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RADIATION ENVIRONMENT FOR ATS-F

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Space and Earth Sciences Directorate
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January 1974

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Foreword

A special study was conducted to determine the ambient trapped particle fluxes incident on the ATS-F satellite. Several synchronous circular flight paths were evaluated and the effect of parking longitude on vehicle encountered intensities was investigated. Temporal variations in the electron environment were considered and partially accounted for. Magnetic field calculations were performed with a current field model extrapolated to a later epoch with linear time terms. Orbital flux integrations were performed with the latest proton and electron environment models using new improved computational methods. The results are presented in graphical and tabular form; they are analyzed, explained, and discussed. Finally, estimates of energetic solar proton fluxes are given for a one year mission at selected integral energies ranging from 10 to 100 Mev, calculated for a year of maximum solar activity during the next solar cycle.

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Introduction

The objective of the present study is to evaluate the charged particle fluxes to be encountered by a spacecraft in a synchronous orbit, specifically as applied to the ATS-F mission. Because synchronous orbits have certain characteristics entirely their own, some general observations are in order.

Circular geosynchronous (geostationary) trajectories are flight paths with a periodicity of exactly 24 hours; this fixes their altitude to about 5.6 earth radii. Satellites in such orbits are co-rotating with the geoid, as if rigidly attached. When the trajectories lie in the equatorial plane, the satellites appear to be stationary in geocentric space (over the equator) on a meridian which is determined by their injection conditions. This position is called the parking longitude. If the plane of the circular orbit is tilted away from the equator, the trace of all subsatellite points (geocentric projections) on the earth's surface form a figure "eight" with its node at the parking position and its axis of symmetry aligned horizontally in the north-south direction (normal to the equator). When inclina- is increased, the size of the projected trace (figure eight) becomes larger, probably reaching its maximum for polar orbits.

In order to determine the effects of parking position on the mission integrated trapped particle fluxes encountered by synchronous satellites, three special parking longitudes were selected for study because of magnetic geometry considerations, namely: 110°E, 290°E, 310°E. For these conditions, circular trajectories were then investigated.

Some comments are necessary at this point in regards to the two new electron environment models used in the flux calculations:, the AE5 for the inner zone ($1.1 < L < 2.8$) by Teague and Vette 1972, and the AE4 for the outer zone ($2.8 < L < 11.$) by Singley and Vette 1972.

Both are static models describing the environment as it existed back in October 1967, at about solar maximum conditions. In constructing these models it was possible to infer a change of the average quiet-time electron flux levels as a function of the solar cycle. However, for the regions of space covered by the various orbits in this study there are no appreciable changes in the time average flux.

Additional static versions of the AE5-AE4 models for the 1964 solar minimum epoch have just been released and will be incorporated into the "Unified Orbital Flux Integration and Analysis System" for future applications (Stassinopoulos and Gregory, 1973).

In the meantime, electron fluxes calculated for the years 1973-76 (next solar min) with the currently in-use solar max models, are inevitably overestimates. To partially compensate for this error, the uncertainty factor attached to the electron results will have to be adjusted in such cases.

Now the ATS-F launch date of 1974.4 places at least half of the satellite's planned lifetime (5 years) into this category. Specifically, the first two mission objectives (one year stationed at 94° west and one year stationed at 35° east) fall entirely within a period of decreased solar activity. Also, the first year of the last mission objective (three years stationed at 105° west) may be a solar min year, depending on the length of the present 20th solar cycle. To correctly evaluate the presented electron fluxes for these mission years, the reduced uncertainty factor given in Appendix A should be used.

Another important feature of the synchronous electron environment is the strong local time dependence of the ambient particle fluxes. The local time variations for high energy electrons (1 - 3 Mev) at synchronous altitudes ($L \sim 5.6$ e.r.) exceed one order of magnitude. These variations are due to distortion of the magnetosphere caused by the solar wind (compression at local noon, elongation at local midnight).

Theoretically, the new outer-zone AE4 recognized this dependence and accounted for it by incorporating an analytic function for its calculation. However, the version distributed in card deck form for practical application purposes provides fluxes which are averaged over local time. The reason behind this simplification is that most users employ the model in orbit- or time-integration processes to missions which have durations of 6 months or more and the local time effects would be averaged out anyway. Hence, in order to save time, core, and effort, a local time average value, which is nearly equivalent to the fluxes at the dawn meridian, was inserted into the model in place of the analytic function.

The consequence of this simplification on circular equatorial synchronous orbits (that is, orbits lying on constant L-shells) is insignificant as long as complete periods (= revolutions = 24-hour intervals) are being considered. But when the circular synchronous orbits are inclined or when the synchronous orbits are elliptical (for any inclination, including equatorial), the results conceivably could be biased for very short term missions or for the flux encountered in a transfer orbit because the vehicle briefly passes through varying L-shells at different local times, without spending more than a fraction of its period at any shell; the averaged flux values yielded by the model for these transit positions may be off (up or down) by as much as a factor of 7, depending on the particular conditions. Since such trajectories have an effective L range from about 5.5 e.r. to about 22.0 e.r. and since the relative shell-related intensities over this L range vary by several orders of magnitude, a significant intrinsic uncertainty is associated with these results for short term missions. However, for long term missions where local times are encountered fairly uniformly, the local time averaged fluxes are appropriate. The effect of this possible error for short term missions is reflected in the uncertainty factor given for the electron data in Appendix A.

In contrast to the electrons, no special considerations are required for the proton results obtained from standard models long in use. Although they describe a static environment, this is a valid representation for these particles because experimental measurements have shown that no significant changes with time have occurred in the proton population. With the exception of the fringe areas of the proton belt, that is at very low altitudes and at the outer edges of the trapping region, the possible error introduced by the static approximation lies well within the uncertainty factor attached to the models. Consequently, the proton data may be applied to any epoch without the need for an updating process.

We wish to emphasize that our calculations are only approximations although they are based on the best available data; as always, we strongly recommend that all persons receiving parts of this report be advised about the uncertainty in the data, as discussed in Appendix A.

Appendix A also contains pertinent information on units, field models, trajectory generation and conversion, etc.

Finally, an explanation regarding the attribute "standard" frequently used in the reformatted OFI (Orbital Flux Integration) Study Reports. The term is applied as a modifier to parameters, constants, or variables in order to indicate or refer to some specific value of these quantites that had been used without change over extended periods of time. Although override possibilities do exist in the OFI system, a routinely submitted production run will, by default option, always use these "standard" values. The term is also used in reference to established forms, style, processes, or procedures, as for example, "standard tables", "standard plots", "standard production runs", etc. A list of some quantities, values, or expressions modified by "standard" is given in Table 1.

Results: Analysis and Discussion

The outcome of our calculations is summarized in Tables 3 to 17, which are all computer produced. The tables are arranged in four sets, where every set pertains to one specific type of table: the first set contains the "L-band" tables, the second the "Spectral Distribution and Exposure Index" tables, the third the tables of "Peaks"*, and the fourth the "Exposure Analysis" summary and the "Time Account" breakdown. All sets except the last contain two similar members: one for low energy protons, and one for electrons, in that order. The last contains only one member. No high energy protons of the trapped particle variety exist in the regions of space visited by synchronous satellites, hence no tables. Further explanations on the tables and a more detailed description of their contents is given in Appendix B. Figure 1 is a guide to table arrangement, as produced by a standard production run of the Orbital Flux Integration (OFI) program UNIFLUX, for a single trajectory.

Some of the tabulated data is also computer plotted in Figures 3 to 14, with additional Figures 15 to 20 containing plots of flight path data. Finally, Figure 21 shows the unattenuated interplanetary solar proton spectrum at 1 A.U., applicable to all trajectories considered in this study. As with the tables, the plots are arranged in four sets, where each set pertains to one specific type of plot: the first set contains "Time and Flux Histograms", the second "Spectral Profiles", the third "Peaks per Orbit"*, and the fourth trajectory "World Map Projections" and "B-L Space Tracings". Again, all sets except the last contain two similar

* Ommitted: not applicable

members: one for each type of particle encountered. The last set contains two independent members. Appendix C describes and explains the plots. Figure 2 is a guide to plot arrangement, as produced by a standard production run for a single trajectory. The final, single, concluding plot (Figure 21) is explained in the section on "Energetic Solar Proton Fluxes."

I. Spectral Profiles

For tabulated data consult Tables 9 - 14.

For plotted data consult Figures 9 - 14.

The integral spectra presented in this report are orbit integrated, statistically averaged, trapped particle spectra, characteristic of the specific trajectories that produced them.

It should be noted that of the trapped particle species, only electrons and low energy protons exist at synchronous altitudes: that is, the synchronous environment is completely devoid of trapped high energy protons.

A comparison of the available data reveals that parking longitude has little effect on mission integrated fluxes; the maximum difference in flux levels due to any parking longitude variation is not likely to exceed 30%. In regards to the electrons, the error introduced by neglecting this change is insignificant, in view of the very large uncertainties associated with the data (about a factor of 5).

This conclusion applies equally to electrons and protons and it includes all energies.

II. Trajectory Data

See Figures 15 - 17 for World Map Projections.

See Figures 18 - 20 for B-L Space Tracings.

A. World Maps

World map projections of trajectories are by definition the surface traces of their subsatellite points.

Projections of circular synchronous equatorial orbits display no salient features; they appear on the equator as a point (see Figures 15 - 17).

B. Magnetic Dipole Mapping

At the geocentric distances of synchronous orbits, the quantities B and L have no physical meaning any more because of the interaction between solar wind and magnetosphere.

The noon-midnight distortion of the magnetosphere, produced by that interaction (compression in the solar and elongation in the antisolar direction), causes a breakdown in the symmetry of the dipole magnetic shell parameter L and introduces significant external currents and fields, whose contributions substantially alter the apparent field strength B at a given synchronous position, that is presently obtained from the dipole terms of the internal field model applied in the calculations.

Therefore, in this study (as well as in every model of charged-particle radiation utilized), these variables are being employed only as ordering parameters.

The magnetic B-L space tracings of the circular equatorial synchronous trajectories appear as small line segments on the plots (Figures 18 - 20) running parallel to the contour of the magnetic dipole equator, but removed from it by a finite distance corresponding to the magnetic latitude of the parking position.

This displacement occurs because the magnetic dipole axis is tilted to the earth's axis of rotation by an angle of about 11.4 degrees. Hence, positions on the geographic equator may be displaced from the geomagnetic equator by that angle, at most. If the parking longitude coincides with the nodes of the two equatorial planes, the trace should be tangent to the equatorial contour in the B-L plots.

The length of the traces is a measure of the B and L variations encountered on a particular trajectory. A relatively stationary circular orbit has the shortest trace.

The selection of a different parking longitude has no effect on the magnitude of the L-interval covered by the trace but it changes slightly the B-interval (maximum variation between smallest and largest interval appears to be less than 10%) and shifts the position of the trace relative to the equatorial contour, both in B and in L.

Energetic Solar Proton Fluxes

Good measurements of solar cycle 20 interplanetary cosmic ray fluxes at about 1 A.U. are now available. These interplanetary particles are also observed over the high latitude polar cap regions. However, at other latitudes the geomagnetic field effectively shields the earth from some of these cosmic rays by deflecting the lower energy particles while only particles with increasingly higher energy penetrate to lower latitudes.

In order to consider the effect of geomagnetic shielding from cosmic rays on an orbiting spacecraft, the total time spent by the vehicle in regions of space accessible to these particles has to be calculated, as a function of particle energy, for the entire lifetime of the satellite. In other words, the exposure of a spacecraft to these particles is in essence a function of trajectory altitude and inclination, and mission duration. Of course, this applies only to the years of increased solar activity, and whether a satellite will "see" energetic solar protons or not, even in accessible regions of the magnetosphere, depends on the epoch within the solar cycle, at which the mission is to be flown. If it coincides with the period of low solar activity (years of solar minimum), it most likely will not encounter any significant number of energetic solar protons, and vice versa.

Having calculated a mission related exposure time for a specific trajectory, one can use experimentally determined low energy cosmic ray fluxes of solar origin from which the galactic background has been subtracted, to obtain vehicle-encountered energetic solar proton intensities. In the present study, the annual mean of event and cycle integrated proton fluxes of cycle 20, given by Stassinopoulos and King (1973) for energies ranging from E>10 Mev to E>100 Mev, were used to estimate cycle 21 intensities on the ATS-F mission.

However, no thorough statistical treatment has yet been worked out in regards to the probability of actual cycle 21 fluxes exceeding the predicted intensities. Crude model confidence levels only are available at this time. The importance of such statistics must be emphasized; it is best demonstrated by the occurrence of the August 4-7, 1972, event, which was the largest recorded in solar cycles 19 and 20, its fluxes exceeding the accumulative total of all other cycle 20 events by about a factor of 2 for the E>10 Mev protons and by a factor of 4 for the E>30 and E>60 Mev particles. Therefore, caution is advisable when using the data presented in this report.

The probability that the estimated fluxes for the ATS-F mission will be exceeded by an actual event, is about 33% for a one year mission duration.

Figure 21 shows annual, omnidirectional, integral spectral profiles of vehicle-encountered energetic solar proton fluxes for several different missions, including ATS-F, in units of particles per square centimeter.

The reason only one curve appears on this graph is because all three investigated trajectories remain completely outside the magnetic dipole shell of L=5 e.r. and, consequently, experience no magnetospheric shielding effects: that is, they all encounter the same 100% exposure to energetic solar protons.

Note: These fluxes apply only to missions planned for periods of increased solar activity. It is not expected that solar-min missions will encounter energetic solar protons of any significance; at least, it is very unlikely (but not impossible) to have a major event occurring during the years of minimum solar activity. The 5-year ATS-F mission, to be launched in mid 1974, will spend approximately half of its lifetime in a solar min period. Hence, no solar protons have to be considered until about 1977. Thereafter, the predicted mean annual intensities should be applied to the remaining 2.5 years. Caution: In evaluating the energetic solar proton radiation hazard please bear in mind that the probability of at least one anomalously large event occurring during the time interval 1977 - 1979 is high.

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APPENDIX A

General Background Information

For the selected flight paths, orbit tapes were generated, with a constant integration stepsize of two minutes, and for a 24 hour flight duration each. Since all the orbits are geosynchronous, this time interval is adequate for a sufficient sampling of the ambient environment. (For more details see section: "Results, I. Trajectory Data".) For the following inclination and parking positions, circular and elliptical trajectories were thus produced:

Incl.	Parking Longitude
0°	110°E, 290°E, 310°E

The orbits were subsequently converted from geocentric polar into magnetic B-L coordinates with McIlwain's INVAR Program of 1965 (Hassit and McIlwain, 1967) and with the field routine ALLMAG by Stassinopoulos and Mead (1972), utilizing the IGRF (1965) geomagnetic field model by Cain and Cain (1971), calculated for the epoch 1975.5.

Orbital flux integrations were performed with Vette's current models of the environment, the new AE5-AE4 for the inner and outer zone electrons, the AP6-AP7 for high energy protons, and the AP5 for low energy protons. All are static models which do not consider temporal variations; this includes the new electron models, at least as far as the present calculations are concerned. See text for further details on this matter.

The documents that describe these models are listed below:

Model	
AE4	Singley and Vette, 1972
AE5	Teague and Vette, 1972
AP5	King, 1967
AP6	Lavine and Vette, 1969
AP7	Lavine and Vette, 1970

The results, relating to omnidirectional, vehicle-encountered, integral, trapped particle fluxes, are presented in graphical and tabular form with the following unit conventions:

1. Daily averages:	total trajectory integrated flux averaged into particles/cm^2 day,
2. Average instantaneous:	time integrated average, characteristic of the orbit, in particles/cm^2 sec,
3. Totals per orbit:	non-averaged, single-orbit, integrated flux in particles/cm^2 orbit, and
4. Peaks per orbit:	highest orbit-encountered instantaneous flux in particles/cm^2 sec,

where one orbit=one revolution.

Please note: We wish to emphasize the fact that the data presented in this report are only approximations. We do not believe the results to be any better than a factor of 2 for the protons and a factor of 5 for the electrons. It is advisable to inform all potential users about this uncertainty in the data. Please also remember that the electrons have been calculated with a model describing the environment at solar maximum. The obtained fluxes are, therefore, an overestimate for those parts of the ATS-F mission which are scheduled to fly around solar minimum, (1975 - 1976, possibly part of 1977, depending on the duration of the present solar cycle). Consequently, it is suggested that for the solar min period of the mission the electron results be taken as an upper limit and the uncertainty factor be applied only in its reducing capacity (divisor).

APPENDIX B

Description of Tables

a) **The L-band Table:**

The table contains 36 L-bands L_i of equal size, covering the range from L = 1.0 to L = 8.2 earth radii in constant increments of .2 earth radii. For the L-intervals determined in this way, orbital spectral functions

$$N(>E,E_N;L_i) = \left[\sum_k J_k(>E;B)\right]_{L_i} \Bigg/ \left[\sum_k J_k(>E_N;B)\right]_{L_i} \qquad \begin{matrix} i=1,36 \\ L_i:\ L_i < L \le L_{i+1} \end{matrix} \qquad (1)$$

are obtained at nine arbitrary energy levels such that the integral spectrum is equal to 1 for $E = E_N$, where E_N was taken to be .1, 5., and .5 Mev for low energy protons, the high energy protons, and the electrons, respectively. The notation L_i is used to indicate the L-band from L_i to L_{i+1}, while $J(>E;B)$ is the integral, omnidirectional flux yielded by the environment model used in the calculation. The spectral functions N are evaluated for the total flight time simulated in the study, where the summing index k selects all trajectory points lying in each L_i.

The corresponding orbital distribution functions, representing fluxes above energy E_N, are given by

$$F(E;L_i) = \Delta t\left[\sum_k J_k(>E;B)\right]_{L_i} \qquad (2)$$

where Δt is the constant time increment of orbit integration, whose standard value is 60 seconds. The distribution functions are fluxes accumulated in their respective L_i bands over the total flight period considered.

The orbital distribution functions are listed on the table at the bottom of each L-interval and are labeled "NORMFLUX". The nine integral energy levels selected for the low and high energy protons and for electrons are given below in units of "Mev" for all particles:

Protons		Electrons
Low	High	
.1*	3.	.0
.5	5.*	.5*
.9	10.	1.0
1.1	15.	1.5
1.5	20.	2.0
2.0	25.	2.5
2.5	30.	3.0
3.0	50.	4.0
3.5	100.	5.0

where the normalization energy is indicated by a star (*).

b) The Spectral Distribution and Exposure Index Table:

This table has three parts:

I. The spectrum $\Psi_j(\Delta E)$ given in % for energy intervals that correspond to the energy levels of the previously discussed table (L-bands), with two special columns showing the total orbit integrated flux for these energy intervals averaged into instantaneous I_j^S and daily I_j^D intensities

$$\Psi_j(\Delta E) = 100 \frac{I_j^D(\Delta E)}{F(>E_1)} \qquad j=1,9 \qquad (3)$$

where

$$F(>E_1) = C \sum_{k=1}^{k_0} J_k(>E_1;B,L)\Delta t \qquad (4)$$

$$I_j^D(\Delta E) = C \sum_{k=1}^{k_0} \Delta t \left\{ J_k(>E_j;B,L) - J_k(>E_{j+1};B,L) \right\} \qquad (5)$$

$$I_j^S(\Delta E) = I_j^D(\Delta E)/86400 \qquad (6)$$

$$C = \frac{24}{T} \quad , \quad T = k_0 \Delta t \qquad i=1,36$$

and where k_0 is the upper limit of k. It is equal to the total number of time increments considered in the study.

