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DATA PROCESSING AND PROGRAMMER'S GUIDE FOR THE HELIOS-1 AND -2 COSMIC RAY EXPERIMENTS

Helios Documentation kept with group. See elsewhere for main document named above.

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Goddard Space Flight Center
Greenbelt, Maryland

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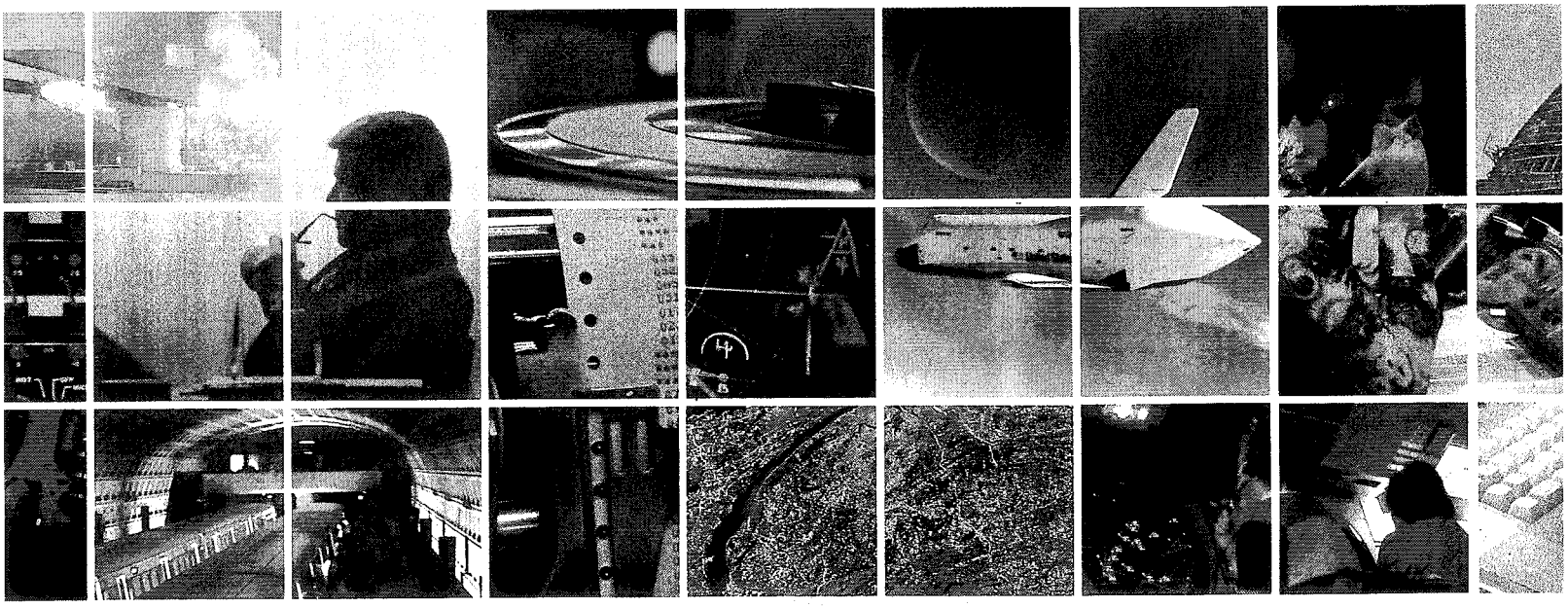

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COMPUTER SCIENCES CORPORATION

DATA PROCESSING AND PROGRAMMER'S GUIDE FOR THE HELIOS-1 AND -2 COSMIC RAY EXPERIMENTS

Prepared for
GODDARD SPACE FLIGHT CENTER

By
COMPUTER SCIENCES CORPORATION

Under
Contract No. NAS 5-24350
Task Assignment 721

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```
**** TSO FOREGROUND HARDCOPY ****
DSNAME=SB$HL.LIB.CNTL                                    (AMATRIX )

