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EXPECTED ELECTRON AND PROTON ENVIRONMENT FOR THE COSMIC X-RAY EXPERIMENT ABOARD THE OSO-I AND OSO-H

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JULY 1971

GSFC

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

EXPECTED ELECTRON AND PROTON ENVIRONMENT FOR THE COSMIC X-RAY EXPERIMENT ABOARD THE OSO-I AND OSO-H SATELLITES

A special study to evaluate the OSO missions
in terms of their predicted ambient radiation intensities

by

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Theoretical Studies Branch

July 1971

GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland

EXPECTED ELECTRON AND PROTON ENVIRONMENT FOR THE COSMIC X-RAY EXPERIMENT ABOARD THE OSO-I AND OSO-H

Forward

At the request of the senior experimenter and the project office, a special study was conducted to determine the ambient trapped particle fluxes encountered by the OSO-I, in order to evaluate the contamination of the cosmic x-ray detectors during times of apparantly normal data aquisition in order to develop means for rejection of background events and/or provide a suitable normalization monitor. In response to further requests, the study was expanded in order to provide data for the determination of possible radiation damage to COS/MOS devices on OSO, I and H.

Several groups of scientists and engineers, related either to the OSO-I or the OSO-H project, were briefed in separate meetings at which the data were presented and explained and the results were discussed. Two meetings were held at Goddard and a special "OSO-H Meeting on Radiation Effects" was organized at NRL. Names and affiliations of participants are given in the attached distribution list.

Introduction

The results contained in this report are valid for both vehicles, OSO-I and OSO-H, since their nominal orbits are identical, but with the reservation that their effective launch date will not be more than one year apart.

Due to its low altitude and small inclination, the OSO (H and I) trajectory lies entirely in a region of magnetic B/L-space commonly referred to as the "inner zone" ($1.0 \lesssim L \lesssim 2.2$). This fact simplifies calculations and considerably improves the quality of the predictions, because lasting solar cycle effects, which are more severely experienced in the outer zone, do not have tobe taken into account.

On the other hand, launch epoch for both missions is sometime in 1974, that is, during the period of the next solar minimum . Consequently, conditions prevailing then in the radiation belt would most likely resemble those that existed during the last solar minimum, namely in 1964, with the exception of the artificial "Starfish" electrons that populated the inner zone from July 1962 to about 1968. These would have to be removed, in order to obtain a reasonable approximation for the 1974 environment. This process still involves some handwaiving, which in turn degrades somewhat the quality of the predictions.

The vehicle encountered electron fluxes in our study are calculated with Vette's AE2 model, which describes the environment as it actually existed back in 1964, when the artificials were vastly predominant in the inner zone. Since the model does not account for time dependent changes, it was updated by decaying the fluxes exponentially up to an epoch, at which it was felt that the natural beckground levels had been reached. This was done with experimentally determined decay lifetimes, defined as functions of B, L, and E (energy).

Orbital flux integrations for high energy protons were performed with Vette's current models AP1, AP6, AP7. As in the case of the AE2 (electrons), these are static models which do not consider temporal variations. However, for the protons this is a valid representation because experimental measurements have shown no significant changes with time. 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 of 2, attached to the models. Consequently, the proton models may be applied to any epoch without the need for an updating process.

Classification of orbit integrated spectra as hard or soft is relative; it is based on an overall evaluation of near earth space in terms of circular trajectories between equatorial and polar orbits.

Occasionally discontinuities appear in the proton spectra. These "breaks" occur because the complete proton environment is being described by three (formerly four) independent maps or grids, each valid only over a limited energy range; for certain critical orbital configurations the discontinuities are then produced when moving from one energy range to another. They are caused, in part, by the exponential energy parameter of the model which in many instances had to be extrapolated to make up for lacking data and, in part, to insufficient experimental measurements over some areas of B/L-space; furthermore, the discontinuities reflect the fact that the available data cannot be completely matched at their overlap. In order to overcome such spectral breaks, a continuous weighted mean curve is usually drawn, connecting the adjacent segments; it should be regarded as an approximate spectral distribution. In doing this, the AP1 results ($30 < E(\text{Mev}) < 50$) have to be totally ignored sometimes. The OSO orbit belongs to the affected group.

Attachment A contains other pertinent background information with regard to units, field models, trajectory generation and conversion, etc. At this point, we wish to emphasize again that our calculations are only approximations; we strongly recommend that all persons to receive parts of this report be advised about the uncertainty in our data.

Results: Analysis and Discussion

Our calculations are summarized in Tables 1, 2, 3 for electrons and Tables 4, 5 for protons. The superimposed spectral distribution of both types of particles is given graphically in Figure 1.

The electron spectrum above $E = 1$ Mev may be classified as "hard" for a near earth space mission, while the protons rate a "very hard" classification for energies $E > 15$ Mev. Figures 2 and 3 give the characteristic spectral profiles of the investigated trajectory, for electrons and protons separately, plotted by computer.

Table 6 indicates what percent of its total lifetime the satellite spends in "flux-free" regions of space, what percent of its total lifetime 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 electron or proton per square centimeter per second, having energies $E > .5$ Mev and $E > 5.$ Mev respectively; this includes regions outside the radiation belts. Similarly, we define as "high intensity" those regions of space, where the instantaneous, integral, omnidirectional, trapped particle flux is greater than 10^5 electrons with energies $E > .5$ Mev, and greater than 10^3 protons with energies $E > 5.$ Mev. The values given in Table 7 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.

Figures 4 and 5 are computer plots of instantaneous peak electron ($E > .5$ Mev) and proton ($E > 5.$ Mev) intensities per orbit, for a sequence of about 30 revolutions. A periodic pattern is evident, based on the daily cycle of about 15 revolutions. Cycle and pattern are functions of the orbit-period, which determines the precession of the trajectory. Because of the circular form of the orbit (eccentricity = 0), no significant changes are expected to occur in either with time.

In regards to the displayed data, especially noteworthy is the fact that the OSO trajectory offers several consecutive virtually flux-free revolutions per day, in the electron as well as in the proton medium. Specifically, There are about three (3) flux-less orbits for electrons and about five (5) for protons.

The described phenomenon is a special feature of this particular flight path. A change in inclination or altitude will affect the radiation-free period.

In Figures 6 and 7 time- and flux-histograms of the orbit are depicted on the same graph, one for electr ns and one for protons, in terms of the magnetic parameter L. The unmarked contour shows averaged instantaneous intensities of the trajectory, for L-bands of constant width of .1 earth radius; the contour marked with X's indicates the percent of total lifetime spent by the vehicle in each L-interval.

