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Enclosure (1) to LMSC/D117624
7 June 1971

SEVENTH QUARTERLY PROGRESS REPORT
FOR
LOCKHEED EXPERIMENT ON ATS-5
(1 March through 31 May 1971)

Contract No. NAS 5-10392

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ABSTRACT

The Lockheed experiment on ATS-5 is continuing in its successful operation. A detailed study of individual isolated magnetospheric substorms is being made utilizing coordinated observations by several groups of experimenters. The study of the average properties of the ambient plasma is continuing.

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Enclosure (1) to LMSC/D1178
7 June 1971

SEVENTH QUARTERLY PROGRESS REPORT
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INTRODUCTION

Effort during this quarter has been directed in two principal areas. The problem of understanding the complex series of phenomena known as a magnetospheric substorm has been attacked by means of an intensive study of several isolated events for which coordinated observations from several sources are available. Further work on documenting the average properties of the ambient environment has included the development of a computer technique for filtering out the noise during the many periods of marginally usable data so that meaningful average values can be computed.

DISCUSSION

On day 44 of 1971 a particularly fortuitous set of circumstances allowed us to obtain an unusually complete set of coordinated observations on an isolated substorm which occurred in the immediate vicinity of the ATS field line. In addition to the particle flux data from ATS-5, all-sky camera data were acquired by the Lockheed group making observations in Thompson and Gillam, Canada, and VELA plasma data were also acquired deep in the plasma sheet at $17 R_E$ in the tail. Magnetometer data from EXPLORER-35 in interplanetary space, from ATS-5 and from the specially operated stations at Thompson and Lynn Lake, Canada, as well as from the standard observatories are also available. This particular substorm had a well-developed growth phase beginning approximately two hours before the auroral breakup at 0530 UT, which was

marked by the commonly observed signatures in the ATS-5 particle data. Figure 1 shows some of the ATS-5 data during the event of interest.

In addition to the above-mentioned event, several isolated substorms are under study for which data both from ATS-5 and from the University of Alberta magnetometer net are available. This net consists of up to ten stations spread out along a magnetic meridian near 115° West longitude in central Canada.

A relatively simple and very efficient filter program has been developed to remove most of the noise from the UDLE data. The program operates by comparing each data sample in context with the neighboring data samples by an adjustable limit on the rate of change of the analog output. Figure 2 shows a typical one-hour section of noisy data before filtering; the data are shown at 2.5-second intervals. Figure 3 shows this data after passing through the filter with a relatively narrow filter parameter. The "bad" samples have been replaced by the local average of the "good" samples.

For the sake of efficiency and reliability the program was kept simple and because of this, it can not recognize the difference between rapidly changing "good" data and "bad" data and therefore rejects data which is too rapidly varying. We required that the filtered data should faithfully reproduce the correct one-minute average of the "good" data, but allowed it to distort the higher frequency components. It rejects steep slopes in the data, but will accept step-function changes in the data if a new value of sufficient consistency is found. An example of its effect on rapidly varying data is shown in Figures 4 and 5 which show unfiltered and filtered data, respectively.

PROGRAM FOR NEXT REPORTING INTERVAL

Further work on the isolated substorms under study should lead to joint papers in cooperation with the various groups making coordinated observations. Further work on the average plasma properties, incorporating a larger quantity of the available data, will be carried out. An invited review paper entitled "The Behavior of Low-Energy Particles During Substorms"