//MATGEN  EXEC  PGM=HBMATRIX,REGION=300K                                  00000010
//* CONSISTENCY CHECK USE OF MATRIX PROGRAM                               00000011
//*  ON P CARD    COL 22 =  1                                             00000012
//*               COL 66-71 SPECIFIES 'TOLERANCE' TRY 1.5 OR LESS         00000013
//*               COL 72    CONTINUATION                                  00000014
//*   CONTINUATION CARD : COL 30-71, 6 FIELDS, 7 COLUMNS EACH :           00000015
//*          FIELD # 1   POWER GAMMA IN R=E**GAMMA   TRY   1.75           00000016
//*                # 2   = (A THICK + B THICK) / (B THICK)                00000017
//*                # 3   = (A THICK) / (B THICK)                          00000018
//*                # 4   A MEV/CH  (HIGH GAIN OR LOW GAIN)                00000019
//*                # 5   B MEV/CH  (HIGH GAIN OR LOW GAIN)                00000020
//*                # 6   SUMC MEV/CH  (HIGH GAIN OR LOW GAIN)             00000021
//*   A -> D1   B -> D2    SUMC -> E  FOR THE LET DETECTOR                00000022
//*   MUST BE A 3 PARAM STOPPING PLOT FOR USE OF THE CHECK                00000023
//*                                                                       00000024
//*  FOR HET DETECTOR HELIOS-A                                            00000025
//*        A  =  .188  MEV/CHAN                                           00000026
//*        B  =  .204  MEV/CHAN                                           00000027
//*  CI+ CII  =  1.04  MEV/CHAN                                           00000028
//*                                                                       00000029
//*  FOR LET-1 DETECTOR HELIOS-A                                          00000030
//*        D1 = .2   MEV/CHAN                                             00000031
//*        D2 = .196 MEV/CHAN                                             00000032
//*        E  = 2.1  MEV/CHAN                                             00000033
//*                                                                       00000034
//STEPLIB   DD  DSN=SB$HL.HELIOS.LOAD,DISP=SHR                           00000035
//FT06F001  DD  SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=7265,          00000038
//  BUFNO=1)                                                             00000040
//FT07F001  DD  SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=3429,          00000050
//  BUFNO=1),SPACE=(CYL,(7,5))                                           00000060
//FT10F001  DD  DSN=HELFLUX,UNIT=(6250,,DEFER),VOL=SER=DUMFLX,           00000070
//  DISP=SHR,DCB=BUFNO=1                                                 00000080
//FT49F001  DD  UNIT=SYSDA,SPACE=(TRK,(5,5)),                            00000090
//  DISP=(NEW,DELETE,KEEP),DCB=BLKSIZE=1088                              00000100
//FT50F001  DD  DSN=SB$HL.FLUXCAT2.DATA,DISP=SHR                         00000110
//PLOTDATA  DD  UNIT=SYSDA,DISP=(NEW,DELETE),SPACE=(TRK,(60),,CONTIG)    00000120
//FLUXSAVE  DD  UNIT=SYSDA,DISP=(NEW,DELETE),SPACE=(TRK,(10),,CONTIG)    00000130
//MISSING   DD  UNIT=SYSDA,DISP=(NEW,DELETE),SPACE=(TRK,(10,5))          00000140
//OVERFLOW  DD  UNIT=SYSDA,DISP=(NEW,DELETE),SPACE=(TRK,(10,5))          00000150
//SYSUDUMP  DD  SYSOUT=A                                                 00000160
//ABNLDUMP  DD  DUMMY                                                    00000170
//CARDS  DD  *,DCB=BLKSIZE=800                                           00000180
```

Proton - / helios version

ABSTRACT

This document describes briefly the instrumentation for the cosmic ray experiment onboard Helios-1, and -2 spacecraft, and the various analytical procedures used to study the experiment data. The primary purpose of the document is to provide a guide to the Helios data processing system in use on the IBM 3081 at GSFC. This multi-program software system performs general data reduction, quality control, data base management, and data analysis.

ACKNOWLEDGEMENT

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Section 1
HELIOS-1 AND -2 COSMIC RAY EXPERIMENTS

1.1 OBJECTIVES

This report describes the procedures used to prepare for analysis the galactic and solar cosmic ray experiment data taken during the Helios-1 and -2 missions. The Helios-1 spacecraft was launched on December 10, 1974, and Helios-2 was launched on January 15, 1976. The Helios-1 and -2 spacecraft were developed by the Federal Republic of Germany (FRG) in a cooperative program with NASA. NASA supplied the launch vehicle and experiments were performed by scientists from both the FRG and NASA. The purpose of the mission was to make measurements of the interplanetary medium from the vicinity of the Earth orbit to 0.3 Astronomical Units (AUs). A plot of the Helios-1 and -2 orbits is given in Figures 1 and 2. To facilitate the experimental data collection, the spacecraft spin axis was maintained normal to the ecliptic at a nominal spin rate of 1 revolution per second. In addition, the spacecraft telemetry bit rate could be adjusted from 8 to 4096 bits per second (bps) in multiples of 2. While the spacecraft was moving to perihelion, the telemetry bit rate was generally 8 to 512 bps; at 0.3 AU the higher telemetry rates (i.e. 1024, 2048 and 4096 bps) were used. Instrument descriptions written by the experimenter can be found in Volume 4 of the "User's Manual for the Helios Spacecraft" and in References 1 and 2. More detail on the Helios-1 and -2 mission objectives can be found in References 1, 2, and 3. A summary of the experimental results, including a bibliography of the major papers published by the experiment team up through the summer of 1979, can be found in Reference 3.

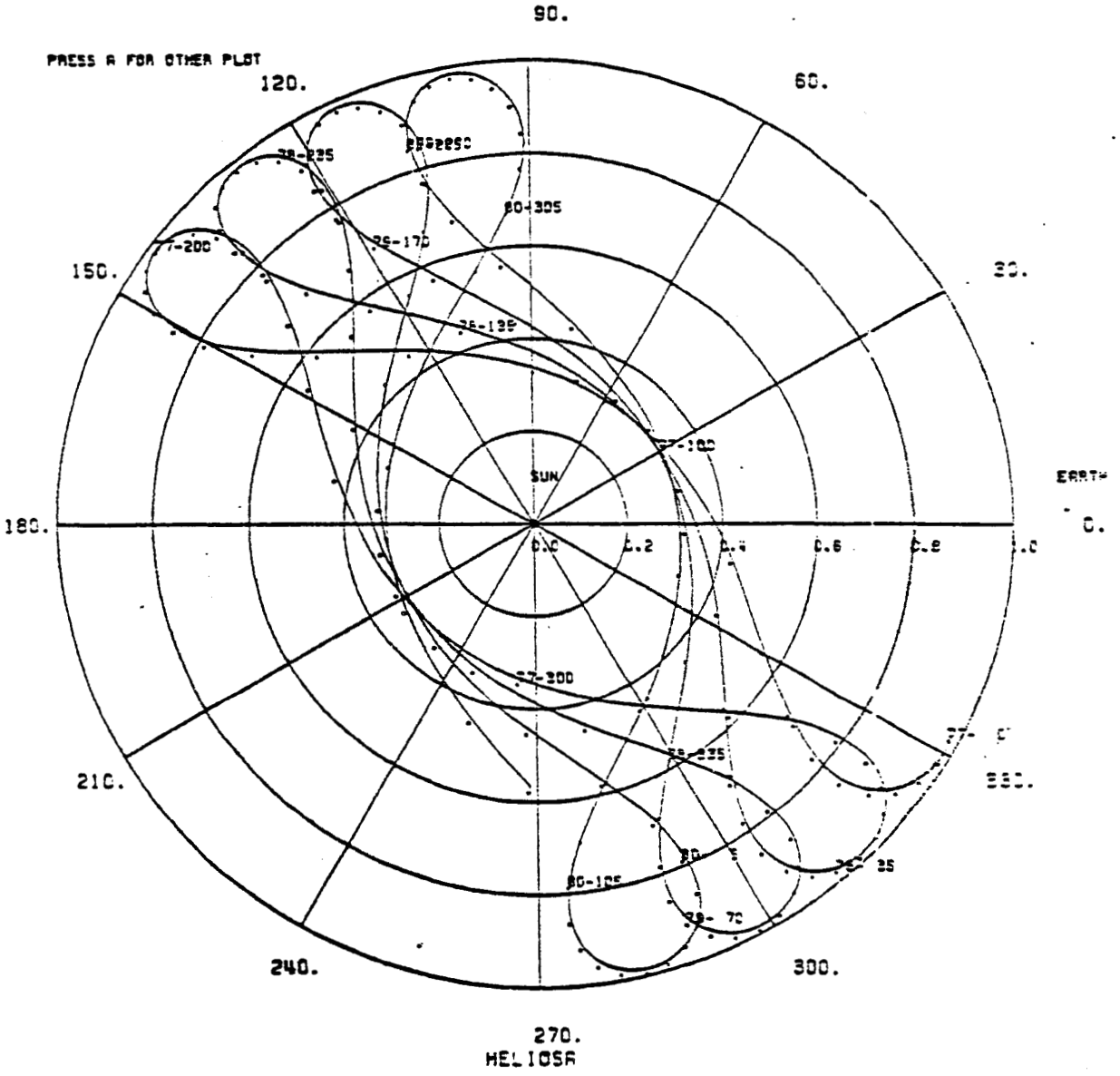


Figure 1: Polar Orbit Plot (1977-1981) for Helios 1
Relative to the Sun/Earth Line

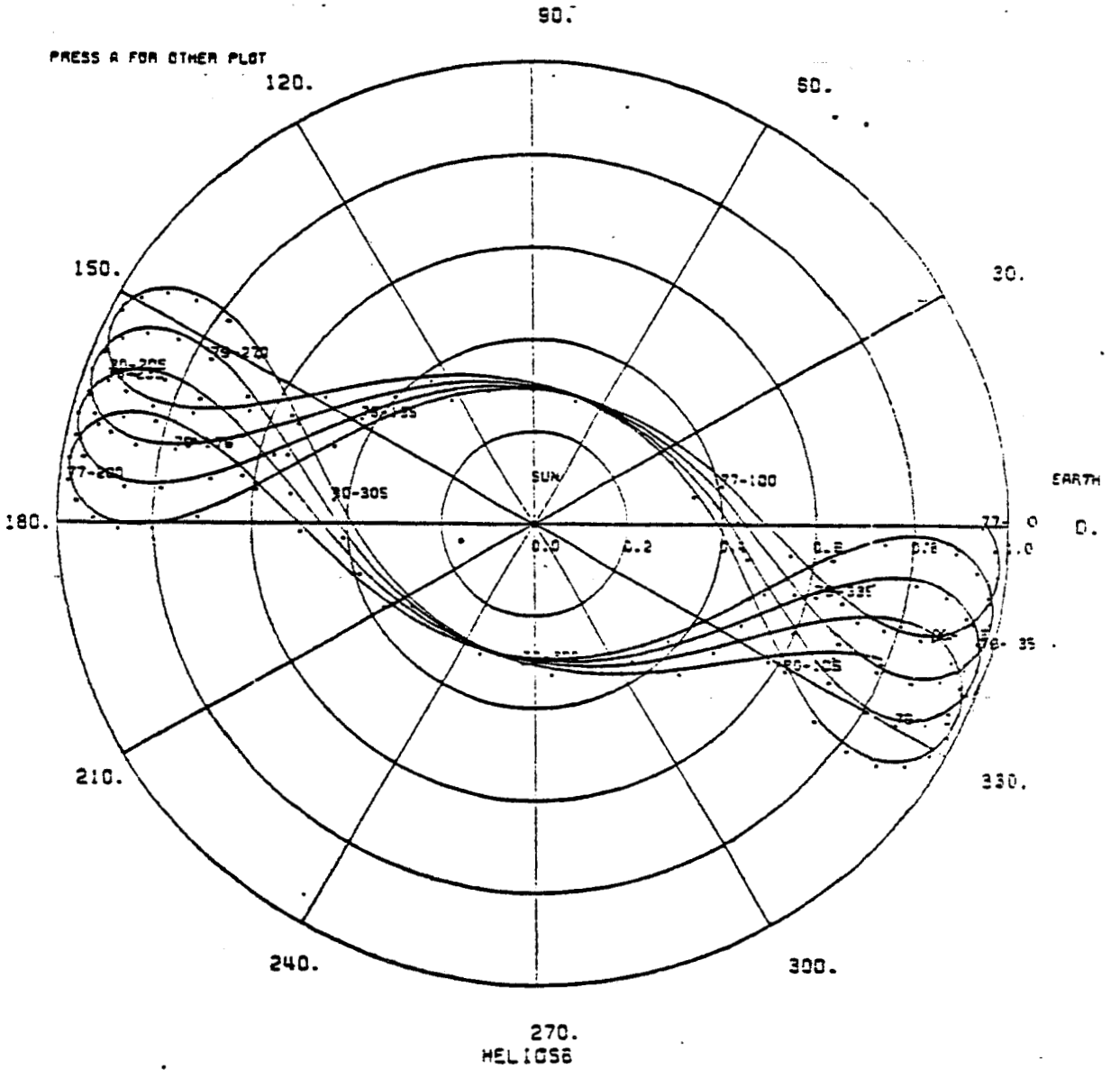


Figure 2: Polar Orbit Plot (1977-1981) for Helios 2
Relative to the Sun/Earth Line

1.2 INSTRUMENTATION

The Helios cosmic ray experiment (Experiment No. 7) incorporated three types of cosmic ray sensor systems for measuring charged particles, and a gas proportional counter for measuring solar X-rays. The High Energy Telescope (HET) cosmic ray detector measured electrons in three energy ranges between 2 and 8 MeV, as well as protons and alpha particles in three energy ranges between 20 and 800 MeV/nucleon. The first type of Low Energy Telescope (LET-I) measured protons and Z>1 particles in three energy ranges between 3 and 21 MeV/nucleon. The second type of Low Energy Telescope (LET-II) measured protons in several energy ranges between 0.21 and 2.1 MeV, alpha particles in the range between 0.6 and 2.1 MeV/nucleon, and electrons in four ranges between 0.12 and 2 MeV. There were two LET-IIs flown on each mission; one was mounted to point 20° above the ecliptic and the other pointed 20° below the ecliptic. Counting rate data were sectored into eight 45° sectors for a number of coincidence modes from each telescope. Under optimum telemetry rate conditions, five events per second were pulse height analyzed and the rate data cycle was approximately 5 minutes. At the slowest combination of bit rate and formats, a complete data cycle required about 2.5 hours. For more detail on the Helios-1 and -2 cosmic ray telescopes and telemetry modes, see References 1, 2, and 4 as well as Appendix A and B.

The experiment also contained a gas proportional counter for measuring solar X-rays in the range of 2 to 8 KeV. The gas proportional counter consisted of two independent counters sharing one pressure vessel. The primary X-ray data were obtained through a very narrow collimator. Using on-board electronics, data were accumulated in eight sections of 0.17° or 0.34° centered on the Sun. Such a system facilitated the monitoring and locating of sources of solar activity. The second aperture was viewed by means of a 53° collimator. Only low energy X-rays in the range from 2 to 8 KeV were allowed through the foils. This counter monitored detector background as well as low energy solar electrons.

1.3 EXPERIMENTAL DATA MEASUREMENTS

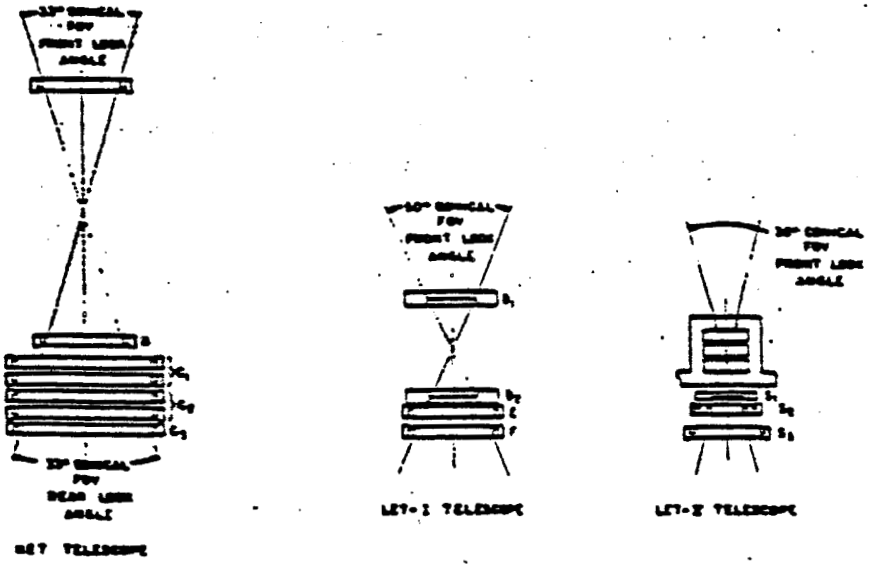
Each of the three particle detectors on Helios-1 and -2 rotated perpendicularly to the spacecraft spin axis. This allowed the incoming particle rate data to be divided into eight sectors. The individual sector count rates were collectively fit to determine the amplitude and phase of any cosmic ray anisotropy. The analytical expression used for the geometric corrections and error analysis of the Helios-1 and -2 cosmic ray data are given in Reference 4. These formulas also take into account the finite detector geometries, the variable interplanetary magnetic field and the background count rate of the particle detectors. A description of the programs which make these corrections is given in Reference 4. These programs can be used when there is a large amount of cosmic ray data which have a COS distribution and an average energy $\geq$ 1 MeV.

The actual data which were sent back by the Helios cosmic ray telescopes consisted of the following four generic types:

- Rates data
- Pulse Height Analysis (PHA) data
- Internal Calibration data
- Engineering and Housekeeping data

Rates data represent the total number of times per accumulation interval that signals exceeding specified amplitudes from one or more detectors in each telescope occurred in coincidence. These rate events were counted (accumulated) in a 24-bit counter for a period of time dependent on the bit rate and mode of spacecraft operation. Prior to transmission, data from each 24-bit counter were compressed to 12 bits by converting the number to its logarithm. After receipt of rate data on the ground, the log of each 12-bit rate word was converted back to its integer equivalent and divided by the length of the accumulation interval to yield counts per unit time (See Appendix C). For the HET system,

there are 15 basic coincidence/anti-coincidence equations and 6 single rates produced. (Note: Refer to Figure 3 for the description of where each detector element (i.e., A1) was located in a particular telescope. For more details on each detector, see References 1 and 2, and Appendix A). The rates are multiplexed into 10 telemetry words using the telemetry formats as described in Appendix C. The unsectored rate counters (R) and sectored rate counters (SR) which are used for each rate along with the particle and energy which can be measured by the counters are shown in Table 1. Note that two of the basic coincidence/anti-coincidence measurements made by the HET are sectored into eight sections and output using the sectored rate counter-1 (SR-1). The other HET rate output is sent using unsectored rate counters R1 to R8 and R-14.



A schematic drawing of the Goddard-University of New Hampshire array of solid-state detector telescopes on Pioneer-10 and -11, and the Goddard experiment on Helios I and II. For particles which traverse the High Energy Telescope (HET) (coincidence condition A · B·CIII), the pulse heights of B, CI+CII, and CIII are measured separately. For stopping particles, the pulse heights in A, B, and CI+CII were measured. The complete Pioneer system, including electronics, weighed less than 3.3 kg.

Figure 3: HET, LET-I and LET-II Telescope Assemblies

TABLE 1

Rate Counter and the Corresponding Coincidence/Anti-coincidence Rates

Notes: K1 = A + B + 1.8(C1 + C2)
ED = D1 + D2 + 1.6E
Rates 1, 2A, 2B, 3A, 11 A and 11 B are PHA conditions

RATE	COINCIDENCE DESCRIPTION
SR3D(5)	S1(8).¬S2.¬S2(A).¬S3(5)
SR3D(6)	S1(8).¬S2.¬S2(A).¬S3(6)
SR3D(7)	S1(8).¬S2.¬S2(A).¬S3(7)
SR3D(8)	S1(8).¬S2.¬S2(A).¬S3(8)
SR3D(9)	S1(8).¬S2.¬S2(A).¬S3(9)
SR3E(1)	¬S1.S2(5).¬S2(A).¬S3(1)
SR3E(2)	¬S1.S2(5).¬S2(A).¬S3(2)
SR3E(3)	¬S1.S2(5).¬S2(A).¬S3(3)
SR3E(4)	¬S1.S2(5).¬S2(A).¬S3(4)
SR3E(5)	¬S1.S2(5).¬S2(A).¬S3(5)
SR3E(6)	¬S1.S2(5).¬S2(A).¬S3(6)
SR3E(7)	¬S1.S2(5).¬S2(A).¬S3(7)
SR3E(8)	¬S1.S2(5).¬S2(A).¬S3(8)
SR3E(9)	¬S1.S2(5).¬S2(A).¬S3(9)
SR3F(1)	¬S1.S2(6).¬S2(A).¬S3(1)
SR3F(2)	¬S1.S2(6).¬S2(A).¬S3(2)
SR3F(3)	¬S1.S2(6).¬S2(A).¬S3(3)
SR3F(4)	¬S1.S2(6).¬S2(A).¬S3(4)
SR3F(5)	¬S1.S2(6).¬S2(A).¬S3(5)
SR3F(6)	¬S1.S2(6).¬S2(A).¬S3(6)
SR3F(7)	¬S1.S2(6).¬S2(A).¬S3(7)
SR3F(8)	¬S1.S2(6).¬S2(A).¬S3(8)
SR3F(9)	¬S1.S2(6).¬S2(A).¬S3(9)
SR3G(1)	¬S1.S2(7).¬S2(A).¬S3(1)
SR3G(2)	¬S1.S2(7).¬S2(A).¬S3(2)
SR3G(3)	¬S1.S2(7).¬S2(A).¬S3(3)
SR3G(4)	¬S1.S2(7).¬S2(A).¬S3(4)
SR3G(5)	¬S1.S2(7).¬S2(A).¬S3(5)
SR3G(6)	¬S1.S2(7).¬S2(A).¬S3(6)
SR3G(7)	¬S1.S2(7).¬S2(A).¬S3(7)
SR3G(8)	¬S1.S2(7).¬S2(A).¬S3(8)
SR3G(9)	¬S1.S2(7).¬S2(A).¬S3(9)
SR3H(1)	¬S1.S2(8).¬S2(A).¬S3(1)
SR3H(2)	¬S1.S2(8).¬S2(A).¬S3(2)
SR3H(3)	¬S1.S2(8).¬S2(A).¬S3(3)
SR3H(4)	¬S1.S2(8).¬S2(A).¬S3(4)
SR3H(5)	¬S1.S2(8).¬S2(A).¬S3(5)
SR3H(6)	¬S1.S2(8).¬S2(A).¬S3(6)
SR3H(7)	¬S1.S2(8).¬S2(A).¬S3(7)
SR3H(8)	¬S1.S2(8).¬S2(A).¬S3(8)
SR3H(9)	¬S1.S2(8).¬S2(A).¬S3(9)
SXRY(1)	SECTORED X-RAY(1)
SXRY(2)	SECTORED X-RAY(2)
SXRY(3)	SECTORED X-RAY(3)
SXRY(4)	SECTORED X-RAY(4)
SXRY(5)	SECTORED X-RAY(5)
SXRY(6)	SECTORED X-RAY(6)
SXRY(7)	SECTORED X-RAY(7)
SXRY(8)	SECTORED X-RAY(8)
SXRY(9)	SECTORED X-RAY(9)
R1	(A2.K1+A1.C1).B.¬C3
R2A	A1.¬A2.B.C3
R3A	A2.B.C3
R4A	A2.B.K2.C1.¬C2
R5A	A2.B.K2.C1.C2.¬C3
R6A	A1.¬A2.B.¬C1
R7A	A1.¬A2.B.C1.C2.¬C3
R8A	A2.B.K1.C1.¬C2
R9A	S1.S2.S2(A).S3
R10A	D1(1)
R11A	D1.D2.¬F
R12A	D1.D2.E1.¬F
R13A	D1.D2.E2.¬F
R14A	D1
R15A	S1(1).¬S2.¬S2(A).¬S3
R16A	S1.S2(1).¬S2(A).¬S3
R17A	S1
R18A	S1(1).¬S2.¬S2(A).¬S3
R19A	S1.S2(1).¬S2(A).¬S3
R20	UNSECTORED X-RAY
R2B	A1.B.K2.¬C3
R3B	A2.B.K2.¬C1
R4B	A1
R5B	A2
R6B	A1.¬A2.B.C1.¬C2
R7B	A2.B.K1.¬C1
R8B	A2.B.K1.C1.C2.¬C3
R9B	S1.S2.S2(A).S3
R10B	D1(2)
R11B	D1.D2.SIGMA-D.¬F
R12B	D1.D2.SIGMA-D.E3.¬F
R13B	D1.D2.SIGMA-D.E4.¬F
R14B	D2
R15B	S1(2).¬S2.¬S2(A).¬S3
R16B	S1.S2(2).¬S2(A).¬S3
R17B	S2
R18B	S1(2).¬S2.¬S2(A).¬S3
R19B	S1.S2(2).¬S2(A).¬S3
R10C	D1(3)
R14C	E1
R15C	S1(3).¬S2.¬S2(A).¬S3
R16C	S1.S2(3).¬S2(A).¬S3
R17C	S2(A)
R18C	S1(3).¬S2.¬S2(A).¬S3
R19C	S1.S2(3).¬S2(A).¬S3
R10D	D1(4)
R14D	F
R15D	S1(4).¬S2.¬S2(A).¬S3
R16D	S1.S2(4).¬S2(A).¬S3
R17D	S3
R18D	S1(4).¬S2.¬S2(A).¬S3
R19D	S1.S2(4).¬S2(A).¬S3
R10E	D1(5)
R14E	E
R17E	S1
R10F	D1(6)
R14F	C1
R17F	S2
R10G	D1(7)
R14G	C2
R17G	S2(A)
R10H	D1(8)
R14H	C3
R17H	S3

Notes :

K1 = A + B + 1.8 (C1 + C2)

ED = D1 + D2 + 1.6E

Rates 1, 2A, 2B, 3A, 11 A and 11 B are PHA conditions

For the LET-I system, the R10 to R14 and SR1 counters are used. Twelve single rates and six coincidence/anti-coincidence equations are monitored. The rates D1.D2.-F and D1.D2.E1.-F are sent back both in sectored and unsectored format. For each of the two LET-II systems, four single rates and 16 coincidence/anti-coincidence equations are monitored, as shown in Table 1. (Note in Table 1, the two LET-II systems are labeled as VLET-1 and VLET-2). Counters R9, R15 to R19, and SR2 to SR3 are used to accumulate LET-II data. Finally, the solar X-ray data are accumulated in counters R20 and SR4. For more details on the Helios rates system, see Appendix C.

Pulse Height Analyzer (PHA) data represent the digitized amplitude of each of three specified detector signals appearing in coincidence. The PHA resolves the amplitude of each pulse into one part in 1024 (10 bits). Each amplitude is transmitted in binary form as a 12-bit word. Each PHA readout is a selected coincidence event during the accumulation interval and the data represent the amplitudes of each of the three detector signals rather than the number of events per unit time. Four HET coincidence counters and two LET conditions can initiate PHA analysis. These conditions are labeled by an asterisk in Table 1. The method used for selecting which PHA event is to be sent along with other details of how the PHA system works, is given in Appendix C. Normally, the HET and LET PHA blocks alternate with one another in the data.

The internal calibration data as well as the engineering and housekeeping data are used by the experimenter for checking the operation of their instruments. This information is only used on special occasions by the experimenter and is not directly used for the routine processing of the particle data.

Section 2
ANALYSIS

2.1 INTRODUCTION

The previous section described the data which are input to the Helios data processing system. This section will describe the output from the Helios data processing system as well as list crucial information for understanding the appropriate output. Basically, routine analysis of the output from the cosmic ray data processing system will consist of either time history analysis or energy spectra analysis. Time history analysis examines the measured differential or integral intensities of different particle species over time. This analysis will often indicate time periods when the scientific data were particularly noteworthy and may also show evidence that the instrument was not operating properly. Energy spectra analysis is used to assure proper operation of the instrument and to study the energy spectra of the data during times of particular scientific interest. Examples of each type of analysis are given in the following section.

2.2 TIME HISTORY ANALYSIS

Often, an analytical effort will begin by examining the flux of different particle species as a function of time. For Helios-1 and -2 the following data are plotted versus time as part of the normal production processing:

- R1, (A2.K1+A1.C1).B.-C3, Protons, Z≥2: 20-56 MeV/nucleon Electron: 2-8 MeV
- R2A, A1.-A2.B.C3, Protons > 230 MeV
- R2B, A1.B.K2.-C3, Z≥2 : 20-56 MeV/nucleon
- R3A, A2.B.C3, Alphas > 56 MeV/nucleon
- R4B, A1
- R5B, A2
- R6A, A1.-A2.B.-C1, Electrons: 2-4 MeV
- R6B, A1.-A2.B.-C1.-C2, Electrons: 4-6 MeV
- R7A, A1.-A2.B.C1.C2 C3, Electrons: 6-8 MeV
- R7B, A2.-B.K1.-C1, Protons, Alphas: 20-30 MeV/nucleon
- R8B, A2.B.K1.C1.C2.-C3, Protons, Alphas: 45-56 MeV/nucleon
- R9B, S1.S2.S2(A).S3
- R10A (Helios-2 only), D1(1)
- R10B, D1(2) .3 MeV/nucleon
- R10C, D1(3) .43 MeV/nucleon
- R10D, D1(4) .68 MeV/nucleon
- R10E, D1(5) .94 MeV/nucleon
- R10F, D1(6) 1.4 MeV/nucleon
- R10G, D1(7) 2.0 MeV/nucleon

- R10H, D1(8) 3.0 MeV/nucleon
- R11A, D1.D2.-F, Protons, Z≥2:3-21 MeV/nucleon
- R12A, D1.D2.E1.-F, Protons, Z≥2:6-21 MeV/nucleon
- R13A, D1.D2.E2-F, Protons, Z≥2:10-21 MeV/nucleon
- R14A, D1
- R14B, D2
- R14C, E1
- R14D, F
- R14E, E
- R14F, C1
- R14G, C2
- R14H, C3
- R15B, S1(2).-S2.-S2(A).-S3 Protons: .72 2.1 MeV
- R16A, S1.S2(1).-S2(A).-S3 Protons: 3.2-21 MeV
- R16B, S1.S2(2).-S2(A).-S3 Protons: 5.7-21 MeV
- R16C, S1.S2(3).-S2(A).-S3 Protons: 15.1-21.2 MeV
- R17B, S2 VLET-1
- R17F, S2 VLET-2
- R17H, S3 VLET-2
- R20 - unsectored X-ray data
- SR1A, A1.-A2.B.C1.-C3, Electrons: 4-8 MeV
- SR1B, A2.B.K1.-C3, Protons, Z≥2: 20-56 MeV/nucleon
- SR1C, D1.D2.-F, Protons, Z≥2: 3-21 MeV/nucleon
- SR1D, D1.D2.E1.-F(9), Protons, Z≥2: 6-21 MeV/nucleon

- SR2A (Helios-2 only) S1(5),-S2,-S2A,-S3(9) Protons: 12-2.1 MeV
- SR2B, S1(6),-S2,-S2(A),-S3(9) Protons: .52-2.1 MeV
- SR2C, S1(7),-S2,-S2(A),-S3(9) Protons: 1.1-2.1 MeV
- SR2D, S1(8),-S2,-S2(A),-S3(9) Protons: 1.5-2.1 MeV
- SR2E, -S1,S2(5),-S2(A),-S3(9) Electrons: .12-2 MeV
- SR2F, -S1,S2(6),-S2(A),-S3(9) Electrons: .40-2 MeV
- SR2G, -S1,S2(7),-S2(A),-S3(9) Electrons: .68-2 MeV
- SR3A (Helios-2 only) same as SR2A from VLET-2
- SR3B - same as SR2B from VLET 2
- SR3C - same as SR2C from VLET 2
- SR3D - same as SR2D from VLET 2
- SR3E - same as SR2E from VLET 2
- SR3F - same as SR2F from VLET 2
- SR3G - same as SR2G from VLET 2
- SR3H - same as SR2H from VLET 2
- 3.31-6.05 MeV Proton Flux - LS2
- 6.05-21.6 MeV Proton Flux - LS3
- 31.0-57.22 MeV Proton Flux - HS3
- 141.-219 MeV Proton Flux - HPFB
- 3.20-4.98 MeV Alpha Flux - LS2
- 5.35-21.6 MeV Alpha Flux - LS3
- 31.12-57.53 Alpha Flux - HS3
- 135.8-240.0 MeV Alpha Flux - HPFB

Figures 4 through 24 show examples of the data taken by Helios during the first week of September 1977; the data were averaged over 1-hour intervals. The R1, R3A, and R12A data are routinely delivered to the National Space Science Data Center (NSSDC) along with orbit information and sectored X-ray data.

The rates data are primarily used for monitoring general cosmic ray activity. When more detailed flux information about individual events is required, the PHA data are used. Here, flux is defined as the number of particles/unit time/unit energy interval/detector area/solid angle. The number of particles per unit time is measured by the rate counters. The unit energy intervals, which can be measured by the HET, LET, and VLET detectors, are given by the threshold, channel width, and full scale readings for each detector as defined in Table 2. The product of the detector area and solid angle measured by the detector is called the "geometry factor". The geometry factor for the various detectors is given in Table 2. The actual equation which is used to calculate particle flux from PHA data is the following:

$$\text{flux} = \frac{n * R}{T * GF * E * N}$$

n = number of events measured by the PHA detectors
T = time elapsed
GF = Geometry Factor
E = Energy bin
R = number of events measured by the rate counters
N = total number of events in the PHA energy matrix as measured by the rate counter

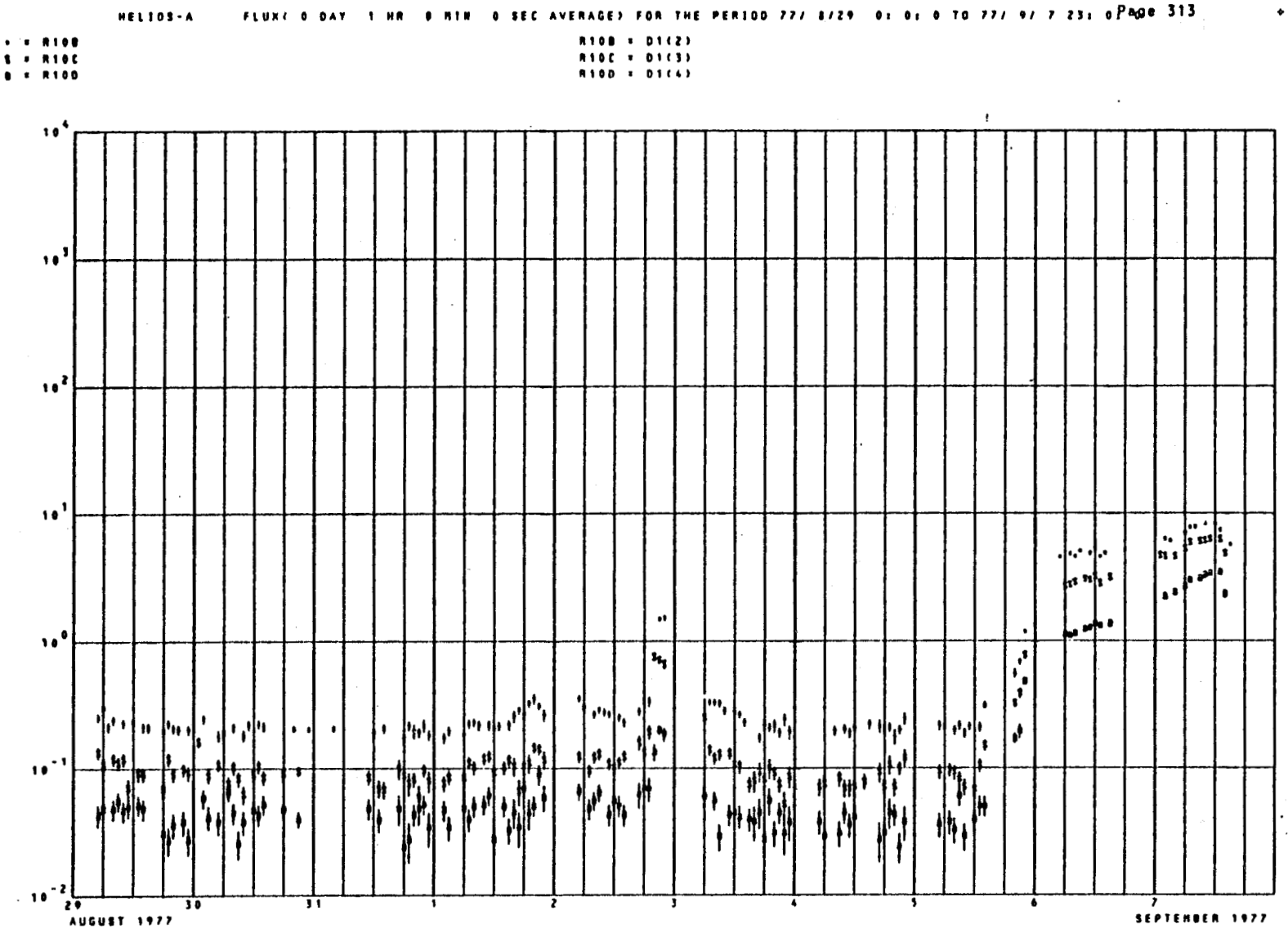


Figure 4: Sample Rate Plots

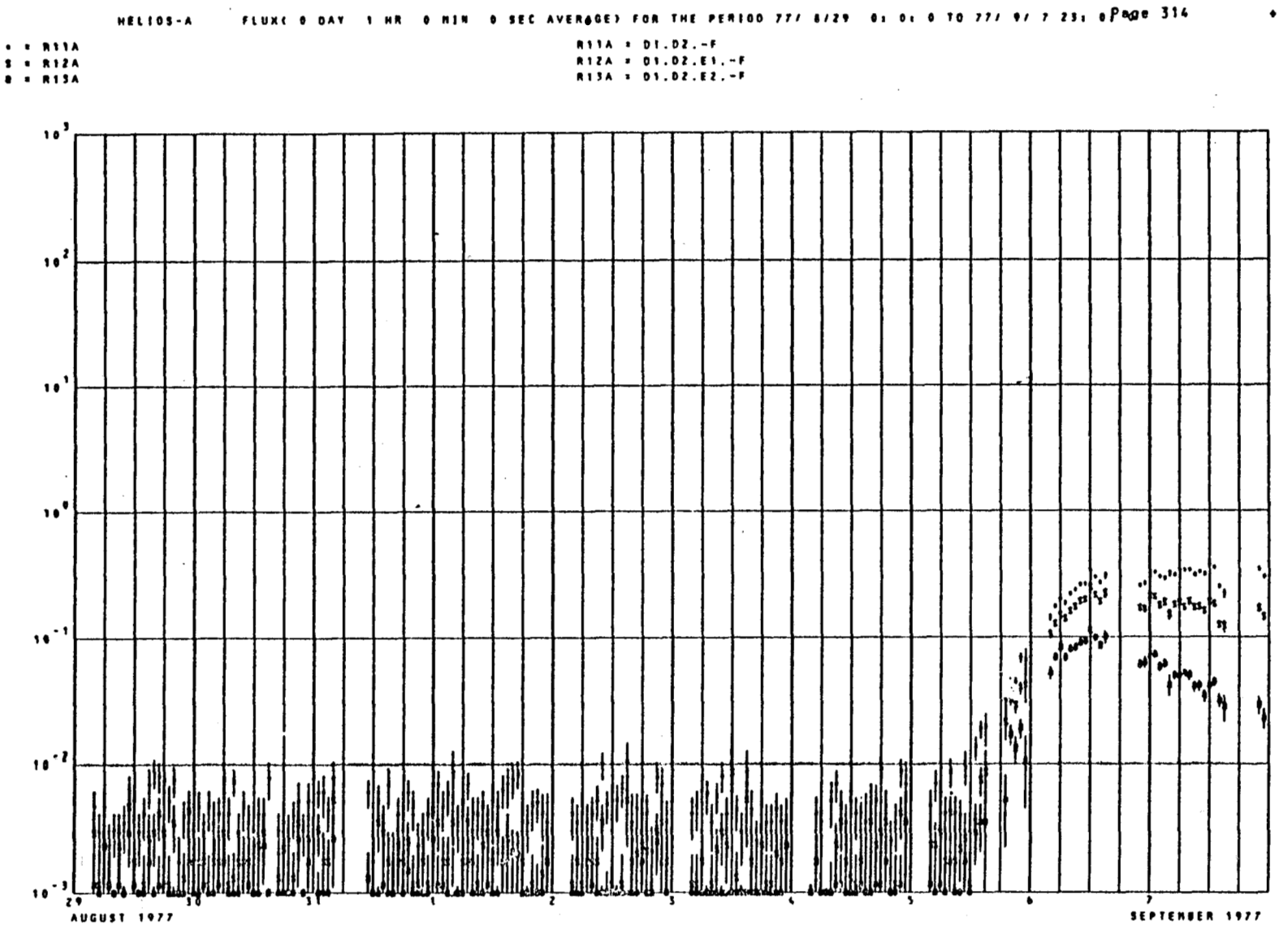


Figure 5: Sample Rate Plots

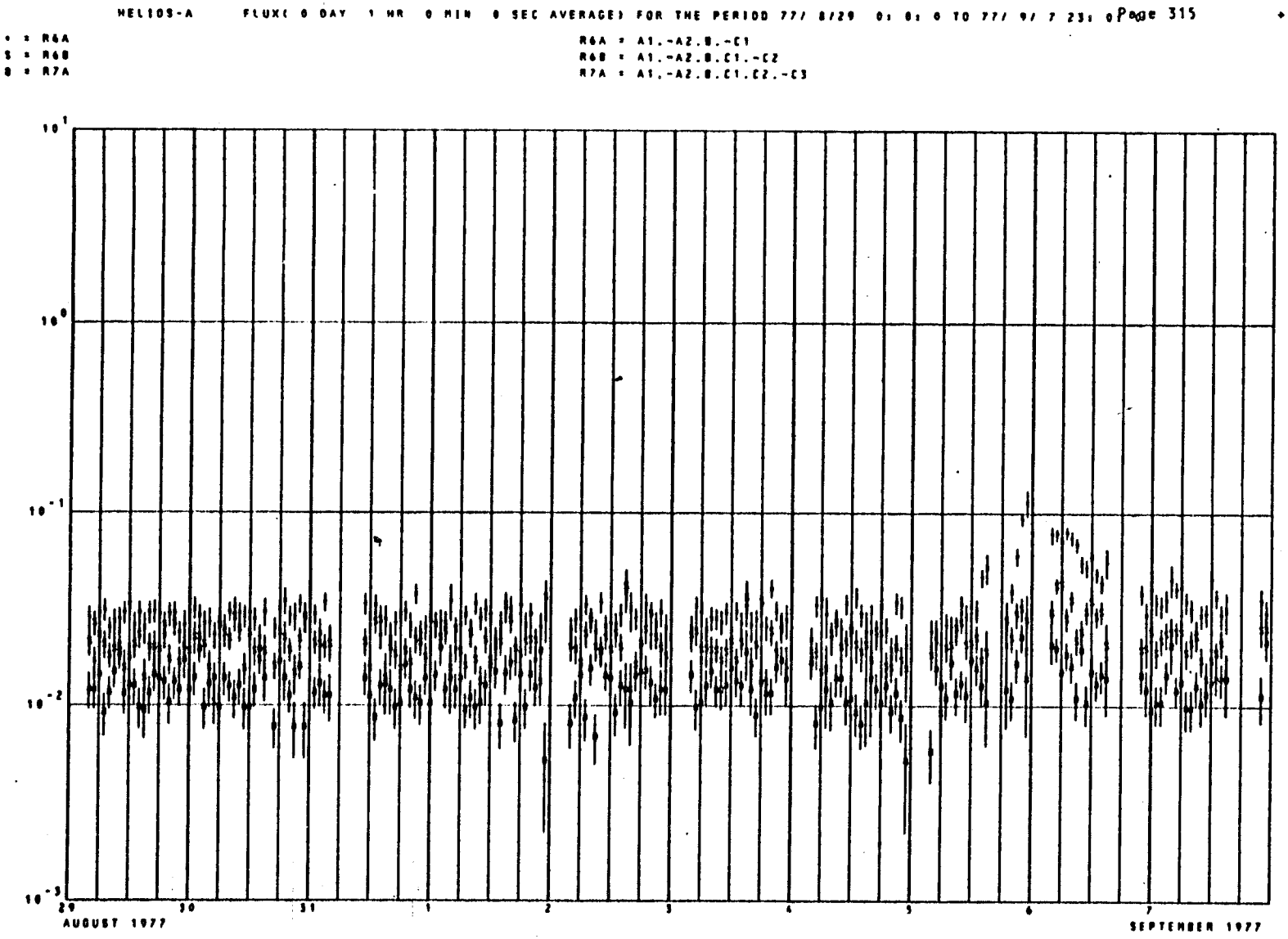


Figure 6: Sample Rate Plots

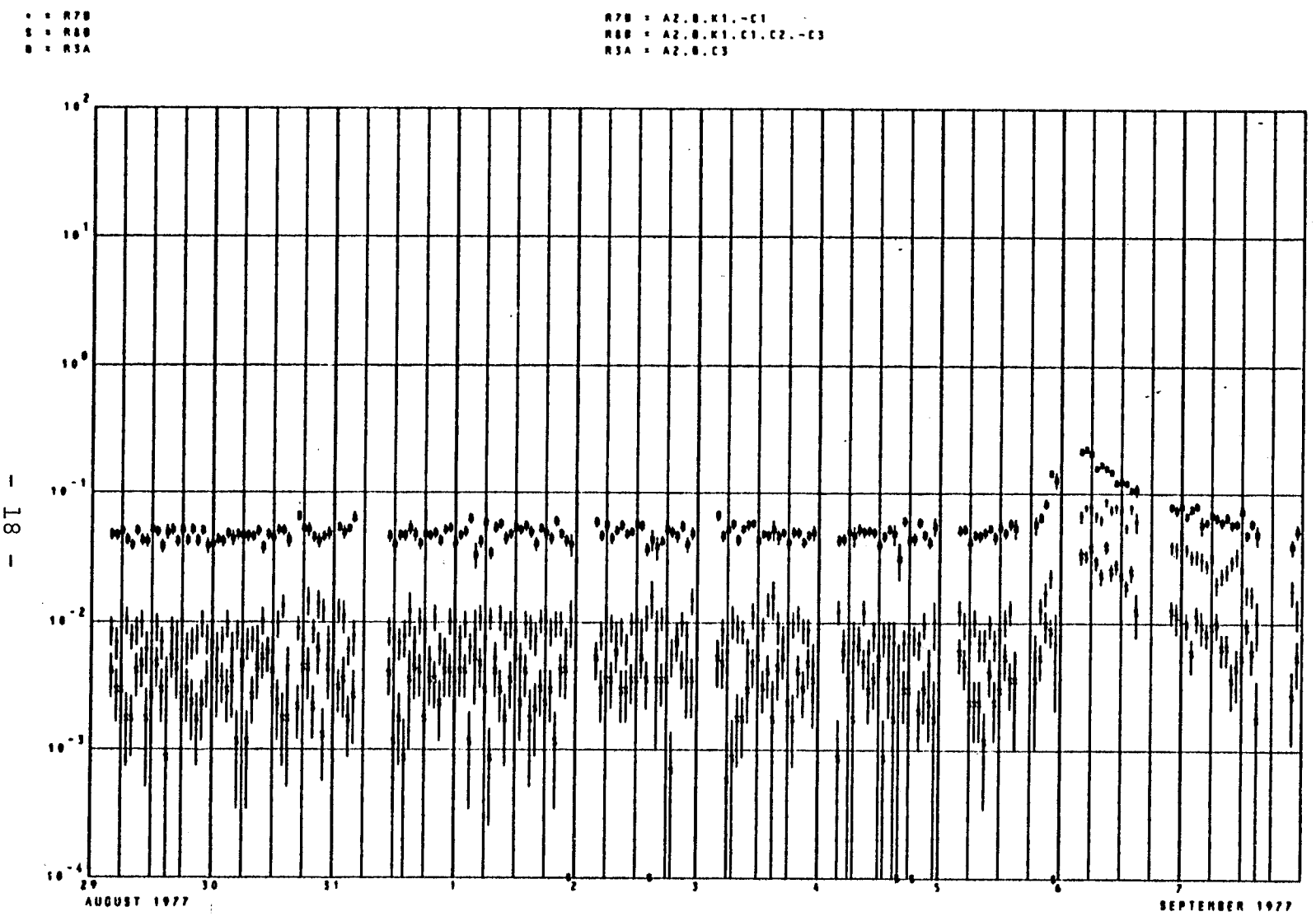


Figure 7: Sample Rate Plots

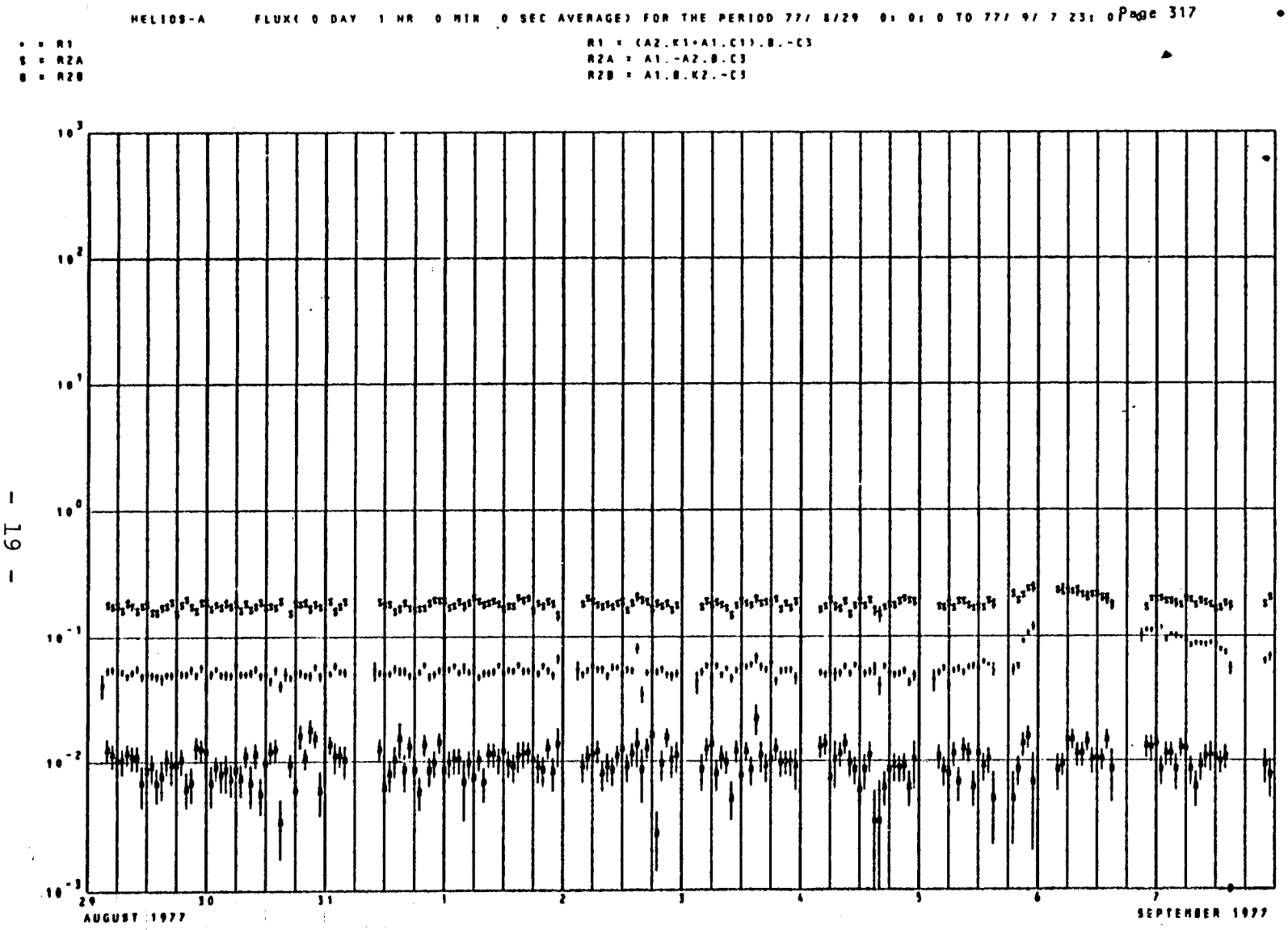


Figure 8: Sample Rate Plots

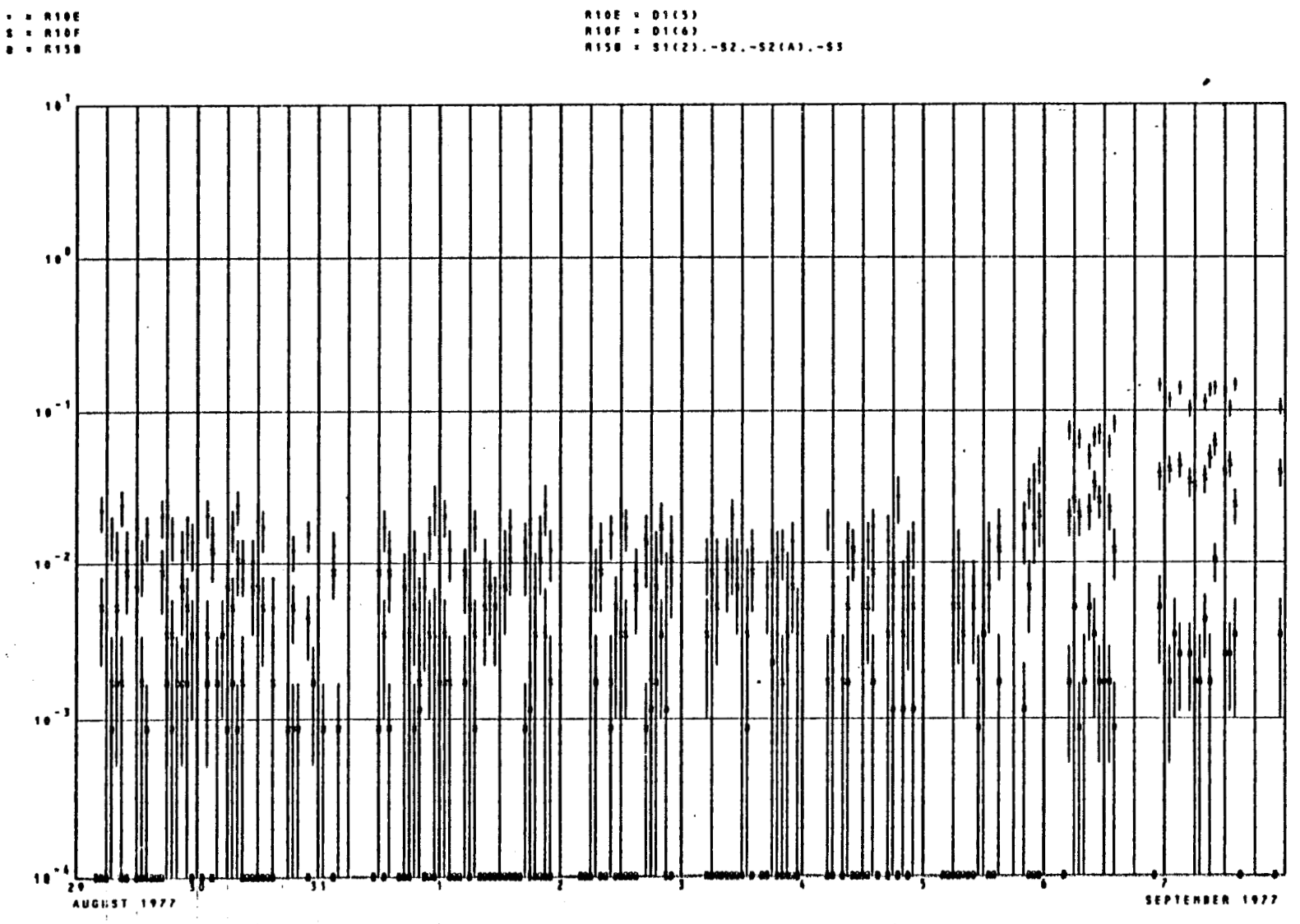


Figure 9: Sample Rate Plots

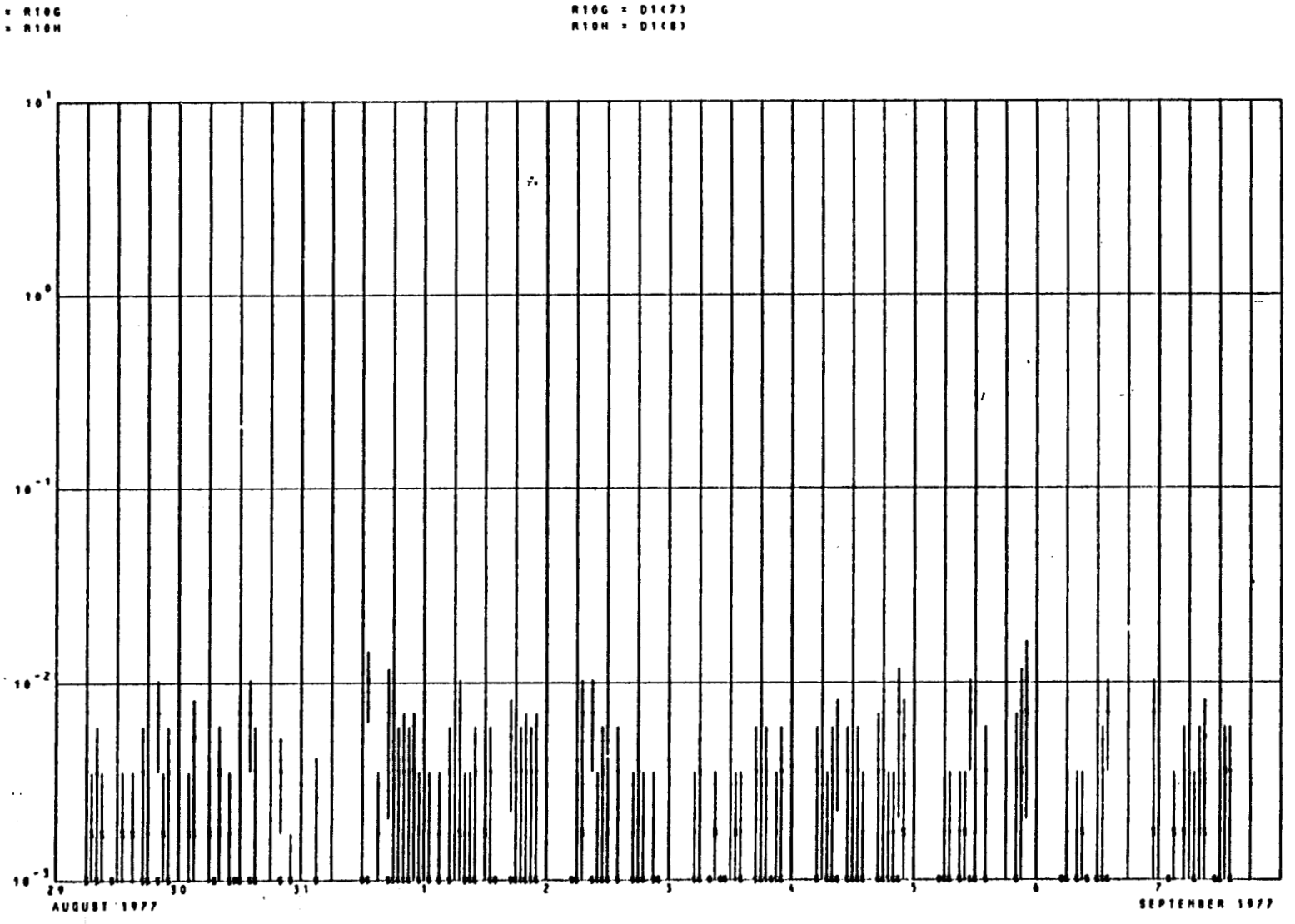


Figure 10: Sample Rate Plots

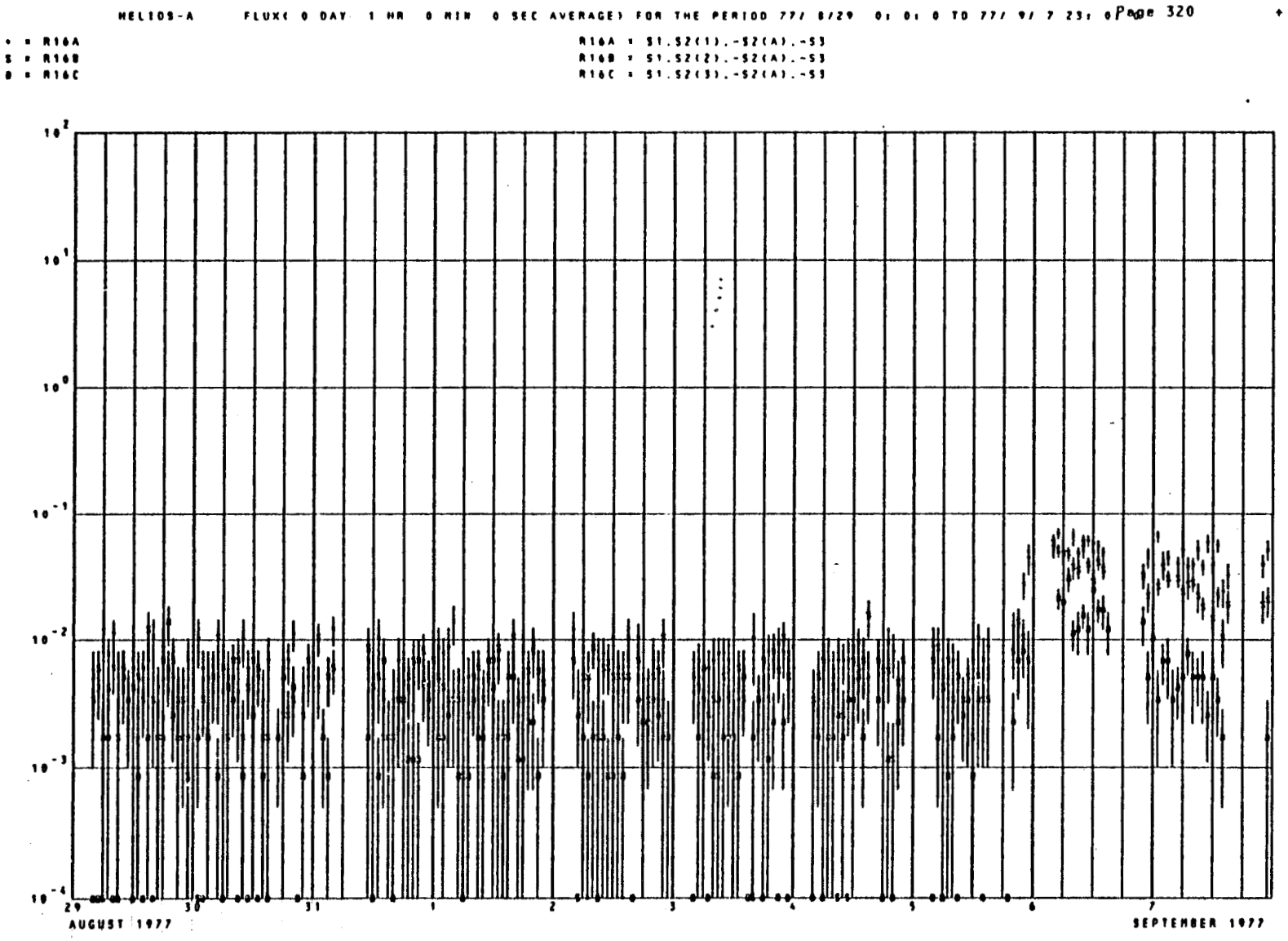


Figure 11: Sample Rate Plots

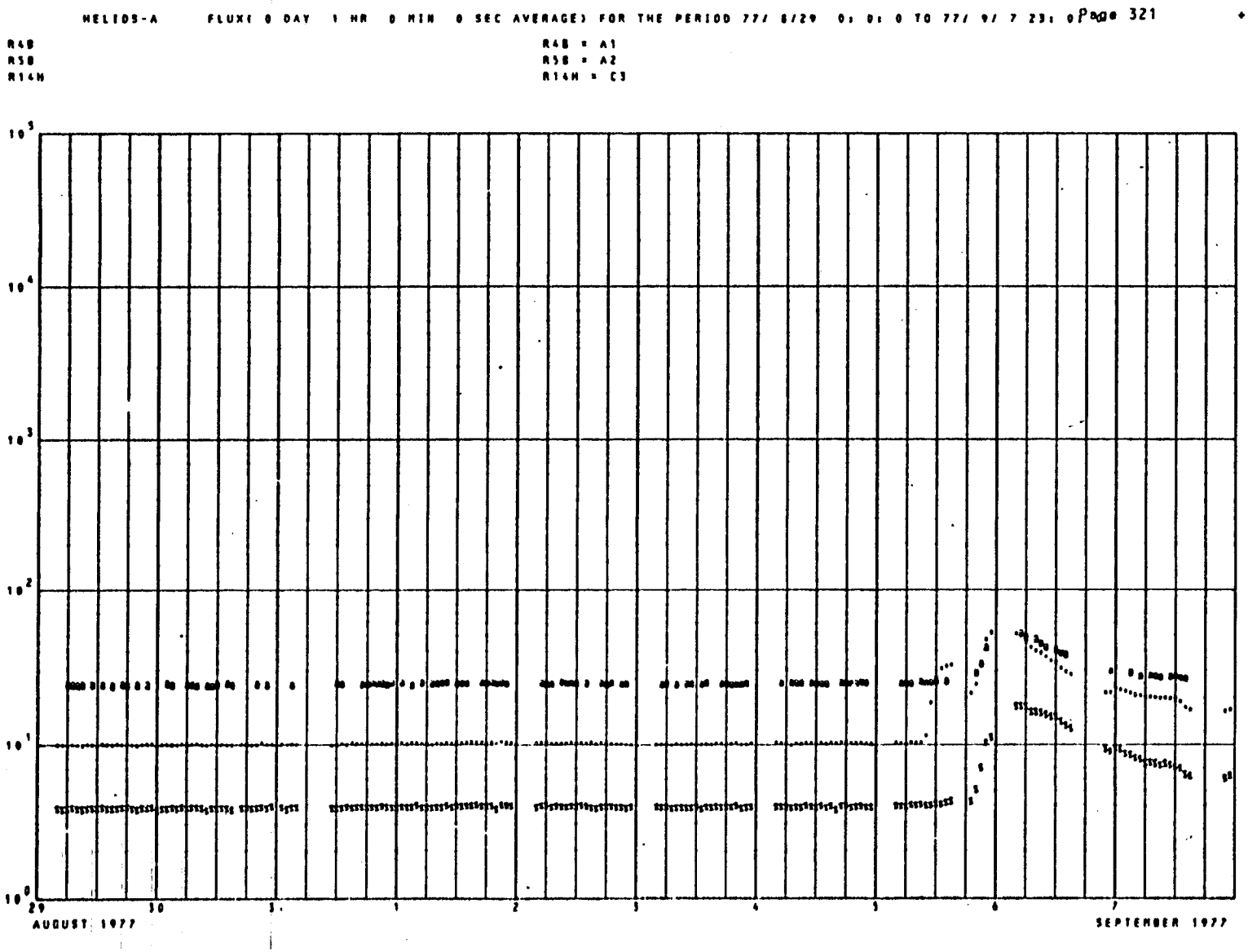


Figure 12: Sample Rate Plots

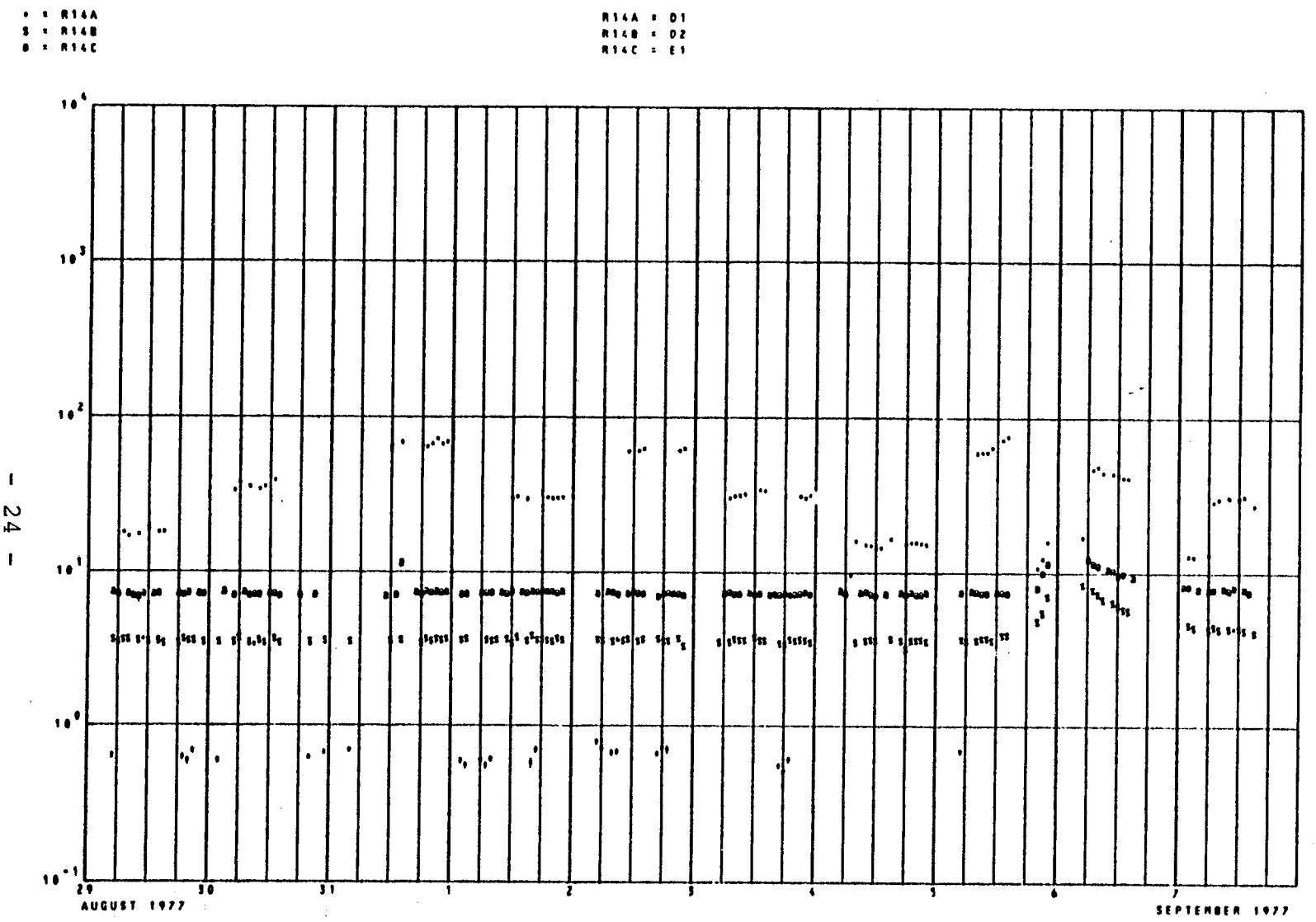


Figure 13: Sample Rate Plots