II. The composite orbit spectrum for integral energies, giving the total vehicle encountered fluxes averaged into daily $S^D(>E_j)$ and per second $S^S(>E_j)$ intensities for 15 discrete energy levels:

$$S^D(>E_j) = c\Delta t \sum_{m=0}^{T} J_m(>E_j) \qquad j=1,15 \qquad (7)$$

$$S^S(>E_j) = S^D(>E_j)/86400 \qquad (8)$$

where the summation is performed for the entire simulated mission duration T and includes all fluxes with energies greater than E_j.

III. The exposure index, given (for the normalization energy used in the L-band table) at nine successive intensity ranges R_n one order of magnitude apart, in terms of exposure duration $\tau(R_n)$, converted to hours, and total number of particles $\phi(>E_N;R_n)$ accumulated while in that intensity range. The notation R_n is used to indicate the intensity range from r_n to r_{n+1}:

$$\phi(>E_N;R_n) = \tau(R_n)\ \theta(>E_N;R_n) \qquad \begin{matrix} n=1,9 \\ R_n \equiv r_n < r \leq r_{n+1} \end{matrix} \tag{9}$$

$$\theta(>E_N;R_n) = \left[\sum_{\ell} J(>E_N;r)\right]_{R_n} \Big/ \zeta_n \tag{10}$$

$$\tau(R_n) = \Delta t\ \zeta_n \tag{11}$$

where ζ_n is the upper limit of ℓ in each R_n.

c) The Table of Peaks:*

In this table, the absolute instantaneous peak flux encountered during each successive orbit (revolution) is listed for the indicated energy range. There are nine columns on this table. Column 1 is an orbit counting device, based on the period of the orbit when the trajectory lies in the equatorial plane and is circular, on the physical perigee in all elliptical cases, and on the equatorial crossing for circular inclined trajectories. Column 2 gives the peak flux. Columns 3, 4, and 5

*Ommitted : Not applicable to synchronous orbits indicate the spacecraft position in geocentric coordinates at which the peak was encountered, while columns 6, 7, and 8 determine respectively the time and the magnetic B-L coordinates for this event. It should be noted that all simulated flight paths for the purpose of orbital radiation studies start at $t_0 = 0$ hours. Finally, the last column indicates the total flux encountered during that particular orbit. It is advisable to disregard the last line on this table because many times that orbit is incomplete and the fluxes or positions shown do not correspond to true peaks.

d) The Exposure Analysis Summary:

The summary is contained in the left half of this last table of each set as a semi-independent and separate table. It indicates what percent of its total lifetime T the satellite spends in "flux free" regions of space, what percent of T in "high intensity" regions, and while in the latter, what percent of its total daily flux it accumulates.

In the context of this study, the term "flux free" applies to all regions of space where trapped particle fluxes are less than one proton or electron per square centimeter per second, having energies E > .1, E > 5., and E > .5 Mev for the low energy protons, the high energy protons, and the electrons, respectively; by definition, this includes all regions outside the radiation belts. The concept of "trapped particle fluxes" is meant to include stably trapped, pseudo-trapped, and transient fluxes, as long as they are part of or contained in the environment models used and, in the case of transients or pseudos, their sources are considered powerful enough to supply them frequently in substantial numbers.

Similarly, we define as "high intensity" those regions of space where the instantaneous, integral, omnidirectional, trapped-particle flux is greater than 10^3 protons with energies $E > .1$ or $E > 5.$ Mev, and greater than 10^5 electrons with energies $E > .5$ Mev.

The values given in this table are statistical averages, obtained over extended intervals of mission time. However, they may vary significantly from one orbit to the next, when individual orbits are considered.

e) The Time Account Breakdown:

The breakdown of orbit time is given in the right half of the last table of every set, in the same semi-independent form as the summary. The table shows the total lifetime spent by the vehicle in the inner zone T^i $(1.0 < L \leq 2.5)$ and the outer zone T^o $(2.5 < L \leq 7.0)$ of the trapped particle radiation belt, and also the percent duration spent outside that region $(L > 7.0)$, which is denoted by T^e (T-external), such that for any mission

$$T = T^i + T^o + T^e = 100\%.$$

The confinement of the outer zone within the boundary of the $L = 7.0$ volume is arbitrary and has no physical meaning. It is intended only as a simplification to facilitate our calculations. The region considered "external" $(L = 7.0)$ in this study is still partially a domain of the outer zone, at least as far out as $L = 11.0$ earth radii, according to the latest electron models (Singley and Vette, 1972).

A last item on this table: the inner zone time T^i may be subdivided into two parts: the percentage of time spent outside the region $(1.0 < L \leq 1.1)$ and inside the region $(1.1 < L \leq 2.5)$.

APPENDIX C

Description of Plots

a) The Time and Flux Histogram:

This plot shows two curves superimposed on the same graph, namely, one each for the variables "time" and "flux". Both are given as functions of the parameter L (earth radii) within the range 1 - L - 7, on a semi-log scale. The plot depicts: (1) by a plain curve the characteristic trajectory intensities as obtained from the orbital integration process in terms of averaged, integral particle fluxes above a given energy, over constant L-bands of .1 earth radius width, and (2) by a contour marked with symbols the percent of total lifetime (%T) spent in each L-interval. The logarithmic ordinate relates to the time-flux variables. The printed numbers are powers of 10 and pertain to the fluxes; the scale values for the time curve are given in the upper part of the ordinate label: from 10^{-3} to 10^{2} percent of T. The type of particles, their integral energy, and the units, are all given in the lower part of the label. The label on top of the graph lists some useful information about the trajectory.

b) The Spectral Profile:

A graphical presentation of the final spectral distribution, obtained from the orbital integration process. The plot is a semi-log graph, where the abscissa is a linear energy scale for integral particle energies

E_0 in Mev, and the ordinate is a logarithmic scale for the orbit integrated fluxes, given in daily averages for energies greater than E_0; the printed scale values are powers of 10.

c) Peaks per Orbit:*

Here the absolute peak intensities, encountered per period, are plotted for the duration of the total flight time considered (1 period = 1 revolution = 1 orbit). The logarithmic ordinate relates to instantaneous particle fluxes of the environment at the indicated energy threshold, while the abscissa is a linear orbit enumeration.

d) World Map Grid Projection of Orbits:

The trajectory is plotted for several revolutions on a global map produced by a Miller Cylindrical Projection. The contours of the continents have been omitted for clarity. The positions of either equatorial crossing, of physical perigee, or of period commencement are indicated by numbers identifying the orbits shown in this graph. For all trajectories, the distance between successive sequential numbers is a measure of the orbit precession.

e) B-L Trace of Orbits:

This plot shows a trace of the trajectory in B-L space on a semi-log scale. Several orbits are usually depicted, each identified by its sequential number. The magnetic equator is entered on all plots. The logarithmic ordinate relates to the field strength B in gauss; the

* Ommitted : Not applicable to synchronous orbits

printed values are exponents of 10. L is given in earth radii on the linear abscissa.

TABLE 1

Partial Listing of
Parameters, Constants, Variables, or Expressions
designated as "standard" in the text

1. Standard Tables: set of tables as listed in Figure 2, in the regular format described in Appendix B.

2. Standard Plots: set of plots as listed in Figure 2A, in the regular format described in Appendix C.

3. Standard Production Run: a production run processed on default options.

4. Standard Integration Stepsize: constant time increment of orbit integration: 1' (60").

5. Standard Energies: low energy protons E>.1 Mev, high energy protons E>5. Mev, and electrons E>.5 Mev.

6. Standard Procedure: established procedure normally followed vs. procedure followed in special cases.

TABLE 2

B and L Extrema of Synchronous Trajectories

Circular orbits
Inclination 0°
Altitude 35863 km

Parking Longitude (degr.)	B-Range (gamma) min	B-Range (gamma) max	L-Range (e.r.) min	L-Range (e.r.) max
110°	114	114	6.86	6.86
290°	109	109	7.02	7.02
310°	108	108	6.98	6.98

Tabla 3

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*****************************************************************************************************************
** ORBITAL FLUX STUDY WITH COMPOSITE PARTICLE ENVIRONMENTS: VETTES AP5, AP6, AP7; AE4, AE5, FOR SOLAR MAXIMUM **** UNIFLX OF 1973 **
** ELECTRON FLUXES EXPONENTIALLY DECAYED TO 1970. 0 WITH LIFETIMES: E.G.STASSINOPOULOS&P.VERZARIU ** CUTOFF TIMES:              **
** MAGNETIC COORDINATES B AND L COMPUTED BY INVARA OF 1972 WITH ALLMAG, MODEL  4:  CAIN&SWEENEY 120-TERM POGO 8/69 * TIME= 1975.5 **
** VEHICLE : ATS-F (110) ** INCLINATION= 0DEG ** PERIGEE=35863KM ** APOGEE= 35863KM ** B/L ORBIT TAPE: TD7512 ** PERIOD= 24.000 **
*****************************************************************************************************************
                    ***************************  LOW ENERGY PROTONS  ******************************
                    ** SPECTRAL DISTRIBUTION : NORMALIZED BY FLUX OF ENERGY GREATER THAN .100 MEV **
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L - B A N D S (M A G N E T I C S H E L L P A R A M E T E R I N E A R T H R A D I I) L - B A N D S

ENERGY LEVELS >(MEV)	*1.0-1.2*	*1.2-1.4*	*1.4-1.6*	*1.6-1.8*	*1.8-2.0*	*2.0-2.2*	*2.2-2.4*	*2.4-2.6*	*2.6-2.8*	*2.8-3.0*	*3.0-3.2*	*3.2-3.4*
.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.900	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

L - B A N D S (M A G N E T I C S H E L L P A R A M E T E R I N E A R T H R A D I I) L - B A N D S

ENERGY LEVELS >(MEV)	*3.4-3.6*	*3.6-3.8*	*3.8-4.0*	*4.0-4.2*	*4.2-4.4*	*4.4-4.6*	*4.6-4.8*	*4.8-5.0*	*5.0-5.2*	*5.2-5.4*	*5.4-5.6*	*5.6-5.8*
.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.900	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

L - B A N D S (M A G N E T I C S H E L L P A R A M E T E R I N E A R T H R A D I I) L - B A N D S

ENERGY LEVELS >(MEV)	*5.8-6.0*	*6.0-6.2*	*6.2-6.4*	*6.4-6.6*	*6.6-6.8*	*6.8-7.0*	*7.0-7.2*	*7.2-7.4*	*7.4-7.6*	*7.6-7.8*	*7.8-8.0*	*8.0-OVR*
.100	0.0	0.0	0.0	0.0	0.0	1.00E 00	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	3.53E-02	0.0	0.0	0.0	0.0	0.0	0.0
.900	0.0	0.0	0.0	0.0	0.0	1.25E-03	0.0	0.0	0.0	0.0	0.0	0.0
1.10	0.0	0.0	0.0	0.0	0.0	2.34E-04	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	8.25E-06	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	9.90E 10	0.0	0.0	0.0	0.0	0.0	0.0

