agreement between near equatorial crossings of ISEE 1 and Explorer 45.

In this paper, measurements from the charge-energy-mass (CHEM) instrument on the Active Magnetospheric Particle Tracer Explorers (AMPTE), Charge Composition Explorer (CCE) satellite have been used to compile a data set of ion fluxes over the equatorial range from L=1–9, covering all local times, for all quiet periods between August 1984 and January 1989. This data set is unique for several reasons: it separates the various ions, H^+, He^+, He^{++}, and O^+; it spans the entire trapping range of the magnetosphere, 1–9 R_E, at the equator, so that the entire pitch angle distribution is sampled; and it covers the energy range 1–300 keV/e that is responsible for the ring current.

Our objective is to make a comprehensive test of the standard diffusion model using the AMPTE/CHEM measurements. In section 2, we discuss the instrumentation and orbital characteristics of the spacecraft. In section 3 we discuss the selection criteria used in compiling the data set. We bin this data set by L shell and magnetic moment for comparison to radial diffusion theory, and tabulate the averaged fluxes in Appendix A on microfiche[1]. We present the standard radial diffusion model in section 4 where we adopt models of neutral atom densities, plasmasphere density and composition, charge exchange loss, and Coulomb drag to implement the theoretical losses. We present significant updates in the previously used charge exchange cross sections in Appendix B on microfiche. We compare the above detailed model with data in section 5 using a χ^2 minimization technique to optimize the adjustable parameters of the model. Still, the global fit is not good, particularly at low energies (<30 keV) and low altitudes (<4 R_E) where the data indicate much faster transport than predicted by the L^6 dependence of the standard diffusion coefficient.

2. INSTRUMENTATION

Ion composition measurements were made with the University of Maryland/Max-Planck-Insitut für Aeronomie CHEM spectrometer on the AMPTE/CCE spacecraft. The CCE orbit was nearly equatorial, with an apogee of 8.8 R_E, perigee of 1100 km, inclination of 5°, and with an orbital period of approximately 16 hours. The apogee precesses to earlier local times, taking about 16 months for CCE to return to its original orbit. Thus CCE processed around the magnetosphere three and a half times before being turned off in the summer of 1989. This was an ideal orbit for measuring the equatorial trapped particles. Since the CCE spin axis typically points within 10° of the sun, and the instruments view in the spin plane perpendicular to that axis, all pitch angles are usually sampled.

A complete description of the CHEM spectrometer has been given elsewhere [*Gloeckler et al.*, 1985], so we summarize here. CHEM measures the mass, charge state, and energy of ions in the energy range 1–300 keV/e, as well as their incident direction resolved into 32 sectors. The energy per charge (E/Q) is determined with an electrostatic deflection system stepping through 32 logarithmically spaced voltages. The ions are then post accelerated by ~22 kV, penetrate a carbon foil, coast 10.5 cm and finally strike a solid-state detector (SSD). Secondary electrons ejected from the foil strike a microchannel plate producing the "start" signal while electrons from the surface of the SSD likewise produce the "stop" signal for a time-of-flight measurement. A third signal from the

The major sources of background are high-energy electrons in the outer radiation belt ($L>2$) and high-energy protons in the inner radiation belt ($L<2$) that penetrate the instrument causing "accidental" coincidences. This mainly affects the "double" coincidences, ions lacking an SSD signal, which are primarily $E<8$ keV H^+, $E<15$ keV He^+, and $E<39$ keV O^+. Higher energy or multiply charged ions generate a "triple" coincidence and are thus relatively immune to accidental background rates. Yet even for these "triples," we find some regions (i.e., inner belt $L<2$) in which the fluxes are so low and the background so high that we cannot effectively measure the 1–300 keV/e ions.

3. DATA

Global Coverage

From launch in 1984 until June 1989, the CCE spacecraft completed three and a half local time sweeps of the magnetosphere. From this five year period, we have selected days in 1985–1987 that represent the quietest periods of the mission, spanning the 1986 solar minimum (Table 1). None of the days in 1984, 1988, or 1989 was as quiet as these and were therefore excluded from the data set. These orbits, plotted in Figure 1, show nearly complete local time coverage, as well as radial coverage from essentially 1–9 R_E. The data were binned in 0.2 ΔL^* shell increments, but only those between 2.5–7.5 L^* were used, where L^* is the corrected L shell value defined below. H^+, He^+, He^{++}, and O^+ ions in the energy range 1–300 keV/e were each separately binned into 32 logarithmic energy bins. Only locally mirroring ions with pitch angles between 70° and 110° were accepted, recognizing that in the off equatorial orbits, these pitch angles can be as small as 45° measured at the equator. This averaged data set is tabulated in Appendix A on microfiche, including statistical variations.

The derivation of L^* follows from a suggestion of *Roederer* [1970], that a corrected L shell variable be used to identify drift shells. Since the original L shell formulation [*McIlwain*, 1961] used an internal magnetic field alone, the correlation between L shell and drift shells breaks down near geosynchronous orbit where the distortions due to external fields (e.g., magnetopause currents) begin to be significant. Roederer used a realistic magnetospheric magnetic field and showed that equatorially mirroring particles followed drift shells of constant equatorial magnetic field magnitude. Thus we derive L^* for a given point by finding the equatorial magnetic field magnitude, B_{eq}, and then calculating the equivalent dipole L shell given by the formula,

$$L^* = (B_0/B_{eq})^{1/3} = \left(\frac{B_0\sqrt{1+3\cos^2(\lambda)}}{|B|\sin^6(\lambda)} \right)^{1/3} \qquad (1)$$

where B_0 is the Earth's equatorial surface field, and λ is the magnetic latitude. We calculate B_{eq} by using the measured magnetic field magnitude, $|B|$, from the magnetometer experiment aboard CCE, averaging it over a 3-min interval, and extrapolating it to the magnetic equator using a dipole field model and the IGRF80 model magnetic latitude. If $|B|$ is stable and well defined, the correction is meaningful, but when the fluctuations in $|B|$ are large compared to the average, the method becomes suspect. Thus we have not tried to extend the method beyond L^*=7.5.

Selection Criteria

Since our goal was to collect a quasi-equilibrium data set, we based the selection criteria for the days listed in Table 1 on estimates of magnetospheric activity. We have used six basic criteria: four

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[1] Appendices A and B are available with entire article on microfiche. Order from American Geophysical Union, 2000 Florida Avenue, N.W., Washington, DC 20009. Document A93-001;$2.50. Payment must accompany order.