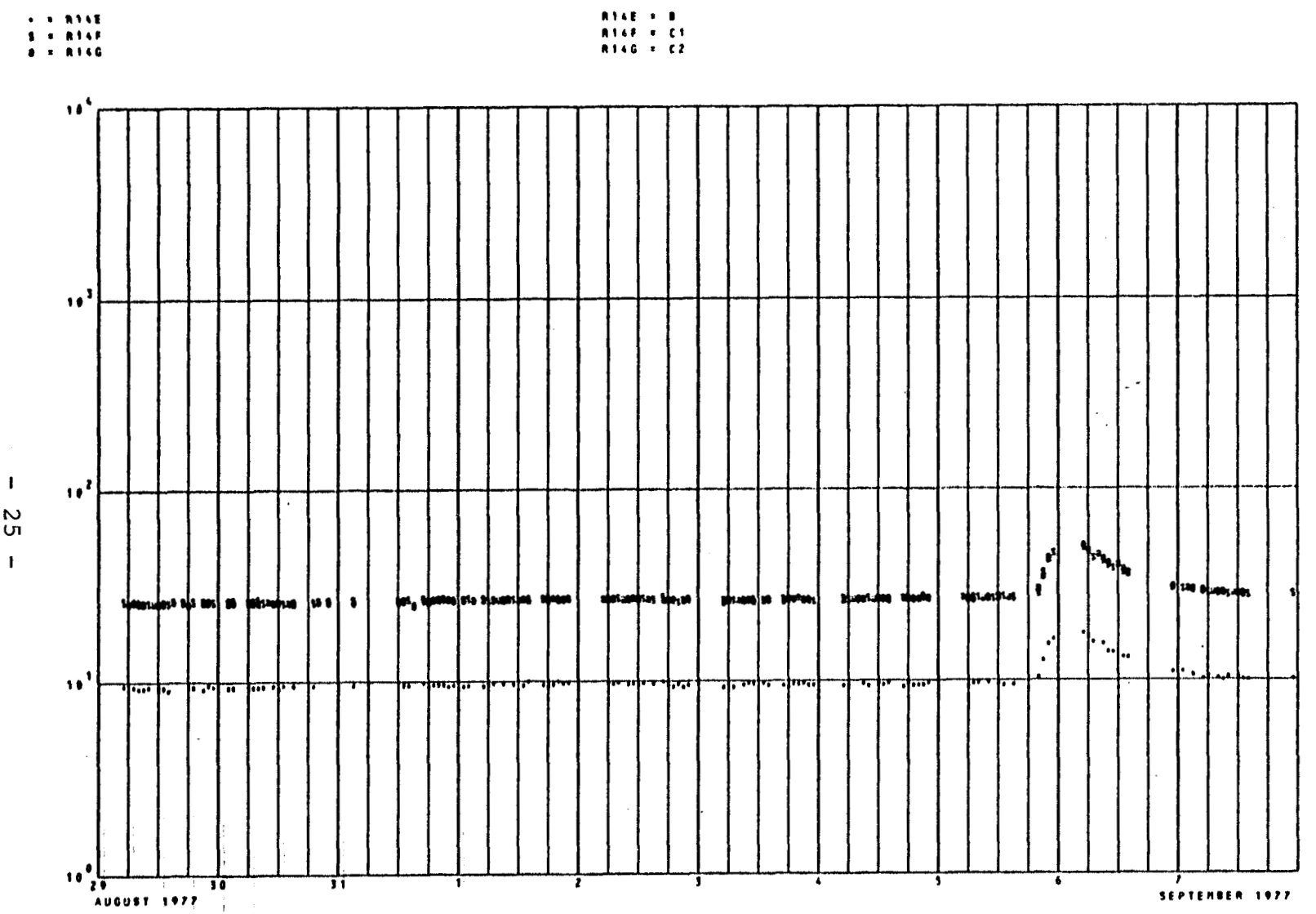


Figure 14: Sample Rate Plots

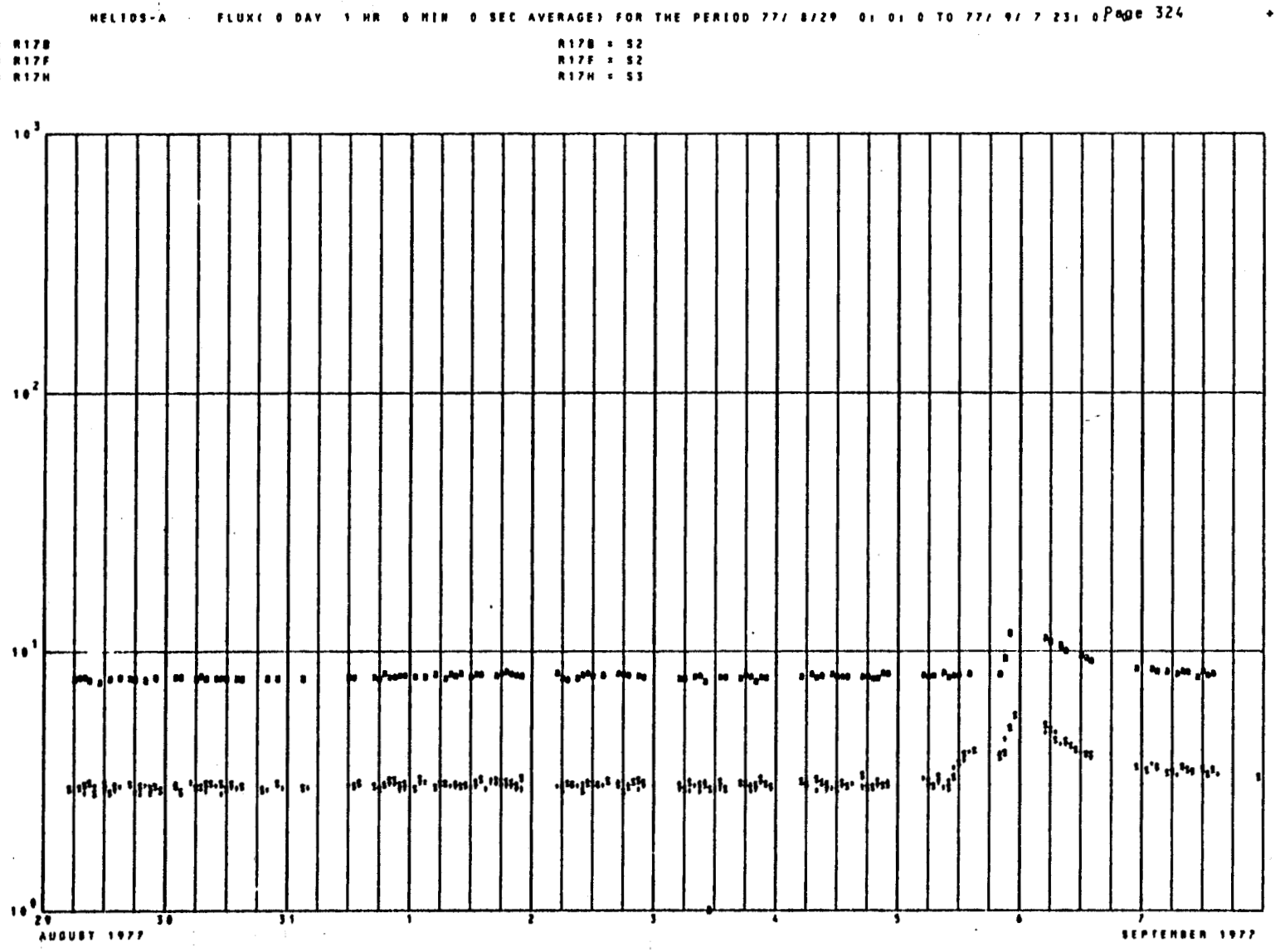


Figure 15: Sample Rate Plots

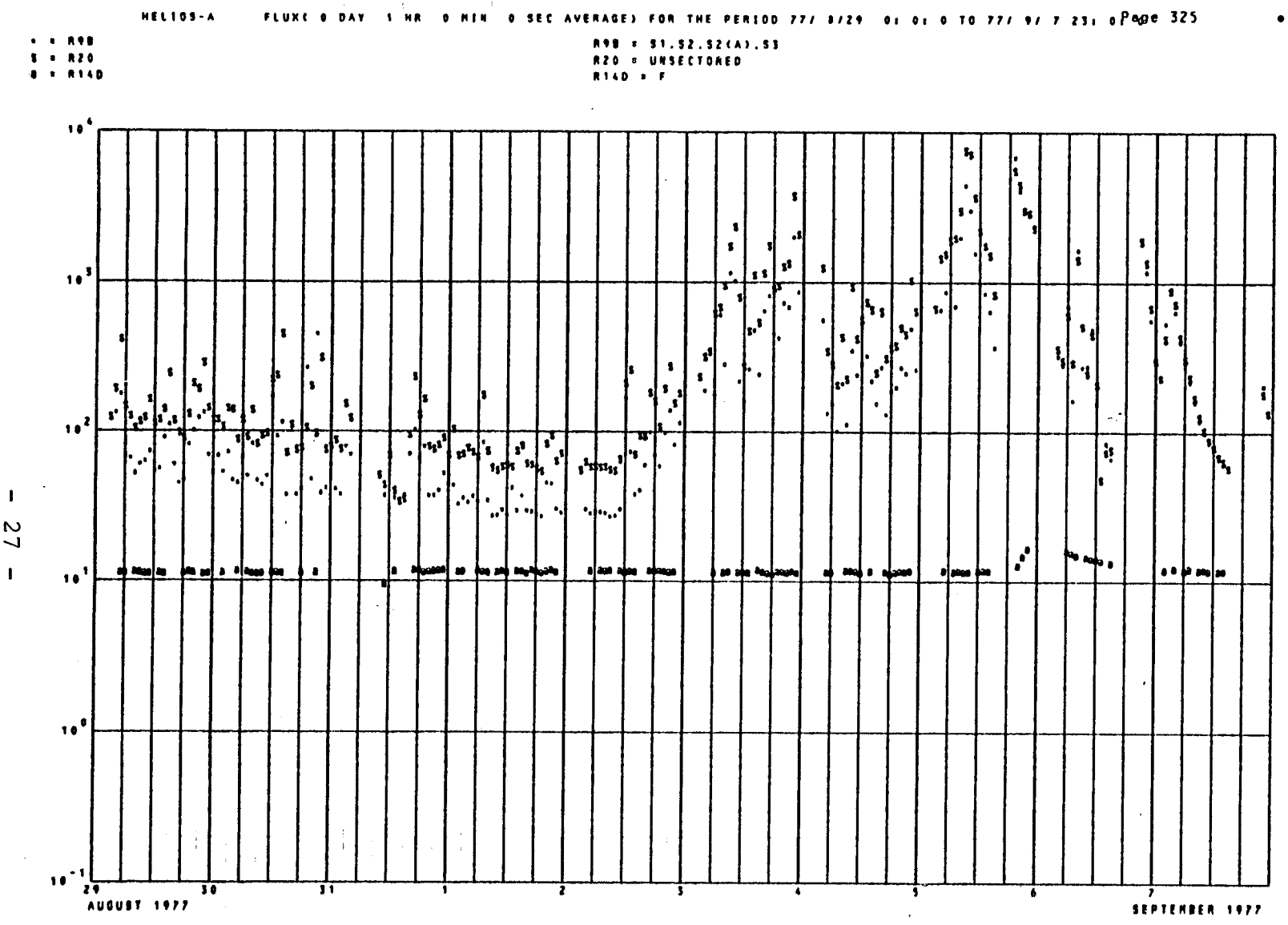


Figure 16: Sample Rate Plots

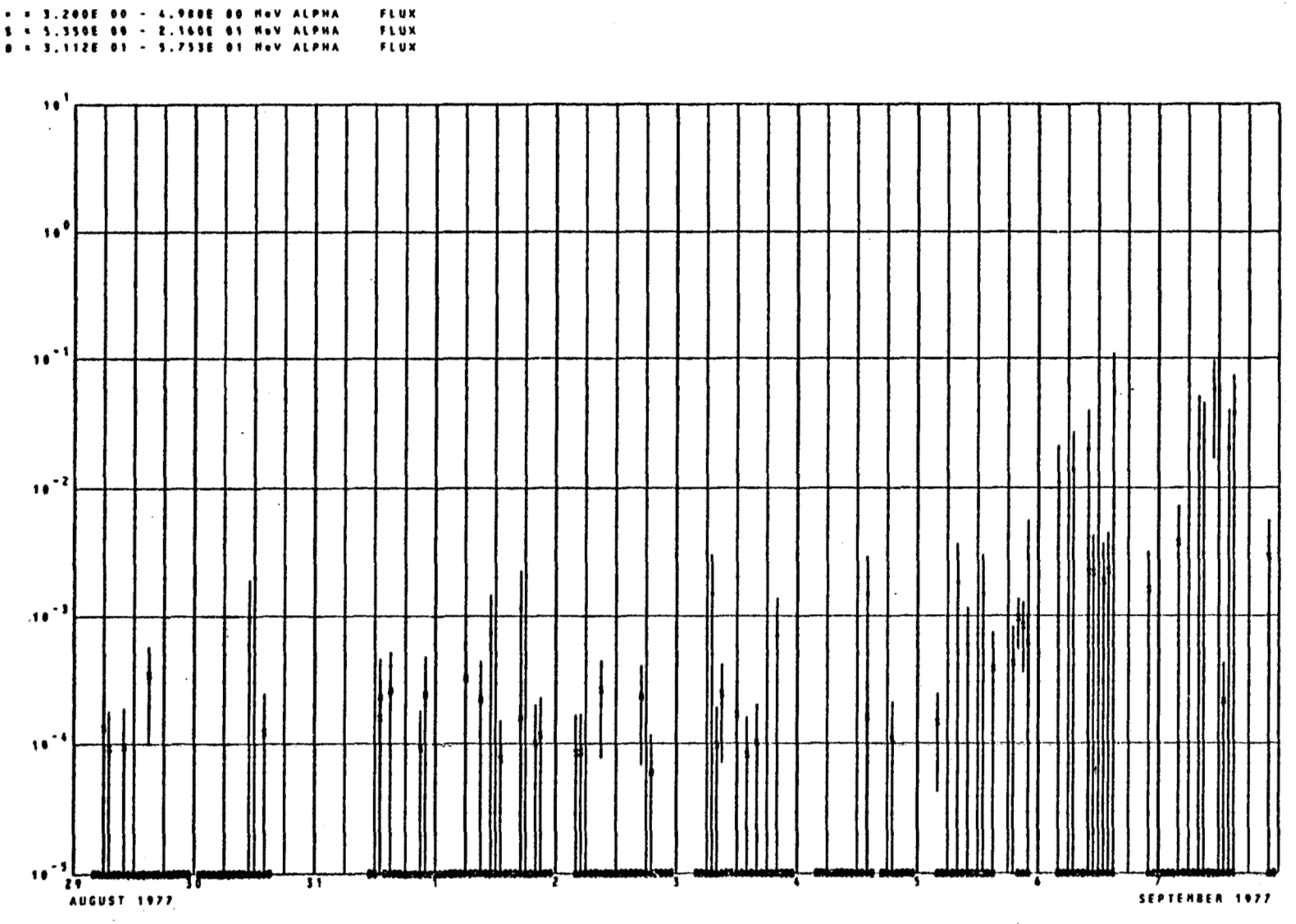


Figure 17: Sample Rate Plots

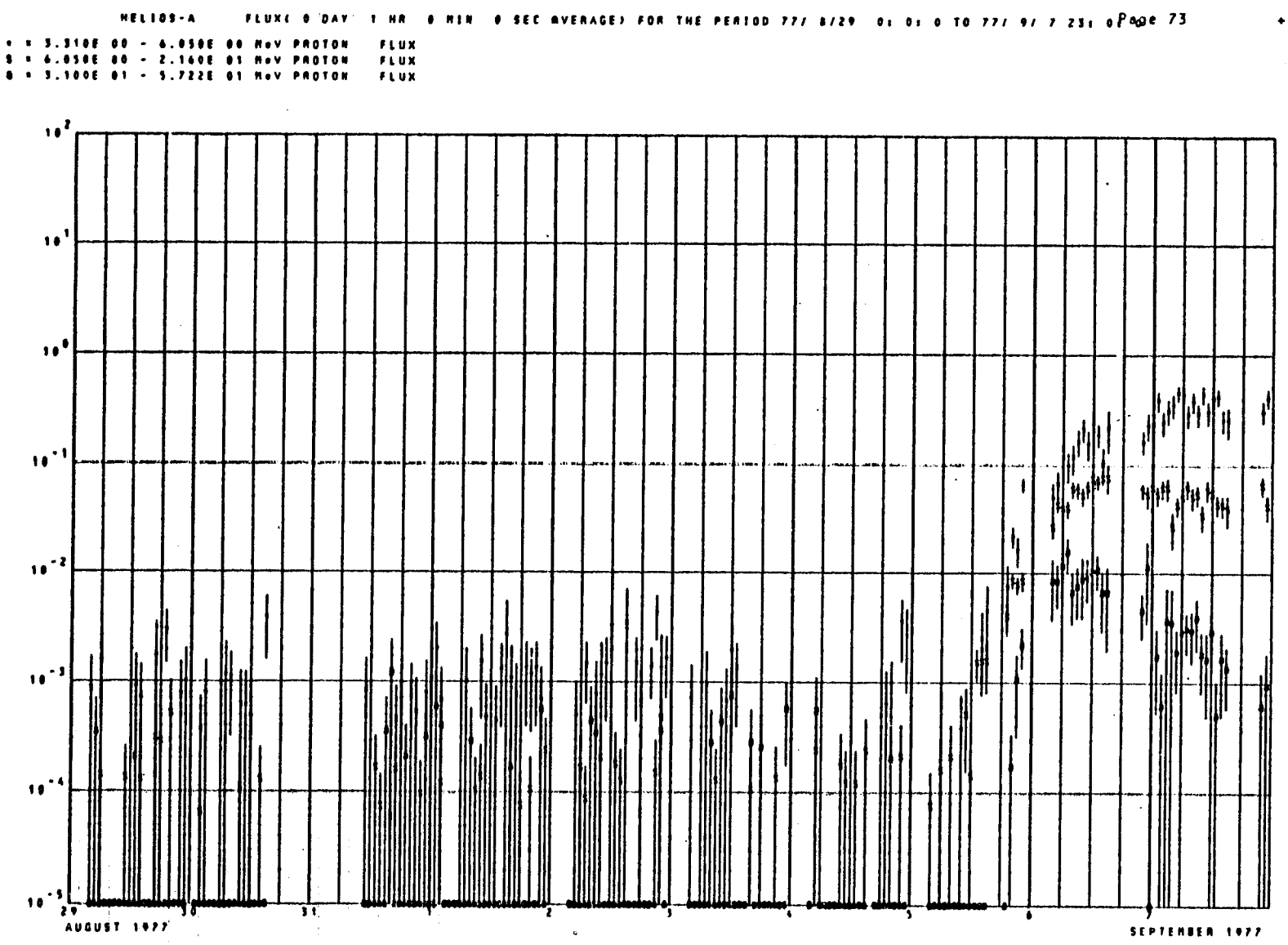


Figure 18: Sample Rate Plots

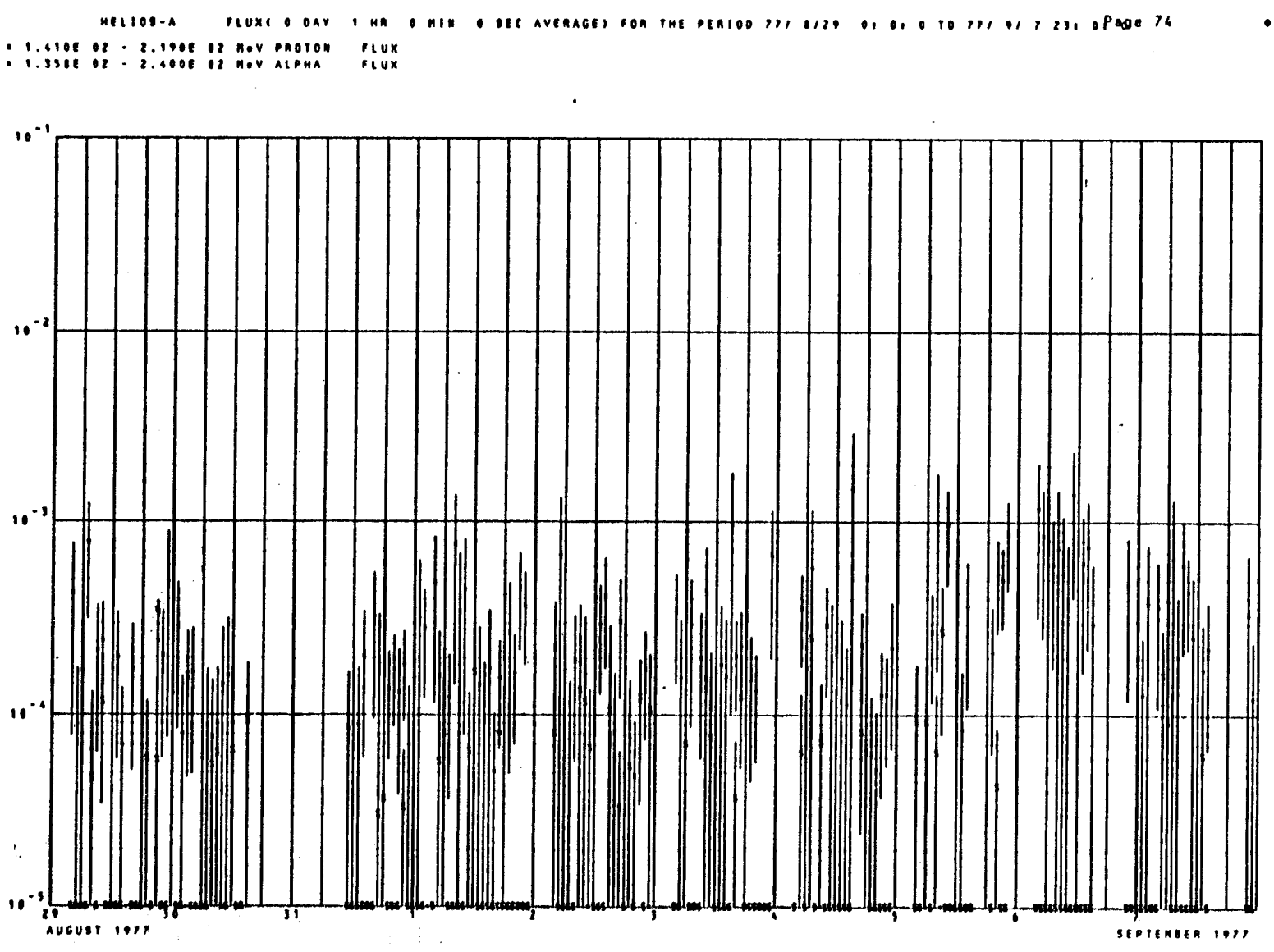


Figure 19: Sample Rate Plots

* = SR2B(9)
$ = SR3B(9)
@ = SR2C(9)
# = SR3C(9)

SR2B(9) = S1(6).-S2.-S2(A).-S3(9)
SR3B(9) = S1(6).-S2.-S2(A).-S3(9)
SR2C(9) = S1(7).-S2.-S2(A).-S3(9)
SR3C(9) = S1(7).-S2.-S2(A).-S3(9)

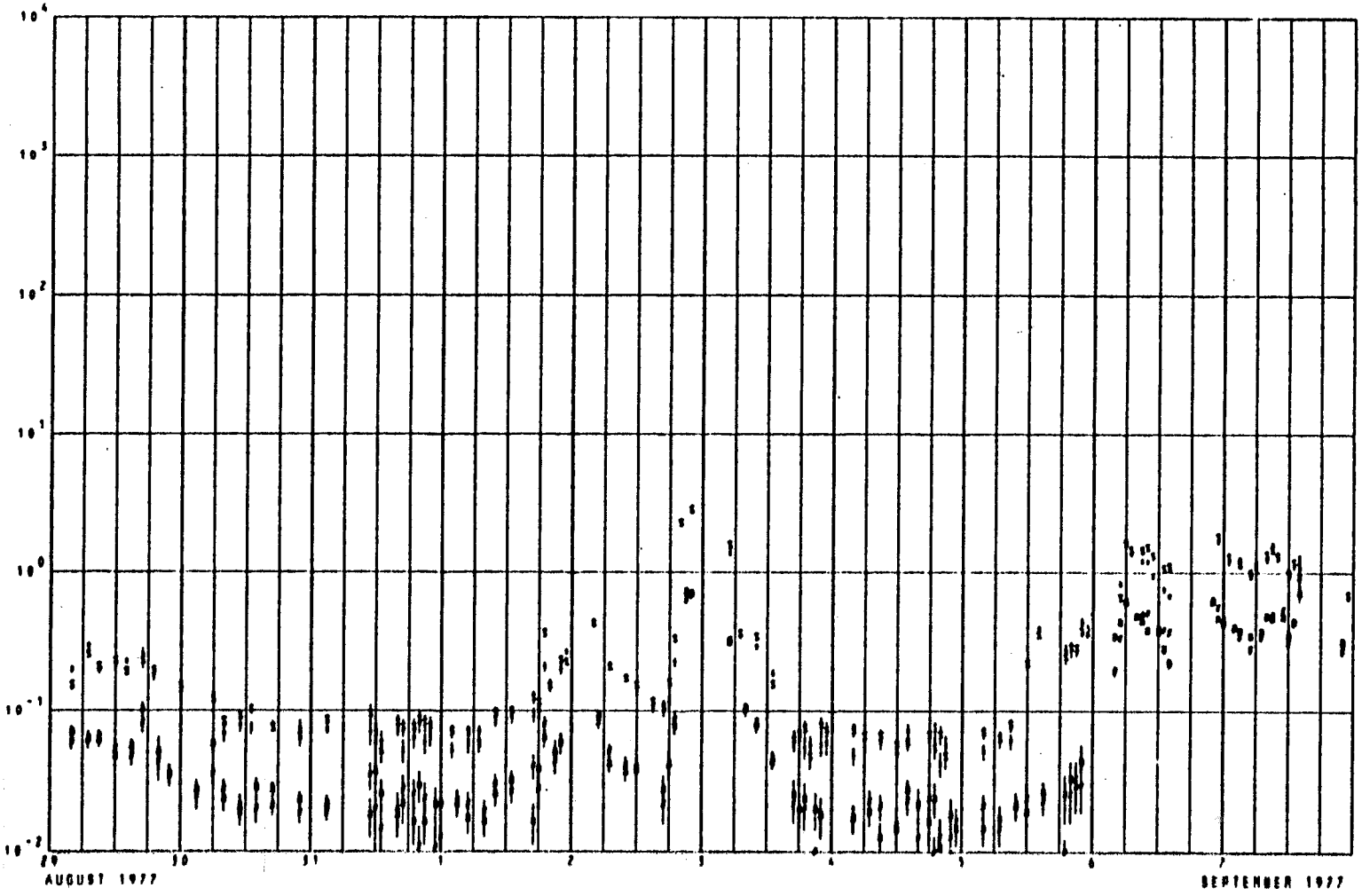


Figure 20: Sample Rate Plots

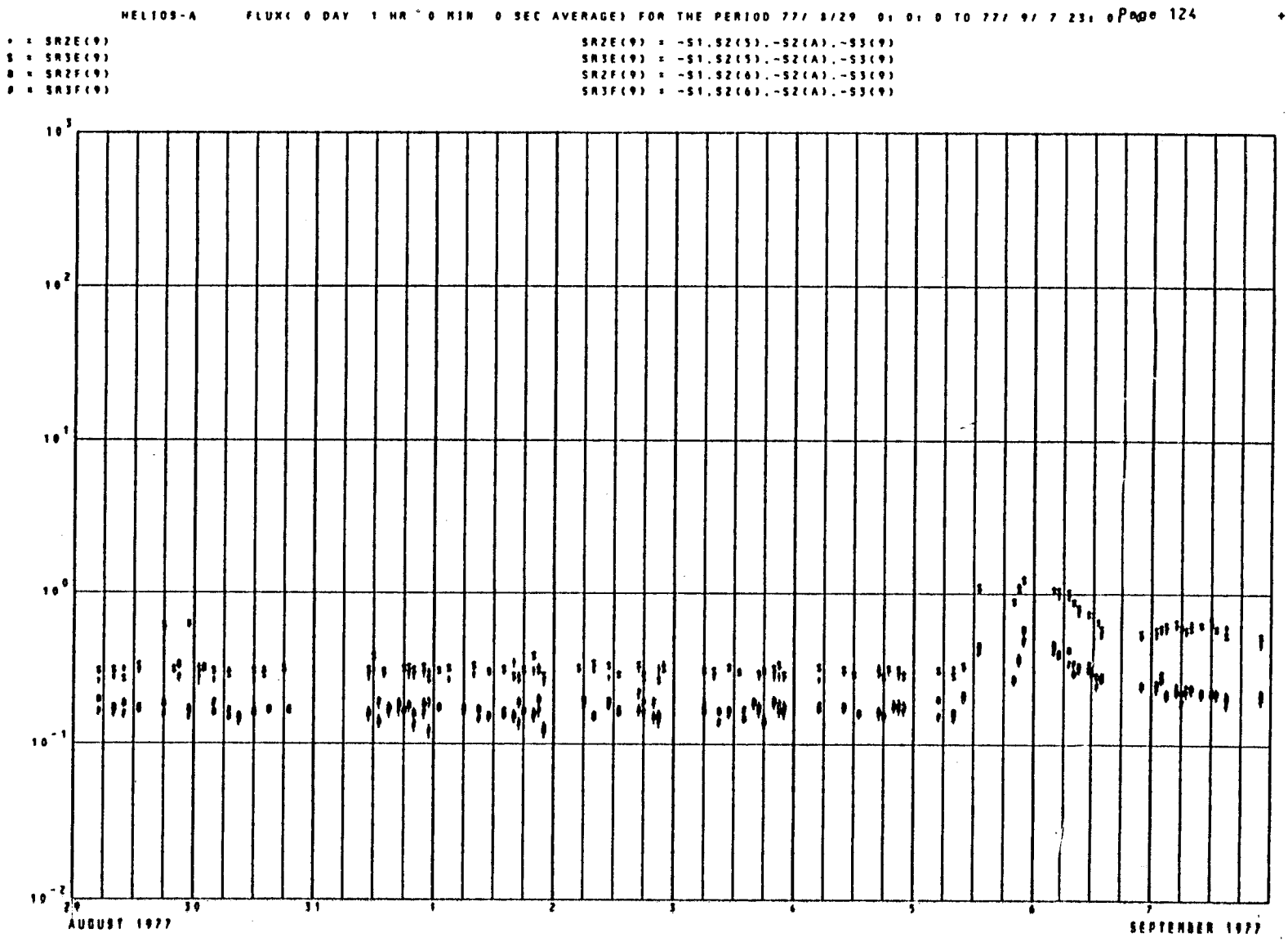


Figure 21: Sample Rate Plots

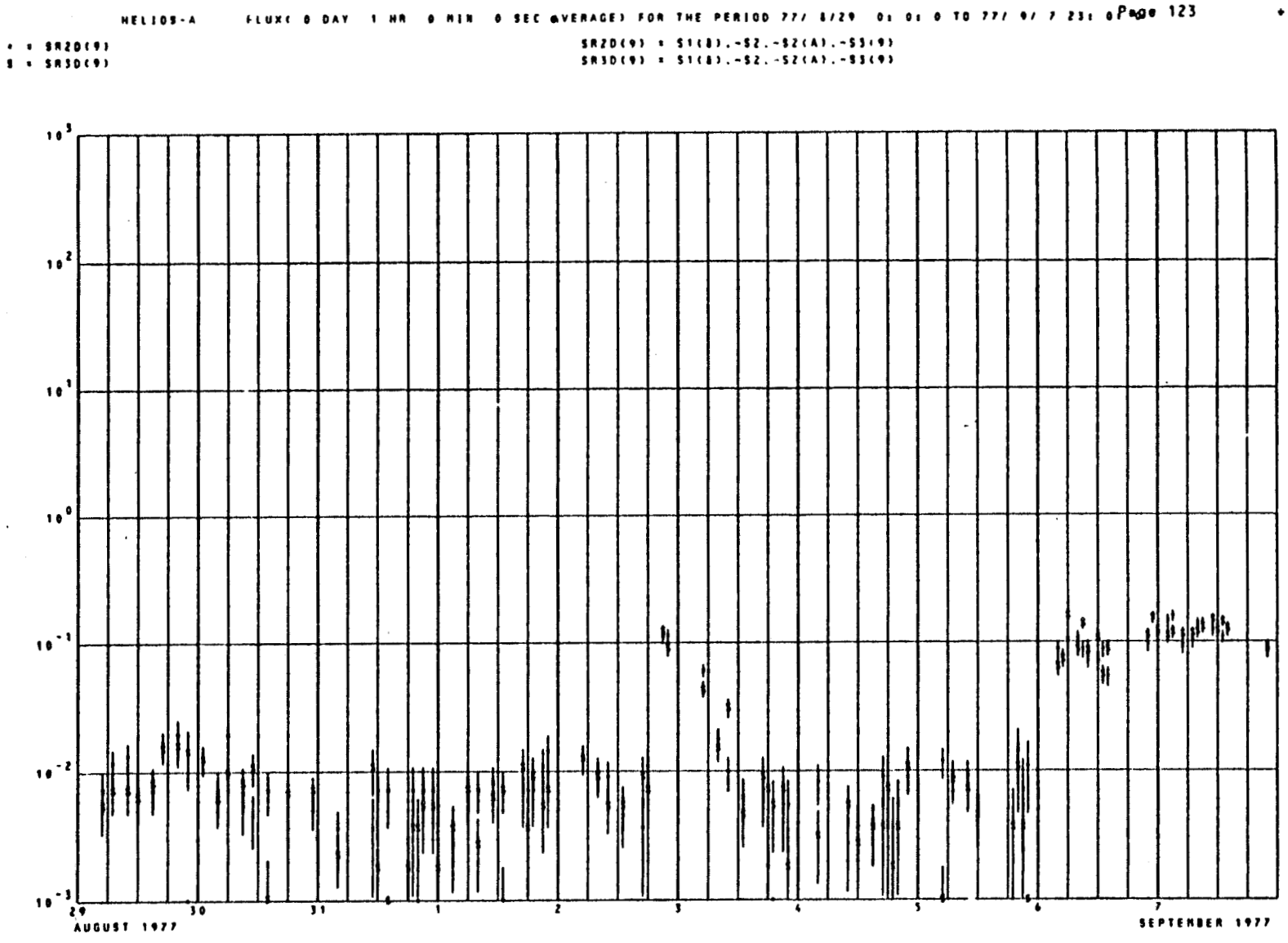


Figure 22: Sample Rate Plots

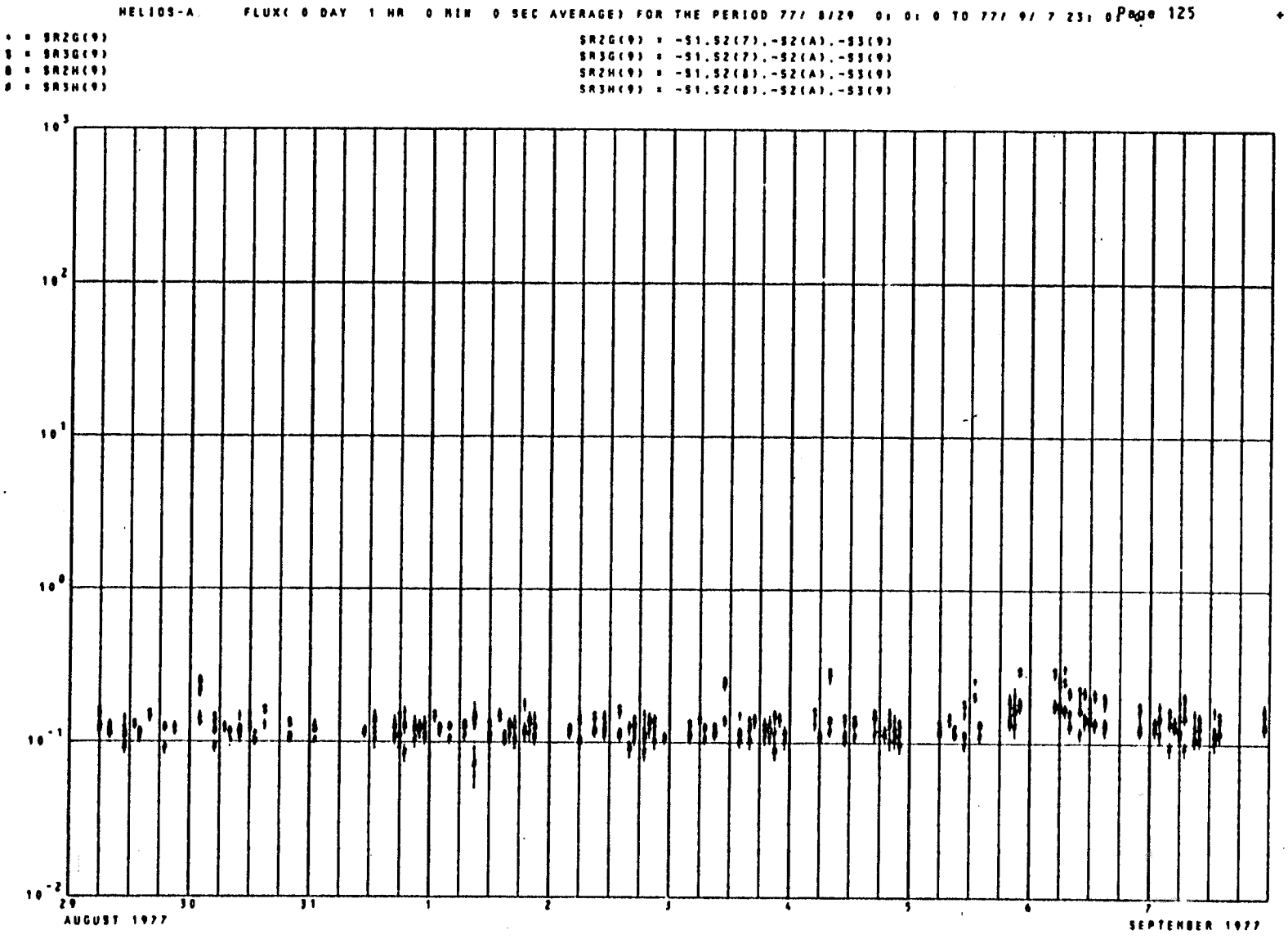


Figure 23: Sample Rate Plots

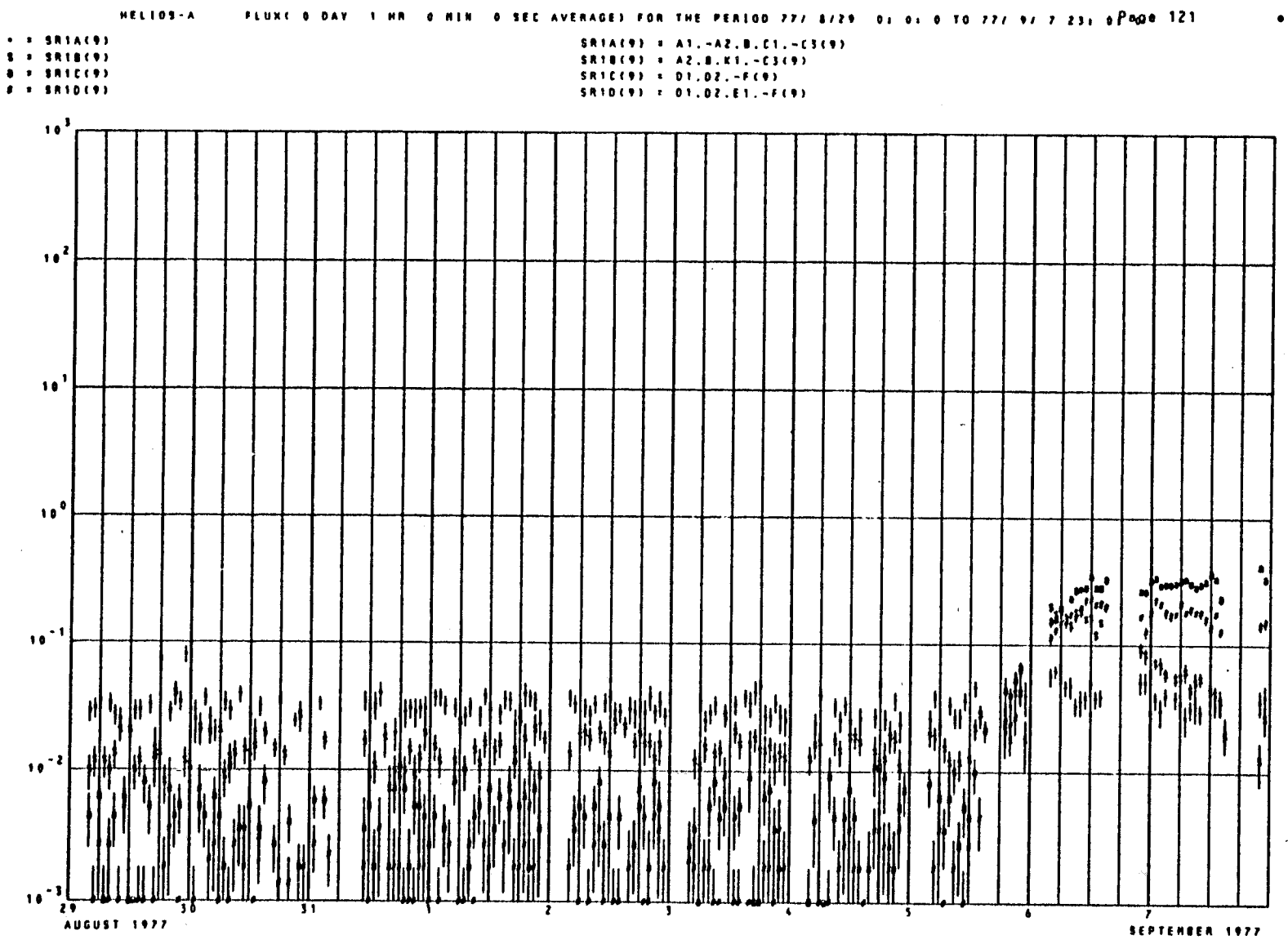


Figure 24: Sample Rate Plots

TABLE 2

Summary of the Characteristics of Each of the Telescopes and the Component Detectors

Telescope	HET	LET-I	LET-II
Geometrical Factor (cm**2-ster)	.015	.22	.155
Detectors (thickness x area)	A,B:2.5 mm x 3 cm**2 C's:2.5 mm x 8.5 cm**2	D1,D2:100 u x 1 cm**2 - E,F:2.5 mm x 3 cm**2	S1:50 u x 50 mm**2 S2:2.5 mm x 50 mm**2 Sa:2.5 mm x 50 mm**2 S3:2.5 mm x 200 mm**2

The choice of both the averaging interval and the width of the energy bin is determined by the experimenter, based on the phenomena being studied. The experiments have been designed to provide enough PHA and rate equations so that information on many types of particles in many energy ranges of interest can be studied. In addition, the sectored rate data will provide information on cosmic ray anisotropies.

2.3 ENERGY SPECTRA ANALYSIS

It is often necessary to examine the detailed energy spectra (i.e., double dE/dx plots) for particular charged particles. The major objectives for examining these plots are to:

- Assure proper operation of the instrument
- Identify gross changes in instrument response
- Study the energy spectra of various isotopes
- Identify short term variations by comparing energy spectra taken at different times
- Identify radial gradients in the cosmic ray flux between 0.3 and 1 AU by comparing Helios-1 and Helios-2 data
- Identify radial gradients in the cosmic ray flux at greater than 1 AU by comparing Helios and Pioneer data

To assure proper operation of the instruments, a check is made with completely different detector systems in the regions where the response functions overlap. Additionally, the two VIET systems can be checked for self-consistency. When differences do occur, corrections for deadtime, accidental coincidences, and anti-coincidences can be made on a case by case basis. There are computer programs available which aid in making these intercomparisons.

In the normal production mode, 11 energy spectra are generated for Helios-1 and 16 spectra are generated for Helios-2. Tables 3 and 4 list the features of each spectra which are generated while Figures 25-35 show examples of the Helios-1 spectra which were generated using data taken between September 6 and 10, 1977. These spectra were chosen as examples because the data were taken during a time of heavy

TABLE 3

Helios-1 Matrix Plots Routinely Produced

1) A vs B
A1.B.K2.-C3
Event Type=3
C1+C2=0
Compression factor=4

2) A vs B
(A2.K1+A1.C1).B. approximately C3
Event Type=2
C1+C2=0
Compression factor=1

3) A vs C1+C2
A1.B.K2.-C3
Event Type=3
100≤B≤400
Compression factor=4

4) A vs C1+C2
(A2.K1+A1.C1).B.-C3
Event Type=2
25≤B≤100
Compression factor=1

5) B vs C3
A2.B.C3
Event Type=1
0≤C1+C2≤200
Compression factor=1

6) B vs C3
A1.-A2.B.C3
Event Type=0
0≤C1+C2≤50
Compression factor=1

7) D1 vs D2
D1.D2.-F
Event Type=1
0≤E≤1
Compression factor=1

8) D2 vs E
D1.D2.-F
Event Type=1
2≤D1≤9
Compression factor=1

9) D2 vs E
D1.D2.-F
Event Type=1
6≤D1≤38
Compression factor=1

10) D1 vs D2
D1.D2.SUM D.-F
Event Type=0
0≤E≤1
Compression factor=4

11) D2 vs E
D1.D2.SUM D.-F
Event Type=0
10≤D1≤530
Compression factor=4

TABLE 4

Helios-2 Matrix Plots Routinely Produced

1) A vs B
A1.B.K2.-C3
Event Type=3
C1+C2=0
Compression factor=4

2) A vs B
(A2.K1+A1.C1).B. approximately C3
Event Type=2
C1+C2=0
Compression factor=1

3) B vs C1+C2
A1.B.K2.-C3
Event Type=3
60≤A≤250
Compression factor=4

4) A vs C1+C2
A1.B.K2.-C3
Event Type=3
60≤B≤400
Compression factor=4

5) A vs C1+C2
(A2.K1.+A1.C1).B.-C3
Event Type=2
15≤B≤80
Compression factor=1

6) B vs C1+C2
(A2.K1.+A1.C1).B.-C3
Event Type=2
15≤A≤80
Compression factor=1

7) D1 vs D2
D1.D2.-F
Event Type=1
0≤E≤1
Compression factor=1

8) D1 vs D2
D1.D2.SUM D.-F
Event Type=0
0≤E≤1
Compression factor=4

9) D2 vs E
D1.D2.-F
Event Type=1
3≤D1≤60
Compression factor=1

10) D1 vs E
D1.D2.-F
Event Type=1
3≤D2≤60
Compression factor=1

11) D1 vs D2
D1.D2.SUM D.-F
Event Type=0
0≤E≤1
Compression factor=8

12) D2 vs E
D1.D2.SUM D.-F

Event Type=0
12≤D1≤120
Compression factor=2

13) D1 vs E
D1, D2, SUM D, =F
Event Type=0
8≤D2≤120
Compression factor=2

14) D1 vs E
D1, D2, SUM D, =F
Event Type=0
0≤D2≤4095
Compression factor=8

15) D1 vs E
D1, D2, SUM D, =F
Event Type=0
0≤D2≤4095
Compression factor=16

16) D1 vs D2
D1, D2, SUM D, =F
Event Type=0
0≤E≤1
Compression factor=16

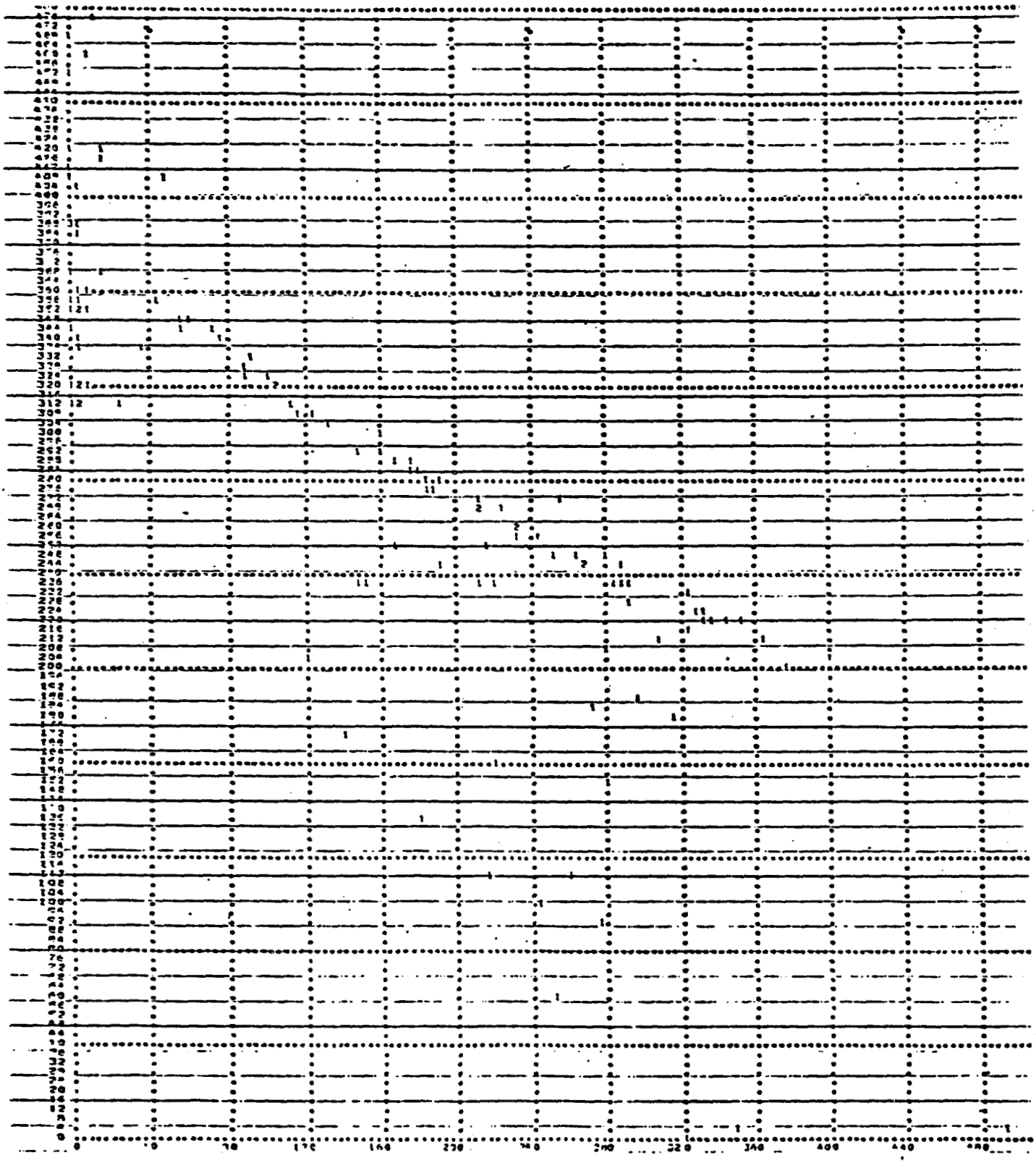


Figure 25: Sample Energy Spectra (1 of 11)

A vs B A1.B.K2.~CIII

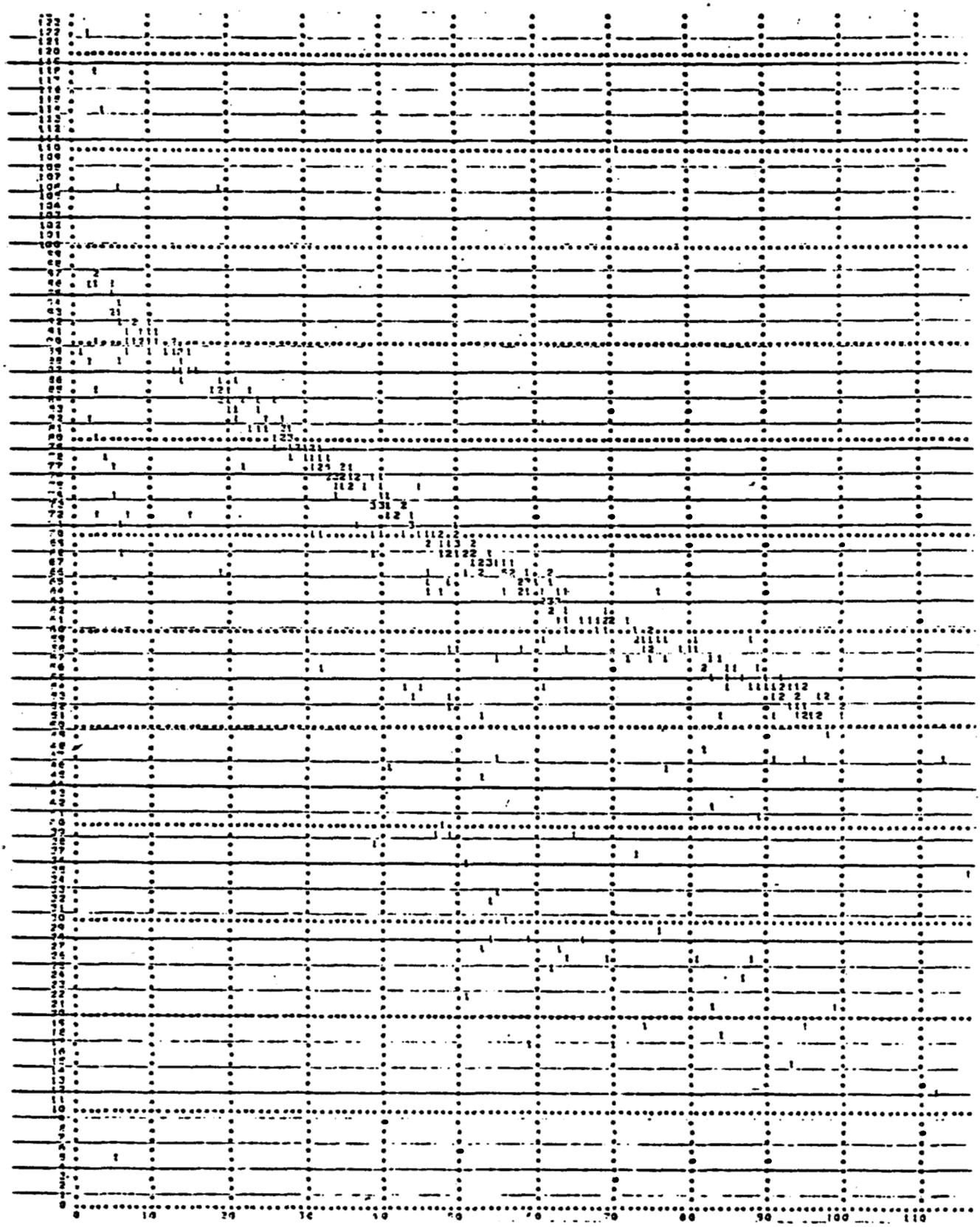


Figure 26: Sample Energy Spectra (2 of 11)

A vs B (A2.K1 + A1.CI).B.~CIII

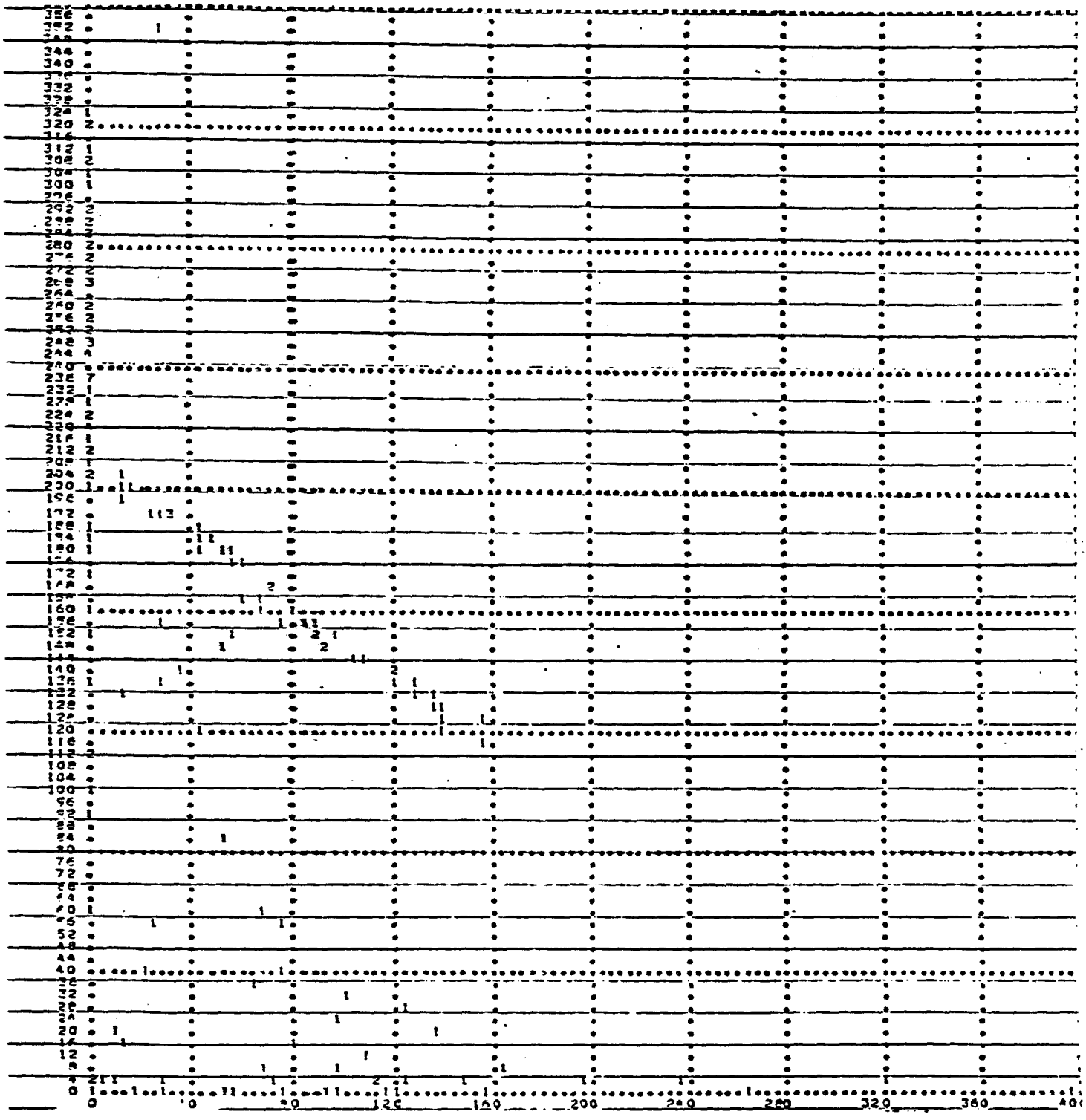


Figure 27: Sample Energy Spectra (3 of 11)

A vs CI+CII A1.B.K2.~CIII

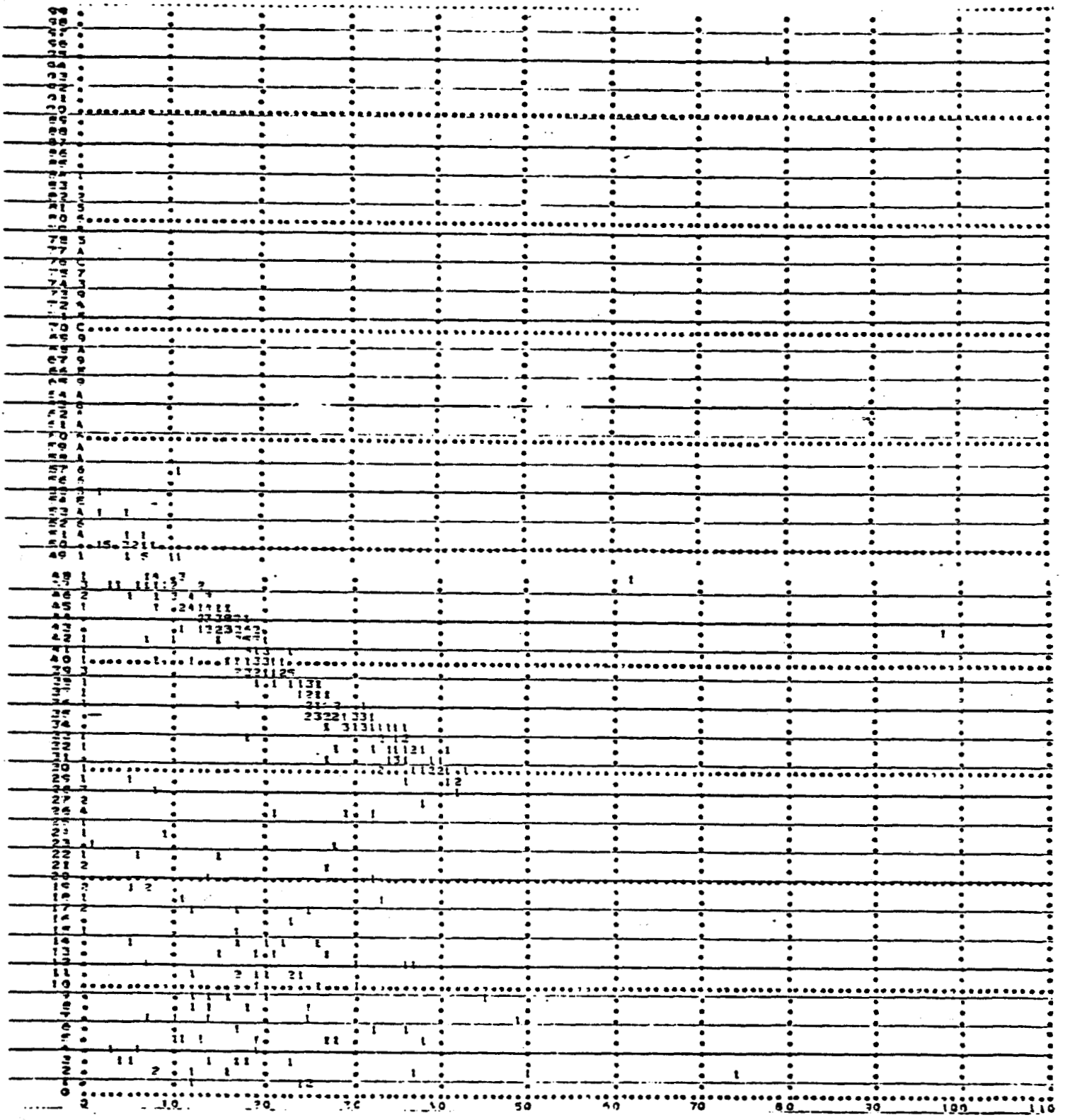


Figure 28: Sample Energy Spectra (4 of 11)
A vs CI+CII (A2.K1+A1.CI).B.~CIII

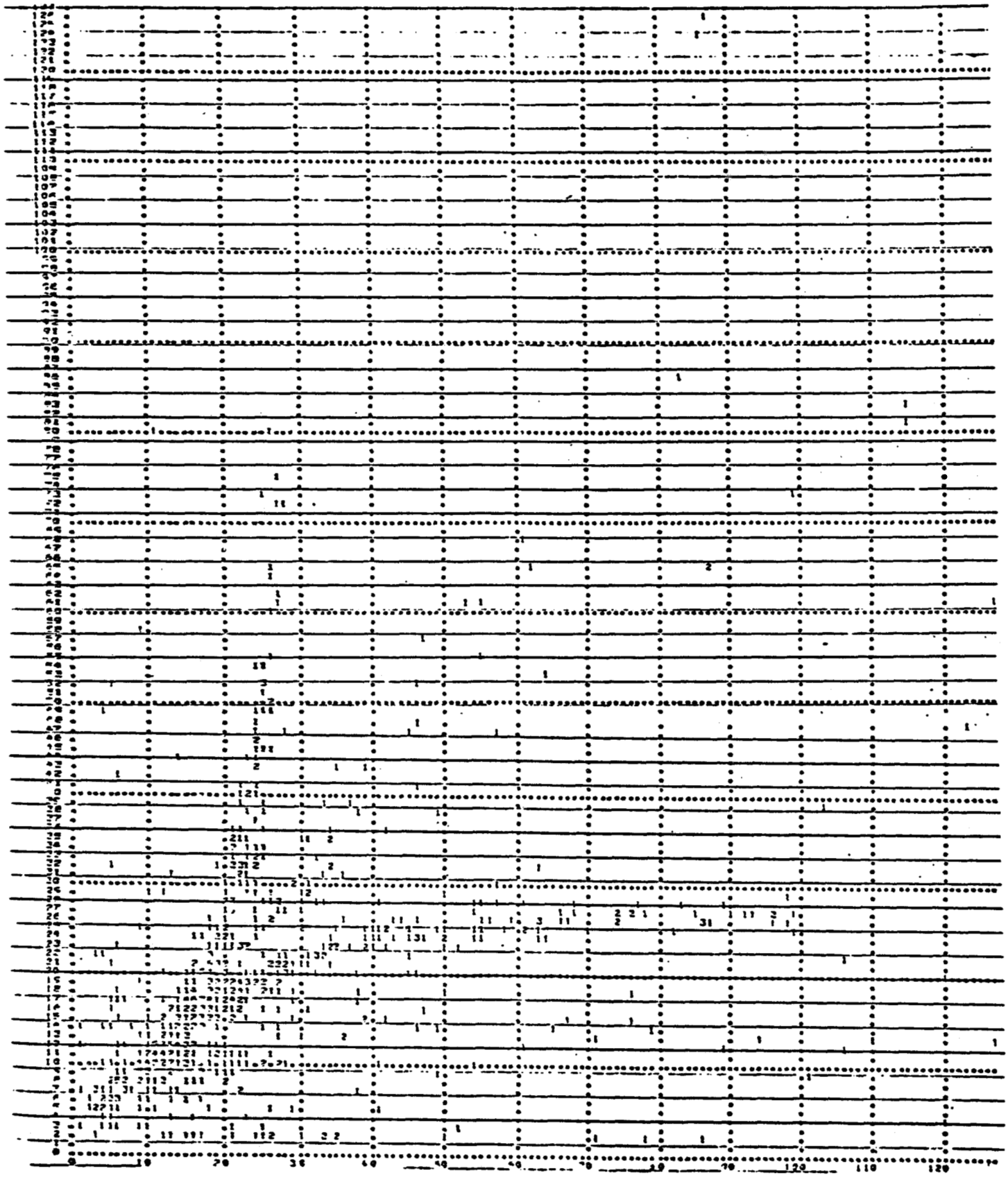


Figure 29: Sample Energy Spectra (5 of 11)

B vs CIII A2.B.CIII

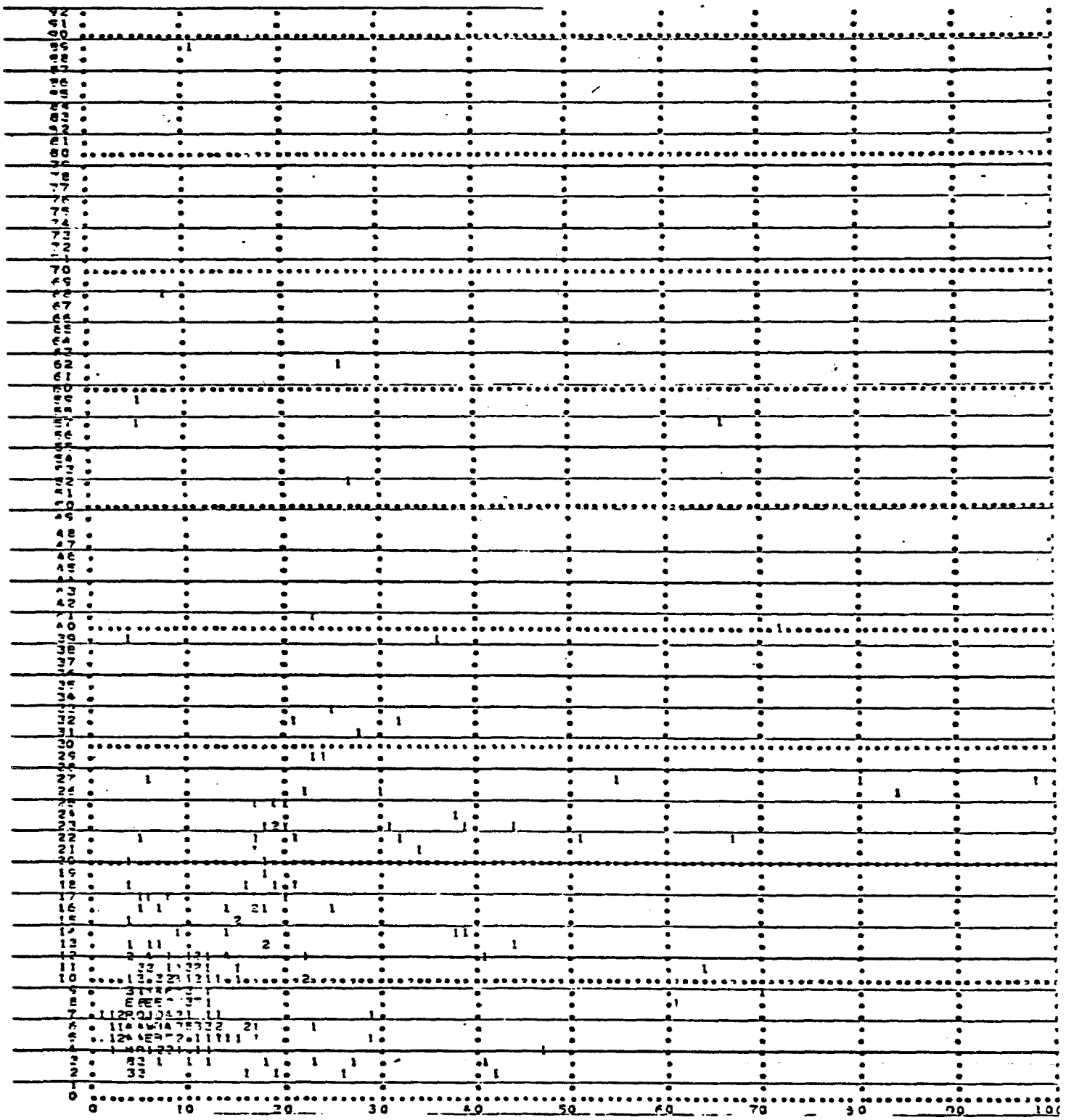


Figure 30: Sample Energy Spectra (6 of 11)

B vs CIII A1.~A2.B.CIII

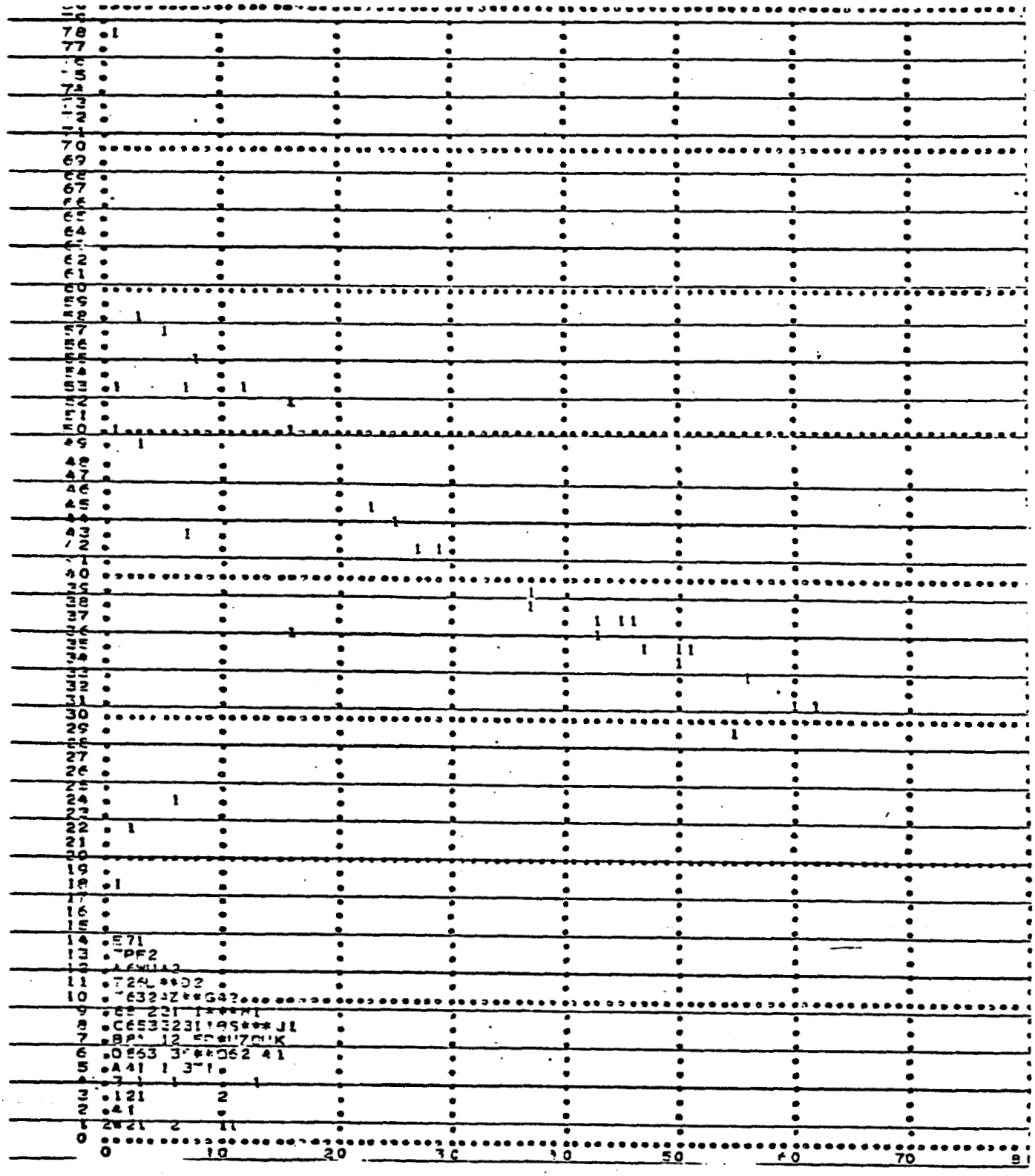


Figure 31: Sample Energy Spectra (7 of 11)

DI vs DII DI.DII.~F

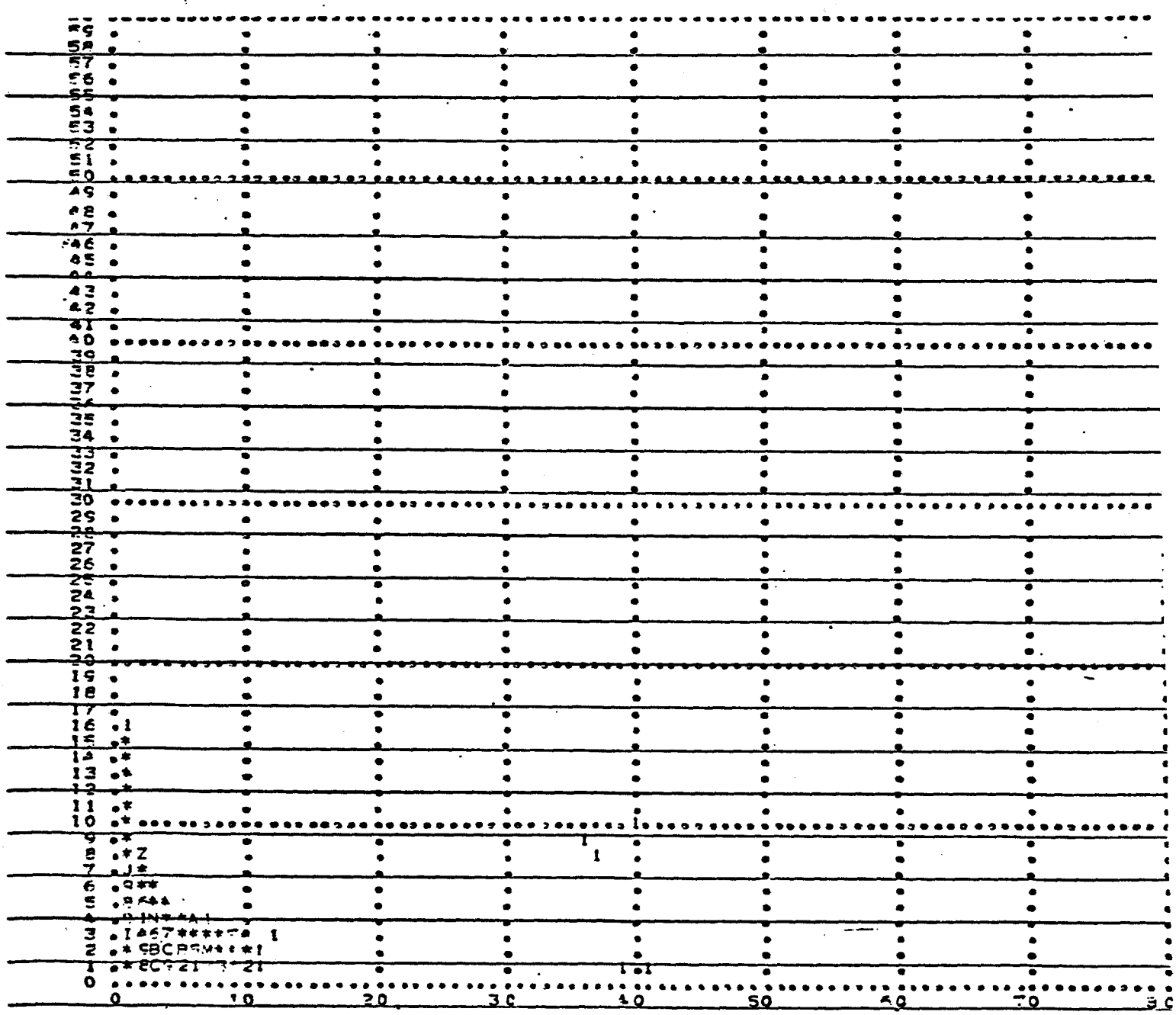


Figure 32: Sample Energy Spectra (8 of 11)

DII vs E DI.DII.~F

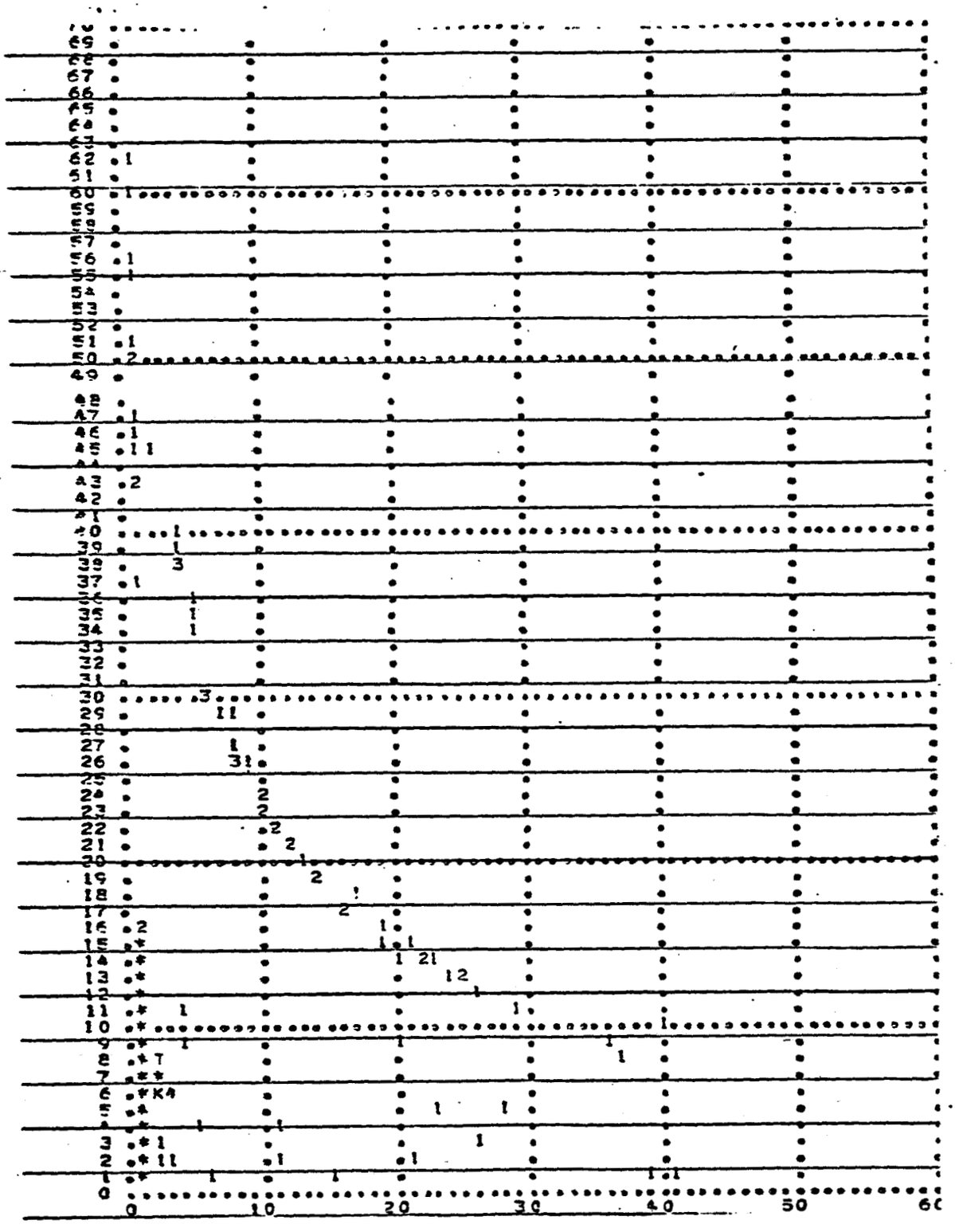


Figure 33: Sample Energy Spectra (9 of 11)

DII vs E DI.DII.~F

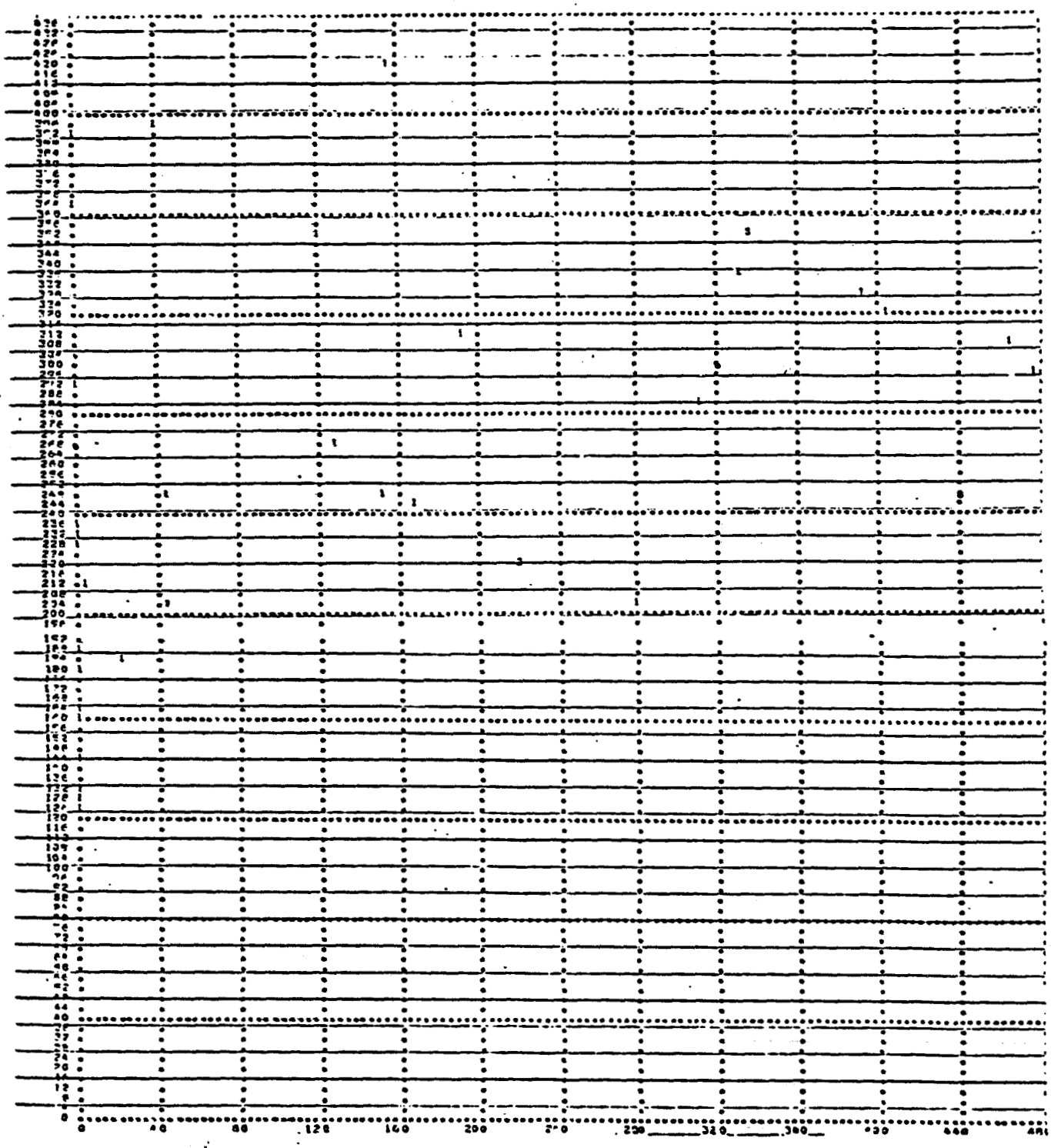


Figure 34: Sample Energy Spectra (10 of 11)

DI vs DII DI.DII.SUM-D.~F

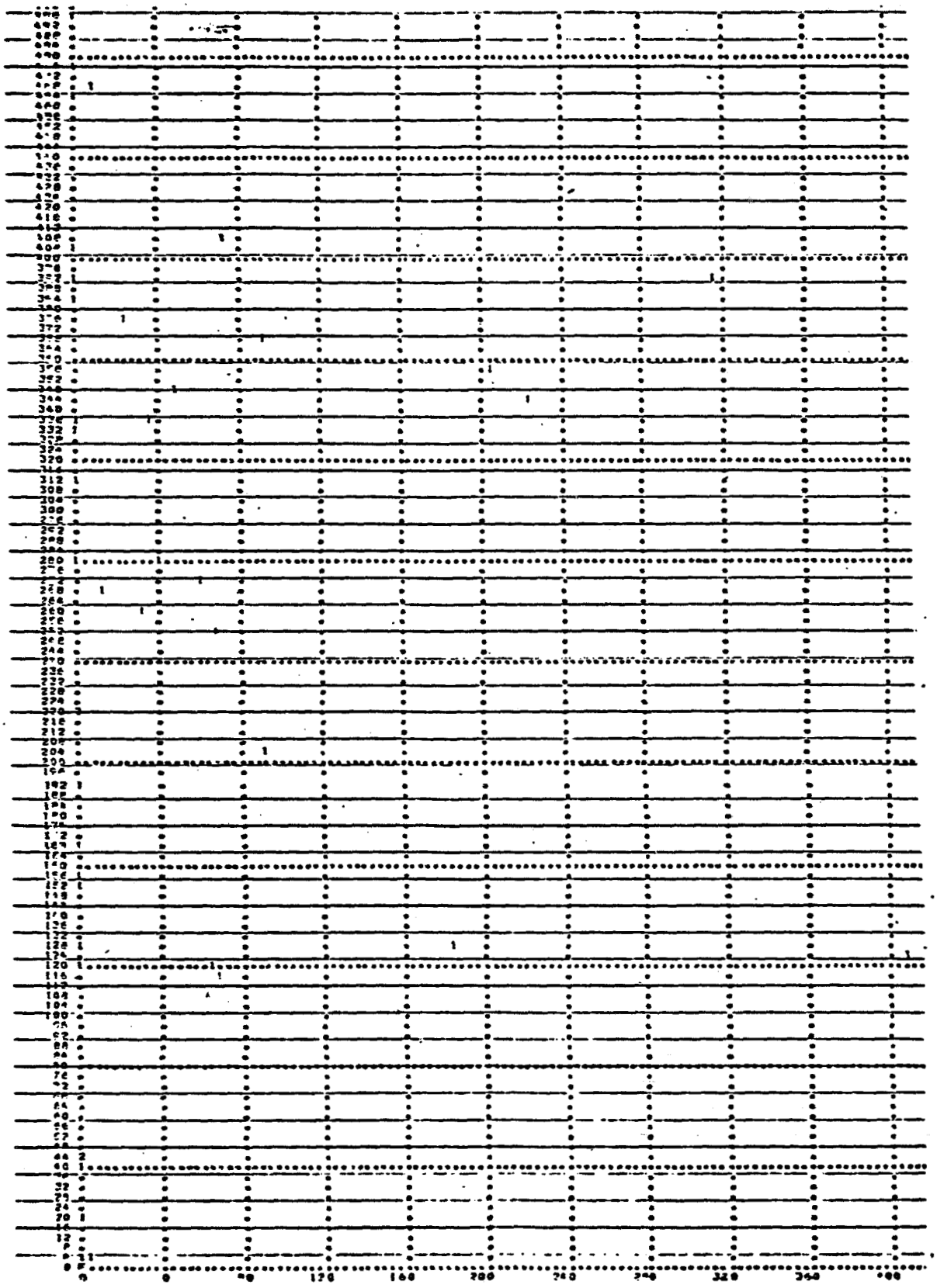


Figure 35: Sample Energy Spectra (11 of 11)

DII vs E DI.DII.SUM-D.~F

solar activity (see Figures 4 through 24) when Helios-1 was close to the Sun (see Figure 1). Normal energy spectra would contain much less data if only 5-days of data were used. An examination of Figure 25 shows that the energy measured by the HET detector element A versus detector element B is plotted and that this PHA data mode is initiated by an A1.B.K2.-C3 condition (see rate equation 2A in Table 1). The scale used in the horizontal and vertical axes of Figure 25 is "channel number", which corresponds to the amount of energy deposited in each layer of the detector. To convert channel numbers to energy units, the data given in Table 2 should be used.

Figure 25 depicts only the bottom half of the A vs B pulse height analyzer dynamic range. (Note full scale=4096 channel numbers). To display heavier or lighter particles on the same type of plot, various compression ratios are used. The example given in Figure 25 shows the output of the A and B detectors compressed 4 to 1, i.e., each row and each column represents the total events in four consecutive PHA addresses. The heavier particles are seen by using a large compression factor since they deposit more energy on the detectors; similarly lighter particles are seen using a smaller compression factor. The scales used in Figures 25-35 have been set so that the particles most often studied can be identified. Moreover, the coincidence condition which initiates the analysis will partially determine the type of events which are seen most often. For example, the A1.B.K2.-C3 condition will most often record particles with $Z \geq 2$ in the 20-56 MeV/nucleon energy range. Protons in the same 20-56 MeV/nucleon energy range can best be studied by plotting the detector A vs detector B output taken with the (A2.K1+A1.C1).B.-C3 coincidence condition and a compression factor of 1; an example of typical output for this case is shown in Figure 26.

Section 3
SOFTWARE SYSTEM

3.1 SOFTWARE SYSTEM OVERVIEW

The Helios-1 and -2 cosmic ray telescope multiprogram data processing system performs separate tasks for general data reduction, quality control, establishing data bases, and data analysis. The system is designed to process large quantities of data off-line. However, the system can provide a "quicklook" data listing when fast processing of the data is needed. An overview of the Helios Data Processing system flow that is presently utilized on the SACC IBM 3081 computer at GSFC is illustrated in Figure 36.

The design of the Helios data processing system paralleled that of the Pioneer data processing system (Reference 5). Whenever applicable, the Pioneer computer software was extracted and used in the corresponding Helios routine. This approach reduced redundant coding considerably. Programmers who maintain the Helios system and incorporate enhancements into it should investigate making similar enhancements to the corresponding Pioneer logic. Programmers also should review the Helios software documentation in References 6, 7, 8, 9, 11 and 13.

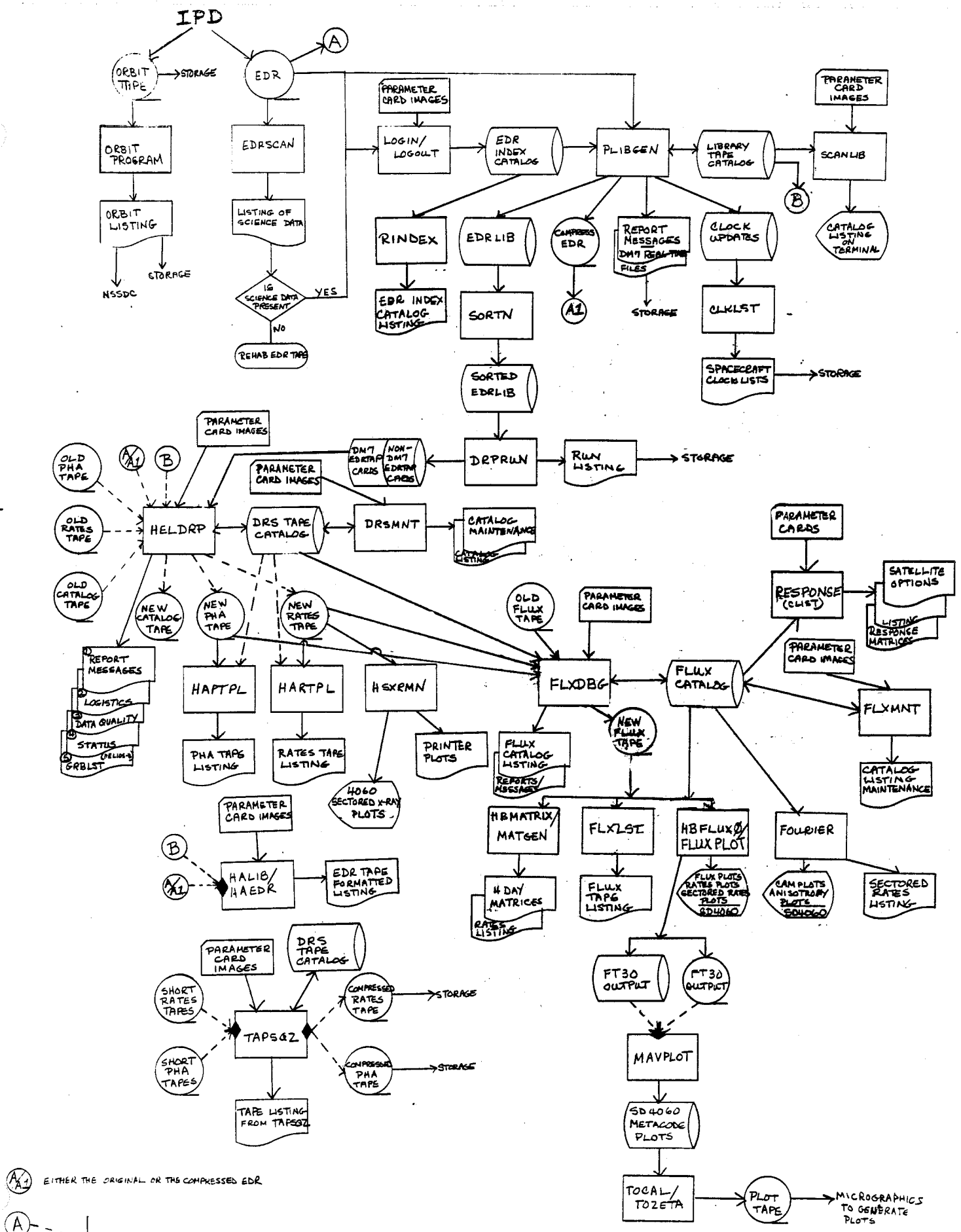


Figure 36: Helios Data Processing System

HELDRR document

In particular, the appendices in Reference 7 contain the following:

- Experimenter Data Record (EDR) Formats
- Orbit/Attitude Tape Descriptions
- PHA Tape Logical Record Format
- Rates Tape Logical Record Format
- Description of the Data Set INDEX
- Description of the Data Set CATALOG
- Description of the Data Set DRSLOG
- Description of the Data Sets DRSCTP, DRSCT1, DRSCT2, DRSCT3, and DRSCT4
- Listing for a Sample Helios Command Tape (not processed)

The other information which is available in these references can be deduced from their titles.

The major data processing programs in the order in which they are run, along with the mnemonic name containing the JCL or CLIST, the location of the mnemonic (either 'SB#HL.LIB.CNTL' or 'SB#HL.LIB.CLIST') and the general function of the mnemonic are given below :

Note:

* This program is run periodically, as needed.

** A CLIST is available to execute this program.

Program Name	Mnemonic Name	Location CNTL/ CLIST	Function of Mnemonic
RINDEX*	RINDEX	CLIST	Lists tape status words in the 'INDEX' data set
LOGOUT*	LGOUTA	CNTL**	Enters new output EDR

	or B		library tapes into 'INDEX' data set
LOGIN	LGINA or B	CNTL**	Enters EDR tapes to be logged into the 'INDEX' data set
LIBGEN/ SORTN	LGEXECA or B	CNTL**	Compresses EDR tapes onto the EDR library tapes, updates 'CATALOG' data set, updates the 'CLOCK' data set and sorts FT08F001 data set for input to DRPPUN.
PATRICK	LBCKINCT	CNTL**	Creates a tape backup of the HELIOS-A and -B 'INDEX' and 'CATALOG' data sets
	LRLINCTA or B	CNTL**	Reloads the Helios-A or B 'INDEX' and 'CATLOG' from tape to disk
TAPESCAN	LTSCPYA or B	CNTL	Copies EDR library tapes at a 3 to 1 ratio to backup tapes
	LTRESTA or B	CNTL	Used to restore an EDR library tape from its backup tape
DRPPUN	DRPPUNA or B	CNTL**	Creates 'HELDRP' program input 'EDRTAP' namelist cards from 'FT08F001' data set produced by the 'LIBGEN' program
HELDRP	DRPPROC	CNTL**	Performs the general data reduction of EDR data, updates DRS catalogs and rate and PHA tapes
PATRICK	DCPYRATA or B DCPYPHAA or B	CNTL	Creates tape backups of rate and PHA tapes
FLXDBG	FLUXDBGA or B	CNTL	Inserts and/or adds the rate and PHA data to the 'FLUX' data base and updates the 'FLUX' catalog data set
PATRICK	FCATBACK	CNTL	Copies 'FLUX' catalog to tape
	FCATRELO	CNTL	Reloads 'FLUX' catalog to disk.
	FTPCPYA or B	CNTL	Copies 1600 BPI 'FLUX' tapes
	F4TO1A or B	CNTL	Copies 1600 BPI 'FLUX' tapes to 6250 BPI 'FLUX' tapes at a 4 to 1 ratio

DIFFIX	UPD6250	CLIST	Updates the end AFN of the current 6250 BPI flux tape in the '6250' FLUX source in the 'FLUX' catalog data set for either Helios-A or -B.
ADFLUX*	ADD6250	CLIST	Adds the next 6250 BPI flux tape to the '6250' source in the 'FLUX' catalog for either Helios-A or -B.
FLUXPLOT*	PLOTHEL	CLIST	Updates standard rate, flux and sectored rate time history analysis plots
MATGEN*	MATRIX	CLIST	Updates HELIOS-A standard line printer PHA matrices
HSXRMN*	ASXRPLTA or B	CNTL	Updates standard sectored xray analysis plots

More information about these programs can be found in Section 3.7, including the program name or entry point, the mnemonic name, the location of the program source code and documentation, the method of the program execution, and the purpose of the program.

Besides the main processing programs, it is often necessary to run various utility programs to list the contents of the tape catalogs used by the data processing system and to ensure that these catalogs are properly maintained. (Note: These tape catalogs are described in Section 3.4). The following is a list of major catalog listing and/or maintenance programs along with their mnemonic names in 'SB#HL.LIB.CNTL' or 'SB#HL.LIB.CLIST' and the function of each mnemonic.

* This CLIST resides in 'SB#HP.LIB.CLIST'.

Program Name	Mnemonic Name	Location CNTL/ CLIST	Function of Mnemonic
SCANLIB	SCANLIB	CLIST	Lists EDR tape information from the 'CATLOG' data set by day or record

DRSMNT	DRSLSTA or B	CNTL	Lists the current DRS catalog
	DRSADDA or B	CNTL	Adds blank tapes back into DRS catalog
	DRSRESA or B	CNTL	Restores the current DRS catalog to disk
FLXMNT	FCATLST	CNTL	Lists the HELIOS-A and -B FLUX catalog sources
	FCATINT	CNTL	Initializes a new FLUX catalog source to a specified satellite
	FCATADDA or B	CNTL	Adds blank tapes to a specified satellite
	FCATDLTA or B	CNTL	Deletes a FLUX catalog source from a specified satellite
LOGISH	ULOGMNT	CNTL	Clears duplicate or user specified entries from the 'DRSLOG' data set
RESTORE	URESTORE	CNTL	Restores the current 'DRSLOG' from tape
ZEROLOG	UZERLOGA or B	CNTL	Writes 'DRSLOG' to tape (OLDLOG) and clears it; run only when 'DRSLOG' data set has filled
RESPONSH	RESPONSE	CLIST*	Lists particle/event type table of the conversion from detector pulse height to incident particle energy
	URESPONS	CNTL	Same as RESPONSE but runs in background.
CLKLST	CLKLST	CLIST	Lists spacecraft clock resets contained in 'SB#HL.CLOCKA or B.CNTL'

More information on these catalog listing and maintenance programs may be found in Section 3.8.

In addition to catalog maintenance program utilities, various utilities exist for listing, maintaining, archiving and restoring critical data sets. The following is a list of these utility programs.

* This CLIST resides in 'SB#HP.LIB.CLIST'.

** This CLIST resides in 'SYS1.CLIST'

Program Name	Mnemonic Name	Location CNTL/ CLIST	Function of Mnemonic
LISTPDS	UTSO	CNTL	Lists 'SB#HL.LIB.CNTL', 'SB#HL.LIB.CLIST', and 'SB#HP.LIB.CLIST' partitioned data sets (PDS)
	LPDS	CLIST*	Lists any user specified PDS
SAVEDS	USAVEDS	CNTL	Opens and closes all data sets to prevent archival by the SACC ASM2 disk maintenance system; run once per week.
IEBCOPY	UDRPRELO	CNTL	Restores all 4 HELDRP load modules to disk
	UBCKDRPL	CNTL	Copies all 4 HELDRP load modules to tape (TD7559)
TAPESCAN	UCPYDRPL	CNTL	Creates a backup of TD7559 to TD7785
IEBCOPY/ IEBGENER	CRBKRS	CLIST*	Back up to tape or restore to disk any HELIOS data set, offline records of the contents of this tape are maintained by the HELIOS data technician; backup level 1.
LIBMAN	ARCHIVE	CLIST*	Backs up to tape using the LIBMAN system; online records of the contents of this tape are maintained in the system catalog; backup level 2.
	RESTORE	CLIST*	Restores to disk using the LIBMAN system
TAPESCAN	BKLIBMAN	CLIST*	Creates a backup of Pioneer, Helios or IMP LIBMAN tapes
ASM2	$AR	CLIST**	Archives a data set into the SACC ASM2 archives; backup level 3.
	$RA	CLIST**	Restores a data set from the ASM2 system

See Section 3.9 for more information.

To obtain, modify or compress information from the tapes produced by the data reduction system, the following utility programs are used.

PROGRAM	LIB.CNTL MNEMONIC	FUNCTION OF MNEMONIC
EDRSCAN	UEDRSCAN	Scans EDR tapes for existence of science data.
	ULIBSCAN	Same as UEDRSCAN but uses EDR library tapes.
HAEDR	UEDRLIST	Formatted listing of EDR tapes.
HALIB	ULIBLTST	Formatted listing of EDR library tapes.
ORBIT	TRAJECT	Lists selected words Helios-A or -B orbit/ attitude tapes.
HELIOS2T	TRAJECTB	Lists all parameters from Helios-A or-B orbit/attitude tapes.
HARTPL	URATLSTA or B	Formatted listing of rates tape.
RTLSTS	URATLSTS	Formatted listing of only the event type rates (R1, R2A, R2B, R3A, R11A, and R11B) from rates tape.
HARPTL	UPHALSTA or B	Formatted listing of PHA tape.
FLXLST	UFLXTPL	Formatted listing of flux tape.
QBOFIX	UQBOFIX	Corrects inconsistencies between the blackout mode indicator and the ratio of PHA pages on a user specified rate tape.
TAPSQZ	UTPSQPHA or B UTPSQRTA or B	Compresses short PHA or rate tapes produced by HELDRP onto a single tape. The tapes to be compressed must be in time order in the current 'DRS' catalog. The output tape must be within the rate or PHA tape block and not appear as a blank or active tape.

Section 3.10 gives more information about these programs. The above list only describes the more commonly used tape utilities. Many more utility programs exist that may be useful to the Helios maintenance programmer. The following is a list of the data sets that contain additional tape utility source code :

'SB#HL.TAPEDMPS.SOURCE'
'SB#HL.HARTPL.SOURCE'
'SB#HL.TEMPSCAN.SOURCE'
'SB#HP.ZBJHB.FORT'
'SB#HL.QBOFTX.SOURCE'

Most of the program functions may be deduced from their mnemonic names as well as LOOKATME members within the data set.

In order to analyze the flux data base produced by the data reduction system, the following programs are used. These are in addition to the program MATGEN and the version of the program FLUXPLOT without the LIST option mentioned earlier in this Section and in Section 3.7. The CLIST type mnemonics all reside in 'SB#HP.LIB.CLIST'.

PROGRAM NAME	MNEMONIC NAME	TYPE	FUNCTION OF MNEMONIC
FLUXPLOT	ANEWPROC	CNTL	Produces listings (LIST and/or plots and/or op-
tion)			LIST tapes of rate and/or flux values over specified time periods, averaging intervals, etc.
	AMAVPROC	CNTL	Same as ANEWPROC except the 'LIST' FT30F001 output is written to a disk data set for input to MAVPLOT.

MAVPLOT	MAVPLOT	CLIST	Reads the 'LIST' output from FLUXPLOT and produces 1 to N interval moving average time history plots in SD4060 Meta code into a user specified data set. This data set may be written to tape using the IEBGENER utility or it may be converted to ZETA or CalComp plot code by the TOZETA or TOCAL programs invoked by the CNV4060 CLIST.
TOZETA/ TOCAL	CNV4060	CLIST	Converts SD4060 Meta code on tape or disk to ZETA or CalComp code on tape.
GRDSZDK/ GRDSZTP	GRDSZ	CLIST	Prompts user for the length and height of the desired plot grid, calculates additional amount of space (in inches) needed to hold the title information and axes labels and creates the FT05F001 input data set for TOZETA or TOCAL.
FOURIER	AFOURLST	CNTL	Produces listings and/or flux plots and/or anisotropy plots

and/or polar (CAM) plots of specified sectored rate mnemonics, time periods, averaging intervals, etc.

More information on these analysis programs may be found in Section 3.11. The LIB.CNTL data set also contains models of most every type of FLUXPLOT function, including an EXEC JCL statement, that supply overriding symbolic parameters to the FLUXPLOT procedures and typical data card setups. These setups are located either in members that begin with the letters 'A' (analysis) or 'S' (special analysis).

Finally, there are two programs that are virtually never used at present, but are maintained in case they are ever needed in the future. The first of these is the program HASDMN which produces polar (CAM) plots from rate tapes. This program was replaced by the polar (CAM) plot option of the FOURIER program. The second program is SELECT (HBSELECT) which produces line printer matrices of 'selected' energy channels from the pulse height analyzer data. This program was used during the initial calibration of the instrument. However, this program may be needed in the future and should be maintained. Refer to Section 3.11 for more information about these programs.

3.2 INPUT DATA

The input data for the Helios data processing systems consists of Experiment Data Record (EDR) tapes and trajectory (ORB/ATT) tapes. A detailed description of the experiment PHA and rate collection systems, may be found in Reference 5, Volume 2, Appendices C and D. The EDR and ORB/ATT tape formats are given in Reference 7, Appendices A and B, respectively.

3.3 OVERVIEW OF THE CNTL AND CLIST LIBRARIES

3.3.1 Overview

Several years ago, the Helios cosmic ray experiment was assigned a project user identifier on the SACC computer. This was done as an aid in the organization of project data sets and tapes specific to the experiment. The original project identifier was 'SDHEL'. After the installation of the IBM 3081 and the subsequent conversion from the MVT operating system to the MVS operating system, the identifier was changed to 'SB#HL'. The CNTL library contains the current JCL and data cards to execute all programs in the Helios software system. CLIST libraries contain TSO command lists which aid the Helios user in performing many of the routine functions relative to production, maintenance and analysis. To obtain a listing of these libraries, enter the following command :

