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EXPLORER 45 (S^3-A) OBSERVATIONS OF THE MAGNETOSPHERE AND MAGNETOPAUSE DURING THE AUGUST 4-5, 1972, MAGNETIC STORM PERIOD

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APRIL 1974

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GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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APRIL 1974

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ABSTRACT

The Explorer 45 (S^3-A) satellite performed extensive field and particle measurements in the heart of the magnetosphere during the double magnetic storm period of August 4-6, 1972. Both ground level magnetic records and the magnetic field deformations measured along the orbit by the satellite indicated the existence of only a moderate ring current. This was confirmed by the measurements of the total proton energy density by the on-board particle detectors, which showed a maximum energy density less than those observed during the December 1971 and June 1972 magnetic storms. The plasmapause in the noon quadrant was eroded continuously from the onset of the first storm at the beginning of August 4 to an altitude below L = 2.07 at about 18 hours on August 5. During the orbit containing the second sudden commencement a large amount of low frequency electric and magnetic field noise was encountered throughout the entire orbit. The most remarkable observation during this orbit was the

contraction of the magnetopause to distances inside the satellite at L = 5.2. The magnetic field reversed direction and increased in magnitude to more than 320 γ, the particle detectors encountered huge fluxes of streaming protons, and the fields detectors measured intense broadband noise. Following the period of magnetospheric boundary crossings, Explorer 45 encountered a series of large amplitude magnetospheric oscillations, seen both in the DC and low frequency field measurements, and in the intensities of the particle fluxes. As with other storms a region of detached plasma or a tail-like structure was encountered in the dusk hours during the development of the second main phase, and a nose structure in the proton ring current distribution was observed, which has been shown to be a characteristic feature in the dusk hours during the ring current development.

EXPLORER 45 (S^3-A)

OBSERVATIONS OF THE MAGNETOSPHERE AND MAGNETOPAUSE DURING THE AUGUST 4-5, 1972, MAGNETIC STORM PERIOD

The Explorer 45 (S^3-A) satellite performed extensive field and particle measurements in the heart of the magnetosphere during the historic storm period in early August of 1972. The object of this paper is to summarize the results of initial analyses performed on these data by the S^3-A experimenters, and thereby present a number of phenomena unusual in their magnitude or occurrence. These include the geomagnetic field deformation during the magnetic storms of August 4 and 5, the proton ring current energy density profiles and locations of the plasmapause during this period, measurements of intense VLF electric field noise, and finally the surprising observation of the magnetopause at about $5R_E$. The paper also includes summary plots of data from all detectors aboard the satellite during the onset of the second and more intense storm.

A description of the spacecraft, a summary of the detector characteristics, and the mission objectives are given by Longanecker and Hoffman (1973). The satellite was launched into an elliptical orbit with an apogee of $5.2R_E$, an inclination of only 3.6°, and a period of 7.8 hours. Thus the satellite orbits the earth about three times daily. In the August, 1972, period apogee was at about 15 hours local time so that data were acquired near local noon during outbound orbits and towards dusk during inbound orbits (see Figure 1). For about four hours around apogee the satellite moved nearly synchronously with the earth's rotation.

The Magnetic Storm Period

A high density beam of plasma was observed between the sun and earth on August 3, 1972. On August 4 the beam struck the earth's magnetosphere causing a number of unusual geophysical events (Lincoln and Leighton, 1972). These events included significant reconfigurations of the magnetosphere and will be discussed here in terms of the magnetic deformations, the behavior of the plasmapause in the noon quadrant, and the energy density in the ton ring current.

Figure 2 shows the magnetic signature of the interaction on August 4 and 5 in the auroral zone at College, at low latitude at Honolulu, and at Explorer 45. The ΔB profiles from the fluxgate magnetometer aboard the satellite, shown at the bottom of the figure and labeled with orbit numbers, begin at L's of about 2.5, reach apogee near their centers, and return to the starting L values. A double sudden commencement occurred near the beginning of August 4, and is clearly seen in both the Honolulu and satellite magnetograms. This was followed by a moderate main phase of -118γ in Dst, which developed rapidly during the first quarter of the day (M. Sugiura and D. J. Poros, private communication, 1973), and is clearly evident in the Honolulu field depression and by the field depressions at Explorer 45 during Orbit 820 as it passed through the storm-time ring current. After about 14 hours of recovery, the next sudden commencement occurred at 2054 U.T., followed by enormous magnetic fluctuations at both high and low latitudes. The disturbance at Honolulu was so intense that the magnetogram was unreadable near 2300 U.T. Explorer 45 observed the largest positive disturbance yet recorded in space between 2240 and 2310 U.T. This disturbance will be discussed in detail later. The following main phase had about the same magnitude as the previous storm (-125γ), but the storm period was not declared over until August 7 (Lincoln and Leighton, 1972), at which time Dst was still 45γ negative.

Figure 3 shows the behavior of the plasmapause in the noon quadrant during this period as measured by the DC electric field detector (Maynard and Cauffman, 1973). The plasmapause was eroded continuously from the onset of the first storm until recovery finally set in on August 6. The minimum value of the plasmapause (on Orbit 824) is in doubt because the satellite was already beyond it at the beginning of data acquisition at L = 2.07. Theis and Brace (1973) have reported that according to the low altitude measurements from ISIS-II at 0940 U.T. on August 5 on the early morning side (0500 L.T.), the plasmapause was observed at about L = 2 with a trough between L = 1.9 and 1.25, implying that perhaps the plasmapause was at one time even lower. The behavior of the plasmapause location is similar to the night quadrant behavior reported earlier for the December 17, 1971, storm (Maynard and Cauffman, 1973) but smoothed and delayed as one might expect from corotation arguments (Carpenter et al., 1969; Chappell et al., 1971).

The proton ring current energy density profiles for a series of Explorer 45 orbits during the two storms are displayed in Figure 4. These densities are the integrals over both pitch angle and energy from 1 keV to 872 keV. The first orbit, 818, which occurred primarily before the two sudden commencements early on Aug. 4 (see Figure 2), provides an approximate quiet time energy density profile.

The profiles during the first main phase are given by Orbit 819 inbound and 820 outbound. Note that the intensities are enhanced over the quiet-time profile only beyond about 3.2 R_E, with the largest intensities during the inbound traversal at dusk.

The sudden commencement at 2054 U.T. on August 4 occurred during the outbound portion of Orbit 821 at an L of 3.8, at which time there was almost a step function increase in energy density, probably from field compression. As will be shown later, several magnetospheric boundary crossings occurred near apogee at 2240 U.T. After returning to the magnetosphere the satellite encountered large fluctuations in the proton population.

Dst showed a surprising recovery to -16γ during midday of August 5, but then rapidly plunged to a minimum of about -100γ from 1600 U.T. to noon of the next day (M. Sugiura and D. J. Poros, private communication, 1973). The ring current finally appeared to be fairly symmetric by Orbit 824 at the end of August 5, as the satellite magnetogram in Figure 2 and the energy density profile in Figure 4 indicate.

Compared to the maximum energy densities measured by Explorer 45 during the magnetic storms of December, 1971, and June, 1972, marked as a bar on the upper right portion of the figure, the proton ring current was not as highly enhanced during these August events. This is reflected in the very moderate Dst values. Considering the extremely high speed and density of the solar wind which was observed during this period (Wolfe et al., 1972), and the large magnetic fluctuations which occurred, it seems rather incongruous that only a nominal ring current developed.

ORBIT 821

As shown in the previous section, the sudden commencement of the second storm and the very large amplitude magnetic fluctuations occurred during Orbit 821. A summary of the measurements from Explorer 45 during this orbit is presented in Figures 5a and 5b. These summary plots illustrate the full range of capabilities of the satellite instrumentation as well as the value of the collective data which is processed and displayed in a unified format. The top portion of the figures contains data from the fields detectors and the bottom portion from the particle detectors.

The top two panels are spectrograms of AC electric and magnetic field data. The electric field data were acquired from spherical sensors on the ends of two booms forming a single axis about 5 meters tip-to-tip and processed on-board by the DC electric fields experiment in several very low frequency bands (< 30 Hz) (Maynard and Cauffman, 1973) and by the AC electric fields experiment (Anderson and Gurnett, 1973), which covered the range from 20 Hz to 100 kHz with 15 narrow-band filters and one wide-band (100 Hz to 10 kHz) filter. The AC magnetic field data came from two search coil magnetometers, the X axis being perpendicular to the spin axis and the Z axis being parallel to the spin axis (Parady and Cahill, 1973). The alternating intensities in the AC magnetic field spectrograms are caused by automatic switching between two sensitivity levels.