ATTACHMENT A

General Background Information

For the specified OSO-H trajectory, an orbit tape was generated with an integration stepsize of one minute and for sufficiently long flighttime, so as to insure an adequate sampling of the ambient environment; on account of its period, which determines the rate of orbit-precession, the following circular flight path of 48-hour duration was produced:

Inclination	Perigee	Apogee
33°	556km	556km

The orbit was subsequently converted from geocentric polar into magnetic B-L coordinates with McIlwain's INVAR program of 1965 and the field routine ALLMAG by Stassinopoulos and Mead, utilizing the POGO (10/68) geomagnetic field model by Cain and Langel, calculated for the epoch 1974.0 (B is the field strength at a given point and L is the geocentric distance to the intersect of the field line, through that point, with the geomagnetic equator).

Orbital flux integrations were performed with Vette's current models of the environment, the AE2 for electrons and the AP1, AP6, AP7 for high energy protons. All are static models which do not consider temporal variations. See the text of the report for further details on this matter.

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

1. Daily averages: total trajectory integrated flux averaged into particles/cm^2 day,
2. Totals per orbit: non-averaged, single-orbit integrated flux in particles/cm^2 orbit,
3. Peaks per orbit: highest orbit-encountered instantaneous flux in particles/cm^2 sec,

where 1 orbit = 1 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 3 for the electrons. It is advisable to inform all potential users about this uncertainty in the data.

DISTRIBUTION LIST FOR OSO - I & H REPORT

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RUN.TIME =163.82 SECS
PRINT = 1

ORBITAL FLUX STUDY WITH COMPOSITE ELECTRON ENVIRONMENT* (VETTES AE2) * DATE OF RUN = YEAR 1971. DAY 0149
MAGNETIC COORDINATES B&L COMPUTED BY INVARA OF 1971 * CAIN&LANGEL 143-TERM POGO 10/68 FOR TIME= 1974.000 * FLUX CODE ME(2)

FLUXES EXPONENTIALLY DECAYED WITH DECAY-FACTOR D1 = VETTE TBLE *** DECAY DATE = YEAR 1967. . MONTH 6. . DAY 0.

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>.5MEV (EXCEPT WHERE ENERGY IS SPECIFIED. AS IN SPECTRUM)

INCLINAT.= 33 * PERIG.= 556 * APOG.= 556 KM * B&L ORBIT TAPE TO 6296 * PERIOD = 1.596 * VEHICLE = [redacted]

L - BANDS (MAGNETIC SHELL PARAMETER IN EARTH RADII) L - BANDS

ENERGY RANGES (MEV)	*0.00-1.22*	*1.22-1.27*	*1.27-1.32*	*1.32-1.37*	*1.37-1.45*	*1.45-1.55*	*1.55-1.65*	*1.65-1.75*	*1.75-1.85*	*1.85-1.95*	*1.95-2.05*	*2.05-2.15*
0-.5	3.35E 07	2.39E 08	8.88E 08	6.36E 08	4.77E 08	2.86E 08	2.08E 08	3.67E 08	4.49E 08	5.90E 08	1.10E 07	0.0
.5-1	3.91E 07	8.56E 07	2.51E 08	1.41E 08	9.73E 07	5.39E 07	2.65E 07	3.77E 07	2.63E 07	1.31E 07	2.60E 05	0.0
1-2	5.92E 07	8.36E 07	1.78E 08	8.85E 07	6.30E 07	3.96E 07	1.52E 07	1.11E 07	3.98E 06	2.13E 06	3.10E 04	0.0
2-3	1.16E 07	2.23E 07	5.96E 07	3.04E 07	2.04E 07	1.15E 07	4.17E 06	2.67E 06	1.22E 06	7.37E 05	1.25E 04	0.0
3-4	1.55E 06	4.98E 06	2.19E 07	1.08E 07	6.68E 06	3.52E 06	1.11E 06	6.91E 05	3.95E 05	2.64E 05	5.64E 03	0.0
4-5	2.03E 05	1.71E 06	7.89E 06	3.73E 06	2.27E 06	9.90E 05	2.94E 05	1.94E 05	1.25E 05	9.34E 04	2.29E 03	0.0
5-6	2.70E 04	5.77E 05	2.93E 06	1.33E 06	7.82E 05	3.08E 05	7.96E 04	4.93E 04	3.95E 04	3.44E 04	1.00E 03	0.0
6-7	3.68E 03	[illegible].55E 05	1.10E 06	4.84E 05	2.50E 05	9.24E 04	2.13E 04	1.37E 04	1.25E 04	1.15E 04	4.39E 02	0.0
GT.7	5.70E 02	1.03E 05	6.27E 05	2.63E 05	1.32E 05	3.96E 04	8.05E 03	5.19E 03	5.78E 03	6.55E 03	3.45E 02	0.0
TOTAL =	1.45E 08	4.38E 08	1.41E 09	9.13E 08	6.68E 08	3.96E 08	2.56E 08	4.19E 08	4.81E 08	6.06E 08	1.13E 07	0.0

L - BANDS (MAGNETIC SHELL PARAMETER IN EARTH RADII) L - BANDS

ENERGY RANGES (MEV)	*2.15-2.25*	*2.25-2.35*	*2.35-2.45*	*2.45-2.55*	*2.55-2.65*	*2.65-2.75*	*2.75-2.85*	*2.85-2.95*	*2.95-3.10*	*3.10-3.30*	*3.30-3.50*	*3.50-3.70*
0-.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GT.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL =	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 - BANDS (MAGNETIC SHELL PARAMETER IN EARTH RADII) L - BANDS

ENERGY RANGES (MEV)	*3.70-3.90*	*3.90-4.10*	*4.10-4.30*	*4.30-4.50*	*4.50-4.70*	*4.70-4.90*	*4.90-5.10*	*5.10-5.30*	*5.30-5.50*	*5.50-5.70*	*5.70-5.90*	*5.90-9.99*
0-.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
.5-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6-7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GT.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL =	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2

ORBITAL FLUX STUDY WITH COMPOSITE ELECTRON ENVIRONMENT* (VETTES AE2) * DATE OF RUN = YEAR 1971, DAY 0149
FLUXES EXPONENTIALLY DECAYED WITH DECAY-FACTOR D1 = VETTE TBLE *** DECAY DATE = YEAR 1967. , MONTH 6. , DAY 0.