```
EX 'SB#HL.LIB.CLIST(SUBCR)' 'UTSO'
```

3.3.2 The 'SB#HL.LIB.CNTL' Data Set

The 'SB#HL.LIB.CNTL' JCL library is organized such that all member names begin with a letter of the alphabet indicating the software subsystem with which they are associated. Those that begin with 'L' support the EDR library generator subsystem; 'D' represents the data reduction subsystem; 'F' is the flux data base generation subsystem; 'T' is the trajectory subsystem; 'A' indicates the analysis (standard production) subsystem; 'S' represents the special analysis programs and data card setups, and finally, 'U' stands for the utility programs other than those routinely run as a part of the other subsystems. Furthermore, the last letter of the member name indicates the satellite identifier if the member is satellite dependent. Those ending with the letter 'A' are for Helios-A, while those ending with the letter 'B' are for Helios-B. Programmers who

maintain Helios software should refer to this CNTL library for the current JCL for all programs currently in the Helios system. The JCL for new programs should be stored in the appropriate subsection of this data set.

3.3.3 The 'SB#HL.LIB.CLIST' Data Set

The 'SB#HL.LIB.CLIST' data set contains TSO command lists which were developed to support various functions of production, data processing and analysis specific to the Helios project. The following is a list of these commands and their function in the system.

'SB#HL.LIB.CLIST' Commands:

COMMAND	FUNCTION
ADD6250	- Adds a new 6250 flux tape to the 'FLUXCAT2' 6250 flux source for either 'A' or 'B'.
CLKLST	- Lists the 'CLOCK' data set of spacecraft clock resets.
COPYBACK	- Restores 'INDEX' and 'CATLOG' from tape to disk.
HELDRP	- Performs standard production data reduction processing.
LIBGEN	- Performs standard production EDR library generation.
LOADR2A	- Loads R2A rate mnemonic to disk using LIST=LIST option of the FLUXPLOT program. 'SB#HL.R2AA.DATA' is loaded for HELIOS-A or 'SB#HL.R2AB.DATA' for -B. These data sets can subsequently be used as input to the 'MAVPLOT' CLIST.
LSTCAT	- List the current 'A' and 'B' DRS catalogs and the current FLUX catalog.

MATRIX - Submits the standard production 4 day average line printer MATRIX runs to the background job queue for either 'A' or 'B'.

PLOTHRL - Submits the standard production hourly average, 10 days / frame SD4060 rate, flux and sectored rate plots to the background job queue for either 'A' or 'B'.

RINDEX - List tape status information from the 'INDEX' data set for either 'A' or 'B'.

SCANLIB - Lists the EDR tape information from the 'CATLOG' data set for the given day or record for either 'A' or 'B'.

SUBCP - Submits the given member of 'SB#HL.LIB.CNTL' or a QEDed member to the background job queue and preserves the project id. (SB#HL) in the job name.

UPD6250 - Updates the end absolute file number (AFN) in the '6250' flux source in the 'FLUXCAT2' data set to match that in the 'NEWA' or 'NEWB' flux sources. This is run only when data has been added on to the end of the data base and the 1600 BPI tapes have been copied to the 6250 BPI data base.

Section 3.12 contains more information about these CLISTs, including their function, syntax, operands, CLIST queries, program queries, etc. This information is also available to the user online via the the system HELP command, provided the data set 'SB#HL.HELP.TEXT' is concatenated to the system HELP data sets. The method for accomplishing these concatenations is outlined in Subsection 3.3.4.

3.3.4 The 'SB#HP.LIB.CLIST' Data Set

The 'SB#HP.LIB.CLIST' data set contains TSO command lists which were developed to support various functions of production, maintenance and analysis that are common among several

LHEA experiments, primarily Helios, Pioneer, ISEE, IMP and Voyager. The following is a list of these commands and their functions.

'SB#HP.LIB.CLIST' COMMANDS:

COMMAND	FUNCTION
ADD	- Submits a background job to add a new tape volume to a user ID and type currently initialized in the 'LIBMAN' archive/restore data set management system.
ALNEW	- Allocates and catalogs a new data set on disk as per user specifications.
ARCHIVE	- Submits a background job to archive (copy) a data set to the 'LIBMAN' tape which has been initialized for the userid qualifier of the data set to be archived.
ASM2CR	- Lists the Cosmic Ray project data sets which have been archived by the ASM2 space management system in the past ten days. All data sets archived for Pioneer (SB#PR), Helios (SB#HL), IMP (SB#IM), Voyager (SB#VG), ISEE (SB#IC), and project independant (SB#HP) are listed.
BKLIBMAN	- Submits a background job to copy a project 'LIBMAN' tape to it's backup tape. Currently the HELIOS, IMP, PIONEER, ISEE, VOYAGER, or GENERAL (SB#HP) 'LIBMAN' tapes may be backed up by this command.
CNV4060	- Builds and submits a background job to run either the 'TOZETA' or 'TOCAL' program which convert 'SD4060' meta plot code to 'ZETA' or 'CALCOMP' plot code, respectively. The input 'SD4060' code may reside on either tape or disk, and may be produced by either the 'FLUXPLOT' or 'MAVPLOT' programs. The output 'ZETA' code is written to a user specified 9-TRACK 1600 BPI tape and file. The output

'CALCOMP' code is always written to file 1 of a user specified 7-TRACK 800 BPI tape.

COPYLIB - Builds and submits a background job to run the 'COPYLIB' program which copies the members of any RECFM=FB, LRECL=80 partitioned data set to either NL or SL tapes in either EBCDIC or ASCII character sets. One tape file is created for each member of the PDS.

CPY4060 - Builds and submits the JCL to the background to copy the SD4060 META plot code produced by the 'MAVPLOT' CLIST/ program to a user specified tape and file for plotting on the FR80 in Bldg. 23.

CRBKPS - This command performs multiple functions for creating backups of and restoring critical data sets for the IMP, HELIOS, PIONEER and ISEE projects as well as creating a backup of each project's tape. The execution of this CLIST is solely the responsibility of the cosmic ray data technician. Requests for backups of modified data sets or restores of previously backed up data sets are made via a standard request form. Offline records of the contents of each project's backup tape are located in the cosmic ray data room (Bldg. #2 , Room 242).

DIRFIX - This command is used to execute the 'DIRFIX' program in the foreground. 'DIRFIX' will list/alter user specified words within user specified records of a user specified data set. Therefore, the user must be familiar with the format of the data set being read by this program.

FESAVEDA- Fetches and purges the output from the jobs submitted by the 'SAVEDA' CLIST so that the output wil not print on the remote line printers in the SACC computer room.

FESAVEDS- Fetches and purges the output from the jobs submitted by the 'SAVEDS' CLIST so that the output wil not print on the remote line printers in the SACC computer room.

GRDSZ - This command is used to execute either the 'GRDSZDK' or 'GRDSZTP' program which creates a data set containing the the input card to the 'TOZETA' or 'TOCAL' program. The CLIST/program prompts the user for the desired length and height of the plot grid, and then calculates the additional space in inches to hold the title information and axis labels. This CLIST is invoked automatically by the 'CNV4060' CLIST.

INIT - Submits a background job to initialize the specified USERID,TYPE and VOL into the 'LIBMAN' archive/restore system.

LAB - Builds and submits JCL to perform tape labelling for any user specified tape.

LPDS - Submits a background job to execute the 'LISTPDS' procedure for any user specified PDS.

L26 - Lists start and end dates of the possible 26 day periods for both normal and leap years required by some forms of analysis routinely produced.

MAVPLOT - This command is used to invoke the MAVPLOT foreground program which produces 1 to N interval moving average SD4060 META plot code to a user specified disk data set. Input to the program is a disk data set produced by the LIST=LIST option of the FLUXPLOT program. The MAVPLOT program has the capability of producing three types of plot frames as follows:

1) linear time history plots
2) semi-log time history plots
3) semi-log time history with manual grid specifications.

A listing of the data plotted may also be created if the user desires. Once the plots have been created, control returns to the CLIST where the user is queried for the destination of the plots produced as follows:

1) ZETA or CLACOMP plotter

2) SD4060 (FR80) plotter.

If the ZETA / CLACOMP option is chosen the CNV4060 CLIST is invoked. If the SD4060 is chosen the CPY4060 CLIST is invoked. If neither is desired an appropriate message is written and the CLIST terminates.

MVTFORTH- This command is used to invoke the older MVT version of the FORTRANH compiler rather than the FORTRANH EXTENDED compiler invoked by the FORTH system CLIST. This version of the compiler is needed when modifications to an existing program have been made and the changed routine is to be linked into an existing load module which was compiled and linked through the MVT FORTRANH compiler, because the external system routines contained in the existing load module were included from the 'SYS1.MVTFTLIB' data set rather than 'SYS1.FORTLIB'.

NBI - This command is used to transfer the disk data set output produced by the NBI option of the NSCRIP command to disk on the NBI word processor in Building 2, Room 249.

NSCRIP - Builds and submits JCL to execute a modified version of the of the SCRIPT procedure which allows for the creation of a data set which can be tranferred to the NBI word processor.

REL4060 - Builds and submits IEBGENER JCL to reload SD4060 META plot code from tape to disk. This reverses the CPY4060 CLIST.

RESPONSE- Executes the response matrix listing/plotting program in foreground for ISEE, Voyager, Pioneer or Helios.

RESTORE - Builds and submits JCL to execute the RESTORE option of the LIBMAN ARCHIVE/RESTORE data set management system.

SAVEDA - Submits background jobs to access critical data sets belonging to the projects Voyager, ISEE-3, GRB, LEGS

and HEAO-B. This is done to prevent data set archival by ASM2. The command is issued weekly by the cosmic ray data technician.

SAVEDS - Submits background jobs to access critical data sets belonging to the projects Pioneer, Helios, and IMP. This is done to prevent data set archival by ASM2. The command is issued weekly by the cosmic ray data technician.

SID - Used to profile a user to a specific project ID. The profile will specify a prefix to be appended to all non-fully qualified data set names used during the TSO session. If the user is logged on under a sponsor code which is invalid for the new project, the user will be asked to log on under the proper sponsor code.

START - Initiates a user's TSO session and allows him to profile the session to a specified project ID. It concatenates the appropriate CLIST and HELP libraries accordingly, and charges to the proper sponsor code. It also displays the time and shows all the user's jobs which are presently in the system. This CLIST is normally invoked automatically when the user issues the LOGON command.

TPSCAN - Builds and submits JCL to run the system processor TAPESCAN in background. A summary of information residing on the scanned tape is printed. Labels themselves, as well as some data blocks are listed in both character and hexadecimal format. Output will be sent to the fetch queue.

More information on these CLISTs may be found in Reference 14, or via the system HELP command , provided the data set 'SB#HP.HELP. TEXT' is concatenated to the system HELP data sets.

3.3.5 Concatenating the CLIST and HELP Libraries

In order to concatenate the CLIST and HELP libraries to the system CLIST and HELP libraries, the user may enter the command:

```
EX 'SB#HP.LIB.CLIST(START)'
```

An alternative is for the user to copy the START member from 'SB#HP.LIB.CLIST' into his own LIB.CLIST. This will cause the CLIST member START to be invoked automatically upon LOGON to TSO. In any event, once this CLIST has executed, the member names in the SB#HL and SB#HP CLIST libraries become command names. Online documentation for each command is available by entering:

```
HELP COMMAND NAME
```

3.4 CRITICAL DATA SETS

The following section describes critical data sets which are used by various Helios production programs. Except for CNTL and CLIST data sets, all are accessed twice a week by the SAVEDS program to prevent their archival by ASM2.

3.4.1 Critical Object Modules and Load Libraries

The following data sets contain the program load modules which are used routinely.

SB#HL.ZBRXD.OHELIOSA.LOAD
SB#HL.SBCID.OHELIOSA.LOAD
SB#HL.DRPPUN.LOAD
SB#HL.LIBGEN.LOAD
SB#HL.HFLXDBG.LOAD
SB#HL.HELIOS.LOAD
SB#HL.LIB.LOAD
ZBJHB.LIB.LOAD
SB#HL.FOURHEL.LOAD
SB#HL.FLXMNT.LOAD
SB#HL.HSXRMN.LOAD

3.4.2 Critical Catalog Data Sets

The following are critical catalog data sets which are used to control various production data processing and analysis programs or to store vital information needed for production processing.

DATA SET	FUNCTION
SB#HL.CLOCKA.CNTL	Helios-A spacecraft clock information for all days processed by LIBGEN; used in correction of DM7 data times
SB#HL.CLOCKB.CNTL	Same as above for Helio-B
SB#HL.HADRSCTP.DATA	Pointer to current Helios-A Reduction System (DRS) Catalog
SB#HL.HBDRSCTP.DATA	Same as above for Helios-B
SB#HL.HADRSCT1.DATA	First Helios-A DRS Catalog
SB#HL.HADRSCT2.DATA	Second Helios-A DRS Catalog
SB#HL.HADRSCT3.DATA	Third Helios-A DRS Catalog
SB#HL.HADRSCT4.DATA	Fourth Helios-A DRS Catalog
SB#HL.HBDRSCT1.DATA	First Helios-B DRS Catalog
SB#HL.HBDRSCT2.DATA	Second Helios-B DRS Catalog
SB#HL.HBDRSCT3.DATA	Third Helios-B DRS Catalog
SB#HL.HBDRSCT4.DATA	Fourth Helios-B DRS Catalog
SB#HL.HADRSLOG.DATA	Helios-A FILE/LOGISTICS/HISTORY Catalog
SB#HL.HBDRSLOG.DATA	Helios-B FILE/LOGISTICS/HISTORY Catalog
SB#HL.FLUXCAT2.DATA	Flux Catalog Data Set
SB#HL.HAINDEX.DATA	Index to Helios-A catalog
SB#HL.HBINDEX.DATA	Index to Helios-B catalog
SB#HL.HACATLOG.DATA	Cross-reference of Helios-A EDR library tapes and files.
SB#HL.HBCATLOG.DATA	Cross-reference of Helios-B EDR library tapes and files.

3.4.3 The 'SB#HL.FLUXCAT2.DATA' Data Set

The format and information contained in the 'SB#HL.FLUXCAT2.DATA' data base are given in Reference 9. The source tapes for the flux data base catalog are listed below.

Helios-A

- NEWA : standard 1600 BPI flux data base tapes generated from the rates and PHA tapes in the DRS catalogs which in turn are generated from the EDR tapes. Trend checked.
- 6250 : same information as NEWA but packed on 6250 BPI tapes.

Helios-B

- NEWB : equivalent to the Helio-A NEWA tapes
- 6250 : equivalent to the Helios-A 6250 tapes

3.5 TAPE LIBRARY SYSTEM (TLS)

All tapes used by the Helios Data Reduction and Analysis System are assigned to tape slot locations which are owned by the project user identifier SB#HL. To obtain a line printer listing of all the tape volume serial numbers and their corresponding slot locations in the SACC computer room, enter the TSO command TLSREP and input the SB#HL ID when prompted to do so. All tapes presently in TLS have been titled such that the reader may easily determine their function in the system. On occasion the user may find it necessary to remove, assign, modify or show tapes in the system during their TSO session. See the Tape Library System User's Guide prepared by the Science and Applications Computing Center (SACC), March 1975, for documentation on the various TLSUPDTE commands.

In April 1983, the SACC required all users of the Tape Library System to reduce their slot allocation by one third. Due to this reduction requirement, many of the SB#HL tapes were removed from the SACC computer room floor to the tape cabinets in the hallway of the Building 2, 2nd floor, South Wing. The following is a summary of what was removed.

Helios-A :

EDR library tapes - HAL001 - HAL079
EDR library tape backups - HAC001 - HAC030
All inactive used PHA and rate tapes up to about 1980 and their backups *
All 1600 BPI flux tapes up to about 1980 and their backups *

Helios-B :

EDR library tapes - HBL001 - HBL103
EDR library backups - HBC001 - HBC035
All PHA and rate tapes and their backups *
All 1600 BPI flux tapes and their backups *

3.6 DATASET ARCHIVAL

3.6.1 Dataset Archival

There are three archival systems presently in use by the Cosmic Ray group.

Generally, backups are made whenever a data set is modified in some way. A new member might be added or an old member altered. Frequently, one small change can affect several data sets which must all be backed up to insure that the most recent version of the data set is accessible. The group makes use of several systems as an added safety precaution.

---

* Refer to the appropriate catalog listing for a list of these tape volumes.

Before any archival is done, two procedures must be followed to conserve track space and tape footage. It is important to first compress the data set and then to release any extra track space. These steps are accomplished by issuing the commands shown below.

