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テスト粒子シミュレーションを用いたEnceladus衛星起源のH2O分子と電子の弾性衝突
Test-particle simulation of electron elastic collision with neutral H2O molecule originated from Enceladus

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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 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 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.

In the present study, we examine the variation of energetic electron pitch angle distribution at the magnetic equator and loss rate of precipitated electrons into Saturn's atmosphere through pitch angle scattering due to elastic collisions with neutral H_2O along Saturn's dipole magnetic field line around Enceladus. We conduct one dimensional test-particle simulation for monoenergetic electrons along Saturn's dipole magnetic field line around Enceladus when the co-rotating electron flux tube passes the dense H_2O region in the vicinity of Enceladus (˜6.4 minutes). The initial electron pitch angle distribution is assumed to be isotropic. In case of 1 keV electron, Tadokoro et al., [2014] showed that

1. 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 and that the distribution around 90 degrees shows significant scattering due to the dense region of H_2O,
2. It is found that the electrons of ˜19 % to the total number of equatorial electrons at the initial condition are lost in ˜380 seconds.
3. The calculated loss time is fourth faster than the loss time under the strong diffusion.

We also show the loss rates through pitch angle scattering of electrons with not only 1 keV but also several hundreds eV ? several tens of keV.

キーワード: テスト粒子シミュレーション, 弾性衝突, エンケラドス衛星, 土星
Keywords: Test particle simulation, elastic collision, Enceladus, Saturn