Because of the unusual geophysical conditions, the DC electric fields measurements in the third panel were saturated during most of this orbit indicating that the satellite was outside the plasmapause (Maynard and Cauffman, 1973). Note that in the summary plot all data points from the DC experiment during one-quarter of a rotation of the satellite are plotted once every minute. Saturation is indicated by one or more of these points being at the 125 mV level. On the outbound leg the plasmapause was crossed one minute before the summary plots begin, and on the inbound leg the plasmapause was encountered at 0206 U.T. with the rise in maximum signal thereafter being due to the $\vec{v} \times \vec{B}$ contribution to the signal.

The lower three curves contain the fluxgate magnetometer data: ΔB ($B_{(measured)}$ - $B_{(reference)}$) and the two conventional field angles of the measured field, the declination and inclination (Cahill, 1973).

The spectrograms for electrons and protons near the middles of Figures 5a and 5b refer to the fluxes of 90° pitch angle particles. The measurements up to about 30 keV come from electrostatic analyzers with channeltron detectors, and the high energy measurements come from a four channel magnetic spectrometer with solid state detectors for electrons and a pair of two element solid state detectors for protons (Longanecker and Hoffman, 1973).

The pitch angle (P.A.) parameters are the ratios of fluxes at 85° and 35° pitch angles for 50 keV and 9 keV electrons and protons. A ratio of 1 indicates isotropy over that particular pitch angle range. The very bottom panel contains the energy density for protons integrated in energy from 1 keV to 872 keV and for electrons integrated from 1 keV to 400 keV, but both are differential in pitch angle for near 90° particles.

Below the plots are listed common orbital parameters.

The following features are evident from these summary plots:

1. A large amount of low frequency electric and magnetic field noise throughout the entire orbit, with tremendous enhancements around 2300 U.T. and 0100 U.T.
2. The sudden commencement at 2054 U.T., which appears in the magnetic field strength, the pitch angle parameters and the particle energy densities.
3. A very unusual set of observations from about 2240 to 2310 U.T. interpreted later as a boundary crossing. All the AC fields detectors measured extremely high intensities, the magnetic field changed direction and ΔB became abnormally positive. There were factors of ten enhancements in the intensities of particles whose pitch angles were calculated to be near 90° on the basis of the measured magnetic field, and the pitch angle distributions for protons became very anisotropic.
4. Large amplitude low frequency fluctuations (period $\sim$ 3-4 minutes) from 2320 to about 0105 U.T. They appeared in the magnetic field direction and

amplitude, the low frequency AC electric field signal, and in the particle spectrograms, pitch angle parameters and energy densities.

5. A region of detached plasma (Chappel et al., 1971) or a tail-like structure (Chen et al., 1973) from 0100 to 0112 U.T., indicated by the lack of saturation in the DC electric fields signal during this time interval, and a region of variations in plasma density and temperature just outside the plasmapause from 0141 to 0206 U.T., identified by sporadic saturation.

6. A nose structure in the proton spectrogram from 0200 to 0220 U.T. which has been shown to be a characteristic feature in the dusk hours of the ring current enhancement (Smith and Hoffman, 1973).

Some of the features noted above will now be discussed in more detail.

Figure 6 is a plot of the spectrum analyzer data from the AC electric fields detector, which is a more quantitative display of the data than the top panel of the summary plot. The most prominent feature in the electric field data is the intense broadband noise commencing abruptly at 2240 U.T. It will be shown later that this noise occurred when the satellite was within the magnetosheath.

The amplitude of the signals in the narrow band filters from 35 Hz to 100 kHz were 5 to 80 times larger than pre-boundary crossing levels. The peak amplitudes observed ranged from 1 mV/m for the 35 Hz and 62 Hz channels down to 18 μV/m for the 100 kHz channel. This magnetosheath noise was the most intense broadband noise yet observed by Explorer 45. In the wideband analog data the magnetosheath noise appeared as hiss up to about 3 kHz plus frequent impulses across the entire wideband spectrum from 100 Hz to 10 kHz.

From 2300 to 2315 U.T. the peak amplitudes in the channels below 10 kHz increased nearly another order of magnitude over the initial boundary crossing levels. During this 15 minute interval the amplitudes in these channels rose and fell together more than an order of magnitude quasi-periodically with periods of 2 to 3 minutes. Similar but less intense fluctuations were observed in the channels below 1 kHz beginning about 15 minutes before the boundary crossing.

Another distinctive feature of the electric field data associated with the magnetic storm was the noise present in the 10 kHz channel from 2153 to 0115 U.T. This noise had peak amplitudes from 45 μV/m to 260 μV/m during this time. In the wideband analog data also acquired from the satellite this noise appeared as a band 1 to 2 kHz wide which was fluctuating up and down in frequency by a few kHz with periods of a few minutes. This noise band was usually slightly above the local electron gyrofrequency and consisted of both a steady component of diffuse noise and an impulsive component with many short, $\sim$ 0.1 second, bursts extending across the entire noise band. On Orbit 821 the onset of this noise band occurred nearly concurrent with the increase in the intensity of low energy electrons at 2157 U.T. in Figure 5a. Similar fluctuating noise bands slightly above the local electron gyrofrequency were observed subsequently on Orbits 822 and 823, and also during other magnetic storms.

A third feature of the electric field data associated with the magnetic storm was the electrostatic noise observed in the frequency range 35 Hz to 5.62 kHz from 0148 to 0205 U.T. just outside the plasmasphere near the inbound Orbit 821 plasmapause crossing and in conjunction with the sporadic saturation of the DC electric fields signal discussed earlier. The plasmapause crossing was identified by the onset of the electromagnetic plasmaspheric hiss in the channels from 200 Hz to 1.78 kHz at about 0205 U.T. in Figure 6 and by the return from saturation of the DC electric field signal at 0206 U.T. in the summary plots. A similar band of electrostatic noise just outside the plasmapause was observed on Explorer 45 during the December 1971 magnetic storm (Anderson and Gurnett, 1973).

Boundary Observation

We will finally consider the magnetosphere boundary observations in more detail.

An expanded view of a portion of the magnetic field measurements during Orbit 821 appears in Figure 7. The satellite, outbound near local noon at 2030 U.T. (see Figure 1), measured a field magnitude near L = 3 which was depressed due to inflation by the storm ring current established earlier. A sudden increase in the field at 2055 U.T. was followed at 2145 U.T. by an increase in field inclination that usually accompanies increasing inflation of the magnetosphere. The magnitude continued to rise to 80γ above the internal reference field magnitude at 2230 U.T. with increasing fluctuations in magnitude and direction. Then suddenly at 2241 U.T. a very large magnitude and direction change occurred. The magnitude jumped to more than 320γ above the internal reference field magnitude for the next ten minutes and remained more than 160γ above the reference field until 2310 U.T. During the same interval the inclination dropped 30° below predicted and the declination rose to 60° above predicted values. The field was thus deformed to the east, 60° to the magnetic meridian plane, and inclined somewhat away from the earth. The fluctuations in magnitude and direction that commenced near 2200 U.T. increased in amplitude after 2255 U.T. and increased even further after 2310 U.T., when the field returned to a more dipolar magnitude and direction.

The most direct interpretation of the magnetic field direction and magnitude changes near 2240 U.T. is that the magnetopause moved past the satellite and that Explorer 45 remained in the magnetosheath until 2310 U.T.

This conclusion is confirmed when we add the charged particle data to the magnetic field information. In Figure 8 we again present the magnetic field measurements, but this time they are expanded around the field reversal near 2241 U.T. In addition the top panel of the figure contains proton measurements made by the cylindrical electrostatic analyzer-channeltron detector with the energy stepped once each revolution of the satellite. The curves are plotted alternately dashed and solid for ease in distinguishing each energy step. Pitch angle scans were obtained from near 0° to near 180° twice each roll in a normal magnetospheric magnetic field configuration because of the geometry between the spin axis, detectors and magnetic field. The second and third panels contain data from two channels of the solid state proton detector. The blanks in the curves for these two channels are due to a different mode of instrument operation which occurred every fourth revolution.

