

E4 data availability

Helios mini workshop

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E4 data availability

Data at NSSDC

- Helios 1 and 2 data and documentation from E4 are available from NSSDC:

http://spdf.sci.gsfc.nasa.gov/pub/data/helios/helios1/search_coil_magnetometer/8-s_avg_spect_den_8_chan_6.8-1470/

http://spdf.sci.gsfc.nasa.gov/pub/data/helios/helios2/search_coil_magnetometer/8-s_avg_spt_den_8_chan_6.8-1470hz/

- Only a small set of the total data is archived there - the rest is most likely lost
- For Helios 1: 9 tape dump files covering the time span from 1974-12-10 to 1975-09-20
- Some Helios 1 data have low time resolution
- For Helios 2: 9 tape dump files covering the time span from 1976-01-15 to 1976-03-10

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Data format

- The data is encoded in binary (tape dump) files
- Tapes were written with a PDP 11
- Binary Data had been produced with a HP 3000
- Binary data contain
 - Character strings
 - Integer numbers (2 bytes, big endian)
 - Floating point (real) numbers (4 bytes, big endian, in HP 3000 representation)
 - Floating point (real) numbers (8 bytes, big endian, in HP 3000 representation)

E4 data availability

```

2 *****
3
4           E4ADR TAPE RECORDS   FILE: "E4FORMAT.GBEIN"
5                               05.03.81
6 *****
7
8
9
10
11 1. TAPE HEADER
12 =====
13
14 WORDNUMBER  TYPE                CONTENT
15 -----
16           1    INTEGER          100  LABEL
17           2    INTEGER          LENGTH OF RECORD IN WORDS
18           3    CHARACTER        "**** E4ADR TAPE HEADER/HELIOS A ****"
19                               "**** E4ADR TAPE HEADER/HELIOS B ****"
20           21   INTEGER          NUMBER OF TAPE
21           22   INTEGER          NUMBER OF SERIES
22           23   INTEGER          YEAR OF GENERATION
23           24   INTEGER          MONTH      "
24           25   INTEGER          DAY        "
25           26   INTEGER          HOUR      "
26           27   INTEGER          MINUTE    "
27           28   INTEGER          MAX. LENGTH OF DATA RECORD IN WORDS
28           29   INTEGER          OUTPUT DEVICE
29           30   INTEGER          PPI
30           31   INTEGER          AVERAGE TIME OF TAPE IN SECONDS
31           32-60  FREE
32
33
34 2. DAY LABEL
35 =====
36           1    INTEGER          99  LABEL
37           2    INTEGER          12  - LENGTH OF RECORD IN WORDS
38           3    INTEGER          NUMBER OF DAYS SINCE LAUNCH
39           4    CHARACTER        "****DAY LABEL****"
40
41
42 3. SCIENCE DATA
43 =====
44           1    INTEGER          11  - MEANVALUES
45                               12  - MAXIMALVALUES
46                               13  - WAVEFORMVALUES
47           2    INTEGER          LENGTH OF RECORDS IN WORDS
48           3    INTEGER          NUMBER OF DAYS SINCE LAUNCH
49           4-7  LONG            FRACTION OF DAY (DECIMAL)
50           8-9  FREE
51           10   INTEGER          NUMBER OF VECTORS IN RECORD
52           11   FREE
53           12   INTEGER          FORMAT
54           13   INTEGER          BIT RATE
55           14   INTEGER          DISTRIBUTION MODE
56           15-18 LONG            VECTOR STEP TIME IN FRACTION OF DAY
57           19-21 FREE

```

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```

5-      22      INTEGER      90 - HELIOS 1
59
60      23-24    REAL          91 - HELIOS 2
61      25,26    REAL          ECLIPT. LAT. OF SPIN AXIS (RAD)
62      27,28    REAL          ECLIPT. LONG. OF SPIN AXIS (RAD)
63      29-30    REAL          FREE
64      31-32    REAL          ECLIPT. LONG. OF HELIOS POS.(RAD)
65      33-34    REAL          DISTANCE FROM SUN (AU)
66      35,36    REAL          FREE
67      37,38    REAL          HELIOGRAPH. LAT. OF HEL. POS.(RAD)
68      39,40    REAL          ANGLE HELIOS-SUN-EARTH (RAD)
69      41,42    REAL          FREE
70      43-46    LONG          SAMPLING RATE IN ORIS. DATA
71      47-66    LONG          (ONLY AVERAGE TAPES)
72      67-70    LONG          VECTOR STEP TIME " "
73      71-74    LONG          (ONLY AVERAGE TAPES)
74      74-80    LONG          FREE
75      TRIP LIGHT TIME IN FRACTION OF DAY
76      SPIN PERIOD IN FRACTION OF DAY
77      FREE
78
79      DATA PART OF REC
80
81      81      INTEGER      0 - GOOD QUALITY
82      82      INTEGER      1-7- RAD QUALITY
83      82      INTEGER      0 - Y - SENSOR
84      83      INTEGER      1 - X - SENSOR
85      83      INTEGER      AMPLIFICATION FACTOR
86      ( 0 - .4, 1 - .08
87      2 - 10., 3 - 2. )
88      84      INTEGER      FACTOR, ONLY IN AVERAGE TAPES
89      85-86    REAL          SAMPLING RATE (IN AVERAGE TAPES
90      NUMBER OF GOOD VECTORS FOUND
91      IN THIS AVERAGE INTERVALL.
92      SEE WORD 41,42 )
93      87-118   REAL          16 WORDS, 8X,8Z,7X,7Z,...,1X,1Z
94      FOR MEAN VALUES
95      87-102   INTEGER      16 WORDS, 8X,8Z,7X,7Z,...,1X,1Z
96      FOR MAXIMAL VALUES
97
98      REPETITIONS FOR N MORE VECTORS AS SPECIFIED IN WORD 10
99
100     *****

```

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Data format

- Data in the binary files are organized in records:
- Tape header - Day label - Science data with `numvec` vectors ...
- After a day label there are several science data records, each containing `numvec` vectors
- A new day label is inserted when the day changes
- a file typically contains about ten day label records and thousands of science data records

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Program to read data

- I have written a program to read ADR tapes and produces tabular ASCII output with columns
 - UTC (in ISO 8601 format)
 - solar distance [AU]
 - Ecliptical longitude of Helios (epoch B1950) [degrees]
 - Quality flag
 - Sensor ('X', 'Y', 'Z')
 - 8 frequency channels (average data)