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>.5MEV (EXCEPT WHERE ENERGY IS SPECIFIED, AS IN SPECTRUM)

INCLINAT.= 33 * PERIG.= 556 * APOG.= 556 KM * B&L ORBIT TAPE TC 6296 * PERIOD = 1.596 * VEHICLE = OSO - I

SPECTRUM IN % OE

ENERGY RANGES (MEV)	AVERAGED TOTAL FLUX (PER DAY)	SPECTRUM (PER CENT)
0-.5	4.185E 09	72.86
.5-1	7.717E 08	13.43
1-2	5.439E 08	9.47
2-3	1.647E 08	2.87
3-4	5.191E 07	0.90
4-5	1.751E 07	0.30
5-6	6.151E 06	0.11
6-7	2.182E 06	0.04
GT.7	1.191E 06	0.02
TOTAL =	5.744E 09	100.00

COMPOSITE ORBIT SPECTRUM

ENERGY GRTR.THAN (MEV)	AVERAGED INTEG.FLUX (PER DAY)
0.0	5.744E 09
0.25	2.563E 09
0.50	1.559E 09
0.75	1.081E 09
1.00	7.875E 08
1.25	5.851E 08
1.50	4.364E 08
1.75	3.246E 08
2.00	2.436E 08
2.25	1.807E 08
2.50	1.361E 08
2.75	1.029E 08
3.00	7.894E 07
3.25	6.016E 07
3.50	4.610E 07
3.75	3.536E 07
4.00	2.703E 07
4.25	2.098E 07
4.50	1.629E 07
4.75	1.215E 07
5.00	9.524E 06
5.25	7.331E 06
5.50	5.661E 06
5.75	4.348E 06
6.00	3.373E 06
6.25	2.595E 06
6.50	2.013E 06
6.75	1.514E 06
7.00	1.191E 06

EXPOSURE INDEX

INTENSITY RANGES (EL/CM**2/SEC)	DURATION OF EXPOSURE (HRS)	TOTAL NO. OF ACCUMULATED PARTICLES (E>.5)
ZERO FLUX	38.1	1.085E 04
1.E0-1.E2	2.18	1.525E 05
1.E2-1.E3	1.33	1.973E 06
1.E3-1.E4	1.63	2.606E 07
1.E4-1.E5	2.58	3.911E 08
1.E5-1.E6	2.20	2.659E 09
1.E6-1.E7	0.0	0.0
1.E7-1.E8	0.0	0.0
1.E8-INFIN	0.0	0.0
TOTAL =	48.017	3.118E 09

** GENERAL OUTPUT FOR ALL ORBITS **
************************************** ONE PERIOD = TIME INTERVAL TAU = ONE ORBIT **************************************

TABLE OF PEAK AND TOTAL FLUX PER TAU-PERIOD

ORBITAL FLUX STUDY WITH COMPOSITE ELECTRON ENVIRONMENT* (VETTES AE2) * DATE OF RUN = YEAR 1971, DAY 0149
FLUXES EXPONENTIALLY DECAYED WITH DECAY-FACTOR C1 = VETTE TBLE *** DECAY DATE = YEAR 1967. , MONTH 6. , DAY 0.

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>.5MEV (EXCEPT WHERE ENERGY IS SPECIFIED, AS IN SPECTRUM)

INCLINAT.= 33 * PERIG.= 556 * APOG.= 556 KM * BBL ORBIT TAPE TD 6296 * PERIOD = 1.596 * VEHICLE = OSO - I

PERIOD NO.	PEAK FLUX ENCOUNTERED	POSITION AT WHICH ENCOUNTERED LONGITUDE	LATITUDE	ALTITUDE	ORBIT TIME (HRS)	FIELD(B) (GAUSS)	LINE(L) (E.R.)	TOTAL FLUX/ORBIT (NOT AVERAGED)
1	9.989E-01	120.43	-28.54	548.8	1.06667	0.43655	1.796	3.033E 03
2	9.988E-01	94.25	-28.00	548.4	2.65000	0.40959	1.794	3.482E 03
3	9.985E-01	71.90	-28.59	548.7	4.25000	0.34891	1.785	3.680E 03
4	1.071E 04	41.99	-26.82	547.6	5.81667	0.26239	1.677	3.089E 06
5	4.213E 04	27.27	-29.69	549.4	7.45000	0.24568	1.789	2.805E 07
6	2.635E 05	-20.78	-20.95	544.8	8.93333	0.20729	1.324	1.101E 08
7	5.929E 05	-36.34	-24.87	546.5	10.56667	0.19602	1.280	2.389E 08
8	7.122E 05	-43.53	-30.22	549.6	12.23333	0.19601	1.307	3.081E 08
9	6.008E 05	-49.22	-32.81	552.3	13.90000	0.19809	1.315	3.005E 08
10	7.302E 05	-46.26	-30.89	554.8	15.60000	0.19571	1.303	4.069E 08
11	3.621E 05	-49.59	-24.58	555.4	17.28331	0.19085	1.222	1.636E 08
12	1.651E 04	-37.47	-3.52	555.4	19.06667	0.20980	1.147	5.661E 06
13	6.974E 03	-75.12	-12.44	555.3	20.58331	0.21372	1.140	1.645E 06
14	2.546E 01	-94.87	-9.47	555.2	22.20000	0.23156	1.105	2.880E 03
15	9.973E-01	173.73	-32.92	552.9	23.48331	0.41166	1.769	0.0
16	9.989E-01	114.55	-28.36	548.0	24.93330	0.43423	1.797	0.0
17	9.982E-01	-84.33	26.15	557.0	25.70000	0.37547	1.779	0.0
18	3.100E 01	44.57	-19.72	544.2	28.01666	0.26555	1.428	9.600E 02
19	1.836E 04	43.68	-28.99	548.3	29.71666	0.26627	1.768	6.142E 06
20	7.421E 04	-7.27	-18.09	543.7	31.18330	0.22158	1.352	4.158E 07
21	3.266E 05	-26.58	-20.68	544.5	32.79999	0.20215	1.285	1.362E 08
22	6.421E 05	-38.56	-26.03	546.6	34.45000	0.19528	1.281	2.624E 08
23	6.974E 05	-45.42	-30.93	549.4	36.11664	0.19628	1.307	3.070E 08
24	5.936E 05	-46.69	-32.95	552.1	37.79999	0.19838	1.3[illegible]0	3.148E 08
25	7.523E 05	-40.38	-28.10	553.9	39.51666	0.19511	1.298	4.032E 08
26	1.870E 05	-51.87	-23.32	554.1	41.16664	0.19084	1.206	7.867E 07
27	3.087E 03	-37.35	0.26	554.6	42.96666	0.21812	1.148	1.201E 06
28	2.174E 03	-77.81	-10.80	554.1	44.46666	0.21854	1.135	5.366E 05
29	2.405E 00	-94.66	-5.77	554.1	46.09999	0.23696	1.107	0.0
30	9.980E-01	172.02	-32.76	552.1	47.36664	0.41375	1.776	0.0

Table 3

Table 4

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>5 MEV (EXCEPT WHERE ENERGY IS SPECIFIED, AS IN SPECTRUM)

ORBITAL FLUX STUDY FOR COMPOSITE PROTON ENVIRONMENT * GRIDS AP1,AP7,AP6,AP5 * DATE OF RUN = YEAR 1971, DAY 0149
INCLINAT.= 33 * PERIG.= 556 * APOG.= 556 KM * REL ORBIT TAPE TD 6296 * PERIOD = 1.596 * VEHICLE =.050-I

