Astrophysics Strategy and SPICA/LiteBIRD

By addressing following three questions and through international cooperation, Astrophysics Strategy aims to shed light on the origins of the universe and structural formation from a galaxy to planets. 1. How did the universe begin? 2. How did the universe evolve?, and 3. Elucidating formation process, diversity, and universality of the structure of universe.

1. Seed of the Structure of Universe
2. Development of Galaxies
3. Large-scale structure of the cosmos

Credit: NASA / WMAP Science Team
“Hayabusa” spacecraft brought back the material of Asteroid Itokawa while establishing innovative ion engines. “Hayabusa2”, while utilizing the experience cultivated in “Hayabusa”, is approaching C type Asteroid Ryugu in order to elucidate the origin and evolution of the solar system and primordial materials that would have led to emergence of life.
Hayabusa2 detected Ryugu asteroid through an onboard camera in Feb.
Hayabusa2, Launch on 2014, Rendezvous on 2018, Earth Return on 2020
MMO/BepiColombo is a probe to Mercury to elucidate its magnetic field and its interaction with the harsh solar wind in the close proximity to the Sun. Due to the technical difficulties (Mercury orbit insertion, intense thermal environment), Mercury remains mysterious. BepiColombo is a cooperative inter-disciplinary project between Japan and Europe for answering the questions inherited from NASA MESSENGER.

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<th>Spacecraft</th>
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<td>MMO (Mercury Magnetspheric Orbiter)</td>
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SLIM (Smart Lander for Investigating Moon) has the purpose of demonstrating a high-precision landing technology. Pin-pointed landing to a desired location on a gravitation body is a required technology for the efficient future exploration program in which multiple landings and sample returns are foreseen.
Martian Moons eXploration = MMX

Martian moons: Phobos, Deimos

Spacecraft: MMX
Target: Phobos
Launch: 2024(TBD)

Timeline:
- Launch: 2024
- Arrival at Mars: 2025
- Sampling
- Departure: 2028
- Return to Earth: 2029
DESTINY+ (Demonstration and Experiment of Space Technology for INterplanetaryvoYagePhaethon fLybydUSTscience) is a planned mission to demonstrate the small platform concept for planetary exploration. Its science dust-oriented: it will be from dust in-situ analysis during interplanetary cruise and from flyby observations of the Geminid meteor shower parent body 3200 Phaethon.
ISAS Small Body Exploration Strategy

Many small bodies are born outside the snow line. These are initially comet-like but can evolve to show a variety of faces. By delivering water and organic compounds, these small bodies may have enabled the habitability of our planet.

_When, who and how?_

Proto-Earth

Icy moons (Ocean-bearing world)

Dust ejecting bodies (Organic compound transport via dust particles)

Martian moons (Fossil of water delivery system)

Primordial asteroids (Water in hydrated minerals)

Jupiter Trojans (Missing link between comets and asteroids)

Comets (Water in the form of ice)

The fleet of ISAS small body missions explores these questions.
Summary

2018 Highlights of ISAS/JAXA
- Hayabusa 2 arrival and touchdown on Ryugu asteroid with CNES/DLR Lander
- Bepi Colombo launch and departure for 7-year journey to the Mercury with ESA.

- ISAS/JAXA puts the highest priority on international collaborations.
  - Foreign Partners join ISAS/JAXA lead Missions
  - ISAS/JAXA joins Foreign Agency lead Missions
  - Joint missions between ISAS/JAXA and other agencies

- ISAS/JAXA continues to promote international collaborations in order to maximize the outcome from the missions in efficient manner within allocated resources.

1) Realize highest outcome of the space science missions in efficient manners
2) Maximize the opportunities to conduct/participate Missions
3) Promote proactive communications among international space science community

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Innovations in Space and on Earth

• **Space exploration technology**
  - Expansion of space development and utilization.
  - Active use of terrestrial technology.

• **Terrestrial technology**
  - Creation of industrial promotion and new industry by commercialization.
  - Distribution of space exploration technology.

Sponsored by the Japan Science and Technology Agency (JST)’s support program for starting up innovation hub.
Outline of “Development and on-site-investigation of ultralight attachment and boom” (Taguchi Industrial Co., Ltd.)

[Background]
- In order to construct a lunar base or a Mars base, construction machinery is transported from the ground, and from the transportation cost aspect, it is required to have "general versatility" and "ultralightweight" that can perform multiple operations with one unit.
- On the ground, due to ultralightweight construction, both construction machinery and attachments are expected to greatly improve transportability, workability, fuel economy, etc., and demonstrate superiority at the construction site.

[Research goals]
- We adopted a highly versatile “hydraulic excavator” as a construction machine to reduce weight, and started weight reduction of its components such as “stick” and “boom.”
- The current "stick" and "boom" are made of "iron" as the main material, but we will manufacture them with lightweight metals or composite materials to achieve weight reduction.
- By making them from two kinds of materials respectively, we will conduct comparative study not only from strength and rigidity but also from various aspects such as manufacturing.