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FINAL REPORT
ON-ORBIT SUPPORT OF DARPA-301 PAYLOAI
CONTRACT N00014-85-C-0429

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LMSC/F067835

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12 November 1985

**FINAL REPORT
ON-ORBIT SUPPORT OF DARPA-301 PAYLOAD
CONTRACT N00014-85-C-0429**

Submitted To:

**Department of the Navy
Office of Naval Research
800 North Quincy Street
Arlington, Virginia 22217**

**W. L. Imhof
J. Mobilia
D. W. Datlowe
G. H. Nakano
E. E. Gaines
J. P. McGlennon**

DEC 20 1985
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report covers the activities in support of the DARPA-301 payload on the P78-1 satellite. Until the middle of September 1985 several high-sensitivity gamma-ray detectors continued to perform well and were completely capable of fulfilling the mission objectives. Examples of on-orbit data are given.			

II. TECHNICAL PLANNING AND LIAISON WITH SATELLITE CONTROL FACILITY

During the course of this program we interacted with the Satellite Control Facility on almost a daily basis. Many of these interactions were by telephone, but one or more representatives of the Space Sciences Laboratory generally went to the Satellite Control Facility (SCF) once a week. On these visits the status of the satellite was considered in detail and we often made suggestions for future action. The operation of the DARPA-301 payload was discussed. The electrical configuration of the entire payload was also changed on occasion to balance the spacecraft power loads. In addition, on a weekly basis several "quick-look" tapes were generally picked up and taken back to the Palo Alto Laboratory for processing.

We also participated in a variety of special meetings, and, when appropriate, comments and recommendations were made. These meetings were held at the Space Sciences Laboratory or at the SCF and they involved personnel from the SCF, the Air Force STP Office, and Lockheed.

III. ASSESS ON-ORBIT OPERATIONS AND QUALITY OF DATA

On a regular basis, often once a week or more frequently, the flight data tapes were subjected to quick-look analyses. These analyses were generally based on strip-chart plots of the various instrument outputs. In this manner the general quality of the flight data was assessed, and the instrument performance sometimes subjected to a detailed evaluation. An example of these strip charts is shown in Figure 1.

On occasion we were asked by the mission team at the Satellite Control Facility to process special playback tapes in order to assess the quality of the data received. These special operations have involved each of the tracking stations at various times. As with most of the quick-look data a special effort was often made to insure that the turnaround time from receipt of the tapes to completion of the quick-look processing was less than 2-3 days.

IV. REGIONAL EVENTS

Although there was no regional event coverage during the time period covered by this report, data were regularly recorded once each day and night in the region of interest. These data provided good information on the background levels and would have been very important for evaluating flight data during a regional event.

We also kept in touch with the customer to be aware of any anticipated special coverages so that the payload configuration could always be in an optimized condition.

There was one opportunity for special coordinations involving the DARPA-301 payload. The necessary ephemeris runs were made and the payload set in a mode to record at the appropriate times, but the results were negative.

V. ANALYSES OF ON-ORBIT DATA

The key instruments in the DARPA-301 payload for fulfilling the mission at the times of interest were the highest sensitivity gamma-ray detectors. These proved to be the large sodium iodide anticoincidence shields surrounding the germanium spectrometers. As discussed below they were still performing to the end of the mission.

Four to six of the GEMS 002 cadmium telluride spectrometers operated steadily, but two of them at times displayed intermittent action. In addition, the cesium iodide anticoincidence counters surrounding the cadmium telluride sensors were still performing and these were very sensitive for the detection of gamma-ray sources in the atmosphere. The two GEMS 001 cesium iodide scintillators were no longer operational, but comparable sensitivities were achieved with the anticoincidence counters around the cadmium telluride sensors and the germanium spectrometers.

When the flight data were surveyed for general quality, the outputs of individual instruments were also studied in detail to determine their sensitivities for mapping gamma-ray sources. Bremsstrahlung x-ray sources, which are often present in the high latitude regions of the auroral zone, proved to be very useful in evaluating the response of the GEMS 2 spectrometers to x-rays. Examples of the strip charts for an unusually strong event are shown in Figure 2 and 3. More detailed plots of the performance of each of the GEMS counters are shown in Figure 4.

The solid state spectrometers (EEM 002, PRM 004, LEP 002) used for measuring electrons and protons were still performing well until the end of the mission. The gain of the EEM solid state detector was monitored with a radioactive in-flight calibration source. An example of one of the calibrations of

the EEM spectrometer is shown in Figure 5. The channel number in which the ²⁴¹Am calibration peak appears is plotted in Figure 6 as a function of time. It can be seen that the gain remained constant to within 2 percent throughout the mission. The EEM 002 spectrometer was probably the most useful of the particle detectors for the missions of prime interest in that it served to monitor the local electron background and also could measure in detail with high sensitivity any injected electrons.

Examples of the EEM response are provided in Figures 7 and 8. The trapped, precipitating, and backscattered electron fluxes are shown for a portion of an orbit. Examples of the energy spectra are shown in Figure 9. Similar outputs of the LEP detector response are plotted in Figures 10 and 11.

VI. SUMMARY

In summary, we provided on-orbit support of the DARPA-301 payload through part of September 1985. During that period the instruments were capable of satisfying the mission objectives.

