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Search for "oxygen torus" in the deep inner magnetosphere - Possible source of O^+-rich ring current

Masahito Nose[1*], Kazue Takahashi[2], R. R. Anderson[3], H. J. Singer[4]

[1]Kyoto University, [2]JHU/APL, [3]University of Iowa, [4]NOAA Space Weather Prediction Center

Previous studies, employing the RIMS instrument onboard the DE-1 satellite, report that a large amount of thermal O^+ ions exist in the outer plasmasphere (L=2.0-5.0) [Horwitz et al., 1984, 1986; Roberts et al., 1987; Comfort et al., 1988; Fraser et al., 2005], in a region called "the oxygen torus". These thermal O^+ ions can be observed frequently, even during low Kp periods (Kp=0-2+), in the late evening hours. Since the termination of the DE-1/RIMS operation about 25 years ago, there have been no instruments that make direct measurements of the oxygen torus, because of difficulty in measuring thermal ion flux with mass and charge state information.

In this study, we intend to detect the oxygen torus with an indirect method using the magnetic field data and the plasma wave data obtained by the CRRES satellite. We estimate the magnetospheric local mass density (rho) from the frequency of the toroidal standing Alfven waves. The local electron number density (n_e) is derived from the plasma wave spectra. Combining these two quantities makes it possible to infer the local average ion mass (M=rho/n_e). We find that M is approximately 3 in the outer magnetosphere (or the plasma trough), while it sometimes shows an enhancement to 5-15 around the plasmapause. This implies the existence of the oxygen torus near the plasmapause. The above method, adopting the toroidal wave frequency, can be considered a powerful tool to detect the oxygen torus and to examine the ion mass in the inner magnetosphere.

A recent study by Nose et al. [2010] presumed that the preexisting thermal O^+ ions in the oxygen torus are locally and nonadiabatically accelerated by fluctuations associated with dipolarization in the deep inner magnetosphere, resulting in formation of the O^+-rich ring current. We will also discuss analysis results of CRRES data in the context of the oxygen torus as an important source of the O^+-rich ring current.