

Test-particle simulation of electron-H₂O elastic collision along the magnetic field line around Enceladus

TADOKORO, Hiroyasu^{1*} ; KATOH, Yuto²

¹Tokyo University of Technology, ²Department of Geophysics, Graduate School of Science, Tohoku University

Saturn's inner magnetosphere is dominated by water group neutrals originated from Enceladus' water plume [e.g., Shemansky et al., 1993; Richardson et al., 1998; Esposito et al., 2005]. The neutrals in the inner magnetosphere contribute to one of the important loss processes of plasma through plasma-neutral collisions. However, little has been reported on a quantitative study of the electron loss process due to electron-neutral collisions. In this paper, we will focus on the collisional loss process with neutrals.

We examine the variation of equatorial electron pitch angle distribution and loss rate of precipitated electrons into Saturn's atmosphere through pitch angle scattering due to elastic collisions with neutral H₂O along Saturn's magnetic field line around Enceladus. We focus on 1 keV electrons as a typical energy in the present study. To examine the variation of those, we perform one-dimensional test-particle simulation when the co-rotating electron flux tube passes the dense H₂O region in the vicinity of Enceladus (~6.4 minutes). Results show that the equatorial electron pitch angle distribution near the loss cone (<20 degrees and >160 degrees) decreases with time through pitch angle scattering due to elastic collisions. It is found that the electrons of ~19 % to the total number of equatorial electrons at the initial condition are lost in ~380 seconds. The calculated loss time is twice faster than the loss time under the strong diffusion.

Keywords: plasma-neutral collision, Saturn, Enceladus, elastic collision, pitch angle scattering