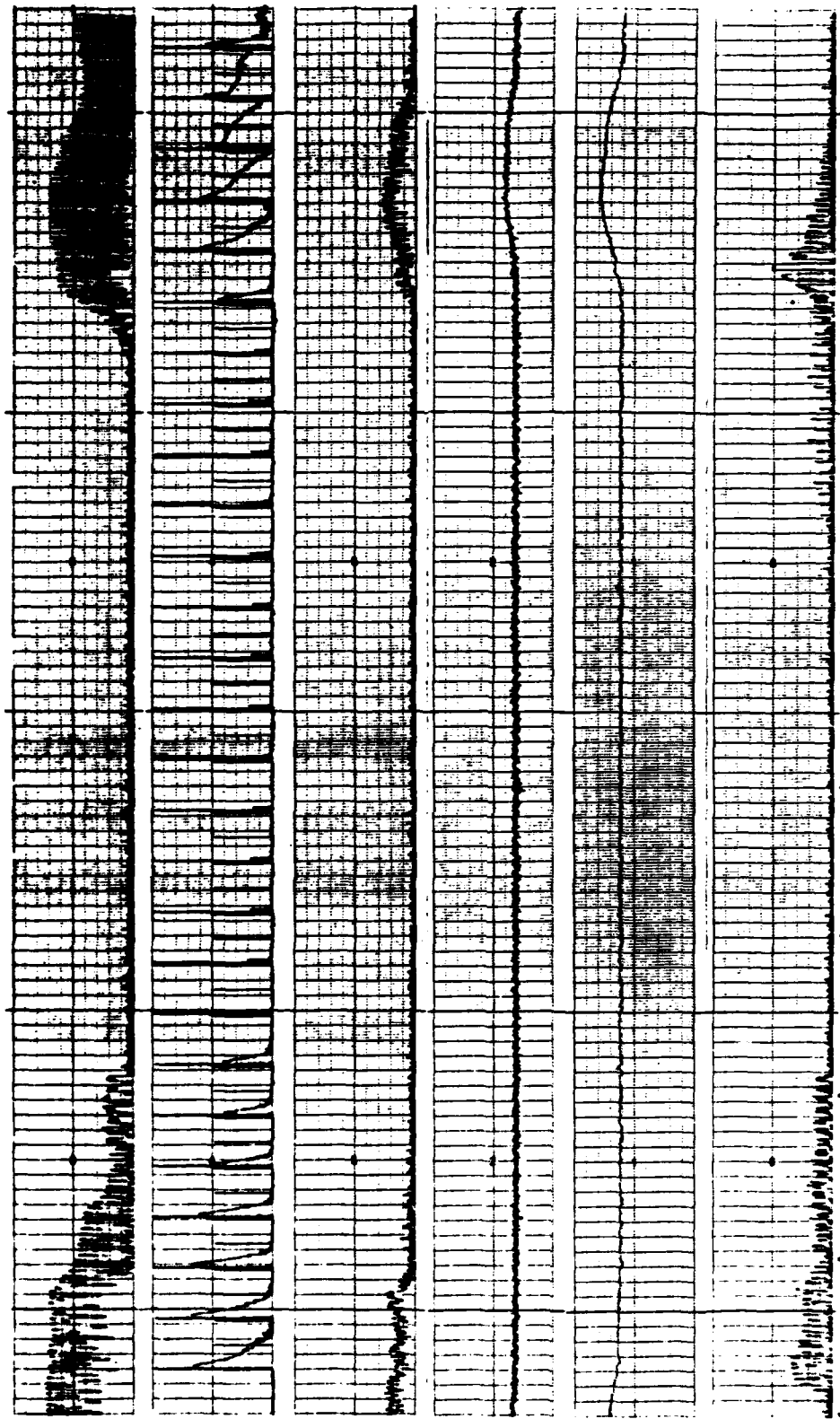
ACKNOWLEDGEMENTS

The efforts of Mr. C. K. Chalmers and K. Van Stone in processing the DARPA 301 data are greatly appreciated. Consultations with Dr. H. D. Voss are also acknowledged.

FIGURE CAPTIONS

- Figure 1. An example of a strip chart showing selected outputs of the DARPA-301 payload on the P78-1 satellite.
- Figure 2. Selected outputs of the DARPA-301 payload during a strong bremsstrahlung x-ray event.
- Figure 3. Selected outputs of the DARPA-301 payload during a strong bremsstrahlung x-ray event.
- Figure 4. Output of the individual GEMS 2 detectors during the x-ray event shown in Figure 3.
- Figure 5. Example of the electron energy spectrum measured in the EEM spectrometer during a calibration mode.
- Figure 6. The calibration peak channel number plotted as a function of time for the entire mission.
- Figure 7. The EEM spectrometer counting rates during a portion of an orbit. Times in the calibration mode are indicated.
- Figure 8. The EEM spectrometer counting rates during a portion of an orbit.
- Figure 9. Examples of the electron energy spectra measured in the EEM spectrometer.
- Figure 10. The LEP spectrometer counting rates during a portion of an orbit.
- Figure 11. The LEP spectrometer counting rates during a portion of an orbit.

