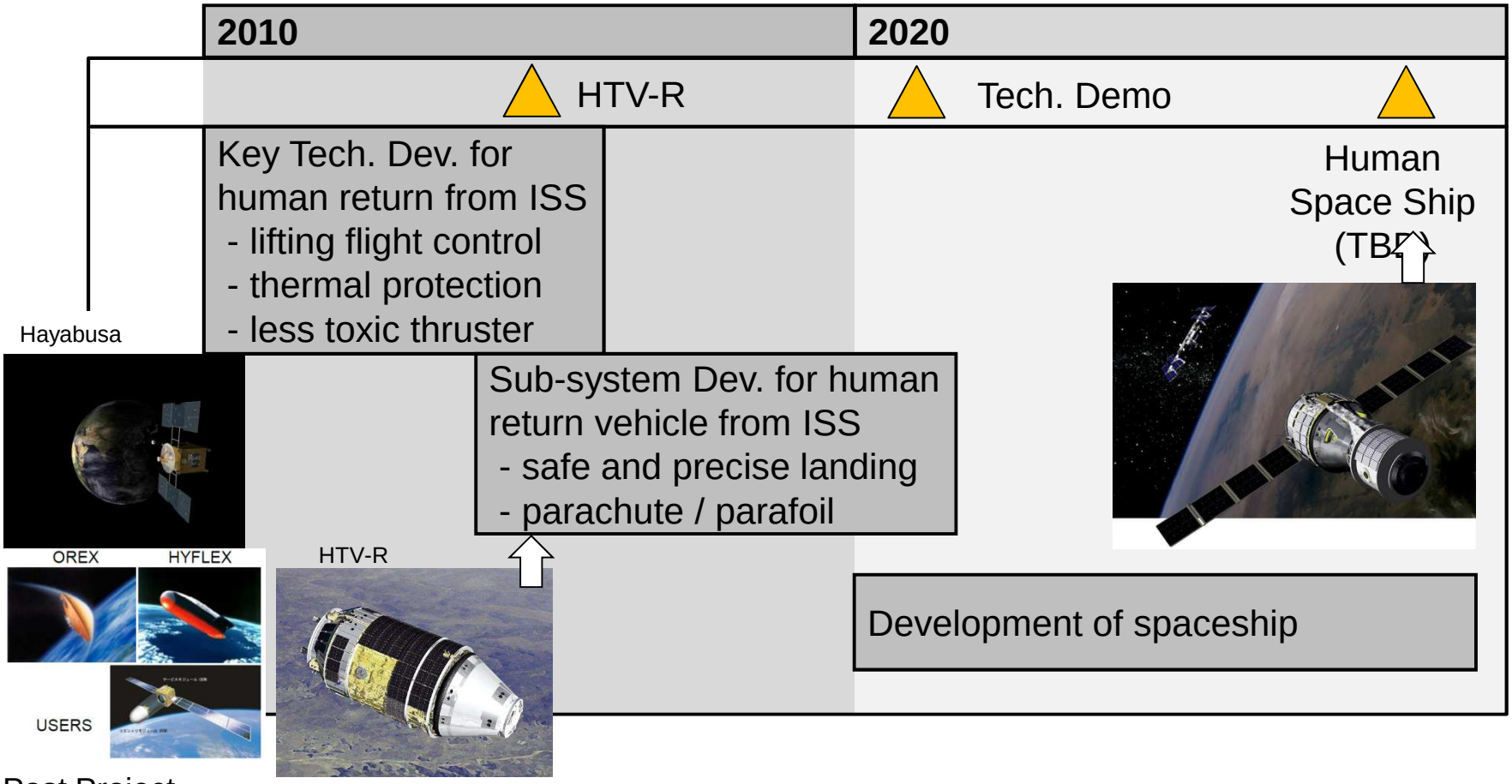
Earth Return

Further interior exploration

Major Technology Development in JAXA

Human Re-entry and Return

- ✓ Thermal protection and lifting flight control of human vehicle during the atmosphere re-entry.
- ✓ Slow descent, soft and precision land at the predetermined area of the earth.