```
1974-12-10T10:00:07 0.98475 77.58 0 Z 1.19E-01 1.08E-03 1.46E-04 5.80E-05
1974-12-10T10:00:15 0.98475 77.58 0 Z 8.23E-04 2.90E-04 1.16E-04 5.99E-05
1974-12-10T10:00:31 0.98475 77.58 0 Z 7.08E-02 2.57E-02 1.11E-02 5.03E-03
1974-12-10T11:17:11 0.98475 77.62 0 Z 7.18E-02 2.53E-02 1.16E-02 5.41E-03
1974-12-10T13:55:39 0.98475 77.69 0 Z 7.08E-02 2.49E-02 1.06E-02 5.34E-03
```

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Caveats

- Variable length records - best opened with record length of 2 bytes
- Files contain undocumented words
 - before tape header
 - between tape header and day label
 - before science label
- Amplification factor is always 10.0, regardless of value of word 83. This can be verified using the high frequency channel 8, which contains background noise that would otherwise make jumps.
- File
SPHE-00358_DD045484_27-JAN-76/DD045484_F1.DAT
is damaged. Only 7 hours (of 12 days) can be read. Could possibly be fixed.

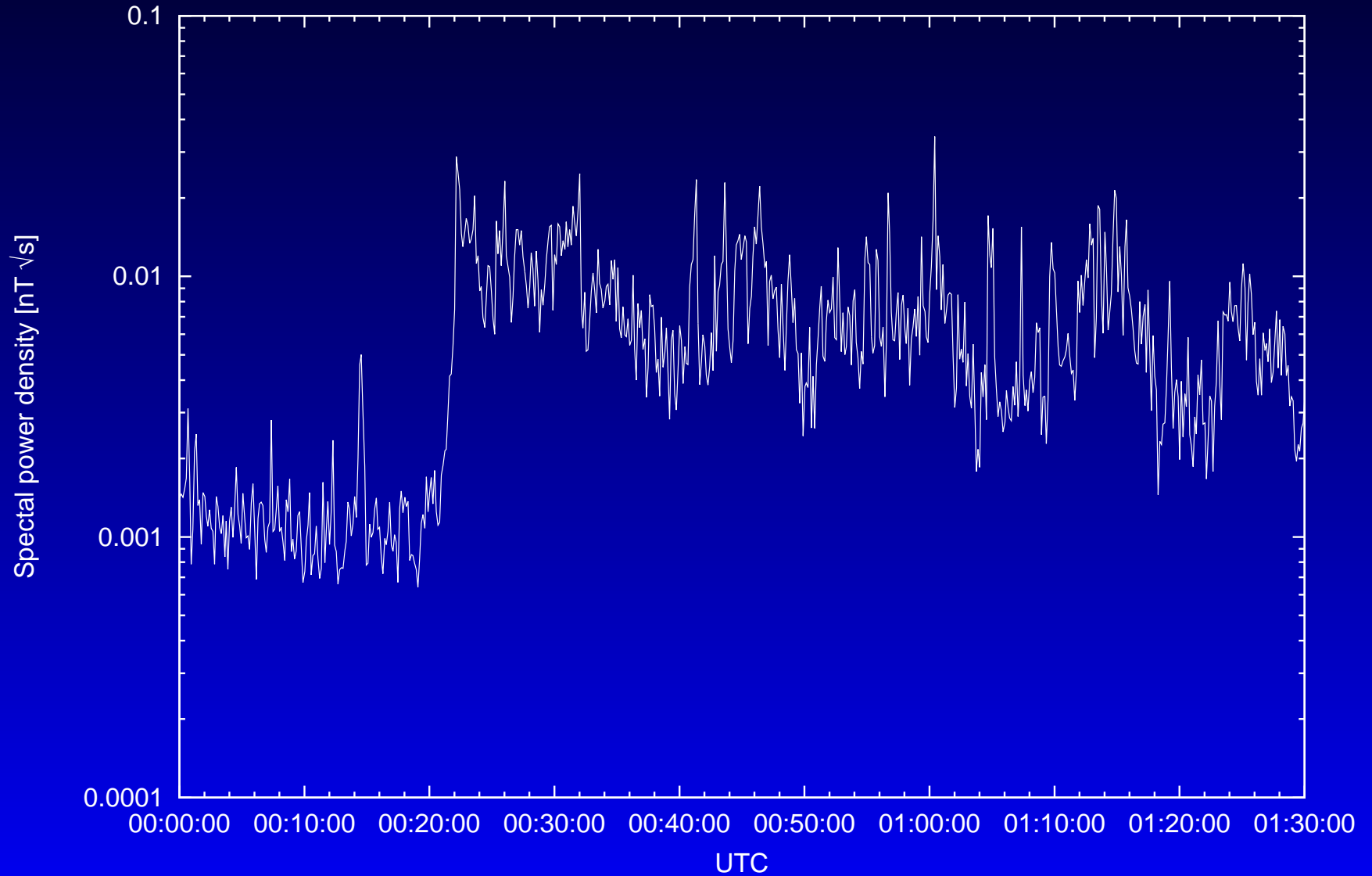
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Example data

- The shock events of 1975-01-08 and 1976-03-30 shown by Fritz Neubauer have been processed using the read program
- Comparison with published results show good match in time and amplitudes
- See following plots

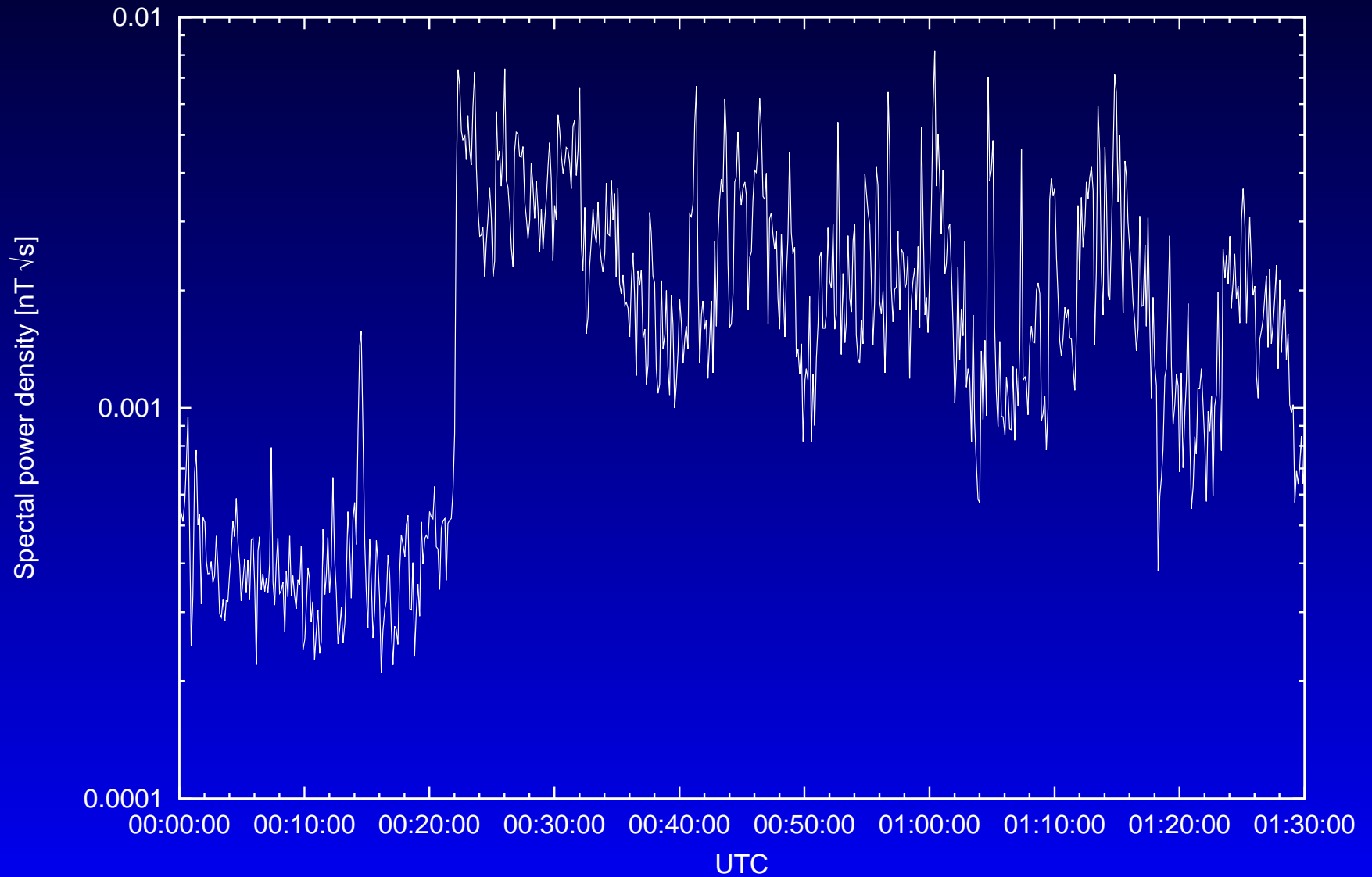
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Helios 1 E4 sensor Y channel 1 1975-01-08 shock



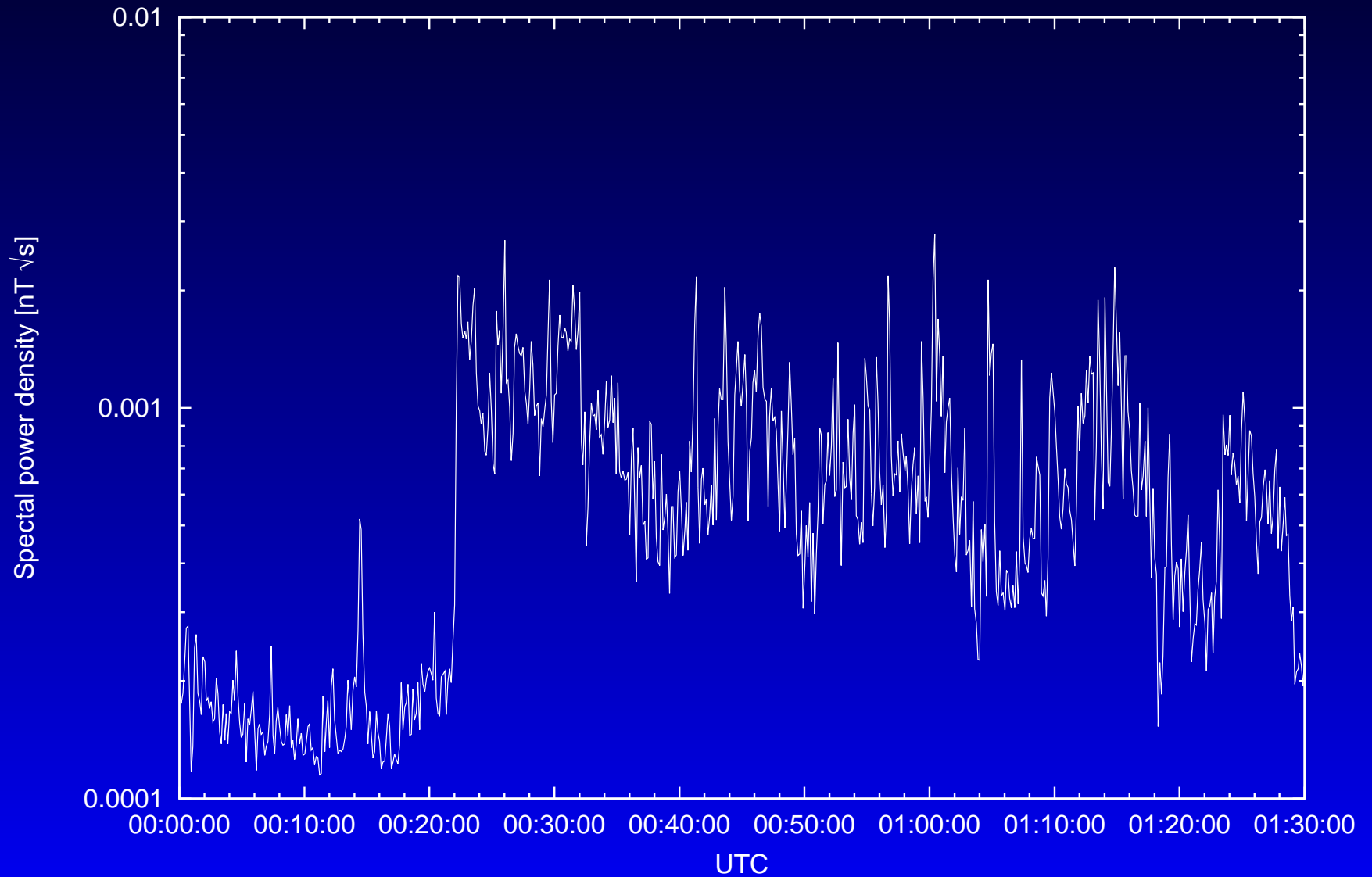