```
COMPRESS 'dsname'
RLSE 'dsname'
```

If further information is needed concerning these commands help is available by entering

```
HELP COMPRESS or HELP RLSE
```

The backup systems which will be discussed are :

- ASM2
- LIBMAN
- Cosmic Ray Tape Backups - Levels 1 and 2

3.6.2 ASM2 : System Archival

The ASM2 archival system causes a specified data set to be copied to tape and deleted and uncataloged from disk. This procedure will occur automatically if the user has exceeded his track allocation, or if a data set has not been accessed during a 14 day period. The Cosmic Ray data technician uses this system upon request, or when the data set in question is not in frequent use. This system is supported by the SACC. Refer to the MVS TSO User's Guide for more information on the available TSO commands developed to support this system.

3.6.3 LIBMAN Archival System

A specified data set is copied from disk to tape; it is neither deleted nor uncataloged.

The programmer is responsible for running LIBMAN backups after completing modifications to a data set. The archival is done via a CLIST which submits a background job. The CLIST is 'SB#HP.LIB.CLIST(ARCHIVE)'. More information will be made available if the user issues the HELP ARCHIVE command.

The user's catalog will reflect data sets archived through LIBMAN. If the command LISTCAT is issued, the archived data sets will be listed with their appropriate backup tapes and a version number indicating when the backup was made. For example, the following line was taken from a LISTCAT done on SB#HL.