Although the presence of the magnetopause in the vicinity of the satellite affected the proton intensities in a complex manner up to the boundary crossing at 2240:36 U.T., it was possible to discern the usual two intensity maxima per revolution at 90° pitch angles, especially at the higher energies.

At 2240:36 U.T. the magnetic field suddenly reversed direction in a few seconds so that it pointed southward (declination near 180°). At the same time the proton measurements showed an onset of streaming protons with one large maximum per revolution. These maxima are 180° out of phase for the two particle detectors because the instruments were mounted on opposite sides of the spinning spacecraft. Following the time of the field reversal, the magnitude steadily increased for the next minute. During the increase the field direction rotated again to the northern hemisphere, returning to a nearly dipolar configuration, although somewhat tilted towards the dusk flank. Throughout this period the streaming protons came generally from the quadrant towards the sun and above the ecliptic plane and were rather independent of the direction of the magnetic field. After the field had rotated northward, the maximum intensities of the protons were at pitch angles of 70° to 80°. The closest that the detectors looked towards the sun was about 30° in the ecliptic plane. It is only because of the continued streaming of the protons after this second field rotation that we claim that the satellite remained outside the magnetosphere.

As previously indicated, Explorer 45 apparently encountered the magnetosheath for brief periods both before and after the one major boundary crossing discussed here. One such case is indicated in Figure 7 at the vertical dashed line. A higher time resolution analysis of the magnetic field data shows a brief field reversal, and the particle detectors observed one maximum in the flux per revolution.

Because the particle detectors probably did not observe the maximum of the proton distribution function for the streaming protons when the satellite was in the magnetosheath, we cannot supply measured values of the density, bulk flow velocity, direction, and temperature of the magnetosheath particles. However, as shown in Figure 9, a comparison of the energy spectrum at the measured maximum intensity of the streaming protons with that just inside the boundary for 90° pitch angle protons illustrates the enormous flux of protons flowing past the magnetosphere at this time. Fluxes greater than 10^9 protons/cm^2-sec-ster-keV were encountered at around 4 keV outside the magnetosphere. The total energy flux integrated over the spectrum from 1 to 100 keV at the maximum intensity was about 240 ergs/cm^2-sec-ster. These data have also been fitted to a Maxwellian velocity distribution with a temperature (kT) of about 3.9 keV, although the fit to the data at low and high energies is not accurate. The average velocity of these protons was 865 km/sec.

During the time of the Explorer 45 boundary crossing the Pioneer 9 spacecraft was located 45° east of the earth-sun line at 0.78 A.U. The Ames Research Center solar wind plasma experiment observed an interplanetary shock at 2323 U.T. on August 4, with a bulk velocity change of 240 km/sec. The velocity peaked at 990 km/sec during the first hour of the next day (Mihalov et al., 1974).

The ATS-5 satellite also encountered magnetopause crossings on August 4 (Cahill and Skillman, 1973). Field reversals near 2120 U.T. and again at 2230 U.T. indicated passage of the magnetopause past the satellite at 6.6 R_E and 15 hours local time.

DISCUSSION

The interactions of the enormous energy fluxes of the solar wind with the magnetosphere during early August of 1972 produced a number of unusual geophysical events. The most significant was the abnormally large deformation of the geomagnetic field, observed both at ground level as fluctuations of such large amplitude and frequency as to be unmeasurable in some cases, and at the Explorer 45 satellite by the observation of the magnetopause at 5.24 R_E, the closest it has ever been observed. Also, the plasmapause in the noon quadrant retracted possibly below two earth radii.

In spite of this magnitude of activity, the ring current developed only to nominal values. This is evidenced by the actual proton energy densities measured, by the ΔB profiles from the satellite magnetometer, and by Dst. It is doubtful that the lack of a large ring current enhancement can be attributed to the establishment of a convection pattern which merely drifted the protons out of the magnetosphere when it was so highly contracted, because there is good evidence that a large ring current is due to deep penetration of high intensities of protons into the magnetosphere, rather than the existence of high intensities at nominal ring current distances (Smith and Hoffman, 1973; Hoffman and Bracken, 1967). The plasmasphere did not seem to constitute an obstacle for the protons, having contracted to three earth radii at dusk on the inbound portion of Orbit 821 after the second storm commencement and perhaps to as low as two earth radii the next day. Thus one could conclude that the storm-time convection system reached these low altitudes. On the other hand there is no evidence for penetration of appreciable ring current protons further in than about 2.8 R_E. Thus we find a rather inconsistent situation from several aspects.

Following the period of magnetospheric boundary crossings, Explorer 45 encountered a series of magnetospheric oscillations, seen in both the particle fluxes and fields measurements. At least two types of oscillations occurred, one during the period immediately after the satellite re-entered the magnetosphere, perhaps due to an adiabatic response of the magnetospheric particle population to a pulsating magnetosphere, the other at the beginning of the next day possibly due to an oscillating behavior in the particle intensities associated with the passage across the satellite of a series of a very distinct particle boundaries (Williams et al., 1973a).

As with other storms (i.e., Barfield et al., 1974), a region of detached plasma or a tail-like structure was observed in the dusk hours during the development of the second main phase. The turbulent nature of this local time region is also evidenced by the temperature and density variations observed for a half earth radius outside the plasmapause. Consistent with previous storms (Smith and Hoffman, 1974), the ring current protons penetrated into the plasmapause in this local time region. However, as the plasmapause retracted further inward in subsequent orbits the penetration of protons did not follow, as previously noted.

This report has summarized the highlights of the measurements made by the instruments aboard Explorer 45 in the noon to dusk sector. While many of the specific phenomena encountered during the storm period have been observed previously by Explorer 45 or other satellites during other magnetic storms, the unusual magnitude of the magnetospheric and plasmaspheric deformations makes this a fascinating event for detailed analysis in its own right, as well as useful for comparative analysis.

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FIGURE CAPTIONS

Figure 1. Orbit of Explorer 45 in L and local time on August 4 and 5, 1972.

Figure 2. Magnetograms of the horizontal intensity of the earth's magnetic field from the College, Alaska, and Honolulu, Hawaii observatories, and the deformation of the field along the trajectory of Explorer 45 [ΔB = B (measured) - B (reference)] during August 4 and 5, 1972. The numbers below the satellite data are the orbit numbers. During the inbound portion of Orbit 820 only sporadic data were acquired.

Figure 3. The position of the plasmapause in the noon quadrant as measured by Explorer 45 during the storm period. The numbers below the points are orbit numbers while those above are the magnetic local times in hours at the boundary crossings.

Figure 4. Energy density profiles for protons as a function of L for a series of orbits during the August 4 and 5 magnetic storms. The energy densities are summations over the energy spectrum from 1 to 872 keV and over all pitch angles. Shaded regions indicate the range of variability of the energy density. Data for L values lower than the location of each "S" are uncorrected for saturation effects in one of the detectors (Williams et al., 1973b).

Figure 5a. Summary plots of data from all detectors on Explorer 45 for Orbit 821 outbound during which time the sudden commencement of the second magnetic storm occurred and the main phase developed. In the spectrograms a darker shading indicates higher intensities. See text for a discussion of the contents of the plots.

Figure 5b. Summary plots of data from all detectors on Explorer 45 for Orbit 821 inbound during which time the main phase developed. In the spectrograms a darker shading indicates higher intensities. See text for a discussion of the contents of the plots.