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Helios 1 E4 sensor Y channel 2 1975-01-08 shock



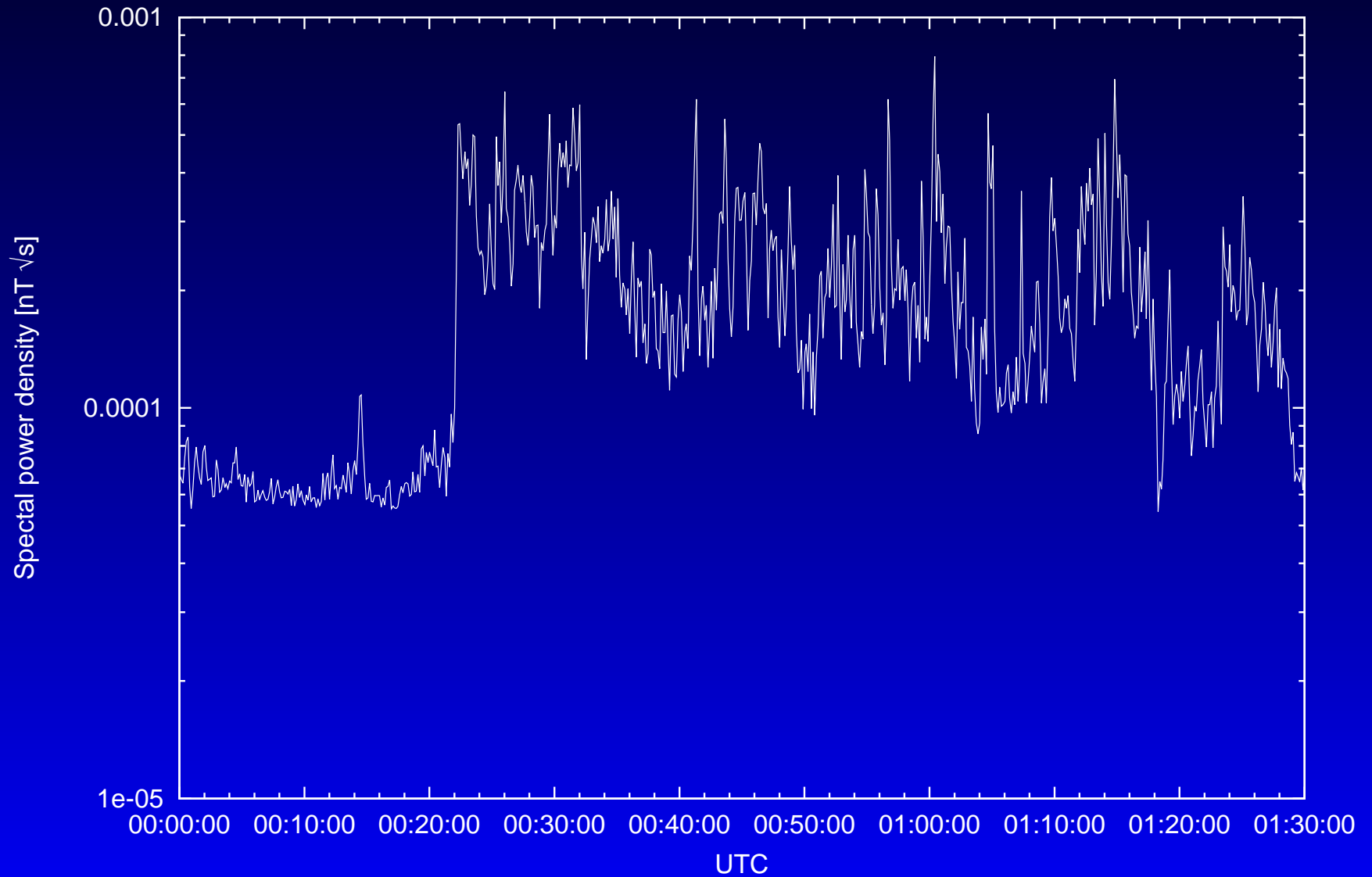
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Helios 1 E4 sensor Y channel 3 1975-01-08 shock



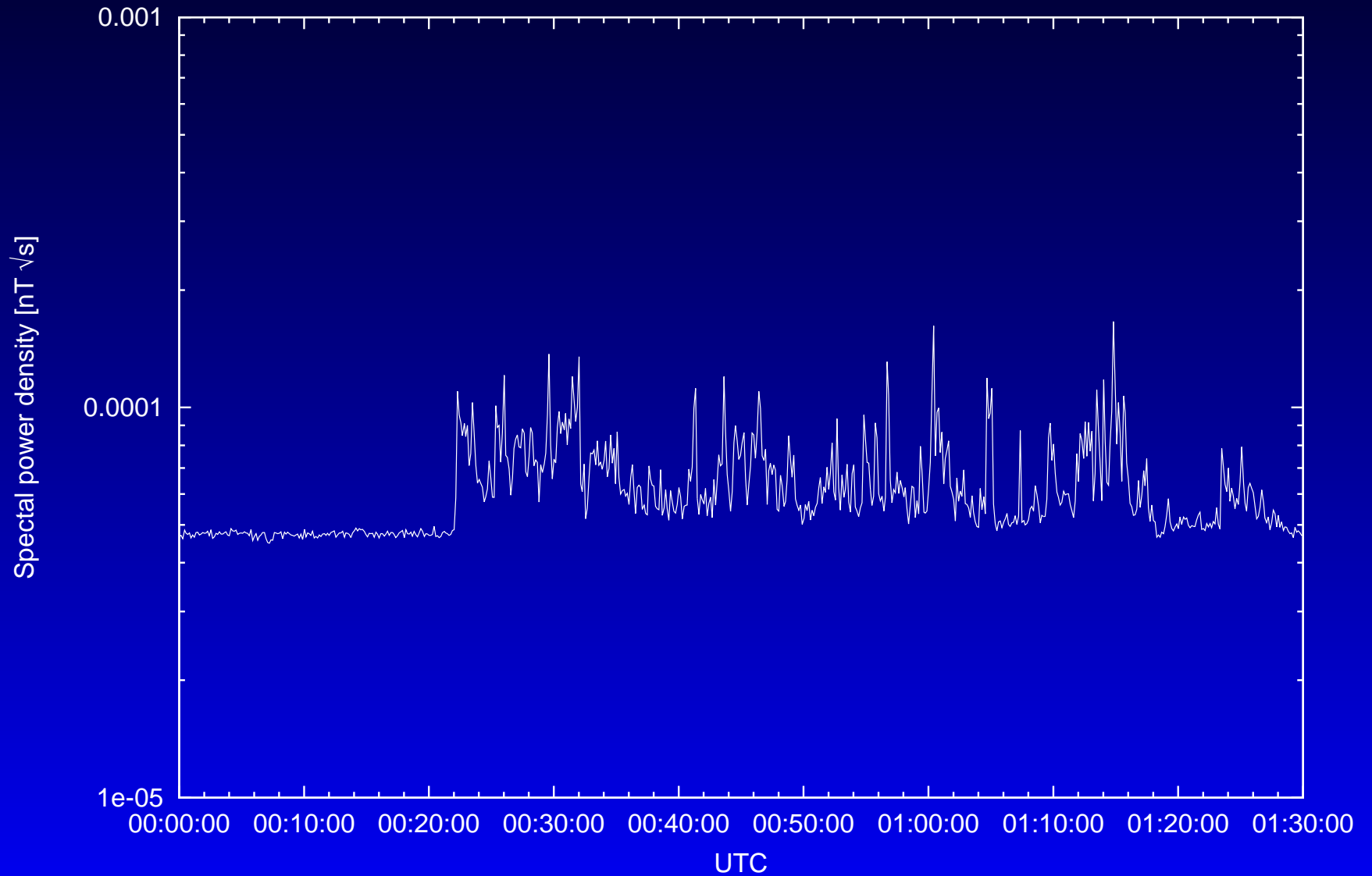
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Helios 1 E4 sensor Y channel 4 1975-01-08 shock

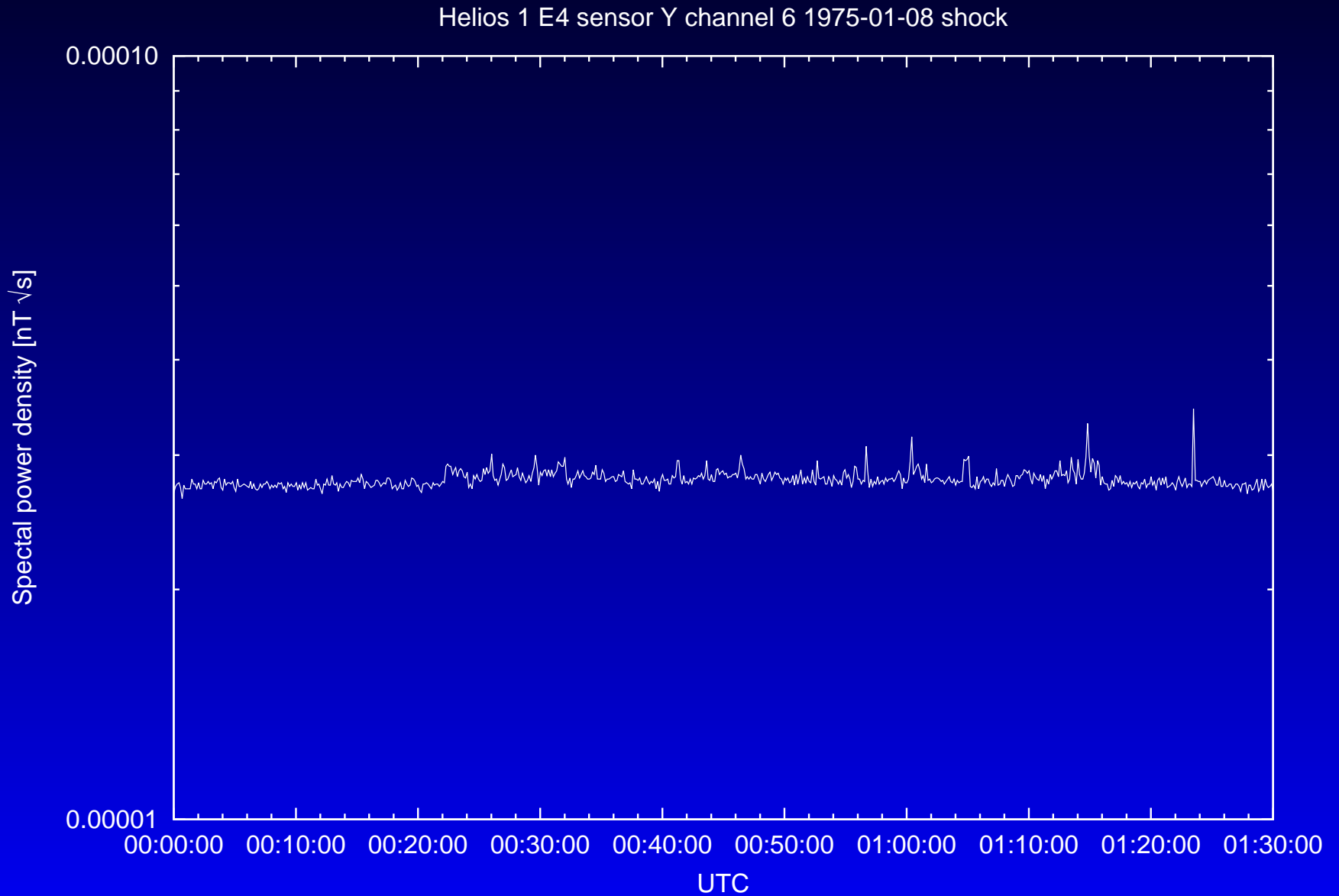