```
TAPE HLIBM1 SB#HL.Z.LISTALL.LOAD.V0183010
```

The version number is interpreted as VERSION 01 (there may be other versions of the data set); the backup was made in 1983 on day 10. The letter 'Z' which appears as part of the data set name, is automatically put in to represent the type of tape used (different tape types are used for other Cosmic Ray projects; issuing the command HELP ARCHIVE will explain further).

Data sets archived in this way may be restored via a second CLIST called 'SB#HP.LIB.CLIST(RESTORE)'. Help is available by issuing the command HELP RESTORE.

Backups of the LIBMAN tapes may be generated by using 'SB#HP.LIB.CLIST(BKLIBMAN)'. The command HELP BKLIBMAN will supply the user with necessary information for this CLIST's execution.

3.6.4 The Cosmic Ray Tape Archival System - Levels 1 and 2

Level 1

The Cosmic Ray data technician maintains backups of critical data sets according to instructions from senior programmers. When a data set is modified, the programmer will request a backup to be made by filing a backup request form with the Cosmic Ray data technician. The form indicates the data set to be backed up, and reasons why (i.e. it was modified, a new option was added, a bug corrected, etc.). It also shows the data set's attributes, and it's location on disk.

The data technician maintains a record of every backup made through these request forms, and also keeps a separate log which lists the tape-file number of the copied data set.

Copying is done through the CLIST 'SB#HP.LIB.CLIST(CRBKRS)'. The CLIST offers the user the option of copying partitioned or sequential data sets from disk to tape. This is done through the system program IEBCOPY. Other options allow the user to restore partitioned or sequential data sets from tape to disk. This is done by the system program IEBGENER.

The user does not need to enter the backup tape to be used since the CLIST will determine the proper tape according to the satellite project being backed up. The user must enter the proper tape file number, which can be found by consulting the log maintained by the data tech.

Level 2

Another option is offered by the 'SB#HP.LIB.CLIST(CRBKRS)'. This option is the Level 2 backup, and is simply a second copy of the Level 1 tape. After several data sets have been copied onto the first backup, the complete tape is copied to a second tape as an added precaution.

For a more detailed description of the CLIST's implementation, the user may issue the command HELP CRBKRS.

3.7 MAJOR DATA PROCESSING PROGRAMS

A description of the major data processing programs is provided in this section.

RINDEX

- Program Name or Entry Point : RINDEX
- Mnemonic Name in 'SB#HL.LIB.CNTL' : This program is invoked interactively in the TSO foreground, by the RINDEX CLIST in 'SB#HL.LIB.CLIST'.
- Source Location : 'SB#HL.PLIBGEN.SOURCE(RINDEX)'
- Documentation : A prologue is part of the source code. The RINDEX CLIST queries the user for responses as it executes interactively in foreground. More information about this CLIST may be found in Section 3.3 and in Section 3.12.
- Method of Execution : The load module in 'SB#HI.LIBGEN.LOAD' is invoked interactively in the TSO foreground.
- Purpose : RINDEX lists, on the terminal, various words from the 'INDEX' data set for either Helios-A or -B. These words contain information about EDR tape status, output EDR library tape status or both. This is dependent on the OPT parameter specified. Possible OPT values are I, O or B, respectively.

LOGOUT

- Program Name or Entry Point : LOGOUT
- Mnemonic Name in 'SB#HL.LIB.CNTL' : Members LGOUTA or B exist in LIB.CNTL, but the program is now invoked interactively in the TSO foreground by the LIBGEN CLIST in 'SB#HL.LIB.CLIST'.
- Source Location : 'SB#HL.PLIBGEN.SOURCE(LOGOUT)'
- Documentation : A programmer's guide is in Reference 6. not much! A user's guide can be found in Reference 11, Section C; CLIST information is in Section 3.3 and in Section 3.12.
- Method of Execution : The load module in 'SB#HI.LIBGEN.LOAD' is invoked interactively in the TSO foreground.
- Purpose : This program is used to enter new output EDR library tape numbers into the 'INDEX' data set for either Helios-A or -B. These tapes are used as output by the EDR library generator program, LIBGEN.

LOGIN

- Program Name or Entry Point : LOGIN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : Members LGINA and B are in LIB.CNTL, but the program is now invoked interactively in TSO foreground by the LIBGEN CLIST in 'SB#HL.LIB.CLIST'.
- Source Location : 'SB#HL.PLIBGEN.SOURCE(LOGIN)'
- Documentation : A programmer's guide is in Reference 6. A user's guide is in Reference 11, Section B. CLIST information can be found in Section 3.3 and in Section 3.12.
- Method of Execution : A load module in 'SB#HL.LIBGEN.LOAD' is invoked interactively in the TSO foreground.
- Purpose : This program is used to enter Experiment Data Record (EDR) tape numbers into the 'INDEX' data set for either Helios-A or -B. These tapes are used as input by the EDR library generator program, LIBGEN.

LIBGEN

- Program Name or Entry Point : PLIBGEN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : Members LGEXECA and B are in LIB.CNTL, but a background job is presently submitted by the LIBGEN CLIST located in 'SB#HL.LIB.CLIST'.
- Source Location : 'SB#HL.PLIBGEN.SOURCE(LBMAIN)' with associated subroutines (COPY,DISCRM,LIBGEN,MOUNTS, SERDSN,SERVOL and UPKLAB).
- Documentation : A programmer's guide is in Reference 6. A user's guide exists in Reference 11 with CLIST information in Section 3.3 and in Section 3.12.
- Method of Execution : A load module exists 'SB#HL.LIBGEN.LOAD'.
- Purpose : Primarily, LIBGEN updates a multiple file, IBM standard label, EDR library tape data base and updates the cross-reference catalog, CATLOG, data set with the Experiment Data Record (EDR) tapes. Secondary functions performed are : a) distribution mode seven (DM7) data times are corrected to the actual spacecraft event time; b) clock updates used in the DM7 correction are made using real time data times; and c) a temporary data set containing information about the EDR data tapes, files, times, bitrate, format, etc., is created. This data set becomes input to a second job stream in the LGEXECA or B JCL that sorts these library files into time order and separates DM7 data files from real time. The output from this sort becomes input to the DRPPUN program.

SORTN

- Program Name or Entry Point : SORTN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : Step 2 in LBEXECA or B.
- Source Location : Consult the Programmer's Assistance Center (PAC).
- Documentation : See Reference 12, pages 205-208.
- Method of Execution : SORTN is a cataloged procedure.
- Purpose : See Reference 12 for a general description. The specific function of SORTN is to sort the Helios-A or -B EDR library generator FT08F001 output data set. This data set contains data records relating to each EDR tape and file processed through LIBGEN. The resulting output disk data set is input to the DRPPUN program invcked by the HELDRP CLIST.

TAPESCAN

- Program Name or Entry Point : TAPESCAN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : LTSCPYA or B and LTSRESTA or B
- Source Location : Consult the PAC.
- Documentation : See Reference 12, pages 224-230 as well as the 'SYS2.DOCUMENT(TAPESCAN)' data set.
- Method of Execution : TAPESCAN is a cataloged procedure.
- Purpose : See Reference 12 for a general description. The specific function of TAPESCAN is to copy the EDR library tapes , produced by the LIBGEN program, to a backup tape. Copies are made at a 3 to 1 ratio converting the tapes from 1600 BPI to 6250 BPI. The LTSRESTA or B mnemonic, reverse this process.

DRPPUN

- Program Name or Entry Point : DRPPUN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : DRPPUNA and B are members in 'SB#HL.LIB.CNTL',however, this program is invoked interactively in the TSO foreground by the HELDRP CLIST in 'SB#HL.LIB.CLIST'.
- Source Location : 'SB#HP.ZBJHB.FORT(DRPPUN)'
- Documentation : A prologue can be found in the source code. More information about the HELDRP CLIST is in Section 3.3 and in Section 3.12 of this document, or in the data set 'SB#HL.HELP.TEXT'.
- Method of Execution : The load module in 'SB#HL.DRPPUN.LOAD' is invoked interactively in the TSO foreground by the HELDRP CLIST.
- Purpose : This program reads the sorted library file data set created by the sort step of the LGEXECA or B background job. It creates EDRTAP NAMELIST cards used by the HELDRP program (one data set contains the DM7 file cards and another the non-DM7 file cards) and through additional TSO commands within the HELDRP CLIST, copies these data cards to the DACCA or B and DREJA or B members in 'SB#HL.LIB.CNTL'.

HELDRP

- Program Name or Entry Point : A or BACCDM7N (DM7 data processing); A or BREJDM7N (non-DM7 data processing)
- Mnemonic Name in 'SB#HL.LIB.CNTL' : DRPPROC exists in LIB.CNTL, however, standard production runs are submitted to the background job queue by the HELDRP CLIST.
- Source Location : 'SB#HL.HELDRP.SOURCE' contains the main routine, HELDRP, and all subroutines.
- Documentation : A prologue can be found in the source code. A programmer's guide is in Refernce 7 while a user's guide is in Reference 11, Section A. More information about the HELDRP CLIST may be found in Section 3.3 and in Section 3.12, or in the data set 'SB#HL.HELP.TEXT'.
- Method of Execution : Load modules are in the following data sets :
    1) 'SB#HL.AACCDM7N.LOAD' - Helios-A DM7
    2) 'SB#HL.BACCDM7N.LOAD' - Helios-B DM7
    3) 'SB#HL.AREJDM7N.LOAD' - Helios-A non-DM7 (real time)
    4) 'SB#HL.BREJDM7N.LOAD' - Helios-B non-DM7 (real time)
- Purpose : The program performs data reduction, as well as quality and synchronization control. It creates a time-ordered series of every read-out rate and PHA data on a specified set of tape volumes. It also updates various cataloged disk data sets which are used to maintain the tapes contained in the data bases , and to maintain records of the processing performed.

FLXDBG

- Program Name or Entry Point : FLXDBG
- Mnemonic Name in 'SB#HL.LIB.CNTL' : FLUXDBGA or B
- Source Location : 'SB#HL.HFLXDBG.SOURCE' contains the Helios dependent routines and 'SB#PR.FLXDBG.SOURCE' contains the subroutines shared by both Helios and Pioneer.
- Documentation : The source code contains a prologue. A programmer's guide is in Reference 9; a user's guide is in Reference 11, Section G.
- Method of Execution : The load module is in 'SB#HL.HFLXDBG.LOAD'.
- Purpose : This program creates a time ordered series of user specified interval summaries of rate and PHA data that constitutes the FLUX data base. The program also updates the FLUXCAT2 data set that is the disk resident catalog of the data contained in the various flux tape data bases. The present flux catalog sources updated by this program are NEWA and NEWB (see Subsection 3.4.4). Input to the program consists of input NAMELIST data cards, rate and PHA tapes.

PATRICK

- Program Name or Entry Point : PATRICK
- Mnemonic Name in 'SB#HL.LIB CNTL' : LBCKINCT, LBLINCTA or B, DCPYPHAA or B, DCPYDATA or B, FCATBACK, FCATRELO, FTPCPYA or B, F4TO1A or B
- Source Location : Consult the PAC.
- Documentation : See Reference 12, pages 174-179.
- Method of Execution : A load module is in the system load library.
- Purpose : See Reference 12 for a detailed description. PATRICK makes backups of all tapes and catalogs created or modified by data reduction processing that are not already backed up by the data processing programs themselves. The F4TO1A or B mnemonic copies the 'NEWA or B' FLUX data base tapes to the '6250' data base at a 4 to 1 ratio.

DIRFIX

- Program Name or Entry Point : DIRFIX
- Mnemonic Name in 'SB#HL.LIB.CNTL' : None; the DIRFIX CLIST resides in 'SB#HP.LIB.CLIST' for general use. The UPD6250 CLIST in 'SB#HL.LIB.CLIST' invokes the DIRFIX CLIST for the specific purpose described below.
- Source Location : 'SB#PR.DIRFIX.SOURCE'
- Documentation : The CLIST/program queries the user for responses and input NAMELIST cards. The DIRFIX CLIST/program documentation is in Reference 14 or in 'SB#HP.HELP.TEXT'.
- Method of Execution : The load module in 'SB#PR.DIRFIX.LOAD' executes interactively.
- Purpose : The general function of DIRFIX is to list/alter user specified words within user specified records of a user specified disk data set. Only persons familiar with the data set contents and structure should use this CLIST/program. The specific function of the UPD6250 CLIST is to update the current end absolute file number in the '6250' FLUX catalog source to match that in corresponding 'NEWA or B' source once the '6250' data base has been updated by the F4T01A or B mnemonics mentioned above. Entries for any additional '6250' tapes are performed by the cognizant Helios programmer/analyst using DIRFIX.

FLUXPLOT (without list option)

- Program Name or Entry Point : HBFLUX0
- Mnemonic Name in 'SB#HL.LIB.CNTL' : AFLXPROC; however, the standard production time-history analysis runs are submitted to the background job queue by the PLOTHEL CLIST.
- Source Location : Source exists on tape.
- Documentation : Program documentation is currently in preparation. User's guides are in Reference 5, Appendix I, page 139, and in Reference 13, Sections I, J, and K. The Helios-A and -B table of rate mnemonics may be found in Reference 11, Section L. An errors data set exists on disk in 'SB#VG.FLUXPLOT.ERRORS'. For more information on the PLOTHEL CLIST, see Section 3.3 and Section 3.12, or 'SB#HL.HELP.TEXT'.
- Method of Execution : The load module is in 'SB#HI.HELIOS.LOAD'.
- Purpose : This program produces listings and/or plots of rate and/or flux values, over specified time periods and averaging intervals.

MATGEN

- Program Name or Entry Point : HBMATRIX
- Mnemonic Name in 'SB#HL.LIB.CNTL' : AMATRIX or AMATRIX1 for no summary listing. The standard production MATGEN runs are submitted by the MATRIX CLIST.
- Source Location : Source exists on tape.
- Documentation : User's guides are in Reference 5, Appendix I, page 147, and in Reference 13, Section L, Mc. For more information on the MATRIX CLIST see Section 3.3 and Section 3.12 or 'SB#HL.HELP.TEXT'.
- Method of Execution : The load module is in 'SB#HL.HELIOS.LOAD'.
- Purpose : MATGEN produces line printer PHA matrices and summary listings of user specified time periods, averaging interval and particles/ event types/compression factors, etc.. Input to this program is through data cards and flux tapes.

```
**** TSO FOREGROUND HARDCOPY ****
DSNAME=SB#HL.LIB.CNTL                                    (AMATRIX )

