SPACE PROPULSION SYMPOSIUM (C4)
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# AERODYNAMIC CHARACTERISTICS OF MAGNETIC SAIL IN MAGNETIZED SOLAR WIND

**Abstract**

There are several concepts utilizing the dynamic pressure of the solar wind for space propulsion in the interplanetary space. These propulsion systems are expected to be suitable for deep space missions because they can save the consumption of the propellant. Magnetic Sail and its derived types create a large artificial magnetosphere around the spacecraft and utilize the magnetosphere as a sail capturing the solar wind dynamic pressure. They are based on a unique idea and expected to be one of promising advanced space propulsion concepts. Although several studies have been conducted, Magnetic Sail and its derived concepts need more detail researches for actual use. The aerodynamic force acting on the magnetosphere turns into the thrust force of Magnetic Sail and it is important to understand the aerodynamic characteristics of the magnetosphere. However, the aerodynamic characteristics of the magnetosphere are very complicated because the shape of the magnetosphere changes depending on the conditions of the solar wind. The flow velocity, density, temperature and so on vary in time. Especially, the solar wind is magnetized by the interplanetary magnetic field and the interplanetary magnetic field dynamically deforms the structure of the magnetosphere. In this study, the aerodynamic characteristics of Magnetic Sail were studied by the numerical simulation based on the magnetohydrodynamics. We focused the dependency of the aerodynamic characteristics on the solar wind flow direction and the effect of the interplanetary magnetic field. As a result, following were clarified. In the case that the interplanetary magnetic field does not exist, the attitude of the spacecraft has dynamic stability when the magnetic moment vector of the spacecraft is perpendicular to the solar wind flow direction. The interplanetary magnetic field reconnects with the magnetic field of the spacecraft and the magnetic reconnection generates a plasma jet in the magnetosphere. Therefore the aerodynamic characteristic of the spacecraft changes depending on the strength and direction of the interplanetary magnetic field: the spacecraft experiences the pitching moment which makes the magnetic moment vector of the spacecraft follow the direction of the interplanetary magnetic field.