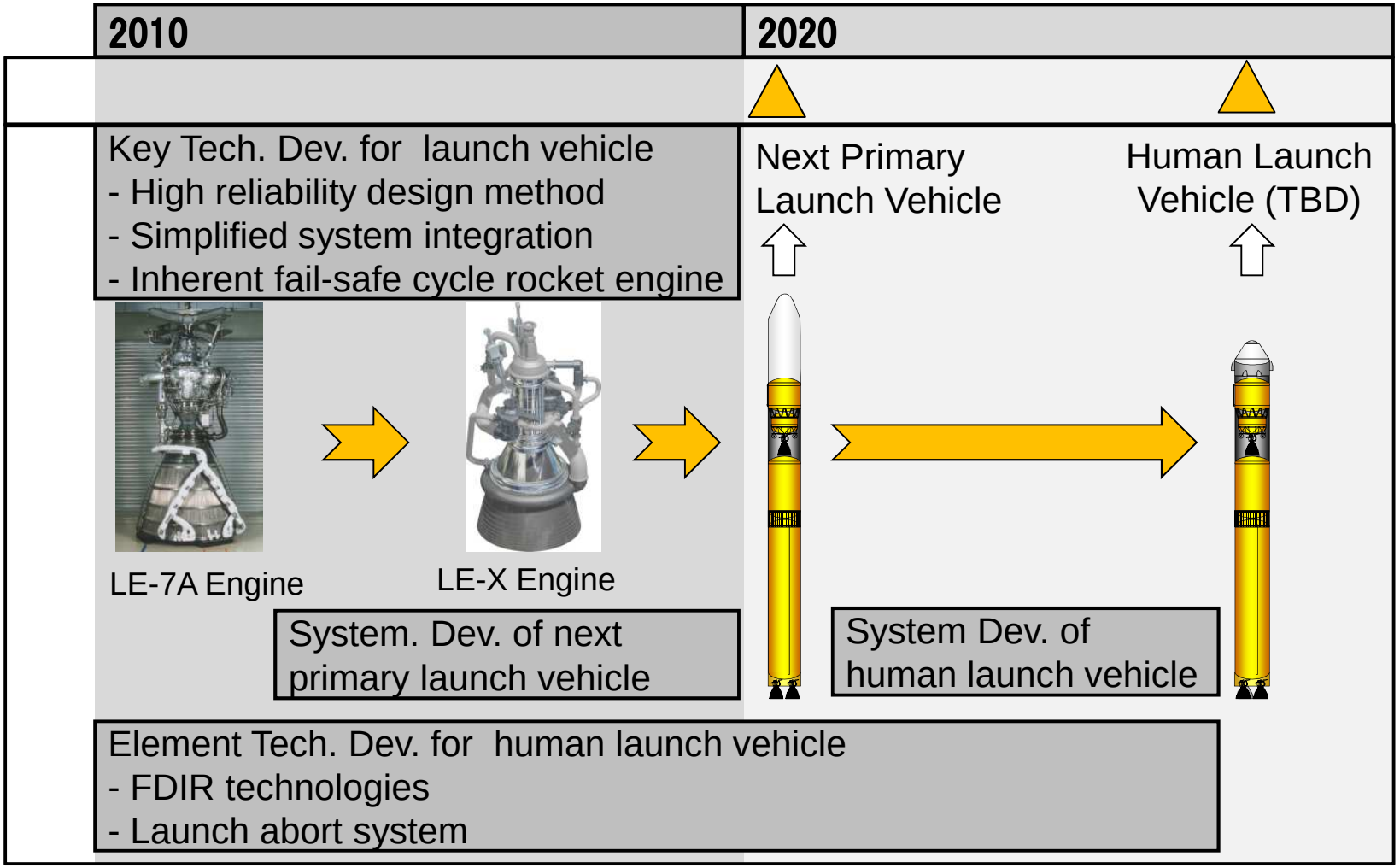


Past Project

Human Rated Launcher

✓The human safety technologies are key for human launch vehicle.

