A Numerical Investigation of Proton Phase Space Densities

Laura R. Jiang

We completed a numerical derivation to investigate proton phase space densities from the empirical AP8 radiation model. Despite the availability of data, there apparently has been no published evaluation of the phase space densities for the geomagnetically trapped radiation zone. We assumed adiabatic proton motion in a dipole magnetic field model; based upon the methods of Thomsen and Paonessa, a numerical procedure determines the proton energies and pitch angles for specified first and second adiabatic invariants. Using matrix methods I reconstructed unidirectional flux *vs* equatorial pitch angle from the omnidirectional flux *vs* $\mathbf{B}/\mathbf{B_0}$, where $\mathbf{B}$ is the local field strength and $\mathbf{B_0}$ is the equatorial field strength. With the above information, we have computed proton phase space densities as a function of of the Earth's radius for several fixed values of the first and second invariants. We found that the phase space densities of low magnetic moment protons generally fall off monotonically as the radial distance decreases from 6 to 2 R_e. At high first and second invariants, however, a phase space density peak appears at about 3.5 R_e, and this relative maximum suggests a "source" of particles at that radial distance.

This work was completed at The University of Kansas under the supervision and guidance of Dr. Armstrong. I would like to dedicate this work to him, a great teacher, with my sincere appreciation and congratulations on his fiftieth birthday.