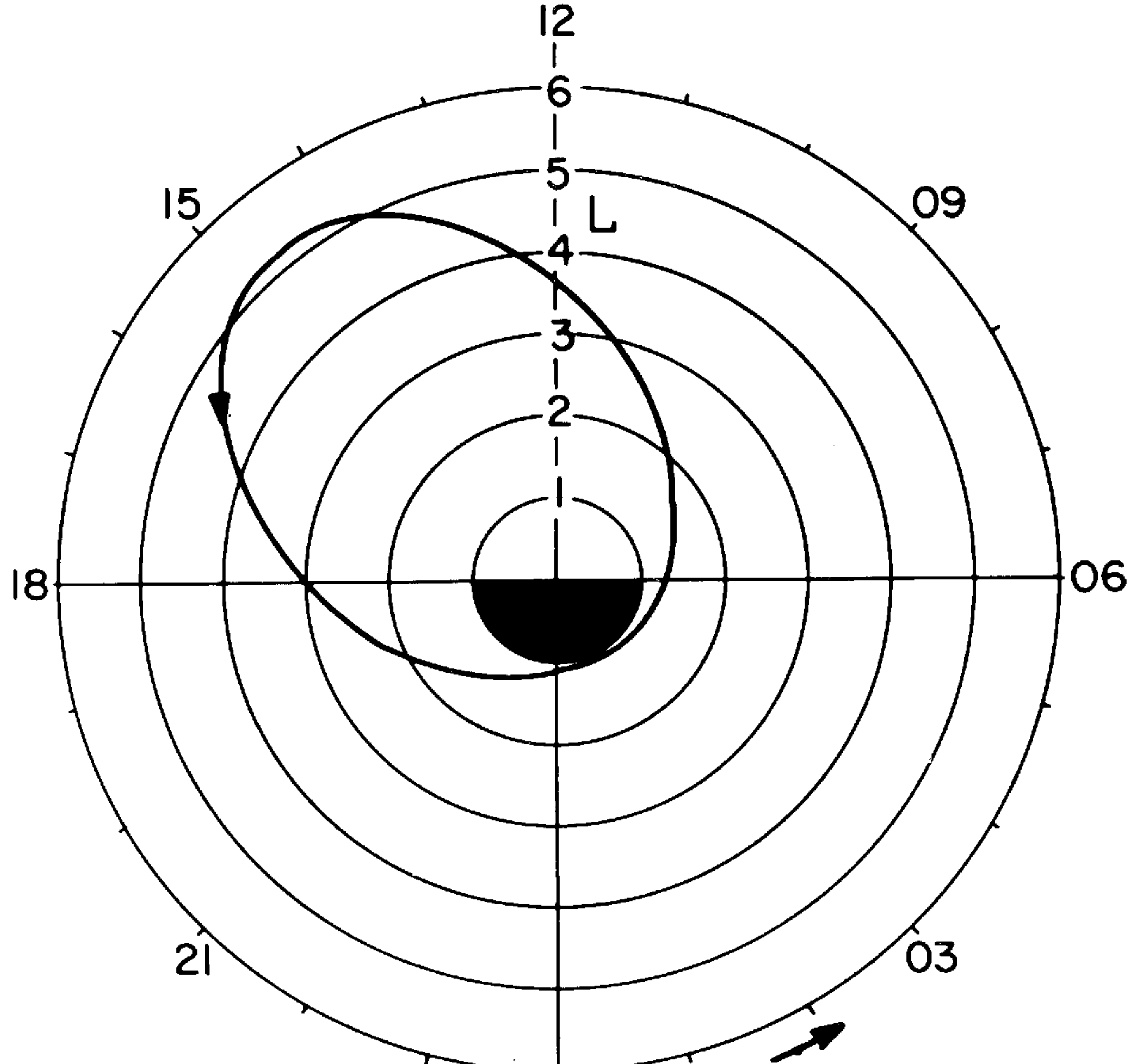
Figure 6. A plot of the spectrum analyzer data from the University of Iowa's AC Electric Field Experiment. The scale for each channel is logarithmic and the range is approximately 1 μV/m to 20 mV/m. For the channels above 10 kHz the bandwidths are approximately 15% of the center frequencies. The bandwidths of the remaining narrow-band filters are approximately 30% of their center frequencies. The wide-band filter (Channel 0) covers the range 100 Hz to 10 kHz. The electron gyrofrequency listed at the bottom of the plot is calculated from the model field and not the measured field. Each vertical line represents the average electric field strength for the previous 67 seconds interval of time. Each dot represents the peak value for the same interval.

Figure 7. Satellite magnetic field measurements during Orbit 821 around the period of the main magnetopause crossing by the satellite on August 4.

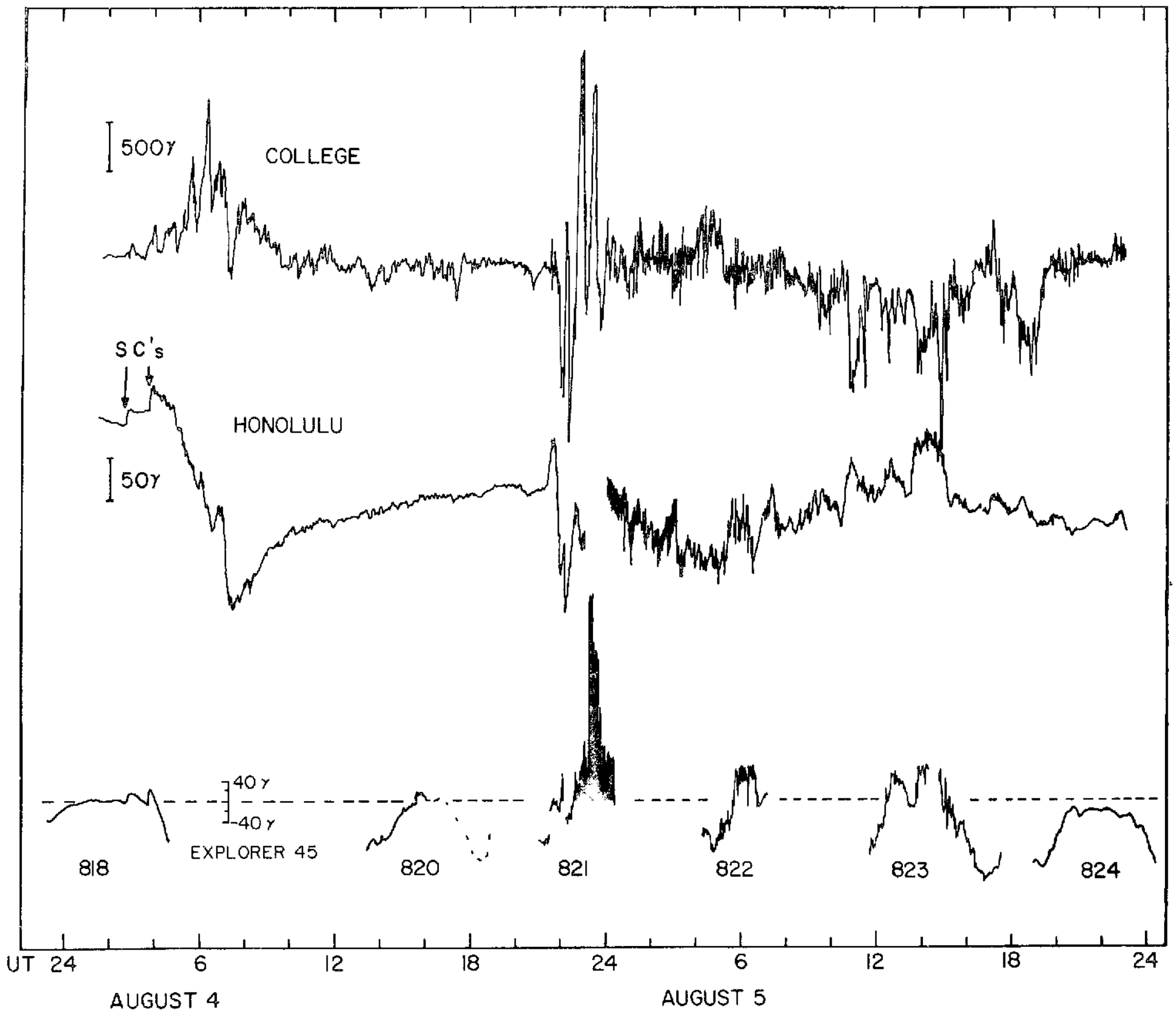
Each set of data points is about a half minute average containing 32 sets of measurements.

Figure 8. Highest time resolution data from the satellite around the main crossing of the magnetopause on August 4. The resolution of the magnetic field data is four seconds. See text for a full explanation of the contents of the figure.