- •Simple, reliable, and low cost cryogenic engine
- •FDIR (fault detection, isolation & recovery) technologies
- •Launch abort system for emergency escape



ECLSS System

✓ The regenerative life support system for long habitation requires water recycle and air revitalization with small sized, light-weight and low power consumption.

2010

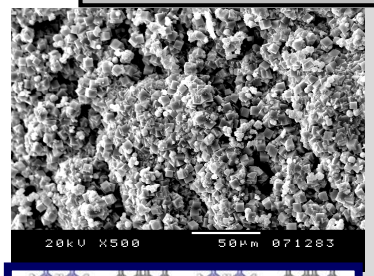
2020

ISS Tech.Demo

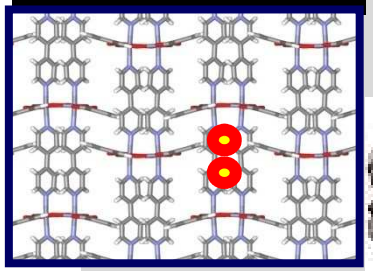
ISS Tech.Demo #2

Key Tech. Dev. for Air and Water Revitalization
- light-weight
- low power

Human Space Ship, etc (TBD)



System Dev. for high performance ECLSS
- CO2 removal
- water recovery
- toilet & shower

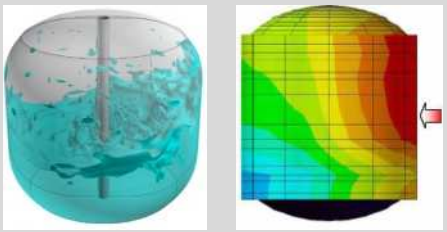


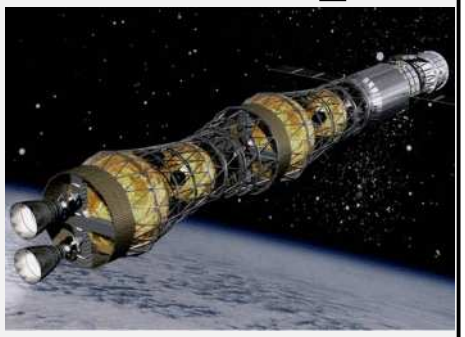
Human System Dev. for Spaceship and lunar exploration
- Human spaceship
- Human lander
- Pressurized rover

Human Orbital Transfer

✓ The human orbital transfer vehicle requires high performance in-space propulsion, such as cryogenic in-space propulsion, etc.

2010	2020
Key Tech. Dev. for human orbital transfer - System integration technologies - In-space operation technologies - Low boil off cryogenic propulsion - LNG propulsion (TBD) - Electrical propulsion (TBD)	Tech. Demo (TBD) Human Orbital Transfer Vehicle (TBD)