Table 4

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** ORBITAL FLUX STUDY WITH COMPOSITE PARTICLE ENVIRONMENTS: VETTES AP5, AP6, AP7; AE4, AE5, FOR SOLAR MAXIMUM **** UNIFLX OF 1973 **
** ELECTRON FLUXES EXPONENTIALLY DECAYED TO 1970. 0 WITH LIFETIMES: E.G.STASSINOPOULOS&P.VERZARIU ** CUTOFF TIMES:                **
** MAGNETIC COORDINATES B AND L COMPUTED BY INVARA OF 1972 WITH ALLMAG, MODEL  4:  CAIN&SWEENEY 120-TERM POGO 8/69 * TIME= 1975.5 **
** VEHICLE : ATS-F (110)  ** INCLINATION=  0DEG ** PERIGEE=35863KM ** APOGEE= 35863KM ** B/L ORBIT TAPE: TD7512 ** PERIOD= 24.000 **
```

ELECTRONS

** SPECTRAL DISTRIBUTION : NORMALIZED BY FLUX OF ENERGY GREATER THAN .500 MEV **

ENERGY LEVELS >(MEV)	*1.0-1.2*	*1.2-1.4*	*1.4-1.6*	*1.6-1.8*	*1.8-2.0*	*2.0-2.2*	*2.2-2.4*	*2.4-2.6*	*2.6-2.8*	*2.8-3.0*	*3.0-3.2*	*3.2-3.4*
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

L - B A N D S (M A G N E T I C S H E L L P A R A M E T E R I N E A R T H R A D I I) L - B A N D S

ENERGY LEVELS >(MEV)	*3.4-3.6*	*3.6-3.8*	*3.8-4.0*	*4.0-4.2*	*4.2-4.4*	*4.4-4.6*	*4.6-4.8*	*4.8-5.0*	*5.0-5.2*	*5.2-5.4*	*5.4-5.6*	*5.6-5.8*
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

L - B A N D S (M A G N E T I C S H E L L P A R A M E T E R I N E A R T H R A D I I) L - B A N D S

ENERGY LEVELS >(MEV)	*5.8-6.0*	*6.0-6.2*	*6.2-6.4*	*6.4-6.6*	*6.6-6.8*	*6.8-7.0*	*7.0-7.2*	*7.2-7.4*	*7.4-7.6*	*7.6-7.8*	*7.8-8.0*	*8.0-OVR*
.0	0.0	0.0	0.0	0.0	0.0	1.56E 01	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	1.00E 00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	1.78E-01	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	4.10E-02	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	9.44E-03	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	2.06E-03	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	4.14E-04	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	7.89E-07	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	2.03E 11	0.0	0.0	0.0	0.0	0.0	0.0

Table 5

** ORBITAL FLUX STUDY WITH COMPOSITE PARTICLE ENVIRONMENTS: VETTES AP5, AP6, AP7; AE4, AE5, FOR SOLAR MAXIMUM **** UNIFLX OF 1973 **
** ELECTRON FLUXES EXPONENTIALLY DECAYED TO 1970. 0 WITH LIFETIMES: E.G.STASSINOPOULOS&P.VERZARIU ** CUTOFF TIMES: **
** MAGNETIC COORDINATES B ANC L COMPUTED BY INVARA OF 1972 WITH ALLMAG. MODEL 4: CAIN&SWEENEY 120-TERM POGO 8/69 * TIME= 1975.5 **
** VEHICLE : ATS-F (290) ** INCLINATION= 0DEG ** PERIGEE=35863KM ** APOGEE= 35863KM ** B/L ORBIT TAPE: T07257 ** PERIOD= 24.000 **

LOW ENERGY PROTONS

** SPECTRAL DISTRIBUTION : NORMALIZED BY FLUX OF ENERGY GREATER THAN .100 MEV **

ENERGY LEVELS >(MEV)	L-BANDS (MAGNETIC SHELL PARAMETER IN EARTH RADII) L-BANDS											
	1.0-1.2	*1.2-1.4*	*1.4-1.6*	*1.6-1.8*	*1.8-2.0*	*2.0-2.2*	*2.2-2.4*	*2.4-2.6*	*2.6-2.8*	*2.8-3.0*	*3.0-3.2*	*3.2-3.4*
.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.900	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENERGY LEVELS >(MEV)	L-BANDS (MAGNETIC SHELL PARAMETER IN EARTH RADII) L-BANDS											
	3.4-3.6	*3.6-3.8*	*3.8-4.0*	*4.0-4.2*	*4.2-4.4*	*4.4-4.6*	*4.6-4.8*	*4.8-5.0*	*5.0-5.2*	*5.2-5.4*	*5.4-5.6*	*5.6-5.8*
.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.900	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENERGY LEVELS >(MEV)	L-BANDS (MAGNETIC SHELL PARAMETER IN EARTH RADII) L-BANDS											
	5.8-6.0	*6.0-6.2*	*6.2-6.4*	*6.4-6.6*	*6.6-6.8*	*6.8-7.0*	*7.0-7.2*	*7.2-7.4*	*7.4-7.6*	*7.6-7.8*	*7.8-8.0*	*8.0-OVR*
.100	0.0	0.0	0.0	0.0	0.0	0.0	1.00E 00	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	4.14E-02	0.0	0.0	0.0	0.0	0.0
.900	0.0	0.0	0.0	0.0	0.0	0.0	1.72E-03	0.0	0.0	0.0	0.0	0.0
1.10	0.0	0.0	0.0	0.0	0.0	0.0	3.49E-04	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	1.45E-05	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	4.86E 10	0.0	0.0	0.0	0.0	0.0

Table 6

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****************************************************************************************************************************
** ORBITAL FLUX STUDY WITH COMPOSITE PARTICLE ENVIRONMENTS: VETTES AP5, AP6, AP7; AE4, AE5, FOR SOLAR MAXIMUM **** UNIFLX OF 1973 **
** ELECTRON FLUXES EXPONENTIALLY DECAYED TO 1970. 0 WITH LIFETIMES: E.G.STASSINOPOULOS&P.VERZARIU ** CUTOFF TIMES: **
** MAGNETIC COORDINATES B AND L COMPUTED BY INVARA OF 1972 WITH ALLMAG. MODEL 4: CAIN&SWEENEY 120-TERM POGO 8/69 * TIME= 1975.5 **
** VEHICLE : ATS-F (290) ** INCLINATION= 0DEG ** PERIGEE=35863KM ** APOGEE= 35863KM ** B/L ORBIT TAPE: TD7257 ** PERIOD= 24.000 **
****************************************************************************************************************************
                         **************************      ELECTRONS      ***************************
                         ** SPECTRAL DISTRIBUTION : NORMALIZED BY FLUX OF ENERGY GREATER THAN .500 MEV **
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ENERGY LEVELS >(MEV)	L - B A N D S (M A G N E T I C			S H E L L		P A R A M E T E R		I N	E A R T H		R A D I I)	L - B A N D S
	1.0-1.2	*1.2-1.4*	*1.4-1.6*	*1.6-1.8*	*1.8-2.0*	*2.0-2.2*	*2.2-2.4*	*2.4-2.6*	*2.6-2.8*	*2.8-3.0*	*3.0-3.2*	*3.2-3.4*
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENERGY LEVELS >(MEV)	L - B A N D S (M A G N E T I C			S H E L L		P A R A M E T E R		I N	E A R T H		R A D I I)	L - B A N D S