HIGH ENERGY

SPECTRUM IN % CE

ENERGY RANGES (MEV)	AVERAGED TOTAL FLUX (PER DAY)	SPECTRUM (PER CENT)
3-5	1.547E 07	37.116
5-15	1.454E 07	34.871
15-30	4.101E 06	9.838
30-50	1.296E 05	0.311
50-100	3.068E 06	7.359
>100	4.379E 06	10.505
TOTAL =	4.168E 07	100.00

COMPOSITE ORBIT SPECTRUM

ENERGY GRTR.THAN (MEV)	AVERAGED INTEG.FLUX (PER DAY)
1	NOT VALID
3	4.168E 07
5	2.621E 07
7	2.001E 07
9	1.659E 07
11	1.439E 07
13	1.284E 07
15	1.168E 07
18	1.038E 07
21	9.417E 06
24	8.670E 06
27	8.071E 06
30	7.576E 06
35	7.076E 06
40	6.515E 06
45	6.008E 06
50	7.446E 06
60	6.675E 06
70	5.994E 06
80	5.391E 06
90	4.856E 06
100	4.379E 06

EXPOSURE INDEX

INTENSITY RANGES (PT/CM**2/SEC)	DURATION OF EXPOSURE (HRS)	TOTAL NO. OF ACCUMULATED PARTICLES (E>5)
0.E0-1.E0	39.133	1.160E 05
1.E0-1.E1	1.333	1.897E 04
1.E1-1.E2	1.467	2.041E 05
1.E2-1.E3	1.550	3.160E 06
1.E3-1.E4	4.133	4.893E 07
1.E4-1.E5	0.0	0.0
1.E5-OVER	0.0	0.0
TOTAL =	48.000	5.243E 07

Table 5

AVERAGED FLUXES ON THIS TABLE ARE IN UNITS OF PARTICLES/CM**2/DAY *** NON-AVERAGED FLUXES ARE IN UNITS OF PARTICLES/CM**2/SEC
ALL FLUXES ON THIS TABLE ARE FOR ENERGIES E>5 MEV (EXCEPT WHERE ENERGY IS SPECIFIED. AS IN SPECTRUM)

ORBITAL FLUX STUDY FOR COMPOSITE PROTON ENVIRONMENT * ORIDS AP1.AP7.AP6.AP5 * DATE OF RUN = YEAR 1971. DAY 0149
INCLINAT.= 33 * PERIG.= 556 * APOG.= 556 KM * REL ORBIT TAPE TO 6296 * PERIOD = 1.596 * VEHICLE =.[redacted]

LOW ENERGY

SPECTRUM IN % OE

ENERGY RANGES (MEV)	AVERAGED TOTAL FLUX (PER DAY)	SPECTRUM (PER CENT)
.10- .50	1.515E 07	18.598
.50-1.10	1.812E 07	22.235
1.10-2.00	1.945E 07	23.867
2.00-3.00	1.409E 07	17.288
3.00-4.00	8.966E 06	11.004
4.00-5.00	5.709E 06	7.007
TOTAL =	8.148E 07	100.00

COMPOSITE ORBIT SPECTRUM

ENERGY GRTR.THAN (MEV)	AVERAGED INTEG.FLUX (PER DAY)
.10	9.149E 07
.30	8.358E 07
.50	7.633E 07
.70	6.974E 07
.90	6.371E 07
1.10	5.822E 07
1.30	5.319E 07
1.50	4.859E 07
1.75	4.340E 07
2.00	3.877E 07
2.25	3.463E 07
2.50	3.093E 07
2.75	2.763E 07
3.00	2.468E 07
3.25	2.205E 07
3.50	1.969E 07
3.75	1.759E 07
4.00	1.571E 07
4.25	1.404E 07
4.50	1.254E 07
4.75	1.120E 07
5.00	1.000E 07

EXPOSURE INDEX

INTENSITY RANGES (PT/CM**2/SEC)	DURATION OF EXPOSURE (HRS)	TOTAL NO. OF ACCUMULATED PARTICLES (E>.1)
0.E0-1.E0	41.667	9.465E 04
1.E0-1.E1	0.093	2.413E 07
1.E1-1.E2	0.217	3.311E 04
1.E2-1.E3	0.950	1.540E 06
1.E3-1.E4	2.450	4.465E 07
1.E4-1.E5	2.650	1.367E 08
1.E5-OVER	0.0	0.0
TOTAL =	48.000	1.830E 08