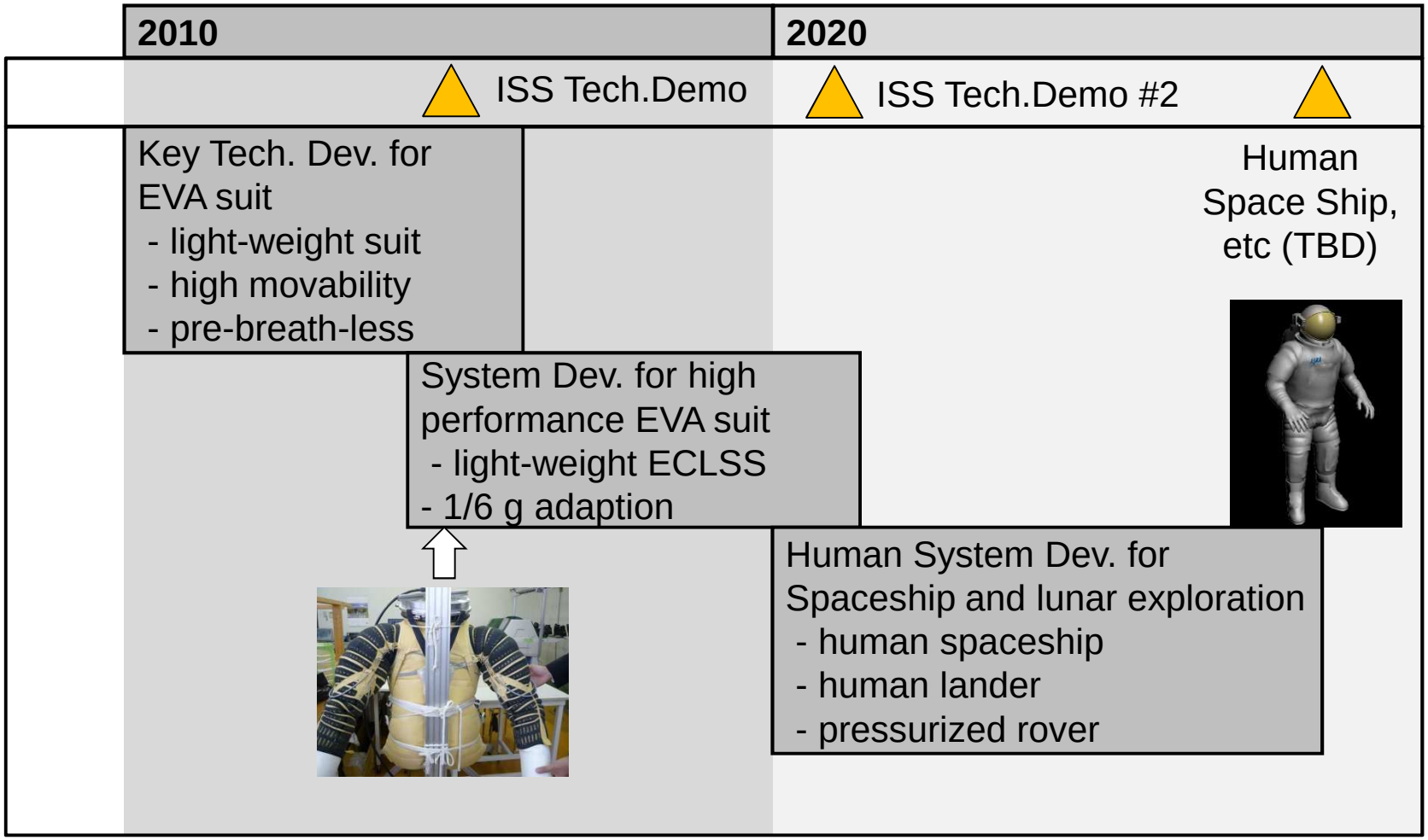




System Dev. for human orbital transfer
- Orbital transfer vehicle

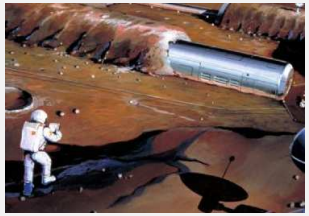
EVA Suit

✓ The advanced EVA suit requires short preparation period, high workability, and less weight comparing to the conventional EVA suit.