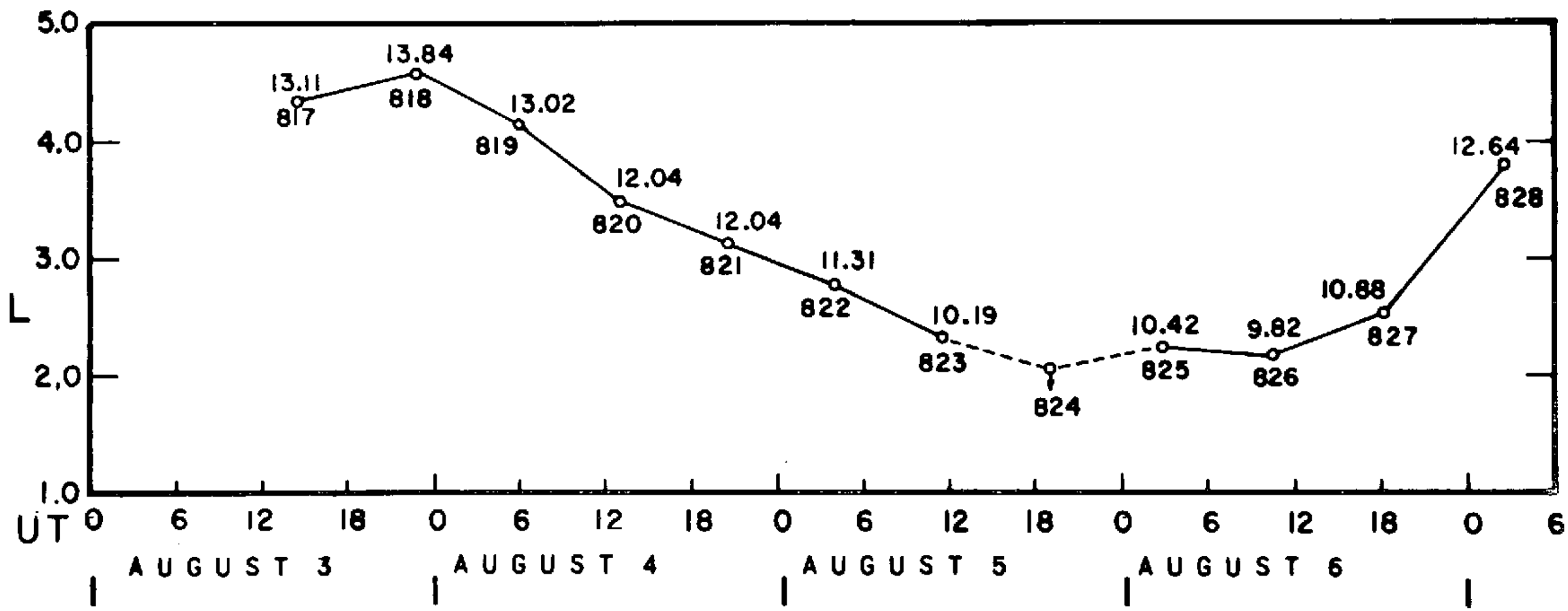
Figure 9. Proton energy spectra at the maximum intensity of the protons streaming in the magnetosheath (upper data set) and at 90° pitch angle just inside the magnetopause (lower data set). The curve is a least squares fit of a Maxwellian velocity distribution to the upper set of data, showing a temperature (kT) of about 3.9 keV.



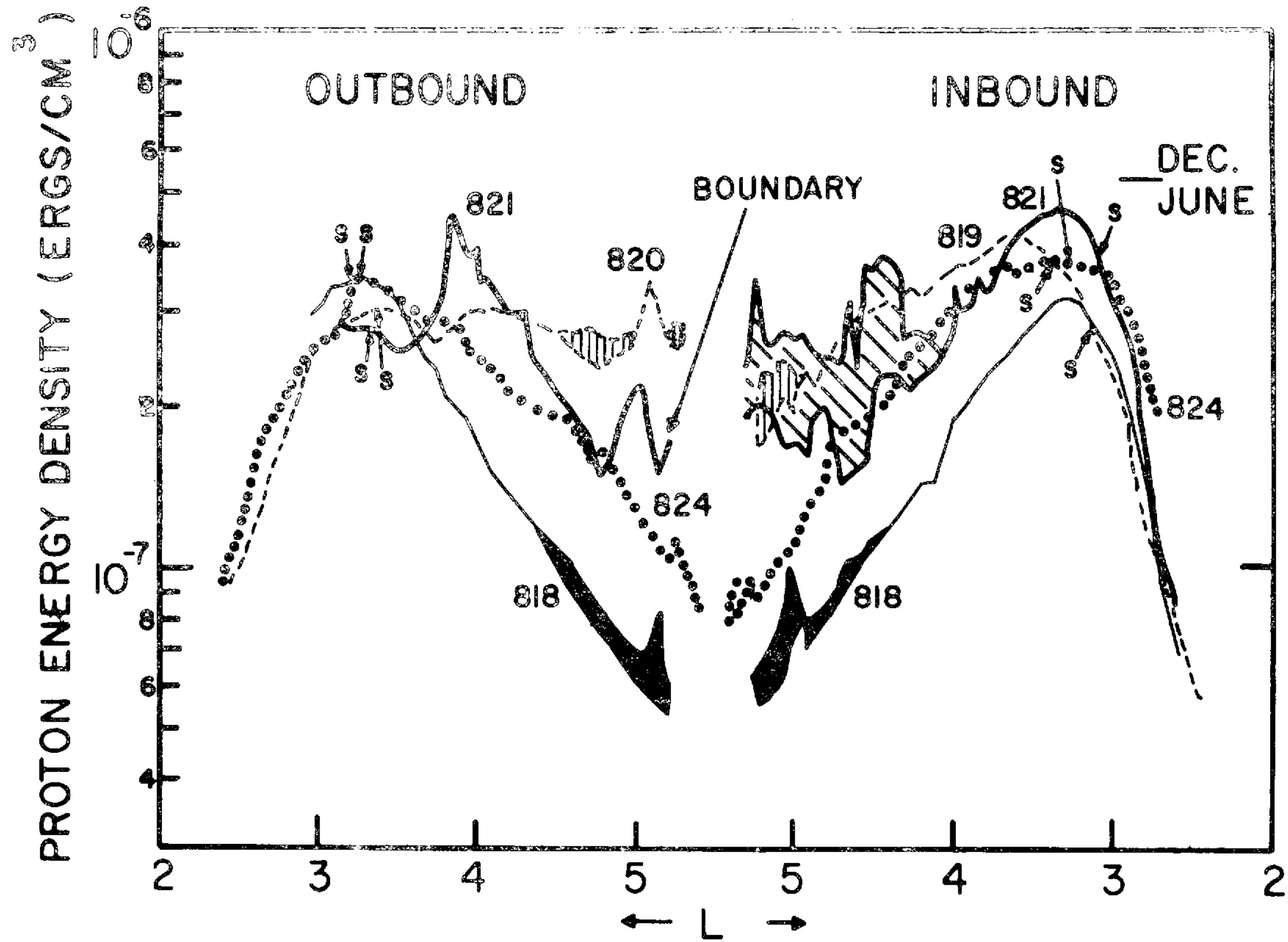
12
6
5
4
3
2
1
L
15
09
18
06
21
03
00
MLT