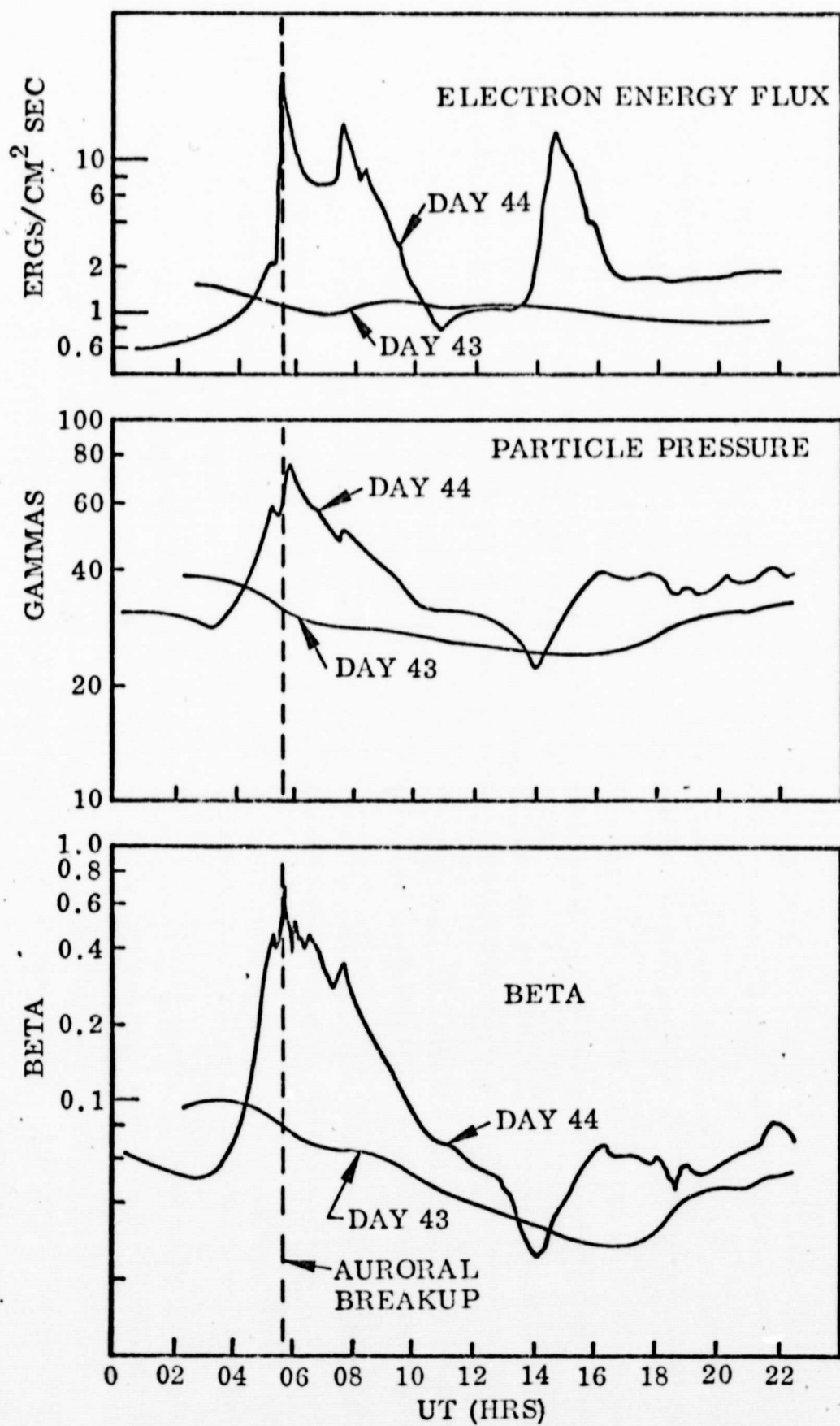


Figure 1. ATS-5 data during a magnetospheric substorm event.