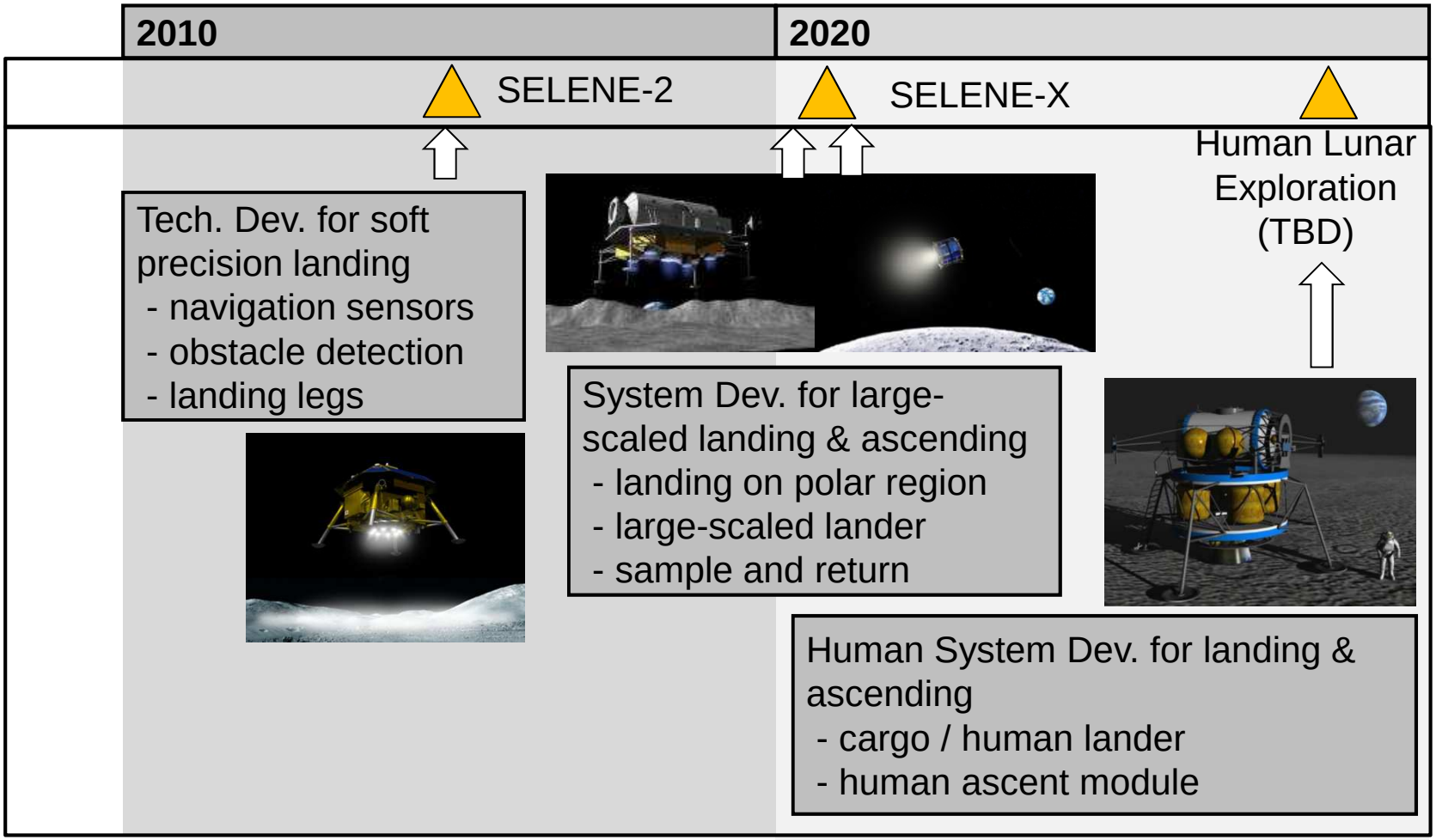
Space Medicine

✓ The space medicine verifies medical safety technique needed for human presence and establish long duration stay on the lunar surface.

2010	2020
ISS Tech.Demo	ISS Tech.Demo #2
Key Tech. Dev. of medicine for human sys. - Verification of medical safety technique on ISS - Medical requirement for long duration stay	Human Space Ship, Lunar Base, etc (TBD)
 System Dev. of medicine for human sys. - Medical requirement for long duration stay	 
Focused R&D in space medical •space radiation monitor •prevention of bone loss •regolith and lunar dust control •mental & psychological support •telemedicine care, space food	Human System Dev. for Spaceship and lunar exploration - verification of medical safety technique for long duration stay