Table 6

OSO - I

Circular

Inclination 33°

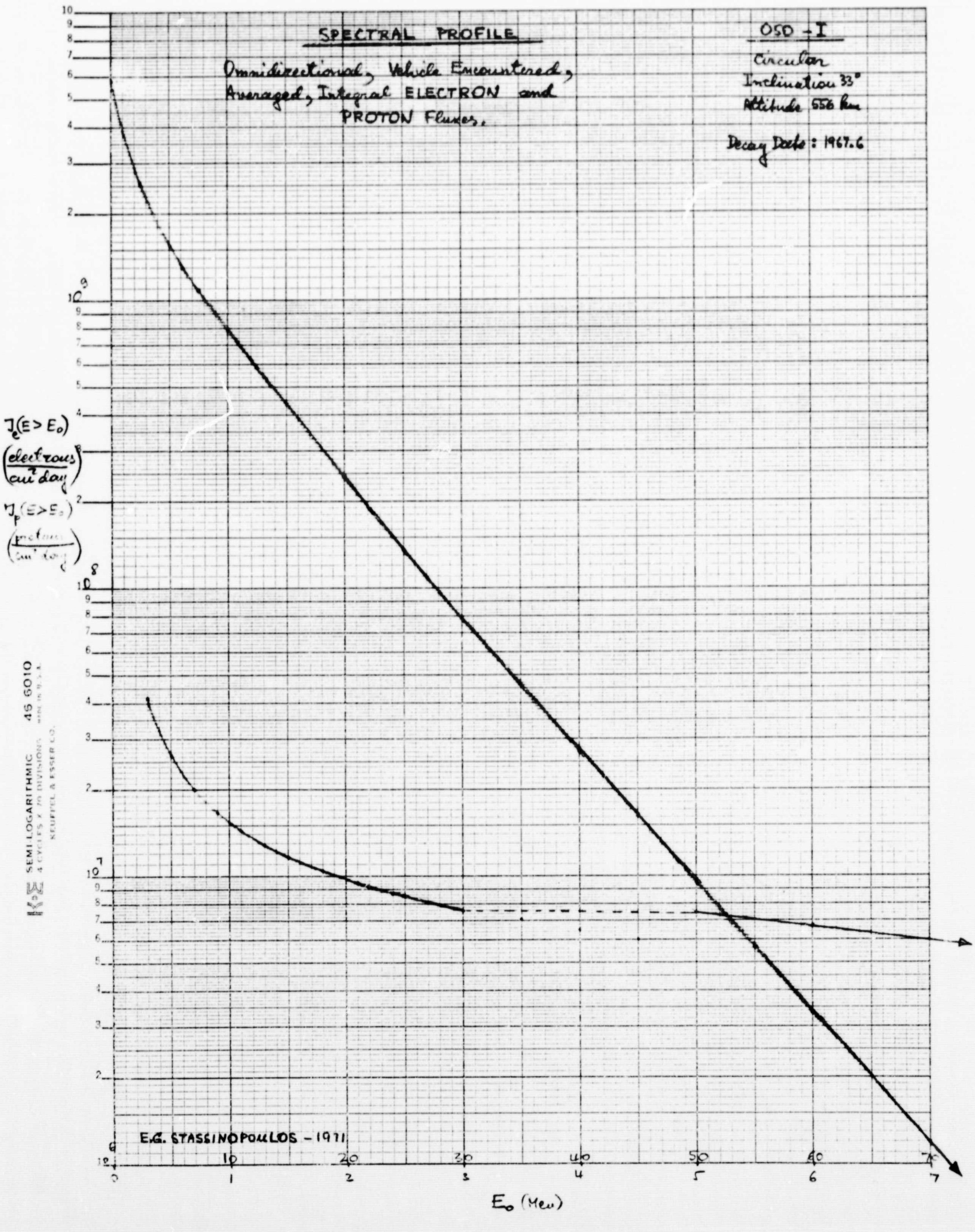
Altitude 556 km

Decay Date: 1967.6

	Electrons (E > .5Mev)	Protons (E > 5.Mev)
1. Fraction of total life-time spent in flux-free regions* of space:	79.2%	81.5%
2. Fraction of total life-time spent in high-intensity regions* of Van Allen Belts:	4.6%	8.6%
3. Fraction of total daily flux accumulated during (2):	86.8%	93.3%

* See text for definition

Figure 1



SPECTRAL PROFILE
Omnidirectional, Vehicle Encountered, Averaged, Integral ELECTRON and PROTON Fluxes.
OSO - I
Circular
Inclination 33°
Altitude 556 km
Decay Date: 1967.6
$J_e(E > E_0)$ (electrons / cm² day)
$J_p(E > E_0)$ (protons / cm² day)
E.G. STASSINOPOULOS - 1971
E_0 (Mev)
SEMI-LOGARITHMIC 46 6010
4 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

