Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PPS23-01 Room:302 Time:May 24 09:00-09:15

Planetary Exploration in a Coming Decade Activity: Suggestions from the 2nd-stage committee to proposals

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Japanese Planetary Science Society started "Planetary Exploration in a Coming Decade" activity in 2010 aiming to organize a new mission to be launched between 2017 and 2027. The second stage of the activity accepted 13 proposals last December. Among them, 8 groups aim new missions, and 5 groups proposes new instruments. The 2nd-stage committee members reviewed each proposal to return comments to improve the proposals from scientific views. We briefly report outline of the discussions held among the committee members.

Keywords: planetary exploration

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PPS23-02 Room:302 Time:May 24 09:15-09:30

Conceptual Study on SLIM - Lunar Landing Demonstration via Small Explorer

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Authors keep perusing the possibility of lunar exploration via small spacecraft. It will enlarge the opportunities of exploration. Especially, high risk challenging missions would become realistic with the small spacecraft. As a first step, smart pin-point landing technology demonstrator, named as SLIM (Smart Lander for Investigating Moon) is now under conceptual study. This paper summarizes the status of SLIM study.

Keywords: Lunar exploration, Soft Landing

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PPS23-03 Room:302 Time:May 24 09:30-09:45

Lunar landing missions for in-situ dating of impact-melt rocks

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In this talk, we suggest a series of lunar landing missions for in-situ dating of impact-melt rocks.

Keywords: moon, radioactive dating, lunar exploration, cratering chronology

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PPS23-04 Room:302 Time:May 24 09:45-10:00

Proposed sample return mission from the lunar farside highland

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Compositional information of the lunar highland is important for understanding the bulk composition and solidification of the lunar magma ocean and for estimating the internal structure of the Moon. However, recent studies [1][2] indicate that the previous understanding [3] of the lunar highland composition based primarily on the lunar samples returned from the nearside by Apollo and Luna missions is insufficient for understanding the overall crustal composition because more primitive highland materials with different composition from the current sample collection, which we do not have, are present in the farside highland.

Therefore, we are proposing a sample return mission to the lunar farside highland to fill the gap in our knowledge by obtaining the most primitive highland material and investigating such previously unknown samples. Information from these samples, such as crystallization age, major and trace element composition, isotopic composition, and crystal texture, are important for understanding the cooling and solidification history of the lunar magma ocean, formation of the crust, degree of differentiation when the highland material crystallized, and composition of the bulk lunar magma ocean.

A region around Freundlich-Sharonov and Dirichlet-Jackson basin where Th content is the lowest [1] and the Mg# (Mg/[Mg+Fe] in mole percent in mafic minerals) is the highest [2], both suggesting that this region is the most primitive highland on the lunar surface, is a potential sampling site. The proposed mission consists of one lander with return capability, a manipulator to collect both regolith and small (a few centimeters in diameter) rocks from around the lander, and spectral cameras for sample selection. Further study is required to estimate the minimum sample requirement of sample number and weight to achieve our scientific goal.

[1] S. Kobayashi, LPSC, #1795 (2010).
[2] M. Ohtake et al., LPSC, #1977 (2011).
[3] P. Warren, Am. Mineralogist, 78, 360-376 (1993).

Keywords: sample return, Moon, farside highland, primitive highland material

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PPS23-05 Room:302 Time:May 24 10:00-10:15

Mars atmospheric escape exploration

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The Mars atmospheric escape exploration working group (post-Nozomi mission WG), established on December 2011, has been investigating a mission to study the atmospheric escape from Mars with emphases placed on its possible impacts on the climate change on early Mars and on understanding the habitable zone of unmagnetized terrestrial planets. Although this mission is not proposed to the category of ”next decade initiatives for lunar planetary explorations”, we consider it fruitful to discuss possible collaborations with relevant research communities. SGEPSS’s activities toward planetary exploration will be also presented.

