Test-particle analysis of electron scattering by neutral H2O along the magnetic field line of Enceladus

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Cassini observations revealed that Saturn's moon Enceladus (3.95Rs) ejects neutral H_2O from its southern pole with temporal variability [e.g., Hansen et al., 2006]. This volcanic activity, so-called 'plumes', leads to the electromagnetic coupling between Saturn's ionosphere and plasmas around Enceladus. The coupling causes auroral activities around the footprint of Enceladus [Pryor et al., 2011]. They reported that observed field aligned fluxes of electrons and ions are sufficient to brighten the footprint aurora observed by EUV onboard Cassini. In contrast, an electron precipitation into the atmosphere through pitch-angle scattering also causes auroral emissions. The dominant physical process controlling the activity of the footprint aurora is still controversial.

In the present study, for the quantitative evaluation of auroral emissions caused by the pitch-angle scattering through elastic collisions between magnetospheric electrons and H_2O particles, we have developed a spatially one dimensional test-particle simulation code along a dipole magnetic field at Enceladus (L = 3.95). We assume that the initial velocity distribution of energetic electrons at the magnetic equator forms a velocity distribution with a loss-cone. It is assumed that the cross sections of elastic collisions are Born-dipole approximation [Khakoo et al., 2008]. 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 a preliminary result of the variability of precipitating electrons and estimation of the expected brightness of auroral emissions.