P78-1
 SEPT. 13, 1985
 K_p ≈ 2



EEM
 CTR

EEM
 SPECTRA

GEMS 2
 SUM

GEMS 2
 ANTI

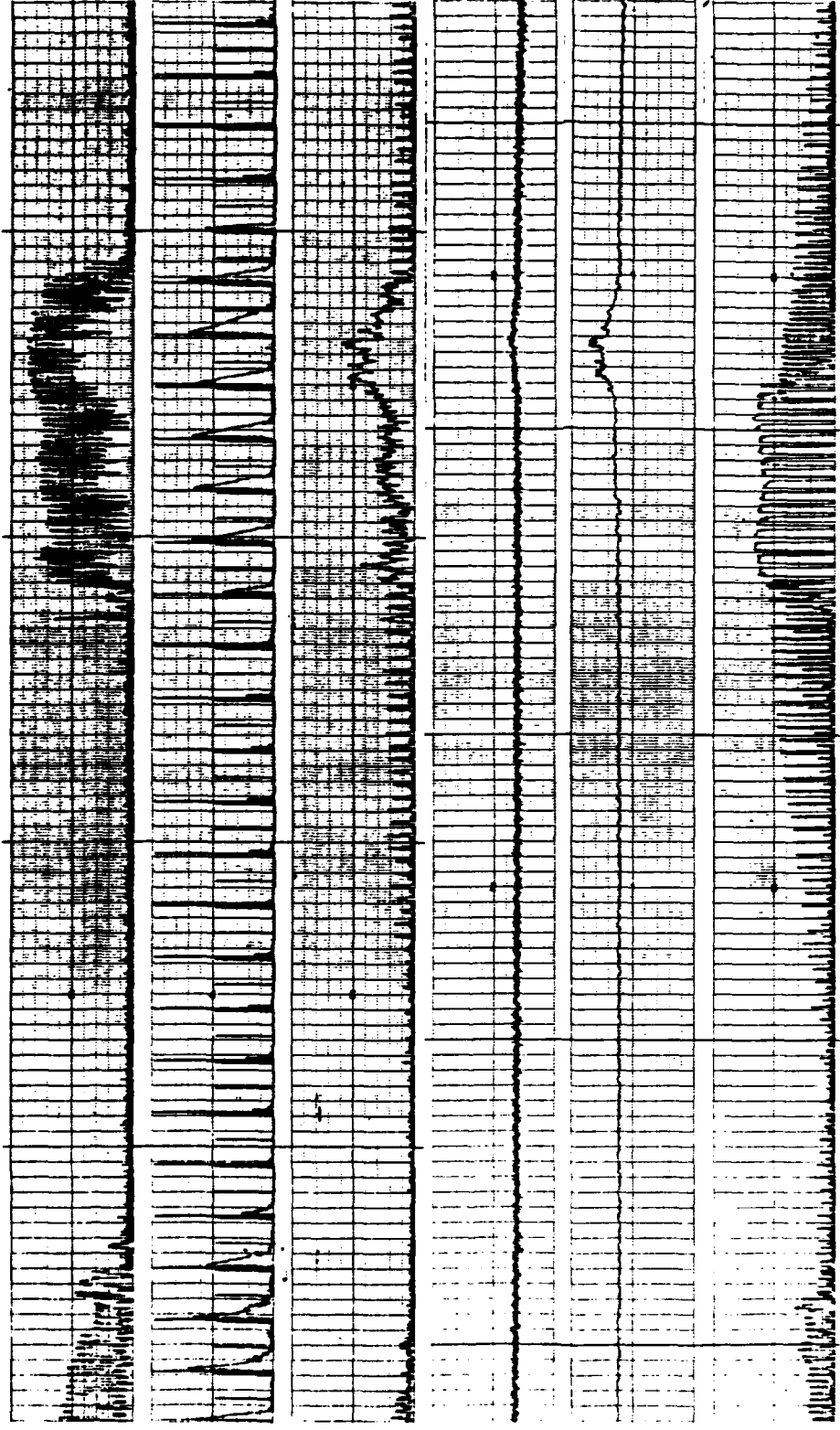
73
 ANTI

LEP
 CTR

UT	14:28:20	14:35:00	14:41:40
LAT (deg)	60.44	81.66	66.77
LONG (deg E)	319.07	264.82	167.78
ALT (km)	529.19	529.2	527.1
L SHELL	6.70	>10.00	4.50