	3.4-3.6	*3.6-3.8*	*3.8-4.0*	*4.0-4.2*	*4.2-4.4*	*4.4-4.6*	*4.6-4.8*	*4.8-5.0*	*5.0-5.2*	*5.2-5.4*	*5.4-5.6*	*5.6-5.8*
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENERGY LEVELS >(MEV)	L - B A N D S (M A G N E T I C			S H E L L		P A R A M E T E R		I N	E A R T H		R A D I I)	L - B A N D S
	5.8-6.0	*6.0-6.2*	*6.2-6.4*	*6.4-6.6*	*6.6-6.8*	*6.8-7.0*	*7.0-7.2*	*7.2-7.4*	*7.4-7.6*	*7.6-7.8*	*7.8-8.0*	*8.0-OVR*
.0	0.0	0.0	0.0	0.0	0.0	0.0	1.83E 01	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	1.00E 00	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	1.53E-01	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	3.32E-02	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	7.18E-03	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	1.52E-03	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	3.12E-04	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	1.70E 11	0.0	0.0	0.0	0.0	0.0

Table 7

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*****************************************************************************************************************
** ORBITAL FLUX STUDY WITH COMPOSITE PARTICLE ENVIRONMENTS: VETTES AP5, AP6, AP7; AE4, AE5, FOR SOLAR MAXIMUM **** UNIFLX OF 1973 **
** ELECTRON FLUXES EXPONENTIALLY DECAYED TO 1970. 0 WITH LIFETIMES: E.G.STASSINOPOULOS&P.VERZARIU ** CUTOFF TIMES:                **
** MAGNETIC COORDINATES B AND L COMPUTED BY INVARA OF 1972 WITH ALLMAG, MODEL  4:  CAIN&SWEENEY 120-TERM POGO 8/69 * TIME= 1975.5 **
** VEHICLE : ATS-F (310) ** INCLINATION=  0DEG ** PERIGEE=35863KM ** APOGEE= 35863KM ** B/L ORBIT TAPE: TD7407 ** PERIOD= 24.000 **
*****************************************************************************************************************
                              *************************** LOW ENERGY PROTONS ***************************
                              ** SPECTRAL DISTRIBUTION : NORMALIZED BY FLUX OF ENERGY GREATER THAN .100 MEV **
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ENERGY LEVELS >(MEV) — L-BANDS (MAGNETIC SHELL PARAMETER IN EARTH RADII) L-BANDS

ENERGY LEVELS >(MEV)	*1.0-1.2*	*1.2-1.4*	*1.4-1.6*	*1.6-1.8*	*1.8-2.0*	*2.0-2.2*	*2.2-2.4*	*2.4-2.6*	*2.6-2.8*	*2.8-3.0*	*3.0-3.2*	*3.2-3.4*
.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.900	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENERGY LEVELS >(MEV) — L-BANDS (MAGNETIC SHELL PARAMETER IN EARTH RADII) L-BANDS

ENERGY LEVELS >(MEV)	*3.4-3.6*	*3.6-3.8*	*3.8-4.0*	*4.0-4.2*	*4.2-4.4*	*4.4-4.6*	*4.6-4.8*	*4.8-5.0*	*5.0-5.2*	*5.2-5.4*	*5.4-5.6*	*5.6-5.8*
.100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.900	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENERGY LEVELS >(MEV) — L-BANDS (MAGNETIC SHELL PARAMETER IN EARTH RADII) L-BANDS

ENERGY LEVELS >(MEV)	*5.8-6.0*	*6.0-6.2*	*6.2-6.4*	*6.4-6.6*	*6.6-6.8*	*6.8-7.0*	*7.0-7.2*	*7.2-7.4*	*7.4-7.6*	*7.6-7.8*	*7.8-8.0*	*8.0-OVR*
.100	0.0	0.0	0.0	0.0	0.0	1.00E 00	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	4.01E-02	0.0	0.0	0.0	0.0	0.0	0.0
.900	0.0	0.0	0.0	0.0	0.0	1.61E-03	0.0	0.0	0.0	0.0	0.0	0.0
1.10	0.0	0.0	0.0	0.0	0.0	3.22E-04	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	1.29E-05	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	5.81E 10	0.0	0.0	0.0	0.0	0.0	0.0

Table 8

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*********************************************************************************************************************************
** ORBITAL FLUX STUDY WITH COMPOSITE PARTICLE ENVIRONMENTS: VETTES AP5, AP6, AP7; AE4, AE5, FOR SOLAR MAXIMUM **** UNIFLX OF 1973 **
** ELECTRON FLUXES EXPONENTIALLY DECAYED TO 1970. 0 WITH LIFETIMES: E.G.STASSINOPOULOS&P.VERZARIU ** CUTOFF TIMES:                **
** MAGNETIC COORDINATES B AND L COMPUTED BY INVARA OF 1972 WITH ALLMAG, MODEL  4:  CAINESWEENEY 120-TERM POGO 8/69 * TIME= 1975.5 **
** VEHICLE : ATS-F (310) ** INCLINATION=  0DEG ** PERIGEE=35863KM ** APOGEE= 35863KM ** B/L ORBIT TAPE: TD7407 ** PERIOD= 24.000 **
*********************************************************************************************************************************
                                 ***************************        ELECTRONS        *****************************
                                 ** SPECTRAL DISTRIBUTION : NORMALIZED BY FLUX OF ENERGY GREATER THAN .500 MEV **
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ENERGY LEVELS >(MEV)	*1.0-1.2*	*1.2-1.4*	*1.4-1.6*	*1.6-1.8*	*1.8-2.0*	*2.0-2.2*	*2.2-2.4*	*2.4-2.6*	*2.6-2.8*	*2.8-3.0*	*3.0-3.2*	*3.2-3.4*
	L - B A N D S	(M A G N E T I C		S H E L L		P A R A M E T E R		I N	E A R T H	R A D I I)		L - B A N D S
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENERGY LEVELS >(MEV)	*3.4-3.6*	*3.6-3.8*	*3.8-4.0*	*4.0-4.2*	*4.2-4.4*	*4.4-4.6*	*4.6-4.8*	*4.8-5.0*	*5.0-5.2*	*5.2-5.4*	*5.4-5.6*	*5.6-5.8*
	L - B A N D S	(M A G N E T I C		S H E L L		P A R A M E T E R		I N	E A R T H	R A D I I)		L - B A N D S
.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ENERGY LEVELS >(MEV)	*5.8-6.0*	*6.0-6.2*	*6.2-6.4*	*6.4-6.6*	*6.6-6.8*	*6.8-7.0*	*7.0-7.2*	*7.2-7.4*	*7.4-7.6*	*7.6-7.8*	*7.8-8.0*	*8.0-OVR*
	L - B A N D S	(M A G N E T I C		S H E L L		P A R A M E T E R		I N	E A R T H	R A D I I)		L - B A N D S