Figure 2

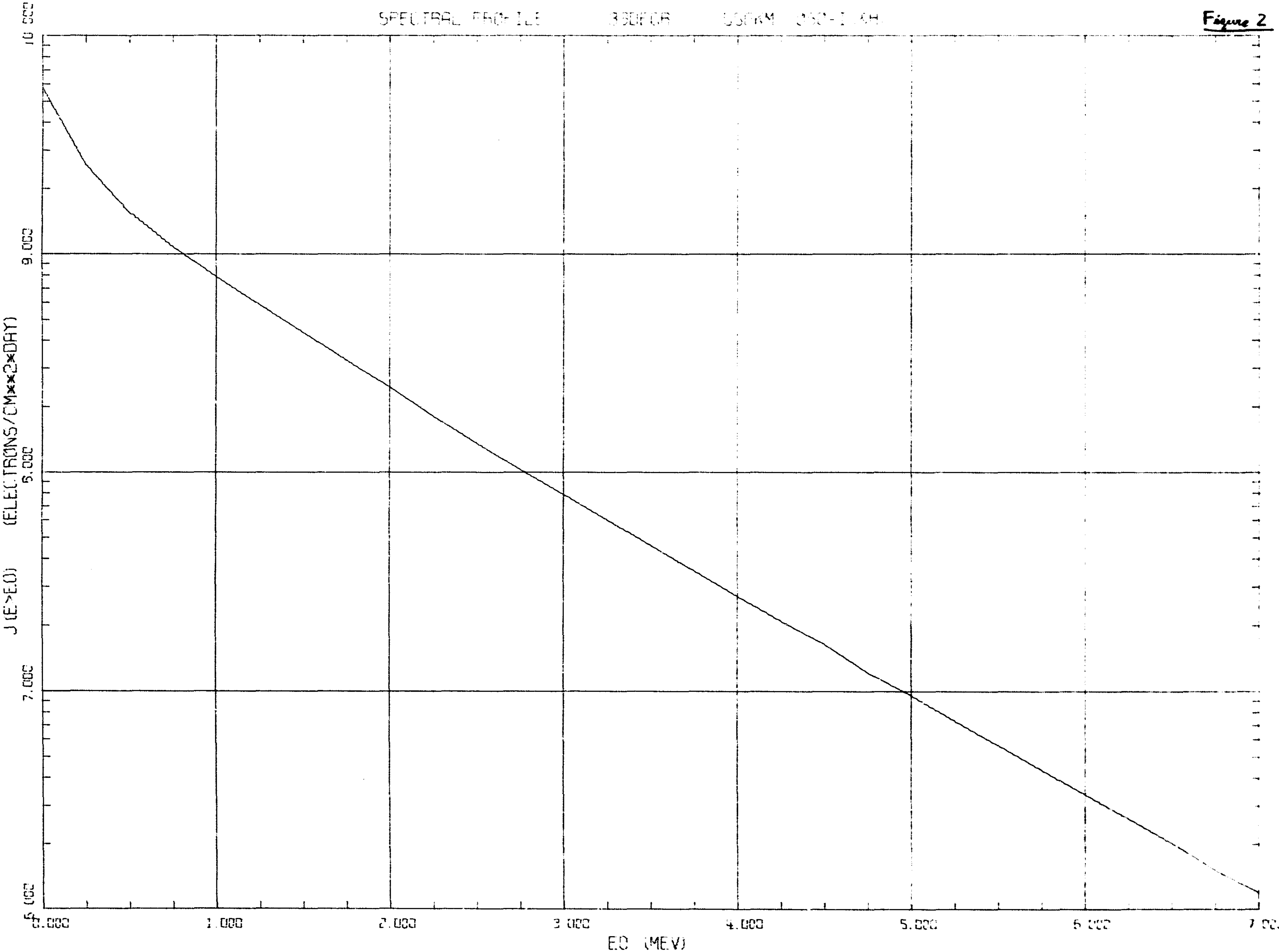

SPECTRAL PROFILE
J(E>E0) (ELECTRONS/CM**2*DAY)
E0 (MEV)
0.000
1.000
2.000
3.000
4.000
5.000
9.000
7.000

Figure 3

SPECTRAL PROFILE 33DEGR 556KM OSO-I DATA SET 1

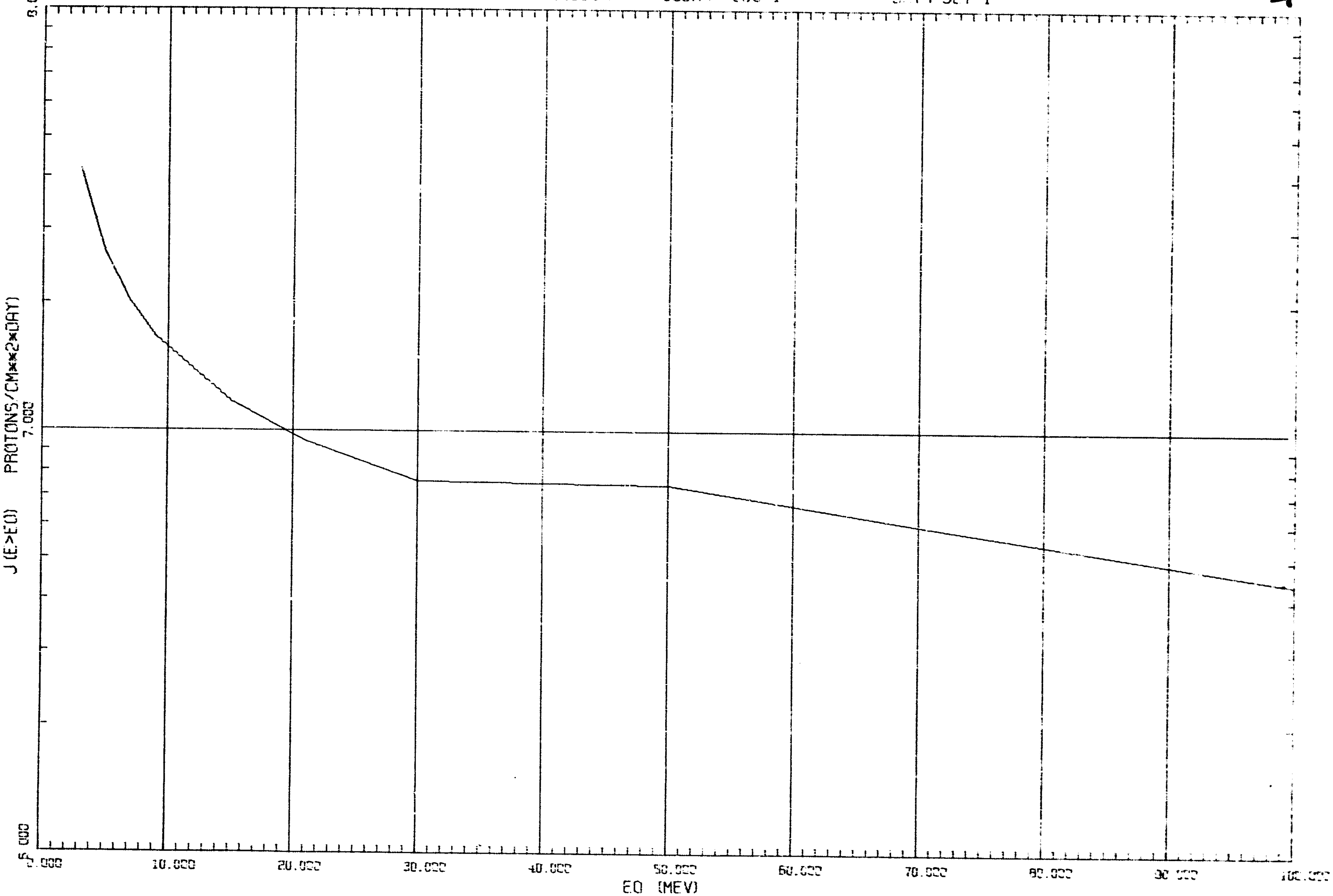


Figure 4

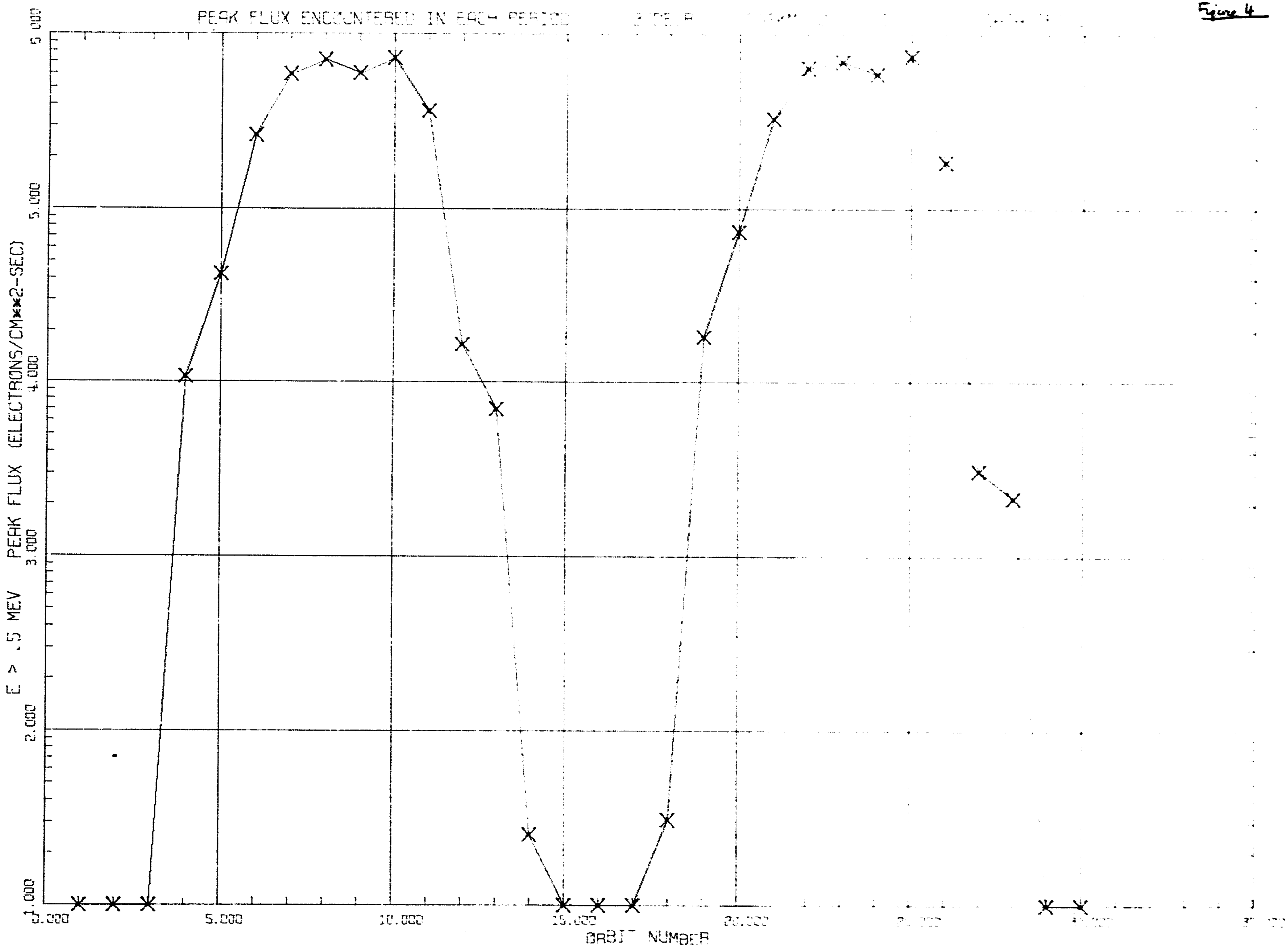
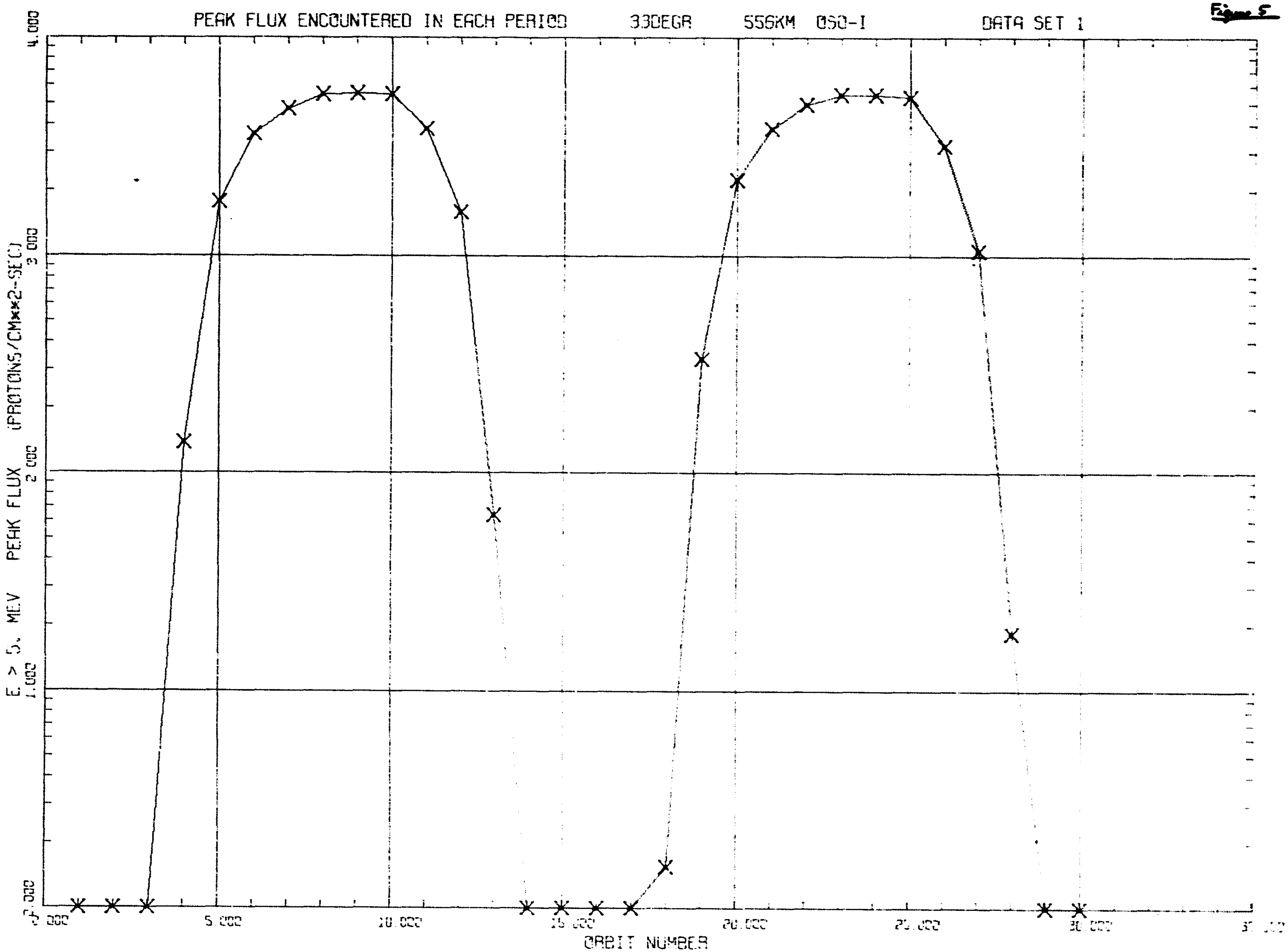

PEAK FLUX ENCOUNTERED IN EACH PERIOD
E > .5 MEV PEAK FLUX (ELECTRONS/CM**2-SEC)
ORBIT NUMBER
0.000
5.000
10.000
15.000
20.000
1.000
2.000
3.000
4.000
5.000

Figure 5



PEAK FLUX ENCOUNTERED IN EACH PERIOD 33DEGR 556KM OSO-I DATA SET 1
E > 5. MEV PEAK FLUX (PROTONS/CM**2-SEC)
4.000
3.000
2.000
1.000
0.000
5.000
10.000
15.000
20.000
25.000
30.000
ORBIT NUMBER

