1.52 ST

Multi-dimensional Modeling for Energetic Oxygen Ions in the Earth's Inner Magnetosphere: Equilibrium Configuration of the Eight Ionic Charge States

Spjeldvik, W. N.[1], Bourdarie, S. [2], Boscher, D. [2], Gusev, A. A. [3], Pugacheva, G. I. [3]

[1]*Physics Department, Weber State University, Ogden, UT 84408-2508, USA,*
[2]*ONERA-CERT / DESP, 2, avenue Edouard Belin, F-31055 Toulouse, France,*
[4]*Astrophysics Department (DAS) - Instituto Nacional de Pesquisas Espaciais (INPE) - Av. dos Astronautas, 1758 - Caixa Postal:515 - Cep.:12227-010 São José dos Campos - S.P. - Brasil*

Energetic Atomic Oxygen ions in the keV and MeV energy range can be supplied to the Earth's Inner magnetosphere from the sun (solar wind and solar energetic particles), from anomalous cosmic rays, and from acceleration processes acting on ionospheric ions. We have built a multi-dimensional oxygen ion model in the following parameters: geomagnetic L-shell, the magnetic moment, the second adiabatic invariant, and the discrete charge state number which for atomic oxygen ions range from 1 to 8. Quiet time, steady state oxygen ion distributions have been obtained numerically from an assumed outer radiation zone boundary condition at L=7, average values of the radial diffusion coefficients, and standard values for the exospheric neutral densities due to the MSIS-86 model. Average distributions of free electrons in the plasmasphere were also assumed with a plasmapause located just beyond L=4. We included the six lowest charge states for oxygen based on a compilation by Spjeldvik and Fritz (in JGR, 1978). Computed distributions illustrate the resulting equilibrium structure of energetic oxygen ions between 10 KeV and 100 MeV kinetic energies. The equatorial structure of the distributions is similar to the earlier findings of large spectral deficits ("holes") located around 1 MeV. The present multi-dimensional results show the magnetic latitudinal extent of this major oxygen ion feature. Clearly, this is an energy range where dynamic variations can be expected following fluctuations in the outer zone boundary conditions and the cross-field transport rates. Deep within the Earth's radiation belts, computed charge state distributions show the predominance of the lower charge states at the lower energies and the higher charges states in the MeV range. Starting with an assumed predominance of charge state six at L=7, the computations show how the oxygen distribution adjusts itself according to the collisional charge exchange processes with inward diffusion. Ions that are of low energy (say in the KeV range) at high L-shells adiabatically increase their energy with transport towards lower L-shells, and this favors their collisional increase in charge state number again as higher energy into the MeV range is attained. Thus oxygen ions, on the average, will undergo both a downshift and an upshift in charge state during their diffusive residence in the Earth's inner magnetosphere.

Keywords: **radiation belt structure**, **spectral features**, **energetic oxygen ions**, **charge states**

Corresponding author's e-mail: WSpjeldvik@Weber.edu