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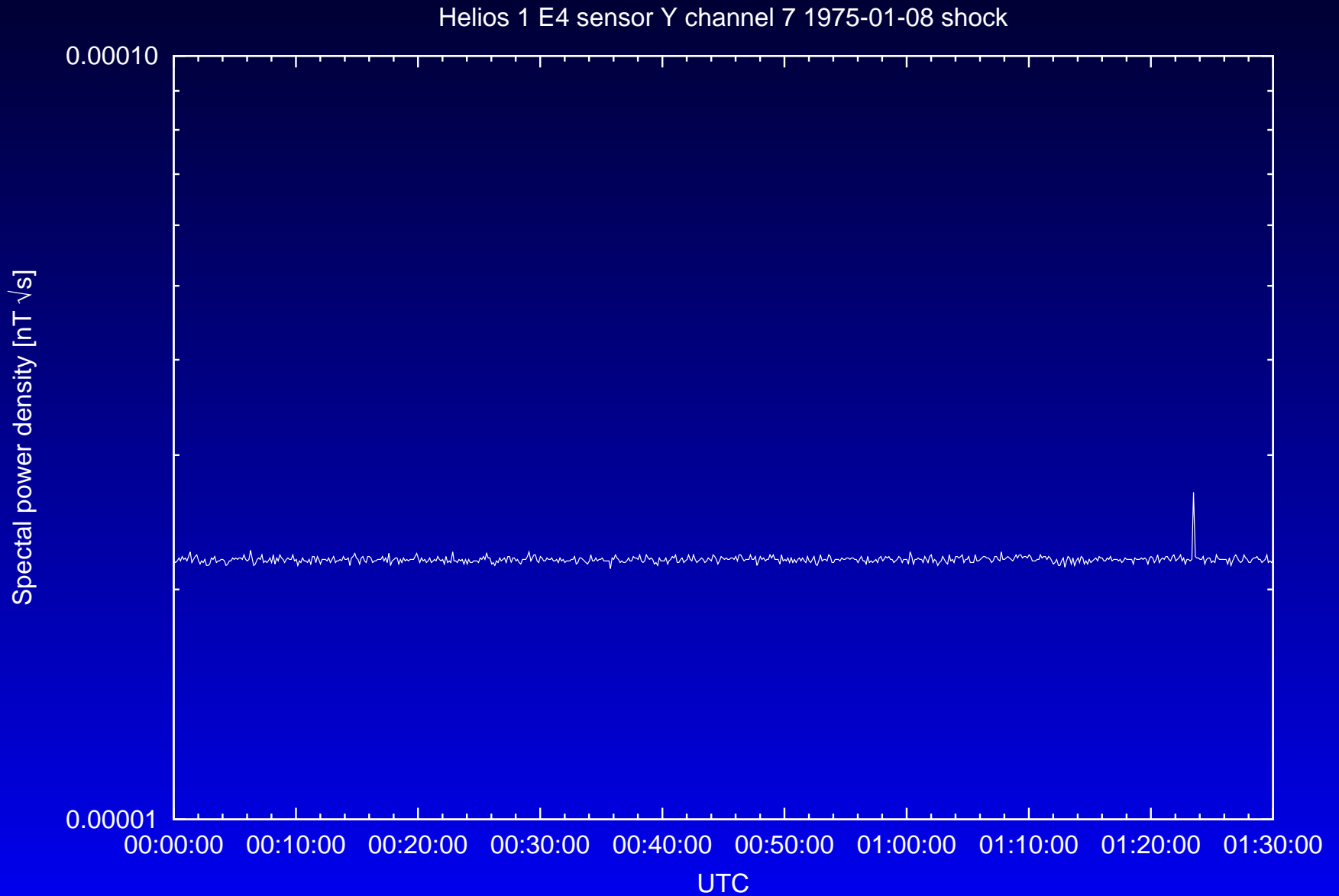
Helios 1 E4 sensor Y channel 5 1975-01-08 shock



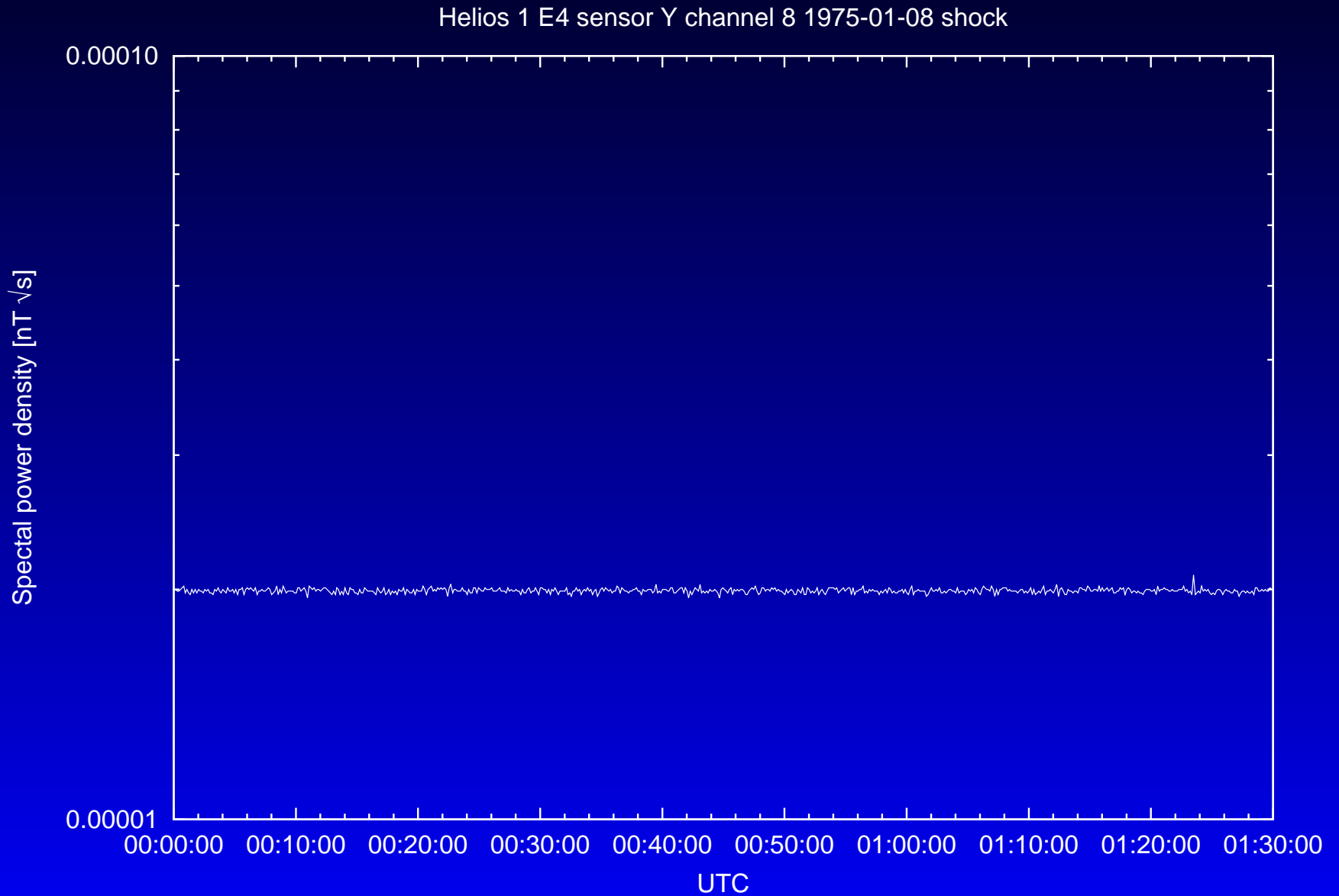
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E4 data availability

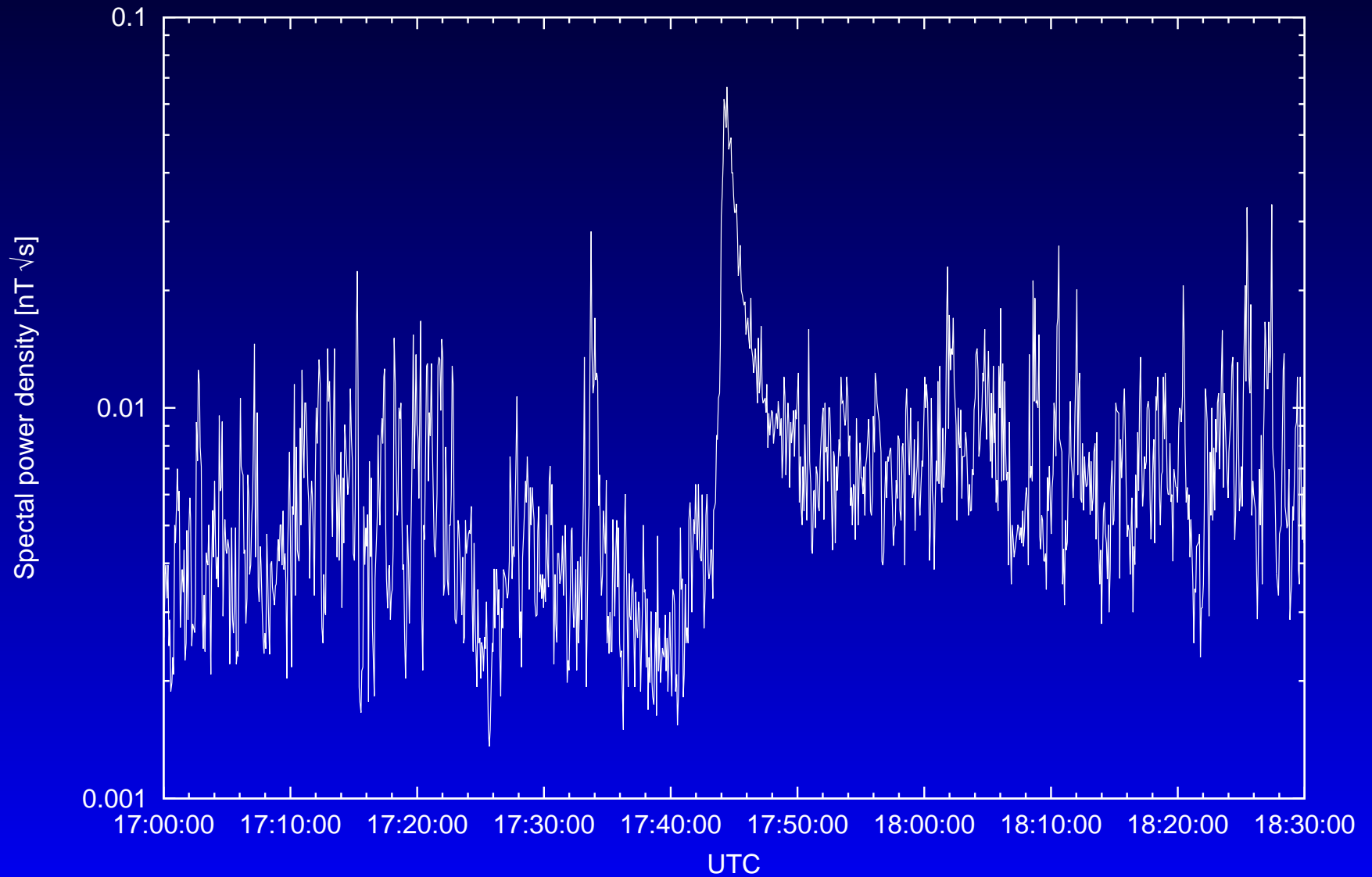


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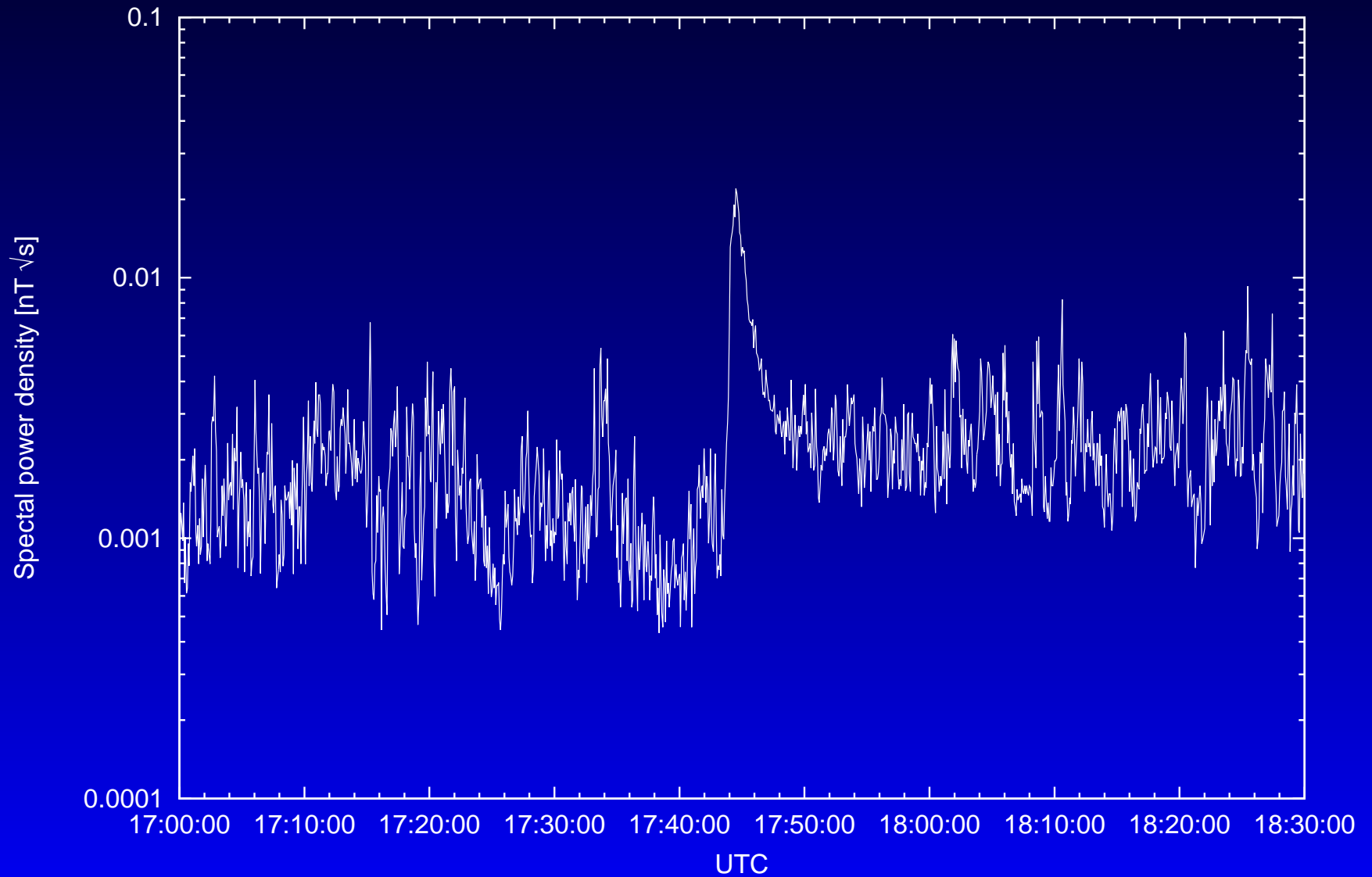
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Helios 2 E4 sensor Y channel 1 1976-03-30 shock



