宇宙機用次世代ホールスラスタの研究開発
Research and Development of Next-generation Hall-Thrusters for Spacecraft

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This presentation summarizes the R&D efforts of 6-kW-class Hall-thruster at JAXA in collaboration with IHI Aerospace, Melco, and Japanese academic community. Our Hall thruster R&D program intends to fill the gap between the existing chemical thrusters and the low-power ion thrusters; in comparison with mono- and bi-propellant chemical thrusters, the thrust level of ion thrusters was quite small and hence application of electric propulsion so far was limited to either station keeping of a medium-class satellite or to main propulsion of small explorers such as HAYABUSA. With the new 400-mN-class Hall-thruster, medium to large satellites of 5 ton or more are possible to be cruised via clustering several 6 kW Hall thrusters that features highly efficient propellant utilization and large delta-V capability. The Hall thruster will become one of the core propulsion technologies that will evolve to active and frequent space transportation in near-earth region and beyond.

Currently, several R&Ds on 6-kW-class Hall thruster are continuing in parallel. The first and most important milestone is the testing onboard engineering test satellite (ETS)-9 that will be launched in 2023. Onboard the ETS-9, along with main flight proven but foreign 4.5 kW thrusters, an experiment of a Japanese 6-kW-class Hall thruster system is planned. For example, operation at a discharge voltage of 300 V and a total power of 6 kW for orbital transfer and limited number of lower power cyclic operation at 3 kW are planned. At the timing of this abstract prepared, critical design review is going on, and preparation of prototype models are in progress. In FY 2021-2022, qualification test campaign including long-term life test, power processing unit (PPU) to thruster coupling test are prepared, and some of them will be reported during the symposium.

While the thruster for ETS-9 places an emphasis on acquiring the first flight experience, specifications and operations of the thruster system are limited. The enhancement of competitiveness of the Hall thruster for ETS-9 is therefore important. In the current research activity, wide throttling capability and lightweight thruster body are pursuit to provide it to a variety of all electric propulsion satellites in the market. Also, thruster and PPU with a wide specific impulse range is under way and some breadboard model demonstrations were conducted focusing on higher Isp for future space exploration. By utilizing the thruster not only in earth orbits but also in interplanetary regions, it is expected to widen the opportunity of employing the thruster and as a result capability for future space missions is strengthened.

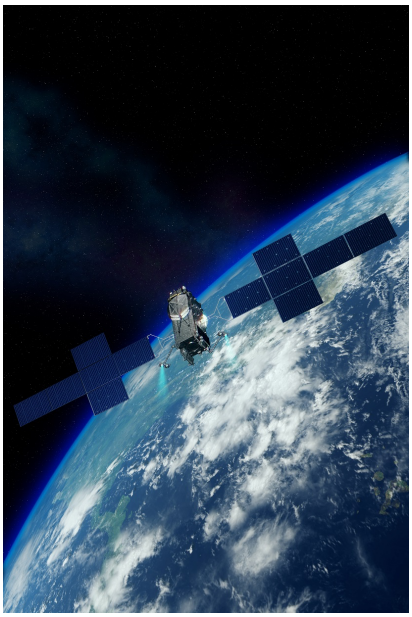

Fig.1 Image of ETS-9 during Orbital Transfer Operation of Hall Thrusters.

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