		Carpenter[1992]	little
Plasma comp.	H^+ only	H^+, He^+, O^+	low L
H geocorona	*Tinsley*[1976]	*Anderson*[1987]	little
He geocorona	none	*Bishop* [1991]	little
e^- temperature	0 eV	1 eV	low E
Coulomb drag e	*Jackson* [1975]	*Itikawa and Aono*[1965]	He low E
Coulomb drag H	*Cornwall*[1971]	Bethe [*Ziegler*, 1980]	He low E
Charge exchange	*Smith and Bewtra*[1978]	*Barnett*[1990]	low E, L

Numerical Algorithm

We have used a fully implicit algorithm (rather than the Crank-Nicholson algorithm which introduced too much numerical diffusion) [*Press et al.*, 1986] to solve the related finite difference equations for f on a 32 x 400 grid of L-M space following SSF. The resulting tridiagonal matrix was solved using standard techniques. The diffusion coefficient was marginally stable in the M domain for less than 200 grid points, but we were able to improve stability by increasing the resolution to 400 grid points. The coupled helium equations were solved by iteration. Details of the numerical methods are given by *Sheldon* [1990]. The iterative procedure for helium resulted in an instability which did not conserve the total number of helium ions. To damp out this instability, we decoupled the equations for the first iteration only. The final helium solution was found to be stable and repeatable.

Validation of Model (Fits A–C)

We began by duplicating as closely as possible the solution given by SSF. We then made several modifications. First we updated the plasmasphere density profile and the neutral H geocorona density profile to agree with more recent measurements. We also modified the Coulomb drag and charge exchange cross sections to agree with the current literature. Finally, we included additional charge exchange reactions, most importantly the plasmasphere H^+ and He^+ reactions. The standard model incorporating these modifications we have called the reference model. We list the changes we have made in Table 2 with comments on their effects.

We varied one parameter at a time to identify the differences. Surprisingly, the model is relatively insensitive to the plasmasphere model or neutral model used. Using neutral H densities from *Rairden et al.* and the "AMHT" values of *Anderson et al.* gave very similar results. The plasmasphere models from GEOS [*Farrugia et al.*, 1989] and ISEE [*Carpenter and Anderson*, 1992] also gave nearly identical fits. Nor did changing the relative abundances of the ions in the plasmasphere by a factor 10 have a great effect. The various loss processes retain their qualitative behavior, and it is generally possible to adjust the diffusion amplitude such that very similar solutions are obtained. More significant were changes in the cross sections for both charge exchange and Coulomb drag.

The importance of losses or transport in the standard model can be found by comparing the relative rates for each term. We plot these rates for H^+, using a profile format (Figure 10) at several fixed values of M. For diffusion, the relative rate is D/L^2, (which is a simplified lower limit, since the coefficient is $\sim D/L^2 + [D'L - 2D]/L^2$). For Coulomb drag it is C/M, while for charge exchange it is Λ, the rate itself. For ring current H^+, charge exchange with neutral H is the dominant loss term except at the highest and lowest energies where Coulomb drag is important. At low L, losses due to electron capture from O^+ dominate over that from neutral H. The steep slope of the diffusion rate profile insures a completely loss dominated regime once the diffusion rate is much lower than the loss rate at low L. The relative importance of Coulomb drag and

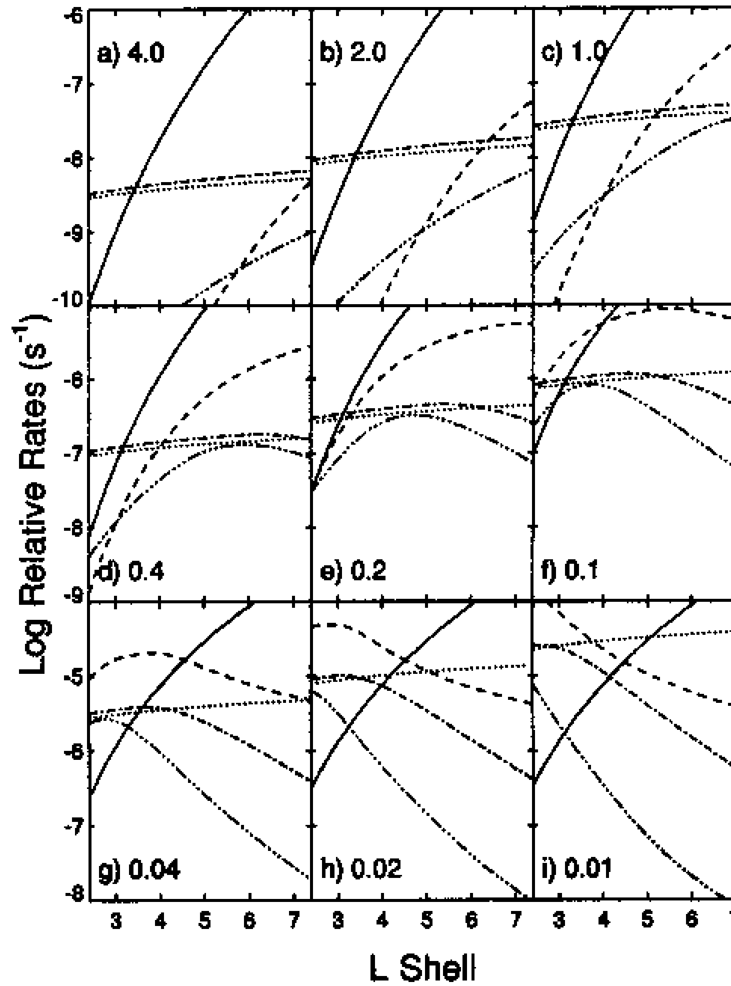

Fig. 10. Model profiles of proton relative rates (s^{-1}) from referenc plotted at magnetic moment=4, 2, 1, 0.4, 0.2, 0.1, 0.04, 0.02, 0.01 keV/n panels (a) through (i), respectively. Solid curve is the diffusion rate ($D/$ dotted is Coulomb drag (C/μ) from SSF, dashed-dotted is Coulomb from *Itikawa and Aono* [1966] incorporating finite electron temperat Dashed curve is the charge exchange rate with neutral H, and dashed-do curve is the charge exchange rate with O^+.

charge exchange also can switch, as shown in Figures 10e and 1 And the electron's finite temperature profoundly affects the low energy Coulomb drag. Thus we can disentangle the various effe of the time-independent solutions by studying the dominant ra governing a region of M-L space.

5. ANALYSIS

Maximum Likelihood Method

We use the standard χ^2 minimization technique as implemen by Marquardt [*Bevington*, 1969] to find the best set of mo parameters to describe the data. Since the phase space densit have a very large dynamic range, we fit their logarithms, definin reduced χ^2 as follows:

$$\langle\chi^2\rangle = \frac{\chi^2}{N - n_{\text{free}}} = \sum_N \frac{[\log(f_{\text{model}}) - \log(f_{\text{data}})]^2}{(N - n_{\text{free}})\sigma^2}$$