.0	0.0	0.0	0.0	0.0	0.0	1.75E 01	0.0	0.0	0.0	0.0	0.0	0.0
.500	0.0	0.0	0.0	0.0	0.0	1.00E 00	0.0	0.0	0.0	0.0	0.0	0.0
1.00	0.0	0.0	0.0	0.0	0.0	1.58E-01	0.0	0.0	0.0	0.0	0.0	0.0
1.50	0.0	0.0	0.0	0.0	0.0	3.46E-02	0.0	0.0	0.0	0.0	0.0	0.0
2.00	0.0	0.0	0.0	0.0	0.0	7.58E-03	0.0	0.0	0.0	0.0	0.0	0.0
2.50	0.0	0.0	0.0	0.0	0.0	1.62E-03	0.0	0.0	0.0	0.0	0.0	0.0
3.00	0.0	0.0	0.0	0.0	0.0	3.32E-04	0.0	0.0	0.0	0.0	0.0	0.0
4.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NORMFLUX=	0.0	0.0	0.0	0.0	0.0	1.81E 11	0.0	0.0	0.0	0.0	0.0	0.0

Table 9

** ORBITAL FLUX STUDY WITH COMPOSITE PARTICLE ENVIRONMENTS: VETTES AP5, AP6, AP7; AE4, AE5, FOR SOLAR MAXIMUM **** UNIFLX OF 1973 **
** ELECTRON FLUXES EXPONENTIALLY DECAYED TO 1970.0 WITH LIFETIMES: E.G.STASSINOPOULOS&P.VERZARIU ** CUTOFF TIMES: **
** MAGNETIC COORDINATES B AND L COMPUTED BY INVARA OF 1972 WITH ALLMAG, MODEL 4: CAIN&SWEENEY 120-TERM POGO 8/69 * TIME= 1975.5 **
** VEHICLE : ATS-F (110) ** INCLINATION= 0DEG ** PERIGEE=35863KM ** APOGEE= 35863KM ** B/L ORBIT TAPE: TD7512 ** PERIOD= 24.000 **

************ LOW ENERGY PROTONS ************

****** SPECTRUM IN PERCENT DELTA ENERGY ******

ENERGY RANGES (MEV)	AVERAGED TOTAL FLUX #/CM**2/SEC	AVERAGED TOTAL FLUX #/CM**2/DAY	SPECTRUM PER CENT
.100-.500	1.105E 06	9.548E 10	96.471
.500-.900	3.899E 04	3.369E 09	3.404
.900-1.10	1.158E 03	1.001E 08	0.101
1.10-1.50	2.585E 02	2.233E 07	0.023
1.50-2.00	9.455E 00	8.169E 05	0.001
2.00-2.50	0.0	0.0	0.0
2.50-3.00	0.0	0.0	0.0
3.00-3.50	0.0	0.0	0.0
3.50-OVER	0.0	0.0	0.0
TOTAL	1.145E 06	9.897E 10	100.000

*** COMPOSITE ORBIT SPECTRUM ***

ENERGY LEVELS >(MEV)	AVERAGED INTEG.FLUX #/CM**2/SEC	AVERAGED INTEG.FLUX #/CM**2/DAY
.100	1.145E 06	9.897E 10
.300	2.152E 05	1.859E 10
.500	4.042E 04	3.492E 09
.700	7.593E 03	6.560E 08
.900	1.426E 03	1.232E 08
1.10	2.679E 02	2.315E 07
1.30	5.033E 01	4.349E 06
1.50	9.455E 00	8.169E 05
1.75	1.169E 00	1.010E 05
2.00	0.0	0.0
2.25	0.0	0.0
2.50	0.0	0.0
2.75	0.0	0.0
3.00	0.0	0.0
3.50	0.0	0.0

* EXPOSURE INDEX:ENERGY >.100MEV *

INTENSITY RANGES #/CM**2/SEC	EXPOSURE DURATION (HOURS)	TOTAL # OF ACCUMULATED PARTICLES
ZERO FLUX	0.0	0.0
1.E0-1.E1	0.0	0.0
1.E1-1.E2	0.0	0.0
1.E2-1.E3	0.0	0.0
1.E3-1.E4	0.0	0.0
1.E4-1.E5	0.0	0.0
1.E5-1.E6	0.0	0.0
1.E6-1.E7	23.800	9.897E 10
1.E7-OVER	0.0	0.0
TOTAL	23.800	9.897E 10

Table 10

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*****************************************************************************************************************************************
** ORBITAL FLUX STUDY WITH COMPOSITE PARTICLE ENVIRONMENTS: VETTES AP5, AP6, AP7; AE4, AE5, FOR SOLAR MAXIMUM **** UNIFLX OF 1973 **
** ELECTRON FLUXES EXPONENTIALLY DECAYED TO 1970. 0 WITH LIFETIMES: E.G.STASSINOPOULOS&P.VERZARIU ** CUTOFF TIMES:                  **
** MAGNETIC COORDINATES B AND L COMPUTED BY INVARA OF 1972 WITH ALLMAG, MODEL  4:  CAIN&SWEENEY 120-TERM POGO 8/69 * TIME= 1975.5 **
** VEHICLE : ATS-F (110)  ** INCLINATION=  0DEG ** PERIGEE=35863KM ** APOGEE= 35863KM ** B/L ORBIT TAPE: TD7512 ** PERIOD= 24.000 **
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************ ELECTRONS ************

****** SPECTRUM IN PERCENT DELTA ENERGY ******

ENERGY RANGES (MEV)	AVERAGED TOTAL FLUX #/CM**2/SEC	AVERAGED TOTAL FLUX #/CM**2/DAY	SPECTRUM PER CENT
.0 -.500	3.442E 07	2.974E 12	93.598
.500-1.00	1.935E 06	1.672E 11	5.262
1.00-1.50	3.227E 05	2.789E 10	0.878
1.50-2.00	7.430E 04	6.420E 09	0.202
2.00-2.50	1.737E 04	1.500E 09	0.047
2.50-3.00	3.883E 03	3.355E 08	0.011
3.00-4.00	9.719E 02	8.398E 07	0.003
4.00-5.00	1.858E 00	1.605E 05	0.000
5.00-OVER	0.0	0.0	0.0
TOTAL	3.678E 07	3.178E 12	100.000

*** COMPOSITE ORBIT SPECTRUM ***

ENERGY LEVELS >(MEV)	AVERAGED INTEG.FLUX #/CM**2/SEC	AVERAGED INTEG.FLUX #/CM**2/DAY
.0	3.678E 07	3.178E 12
.250	7.532E 06	6.508E 11
.500	2.354E 06	2.034E 11
.750	9.935E 05	8.584E 10
1.00	4.193E 05	3.622E 10
1.25	2.012E 05	1.738E 10
1.50	9.652E 04	8.340E 09
1.75	4.631E 04	4.002E 09
2.00	2.222E 04	1.920E 09
2.50	4.857E 03	4.197E 08
3.00	9.738E 02	8.414E 07
3.50	1.059E 02	9.150E 06
4.00	1.858E 00	1.605E 05
4.50	0.0	0.0
5.00	0.0	0.0

* EXPOSURE INDEX:ENERGY >.500MEV *

INTENSITY RANGES #/CM**2/SEC	EXPOSURE DURATION (HOURS)	TOTAL # OF ACCUMULATED PARTICLES
ZERO FLUX	0.0	0.0
1.E0-1.E1	0.0	0.0
1.E1-1.E2	0.0	0.0
1.E2-1.E3	0.0	0.0
1.E3-1.E4	0.0	0.0
1.E4-1.E5	0.0	0.0
1.E5-1.E6	0.0	0.0
1.E6-1.E7	23.800	2.034E 11
1.E7-OVER	0.0	0.0
TOTAL	23.800	2.034E 11

Table 11

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*****************************************************************************************************************************
** ORBITAL FLUX STUDY WITH COMPOSITE PARTICLE ENVIRONMENTS: VETTES AP5, AP6, AP7; AE4, AE5, FOR SOLAR MAXIMUM **** UNIFLX OF 1973 **
** ELECTRON FLUXES EXPONENTIALLY DECAYED TO 1970. 0 WITH LIFETIMES: E.G.STASSINOPOULOS&P.VERZARIU.**.CUTOFF TIMES:              **
** MAGNETIC COORDINATES B AND L COMPUTED BY INVARA OF 1972 WITH ALLMAG. MODEL  4:  CAIN&SWEENEY 120-TERM POGO 8/69 * TIME= 1975.5 **
** VEHICLE : ATS-F (290)  ** INCLINATION=  0DEG ** PERIGEE=35863KM ** APOGEE= 35863KM ** B/L ORBIT TAPE: TD7257 ** PERIOD= 24.000 **
*****************************************************************************************************************************
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**************** LOW ENERGY PROTONS ****************

