Elastic collisions between magnetospheric electrons and neutral H2O molecules in the Enceladus torus by test particle simulation

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Water group neutrals (H_2O, OH, and O) in Saturn's inner magnetosphere play the dominant role in loss of energetic electrons and ions because of abundance of the neutrals [e.g., Paranicas et al., 2007; Sittler et al., 2008]. The observations of injected plasmas 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 studies suggested that the neutral cloud contributes to loss processes of plasma in the inner magnetosphere. However, little has been reported on a quantitative study of the electron loss process due to electron-neutral collisions. Tadokoro et al., [2014] focused on the elastic collision between 1keV electron and neutral H_2O and examined the variation of 1keV electron pitch angle distribution due to elastic collisions with the dense region of H_2O originated from Enceladus using one-dimensional test-particle simulation. They reported that the electrons of ˜11.4% to the total number of equatorial electrons at the initial condition are lost in ˜380sec, corresponding to the co-rotating electron flux tube passes the dense H_2O region in the vicinity of Enceladus. Assuming the uniform azimuth H_2O density structure in the Enceladus torus, they estimated the electron loss rate of 33% during one co-rotation.

In this study, we focus on the elastic collisional loss process with neutral H_2O originated from Enceladus. We show the loss rates through pitch angle scattering of electrons with 500eV-50keV (500eV, 700eV, 1keV, 5keV, 10keV, 20keV, 30keV, 40keV, 50keV) and the comparison of the loss rates between the high (in the vicinity of Enceladus) and low (in the Enceladus torus) H_2O density regions. We also show the calculation errors by making 10 times calculations.