Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PEM026-P12 Room:Convention Hall Time:May 25 10:30-13:00

Two-Dimensional Hybrid-PIC Simulation of Solar Wind Plasma Flow around Magnetic Sail

Masaharu Matsumoto[1*], Yoshihiro Kajimura[1], Hideyuki Usui[2], Ikkoh Funaki[1], Iku Shinohara[1]

[1]JAXA/ISAS, [2]Kobe university

Magnetic sail is a propellant less propulsion system proposed for an interplanetary space flight. The thrust force is produced by the interaction between magnetic field artificially generated by superconducting coils in a spacecraft and a solar wind. Thrust performance of such spacecrafts utilizing solar wind energy can be higher than that of conventional electric propulsion thrusters. Thrust force of a magnetic sail is characterized by the ratio of representative length of magnetosphere and ion Larmar radius at the magnetopause. In the case of ion inertial scale, namely, representative length which is shorter than ion Larmar radius, the simulation model including ion inertial effect must be selected in order to evaluate accurate thrust performance of magnetic sail. Based on the above, We examined the solar wind plasma behavior and thrust of a magnetic sail by two-dimensional X-Y Cartesian, hybrid particle-in-cell (PIC) simulations.

As simulation results, it is found that interplanetary magnetic field (IMF) affects the structure of shock wave around the spacecraft. This is because the solar wind flow is changed by the position of magnetic reconnection points which depend on the direction of IMF. Furthermore, high thrust force acting on the spacecraft can be obtained when IMF becomes perpendicular to the solar wind. The lift force is generated on the spacecraft when IMF becomes not perpendicular but parallel to the solar wind. Although there still exist many phenomena to be clarified and many problems to be overcome in order to realize the system, the magnetic sail is surely worth examining in more detail.

Keywords: Magnetic Sail, Magnetosphere, Hybrid-PIC Simulation