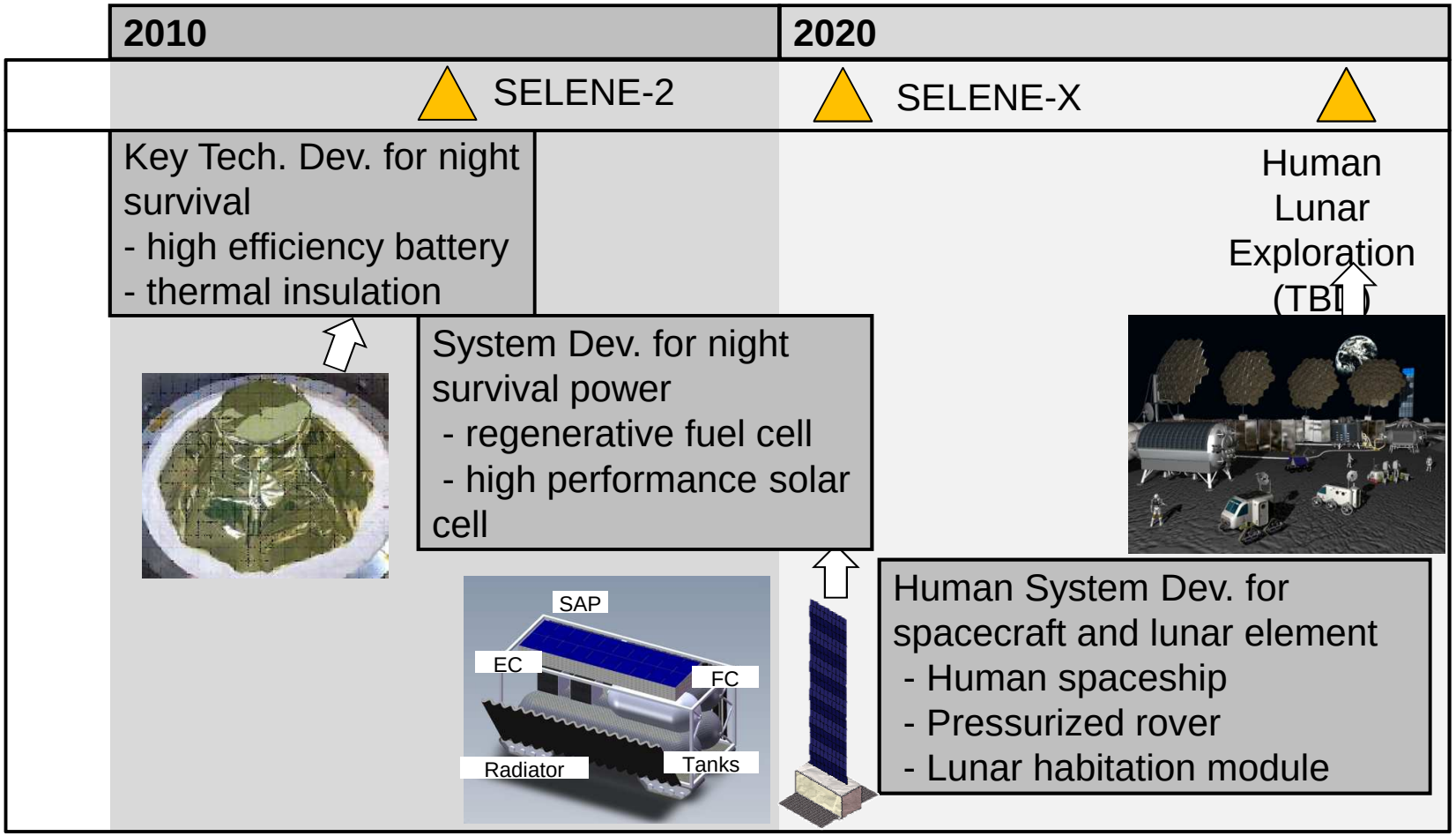
Human Landing on and Ascent from Moon

✓Safe and reliable landing with hazard avoidance.
✓Accurate pin-point navigation for landing.
✓Ascending from moon and Earth return technologies.



Power Technology for Night Survival

✓Provide energy to human elements for long duration including night survival by combining solar power generation, regenerative fuel and Li-ion battery.



Human Surface Mobility

- ✓Robotic surface mobility requiring traction mechanism, efficient power and communication, navigation and manipulation
- ✓Pressurized rover providing long range mobility and habitation capabilities in addition to mobility.