Structure of the Saturnian Magnetosphere for Northward and Southward IMFs

Shunichi Ogi[1]; Keiichiro Fukazawa[2]; Tatsuki Ogino[3]

[1] STEL, Nagoya Univ; [2] STEL,Nagoya Univ; [3] STEL, Nagoya Univ.

Saturn is the sixth planet from Sun. It is the feature of appearance that there is a ring which looks clear to the surroundings of the planet. As physical character, the equatorial radius and mass are large to the next of Jupiter. (Jupiter is the largest in the planets of the solar system.) Rotation period is short and about 10 hours (Rotation speed is fast). Magnetic moment is about 1000 times as large as the Earth's one. However, magnetic field on the surface is almost same. The inclination between the magnetic axis and the rotation axis is 1 degree or less. It is a small value in comparison with other planets. The pole of the magnetic field is contrary to Earth. In Saturn, the north is N-pole. From these features, it is imagined that the Saturnian magnetosphere differs from the Earth's magnetosphere. It is useful to compare with each magnetosphere for understanding of the heavenly body with intrinsic magnetic field and magnetospheric physics. Satellite Cassini reached Saturn in July 2004, and is due to continue inquiry for four years from now on. It is a heavenly body which attracts attention now.

Saturn has a 1000 times as much peculiar magnetic field as Earth and rapid rotation. In order to investigate the structure of the Saturnian magnetosphere, three-dimensional global MHD simulation of interaction between the solar wind and the magnetosphere for northward and southward interplanetary magnetic fields (IMFs) was performed, and quasi-steady magnetospheric structure was obtained and it is compared with the Earth's one.

We use a modified Leap-Frog method to solve 3-D MHD and Maxwell's equations. The grid number of simulation is (nx, ny, nz)=(600, 400, 200), and the grid interval is 0.3 Rs, where Rs stands for the radii of Saturn. As the result of these simulations, it is found that the shape of the Saturnian magnetospheric structure such as lines of magnetic force and plasma sheet is similar to that of the Earth's magnetosphere. However, the dependency of IMF north-south direction is opposite. On the dawn and dusk sides of magnetospheric structure, large vortices appear. It may be originated from a fluid instability such as Kelvin-Helmholtz instability which is excited by velocity shear between the rotational flow and tailward flow of the solar wind. Generation of such a large vortices is not seen in the Earth's magnetosphere.We will discuss the dawn-dusk asymmetry of magnetosphetric structure including the vortices.