MHD Analysis of Thrust Generation Mechanism and Propulsive Performance of Propulsion System Utilizing Artificial Magnetosphere.

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In the interplanetary space, the plasma flow called solar wind flows from the Sun. There is a new concept of space propulsion that creates an artificial magnetosphere around the spacecraft and catches the solar wind by the artificial magnetosphere. When the artificial magnetosphere of several hundreds kilometers in diameter is created, the propulsion systems can generate much larger thrust than that of conventional propulsion systems. However, it is difficult that such large artificial magnetosphere is created by only coil currents because it is estimated that large super-conducting coils in several tens kilometers in radius are needed. Then, Magneto Plasma Sail expands a small magnetosphere by small coils to a large magnetosphere by injecting plasma from the spacecraft. This technique is called magnetic field inflation. Magnetic field inflation is an important technique for realizing Magneto Plasma Sail.

Magneto Plasma Sail generates thrust by two kinds of processes. These processes include complicated interactions between plasma and magnetic field. Although Magneto Plasma Sail is expected to be suitable for deep space explorations, performances of Magneto Plasma Sail have not been clarified because those processes have not been understood in detail. In this research, magnetic field inflation and the interaction between the solar wind and the artificial magnetosphere are studied by magnetohydrodynamic simulations, and mechanism of thrust generation is clarified and performances of Magneto Plasma Sail are estimated. Magnetohydrodynamic interactions between plasma and magnetic field included Magneto Plasma Sail are ideal conditions for thrust generation. So, the purpose of this research is the upper limit efficiency of Magneto Plasma Sail is estimated.