Keywords: Mars, Atmospheric escape, Plasma, Exploration

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PPS23-06 Room:302 Time:May 24 10:15-10:30

Possibility of Lightning and thundercloud observation in Jupiter by JUICE and ground-based-telescope

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Lightning measurement is an excellent way to explore the planetary atmosphere like as in the Earth based on the knowledge of the relationship between the atmospheric dynamics and electrical charge. It has been suggested for a decade that thunderstorms in Jupiter take important roles not only in the investigation of meteorology, which determines the large scale structures such as belt/zone and big ovals, but also in probing the water abundance of the deep atmosphere, which is crucial to constrain the behavior of volatiles in early solar system. Here we suggest lightning measurement with optical camera onboard spacecraft especially in JUICE mission and on a

ground-based telescope. Making use of two H Balmer Alpha line at 656.3 nm filters, the information on the depth of lightning discharge could be derived.

We are suggesting such functions to the onboard camera of JUICE and also plan to try to detect lightning flashes with a 1.6 m reflector of Hokkaido University.

Keywords: Jupiter, thunderstorm, lightning, JUICE, telescope

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PPS23-07 Room:302 Time:May 24 10:45-11:00

Enceladus' exploration: chemical and biological investigations of water-rich plumes

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One of the most remarkable findings by the Cassini mission is perhaps water-rich plumes erupting from warm fractures near the south-pole region of Enceladus. Given such geological activities and detection of sodium-rich salts in the plumes, Enceladus is highly likely to have an interior liquid ocean interacting with rock materials. These observations raise some primary questions regarding planetary sciences and astrobiology: What is the chemical composition of Enceladus ocean? What kinds of metabolic energy source are available? How and when was Enceladus ocean formed? Does the chemical evolution proceed in the ocean? And, is there life there? Answering these questions would provide a dramatic advance in our understanding of habitability of life in the solar system and could be big breakthrough in almost all fields of natural sciences, including earth sciences, biology, chemistry, and astronomy.

Here we propose a chemical and biological exploration for Enceladus plumes with in-situ and sample-return analyses. In-situ mass spectroscopy with a high-resolution multi-turn TOF MS (m/z = 2?1000) would provide the abundances and isotopic compositions of major components of the ocean. Such observational data would allow us to discuss 1) the origin and distribution of volatiles in the Saturn-forming region of the early solar system, 2) biological signatures recorded as anomalies in abundance and/or isotopic compositions, and 3) possible metabolic reactions and energy for chemithoautotrophy. Microscopic analyses for returned samples include synchrotron X-ray analyses, chemical and mineralogical analyses with a nano-SIMS, and calorimetry with radioactive isotopic tracers. Based on results from these analyses, we will be able to 4) characterize physical and chemical conditions of the ocean (pH, hydrogen fugacity, and temperature), 5) discuss the chemical evolution of organic compounds (chemical structure and interactions with minerals), and 6) detect a signature of biological activities.

Keywords: planetary exploration, Saturn, icy satellite, Enceladus, ocean

PPS23-08 Room:302 Time:May 24 11:00-11:15

Sample return from 107P/Wilson-Harrington

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We propose Sample Return mission from 107P/Wilson-Harrington, which is a dormant comet that potentially preserve pristine minerals, ice, and organics in the early solar system. Several sample return missions from primitive undifferentiated asteroids, such as Hayabusa-2, Osiris-REx, and MarcoPolo-R, have been planned to obtain samples from near-Earth C-type or related asteroids. Compared to those asteroids, 107P/Wilson-Harrington may preserve ice in its interior, and sample return of pristine ice is expected in the proposed mission.

Keywords: sample return, primitive bodies, Wilson-Harrington

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Deep Space Exploration Technology Experiment Mission DESTINY

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DESTINY which stands for '**D**emonstration and **E**xperiment of **S**pace **T**echnology for **IN**terplanetary vo**Y**age' is a mission candidate for the 3rd mission of ISAS small science satellite series. The 3rd mission is planned to be decided in 2012, and the select one is scheduled to be launched in 2017.

As illustrated in the Figure, DESTINY will be launched by an Epsilon launch vehicle and firstly placed into a low elliptical orbit, where then its altitude raised by the use of ion engine. When the orbit raising reaches the Moon, DESTINY subsequently is injected into transfer orbit for L2 Halo orbit of the Sun-Earth system by using lunar gravity assist. Upon arrived at L_2 Halo orbit, DESTINY will conduct its engineering experiment as well as scientific observations for at least a half year. If conditions permit, DESTINY will leave L_2 Halo orbit, and transfer to the next destination.

