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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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