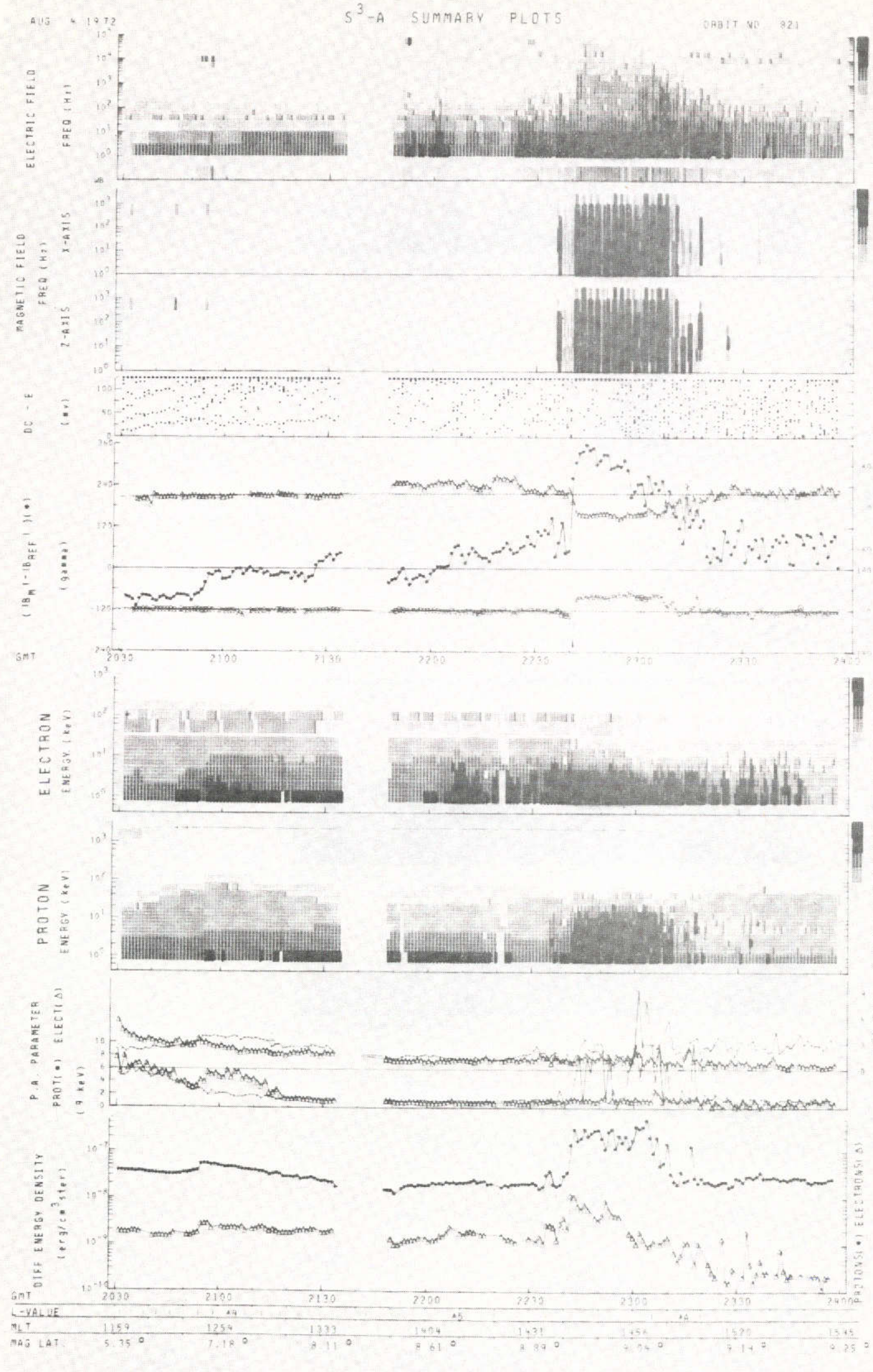
500γ
COLLEGE
SC's
HONOLULU
50γ
40γ
-40γ
EXPLORER 45
818
820
821
822
823
824
UT 24
6
12
18
24
6
12
18
24
AUGUST 4
AUGUST 5



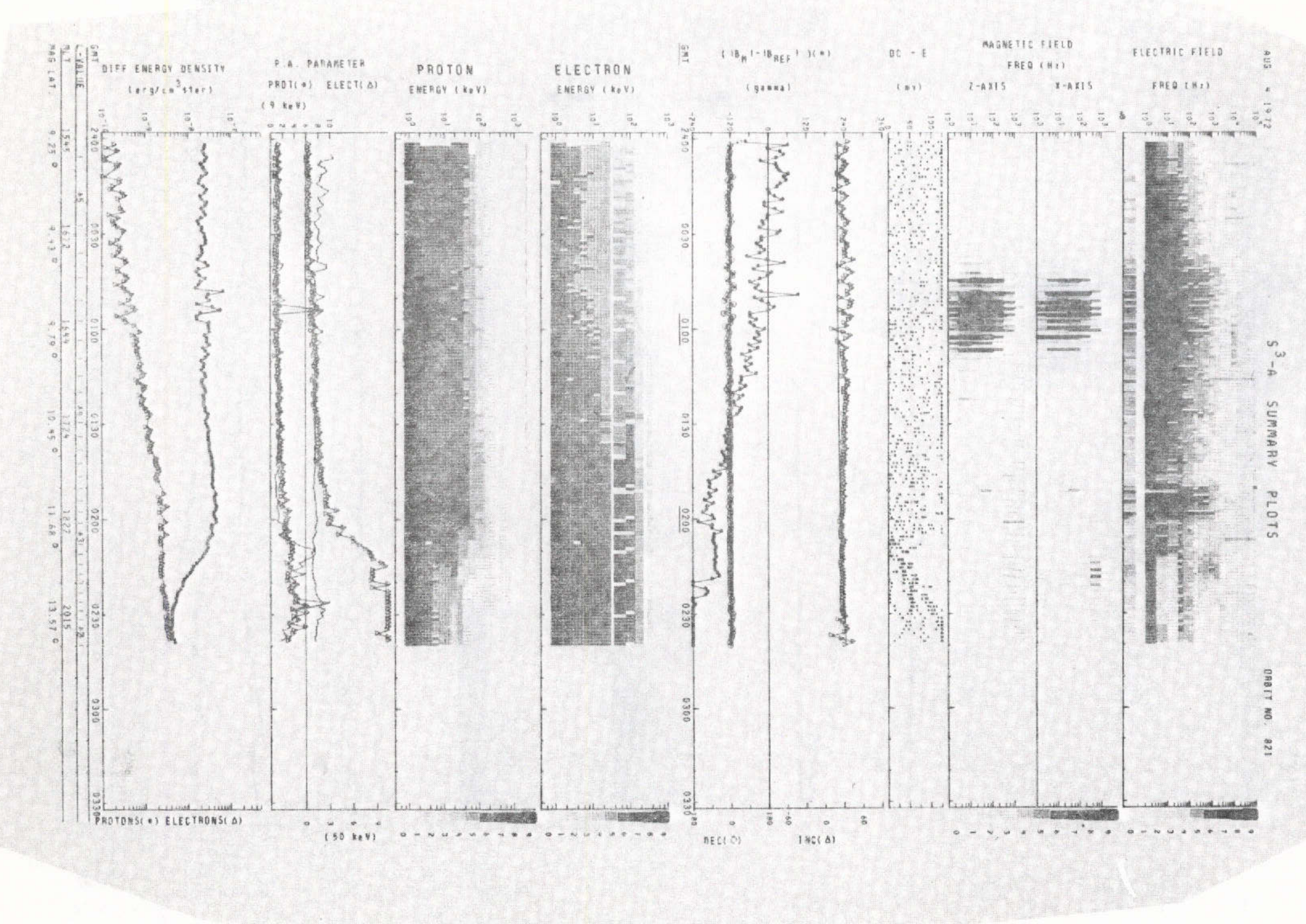
5.0
4.0
3.0
2.0
1.0
L
UT
0
6
12
18
0
6
12
18
0
6
12
18
0
6
12
18
0
6
AUGUST 3
AUGUST 4
AUGUST 5
AUGUST 6
13.11
817
13.84
818
13.02
819
12.04
820
12.04
821
11.31
822
10.19
823
824
10.42
825
9.82
826
10.88
827
12.64
828



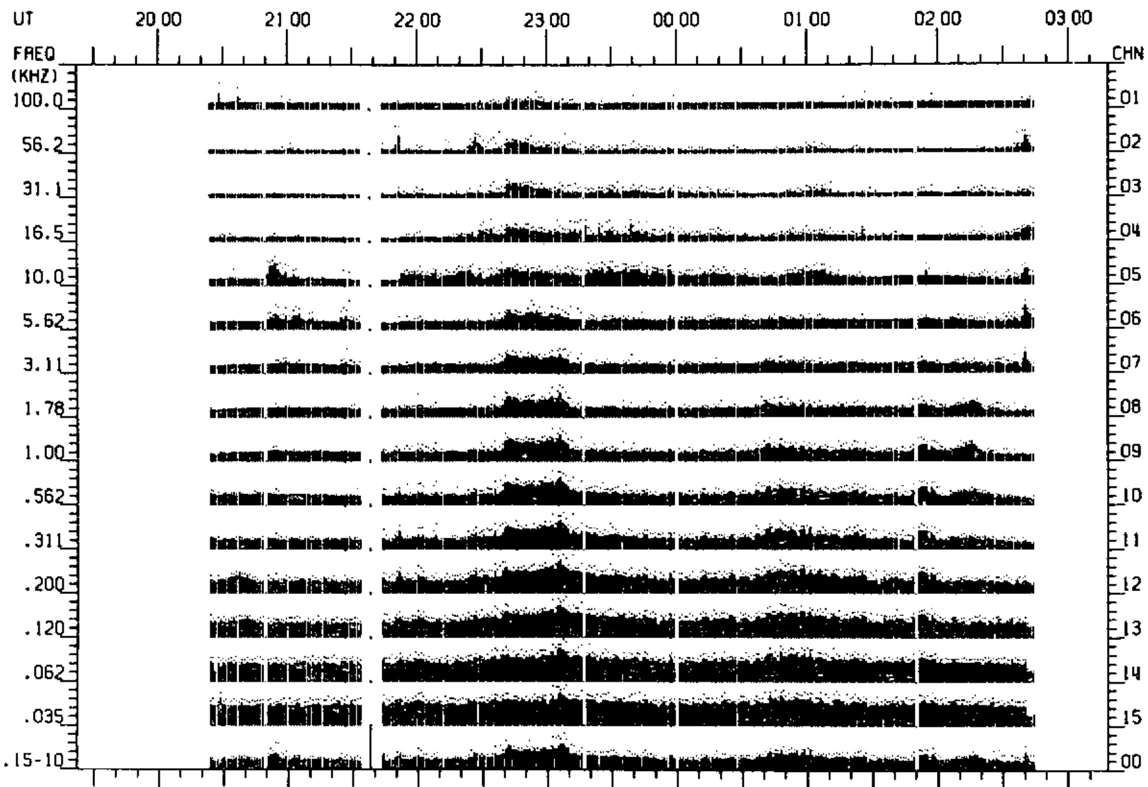
PROTON ENERGY DENSITY (ERGS/CM^3)
10^{-6}
8
6
4
2
10^{-7}
8
6
4
OUTBOUND
INBOUND
BOUNDARY
DEC.
JUNE
821
820
824
818
819
S
2
3
4
5
5
4
3
2
← L →



