at radial distances from 1 to $9R_E$. We selected only those orbits from the quietest part of the mission, approximately 50 orbits between 1985 and 1987, which span solar minimum and which have full local time coverage. The data were collected into four species bins, 32 semilogarithmic energy bins, and 45 L shell bins of ΔL=0.2, averaged over longitude (LT) and time, and converted from energy/charge to magnetic moment, M, so that the data could be directly compared with the model on an i, j mesh in M-L space.

Standard Model

The standard model, discussed in paper 1, assumes a diffusion of particles into the trapping region from an injection boundary or outer boundary at large radial distances while undergoing various loss processes [e.g., *Schulz and Lanzerotti*, 1974]. Injection probably occurs mainly on the nightside, as particles are accelerated in the tail and convect sunward toward the Earth [*Mauk and Meng*, 1983]. The azimuthal symmetry requirement of the standard model represents this as an injection around a complete circle, which we in this work take at L=7.5, assuming azimuthal drift will smooth out any local time effects just outside our boundary. Thus the steady state approximation of the standard model balances the inward diffusion from an external source against the internal losses to determine the radial dependence of the phase space density.

We write the diffusion equation for equatorially mirroring ions, following *Spjeldvik* [1977], as

$$\begin{aligned} 0 &= \frac{\partial f_a(M,L)}{\partial t} \\ &= L^2 \frac{\partial}{\partial L}\left(\frac{D}{L^2}\frac{\partial f_a}{\partial L}\right) - C\frac{\partial f_a}{\partial M} - \Lambda_a f_a \left[+ S_{ab} f_b\right] \end{aligned} \quad (1)$$

where f_a is the phase space density for each species a averaged over LT, L is the L shell coordinate; M is the magnetic moment; D is the radial diffusion coefficient; C is the Coulomb drag coefficient; Λ_a is the charge exchange loss rate; and S_{ab} is the charge exchange source rate, (not applicable for protons) coupling ionic charge states.

The boundary conditions remain identical to those in paper 1, as do the functional descriptions of the loss terms and the effects of Coulomb drag. We have fit the GEOS model plasmasphere (using the parameters from fit 2 of Table 1) [*Farrugia et al.*, 1989] as in paper 1, rather than the more recent ISEE model [*Carpenter and Anderson*, 1992], giving a cold ion density of (in cm^{-3})

$$n_e = n_p = (191{,}000 \pm 17{,}000)/L^4 \quad (2)$$

The electron temperature likewise increases with L, using the same functional form as in paper 1 (in kelvins), we write

$$T_e = 8000 + 6000L + 9.6L^2 \quad (3)$$

These model temperatures are higher than observed (~12,000 K), but for purposes of comparison with paper 1, and because the electron temperatures did not affect the fits, we have not changed them.

As in paper 1, the diffusion coefficient remains the sum of two terms, the diffusion caused by a fluctuating magnetic coefficients [*Fälthammer*, 1965], as discussed in the next section.

Maximum Likelihood Method

In order to adjust the parameters in the model, we employ a maximum likelihood fit, using χ^2 as an indicator of goodness of fit. A reduced χ^2 is calculated from the logarithms of the phase space densities as follows,

$$\langle\chi^2\rangle = \sum_{ij} \frac{[\log(f_{ij}^{\mathrm{model}}) - \log(f_{ij}^{\mathrm{data}})]^2}{\sigma_{ij}^2 (N - n_{\mathrm{free}})} \quad (4)$$

where the sum is over some selected domain of $\sum_{ij} 1 = N$ data points, n_{free} is the number of free parameters being fit, f_{ij}^{model} is the value of the phase space density at mesh point i, j with the corresponding interpolated data, f_{ij}^{data}, at the same point, and σ_{ij} is the error associated with that point. We found that the errors associated with the model were vastly greater than any statistical or measurement errors, so that σ_{ij} was set to 1. To prevent outliers from dominating the fit, we truncated individual χ_{ij}^2 contributions at 10, a 3 order of magnitude deviation. We used the iterative minimization technique of Marquardt [*Bevington*, 1969], to find the best set of model parameters that will describe the data set.

3. Theory

Unlike radiation belt particles, E>0.5 MeV, the keV ring current ions are greatly affected by the tens of kilovolts electric potentials found in even the quiet magnetosphere. Electric fields affect ion transport in at least two major ways, modifying the topology of the drift orbits, and to a lesser extent modifying the drift frequencies. In addition, unlike magnetic fields in the magnetosphere, electric fields can be quite local, with radial and azimuthal gradients modifying the ring current ion transport. All of these effects modify the standard model of quasi-linear resonant radial diffusion developed by *Fälthammer* [1965]. A reformulation of the diffusion model which makes no assumption about resonant frequencies or spatial symmetries is desirable, but for this paper we will attempt to modify the standard model to approximate the effects of a quasi-static electric field.

Modified Topology

Resonant diffusion, the standard mechanism applied to ions that are on closed drift paths around the Earth, is the transport from one closed drift orbit to another that is described by radial diffusion by violation of the third invariant. Thus open drift paths that connect to the plasmasheet and magnetopause delineate the low energy boundary of the standard model. This boundary, also called the Alfvén layer [*Kivelson and Southwood*, 1975], is the high-energy equivalent to the plasmapause, and like the plasmapause, forms an oval shaped perimeter in the equatorial plane. The position and shape of the Alfvén layer depends on the precise ion energy, becoming larger in radius of curvature and more circularlike as the energy of the ions increase. In order for the azimuthally averaged standard model to avoid including