On the way to L_2 Halo orbit, DESTINY will conduct demonstration and experiment on key advanced technologies for future deep space missions. Major items of the technology demonstration are listed as follows.

1. High energy mission by Epsilon rocket

We investigate appropriate rocket configurations and flight path designs, and evaluate the performance of Epsilon rocket to insert spacecrafts into high energy orbits. It provides basic data of Epsilon rocket application to deep space missions.

2. Ultra-Lightweight solar panel

In order to generate large electric power to run m20 ion engine, 'Ultra-Lightweight Solar Panel', which is under development at JAXA, is applied and its performance is evaluated. This solar panel is estimated to achieve power to mass ratio at least double to conventional ones. Future application is expected in outer planet probes (JMO, MELOS) or probes with large ion engines.

3. Large scale ion engine m20

DESTINY is inserted into an elliptical orbit and reaches to a Halo orbit by its own orbital maneuver. For this maneuver, a large ion engine (m20) which is under R&D at JAXA will be adopted and its performance is evaluated. This ion engine has thrust five times as much as m10 used by Hayabusa and will be expected to be applied to large probes such as SOLAR-D or Hayabusa Mk2.

4. Advanced thermal control

In order to manage large amount of heat generated by the large ion engine, advanced thermal control techniques by way of Loop Heat Pipe will be adopted.

5. Orbit determination under low thrust operation

DESTINY will reach to Halo orbit by running ion engine over long duration. In order to reduce burdens to shut down the ion engine each time of orbit determinations, orbit determination under ion engine operation is conducted and its performance is evaluated.

6. Automatic/autonomous onboard operation

In order to increase the efficiency of operation, autonomous and highly functioned spacecraft management system is developed demonstrated on board. This technique is expected to be adopted especially in the deep space missions usually operated under severe communication condition.

7. Halo orbit transfer and maintenance

DESTINY will reach to Halo orbit and maintains the orbit more than one period. In order to reduce the risks of Halo orbit insertion and suppress the amount of orbital maneuvers, the orbit control technique using dynamical system theory is used and its operability is evaluated. This technique will be adopted in SPICA, which will be operated in Halo orbit.

DESTINY itself is an engineering experiment probe which destines L_2. However, its mission profile is naturally applied to lunar missions and escape missions by forking the profile at the lunar encounter. Moreover, the spacecraft's high astronautic performance makes its application to other launch method attractive, such as dual launch with GEO satellite or another deep space probe. The significance of DESTINY from the point of its opening new opportunities for low-cost deep space mission is discussed in the presentation as well.

Keywords: Small Science Satellite, Technology Experiment, Deep Sapce Exploration, DESTINY

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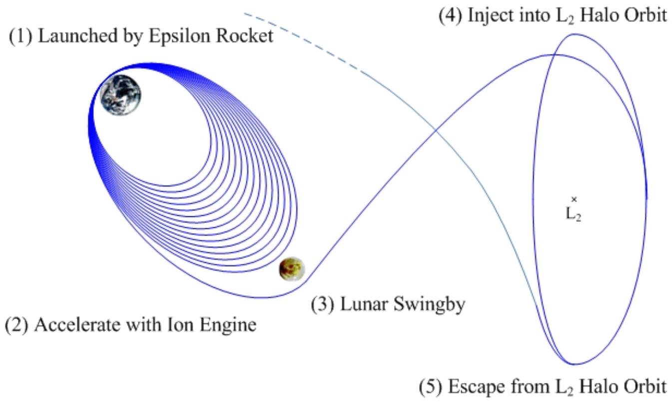

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PPS23-10 Room:302 Time:May 24 12:00-12:15

Planetary Exploration in a Coming Decade Activity: From 2nd to 3rd Stage

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Future Planetary Exploration Working Group of Japanese Planetary Science Society is discussing planetary explorations that will be strongly supported by this community. Then we started "Planetary Exploration in a Coming Decade" activity last year aiming to organize a new mission to be launched between 2017 and 2027. The second stage of the activity is ending after this session. Each proposal of the second stage will be reported in Yu-Sei-Jin jounrnal. Then the third stage starts to reinforce technical aspects of the proposals.

Keywords: Planetary Exploration