****** SPECTRUM IN PERCENT DELTA ENERGY ******

ENERGY RANGES (MEV)	AVERAGED TOTAL FLUX #/CM**2/SEC	AVERAGED TOTAL FLUX #/CM**2/DAY	SPECTRUM PER CENT
.100-.500	5.397E 05	4.663E 10	95.857
.500-.900	2.236E 04	1.932E 09	3.972
.900-1.10	7.698E 02	6.651E 07	0.137
1.10-1.50	1.886E 02	1.629E 07	0.033
1.50-2.00	8.151E 00	7.043E 05	0.001
2.00-2.50	0.0	0.0	0.0
2.50-3.00	0.0	0.0	0.0
3.00-3.50	0.0	0.0	0.0
3.50-OVER	0.0	0.0	0.0
TOTAL	5.630E 05	4.865E 10	100.000

*** COMPOSITE ORBIT SPECTRUM ***

ENERGY LEVELS >(MEV)	AVERAGED INTEG.FLUX #/CM**2/SEC	AVERAGED INTEG.FLUX #/CM**2/DAY
.100	5.630E 05	4.865E 10
.300	1.146E 05	9.902E 09
.500	2.333E 04	2.016E 09
.700	4.748E 03	4.102E 08
.900	9.665E 02	8.351E 07
1.10	1.967E 02	1.700E 07
1.30	4.005E 01	3.460E 06
1.50	8.151E 00	7.043E 05
1.75	1.114E 00	9.629E 04
2.00	0.0	0.0
2.25	0.0	0.0
2.50	0.0	0.0
2.75	0.0	0.0
3.00	0.0	0.0
3.50	0.0	0.0

* EXPOSURE INDEX:ENERGY >.100MEV *

INTENSITY RANGES #/CM**2/SEC	EXPOSURE DURATION (HOURS)	TOTAL # OF ACCUMULATED PARTICLES
ZERO FLUX	0.0	0.0
1.E0-1.E1	0.0	0.0
1.E1-1.E2	0.0	0.0
1.E2-1.E3	0.0	0.0
1.E3-1.E4	0.0	0.0
1.E4-1.E5	0.0	0.0
1.E5-1.E6	23.800	4.865E 10
1.E6-1.E7	0.0	0.0
1.E7-OVER	0.0	0.0
TOTAL	23.800	4.865E 10

Table 12

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***************************************************************************************************************************
** ORBITAL FLUX STUDY WITH COMPOSITE PARTICLE ENVIRONMENTS: VETTES AP5, AP6, AP7; AE4, AE5, FOR SOLAR MAXIMUM **** UNIFLX OF 1973 **
** ELECTRON FLUXES EXPONENTIALLY DECAYED TO 1970. 0 WITH LIFETIMES: E.G.STASSINOPOULOS&P.VERZARIU ** CUTOFF TIMES:                 **
** MAGNETIC COORDINATES B AND L COMPUTED BY INVARA OF 1972 WITH ALLMAG, MODEL 4: CAIN&SWEENEY 120-TERM POGO 8/69 * TIME= 1975.5 **
** VEHICLE : ATS-F (290) ** INCLINATION= 0DEG ** PERIGEE=35863KM ** APOGEE= 35863KM ** B/L ORBIT TAPE: TD7257 ** PERIOD= 24.000 **
***************************************************************************************************************************
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************ ELECTRONS ************

***** SPECTRUM IN PERCENT DELTA ENERGY ******

ENERGY RANGES (MEV)	AVERAGED TOTAL FLUX #/CM**2/SEC	AVERAGED TOTAL FLUX #/CM**2/DAY	SPECTRUM PER CENT
.0 -.500	3.402E 07	2.940E 12	94.546
.500-1.00	1.662E 06	1.436E 11	4.618
1.00-1.50	2.357E 05	2.037E 10	0.655
1.50-2.00	5.100E 04	4.407E 09	0.142
2.00-2.50	1.110E 04	9.590E 08	0.031
2.50-3.00	2.373E 03	2.050E 08	0.007
3.00-4.00	6.132E 02	5.298E 07	0.002
4.00-5.00	0.0	0.0	0.0
5.00-OVER	0.0	0.0	0.0
TOTAL	3.598E 07	3.109E 12	100.000

*** COMPOSITE ORBIT SPECTRUM ***

ENERGY LEVELS >(MEV)	AVERAGED INTEG.FLUX #/CM**2/SEC	AVERAGED INTEG.FLUX #/CM**2/DAY
.0	3.598E 07	3.109E 12
.250	6.604E 06	5.706E 11
.500	1.963E 06	1.696E 11
.750	7.683E 05	6.639E 10
1.00	3.008E 05	2.599E 10
1.25	1.399E 05	1.209E 10
1.50	6.509E 04	5.624E 09
1.75	3.028E 04	2.616E 09
2.00	1.409E 04	1.217E 09
2.50	2.986E 03	2.580E 08
3.00	6.132E 02	5.298E 07
3.50	5.784E 01	4.997E 06
4.00	0.0	0.0
4.50	0.0	0.0
5.00	0.0	0.0

* EXPOSURE INDEX:ENERGY >.500MEV *

INTENSITY RANGES #/CM**2/SEC	EXPOSURE DURATION (HOURS)	TOTAL # OF ACCUMULATED PARTICLES
ZERO FLUX	0.0	0.0
1.E0-1.E1	0.0	0.0
1.E1-1.E2	0.0	0.0
1.E2-1.E3	0.0	0.0
1.E3-1.E4	0.0	0.0
1.E4-1.E5	0.0	0.0
1.E5-1.E6	0.0	0.0
1.E6-1.E7	23.800	1.696E 11
1.E7-OVER	0.0	0.0
TOTAL	23.800	1.696E 11

Table 13

** ORBITAL FLUX STUDY WITH COMPOSITE PARTICLE ENVIRONMENTS: VETTES AP5, AP6, AP7; AE4, AE5, FOR SOLAR MAXIMUM **** UNIFLX OF 1973 **
** ELECTRON FLUXES EXPONENTIALLY DECAYED TO 1970. 0 WITH LIFETIMES: E.G.STASSINOPOULOS&P.VERZARIU ** CUTOFF TIMES: **
** MAGNETIC COORDINATES B AND L COMPUTED BY INVARA OF 1972 WITH ALLMAG, MODEL 4: CAIN&SWEENEY 120-TERM POGO 8/69 * TIME= 1975.5 **
** VEHICLE : ATS-F (310) ** INCLINATION= 0DEG ** PERIGEE=35863KM ** APOGEE= 35863KM ** B/L ORBIT TAPE: T07407 ** PERIOD= 24.000 **

************ LOW ENERGY PROTONS ************

****** SPECTRUM IN PERCENT DELTA ENERGY ******

ENERGY RANGES (MEV)	AVERAGED TOTAL FLUX #/CM**2/SEC	AVERAGED TOTAL FLUX #/CM**2/DAY	SPECTRUM PER CENT
.100-.500	6.449E 05	5.572E 10	95.988
.500-.900	2.587E 04	2.236E 09	3.851
.900-1.10	8.648E 02	7.472E 07	0.129
1.10-1.50	2.079E 02	1.796E 07	0.031
1.50-2.00	8.689E 00	7.508E 05	0.001
2.00-2.50	0.0	0.0	0.0
2.50-3.00	0.0	0.0	0.0
3.00-3.50	0.0	0.0	0.0
3.50-OVER	0.0	0.0	0.0
TOTAL	6.719E 05	5.805E 10	100.000

*** COMPOSITE ORBIT SPECTRUM ***

ENERGY LEVELS >(MEV)	AVERAGED INTEG.FLUX #/CM**2/SEC	AVERAGED INTEG.FLUX #/CM**2/DAY
.100	6.719E 05	5.805E 10
.300	1.346E 05	1.163E 10
.500	2.696E 04	2.329E 09
.700	5.399E 03	4.665E 08
.900	1.081E 03	9.343E 07
1.10	2.166E 02	1.871E 07
1.30	4.338E 01	3.748E 06
1.50	8.689E 00	7.508E 05
1.75	1.164E 00	1.006E 05
2.00	0.0	0.0
2.25	0.0	0.0
2.50	0.0	0.0
2.75	0.0	0.0
3.00	0.0	0.0
3.50	0.0	0.0

* EXPOSURE INDEX:ENERGY >.100MEV *

INTENSITY RANGES #/CM**2/SEC	EXPOSURE DURATION (HOURS)	TOTAL # OF ACCUMULATED PARTICLES
ZERO FLUX	0.0	0.0
1.E0-1.E1	0.0	0.0
1.E1-1.E2	0.0	0.0
1.E2-1.E3	0.0	0.0
1.E3-1.E4	0.0	0.0
1.E4-1.E5	0.0	0.0
1.E5-1.E6	23.800	5.805E 10
1.E6-1.E7	0.0	0.0
1.E7-OVER	0.0	0.0
TOTAL	23.800	5.805E 10