Figure 1

P78-1
 AUG 12, 1985
 K_p ≈ 6⁻



EEM
 CTR

EEM
 SPECTRA

GEMS 2
 SUM

GEMS 2
 ANTI

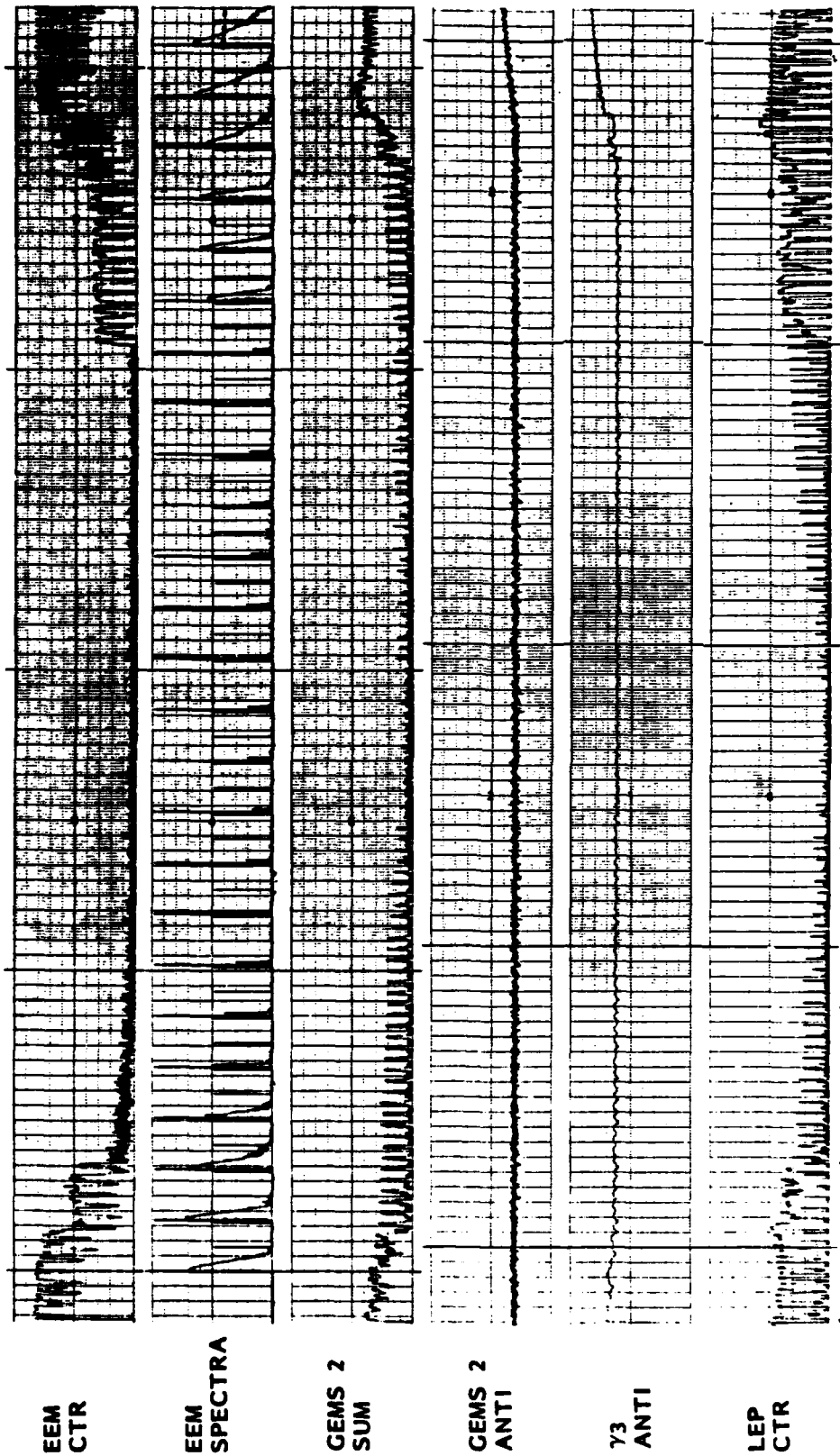
73
 ANTI

LEP

UT	23:11:50	23:18:20	23:25:00
LAT (deg)	73.26	76.19	53.81
LONG(deg E)	174.74	56.65	28.75
ALT (km)	552.4	547.7	537.7
L SHELL	7.75	>10.00	2.60

Figure 2

P78-1
AUG 13, 1985
K_p ≈ 6



EEM
CTR

EEM
SPECTRA

GEMS 2
SUM

GEMS 2
ANTI

73
ANTI

LEP
CTR

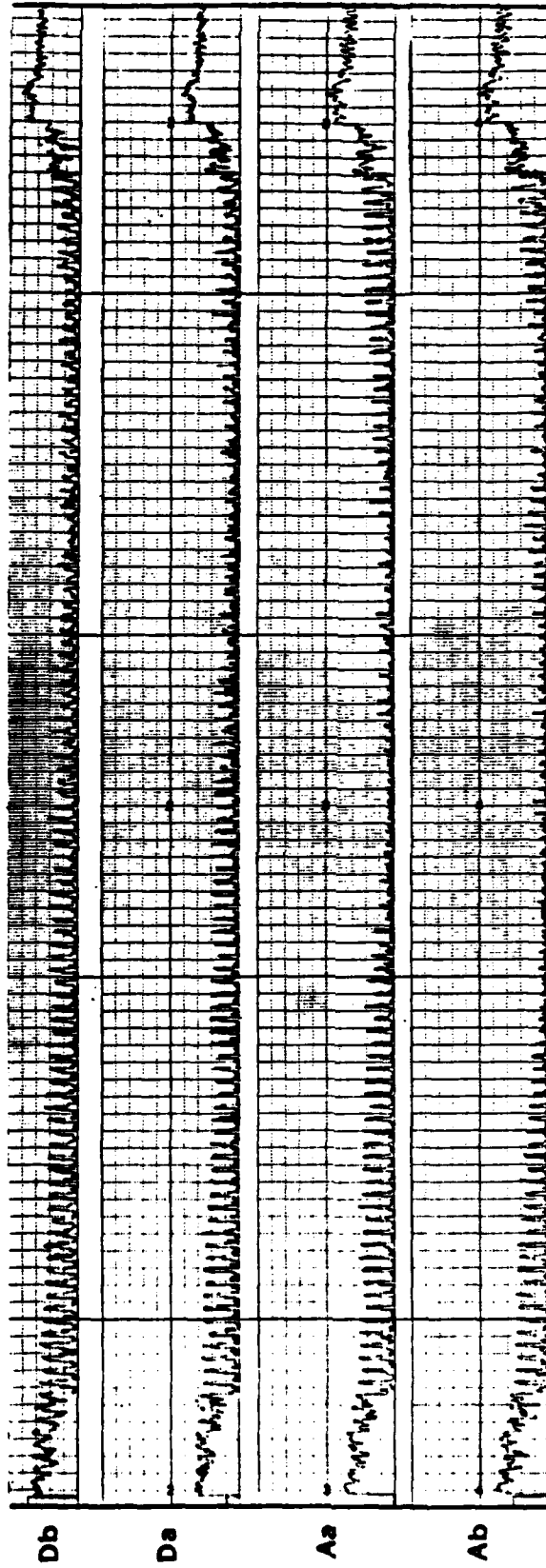
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LAT (deg)	72.50	77.90	54.64
LONG (deg E)	33.14	275.67	246.19
ALT (km)	552.4	547.8	537.7
L SHELL	7.84	>10.00	4.98

Figure 3

P78-1 REV 35541

AUG 13, 1985

X-RAY DETECTORS (GEMS 2)



TIME (UTS) 8:43:20
LAT (deg) 72.50
LONG (deg E) 33.14
ALT (km) 552.4
L SHELL 7.84