ATS-5

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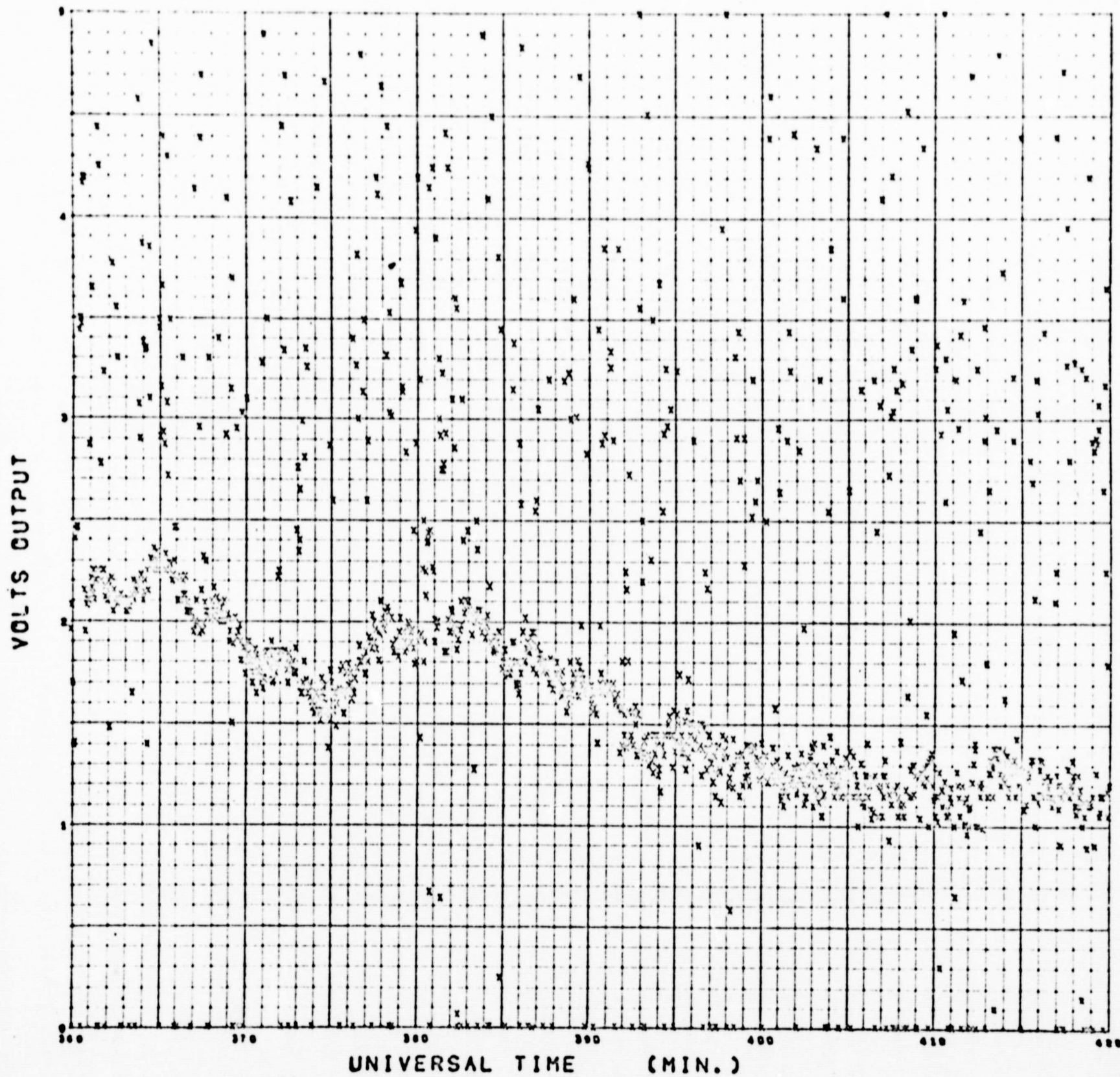


Figure 2. Unfiltered analog output from the 12-keV electron channels at ~2.5-second intervals.

