

ABSTRACTS (MASTER THESIS)

Study on thrust performance evaluation of magneto plasma sail with magnetic nozzle

**(Graduate School of Engineering,
Laboratory of Space Electromagnetic Environment Exploration,
RISH, Kyoto University)**

Tatsumasa Hagiwara

The development of new propulsion system for exploring other planets in the solar system or deep space is necessary to enable short travelling term missions and large payload ratios. Magneto plasma sail (MPS) has been focused on as a candidate system to attain above objectives. The MPS is a propulsion system, which generates its force by the interaction between the charged particles from the sun (solar wind) and magnetic fields inflated by a plasma injection. In the previous studies, the thrust of the MPS was reduced by injecting plasma into the opposite direction of the thrust. The new propulsion system which is called “MPS with magnetic nozzle” is proposed. This proposed system combines the MPS and a magnetic nozzle. The magnetic nozzle itself is a propulsion system, which generates its force by converting the thermal energy of plasma injected into the nozzle magnetic field. In order to demonstrate the mechanism of thrust increase and evaluate the thrust performance, we conducted the laboratory experiments with two types of plasma sources. In the first experiment, we used an MPD arcjet as a plasma source, which produces plasma with arc discharge. The thrust of the MPS with the magnetic nozzle is 12 times larger than that of magnetic sail, and 2 times larger than that of the magnetic nozzle. We succeeded in evaluating the thrust increase experimentally. However, compared with an ion engine, the thrust performance is very low due to high electric power consumption of the MPD arcjet. In the second experiment, therefore, we developed the new low power plasma source consists of a LaB6 cathode, which is widely utilized for thermionic emission source. The thrust of the MPS with the magnetic nozzle is also 17 times larger than that of magnetic sail, and 1.3 times larger than that of magnetic nozzle. Hence, compared the first experiment, thrust performance is improved. We confirmed the usefulness of the LaB6 plasma source as a plasma source of the MPS with the magnetic nozzle.

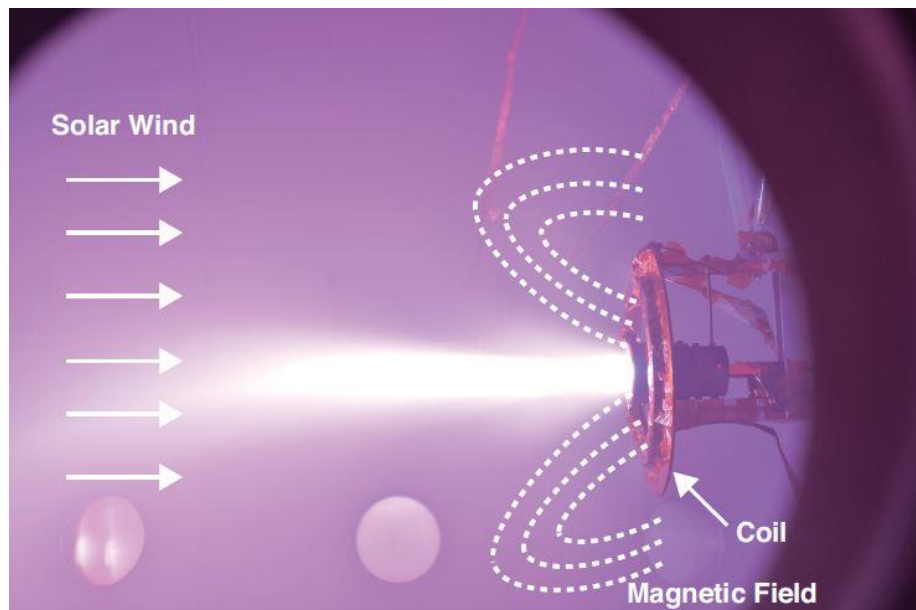


Figure 1. Experiment of the MPS with magnetic nozzle in the plasma chamber.