8:50:00
77.90
275.67
547.8
>10.00

8:56:40
54.64
246.19
537.7
4.98

Figure 4

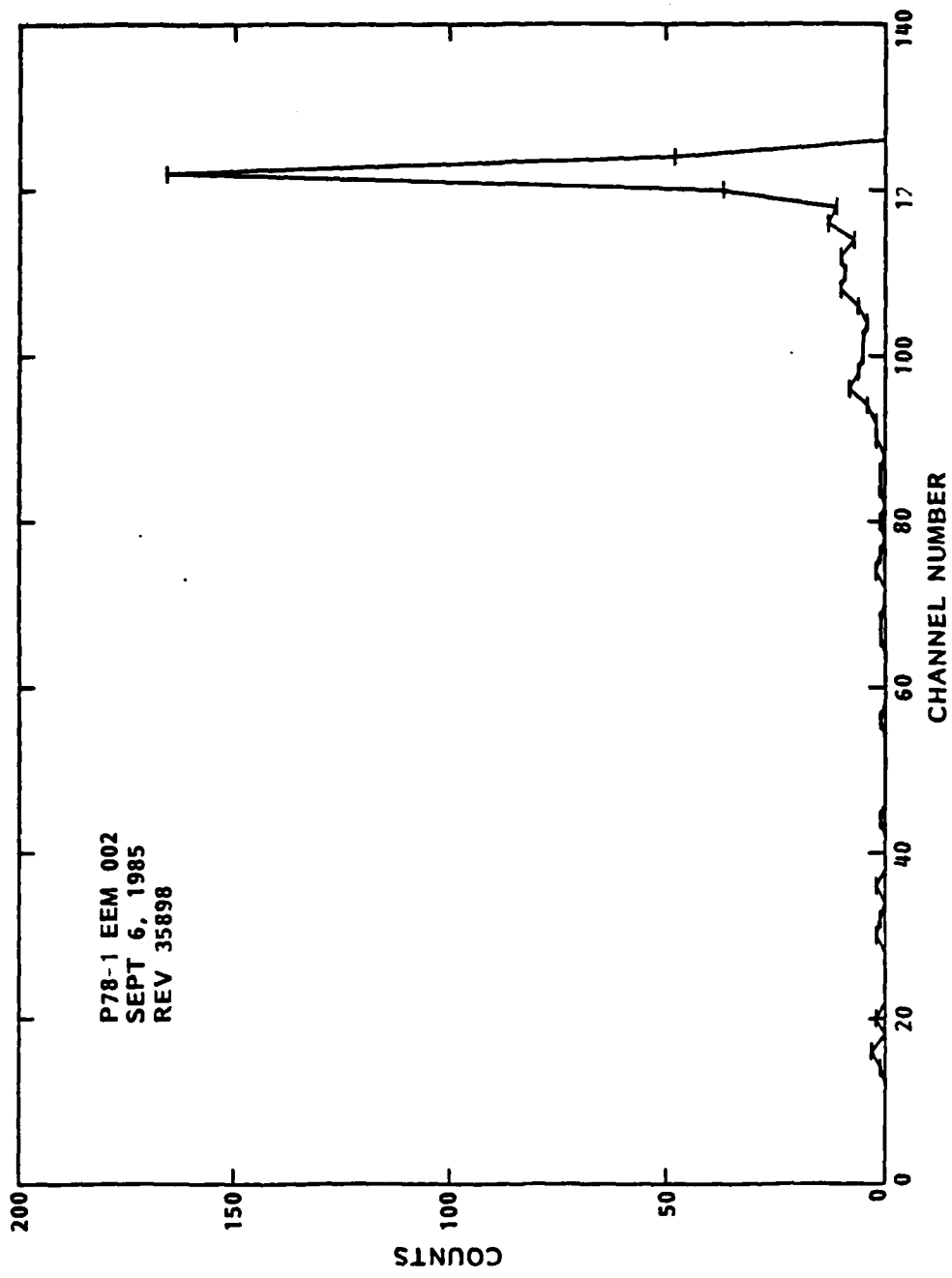


Figure 5