Figure 6

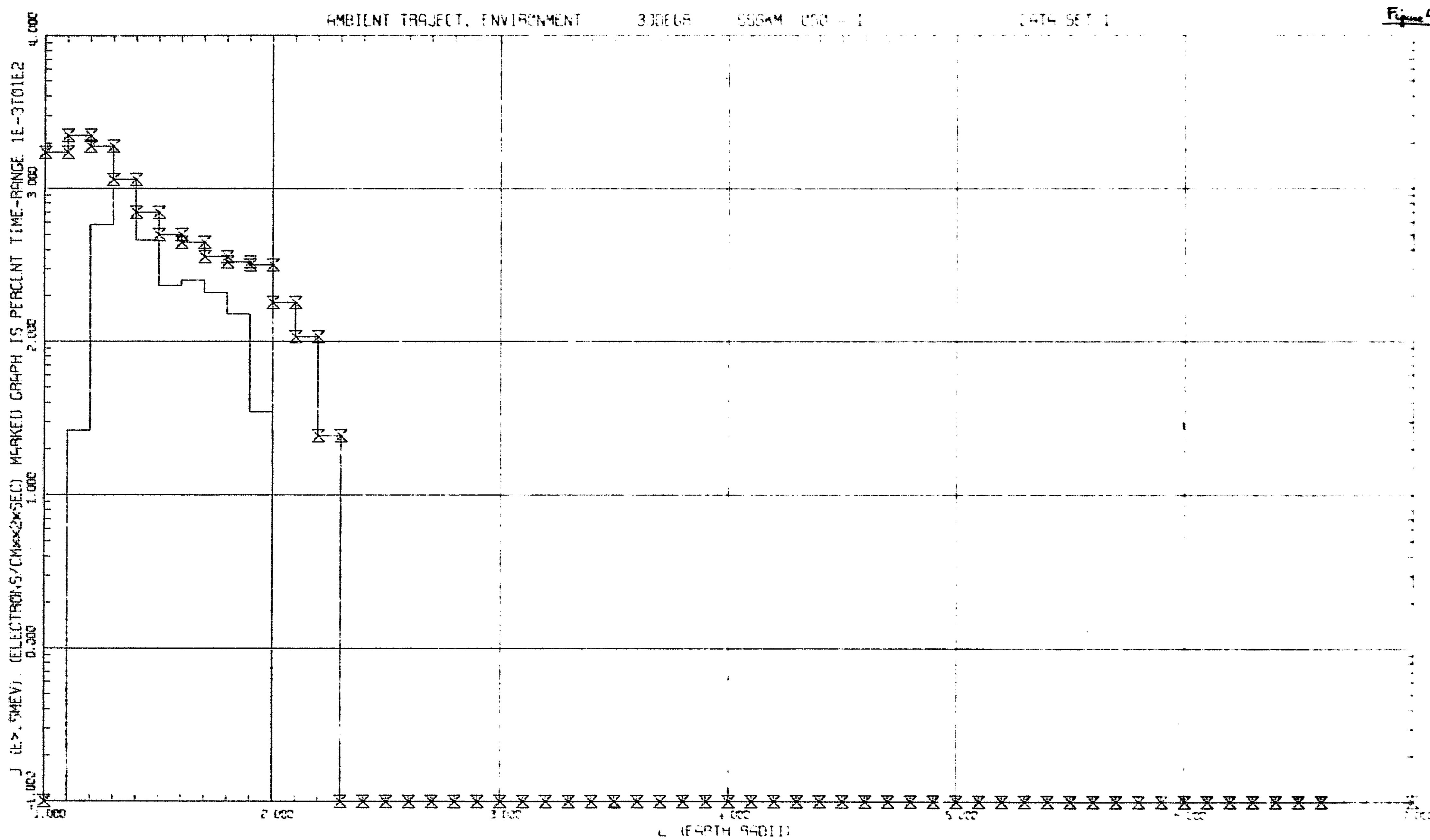
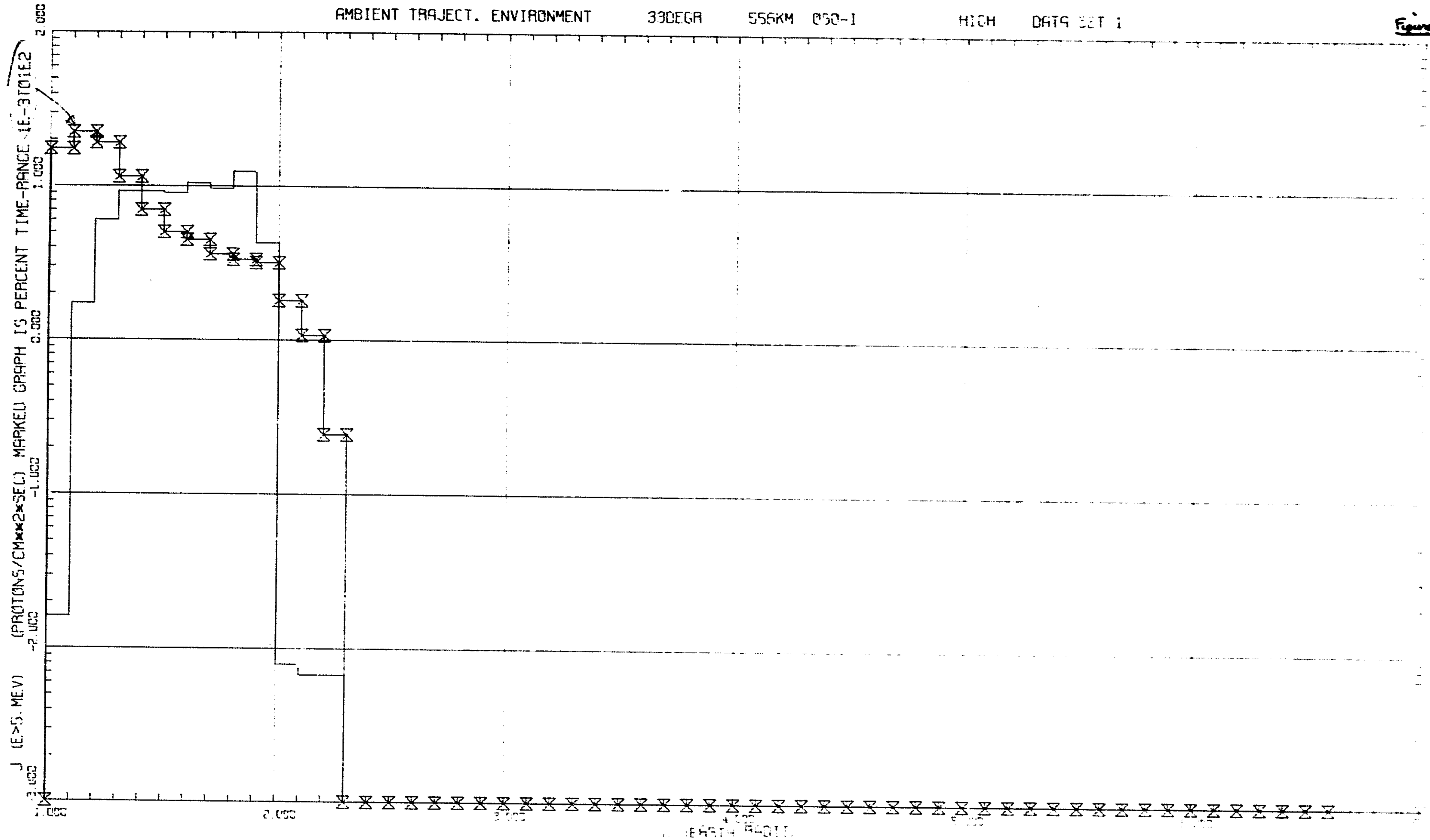

AMBIENT TRAJECT. ENVIRONMENT
DATA SET 1
J (E>.5MEV) (ELECTRONS/CM**2*SEC) MARKED GRAPH IS PERCENT TIME-RANGE 1E-3TO1E2
4.000
3.000
2.000
1.000
0.000
-1.000
1.000
2.000
3.000
4.000
5.000
L (EARTH RADII)

Figure 7



AMBIENT TRAJECT. ENVIRONMENT 33DEGR 556KM 050-I HIGH DATA SET 1
J (E>5. MEV) (PROTONS/CM**2*SEC) MARKED GRAPH IS PERCENT TIME-RANGE 1E-3TO1E2
2.000
1.000
0.000
-1.000
-2.000
-3.000
1.000
2.000
EARTH RADII