Table 14

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*****************************************************************************************************************
** ORBITAL FLUX STUDY WITH COMPOSITE PARTICLE ENVIRONMENTS: VETTES AP5, AP6, AP7; AE4, AE5, FOR SOLAR MAXIMUM **** UNIFLX OF 1973 **
** ELECTRON FLUXES EXPONENTIALLY DECAYED TO 1970. 0 WITH LIFETIMES: E.G.STASSINOPOULOS&P.VERZARIU ** CUTOFF TIMES: **
** MAGNETIC COORDINATES B AND L COMPUTED BY INVARA OF 1972 WITH ALLMAG, MODEL 4: CAIN&SWEENEY 120-TERM POGO 8/69 * TIME= 1975.5 **
** VEHICLE : ATS-F (310) ** INCLINATION= 0DEG ** PERIGEE=35863KM ** APOGEE= 35863KM ** B/L ORBIT TAPE: TD7407 ** PERIOD= 24.000 **
*****************************************************************************************************************
                    ************      ELECTRONS      ************
                    ************************************************
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****** SPECTRUM IN PERCENT DELTA ENERGY ******

ENERGY RANGES (MEV)	AVERAGED TOTAL FLUX #/CM**2/SEC	AVERAGED TOTAL FLUX #/CM**2/DAY	SPECTRUM PER CENT
.0 -.500	3.458E 07	2.988E 12	94.293
.500-1.00	1.762E 06	1.522E 11	4.805
1.00-1.50	2.584E 05	2.233E 10	0.705
1.50-2.00	5.659E 04	4.890E 09	0.154
2.00-2.50	1.248E 04	1.079E 09	0.034
2.50-3.00	2.691E 03	2.325E 08	0.007
3.00-4.00	6.939E 02	5.995E 07	0.002
4.00-5.00	0.0	0.0	0.0
5.00-OVER	0.0	0.0	0.0
TOTAL	3.667E 07	3.169E 12	100.000

*** COMPOSITE ORBIT SPECTRUM ***

ENERGY LEVELS >(MEV)	AVERAGED INTEG.FLUX #/CM**2/SEC	AVERAGED INTEG.FLUX #/CM**2/DAY
.0	3.667E 07	3.169E 12
.250	6.895E 06	5.957E 11
.500	2.093E 06	1.808E 11
.750	8.322E 05	7.190E 10
1.00	3.309E 05	2.859E 10
1.25	1.548E 05	1.338E 10
1.50	7.246E 04	6.261E 09
1.75	3.391E 04	2.930E 09
2.00	1.587E 04	1.371E 09
2.50	3.385E 03	2.925E 08
3.00	6.939E 02	5.995E 07
3.50	6.691E 01	5.781E 06
4.00	0.0	0.0
4.50	0.0	0.0
5.00	0.0	0.0

* EXPOSURE INDEX:ENERGY >.500MEV *

INTENSITY RANGES #/CM**2/SEC	EXPOSURE DURATION (HOURS)	TOTAL # OF ACCUMULATED PARTICLES
ZERO FLUX	0.0	0.0
1.E0-1.E1	0.0	0.0
1.E1-1.E2	0.0	0.0
1.E2-1.E3	0.0	0.0
1.E3-1.E4	0.0	0.0
1.E4-1.E5	0.0	0.0
1.E5-1.E6	0.0	0.0
1.E6-1.E7	23.800	1.808E 11
1.E7-OVER	0.0	0.0
TOTAL	23.800	1.808E 11

TABLE 15

ATS-F (110)

CIRCULAR

INCLINATION: 0 DEG

PERIGEE: 35863 KM

APOGEE: 35863 KM

DECAY DATE: 1970. 0.

**** EXPOSURE ANALYSIS ****

	PROTONS-LOW (E>.100MEV)	PROTONS-HIGH (E>5.00MEV)	ELECTRONS (E>.500MEV)
PERCENT OF TOTAL LIFE-TIME SPENT IN FLUX-FREE REGIONS* OF SPACE :	0.0 %	100.00 %	0.0 %
PERCENT OF TOTAL LIFE-TIME SPENT IN HIGH-INTENSITY REGIONS+ OF VAN ALLEN BELTS :	100.00 %	0.0 %	100.00 %
PERCENT OF TOTAL DAILY FLUX ACCUMULATED IN HIGH-INTENSITY REGIONS:	100.00 %	0.0 %	100.00 %

****

* <1 PARTICLE/CM**2/SEC

+ >1.E5 EL/CM**2/SEC OR 1.E3 PR/CM**2/SEC

ATS-F (110)

CIRCULAR

INCLINATION: 0 DEG

PERIGEE: 35863 KM

APOGEE: 35863 KM

DECAY DATE: 1970. 0.

* PERCENT OF TOTAL LIFETIME SPENT INSIDE AND *
* OUTSIDE THE TRAPPED-PARTICLE RADIATION BELT *

INNER ZONE -TI-* (1.0 < L < 2.8)	:	0.0 %
OUTER ZONE -TO- (2.8 < L < 11.0)	:	99.17 %
EXTERNAL -TE- (L > 11.0)	:	0.83 %
TOTAL	:	100.00 %

*TIME IN INNER ZONE MAY BE SUBDIVIDED AS FOLLOWS:

OUTSIDE TRAPPING REGION (1.0 < L < 1.1)	:	0.0 %
INSIDE TRAPPING REGION (1.1 < L < 2.8)	:	0.0 %

TABLE _

ATS-F (290)

CIRCULAR

INCLINATION: 0 DEG

PERIGEE: 35863 KM

APOGEE: 35863 KM

DECAY DATE: 1970. 0.

**** EXPOSURE ANALYSIS ****

	PROTONS-LOW (E>.100MEV)	PROTONS-HIGH (E>5.00MEV)	ELECTRONS (E>.500MEV)
PERCENT OF TOTAL LIFE-TIME SPENT IN FLUX-FREE REGIONS* OF SPACE :	0.0 %	100.00 %	0.0 %
PERCENT OF TOTAL LIFE-TIME SPENT IN HIGH-INTENSITY REGIONS+ OF VAN ALLEN BELTS :	100.00 %	0.0 %	100.00 %
PERCENT OF TOTAL DAILY FLUX ACCUMULATED IN HIGH-INTENSITY REGIONS:	100.00 %	0.0 %	100.00 %

****

* <1 PARTICLE/CM**2/SEC

\+ >1.E5 EL/CM**2/SEC OR 1.E3 PR/CM**2/SEC

TABLE 16

ATS-F (290)

CIRCULAR

INCLINATION: 0 DEG

PERIGEE: 35863 KM

APOGEE: 35863 KM

DECAY DATE: 1970. 0.

* PERCENT OF TOTAL LIFETIME SPENT INSIDE AND *

* OUTSIDE THE TRAPPED-PARTICLE RADIATION BELT *

INNER ZONE -TI-* : 0.0 %
(1.0 < L < 2.8)

OUTER ZONE -TO- : 99.17 %
(2.8 < L < 11.0)

EXTERNAL -TE- : 0.83 %
(L > 11.0)

TOTAL : 100.00 %

*TIME IN INNER ZONE MAY BE SUBDIVIDED AS FOLLOWS:

OUTSIDE TRAPPING REGION : 0.0 %
(1.0 < L < 1.1)

INSIDE TRAPPING REGION : 0.0 %
(1.1 < L < 2.8)

TABLE _

ATS-F (310)

CIRCULAR

INCLINATION: 0 DEG

PERIGEE: 35863 KM

APOGEE: 35863 KM

DECAY DATE: 1970. 0.

**** EXPOSURE ANALYSIS ****

	PROTONS-LOW (E>.100MEV)	PROTONS-HIGH (E>5.00MEV)	ELECTRONS (E>.500MEV)
PERCENT OF TOTAL LIFE-TIME SPENT IN FLUX-FREE REGIONS* OF SPACE :	0.0 %	100.00 %	0.0 %
PERCENT OF TOTAL LIFE-TIME SPENT IN HIGH-INTENSITY REGIONS+ OF VAN ALLEN BELTS :	100.00 %	0.0 %	100.00 %
PERCENT OF TOTAL DAILY FLUX ACCUMULATED IN HIGH-INTENSITY REGIONS:	100.00 %	0.0 %	100.00 %

****

* <1 PARTICLE/CM**2/SEC

+ >1.E5 EL/CM**2/SEC OR 1.E3 PR/CM**2/SEC

TABLE 17

ATS-F (310)

CIRCULAR

INCLINATION: 0 DEG

PERIGEE: 35863 KM

APOGEE: 35863 KM

DECAY DATE: 1970. 0.

* PERCENT OF TOTAL LIFETIME SPENT INSIDE AND *
* OUTSIDE THE TRAPPED-PARTICLE RADIATION BELT *

INNER ZONE -TI-* (1.0 < L < 2.8)	:	0.0 %
OUTER ZONE -TO- (2.8 < L < 11.0)	:	99.17 %
EXTERNAL -TE- (L > 11.0)	:	0.83 %
