Wave-particle interaction between ion cyclotron waves and Iogenic ions in the Jovian magnetosphere

Yuto Katoh[1]; Fuminori Tsuchiya[1]; Masato Kagitani[2]; Hiroaki Misawa[2]; Akira Morioka[3]; Shoichi Okano[2]; Tooru Sugiyama[4]

[1] Planet. Plasma Atmos. Res. Cent., Tohoku Univ.; [2] PPARC, Tohoku Univ.; [3] Planet. Plasma and Atmos. Res. Cent.,Tohoku Univ.; [4] ESC/JAMSTEC

We discuss wave-particle interaction between ion cyclotron waves and Iogenic ions by hybrid simulations.

The fundamental physics of the mass-loading effect of Iogenic ions is explained by the ion pickup process as follows. Each neutral particle erupted from Io initially has the relative velocity v_b given by $v_b = v_c - v_I$, where v_c and v_I are respectively the corotation speed of Jovian magnetosphere and the orbital speed of Io. After the ionization of neutral particles around Io, these newborn ions are subsequently picked-up by Jovian magnetic field, and the initial velocity distribution of picked-up ions forms a ring distribution which drives instability generating electromagnetic ion cyclotron waves. The excitation of the ion cyclotron waves should result in the significant thermalization of the velocity distribution of picked-up ions via the pich angle scattering. The effect of the wave-particle interaction through the ion pickup process should enhance the merging of Iogenic ions into the torus plasma flow and affect the plasma temperature around Io. Therefore, the dynamics of torus plasma should be discussed with taking into account the kinetic effect of picked-up ions.

In the present study, we perform hybrid simulations to investigate the wave-particle interaction between picked-up ions erupted from Io and the torus plasma flow corotating with Jovian magnetosphere. We assume that the background torus plasma consists of S III ions following with the observations of the Cassini Ultraviolet Imaging Spectrometer (UVIS) while we treat S II ions as Iogenic ions. We simulate ion pickup processes of Iogenic ions generating ion cyclotron waves and discuss the modification of the velocity distribution of picked-up ions due to the wave-particle interaction. The effect of the production rate of Iogenic ions on the time scale of the ion pickup process is also discussed.