Test-particle simulation of electron pitch angle scattering by neutral H2O along the magnetic field line of Enceladus

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Neutral particles in Saturn's inner magnetosphere play the dominant role in a loss process of energetic electrons and ions because of abundance of neutral particles [e.g., Paranicas et al., 2007; Sittler et al., 2008]. The observations of injected electrons and ions in the inner magnetosphere suggest that these particles do not survive very long time due to the neutral cloud originated from Enceladus [e.g., Paranicas et al., 2007; 2008]. Thus, the previous study suggested that the neutral cloud is one of the important loss processes of plasma in the inner magnetosphere. However, a quantitative study of collisions between plasma and neutral has not been examined.

In the present study, we focus on the process of electron pitch angle scattering due to elastic collisions with H_2O when the electron flux tube passes the region of dense H_2O in the vicinity of Enceladus (6.3 min.). This study aims at revealing the variation of equatorial pitch angle distribution of electrons through elastic collisions between magnetospheric electrons with several hundred eV to several keV and neutral H_2O. We have developed a spatially one dimensional test-particle simulation code with monoenergetic electron along a dipole magnetic field at Enceladus (L = 3.95). To examine the variation of pitch angle distribution, we assume that the initial pitch angle distribution is isotropic distribution. We use the cross sections of elastic collisions based on the experimental data [Katase et al., 1986]. An interaction between an electron and a background neutral cloud is solved by the Monte-Carlo method using the differential cross sections of elastic collisions for H_2O. We show time variations of equatorial pitch angle distribution of electrons and electrons within loss cone angle due to the collisions between electron and neutral H_2O. We also discuss the dependency of neutral H_2O model.