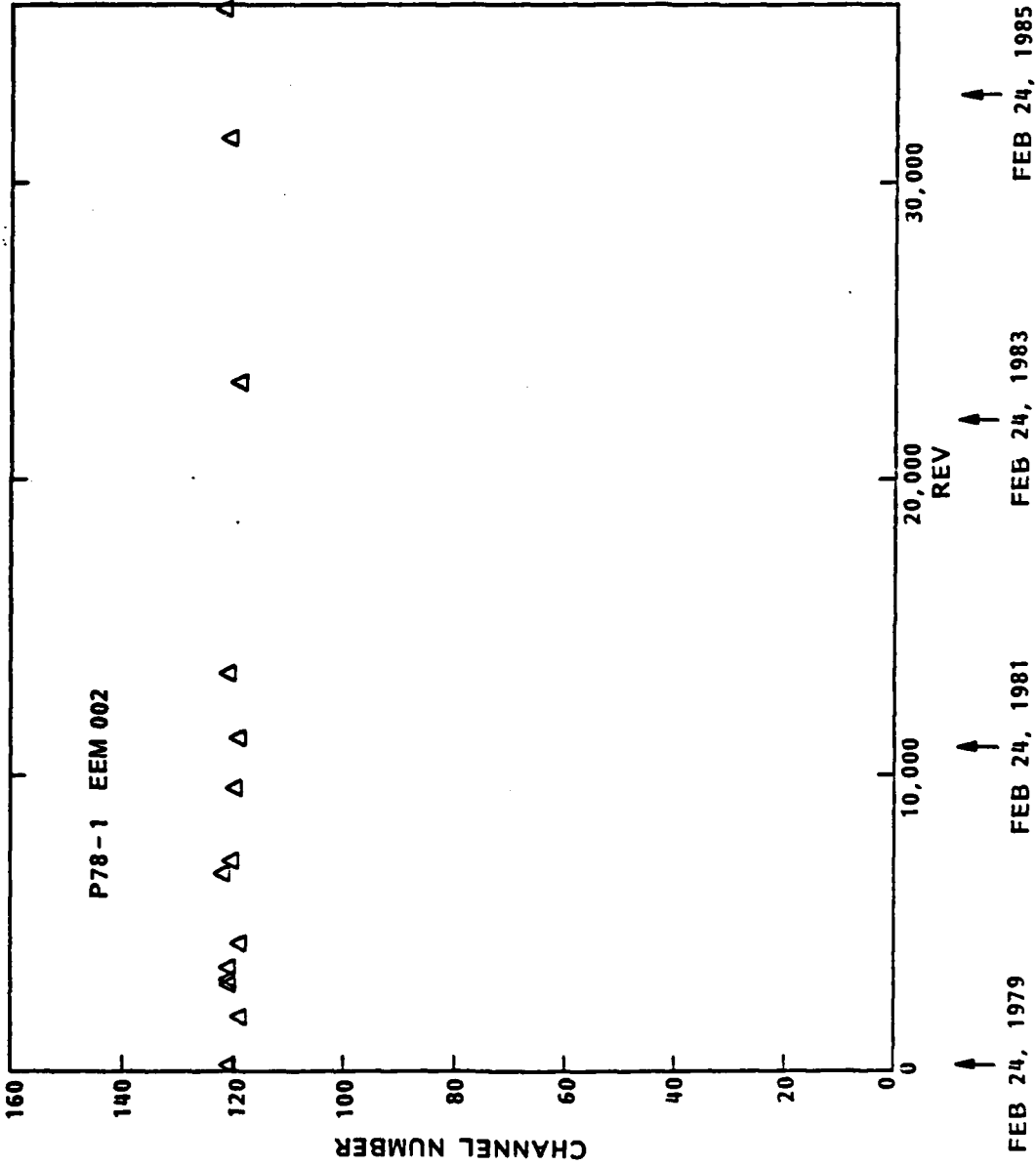
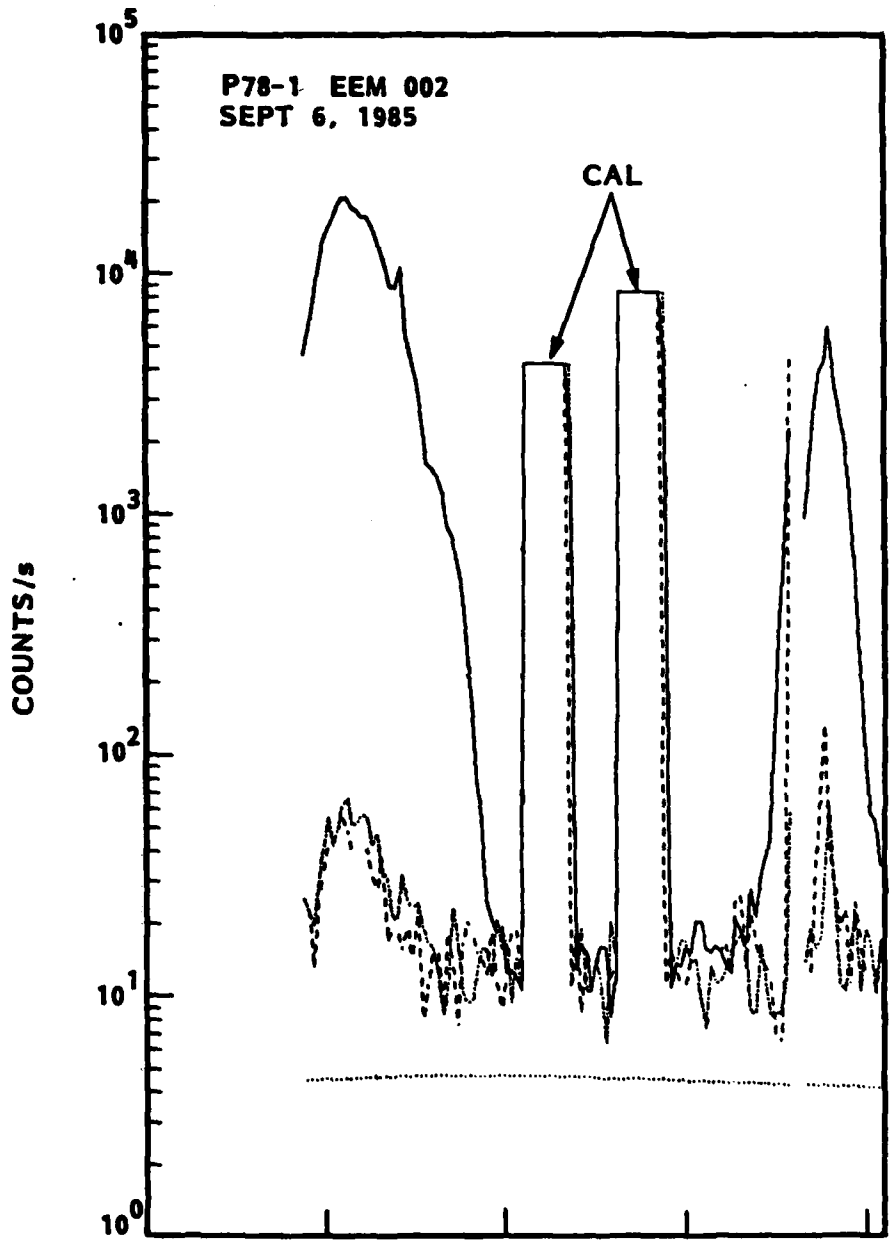
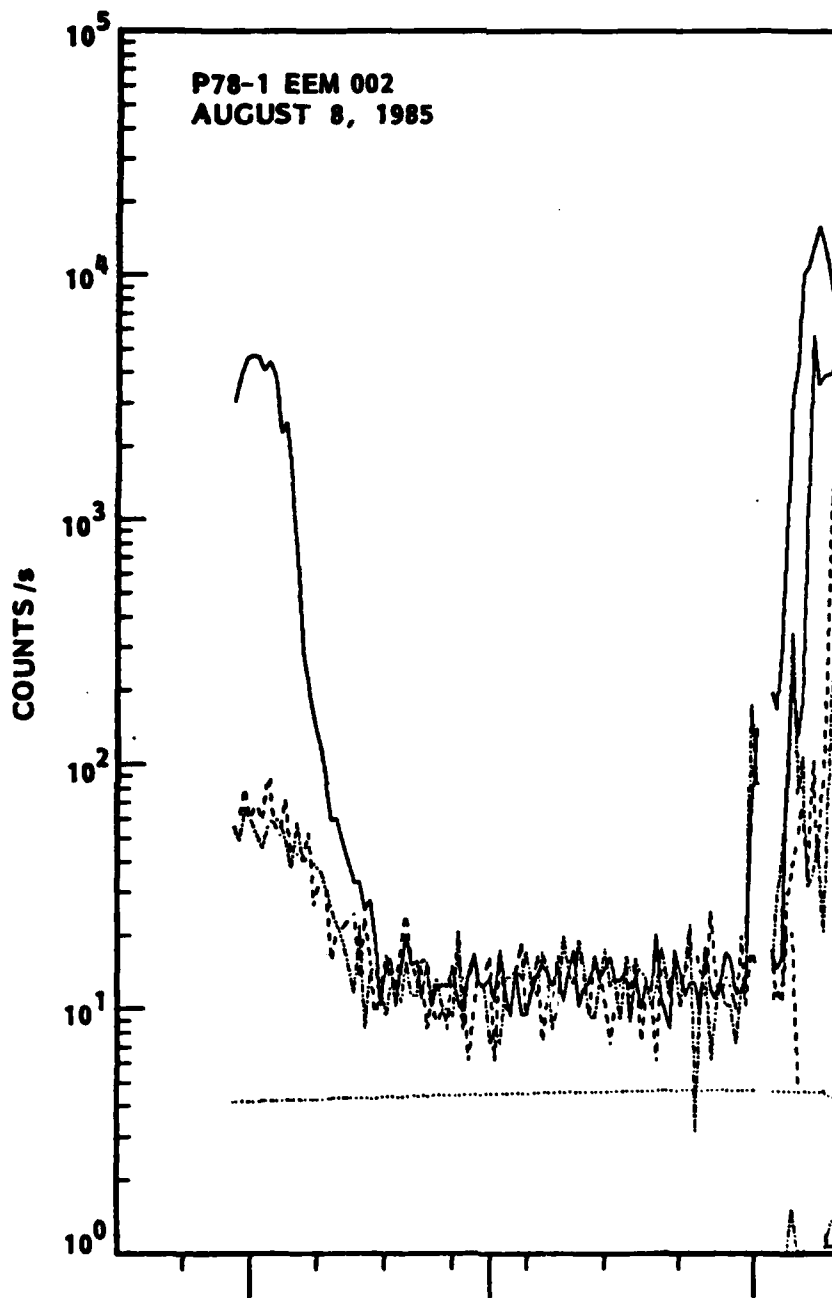