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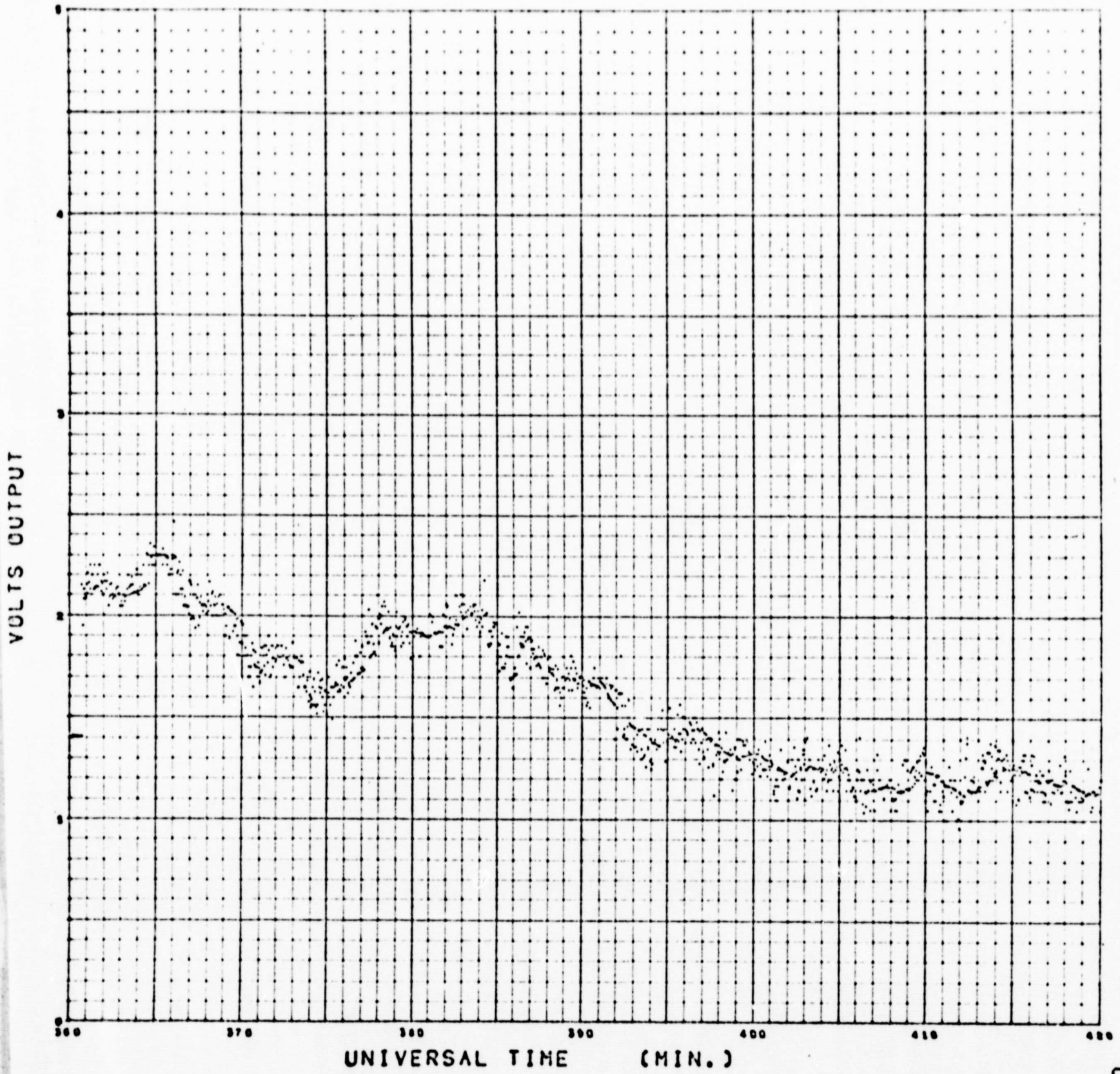


Figure 3. Filtered analog output from the 12-keV electron channel.