//MAIGEN  EXEC  PGM=HBMATRIX,REGION=300K                                  00000010
//* CONSISTENCY CHECK USE OF MATRIX PROGRAM                               00000011
//*  ON P CARD     COL 22 =  T                                            00000012
//*                COL 66-71 SPECIFIES 'TOLERANCE' TRY 1.5 OR LESS        00000013
//*                COL 72    CONTINUATION                                 00000014
//*   CONTINUATION CARD : COL 30-71, 6 FIELDS, 7 COLUMNS EACH :           00000015
//*           FIELD # 1   POWER GAMMA IN R=E**GAMMA   TRY   1.75          00000016
//*                 # 2   = (A THICK + B THICK) / (B THICK)               00000017
//*                 # 3   = (A THICK) / (B THICK)                         00000018
//*                 # 4   A MEV/CH  (HIGH GAIN OR LOW GAIN)               00000019
//*                 # 5   B MEV/CH  (HIGH GAIN OR LOW GAIN)               00000020
//*                 # 6   SUMC MEV/CH  (HIGH GAIN OR LOW GAIN)           00000021
//*   A -> D1   B -> D2    SUMC -> E  FOR THE LET DETECTOR                00000022
//*   MUST BE A 3 PARAM STOPPING PLOT FOR USE OF THE CHECK               00000023
//*                                                                      00000024
//*  FOR HET DETECTOR HELIOS-A                                           00000025
//*        A  =  .188  MEV/CHAN                                          00000026
//*        B  =  .204  MEV/CHAN                                          00000027
//*  CI+ CII  =  1.04  MEV/CHAN                                          00000028
//*                                                                      00000029
//*  FOR LET-1 DETECTOR HELIOS-A                                         00000030
//*        D1 = .2   MEV/CHAN                                            00000031
//*        D2 = .196 MEV/CHAN                                            00000032
//*        E  = 2.1  MEV/CHAN                                            00000033
//*                                                                      00000034
//STEPLIB   DD  DSN=SB#HL.HELIOS.LOAD,DISP=SHR                          00000035
//FT06F001  DD  SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=7265,         00000038
//  BUFNO=1)                                                            00000040
//FT07F001  DD  SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=3429,         00000050
//  BUFNO=1),SPACE=(CYL,(7,5))                                          00000060
//FT10F001  DD  DSN=HELFLUX,UNIT=(6250,,DEFER),VOL=SER=DUMFLX,          00000070
//  DISP=SHR,DCB=BUFNO=1                                                00000080
//FT49F001  DD  UNIT=SYSDA,SPACE=(TRK,(5,5)),                           00000090
//  DISP=(NEW,DELETE,KEEP),DCB=BLKSIZE=1088                             00000100
//FT50F001  DD  DSN=SB#HL.FLUXCAT2.DATA,DISP=SHR                        00000110
//PLOTDATA  DD  UNIT=SYSDA,DISP=(NEW,DELETE),SPACE=(TRK,(60),,CONTIG)   00000120
//FLUXSAVE  DD  UNIT=SYSDA,DISP=(NEW,DELETE),SPACE=(TRK,(10),,CONTIG)   00000130
//MISSING   DD  UNIT=SYSDA,DISP=(NEW,DELETE),SPACE=(TRK,(10,5))        00000140
//OVERFLOW  DD  UNIT=SYSDA,DISP=(NEW,DELETE),SPACE=(TRK,(10,5))        00000150
//SYSUDUMP  DD  SYSOUT=A                                               00000160
//ABNLDUMP  DD  DUMMY                                                  00000170
//CARDS  DD  *,DCB=BLKSIZE=800                                         00000180
```

pioneer/helios version.

HSXRMN

- Program Name or Entry Point : HSXRMN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : ASXRPLTA or B
- Source Location : 'SB#HL.HSXRMN.SOURCE'
- Documentation : A flowchart and directory exist in the source data set. A user's guide is in Reference 11, Section N. JCL user's guide comments exist in the above named mnemonics.
- Method of Execution : The load module exists in 'SB#HL.HSXRMN.LOAD'.
- Purpose : Produces line printer and/or SD4060 plots of Helios-A or -B sectored X-ray data from rate tapes.

3.8 CATALOG LISTING AND MAINTENANCE PROGRAMS

A description of the catalog listing and maintainance programs is given in this section.

SCANLIB

- Program Name or Entry Point : SCANLIB
- Mnemonic Name in 'SB#HL.LIB.CNTL' : None; this program is invoked interactively in the TSO foreground by the SCANLIB CLIST in 'SB#HL.LIB.CLIST'.
- Source Location : 'SB#HL.SCANLIB.SOURCE'
- Documentation : A directory and user's guide are in the source data set. The CLIST/program queries the user as it executes. More information may be found in Section 3.3 and in Section 3.12, or in 'SB#HL.HELP.TEXT'.
- Method of Execution : The load module is in 'SB#GE.LIB.LOAD'.
- Purpose : The program scans the Helios-A or -B 'CATLOG' data set by year and day (Julian) or by record. It produces a list of all EDR tape files for the given day/record.

DRSMNT

- Program Name or Entry Point : DRSMNT is ADDTOLIBed in 'SB#HL.ZBRXD.CHELIOSA.LOAD'
- Mnemonic Name in 'SB#HL.LIB.CNTL' : All mnemonic names beginning with DRS (i.e. DRSADDA, DRSADDB, etc.)
- Source Location : 'SB#HL.DRSMNT.SOURCE'
- Documentation : Program documentation and a user's guide are in Reference 5, Appendix I, page 25, as well as in Reference 13, Section C.
- Method of Execution : LINKGO is used. Other associated subroutines are extracted from 'SB#PR.SBCID.OPIONEER.LOAD'.
- Purpose : This program is used to maintain the Helios-A and -B Data Reduction System (DRS) catalogs. There are nine basic functions performed by this program. Some of the more common uses are adding tapes, and listing and restoring the current catalog. The current catalog is known by the contents of the pointer data set (DRSCTP).

FLXMNT

- Program Name or Entry Point : FLXMNT
- Mnemonic Name in 'SB#HL.LIB.CNTL' : All mnemonic names beginning with FCAT, except for FCATBACK and FCATRELO.
- Source Location : 'SB#HL.FLXMNT.SOURCE'
- Documentation : A user's guide is in Reference 11, Section M.
- Method of Execution : The load module is in 'SB#HL.FLXMNT.LOAD'.
- Purpose : This program will initialize, list, add blanks, list the rate table, and delete from specified flux catalog satellites or sources within a satellite, in the case of the INIT or DELT option.

LOGISH

- Program Name or Entry Point : LOGISH is ADDTOLIBed in 'SB#PP.SBCID.OPIONEER.LOAD'.
- Mnemonic Name in 'SB#HL.LIB.CNTL' : ULOGMNT
- Source Location : 'SB#PR.LOGIST.SOURCE'
- Documentation : A users guide is in Reference 5, Appendix I, page 56, as well as in Reference 13, Section D.
- Method of Execution : LINKGO is used. Other associated subroutines are extracted from 'SB#IM.ADDTOLIB.LOAD'.
- Purpose : This program is used to compress the 'DRSLOG' data set by clearing exact duplicate entries or those that meet user specified criteria.

RESTORE

- Program Name or Entry Point : MAIN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : URESTORE
- Source Location : 'SB#HL.LIB.CNTL(URESTORE)'
- Documentation : None.
- Method of Execution : FORTRAN/LINKGO
- Purpose : This FORTRAN program simply restores to disk the current 'DRSLOG' data set from its backup tape (E03499, File=2 for Helios-A or E04099, File=2 for Helios-B).

ZEROLOG

- Program Name or Entry Point : ZEROLOG
- Mnemonic Name in 'SB#HL.LIB.CNTL' : UZERLOGA or UZERLOGB
- Source Location : 'SB#HL.ZEROLOG.SOURCE'
- Documentation : JCL comments supply the user with input parameter definitions.
- Method of Execution : A load module exists in 'SB#HI.ZBRXD.CHELIOSA.LOAD'.
- Purpose : This program is executed only when the 'DRSLOG' data set is full. Before running the program, the user must TAPESCAN the OLDLOG tape volume to determine the next output file to be written. Once this has been done, the &INPUT NAMELIST card is edited to reflect the next output file on the OLDLOG tape. The program will copy the 'DRSLOG' data set to this tape, zero it out and modify the current DRS catalog to reflect this reset.

RESPONSE

- Program Name or Entry Point : RESPONSH
- Mnemonic Name in 'SB#HL.LIB.CNTL' : URESPONS is the member used for a background run. The program is normally run in foreground using the RESPONSE CLIST in 'SB#HP.LIB.CLIST'.
- Source Location : 'SB#IC.LISTHS2.SOURCE(TESTHS2)'
- Documentation : A programmer's guide and a user's guide are in the source. The RESPONSE CLIST queries the user as it executes. More information about the RESPONSE CLIST may be found in Section 3.3 and in Reference 14 or 'SB#HP.HELP.TEXT'.
- Method of Execution : A load module is in 'SB#PP.SBCID.OPIONEER.LOAD(RESPONSH)'.
- Purpose : This program lists the particle/event type table of the conversion from detector pulse height to incident particle energy.

CLKLST

- Program Name or Entry Point : CLKLST
- Mnemonic Name in 'SB#HL.LIB.CNTL' : None; this program executes in foreground via the CLKLST CLIST in 'SB#HI.LIB.CLIST'.
- Source Location : 'SB#HL.TAPEDMPS.SOURCE'
- Documentation : Comments on the program are in the source code. The CLIST/program queries the user for responses during execution. See Section 3.3 and Section 3.12 or 'SB#HL.HELP.TEXT' for more information.
- Method of Execution : A load module exists in 'SB#HI.CLKLST.LOAD'.
- Purpose : This program lists the spacecraft clock data set ('SB#HL.CLOCKA.CNTL' for Helios-A or 'SB#HL.CLOCKB.CNTL' for Helios-B) for the given start through stop days (RMJD, which is the number of days since Jan. 0, 1972).

3.9 ADDITIONAL DATA SET MAINTENANCE PROGRAMS

The following section describes additional data set maintainance programs.

LISTPDS

- Program Name or Entry Point : LISTPDS
- Mnemonic Name in 'SB#HL.LIB.CNTL' : UTSO; the LPDS CLIST is in 'SB#HP.LIB.CLIST'.
- Source Location : Consult the PAC.
- Documentation : See Reference 12, pages 157-163. More information about the LPDS CLIST may be found in Section 3.3 and in Reference 14 or 'SB#HP.HELP.TEXT'.
- Method of Execution : LISTPDS is a cataloged procedure located in 'SYS3.PROCLIB'.
- Purpose : LISTPDS is an OS/360 utility program for listing and/or punching partitioned data sets. The specific purpose of the UTSO member in LIB.CNTL is to list the following data sets :

  'SB#HL.LIB.CNTL'
  'SB#HL.LIB.CLIST'
  'SB#HP.LIB.CLIST'

The LPDS CLIST may also be used to list any partitioned dataset.

SAVEDS

- Program Name or Entry Point : SAVEDS
- Mnemonic Name in 'SB#HL.LIB.CNTL' : USAVEDS, however, this program is normally run via the SAVEDS CLIST in 'SB#HP.LIB.CLIST'.
- Source Location : Unknown.
- Documentation : No formal documentation exists. More information on the SAVEDS CLIST may be found in Section 3.3 and in Reference 14 or 'SB#HP.HELP.TEXT'.
- Method of Execution : A load module exists in 'SB#PR.SBCID.OPIONEER.LOAD'.
- Purpose : This program is used to locate on disk, open and close data sets listed on the //DSNAMES input cards, so that they will not be archived by the SACC ASM2 disk maintenance system for inactivity.

PATRICK

- Program Name or Entry Point : PATRICK
- Mnemonic Name in 'SB#HL.LIB.CNTL' : UDRPRELO, UBCKDRPL
- Source Location : Consult the PAC.
- Documentation : See Reference 12, pages 174-179. See the JCL comments in the above mnemonics for more information on the specific uses.
- Method of Execution : A load module is in the system load library.
- Purpose : See Reference 12 for a detailed description. The UDRPRELO mnemonic is used to reload all four HELDRP program load modules to disk from the tape TD7559. The UBCKDRPL mnemonic is used to copy the four HELDRP load modules back to TD7559. These two mnemonics are needed primarily for implementing changes to HELDRP routines into the permanent load modules.

TAPESCAN

- Program Name or Entry Point : TAPESCAN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : UCPYDRPL
- Source Location : Consult the PAC.
- Documentation : See Reference 12, pages 224-230.
- Method of Execution : TAPESCAN is a cataloged procedure.
- Purpose : The function of UCPYDRPL is to copy the HELDRP load module tape to its backup, TD7785.

IEBCOPY/IEBGENER/TAPESCAN

- Program Name or Entry Point : IEBCOPY/IEBGENER/TAPESCAN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : None; the CRBKRS CLIST resides in 'SB#HP.LIB.CLIST'.
- Source Location : Consult the PAC.
- Documentation : IEBCOPY is in Reference 12, pages 367-368 and IEBGENER is in Reference 12, pages 369-370. See Section 3.3 and Reference 14 or 'SB#HP.HELP.TEXT' for more information on the CRBKRS CLIST.
- Method of Execution : Load modules for these programs are in the system load library.
- Purpose : The CRBKRS CLIST performs multiple functions. It is for creating backups of disk data sets, restoring data sets to disk and copying the specific backup tape volume for the IMP, Helios, Pioneer and ISEE cosmic ray experiments. Execution of this system is solely the responsibility of the cosmic ray data technician. Requests for backups or restores are made via a request form. All records of the contents of the tapes for the above projects are kept on file in the Cosmic Ray Data Room (bldg. 2, room 242). This is the primary backup system for the Helios project as well as others mentioned above.

LIBMAN

- Program Name or Entry Point : LIBMAN
- Mnemonic Name in 'SB#HL.LIB CNTL' : None; the JCL for all of the LIBMAN functions (ARCHIVE, RESTORE, INIT and ADD) are in 'SB#HP.LIBMAN.CNTL'; however, CLISTs are available in 'SB#HP.LIB.CLIST' for executing these functions under the same mnemonic names as above.
- Source Location : 'ZB2NL.LIBMAN.SOURCE'
- Documentation : No formal program documentation exists. See Section 3.3 and Reference [4] or 'SB#HP.HELP.TEXT' for more information on the LIBMAN CLIST, ARCHIVE and RESTORE CLISTs.
- Method of Execution : ARCHIVE, RESTORE, INIT and ADD are instream procedures. The LIBMAN load module is in 'SB#HP.LIBMAN'LOAD'.
- Purpose : LIBMAN is the second level backup and restore system for the Helios project. Programmers who modify existing programs or incorporate new programs into the Helios system should ensure that the program source code and load module are archived in the proper way. See Section 3.6 for a description of the procedures for implementing new programs or program modifications into the Helios system. The current LIBMAN tape for the Helios experiment is HLIBM[1].

TAPESCAN

- Program Name or Entry Point : TAPESCAN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : None; BKLIBMAN resides in 'SB#HP.LIB.CLIST'.
- Source Location : Consult the PAC.
- Documentation : See Reference 12, pages 224-230. For more information on the BKLIBMAN CLIST, see Section 3.3 and Reference 14 or 'SB#HP.HELP.TEXT'.
- Method of Execution : TAPESCAN is a cataloged procedure.
- Purpose : BKLIBMAN is a CLIST that submits a background TAPESCAN job for copying the LIBMAN tapes to a backup. The user is queried for the appropriate experiment to be backed up. The current backup tape for HLIBM1 is HLIBM2.

ASM2/$AI, $AR, and $RA

- Program Name or Entry Point : ASM2RETU
- Mnemonic Name in 'SB#HL.LIB.CNTL' : None; $AI and $AR reside in the system command library. $RA resides in 'SYS1.CLIST'.
- Source Location : Consult the PAC.
- Documentation : Information on the $AI, $AR and $RA commands may be found in the MVS TSO HELP data set. Enter HELP COMMAND.
- Method of Execution : $AI and $AR are command processors that invoke ASM2 in the TSO foreground. $RA is a CLIST that submits a background job.
- Purpose :

  $AI (archive inquiry) - scans the ASM2 catalog and lists the names of a user's archived data sets.

  $AR (archive) - causes the data set specified to be archived to tape and deleted and uncataloged from disk.

  $RA (reload from archives) - reloads a previously archived data set from an archive tape to a disk and catalogs the data set.

The ASM2 system is the third level backup for the Helios project. See Section 3.6 for more information.

Note - The user should also become familiar with the other $ commands that are available. Specifically the $BI, $BK and $RB commands may be useful in restoring the most recent versions of some data sets.

3.10 TAPE UTILITY PROGRAMS

This section describes the tape utility programs that are used to list, compress, or modify tapes produced by the Data Reduction System.

EDRSCAN

- Program or Entry Point : EDRSCAN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : UEDRSCAN, ULIBSCAN
- Source Location : 'SB#HL.EDRLIST.SOURCE(EDRSCAN)'
- Documentation : No formal program documentation exists. The source code is commented. The JCL comments supply the user with definitions of the &INPUT NAMELIST parameters.
- Method of Execution : A load module is in 'SB#HL.EDRSCAN.LOAD'.
- Purpose : This program scans EDR or EDR library tapes for the existence of science data. A one line message is printed for each file processed giving the number of lines of data and the number of bad lines within the file. If the number of bad lines is equal to the number of lines for a file , the data need not be processed through the Data Reduction System.

HAEDR

- Program Name or Entry Point : HAEDR is ADDTOLIBed in 'ZBJHB.LIB.LOAD'.
- Mnemonic Name in 'SB#HL.LIB.CNTL' : UEDRLIST
- Source Location : 'SB#HL.EDRLIST.SOURCE(HAEDR)'. The subroutines PHAUPK and RATUPK are in 'SB#HI.HELDRP.SOURCE'.
- Documentation : No formal program documentation exists. A user's guide is in Reference 11, Section O.
- Method of Execution : LINKGO. Other associated subroutines are included from the data sets listed in the LINK.SYSLIB concatenation in the JCL.
- Purpose : This program produces a formatted listing of Helios EDR tapes, on the line printer.

HALIB

- Program Name or Entry Point : HALIB is ADDTOLIBed in 'ZBJHE.LIB.LOAD'.
- Mnemonic Name in 'SB#HL.LIB.CNTL' : ULIBLIST
- Source Location : 'SB#HL.EDRLIST.SOURCE(HALIB)'
- Documentation : None; the JCL in 'SB#HL.LIB.CNTL(ULIBLIST)' contains comments defining the input parameters and format.
- Method of Execution : LINKGO. Other subroutines are included from the data sets listed in the LINK.SYSLIB concatenation in the JCL.
- Purpose : This program produces a formatted listing of Helios EDR library tapes.

ORBIT

- Program Name or Entry Point : ORBIT
- Mnemonic Name in 'SB#HL.LIB.CNTL' : TRAJECT
- Source Location : Unknown.
- Documentation : A user's guide is in Reference 11, Section F.
- Method of Execution : LOADER. Other subroutines are included from data sets listed in the SYSLIB concatenation in the JCL.
- Purpose : ORBIT produces a formatted listing on the line printer of selected words from the Helios-A or -B orbit/attitude tapes. Records of these tapes and the actual listings are maintained and kept on file in the Cosmic Ray Data Room (building 2, room 242).

See next page

HELIOS2T

- Program Name or Entry Point : HELIOS2T is ADDTOLIBed in 'ZBJHE.LIB.LOAD'.
- Mnemonic Name in 'SR#HL.LIB.CNTL' : TRAJECTB
- Source Location : 'SB#HP.ZBJHB.FORT(HELIOS2T)'
- Documentation : None; no data cards are required for this program.
- Method of Execution : LOADER. Other subroutines are included from the data sets listed in the SYSLIB concatenation in the JCL.
- Purpose : This program lists all parameters from the Helios-A or -B orbit/attitude tapes and is normally not used except by the Gamma Ray Studies group of the LHEA headed by Dr. Tom Cline.

HARTPL

- Program Name or Entry Point : HARTPL is ADDTOLIBed in 'SB#PR.ZB2NL.OPIOTEMP.LOAD'
- Mnemonic Name in 'SB#HL.LIB.CNTL' : URATLSTA or B
- Source Location : 'SB#HL.HARTPL.SOURCE(HARTPL)'
- Documentation : A user's guide is in Reference 11, Section P. The JCL contains comments describing the SRATLST NAMELIST parameters.
- Method of Execution : LINKGO. Other subroutines are included from 'SB#PR.ZB2NL.OPIOTEMP.LOAD'.
- Purpose : HARTPL produces a formatted listing of all rates contained on the Helios-A or -B rates tapes; subcom data for each record is also listed. The user specifies the data to be listed as a range of records or for a specified time interval. The user may also supply a tape to be read; if omitted, the tape is located in the current DRS catalog (time option only).

RTLSTS

- Program Name or Entry Point : RTLSTS
- Mnemonic Name in 'SB#HL.LIB.CNTL' : URATLSTS
- Source Location : 'SB#HL.HARTPL.SOURCE(URTLSTSH)'
- Documentation : A user's guide is in Reference 11, Section P. The JCL contains comments describing the &RATLST NAMELIST parameters.
- Method of Execution : A load module is in 'SB#HL.RTLSTS.LOAD(RTLSTS)'.
- Purpose : RTLSTS produces a formatted listing of only the event type rate mnemonics (those that trigger PHA conditions). These rate mnemonics are R1, R2A, R2B, R3A, R11A and R11B. The output from this version of the HARTPL program is greatly reduced.

HAPTPL

- Program Name or Entry Point : HAPTPL is ADDTOLIBed in 'SB#PR.ZB2NL.OPIOTEMP.LOAD'.
- Mnemonic Name in 'SB#HL.LIB.CNTL' : UPHALSTA or B
- Source Location : 'SB#HL.HAPTPL.SOURCE(HAPTPL)'
- Documentation : A user's guide is in Reference 11, Section Q. The JCL contains comments describing the &PHALST NAMELIST parameters.
- Method of Execution : LINKGO. Other subroutines are included from 'SB#PR.ZB2NL.OPIOTEMP.LOAD' and 'SB#IM.ADDTOLIB.LOAD'.
- Purpose : HAPTPL produces a formatted listing of Helios-A or -B PHA tapes.

FLXLST

- Program Name or Entry Point : FLXLST
- Mnemonic Name in 'SB#HL.LIB.CNTL' : UFLXLST
- Source Location : 'SB#HL.FLXLST.SOURCE'
- Documentation : A user's guide is in Reference 11, Section H.
- Method of Execution : LOADER. Other subroutines are included from the data sets listed in the SYSLIB concatenation in the JCL.
- Purpose : FLXLST will produce a formatted listing of Helios-A or -B FLUX tapes, on the line printer. The program will list any or all of the eight different record types based on the value or the OPTION input NAMELIST parameter.

QBOFIX

- Program Name or Entry Point : QBOFIX
- Mnemonic Name in 'SB#HL.LIB.CNTL' : UQBOFIX
- Source Location : 'SB#HL.QBOFIX.SOURCE(QBOFIX)'
- Documentation : A prologue is in the source code. The &TAPES NAMELIST has two parameters. They are:
  DTAPE = 'RATTAP' - input rate tape volume
  DTPOUT = 'OUTTAP' - output tape
- Method of Execution : A load module is in 'SB#HI.QBOFIX.LOAD'.
- Purpose : QBOFIX copies Helios rate tapes and corrects ratio/blackout mode indicator inconsistencies. If a rate record contains a zero ratio and the S/C is not in blackout mode or a non-zero ratio and the S/C is in B/O mode, the program will turn the B/O mode logical flag on or off respectively, before writing the record. A message is printed each time either of these conditions is encountered.

TAPSQZ

- Program Name or Entry Point : TAPSQZ is ADDTOLIBed in 'ZBJHE.LIB.LOAD'.
- Mnemonic Name in 'SB#HL.LIB.CNTL' : UTPSQPHA or B and UTPSQRTA or B
- Source Location : 'SB#HL.TAPSQZ.SOURCE'
- Documentation : Comments exist in the source code and in the JCL. A user's guide is in Reference 11, Section S.
- Method of Execution : LOADER. Other subroutines are included from 'SB#HL.ZBRXD.OHELIOSA.LOAD'.
- Purpose : When merging data onto full rate and PHA tapes, the HELDRP program creates a tape to hold data not fitting on the original 2200 foot tape. Since numerous merges of this tape quickly use up the available blank rate or PHA tapes, the TAPSQZ program was written to compress these short tapes onto a single tape. The input tapes must be given in time order as they appear in the current DRS catalog. The output tape must be within the rate or PHA tape block in the catalog, but not as an active or blank tape. Once the tapes are copied, the next DRS catalog is updated with the compressed tape volume replacing those that were squeezed.

3.11 ANALYSIS PROGRAMS

The analysis programs are described in this section.

FLUXPLOT (with LIST option)

- Program Name or Entry Point : FLUXMAIN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : ANEWPROC, AMAVPROC
- Source Location : Source exists on tape.
- Documentation : Program documenation is currently in preparation. User's guides are in Reference 5, Appendix I, page 139, and in Reference 13, Sections I, J and K. The Helios-A and -B table of rate mnemonics is in Reference 11, Section L. An errors data set is in 'SB#VG.FLUXPLOT.ERRORS'.
- Method of Execution : LOADER. The HBFLUX0 load module is linked with either the THLIST or THNULL base on the value of the LIST symbolic parameter passed to the procedure via the EXEC JCL statement.
- Purpose : In addition to the functions mentioned in Section 3.7 under FLUXPLOT, this version of the program allows the user to create a LIST tape (in the case of ANEWPROC) for use on another computer or a LIST data set (in the case of AMAVPROC) for use by the MAVPLOT program.

MAVPLOT

- Program Name or Entry Point : LMAIN is the entry point in the MAVPLOT load module.
- Mnemonic Name in 'SB#HL.LIB.CNTL' : None; the MAVPLOT CLIST is in 'SB#HP.LIB.CLIST'.
- Source Location : 'ZB2NL.MOVAVG.FORT'
- Documentation : The CLIST/program queries the user for responses as it executes interactively. More information on the MAVPLOT CLIST may be found in Section 3.3 and in Reference 14 or 'SB#HP.HELP.TEXT'.
- Method of Execution : The load module in 'SB#HP.LIB.LOAD(MAVPLOT)' is invoked interactively in foreground.
- Purpose : The MAVPLOT program reads the LIST data set produced by FLUXPLOT and writes linear, semi-log or special semi-log SD4060 plot code to disk. The output disk data set is subsequently used as input by the TOCAL or TOZETA program.

TOCAL/TOZETA

- Program Name or Entry Point : TOCAL/TOZETA
- Mnemonic Name in 'SB#HL.LIB.CNTL' : None; JCL for these programs is in 'SB#HP.LIB.CNTL'. However, the CNV4060 CLIST in 'SB#HP.LIB.CLIST' is normally used to execute either of these programs.
- Source Location : 'ZB2NL.TOCAL.SOURCE' and 'ZB2NL.TOZETA.SOURCE'.
- Documenation : No formal program documentation exists. The CLIST queries the user as it executes. More information on the CNV4060 CLIST may be found in Section 3.3 and Reference 14 or 'SB#HP.HELP.TEXT'.
- Method of Execution : A load module for each program is in 'SB#HL.LIB.LOAD'.
- Purpose : The TOCAL and TOZETA programs convert the SD4060 plot code produced by either FLUXPLOT or MAVPLOT into CalComp or ZETA plot code. The user may vary the plot grid size to suit his needs via the FT05F001 input card which is created by the GRDSZDK or GRDSZTP CLIST/program invoked by the CNV4060 CLIST. The height of the plots are restricted to 32 inches.

GRDSZDK/GRDSZTP

- Program Name or Entry Point : GRDSZDK/GRDSZTP
- Mnemonic Name in 'SB#HL.LIB.CNTL' : None; the CLIST resides in 'SB#HP.LIB.CLIST(GRDSZ)'.
- Source Location : 'SB#HP.ZBJHB.FORT' in members GRDSZDK and GRDSZTP.
- Documentation : A prolog and comments are in the source code. The GRDSZ CLIST queries the user as it executes interactively. See Section 3.3 and Reference 14 or 'SB#HP.HELP.TEXT' for more information.
- Method of Execution : The load modules are in 'SB#HP.LIB.LOAD' in members GRDSZDK and GRDSZTP.
- Purpose : This program prompts the user for the plot length and width dimensions in inches of the ZETA or CalComp plots to be produced. The program subsequently calculates the additional horizontal and vertical space required to hold the plot title information and the axes labels. These calculated values are then written to a disk data set where they are input to the TOZETA or TOCAL program. The GRDSZDK version is used when the SD4060 code being converted was produced by the MAVPLOT program and the GRDSZTP version is used when the SD4060 code was written to tape by FLUXPLOT.

FOURIER

- Program Name or Entry Point : MAIN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : AFOURLST, AFOURPLT
- Source Location : 'SB#PR.MULTISAT.FOURIER.SOURCE'
- Documentation : A programmer's and user's guide is in Reference 10. The JCL also contains comments about the input NAMELIST cards.
- Method of Execution : LOADER. The satellite independent routines are included from 'SB#PR.FOURSI.LOAD' while the satellite dependent routines are located in 'SB#HL.FOURHEL.LOAD. The WOLFPLOT routines are in 'SYS2.WOLFPLOT'.
- Purpose : This program produces listings, flux plots, anisotropy plots, and CAMPLOTS with or without magnetic field data of Helios sectored rate data contained in the user specified flux catalog satellite source. The plots may be produced on the line printer, CalComp or SD4060.

HASDMN

- Program Name or Entry Point : HASDMN
- Mnemonic Name in 'SB#HL.LIB.CNTL' : SCAMPLTA or B
- Source Location : Unknown.
- Documentation : A user's guide is in Reference 11, Section Mc. Sample data card setups are in the above members in LIB.CNTL.
- Method of Execution : LINKGO. HASDMN is in 'SB#HL.ZBRTC.OPLOTMOD'.
- Purpose : Produces SD4060 CAMPLOTS of sectored rate data from rate tapes. This program was replaced by the POLAR (CAMPLOT) option of the FOURIER program.

SELECT

- Program Name or Entry Point : HBSELECT
- Mnemonic Name in 'SB#HL.LIB.CNTL' : SELECT
- Source Location : Source exists on tape.
- Documentation : A sample setup of this program exists in the above member in LIB.CNTL.
- Method of Execution : A load module is in 'SB#HL.HELIOS.LOAD'.
- Purpose : Creates line printer matrices similar to MAT-GEN (see Section 3.7).

3.12 'SB#HL.LIB.CLIST' COMMANDS

This section describes the commands in the Helios CLIST library.

ADD6250

- Function : The ADD6250 command is used to add the next 6250 BPI flux tape number and its corresponding start absolute file number (AFN) to the next tape record within the Helios-A or -B '6250' flux source contained in 'SB#HL.FLUXCAT2.DATA'. The user must first execute the 'UPD6250' command to update the last AFN of the '6250' flux tape which precedes the one to be added because the last AFN of that tape is used to calculate the start AFN of the tape being added by this command. Once the new tape has been added, this CLIST invokes the 'UPD6250' command so that the end AFN of the new tape added may be set.
- Syntax : ADD6250
- Operands : None
- CLIST Queries :

  SATELLITE ID (A or B)

  CONTINUE ? (yes or no) - after function and restrictions of this command are written to the terminal

  BACKUP FLUX CATALOG ? (yes or no) - if the backup data set is already in the system catalog
- Program Queries : None
- Execution if not Concatenated to 'SB#HL.LIB.CLIST':
  EX 'SB#HL.LIB.CLIST(ADD6250)'
- Other CLISTs Invoked by this Command :
  'SB#HL.LIB.CLIST(UPD6250)'

CLKLST

- Function : The CLKLST command is used to execute the CLKLST program in foreground (see Section 3.8). The CLIST first searches for the data sets required to execute the program on disk. If there are any data sets missing, a background job is submitted to restore them to disk and the CLIST terminates. Otherwise, the CLKLST program is executed. Output from the program lists at the terminal and on the line printer.

- Syntax : CLKLST

- Operands : None

- CLIST Queries : SATELLITE ID. (A or B)

- Program Queries :
  Entered on a single line are :
  SATELLITE = Helios-A or -B (A8)
  STRT = first Relative Modified Julian Day (RMJD) to be listed (I4)
  IEND = last RMJD to be listed (I4)

- Execution if not Concatenated to 'SB#HL.LIB.CLIST':
  EX 'SB#HL.LIB.CLIST(CLKLST)'

- Other CLISTs Invoked by this Command :
  'SB#HP.LIB.CLIST(RESTORE)'

COPYBACK

- Function : The COPYBACK command is used to submit a background PATRICK job to restore either the Helios-A or -B 'INDEX' and 'CATLOG' data sets from the backup tape Z0085. This command is issued only after the LIBGEN program has terminated abnormally and the user wishes to restore these data sets to their status prior to the bad LIBGEN run.

- Syntax : COPYBACK

- Operands : None

- CLIST Queries : SATELLITE ID. (A or B)

- Execution if not Concatenated to 'SB#HL.LIB.CLIST':
  EX 'SB#HL.LIB.CLIST(COPYBACK)'

- Other CLISTs Invoked by this Command :
  'SB#HI.LIB.CLIST(SUBCR)'

HELDRP

- Function : The HELDRP command performs multiple functions to accomplish the data reduction processing of the EDR data last written to the EDR library data base by the LIBGEN CLIST/program as follows :

  a) A background PATRICK job is submitted to backup the 'INDEX' and 'CATLOG' data sets updated by the LIBGEN run.

  b) The sorted FT08F001 output data set from LIBGEN ('SB#HL.HACSORTN.DATA' for Helios-A or 'SB#HL.HBCSORTN.DATA' for -B) is read by the DRPPUN foreground program which produces the &EDRTAP NAMELIST card input to HELDRP. One set of cards is for DM7 file processing and the other is for real time file processing.

  c) The &EDRTAP cards are copied into the 'SB#HL.LIB.CNTL' data set with the member names of DACCA or B for DM7 file cards and DREJA or B for real time file cards.

  d) The HELDRP runs are submitted to the background job queue for overnight or weekend processing; one run for DM7 file processing and the other for non-DM7 (real time) processing.

  e) A series of messages are written to the user's terminal explaining what has taken place and procedures for completing the processing are given.

- Syntax: HELDRP
- Operands: None
- CLIST Queries :

  SATELLITE ID. (A or B)

  JOB CLASS for HELDRP Runs (E or F)
- Execution if Not Concatenated to 'SB#HL.LIB.CLIST':

  EX 'SB#HL.LIB.CLIST(HELDRP)'
- Other CLISTs Invoked by this Command :

  'SB#HL.LIB.CLIST(SUBCR)'

LIBGEN

- Function : The LIBGEN command performs the following two functions :

  a) The primary function is to enter Experiment Data Record (EDR) tape numbers into the 'A' or 'B' 'INDEX' data set via the LOGIN foreground program (see Section 3.7) and to submit the EDR Library Generator (LIBGEN) program to the background job queue for overnight processing. A series of messages describing the procedures to be followed either to continue the processing after a normal LIBGEN execution or to recover from an abnormal run are listed at the user's terminal.

  b) The secondary function is to enter new output EDR library tape numbers into the 'A' or 'B' 'INDEX' data set via the LOGOUT program and to submit a background LABEL run to write IBM standard labels (SL) at 1600 BPI (den=3).

  The tapes for either function must be placed in the SACC Tape Library System (TLS) and taken to the SACC computer room prior to executing this CLIST.

- Syntax : LIBGEN LIST(yes/no)
  Required - None
  Defaults - LIST(yes)

- Operands :
  LIST(yes/no)
  yes - lists purpose of the CLIST and requirements
  no - skips the above

- CLIST Queries :

  CONTINUE ? (yes/no) - after LIST has been written;
  no prompt if LIST(no) is given.
  LOGIN ? (yes/no)
  LOGOUT ? (yes/no)
  SATELLITE ID ? (A or B)
  FOUR DIGIT EDR or LIB TAPE # (NNNN)
  FOUR DIGIT QUANTITY OF TAPES (NNNN)

- Execution if Not Concatenated to 'SB#HL.LIB.CLIST':

  EX 'SB#HL.LIB.CLIST(LIBGEN)' 'LIST(yes/no)'

- Other CLISTs Invoked by this Command :

  'SB#HL.LIB.CLIST(RINDEX)'
  'SB#HL.LIB.CLIST(SUBCR)' LOGIN option only
  'SB#HP.LIB.CLIST(LAB)' LOGOUT option only

LOADR2A

- Function : The LOADR2A command is used to submit a background FLUXPLOT job which loads the LIST output to a data set in yearly frames and daily averages. The output data set is subsequently read by the MAVPLOT CLIST/program.

- Syntax : LOADR2A IOEST(EXCP #) CLASS(job class)
  Defaults - IOEST(10) CLASS(A)

- Operands :
  IOEST(EXCP #)
  CLASS(job class)

- CLIST Queries :
  SATELLITE ID (A or B)
  START DATE in YY/MM/DD FORMAT
  END DATE in YY/MM/DD FORMAT

- Execution if not Concatenated to 'SB#HL.LIB.CLIST':
  EX 'SB#HL.LIB.CLIST(LOADR2A)' 'IOEST(EXCP #) CLASS(job class)'

LSTCAT

- Function : The LSTCAT command simply submits three background jobs that produce listings of the current Helios-A and -B 'DRS' catalogs and the current 'FLUX' catalog.
- Syntax : LSTCAT
- Execution if not Concatenated to 'SB#HL.LIB.CLIST':
  EX 'SB#HL.LIB.CLIST(LSTCAT)'
- Other CLISTs Invoked by this Command :
  'SB#HL.LIB.CLIST(SUBCR)'

MATRIX

- Function : The MATRIX command is used to submit the Helios-A or -B standard production 4 day average line printer matrix runs to the background job queue. There are 11 jobs submitted for Helios-A and 16 for Helios-B. These are run only to update the matrix analysis kept on file in the Cosmic Ray Data Room (building 2, room 242).

- Syntax : MATRIX LIST(yes/no) TIME(CPU minutes) IO(EXCP #) CLASS(job class) ID(A or B)
  Defaults -
  LIST(yes)
  TIME(2)
  IO(20)
  CLASS(E)
  ID( )

- Operands :
  LIST(yes/no) - Lists function of the CLIST.
  TIME(CPU minutes) - amount of CPU minutes required for each run
  IO(EXCP #) - number of Execute Channel Programs required for each run; the number given is converted to thousands by the system (i.e. 20 = 20,000).
  CLASS(job class) - job classes are A, E or F
  ID(A or B) - satellite ID to be run (A = Helios-A, B = Helios-B); if not specified, the user is queried.

- CLIST Queries :
  SATELLITE ID (A or B) - if not specified when CLIST is invoked
  CONTINUE ? (yes/no) - after LIST has been written; no prompt if LIST(no) is given.
  START DATE (YY/MM/DD) - start year, month and day of the matrices to be run.
  END DATE (YY/MM/DD) - end year, month and day of the matrices to be run.

- Execution if not Concatenated to 'SB#HL.LIB.CLIST':
  EX 'SB#HL.LIB.CLIST(MATRIX)' 'LIST(yes/no)
  TIME(CPU minutes) IO(EXCP #) CLASS(job class) ID(A or
  B)'

PLOTHEL

- Function : The PLOTHEL command is used to submit the Helios-A or -B standard production, one hour average, 10 days per frame, rate, flux and sectored rate FLUX-PLOT runs to the background job queue. These jobs are run only when updates to the existing sets of plots are needed. These plots are kept on file in the Cosmic Ray Data Room (building 2, room 242).

- Syntax :
  PLOTHEL TIME(CPU minutes) IOEST(EXCP #) CLASS(job class)
  Defaults -
  TIME(2)
  IOEST(15)
  CLASS(E)

- Operands :
  TIME(CPU minutes) - number of CPU minutes needed for each run.
  IOEST(EXCP #) - number of EXCPs needed for each run. See a job printout for an example of how to estimate EXCPs
  CLASS(job class) - job class for each run (A,E,F are valid).

- CLIST Queries :
  SATELLITE ID (A or B)
  START DATE (YY/MM/DD)
  END DATE (YY/MM/DD)
  PLOT TAPE NUMBER (HEL01 - HEL15)

- Execution if not Concatenated to 'SB#HL.LIB.CLIST':
  EX 'SB#HL.LIB.CLSIT(PLOTHEL)' 'TIME(CPU minutes) IOEST(EXCP #) CLASS(job class)'

RINDEX

- Function : The RINDEX command is used to invoke the RINDEX program in foreground (see Section 3.7) which lists tape status information from the 'INDEX' data set for either Helios-A or -B.

- Syntax :
  RINDEX OPT(I/O/B) ID(A or B)
  Defaults -
  Both OPT and ID default to null strings ; if not specified when the CLIST is invoked, the user is prompted.

- Operands :
  OPT(I/O/B) - parameter to be passed to the RINDEX program
  I - lists input tape (EDR) status.
  O - lists input tape (LIB) status.
  B - lists both EDR and LIB status.
  ID(A or B) - satellite ID (A for Helios-A or B for Helios-B).

- Execution if not Concatenated to 'SB#HL.LIB.CLIST':
  EX 'SB#HL.LIB.CLIST(RINDEX)' 'OPT(I/O/B)
  ID(A or B)'

SCANLIB

- Function : The SCANLIB command is used to invoke the SCANLIB program in foreground (see Section 3.8). This program scans the Helios-A or -B 'CATLOG' data set for the given year and day or record.
- Syntax : SCANLIB
- Operands : None
- CLIST Queries :

  SATELLITE ID (A or B)

  SCAN OTHER PERIODS OR CATALOG ? (yes or no)
- Program Queries :

  RECORD OPTION? (T or F)

  IF 'T' then

    ENTER RECORD NNNN

  IF 'F' then

    ENTER YEAR AND DAY YY DDD
- Execution if not Concatenated to 'SB#HL.LIB.CLIST':
  EX 'SB#HL.LIB.CLIST(SCANLIB)'
- Other CLISTs Invoked by this Command :
  'SB#HP.LIB.CLIST(RESTORE)' - if load module data set, 'SB#GB.LIB.LOAD', is not in the system catalog

SUBCR

- Function : The SUBCR command is used to submit members from the 'SB#HL.LIB.CNTL' data set or from QED that have a job name prefix of SB#HL. This command will change the job prefix to the user identifier logged on or to the value of the USER keyword operand if specified. It is important that the user of the Helios project library does not change the value of the jobname prefix permanently in the CNTL library to another prefix because SUBCR is invoked by many other CLISTs.

- Synatx : SUBCR 'member name' PROJID('projid')
  USER('usrid')

  Required - 'member name'
  Defaults - PROJID(SB#HL)
  USER(USRID)

- Operands :
  'member name' - mnemonic name in '&PROJID..LIB.CNTL' to be submitted, or '*' if member in QED is to be submitted.
  PROJID('projid') - project LIB.CNTL from which the member name is to be submitted.
  USER('usrid') - if specified, this keyword forces the 'USRID' specified to be appended to the job name rather than the user ID logged on.

- Execution if not Concatenated to 'SB#HL.LIB.CLIST':
  EX 'SB#HL.LIB.CLIST(SUBCR)' 'member name
  PROJII('projid') USER('usrid')'

- Examples :
  1) SUBCR * - causes the jobname to be edited in the QEDed data set from SB#HL to the user identifier logged on; the job is submitted and then the job ID is set back to its original value.
  2) SUBCR * USER(ZBJHB) - causes the jobname to be changed from SB#HLnnn to ZBJHBnnn;

the job is submitted and then the job name is set back to SB#HL.

3) SUBCR DRSLSTA - causes the member DRSLSTA in 'SB#HL.LIB.CNTL' to be QEDed; the job name is changed to the user ID logged on, and the member is submitted to background.

UPD6250

- Function : The UPD6250 command is used to update the end absolute file number (AFN) in the '6250' flux catalog source in 'SB#HL.FLUXCAT2.DATA' for either Helios-A or -B. This update to these sources in the flux catalog is only needed after new data has been added to the end of the flux data base by the FLXDBG program and the '6250' flux source tapes affected have been created using the 'FYTO1A or FYTO1B' members in LIB.CNTL. This CLIST will prompt the user for the end AFN in the 'NEWA' or 'NEWB' flux source of the 'FLUXCAT2' data set.

- Syntax : UPD6250 ID(A or B) CPY(yes/no)

  Defaults -

  ID( ) - default ID is a null string

  CPY(yes)

- Operands :

  ID(A or B) - if ID is not specified when the CLIST is invoked, the user is prompted.

  CPY (yes or no) - CPY is a symbolic that is passed to the DIRFIX CLIST indicating whether or not a backup of the flux catalog is to be made.

- CLIST Queries :

  SATEILITE ID (A or B0 - if not specified when the CLIST is invoked

  CONTINUE ? (yes or no) - after information about the function of the CLIST is listed.

  SIX DIGIT END AFN (NNNNNN) - the end absolute file number in the 1600 BPI flux source in the FLUXCAT2 data set.

  IS 'NNNNNN' CORRECT ? (yes or no) - a check to insure no error has been made.

- Execution if not Concatenated to 'SB#HL.LIB.CLIST':

EX 'SB#HL.LIB.CLIST(UPD6250)' 'ID(A or B) CPY(yes or no)'

- Other CLISTs Invoked by this Command :
  'SB#HI.LIB.CLIST(DIFFIX)'
  'SB#HI.LIB.CLIST(SUBCR)'

REFERENCES

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(6) E. Ronish, and R. Cuddapah, "Helios A/B Library Generator Program (LIBGEN) Maintenance Programmer's Introduction", Computer Sciences Corporation Working Paper, September 21, 1978, unpublished.

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(8) L. Casswell, B. Pynn, "Document for Helios B Gamma Ray Burst Programs", Computer Sciences Corporation Working Paper, CSC/TM-81/6210, May 1981.

(9) E. Ronish and R. Cuddapah, "Pioneer/Helios Flux Data Base Generator (FLXDBG) Maintenance Programmer's Introduction", Computer Sciences Corporation Working Paper, September 21, 1978, unpublished.

(10) J.S. Jacques, "The Multi-Satellite Fourier Analysis Program", GSFC Internal Memorandum, October 1980.

(11) R. Cuddapah, "Helios User's Guide", assembled 1978.

(12) "Science and Applications Center User's Guide", SACC Internal Memorandum, June 1979.

(13) H. Domchick, J. Broomhall, "Pioneer-F/-G User's Guide", assembled 1976, updated 1981.

(14) J. Broomhall, B. Pynn, "Cosmic Ray Project Independent CLIST Commands", Computer Sciences Corporation Working Paper, July 7, 1983, unpublished.

Appendix A
HELIOS 1 AND 2 HARDWARE

This Appendix was taken from the "User's Manual for the Helios Spacecraft" and describes the Cosmic Ray Experiment Hardware. It can be found in a loose leaf binder 'Helios Document Appendices', located in the Cosmic Ray Programming Systems Library.

Appendix B
HELIOS 1 AND 2 MODE TABLE

This Appendix was taken from the "User's Manual for the Helios Spacecraft" and describes the amount of rates and PHA data which are taken in various spacecraft telemetry modes. It can be found in a loose leaf binder 'Helios Document Appendices', located in the Cosmic Ray Programming Systems Library.

Appendix C

THE HELIOS 1 AND 2 SPACECRAFT DATA COLLECTION SYSTEM FOR RATES AND PHA DATA

This Appendix consists of a document prepared by D. Stillwell and R. Joyce in 1973 which describes the rates and PHA spacecraft data collection systems for Helios 1 and 2. It can be found in a loose leaf binder 'Helios Document Appendices', located in the Cosmic Ray Programming Systems Library. Information on the Helios experimental data record and orbit/attitude tape formats used by the experimenters can be found in Reference 6.

HELIOS-A
EDR
ORBIT/ATTITUDE
TAPE FORMAT

- The general format of the orbit/attitude (ORB/ATT) EDR is a label record followed by records of ORB/ATT data.

- The label record (attached) will consist of 72 characters, written in IBM BCD tape format, odd parity.

- The ORB/ATT parameters for HELIOS are shown as items 1-162 on the attached sheets.

- These parameters will appear on the ORB/ATT EDR in the same order as they are on the attachments.

- Each item in the data record is a UNIVAC 1108 double precision word (72 bits).

- The ORB/ATT EDR will be written on seven (7) track, 800 BPI magnetic tape.

- An ORB/ATT data record = 162 double precision words.

- **Each record contains data for one point. The distance between two time points is:**

  - **6 minutes for a distance of Earth-Helios less than one million kilometers and,**

  - **60 minutes for distance more than one million kilometers.**

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HELIOS-A

EDR

ORB/ATT LABEL

FORMAT

This label will preceed all files on the ORB/ATT EDR. The label will consist of 78 characters.

Labels will be written in IBM BCD tape format, odd parity.

1 - 7 + Space	International Code
9 - 11	Tape Type (ORB)
12 - 23	Spaces
24 - 25 + Space	Year of Recording (last 2 digits)
27 - 29 + Space	File Start Time (DAY)
31 - 36 + Space	File Start Time (HHMMSS)
38 - 40 + Space	File Stop Time (DAY)
42 - 47 + Space	File Stop Time (HHMMSS)
49 - 52 + Space	O/A Master Data Tape Number
54 - 55 + Space	O/A Master Data Tape File Number
57 - 62 + Space	Date O/A EDR generated
64 - 66 + Space	O/A EDR Run Number
68 - 69 + Space	O/A EDR File Number
71 - 72 + Space	O/A EDR Reel Number
74 - 76	Experimenter ID
77 - 78	Spares

HELIOS A
ORB/ATT EDR
DATA RECORD
FORMAT

Time Block

1. Julian date, ephemeris time
2. Time in seconds past January 1, 1950, ephemeris time
3. Year
4. Month
5. Day
6. Hour
7. Minutes

(3. – 7.) of Gregorian calendar date

8. Seconds
9. Time from launch in seconds.
10. ET - UTC, in seconds
11. ΔT (Time difference between Orbit and Attitude calculations)
12. Status switch — 0 = both Orbit & Attitude data present; 1 = Orbit data only; 2 = Attitude data only
13. Spare

Heliocentric Block

14. x
15. y
16. z

(14. – 16.) Position coordinates of Helios in A. U.

17. U_x
18. U_y
19. U_z

(17. – 19.) Velocity coordinates of Helios in A. U./DAY

20. - 25. Same as above for Mercury
26. - 31. Same as above for Venus
32. - 37. Same as above for Earth
38. - 43. Same as above for Mars

(20. – 43.) Mean ecliptic and equinox of 1950 July 1, 0 hours.

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Heliocentric Block cont'd

44. - 49. Same as above for Jupiter
50. - 55. Same as above for Moon

} Mean ecliptic equinox of 1950, July 1, 0 hrs.

56. Ecliptical longitude, counted from Mean Equinox
57. Ecliptical longitude, counted from Earth-Sun line
58. Ecliptical latitude of
59. Distance in A. U. of Sun

} Helios

60. - 63. Same as above for Mercury
64. - 67. Same as above for Venus
68. - 71. Same as above for Earth
72. - 75. Same as above for Mars
76. - 79. Same as above for Jupiter
80. - 83. Same as above for Moon

84. Radial velocity
85. Normal velocity

} of Helios in A. U./ DAY.

Voyager does Helio longitude of Earth angle between Helios Sun + earth when its zero heliographic latitude of satellite as same as earth

86. Heliographic Longitude of Helios, counted from the Ascending Node
87. Heliographic latitude of Helios

Number of rotations of the Sun,

88. referred to the Earth
89. referred to Helios

} at 16° heliographic latitude since launch

Geocentric Block

90. Right Ascension of
91. Declination of
92. Distance in A. U. of Earth

} Helios

93. - 95. Same as above for the Moon
96. - 98. Same as above for the Sun

} True Earth Equator and Equinox of date

99. Radial velocity of
100. Normal velocity of

} Helios in A. U./ DAY

101. x
102. y
103. z

} Position of

104. U_x
105. U_y
106. U_z

} Velocity of

} Helios

107. - 112. Same for the Sun

113. Solar ecliptical latitude of Helios
114. Solar ecliptical longitude of Helios

} Mean ecliptic and equinox of 1950 July 1, 0.0 hours.

115. x
116. y
117. z

} Solar Magnetospheric Coordinates of Helios

Distances Block

118. Helios - Mercury
119. Helios - Venus
120. Helios - Earth
121. Helios - Mars
122. Helios - Jupiter
123. Helios - Moon
124. Helios - Moon Orbit

} in A. U.

Angles Block

125. Earth - Helios - Sun
126. Helios - Sun - Earth

} in degree

Angles Block (cont'd)

127.	Sun - Earth - HELIOS	In Degrees
128.	HELIOS - Earth - Moon	
129.	Ecliptic Plane - (Earth - Helios) Line	
130.	Right Ascension of Orbit Pole	
131.	Declination of Orbit Pole	

Attitude Block

132.	Flag for Blackout
133.	Solar Aspect Angle
134.	3-Sigma Value of the Solar Aspect Angle
135.	Pitch Angle
136.	3-Sigma Value of the Pitch Angle
137.	Angle Between Z-Axis and Orbit-Plane
138.	Mercury Aspect Angle (Angle between Z-Axis and HELIOS - Mercury Line)
139.	Venus Aspect Angle
140.	Mean Spin Rate
141.	Ecliptical Longitude of S/C - Spin Axis
142.	Ecliptical Longitude of S/C - Spin Axis Counted from Earth - Sun Line
143.	Ecliptical Latitude of S/C - Spin Axis

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144.
145. First Row (A_{11} A_{12} A_{13}) of the
146.

147.
148. Second Row (A_{21} A_{22} A_{23}) of the
149.

150.
151. Third Row (A_{31} A_{32} A_{33}) of the
152.

Matrix from S/C Spin Axis - Sunline Coordinates to Heliographic Coordinates

153.
154. First Row (A_{11} A_{12} A_{13}) of the
155.

156.
157. Second Row (A_{21} A_{22} A_{23}) of the
158.

159.
160. Third Row (A_{31} A_{32} A_{33}) of the
161.

Matrix from S/C Spin Axis - Sunline Coordinates to Solar Ecliptic Coordinates

162. Spare

HELIOS-A

COMMAND LISTING

Attached is an example of the Command listing to be provided each U.S. Experimenter. Items on the example are explained below:

1. This item provides information on the tape from which the commands were extracted

2. The time of transmission of the first bit of the command from the station.

3. The command number in octal

4. Alpha characters describing the command

5. S/C receipt time of first command bit.

6. Station sending the command

7. Resolution of the command (confirmed, aborted, or undetermined).

SAT ID	TAPE REEL N	START TIME HH MM SS	START TIME DAY YY	REC SIZE	BLOCK SIZE	NETWORK	MDR T	MDR NUM	MDR FILE	DATE MM DD YY
(1) HEACMD	000467	10 31 45	304 74	144	144	GCC	OCDD1	02	02	22 74

(2) TRANSMIT HH MM SS	(3) OCT CMD	(4) COMMAND DESCRIPTION	(5) S/C RECD HH MM SS	(6) DSS TCP	(7) RESOLUTION
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED
10 31 45	301	XXXXXXXX	10 31 53	68A	CONFIRMED