AUG 4 1972
S³-A SUMMARY PLOTS
ORBIT NO. 821
ELECTRIC FIELD
FREQ (Hz)
MAGNETIC FIELD
FREQ (Hz)
X-AXIS
Z-AXIS
DC - E
(mv)
(|B_M|-|B_REF|)(*)
(gamma)
INC(Δ)
DEC(□)
GMT
2030
2100
2130
2200
2230
2300
2330
2400
ELECTRON
ENERGY (keV)
PROTON
ENERGY (keV)
P.A. PARAMETER
PROT(*) ELECT(Δ)
(9 keV)
(50 keV)
DIFF ENERGY DENSITY
(erg/cm³ster)
PROTONS(*) ELECTRONS(Δ)
L-VALUE
MLT
1159
1254
1333
1404
1431
1456
1520
1545
MAG LAT
5.35°
7.18°
8.11°
8.61°
8.89°
9.04°
9.14°
9.25°


S3-A SUMMARY PLOTS
ORBIT NO. 821
AUG 4 1972
DIFF ENERGY DENSITY
(erg/cm3 ster)
P.A. PARAMETER
PROT(*) ELECT(Δ)
(9 keV)
PROTON
ENERGY (keV)
ELECTRON
ENERGY (keV)
(|BM|-|BREF|)(*)
(gamma)
DC - E
(mv)
MAGNETIC FIELD
FREQ (Hz)
Z-AXIS
X-AXIS
ELECTRIC FIELD
FREQ (Hz)
GMT
L-VALUE
M.L.T
MAG LAT.
PROTONS(*) ELECTRONS(Δ)
(50 keV)
DEC(O)
INC(Δ)

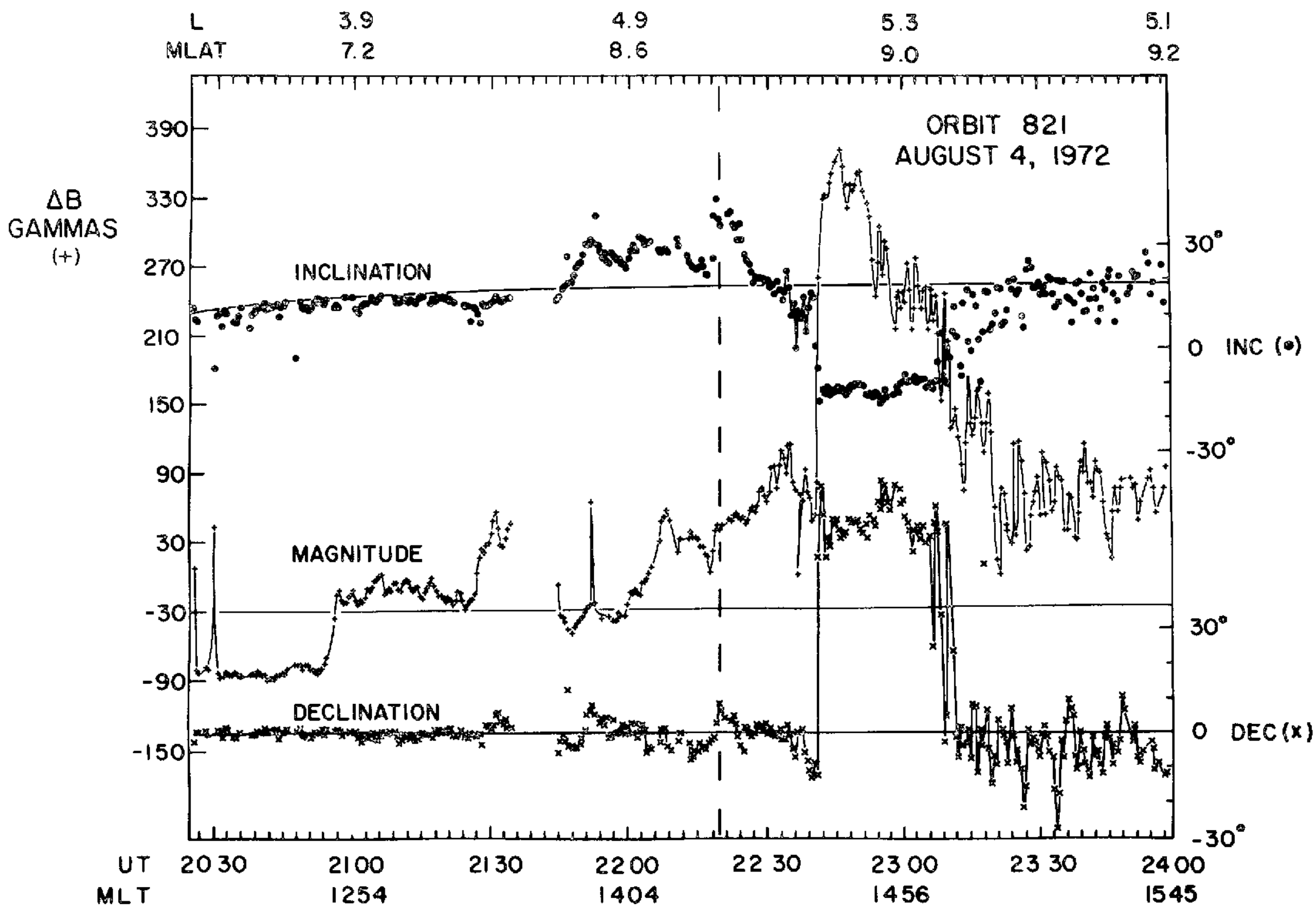
SSS-A ORBIT 0821 DAY 217 AUGUST 04, 1972



