not remove this feature, nor even substantially change its morphology. Since this is in contrast to the changes wrought by the new diffusion coefficient, we proceed to reexamine the diffusion mechanism.

Fit 1b: External + Internal Sources

We then included a hypothetical internal source of electric field fluctuations, holding q=6 but adding L_0 and p to the free parameters, so that we had a six parameter fit. We call this L^p term an "internal" source because for $p < 6$, ΔE^2 is strongest at low latitudes (low L) and decreases with increasing latitude (increasing L). However, the first attempt produced both unstable solutions and unphysical parameters which are symptoms of fitting the wrong functional form to the data. The breakpoint L_0, which defines the location at which internal and external fluctuations have equal amplitude, was placed beyond L=8. The fit also predicted an electric fluctuation power spectrum that grows with frequency ($n, m < 0$), with a minimum (rather than a maximum) at the frequency, Ω_E.

We interpreted this to mean that the stall speed is at higher frequency than expected, causing Ω_E to fit the stall speed. This would be the case if an additional internal (low-latitude) electric field supplements the corotational electric field causing superrotation, or if an incompletely shielded convection electric field is raising the resonant frequency of ions near the stall energy. Since the model now includes a fluctuating internal component, it is not surprising that for consistency it would also require a static internal component as well.

The difficulty is that the additional ionospheric electric field (empirically determined by [*Richmond et al.*, 1980]) or convection electric field is not completely radial, and therefore produces radial drifts that cannot be cancelled by the azimuthal $\vec{\nabla} B$ drifts. We can no longer neatly categorize orbits into eastward and westward drifts with zero drift between the classes; some orbits that do not enclose the Earth ("banana" orbits) contain both eastward and westward motions [*Chen*, 1970; *Strangeway and Johnson*, 1984]. So that stalling is now not only a function of energy, but of location as well; only ions on orbits that pass near a point of zero azimuthal electric field can completely stall, whereas ions in most orbits merely slow down. This velocity variation complicates the simple derivation of drift frequency, $\Omega_T(\mu, r)$, that we presented earlier. Furthermore, these distorted orbits may not couple strongly to the lowest-order spatial harmonics of the perturbation field, but rather may resonate with higher-order (multipole) harmonics. Therefore the correction to *Fälthammer's* [1965] diffusion mechanism is not straightforward.

Fit 2: Minimum Frequency Correction

In an LT-dependent model we can treat the asymmetric orbits exactly, but for our present purposes we need to take an azimuthal average. Calculation of the actual orbital frequency for these distorted orbits is difficult, so instead we estimate the lowest likely frequency, a truncated lower limit for the ion drift frequency, Ω_{min}~0.05 h^{-1}. The exact to have non-zero resonant frequencies so that the diffusion coefficient never goes to zero. Thus we avoid the pitfall that led to the previous unphysical fit.

We fit the same six parameters as before and obtained a χ^2 that was 60% better than fit 1 and with parameters that are more physical. We found the radial gradient of the internal source nearly cancelled the external radial gradient L^6, giving a diffusion coefficient nearly independent of L shell, p=-0.66 for L<L_0. shows, for the first time we have good agreement between the data and the model for all three species. Most of the deviation in the protons occurs in the excluded region of convective transport, or at L<2.6, where some background contamination from the radiation belts is seen (as discussed in paper 1). This background, arising from penetrating MeV protons in the inner radiation belt, is also seen in the low-altitude He^{++} data as well. The small region of disagreement in He^+ around L=4.5 and M<0. keV/nT is due to background from the electron radiation belts. The major region of disagreement for He^+ forms a narrow valley between 2.5–4.0 L, and 0.08–0.3 keV/nT where the fit overestimates the data by a factor of 10–100.

Fit 3: H^+ Only Fit

Since the H^+ data had the best statistics, and to avoid the discrepant He^+ region, we performed another six parameter fit restricting the domain to H^+ alone. We tabulate the fit in Table 1 and plot the ratio of the data to the fit in column of Figure 3. The fit found an unrealistically large power law for the internal source, p=-3.9, partially compensated by a rather steep frequency power law, n=5.6, which substantially improved the low-altitude fit. However, the effect on the helium fit was drastic. Attempts to fit the plasmasphere density, n_e, showed that H^+ alone did not constrain the density since an empty plasmasphere attained the lowest χ^2, which again is an indication that our functional form is not optimal. Since the effect of n_e on the solution within the fit domain is slight, we regard this fit domain as underdetermined, and hence the necessity of a simultaneous fit to helium.

Fit 4: He^+ and He^{++} Fit

A six parameter fit with the domain restricted to He^+ and He^{++} (column 2 of Figure 3) likewise gave an only slightly better fit. The overestimated region in He^+ has been improved primarily by a reduction in the overall diffusion amplitude, with a secondary effect caused by moving the peak frequency toward higher energy. Neither change is outside the realm of possibility, making this a more realistic fit than fit 3 above. The weaker diffusion produced an overestimate of the flux for hydrogen, however, both at low altitudes and at low energies. Thus it appears that the slight overestimate of H^+ in fit 2 probably resulted from the algorithm's attempt to minimize the underestimated region of He^+.

Fit 5: He^+ Restricted Fit

Since the overestimated region of He^+ is affecting the overall fit, we examined the loss processes in this region, but