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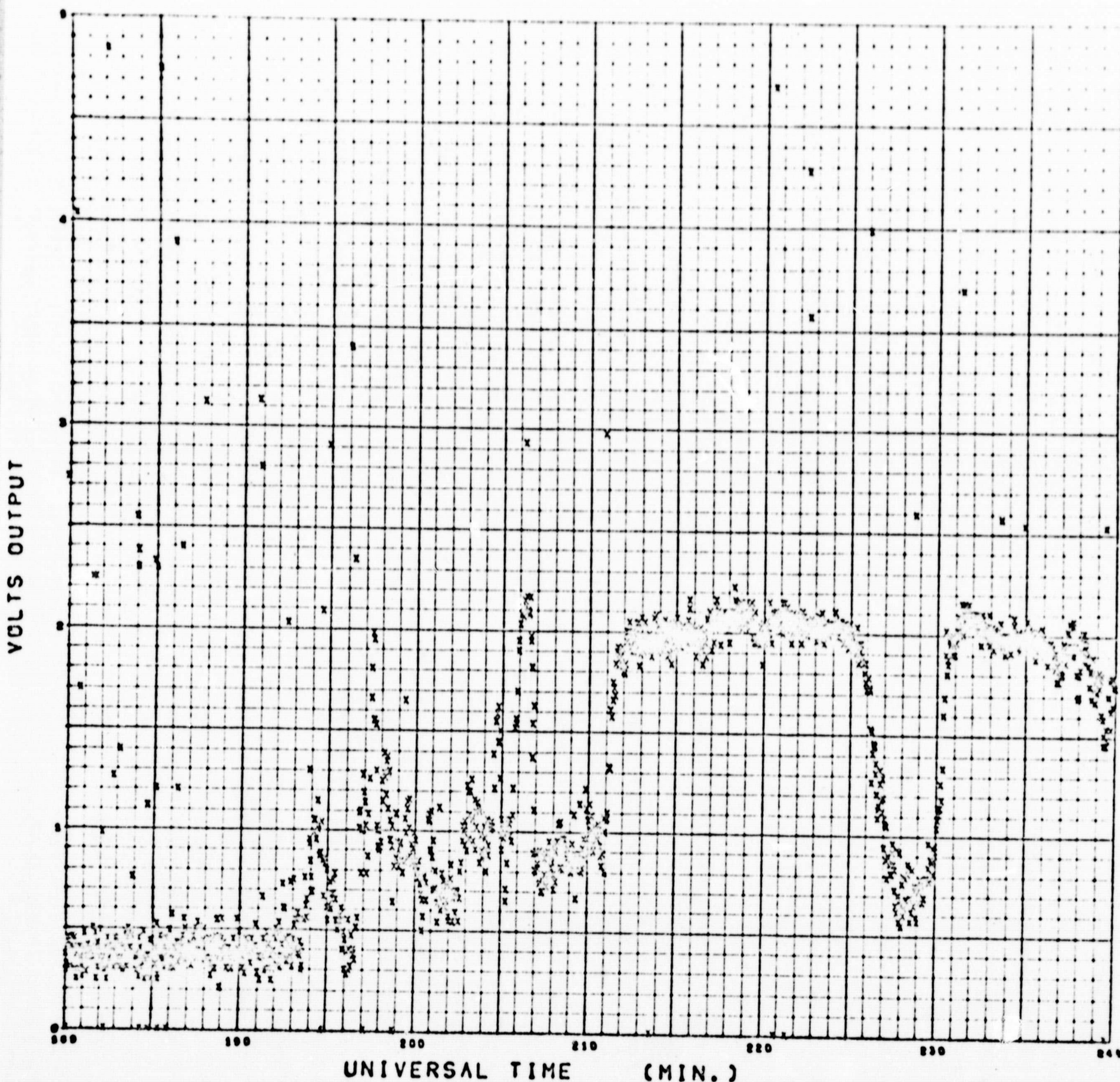


Figure 4. Unfiltered electron data including some rapid variations in the "good" data.