TOTAL	:	100.00 %

*TIME IN INNER ZONE MAY BE SUBDIVIDED AS FOLLOWS:

OUTSIDE TRAPPING REGION (1.0 < L < 1.1)	:	0.0 %
INSIDE TRAPPING REGION (1.1 < L < 2.8)	:	0.0 %

TABLE ARRANGEMENT

Computer Produced Output Tables for Orbital Flux Integrations.

Standard Production Runs with UNIFLUX Program.

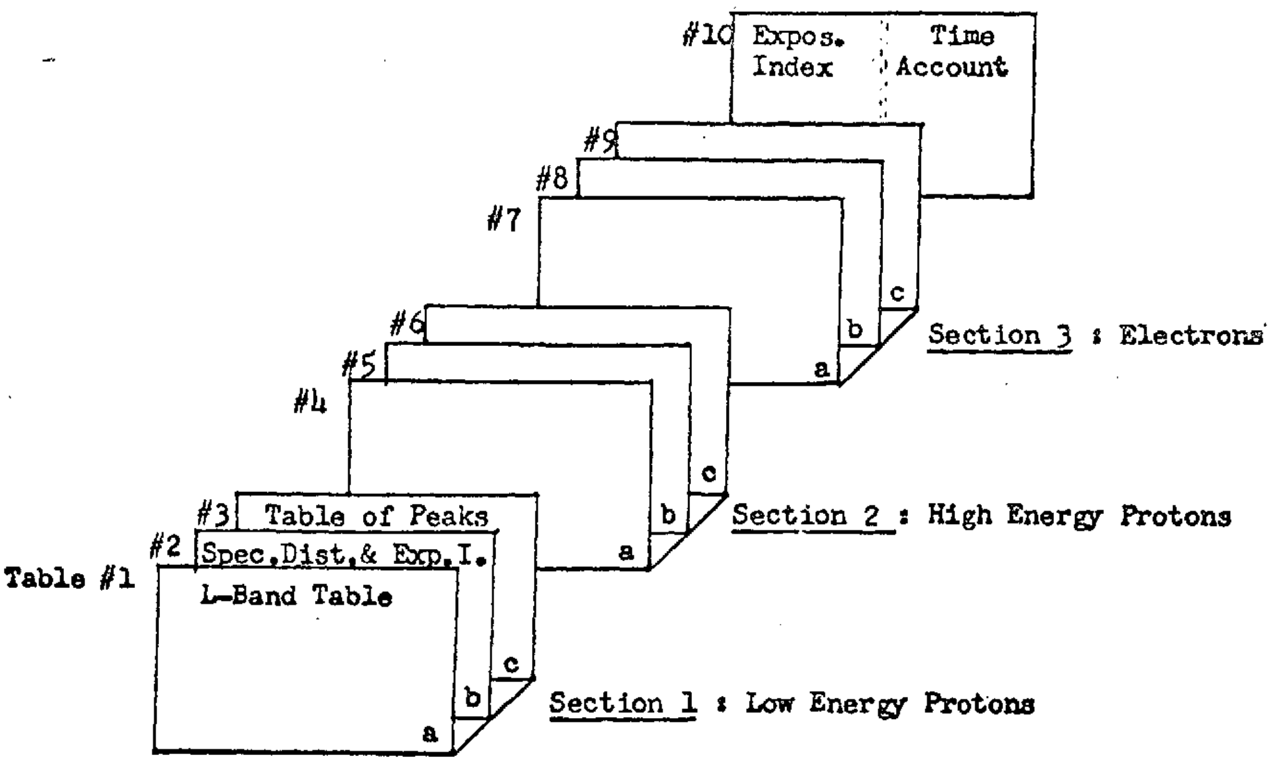


Figure 1 : Set of tables produced for every trajectory considered in a trapped particle radiation study.

PLOT ARRANGEMENT

Computer Produced Plots for Orbital Flux Integrations.

Standard Production Runs with UNIFLUX Program.

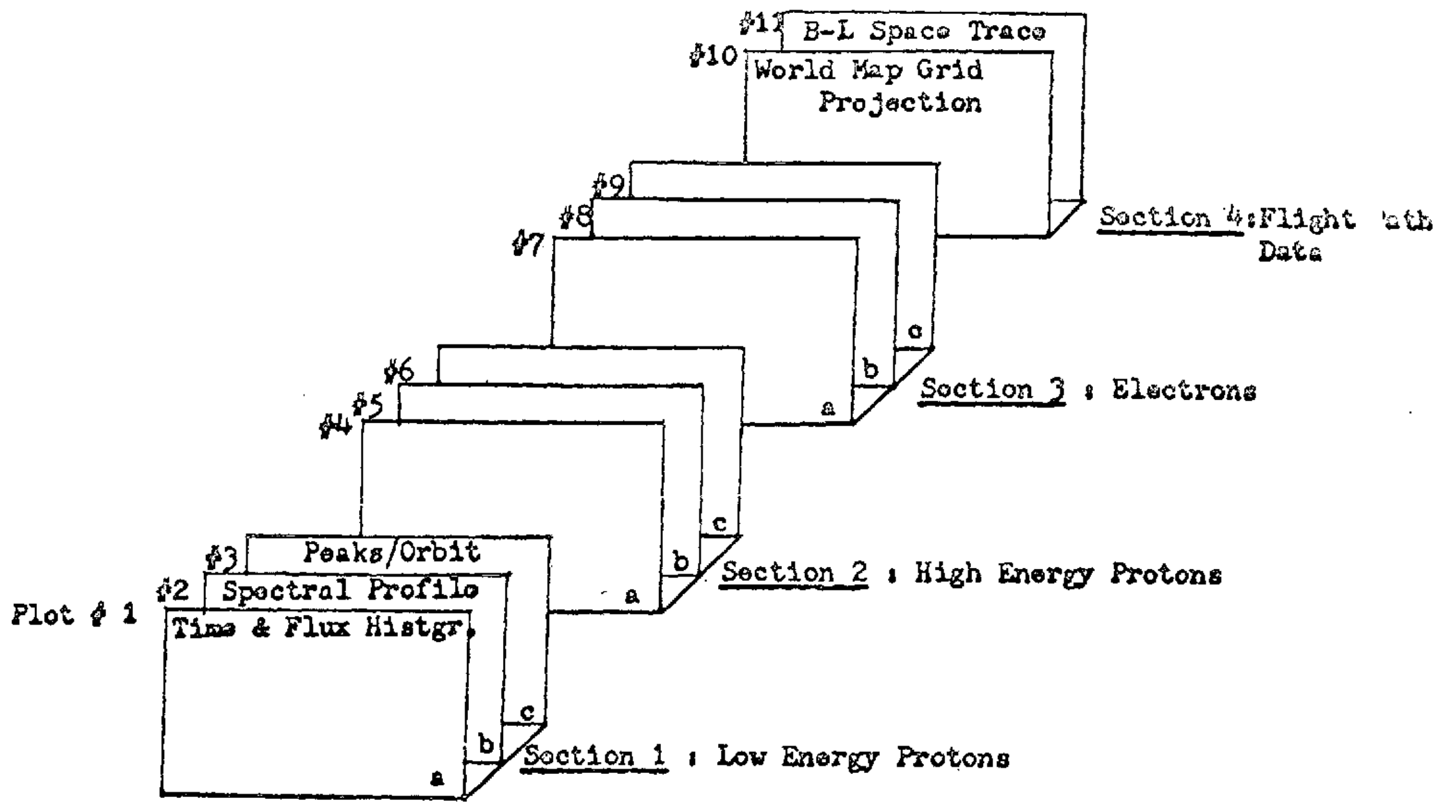
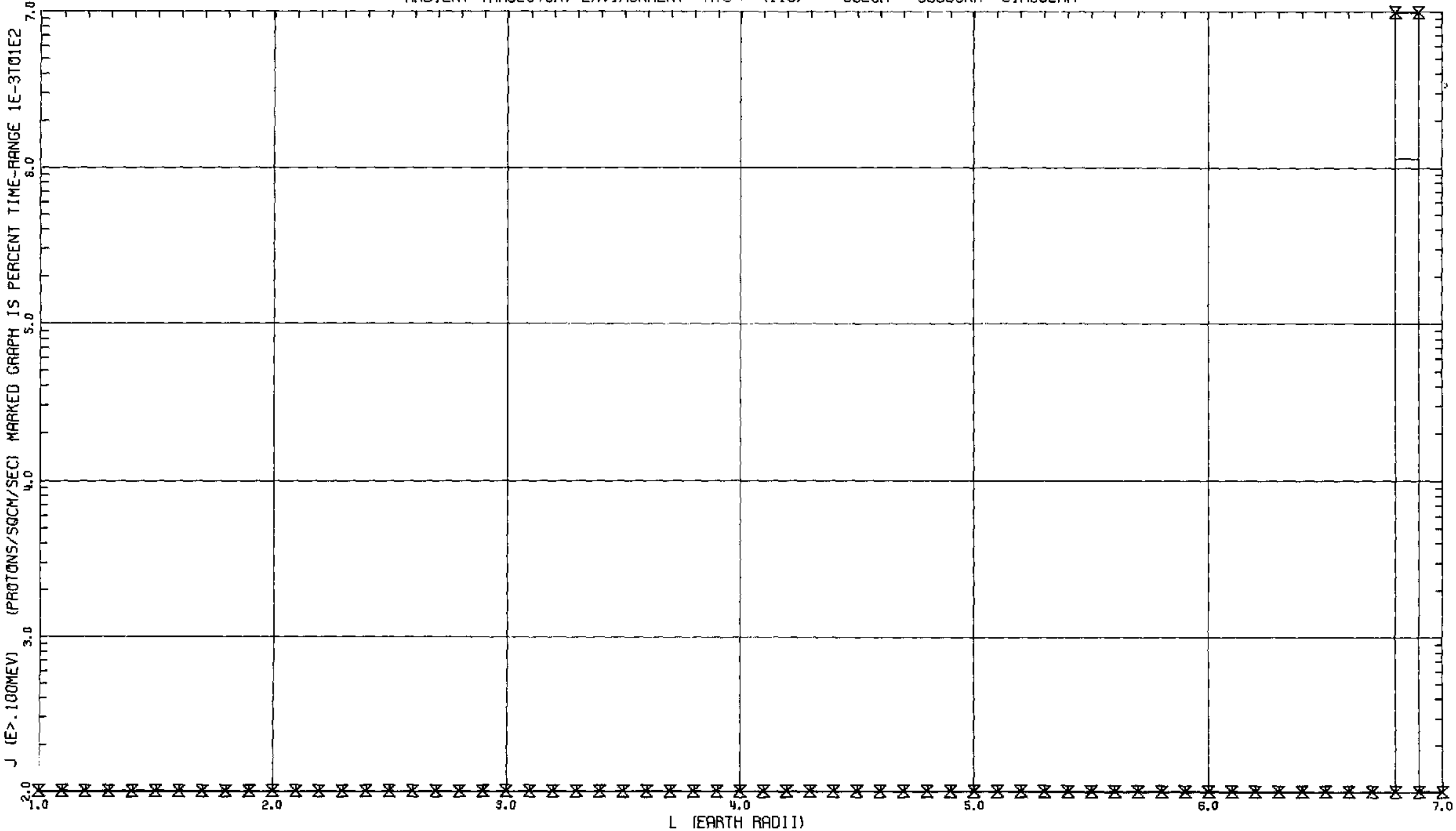


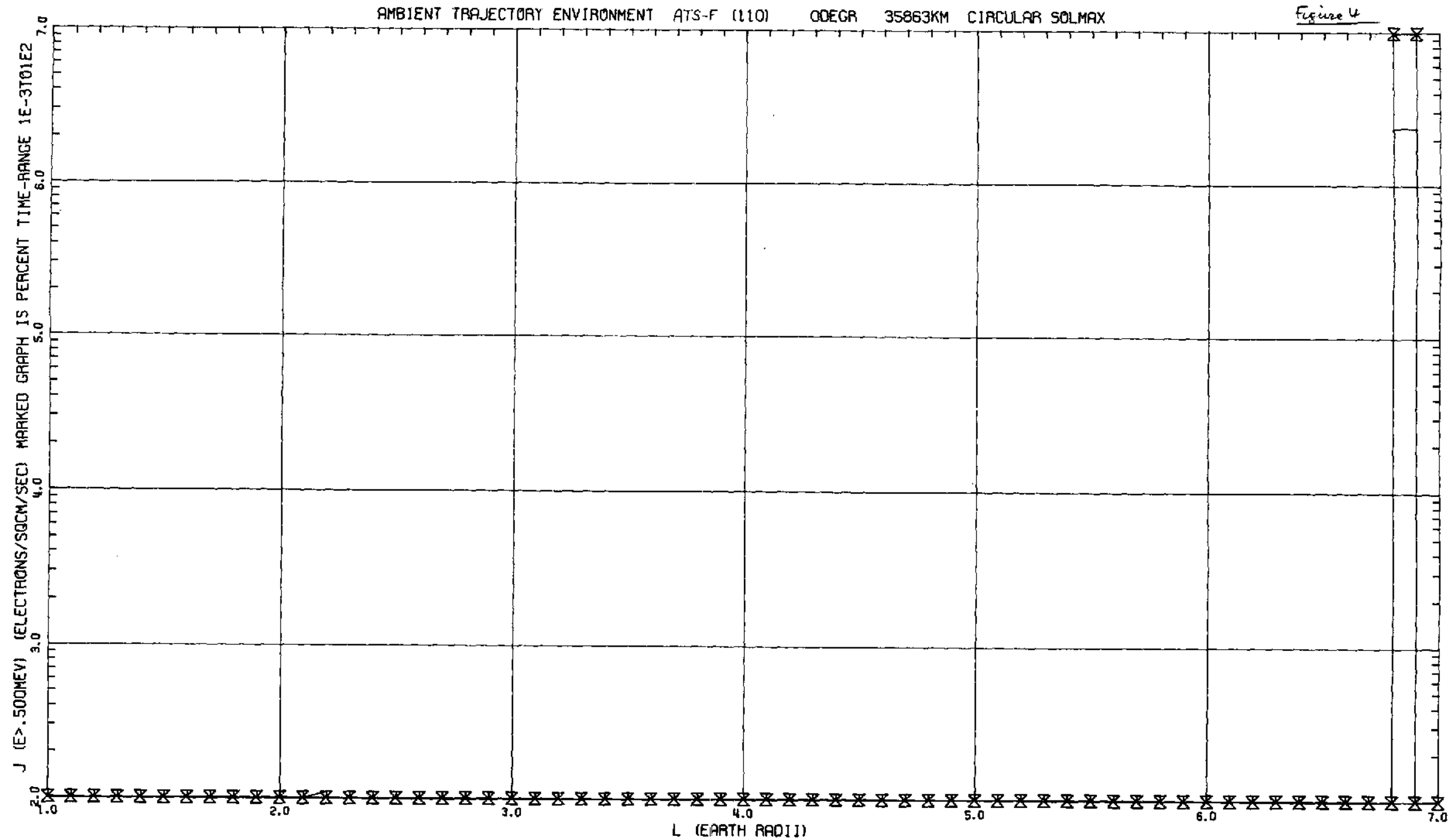
Figure 2 : Set of plots produced for every trajectory considered in a trapped particle radiation study.

* U.S. GOVERNMENT PRINTING OFFICE: 1972 - 735 970/803

Figure 3

AMBIENT TRAJECTORY ENVIRONMENT ATS-F (110) 0DEGR 35863KM CIRCULAR




AMBIENT TRAJECTORY ENVIRONMENT ATS-F (110) 0DEGR 35863KM CIRCULAR SOLMAX
Figure 4
J (E>.500MEV) (ELECTRONS/SQCM/SEC) MARKED GRAPH IS PERCENT TIME-RANGE 1E-3TO1E2
2.0
3.0
4.0
5.0
6.0
7.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
L (EARTH RADII)

AMBIENT TRAJECTORY ENVIRONMENT ATS-F (290) 0DEGR 35863KM CIRCULAR

Figure 5

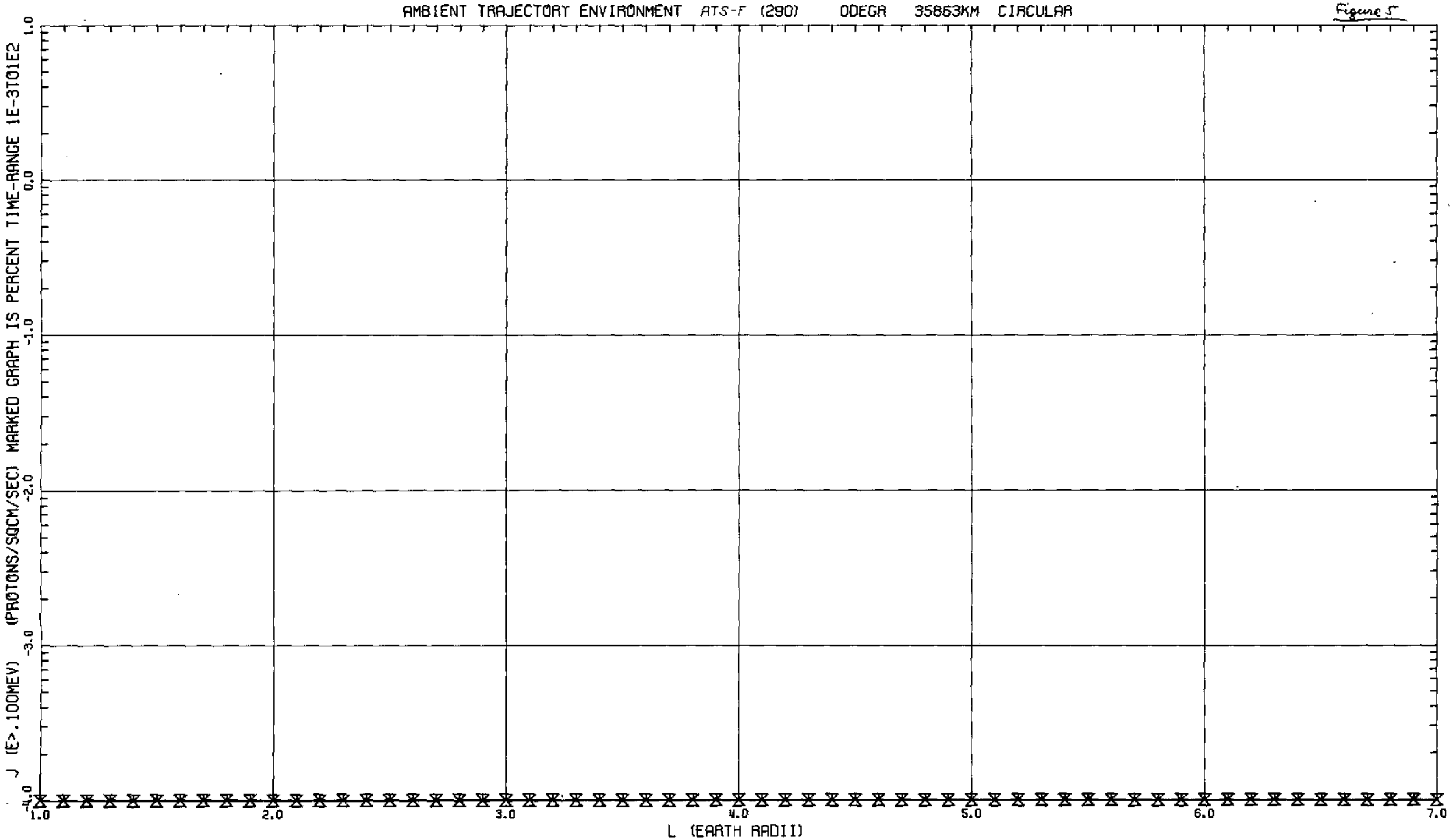
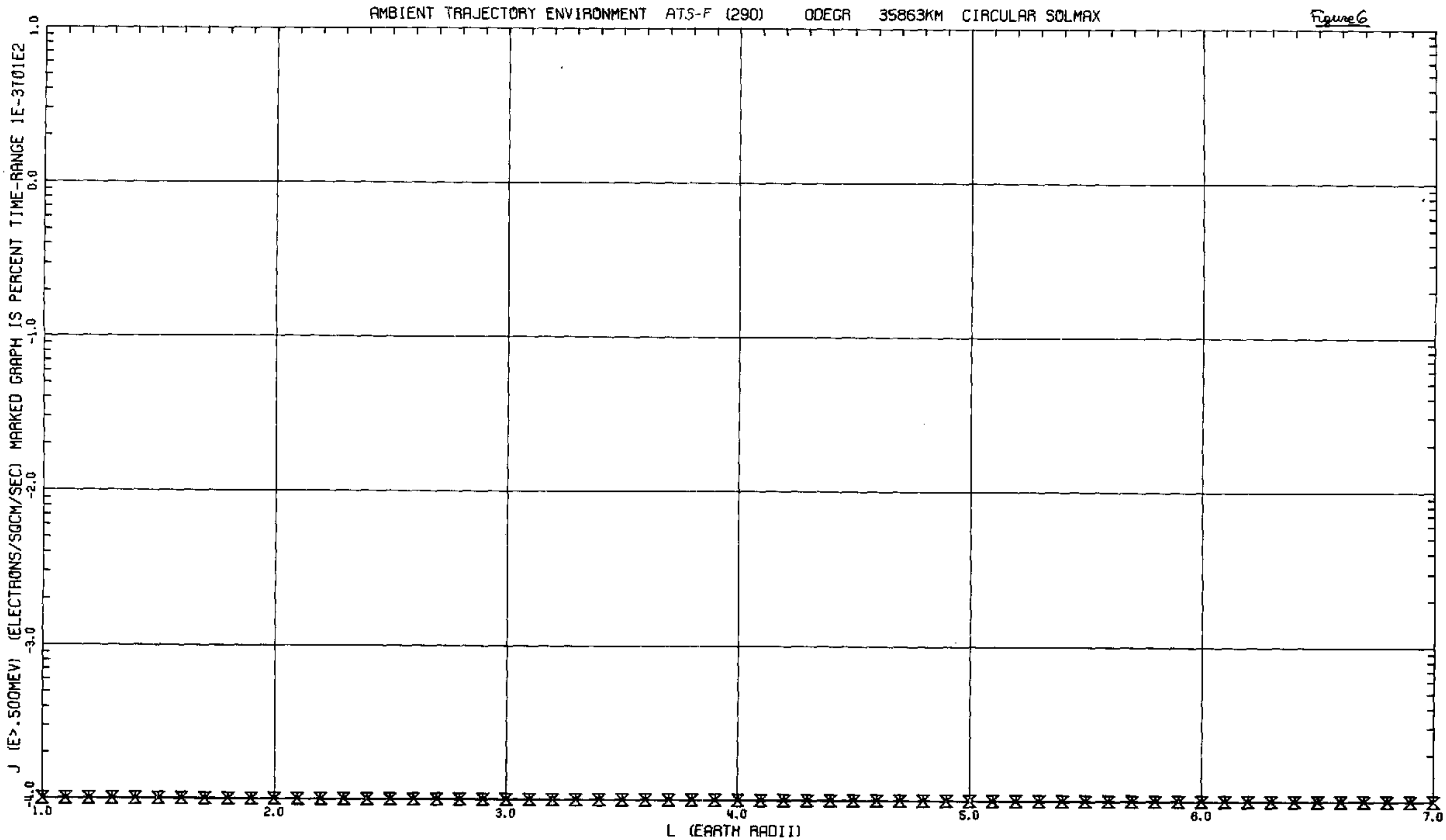
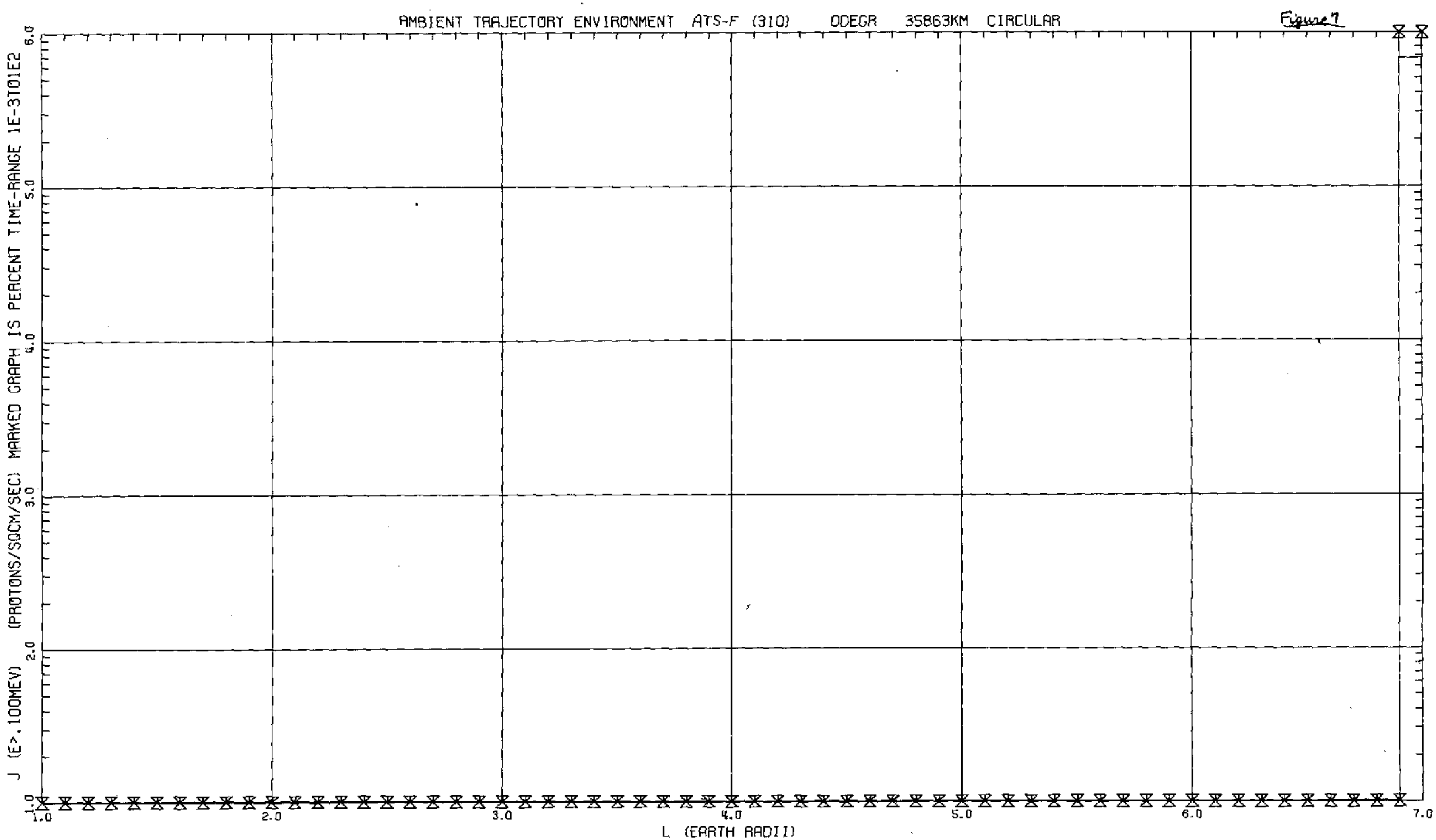
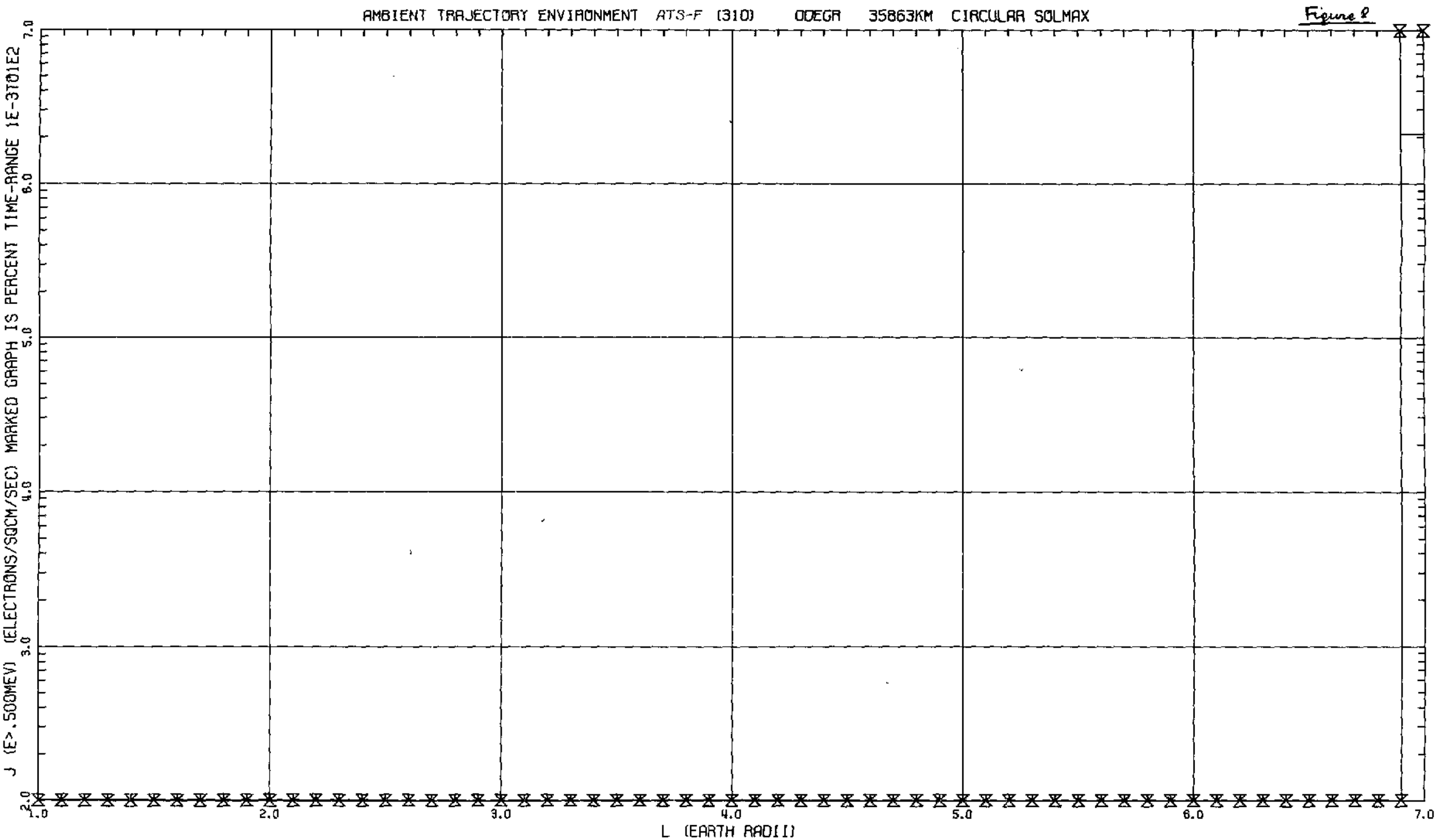


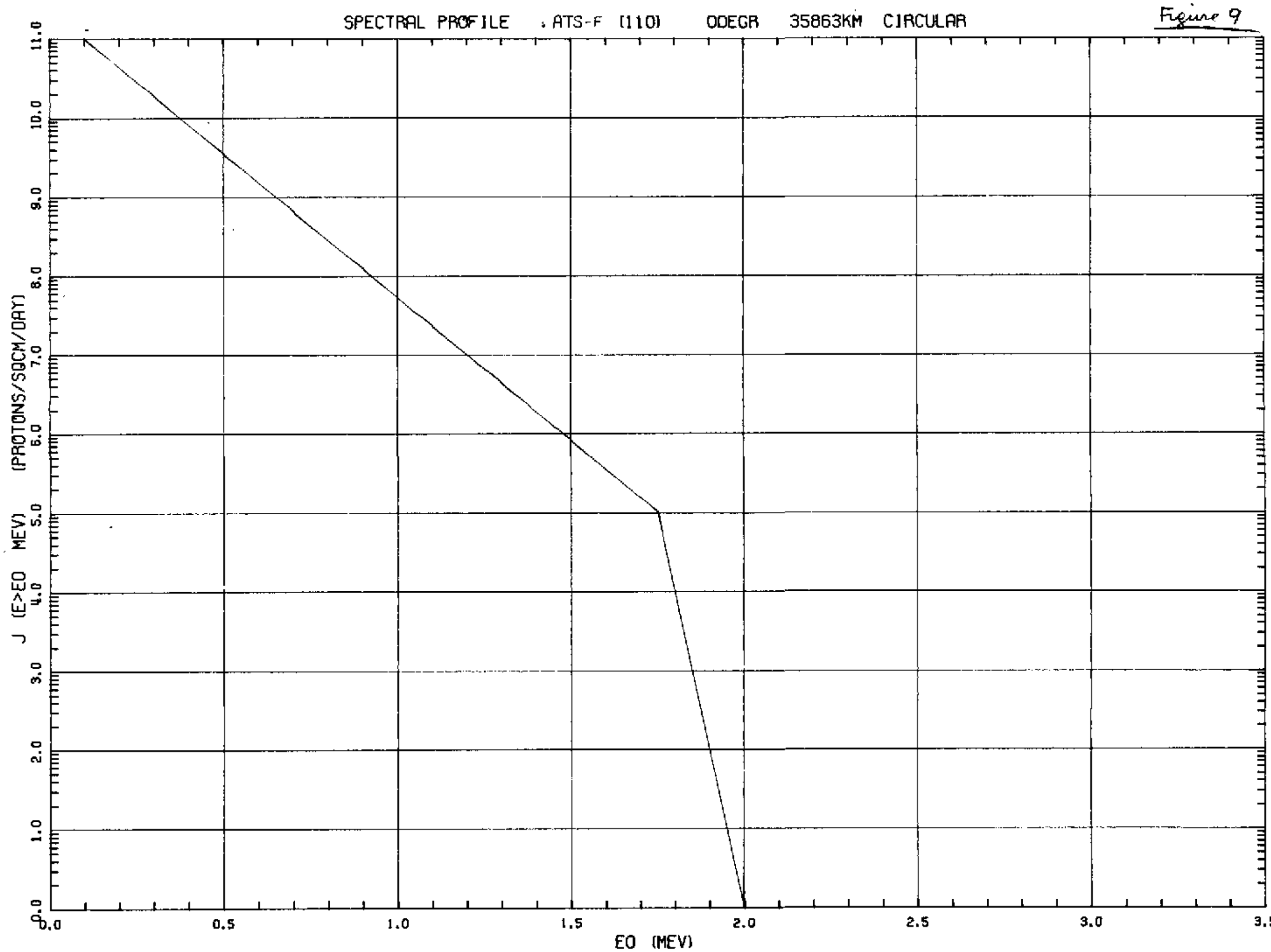
Figure 6


AMBIENT TRAJECTORY ENVIRONMENT ATS-F (290) 0DEGR 35863KM CIRCULAR SOLMAX
J (E>.500MEV) (ELECTRONS/SQCM/SEC) MARKED GRAPH IS PERCENT TIME-RANGE 1E-3TO1E2
1.0
0.0
-1.0
-2.0
-3.0
-4.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
L (EARTH RADII)

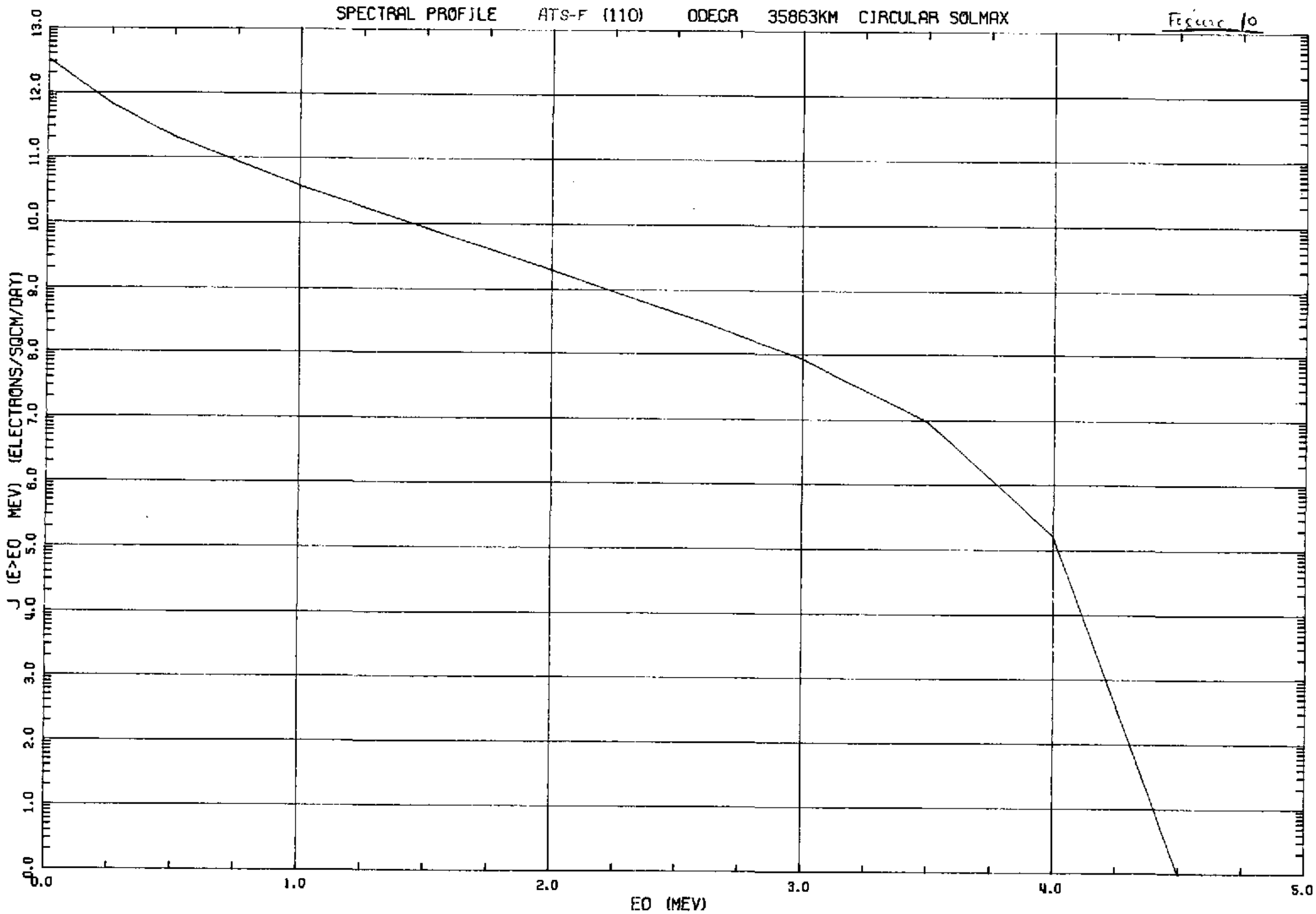

AMBIENT TRAJECTORY ENVIRONMENT ATS-F (310) 0DEGR 35863KM CIRCULAR
Figure 7
J (E>.100MEV) (PROTONS/SQCM/SEC) MARKED GRAPH IS PERCENT TIME-RANGE 1E-3TO1E2
1.0
2.0
3.0
4.0
5.0
6.0
7.0
L (EARTH RADII)



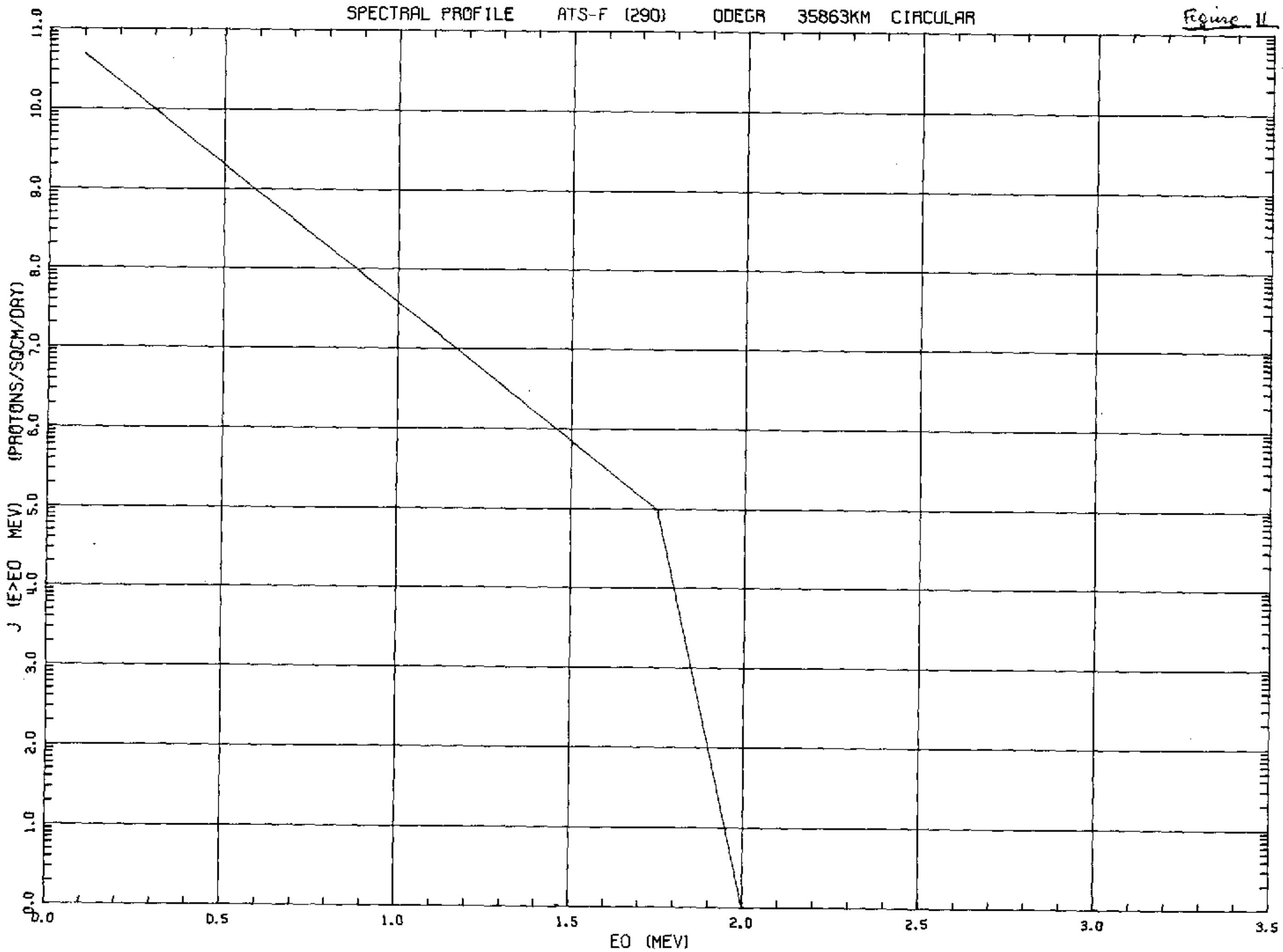
AMBIENT TRAJECTORY ENVIRONMENT ATS-F (310) 0DEGR 35863KM CIRCULAR SOLMAX
Figure 8
J (E>.500MEV) (ELECTRONS/SQCM/SEC) MARKED GRAPH IS PERCENT TIME-RANGE 1E-3T01E2
L (EARTH RADII)



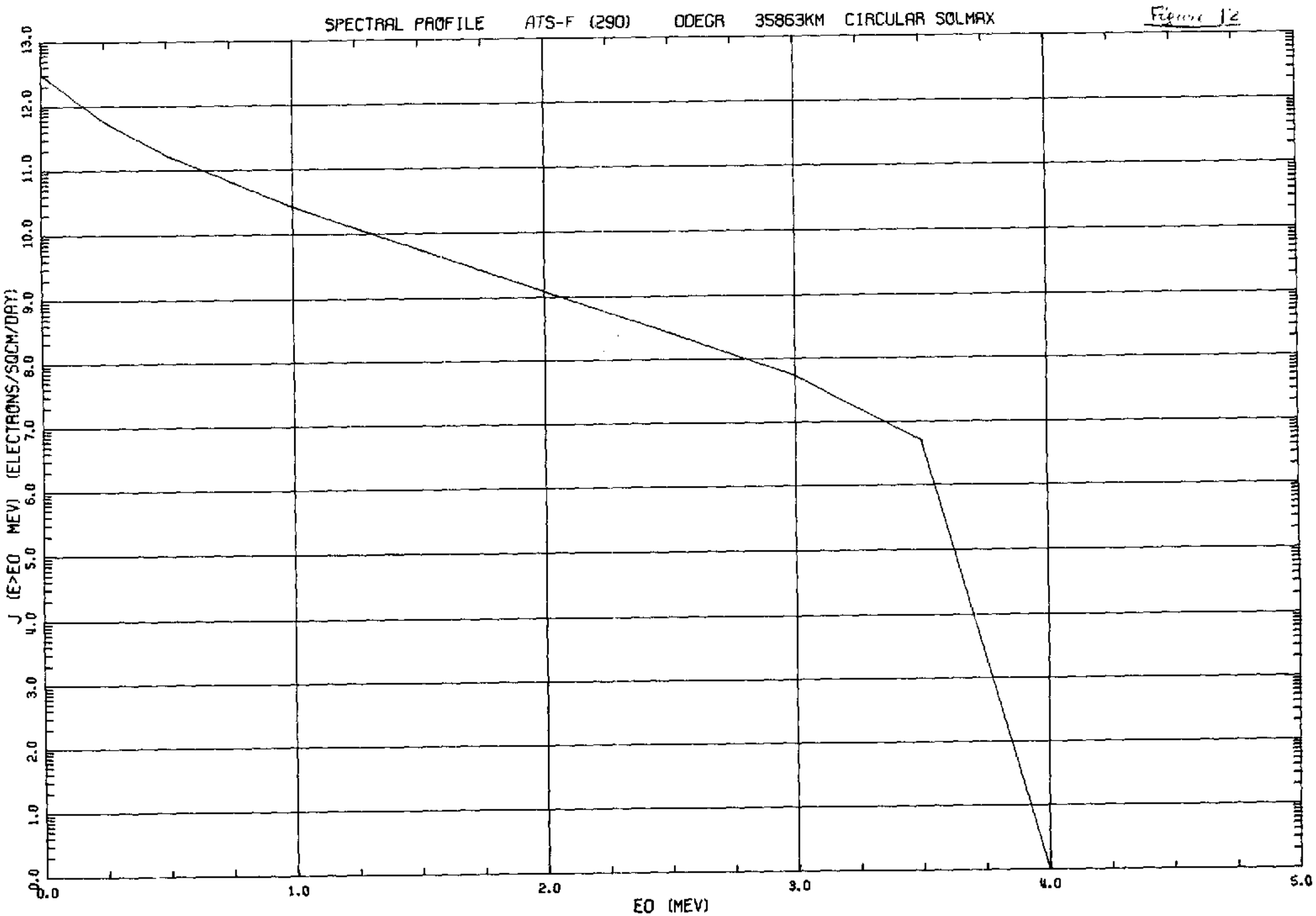
SPECTRAL PROFILE .ATS-F (110) 0DEGR 35863KM CIRCULAR
Figure 9
J (E>E0 MEV) (PROTONS/SQCM/DAY)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
E0 (MEV)



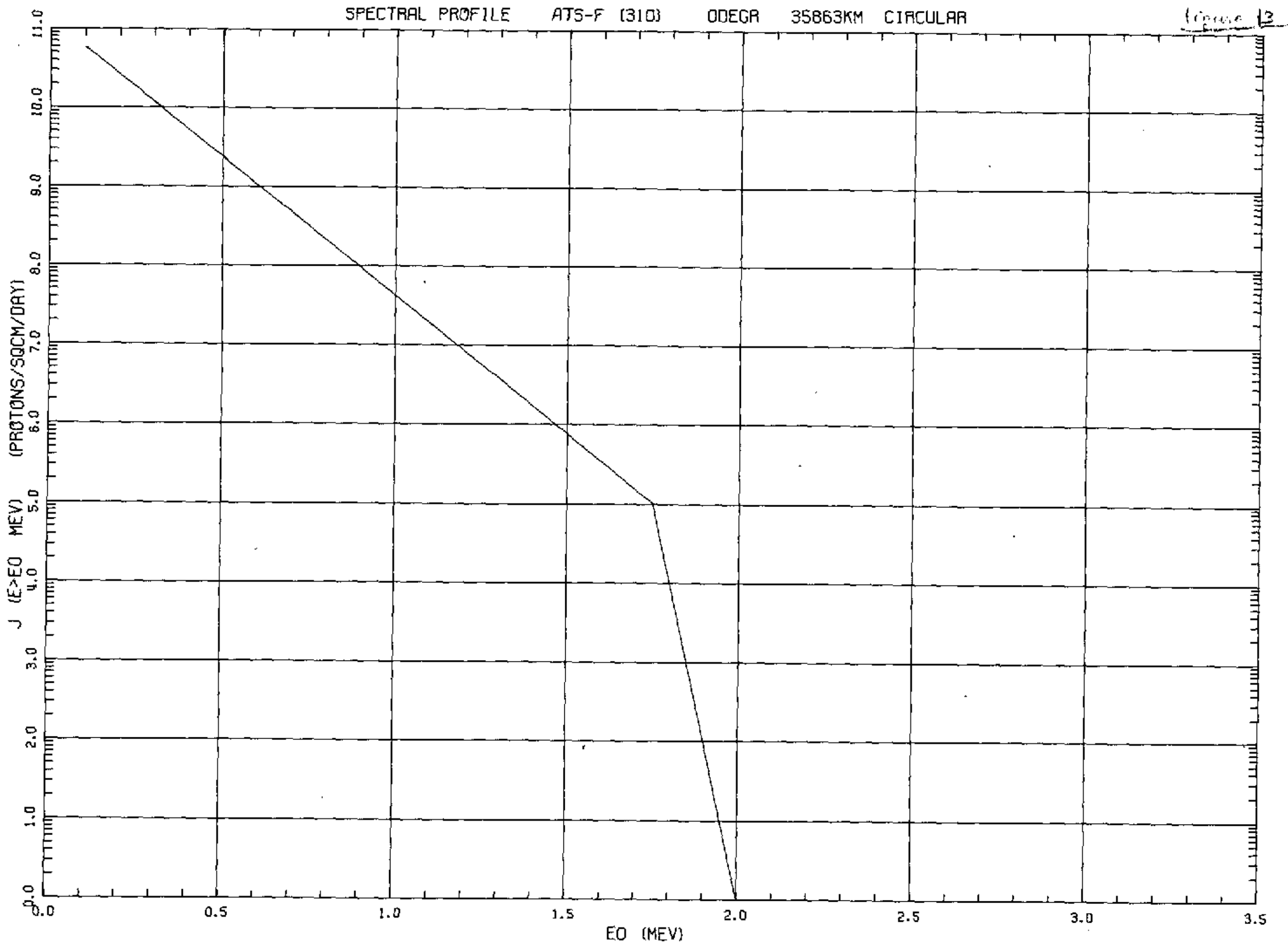
SPECTRAL PROFILE ATS-F (110) ODEGR 35863KM CIRCULAR SOLMAX
Figure 10
J (E>EO MEV) (ELECTRONS/SQCM/DAY)
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
EO (MEV)

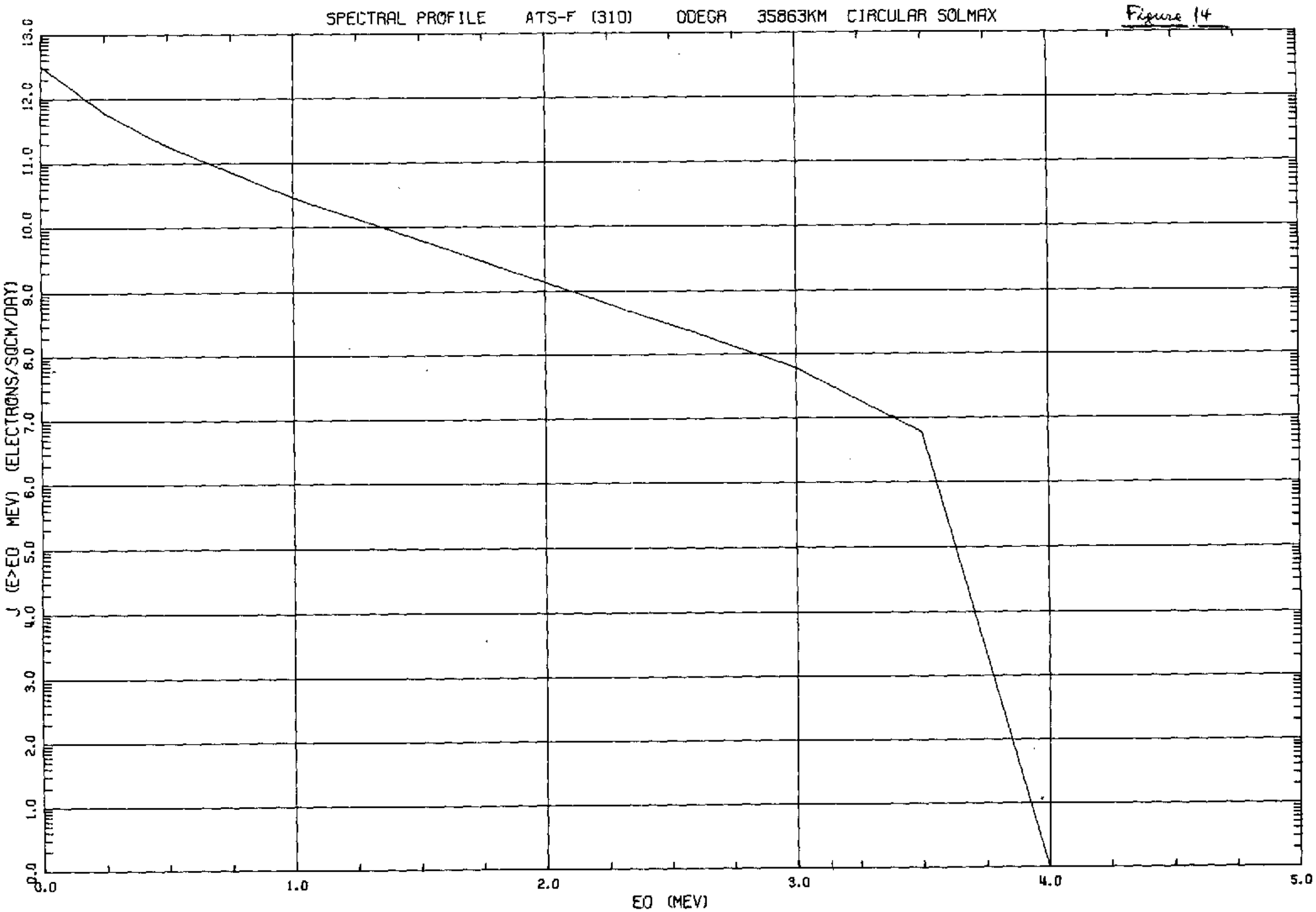


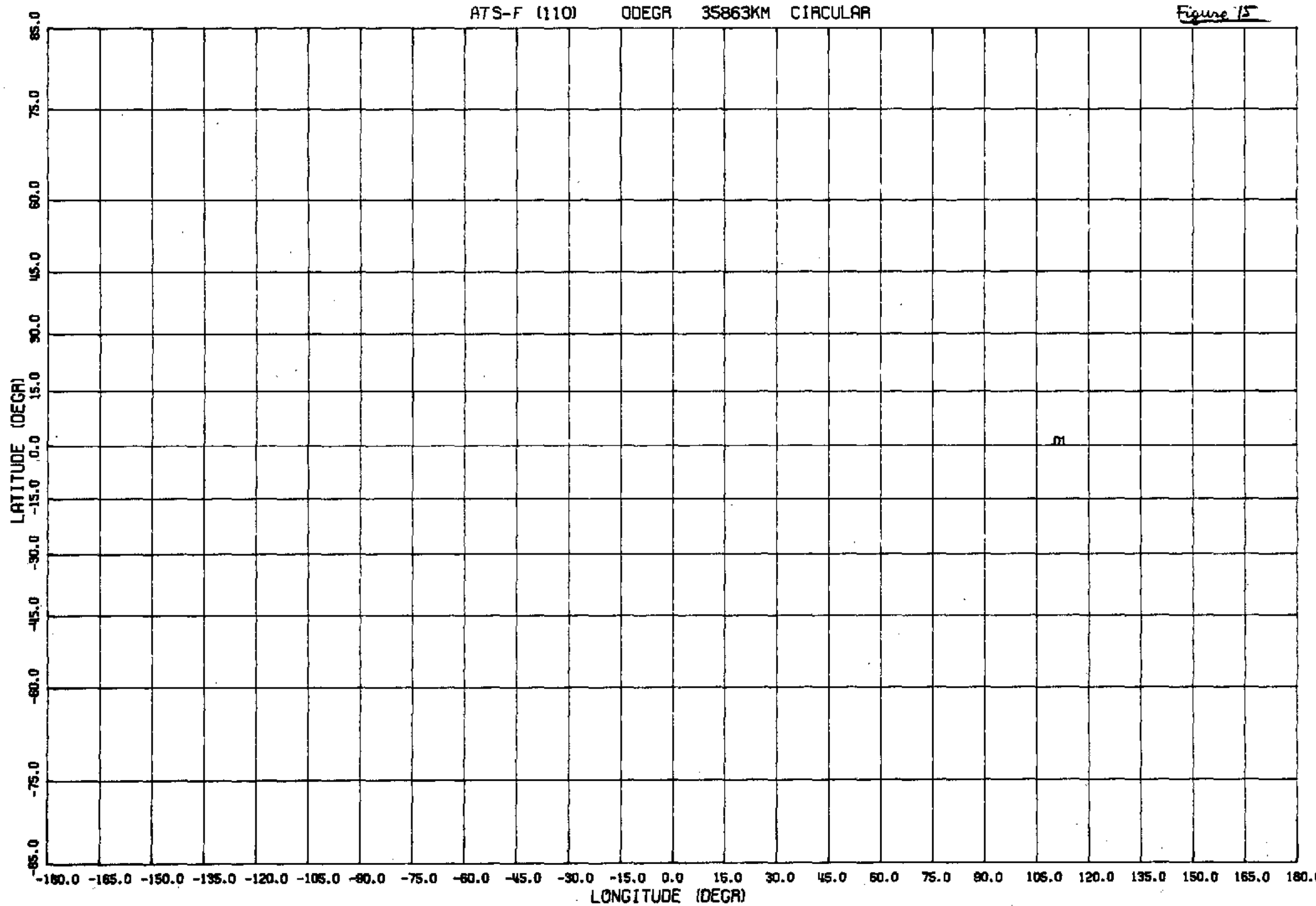
SPECTRAL PROFILE ATS-F (290) 0DEGR 35863KM CIRCULAR
Figure 11
J (E>EO MEV) (PROTONS/SQCM/DAY)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
EO (MEV)

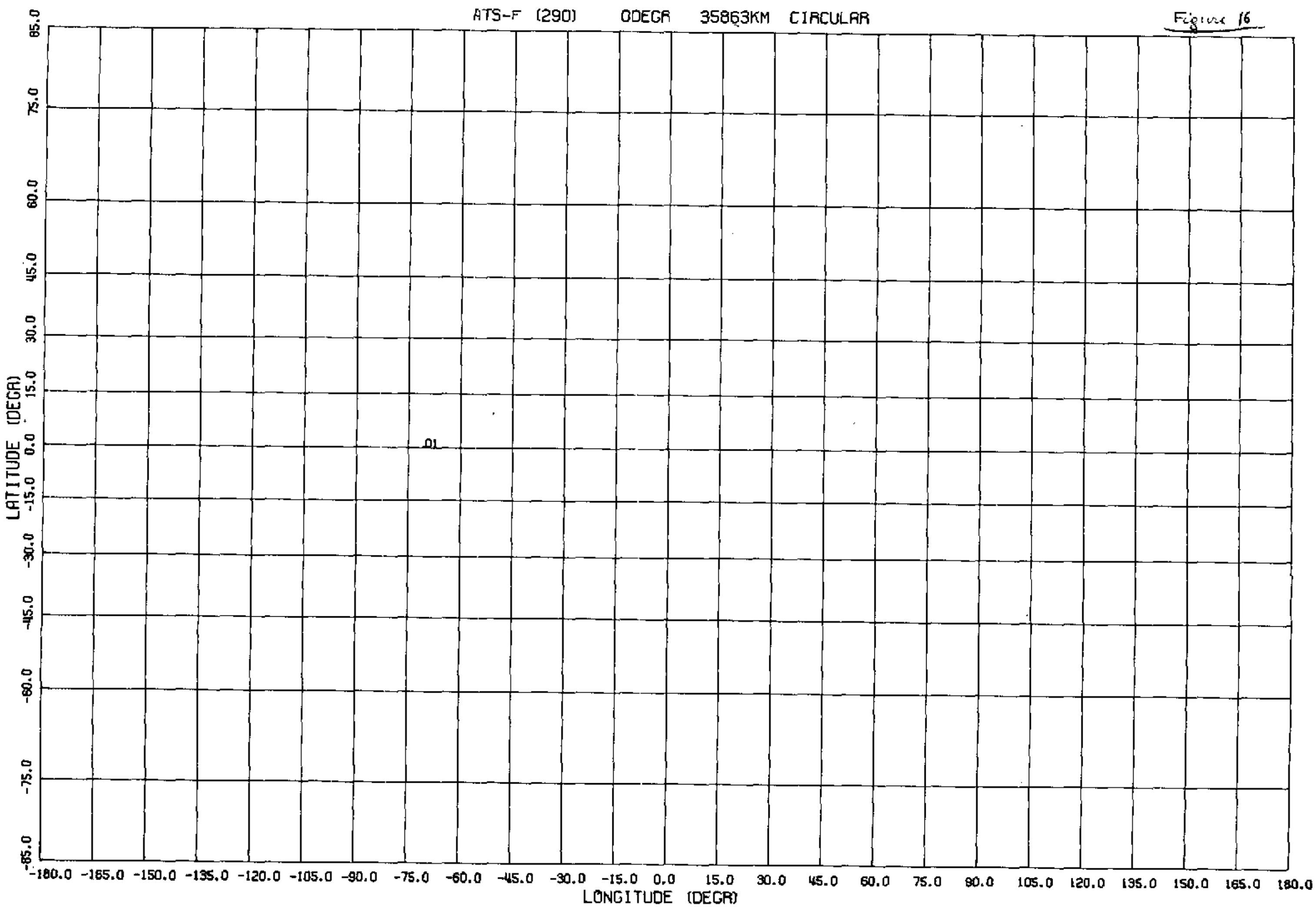


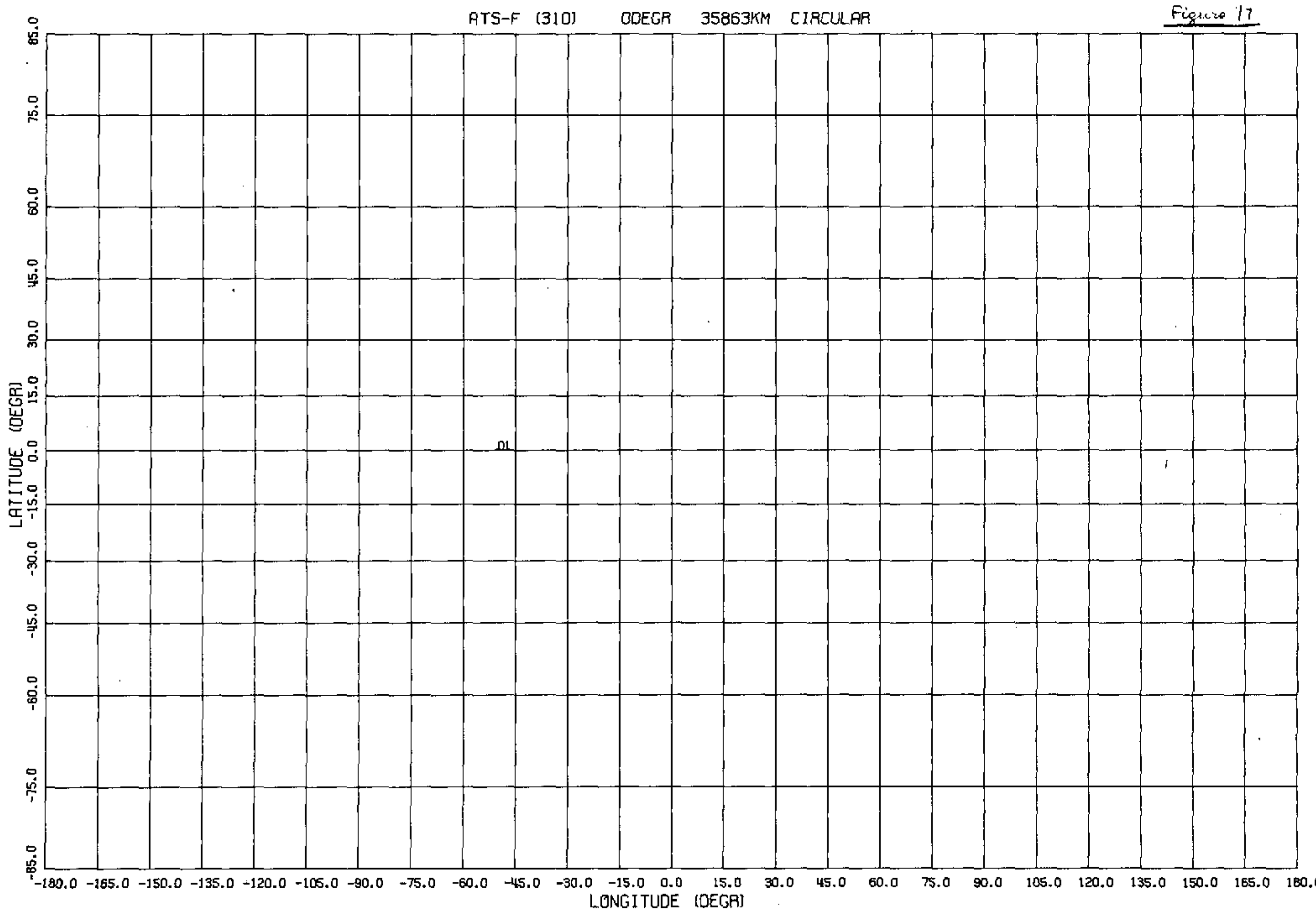
SPECTRAL PROFILE ATS-F (290) ODEGR 35863KM CIRCULAR SOLMAX
Figure 12
J (E>EO MEV) (ELECTRONS/SQCM/DAY)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
0.0
1.0
2.0
3.0
4.0
5.0
EO (MEV)


SPECTRAL PROFILE ATS-F (310) ODEGR 35863KM CIRCULAR
J (E>EO MEV) (PROTONS/SQCM/DAY)
EO (MEV)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0

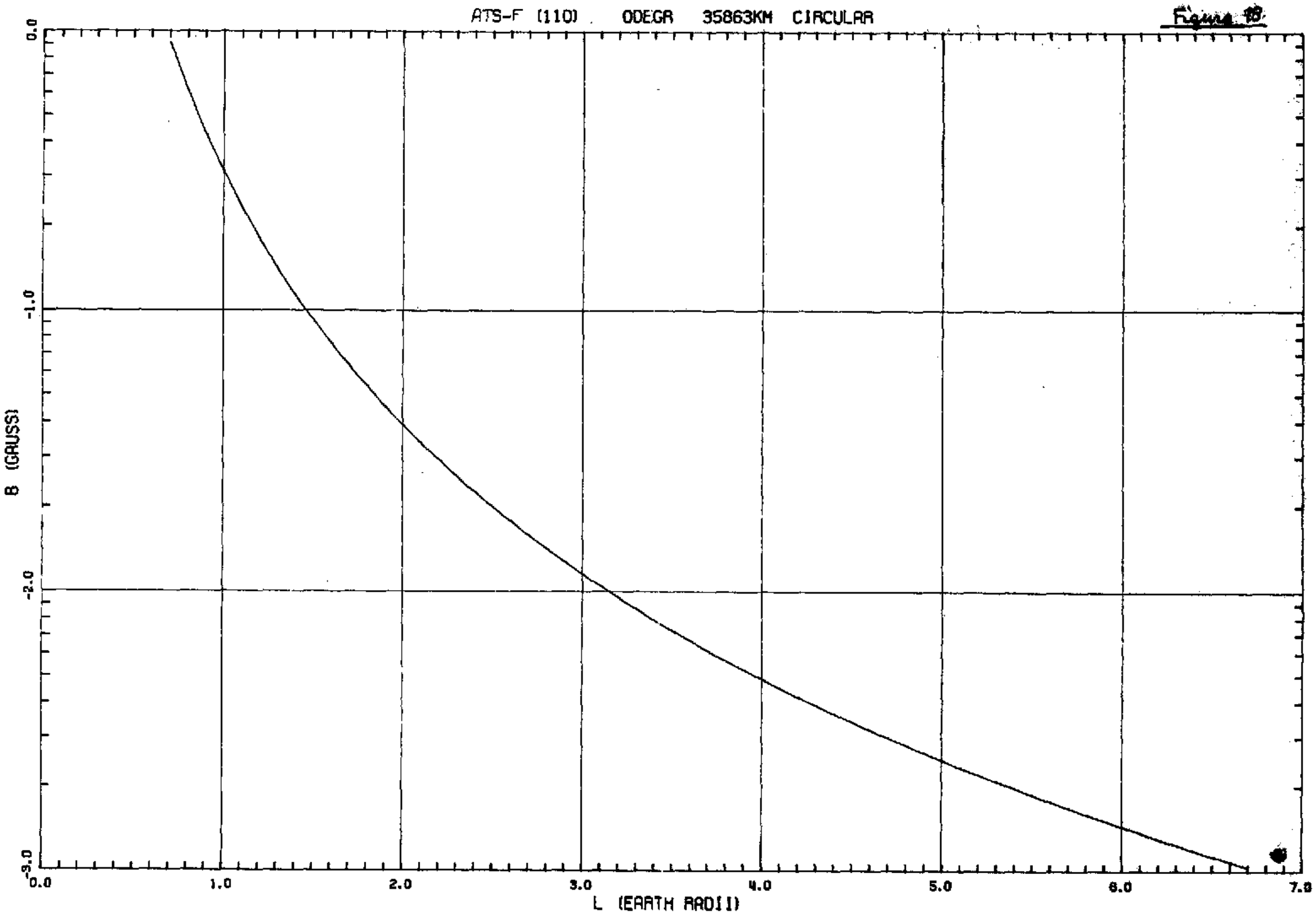

SPECTRAL PROFILE ATS-F (310) 0DEGR 35863KM CIRCULAR SOLMAX
Figure 14
J (E>E0 MEV) (ELECTRONS/SQCM/DAY)
E0 (MEV)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0


ATS-F (110) 0DEGR 35863KM CIRCULAR
Figure 15
LATITUDE (DEGR)
85.0
75.0
60.0
45.0
30.0
15.0
0.0
-15.0
-30.0
-45.0
-60.0
-75.0
-85.0
-180.0 -165.0 -150.0 -135.0 -120.0 -105.0 -90.0 -75.0 -60.0 -45.0 -30.0 -15.0 0.0 15.0 30.0 45.0 60.0 75.0 90.0 105.0 120.0 135.0 150.0 165.0 180.0
LONGITUDE (DEGR)

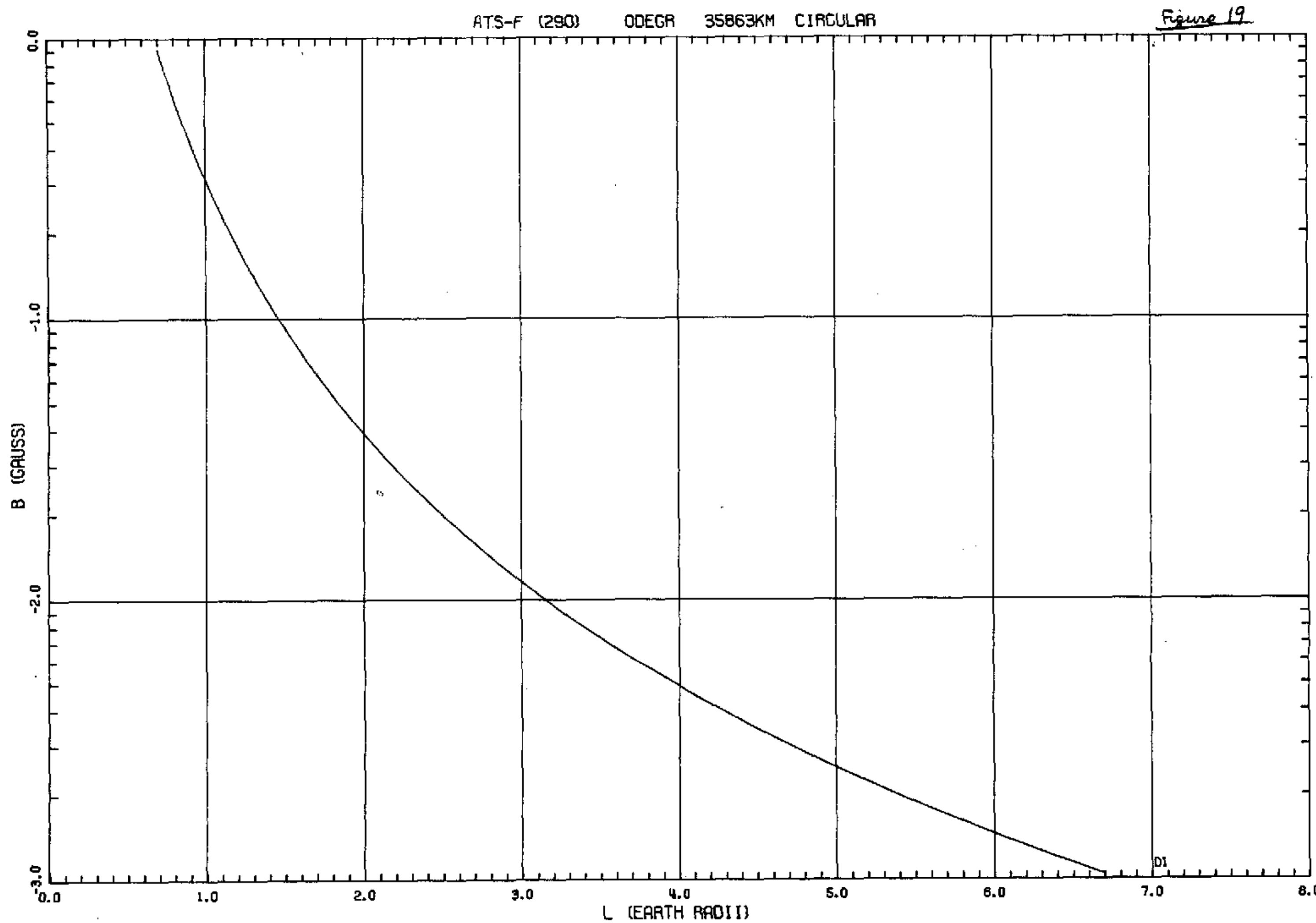

ATS-F (290) 0DEGR 35863KM CIRCULAR
Figure 16
85.0
75.0
60.0
45.0
30.0
15.0
0.0
-15.0
-30.0
-45.0
-60.0
-75.0
-85.0
LATITUDE (DEGR)
01
-180.0 -165.0 -150.0 -135.0 -120.0 -105.0 -90.0 -75.0 -60.0 -45.0 -30.0 -15.0 0.0 15.0 30.0 45.0 60.0 75.0 90.0 105.0 120.0 135.0 150.0 165.0 180.0
LONGITUDE (DEGR)

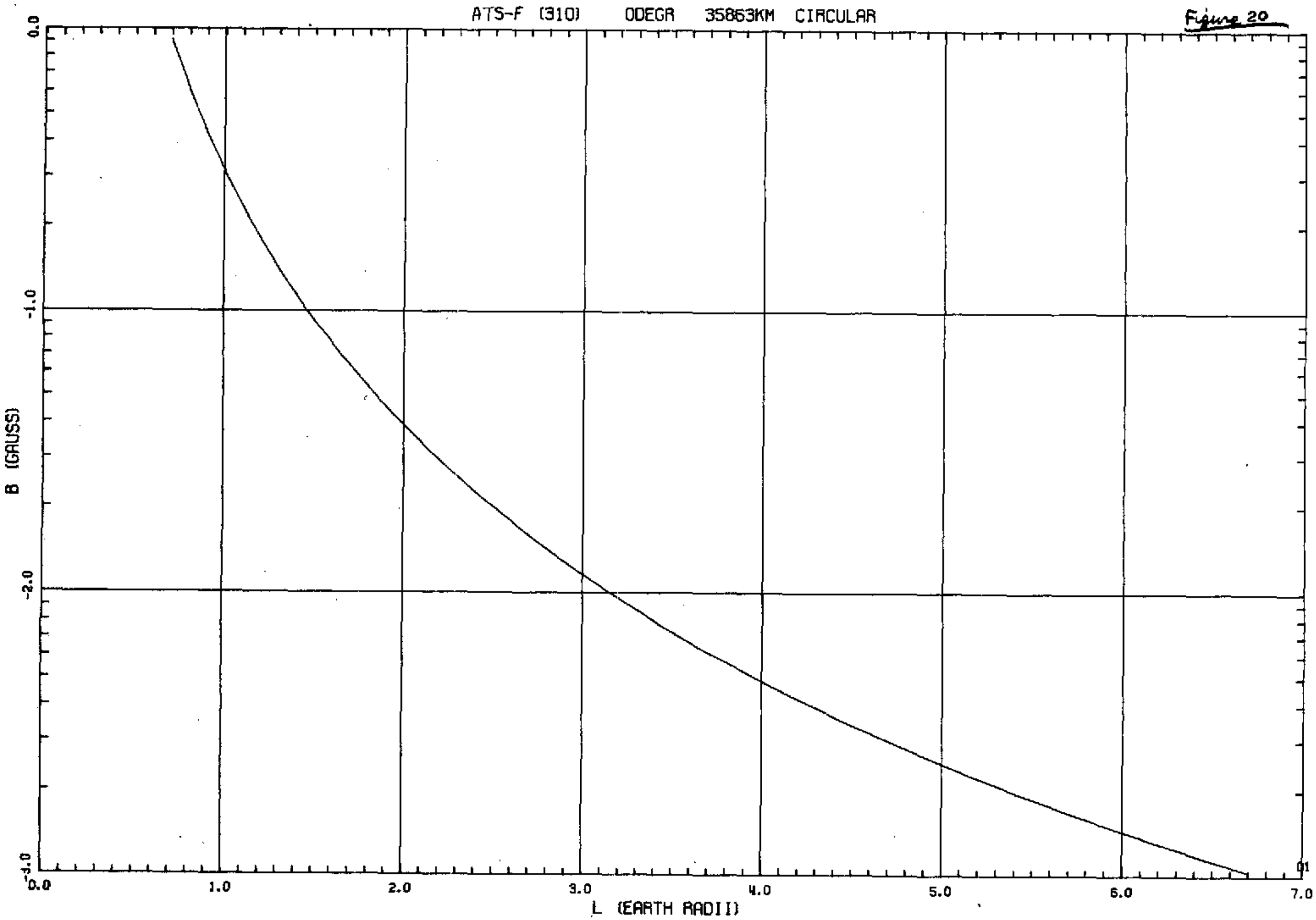


ATS-F (310) 0DEGR 35863KM CIRCULAR
Figure 17
LATITUDE (DEGR)
85.0
75.0
60.0
45.0
30.0
15.0
0.0
-15.0
-30.0
-45.0
-60.0
-75.0
-85.0
01
-180.0 -165.0 -150.0 -135.0 -120.0 -105.0 -90.0 -75.0 -60.0 -45.0 -30.0 -15.0 0.0 15.0 30.0 45.0 60.0 75.0 90.0 105.0 120.0 135.0 150.0 165.0 180.0
LONGITUDE (DEGR)



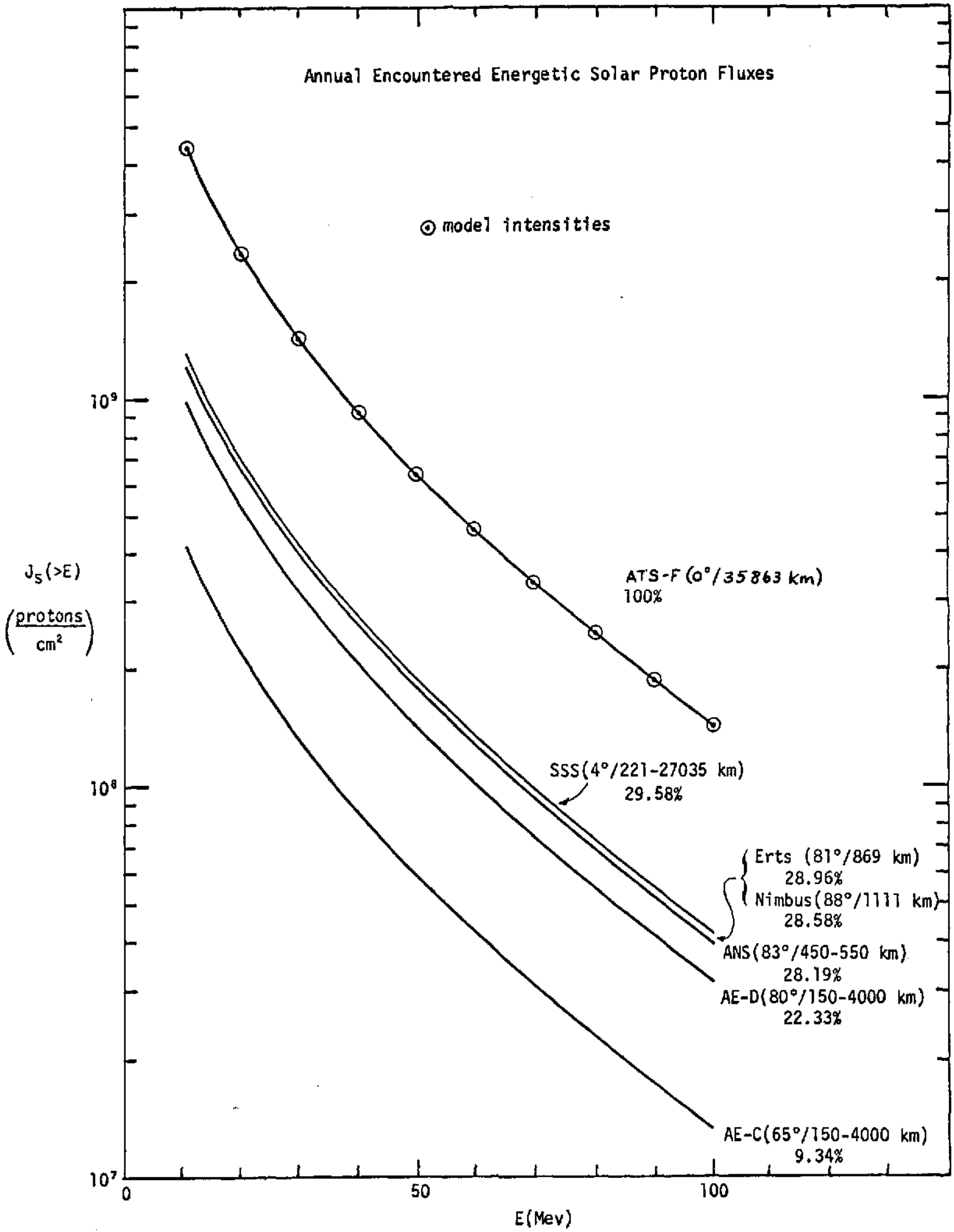
ATS-F (110) ODEGR 35863KM CIRCULAR
Figure 18
0.0
-1.0
-2.0
-3.0
B (GAUSS)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
L (EARTH RADII)


ATS-F (290) 0DEGR 35863KM CIRCULAR
Figure 19
B (GAUSS)
0.0
-1.0
-2.0
-3.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
L (EARTH RADII)
D1



ATS-F (310) ODEGR 35863KM CIRCULAR
Figure 20
0.0
-1.0
-2.0
-3.0
B (GAUSS)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
L (EARTH RADII)

Figure 21


Annual Encountered Energetic Solar Proton Fluxes
model intensities
ATS-F (0°/35863 km)
100%
SSS(4°/221-27035 km)
29.58%
Erts (81°/869 km)
28.96%
Nimbus(88°/1111 km)
28.58%
ANS(83°/450-550 km)
28.19%
AE-D(80°/150-4000 km)
22.33%
AE-C(65°/150-4000 km)
9.34%
J_S(>E)
(protons/cm²)
10⁹
10⁸
10⁷
0
50
100
E(Mev)