Figure 6



TIME (UTS)	4800	5050	5300	5550	5800
LAT. (deg)	51.3	66.5	80.0	78.0	63.8
LONG. (deg E)	159.8	150.4	118.0	25.4	1.1
ALT (km)	541.0	537.3	533.8	530.9	528.9

Figure 7



TIME (UTS)	11:08:20	11:14:10	11:18:20
LAT (deg)	66.67	82.36	72.64
LONG (deg E)	4.14	291.32	225.45
ALT (km)	554.66	553.53	549.45
L SHELL	6.06	>10.00	>10.00

Figure 8

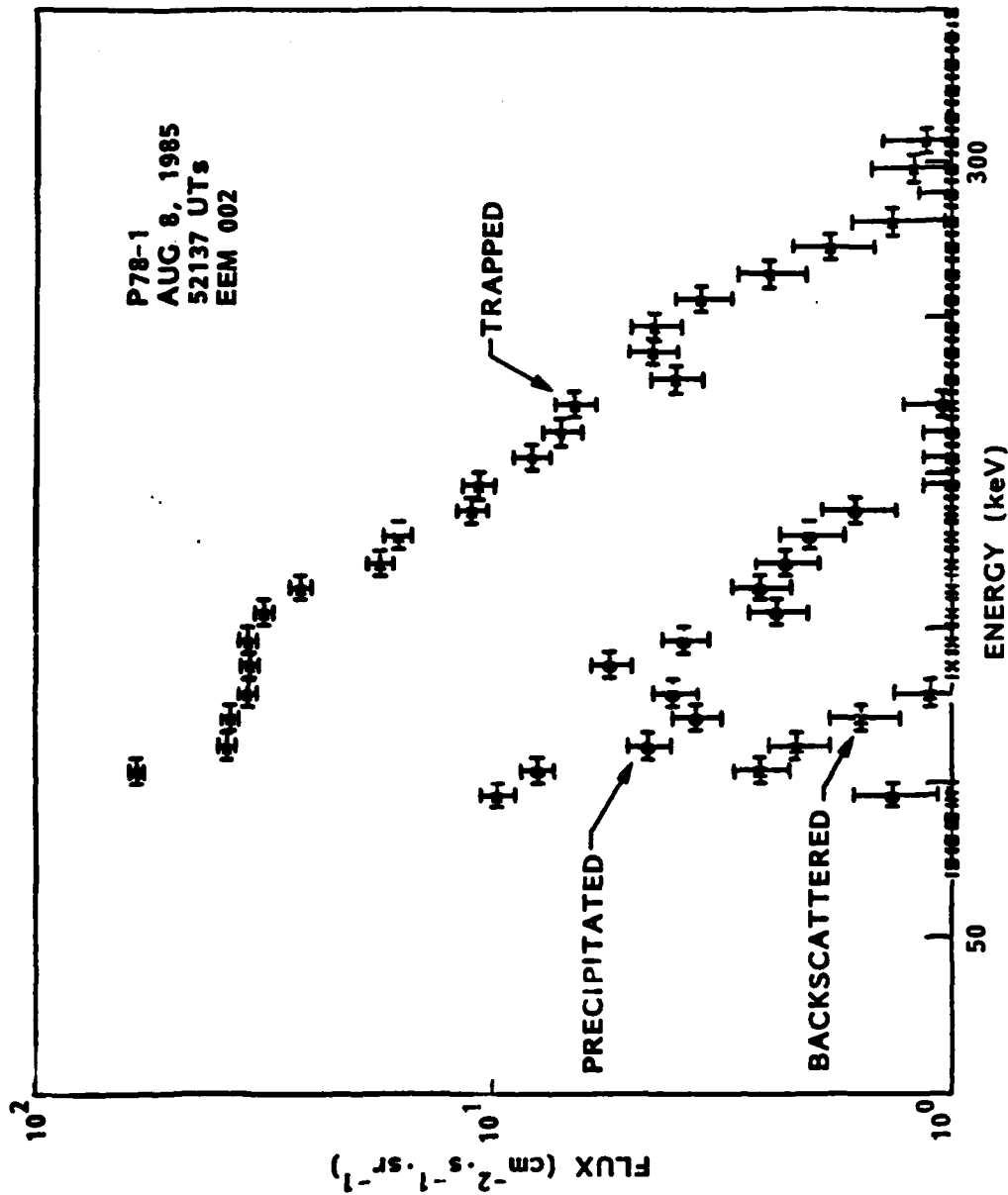
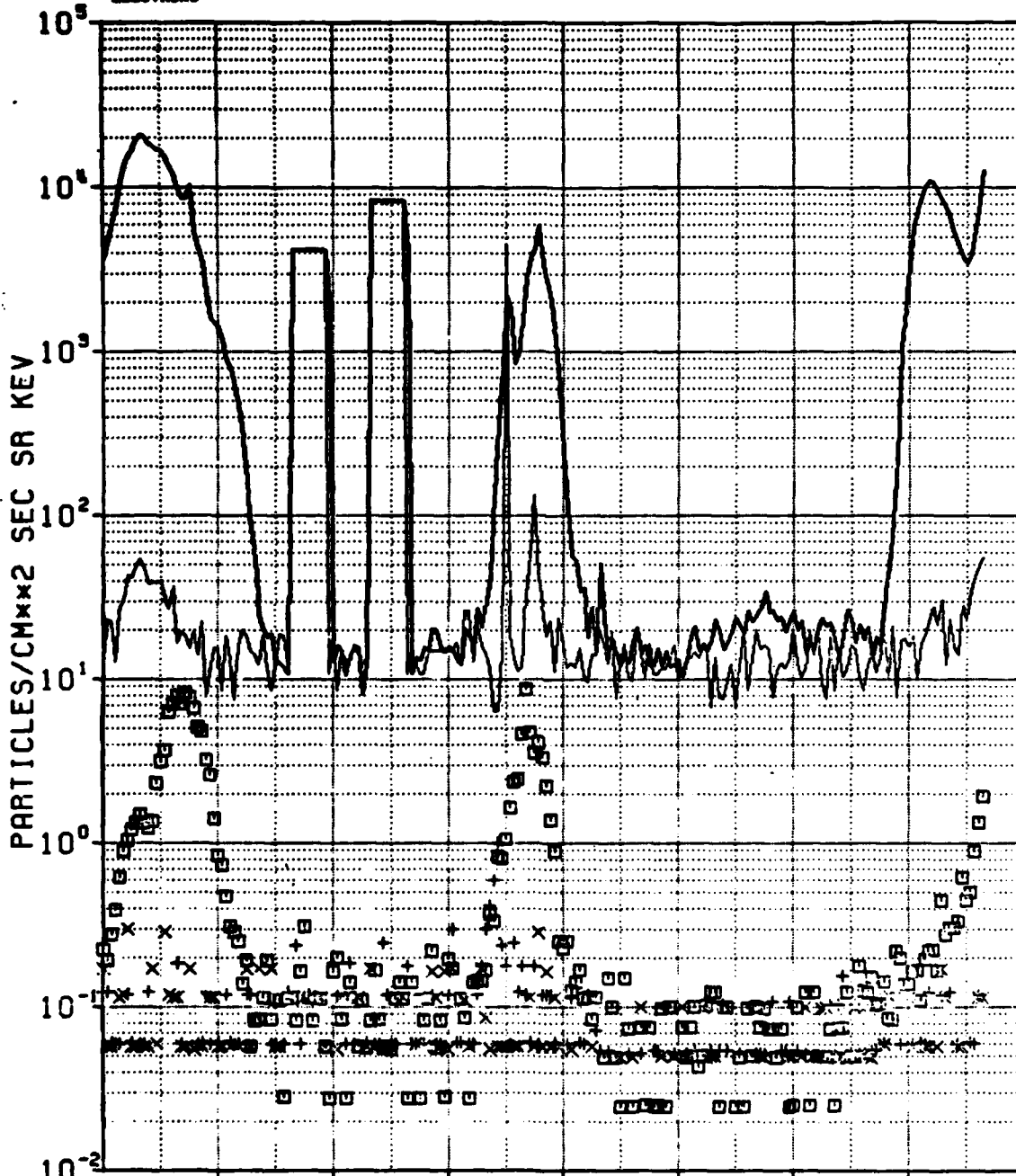


Figure 9

LEP002 REV. 35903. DAY 249.

PROTON ENERGY = 100 TO 180 KEV

PROTONS \square - TRAPPED $+$ - PRECIP \times - BACKSCATTERED
ELECTRONS



UT	5013.110	5206.366	5399.645	5582.989	5769.149	21605.585	21824.955	22037.472
LAT	84.286	75.482	82.354	75.782	84.221	29.592	43.182	56.270
LONG	152.38E	136.85E	78.543	18.115	1.431	95.009	81.230	85.884
MLT	537.848	535.159	532.529	530.459	528.916	545.743	542.865	539.609
L	3.703	8.219	16.582	11.778	5.205	1.183	1.619	2.179
MLT	10.740	9.943	7.570	4.883	3.098	12.358	12.215	12.051
MLIN	-99.000	119.347	-99.000	-99.000	132.748	-99.000	-99.000	-99.000
CONJ	1205.270	1080.412	799.751	563.275	212.655	480.028	468.018	557.099

Figure 10

END

FILMED

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DTIC