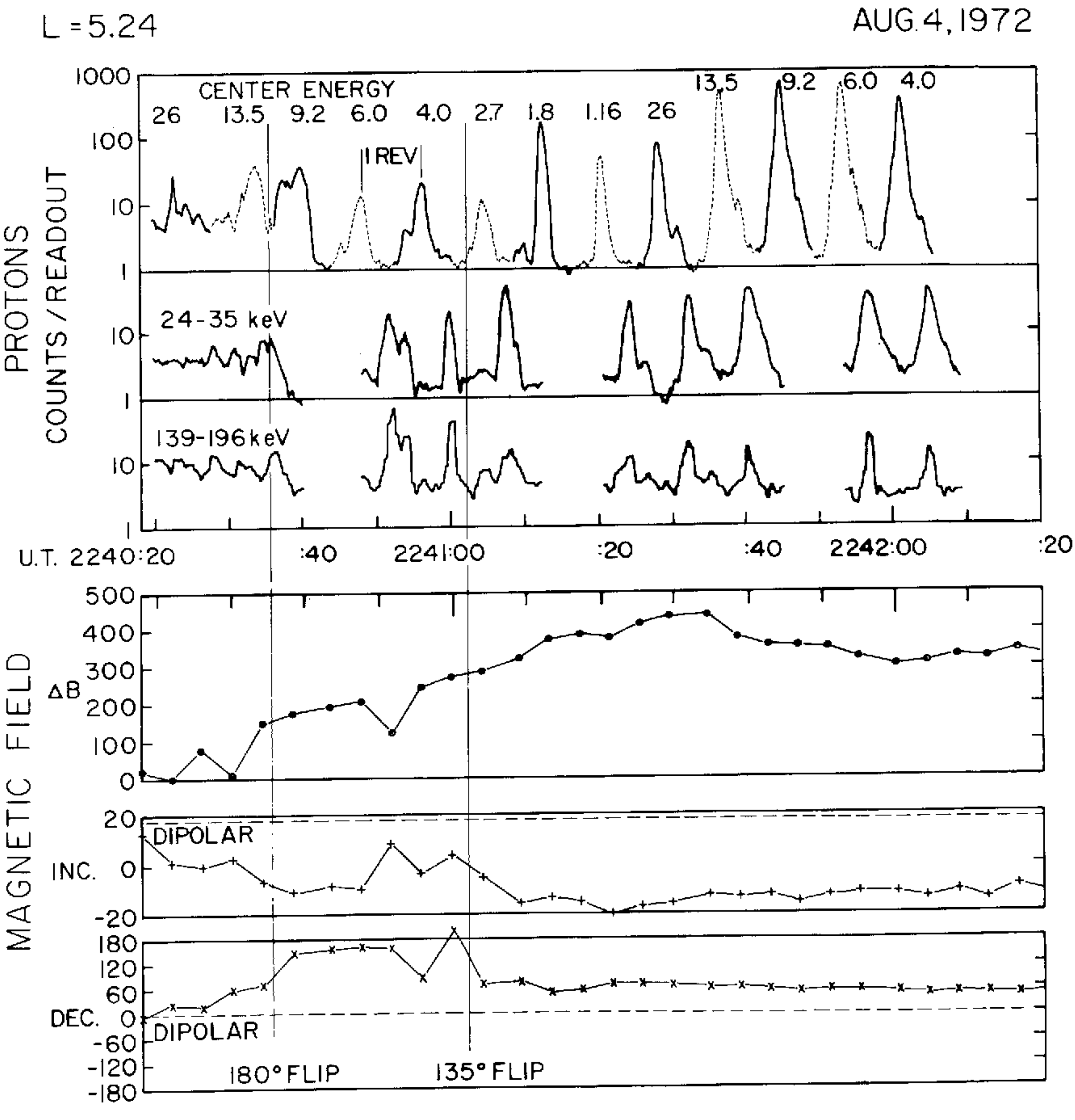
UT	20 00	21 00	22 00	23 00	00 00	01 00	02 00	03 00	UT
L	2.159	3.929	4.913	5.292	5.142	4.457	3.131	1.095	L
MLT	10.400	12.907	14.076	14.942	15.760	16.734	18.378	2.261	MLT
MLAT	.974	7.181	8.612	9.042	9.251	9.788	11.680	4.334	MLAT
F_{α}(KHZ)	86.859	15.583	8.226	6.642	7.270	11.340	35.197	674.518	F_{α}(KHZ)

PLOT BEGINS AT 19 22:00 UT

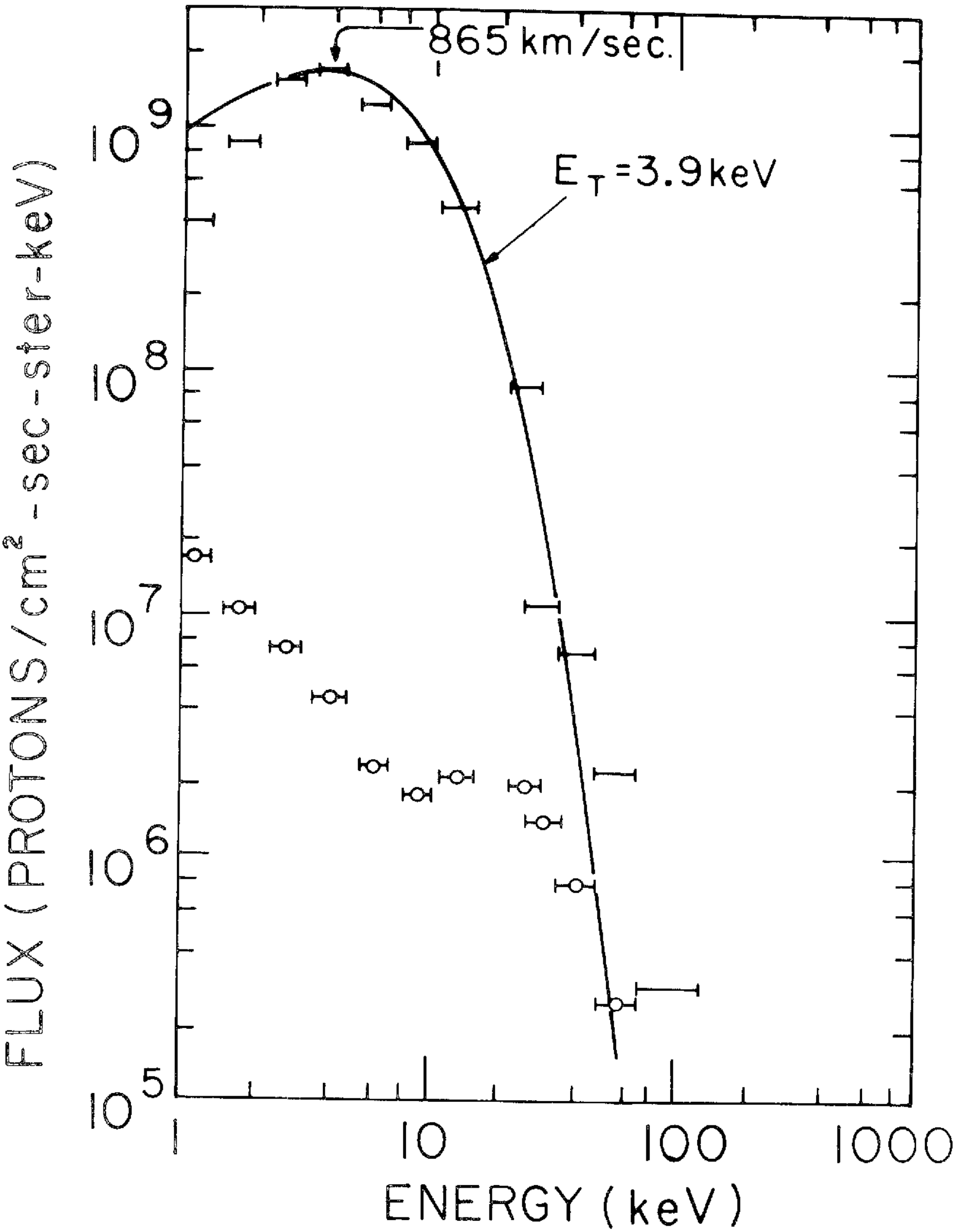
PROGRAM SS525B TAPE BT1447A 73 85 11 0



L 3.9 4.9 5.3 5.1
MLAT 7.2 8.6 9.0 9.2
ORBIT 821
AUGUST 4, 1972
ΔB
GAMMAS
(+)
390
330
270
210
150
90
30
-30
-90
-150
INCLINATION
MAGNITUDE
DECLINATION
30°
0 INC (•)
-30°
30°
0 DEC(x)
-30°
UT 2030 2100 2130 2200 2230 2300 2330 2400
MLT 1254 1404 1456 1545



L = 5.24
AUG. 4, 1972
PROTONS
COUNTS / READOUT
CENTER ENERGY
26
13.5
9.2
6.0
4.0
2.7
1.8
1.16
26
13.5
9.2
6.0
4.0
1 REV
24-35 keV
139-196 keV
1000
100
10
1
U.T. 2240:20
:40
2241:00
:20
:40
2242:00
:20
MAGNETIC FIELD
ΔB
500
400
300
200
100
0
INC.
20
0
-20
DIPOLAR
DEC.
180
120
60
0
-60
-120
-180
DIPOLAR
180° FLIP
135° FLIP


865 km/sec.
E_T=3.9keV
FLUX (PROTONS/cm^2-sec-ster-keV)
10^9
10^8
10^7
10^6
10^5
1
10
100
1000
ENERGY (keV)

NASA–GSFC