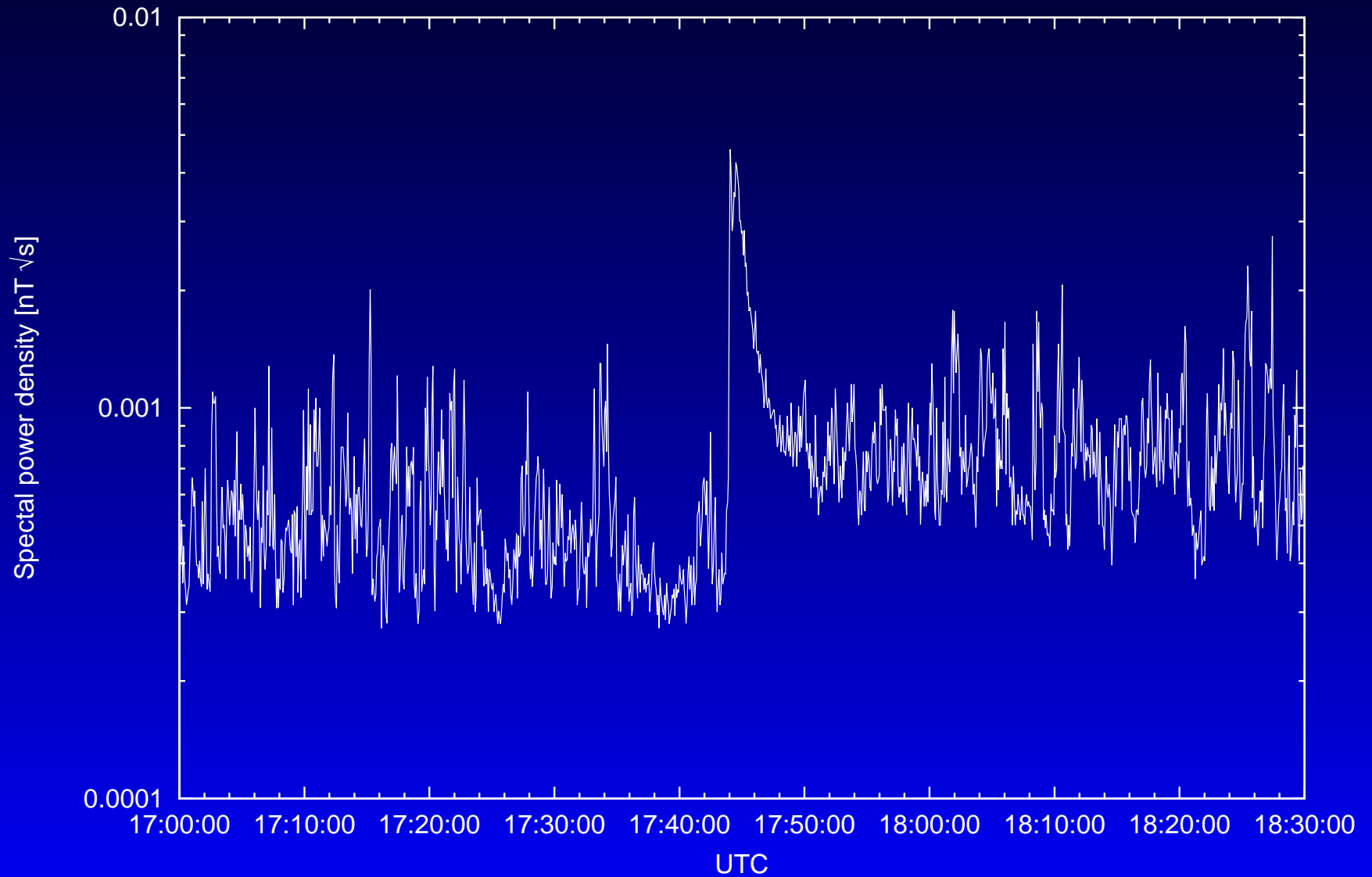
E4 data availability

Helios 2 E4 sensor Y channel 2 1976-03-30 shock



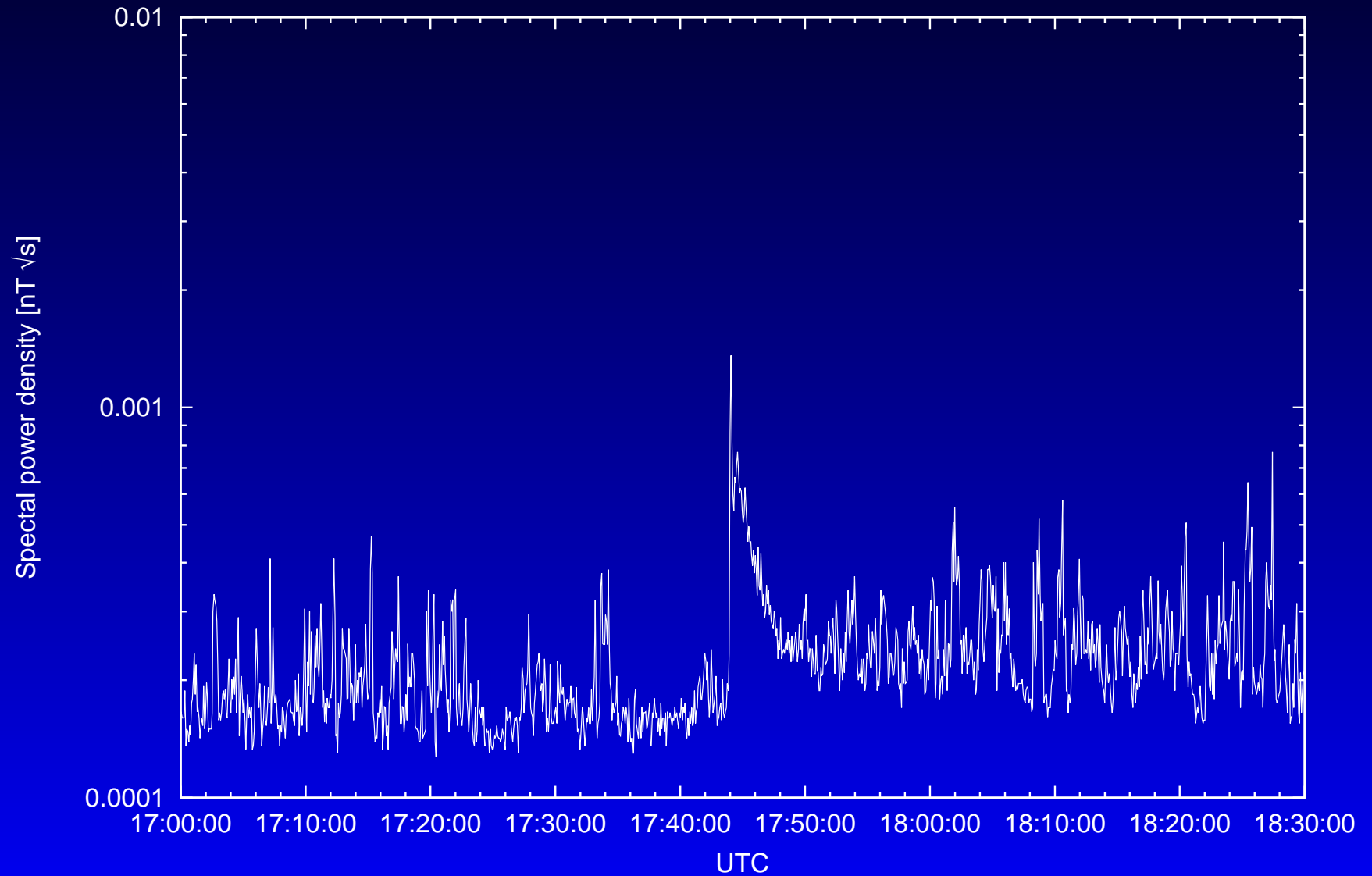
E4 data availability

Helios 2 E4 sensor Y channel 3 1976-03-30 shock



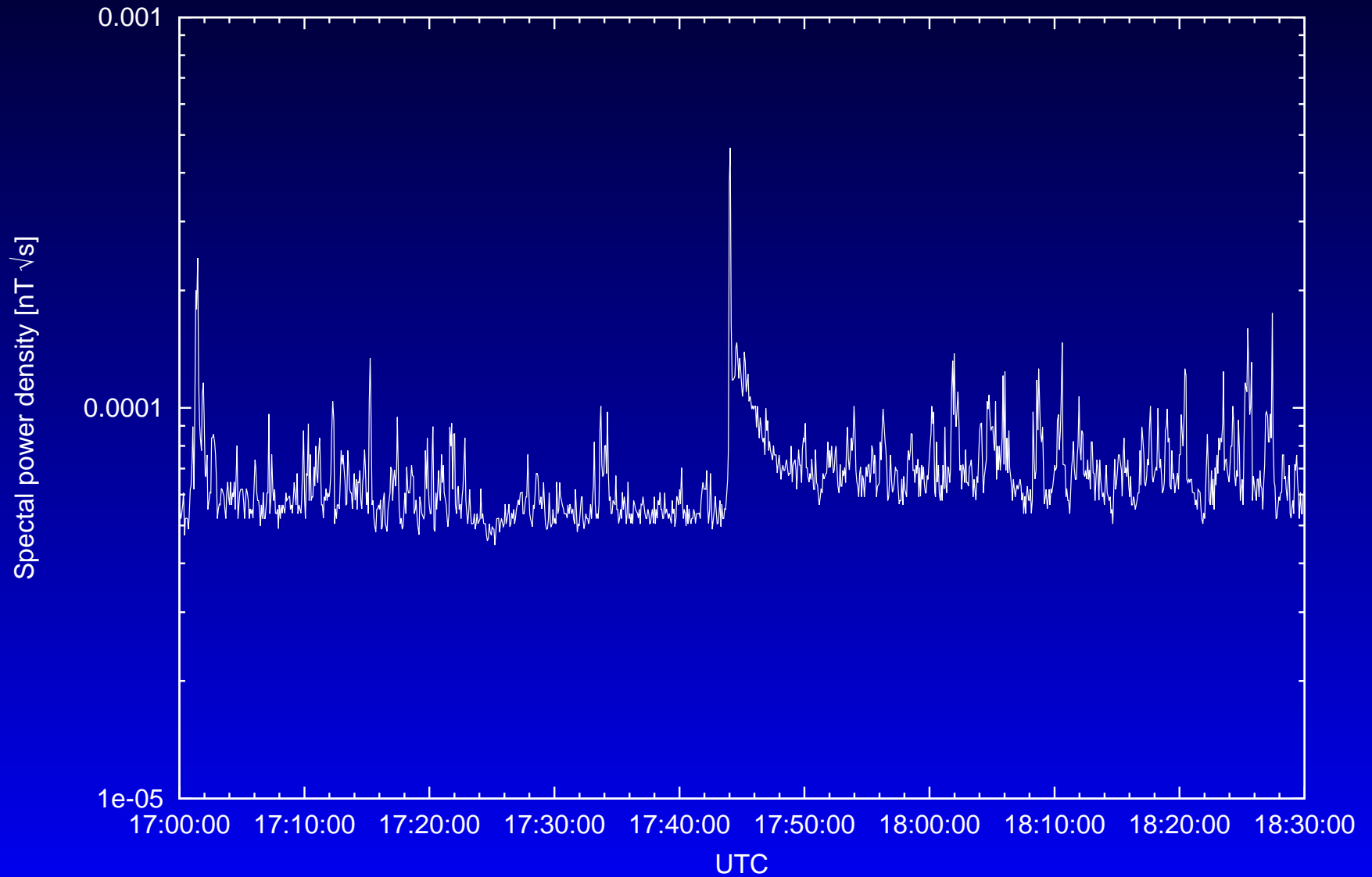
E4 data availability

Helios 2 E4 sensor Y channel 4 1976-03-30 shock



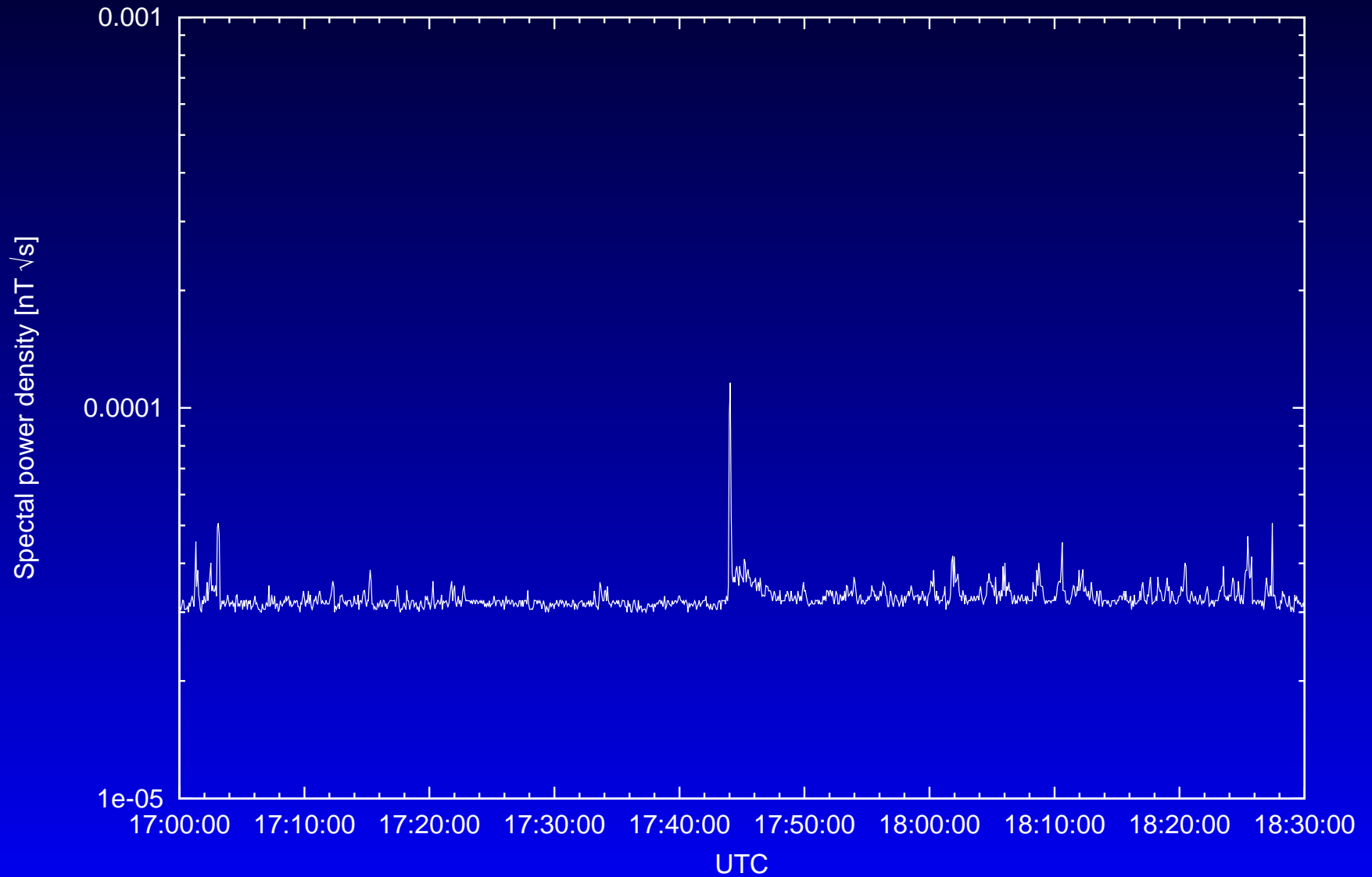
E4 data availability

Helios 2 E4 sensor Y channel 5 1976-03-30 shock

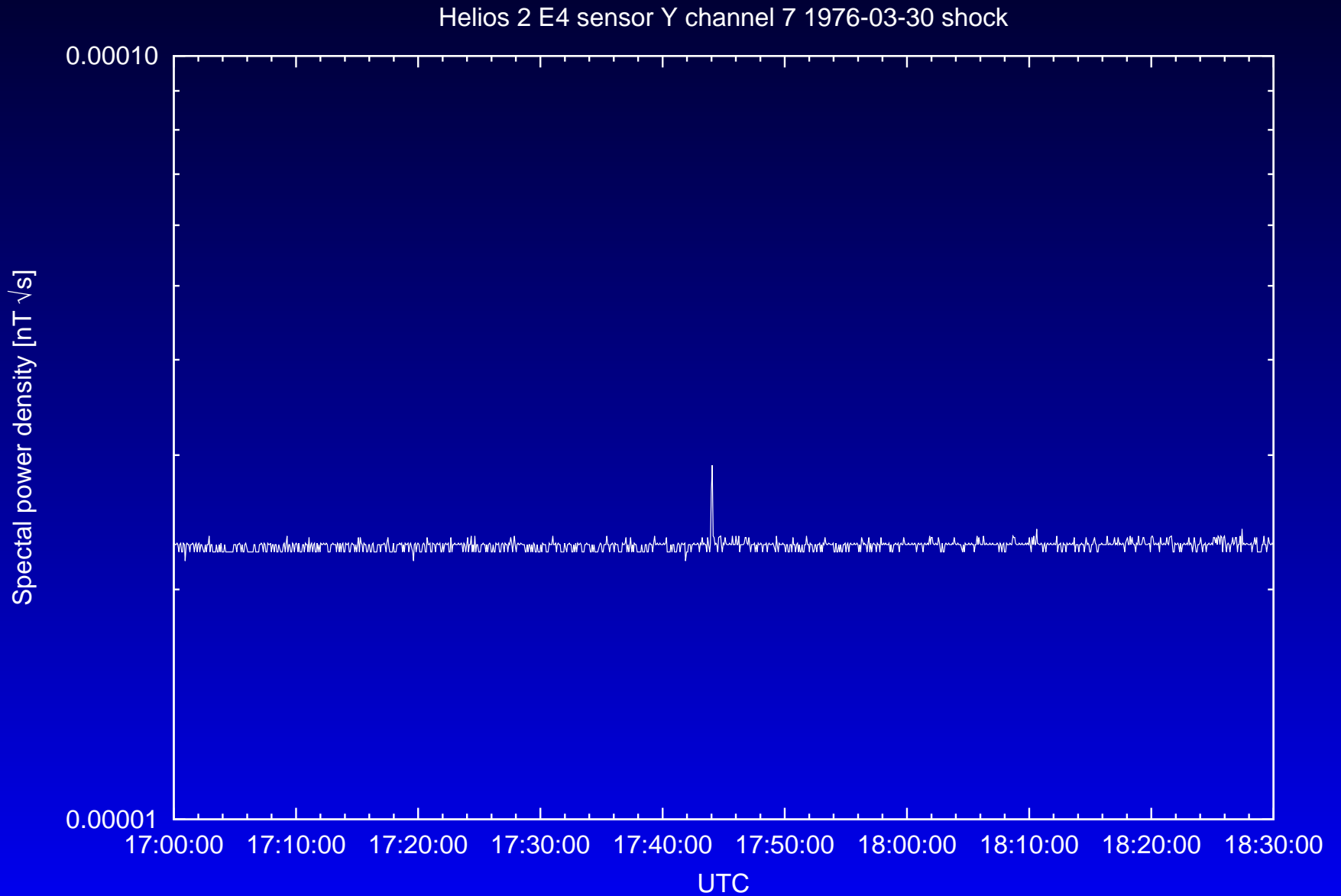