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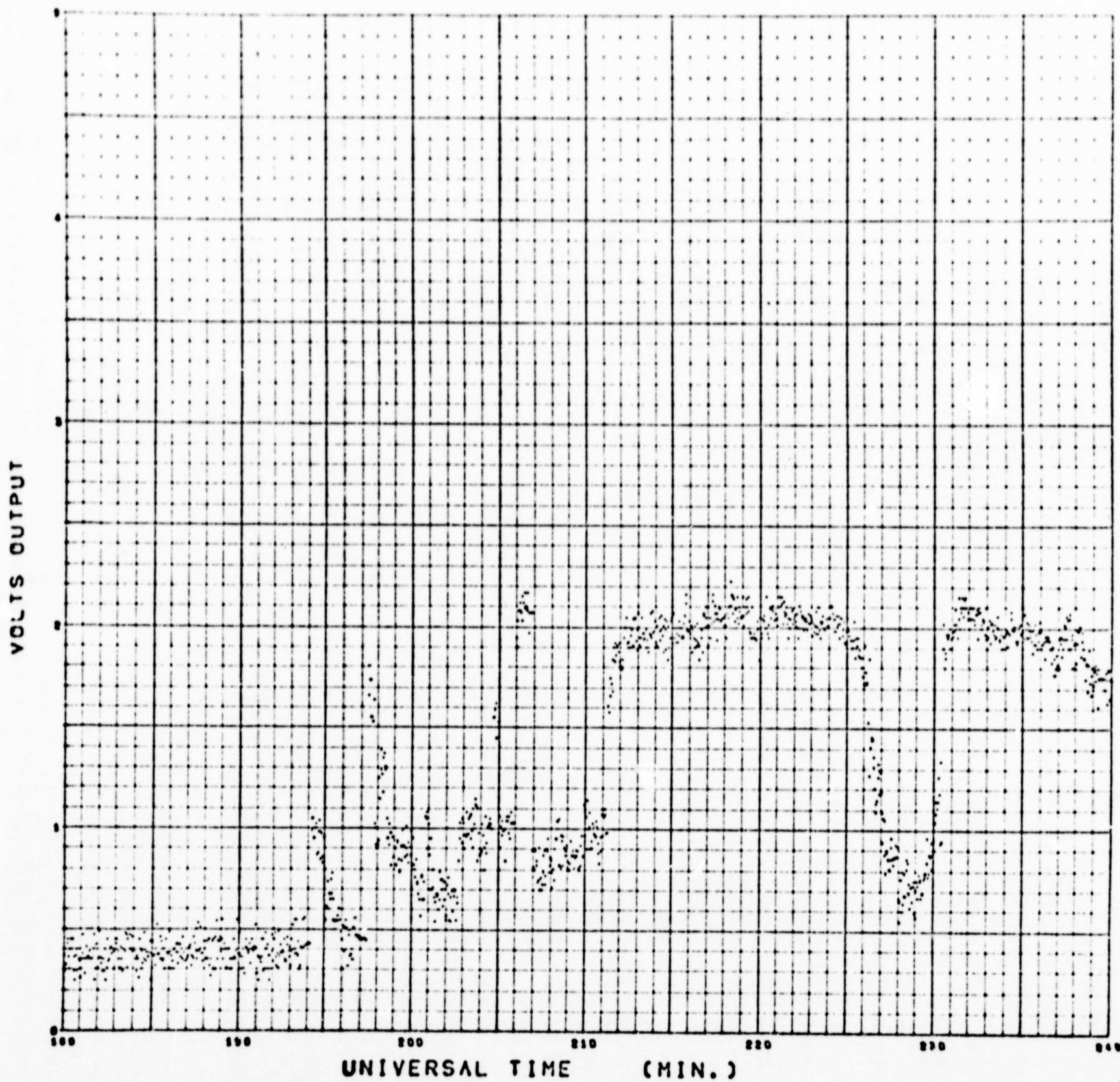


Figure 5. Same data as Figure 4, but after passing through the filter.

by R. D. Sharp and R. G. Johnson will be presented at the Fifteenth General Assembly of the IUGG in Moscow on August 3.

CONCLUSIONS AND RECOMMENDATIONS

The Lockheed experiment is continuing to operate successfully and the analysis of the large body of data is substantially furthering our knowledge of the physics of the magnetosphere. We recommend the continued operation of the payload for at least another year.