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Study of the plasma environment near Ganymede by the Galileo spacecraft observation

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Ganymede is one of Jovian moons and is known as the only satellite that has intrinsic magnetic field. Since Ganymede is located in the Jovian magnetosphere, magnetospheric plasma corotating with Jovian rotation period of 10 hours always blows toward Ganymede at a relative velocity of 176 km/s. So, the characteristic plasma environment is formed around Ganymede due to the interaction between Ganymede's magnetosphere and Jovian magnetospheric plasma.

Although previous studies discussed the morphology of Ganymede's magnetosphere and its plasma environment, most of them are still well unknown and understanding of the interaction is necessary to reveal processes occurring in the Ganymede's magnetosphere.

In the present study, we have analyzed plasma waves observed near Ganymede by the Plasma Wave Subsystem (PWS) and the Magnetometer (MAG) on board the Galileo spacecraft. In particular we have analyzed emissions enhanced at Upper-hybrid resonance (UHR) frequency and have identified its spatial distribution around Ganymede from the data obtained during the four flybys (G01,G02,G07,G29) in which the UHR emissions are clearly seen among the all six Ganymede flybys. Based on the identified UHR frequency and the electron cyclotron frequency estimated from the background magnetic field intensity by MAG, we have analyzed the spatial distribution of electron density around Ganymede. The electron cyclotron frequency is estimated to be 5˜20 kHz in the Ganymede magnetosphere. The result of the analysis shows that fUHR is about 20˜100 kHz and becomes high when the spacecraft is near Ganymede. The maximum of the electron density is estimated to be 200 cm-3 when the spacecraft is at the location closest to Ganymede of 264 km altitude during the G02 orbit.

The Ganymede ambient magnetic field can be classified into three types of condition, (1) both ends are on Ganymede, (2) one end is on Jupiter and another end is on Ganymede, and (3) both ends are on Jupiter. We study the electron density profile and plasma wave measured in each region based on both the MAG data and the trajectory of the Galileo spacecraft. We also analyze the 10 kHz waveform data in order to discuss fine structures of the spatial plasma distribution and plasma waves around Ganymede. By comparing these results to the plasma environment around planets interacting with solar wind and satellites in the planetary magnetosphere, we discuss the characteristic of the Ganymede's magnetosphere.

Keywords: Ganymede, Jupiter, plasma waves, magnetosphere