E4 data availability

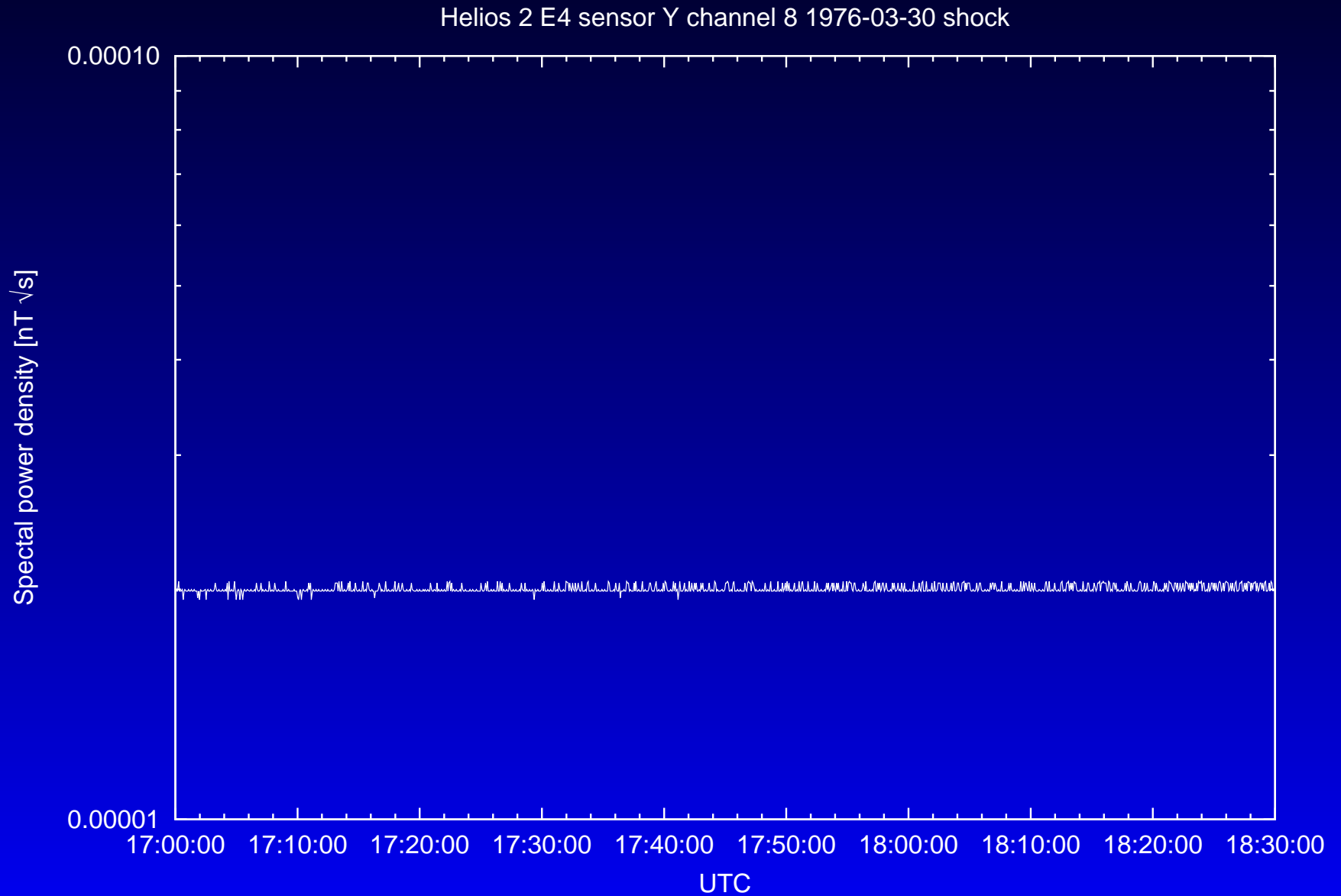
Helios 2 E4 sensor Y channel 6 1976-03-30 shock



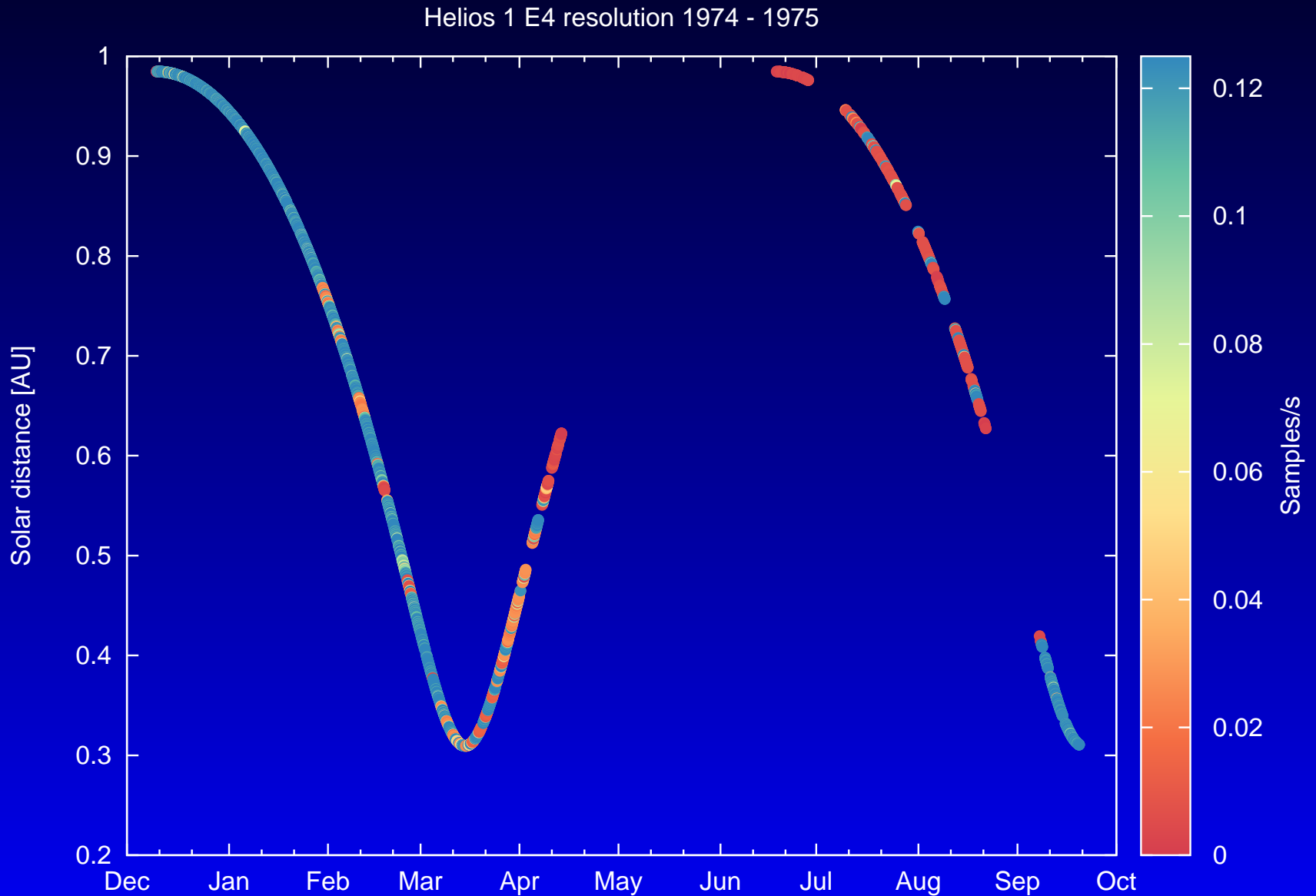
E4 data availability



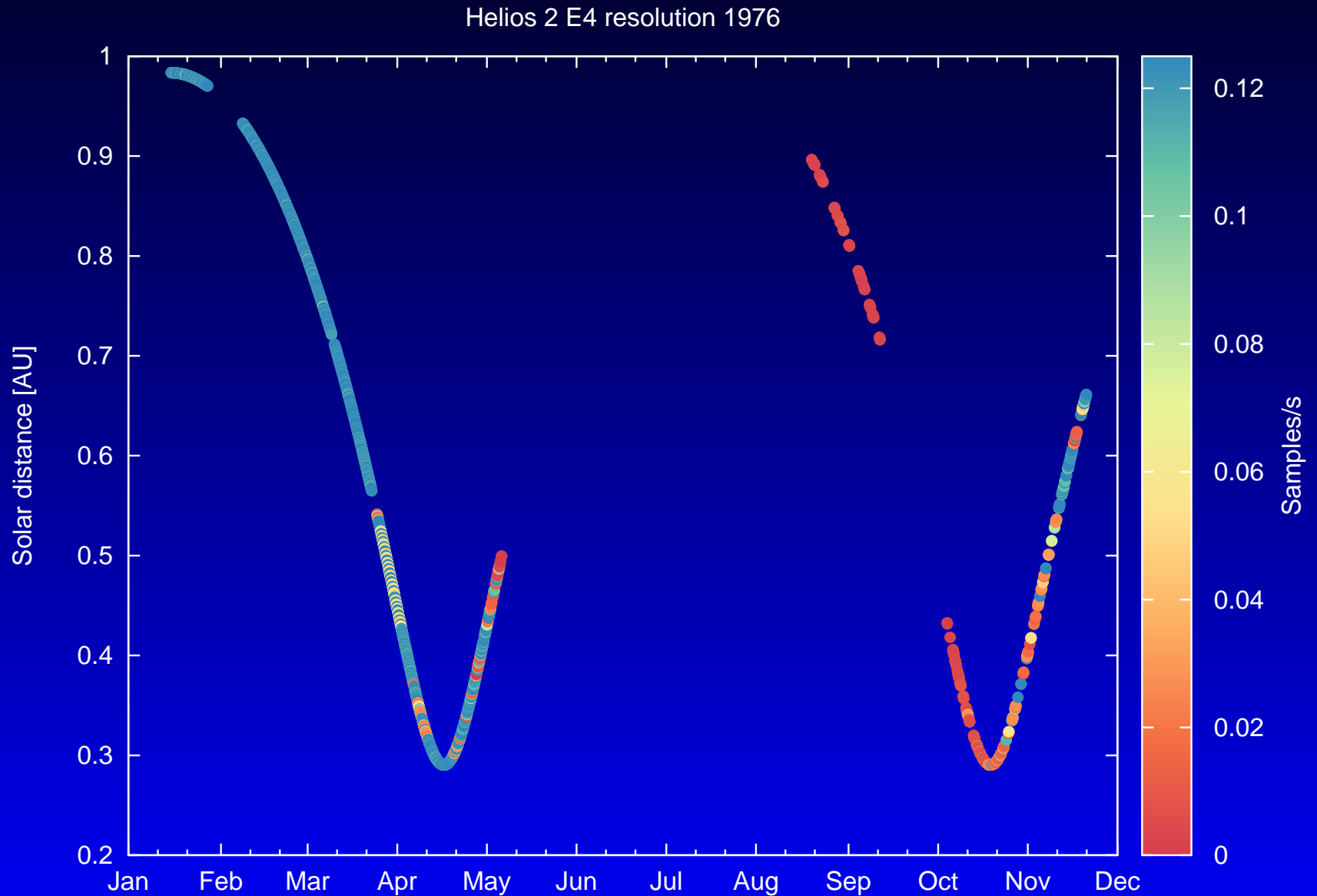
E4 data availability



E4 data availability

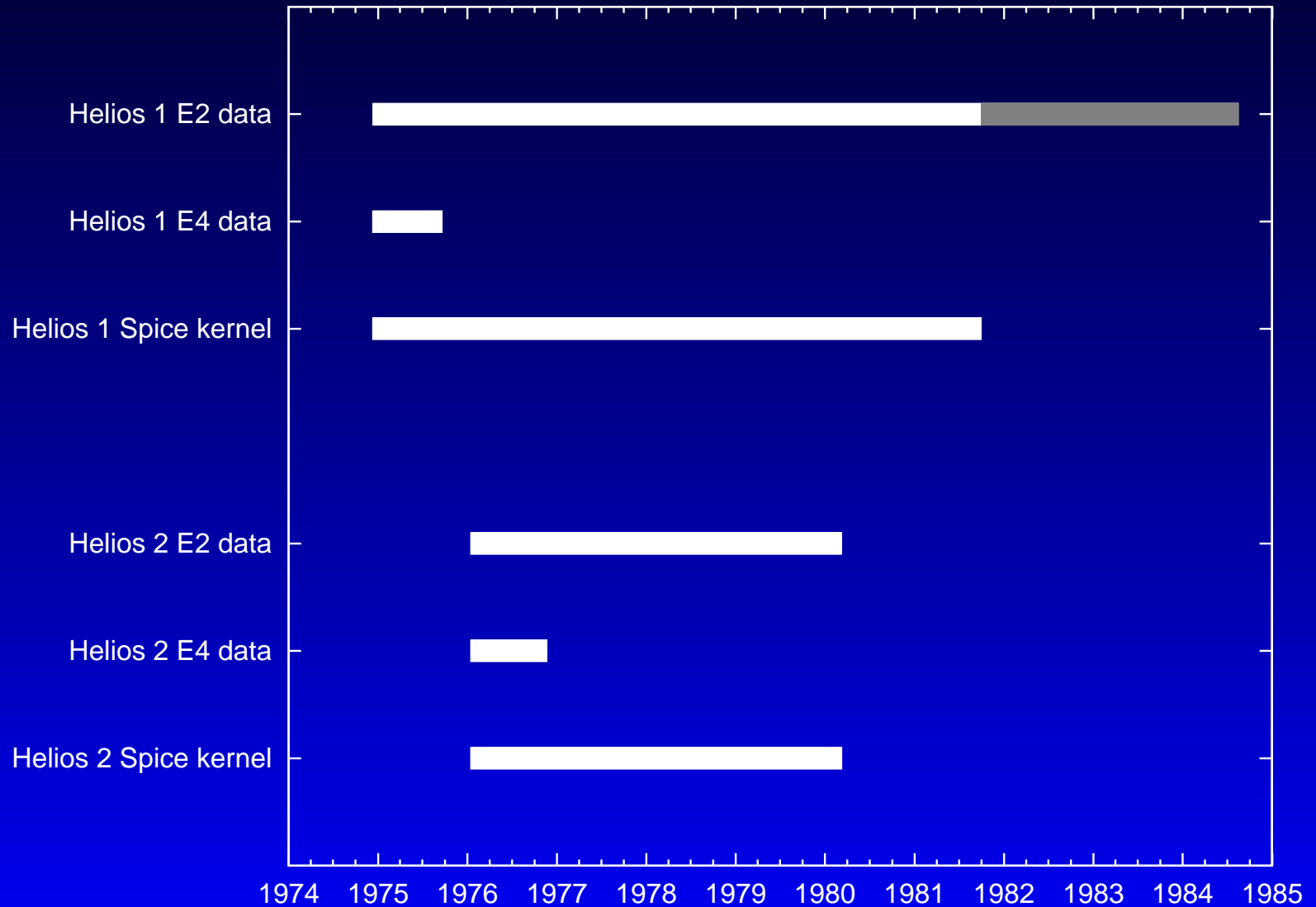


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Time coverage of Helios 1/2 data



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Thank you for your attention