

ULYSSES-KEP/EPAC data files description

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ULYSSES: International Solar Heliospheric Mission
EPAC: Energetic Particle Anisotropy Composition Analyzer
Ion Instrument, Fine Time Resolution
KEP: Principal Investigator: E. Keppler and M. Witte, MPI Lindau

Web: <http://www.mps.mpg.de/en/projekte/ulysses>
Generated by Michael Bruns (bruns@linmpi.mpg.de), May 2003.

Related documents:

Experiment description: Astron. Astrophys., Suppl. Ser., 1992, 92, 317-331
EPAC_coff_spectra.txt on using periods when the C-detector was switched
off.
EPAC_elhpinch.txt on calculating detector pinch through energies.
EPAC_elhspec.txt on calculating contributions to the EL channels
EPAC_geofac.txt on calculating the geometric factors of the
instrument.
EPAC_hsenergies.txt on heavy ion energy ranges.

Further reading:

PhD-theses Univ. Braunschweig (in german, available at MPAE):
Markus Fraenz (1994), Nobert Krupp (1994), Matthias Reuss (1998)

File name and type description

The file name format for the ULYSSES-KEP/EPAC Experiment data files:

ULYKEP-YYYY-TT.dat

Where YYYY: Year and TT: Data Category Type

The ZIP file ULYKEP-YYYY.zip for ESA's Ulysses Data System (UDS)
contains the following files:

ULYKEP-YYYY/ULYKEP-YYYY-BR.dat
ULYKEP-YYYY/ULYKEP-YYYY-EL.dat
ULYKEP-YYYY/ULYKEP-YYYY-ER.dat
ULYKEP-YYYY/ULYKEP-YYYY-EV.dat
ULYKEP-YYYY/ULYKEP-YYYY-HR.dat
ULYKEP-YYYY/ULYKEP-YYYY-HS.dat
ULYKEP-YYYY/ULYKEP-YYYY-OP.dat
ULYKEP-YYYY/ULYKEP-YYYY-OZ.dat
ULYKEP-YYYY/ULYKEP-YYYY-PR.dat
ULYKEP-YYYY/ULYKEP-YYYY-PS.dat
ULYKEP-YYYY/ULYKEP-YYYY-ZR.dat
ULYKEP-YYYY/ULYKEP-YYYY-ZS.dat

All the data files are in ASCII format, records separated with LF
(x0A) and fields with Blank (x20).

OZ and HS data files have variable record length depending on the telescope. All other data files contains the data in fixed record length.

File content description

Each record contains the following fields:

- UTC (%24c) Universal Time for start of measuring interval
e.g. 2000-01-01T00:44:48.000Z
Derived from SCET.
- SCET (%10d) S/C event time for start of measuring interval
e.g. 1577839488
These are 'Seconds from 1950-01-01T00:00:00.000Z as provided by the Ulysses project. Leap seconds are treated such that scet/86400 will give the 0-offset start of an UTC day.
- Identification (%12c)
e.g. HST1S3H1A0C1 or BRT2..H0A1C0 or ER....H1A1C0 or MG.....
Dots are used as filler characters for not applicable fields.
- Type (%6c) e.g.
 - Data Category (%2c)
HK SP ER BR EL PR ZR OP OZ PS ZS HR HS EV EH MG BM
 - Telescope (%2c)
T1, T2, T3, T4
 - Species (%2c)
S1, S2, S3, S4
- Flags (%6c)
Filler Flags for Data Category: EH, MG, BM
The default value "H.A.C." is used if status flags can't be derived.
This sometimes happens for HK and SP.
 - Mode Selection (%2c)
H0, H1 (Light Ion Mode, Heavy Ion Mode)
This affects categories ER,EV,HS,HR only.
 - Discriminator A1 Status (%2c)
A0, A1 (Low Threshold, High Threshold)
This affects categories PS,ZS,PR,ZR,OP,OZ only.
 - Discriminator C Status (%2c)
C0, C1 (Low Threshold, High Threshold)
This affects categories BR,EL only.
- AcquisitionTime (%11.5E) [sec]
(not for Data Category: HK, SP, EV, EH, MG, BM)
- DataValues (%12.5E) single precision float

The error value indicator is -1.0, that value should not be used.

- ER

Type: Event Rate, 3 Omnidirectional Channels.
Units: particles / (s cm² ster)
Values: erl erm erh
Note: Affected by setting of HMOD.

ER are the rate channels ERL, ERM, ERH. They are summed over all 4 telescopes and mark portions of the dE/dx matrix. ERL includes protons and He basically, ERM has mainly C, N, O and ERH all elements above for H1. All three channels are summed over all energy channels in the specific portion of the matrix. In Light Ion Mode H0 ERM contains mainly C, N and ERH all heavier ions.

- BR

Type: Background Data, 3 Channels
Telescope: 1, 2, 3, 4
Units: particles / (s)
Values: bra brb brc

Threshold conditions are:
Channel 1: A_1 B_1 C_1 (all detector rate)
Channel 2: B_1 (B detector rate)
Channel 3: C_1 (C detector rate)

- EL

Type: Electron Data, 2 Energy Channels, Spin Averages
Telescope: 1, 2, 3, 4
Units: particles / (s)
Values: ell elh

Electrons Low: 100-380 keV
Electrons High: E > 180 keV

The upper energy for EL high is not very well defined but is around 2MeV for electrons. Geometric factor is 0.148 cm² sr for direct entry and 0.535 cm² sr for electrons going through A1 baffle (energy dependent).

The ELH channel is also sensitive to cosmic ray energy protons (E>200MeV) with a geometric factor G=4.6 cm² sr. See the documents EPAC_elhspec.txt and EPAC_elhpinch.txt for

details.

- PR

Type: Proton Data, 8 Sectors
Telescope: 2, 3
Units: particles / (s KeV cm² ster)
Values: pr[se] (se=0; se<8; se++)
Note: Affected by setting of DA1. Was already taken into account in the computed values.

Proton rates summed over energy ~500-1000 keV only for telescope 2 and 3. Sectorized into 8 azimuthal sectors in instrument system.

Data affected by noise in telescope 3.

Also different noise levels in telescope 1, 2, 4.

- ZR

Type: Ion Data, 8 Sectors
Telescope: 2, 3
Units: particles / (s cm² ster)
Values: zr[se] (se=0; se<8; se++)
Note: Affected by setting of DA1. See experiment description.

Ion rates summed over energy ~200-1000 keV only for telescope 2 and 3. Sectorized into 8 azimuthal sectors in instrument system.

Data affected by noise in telescope 3.

- OP

Type: Omnidirectional Protons, Spin Averages
Telescope: 1, 2, 3, 4
Units: particles / (s KeV cm² ster)
Values: op
Note: Affected by setting of DA1. Was already taken into account in the computed values.

Proton rates summed over energy ~500-1000 keV.

Data affected by noise in telescope 3.
Also different noise levels in telescope 1, 2, 4.

- OZ

Type: Ions, Spin Averages but 4 Sectors for Telescope 1
Telescope: 1, 2, 3, 4
Units: particles / (s cm² ster)
Values: oz[se] (se=0; se<seNum; se++)
Note: Variable Record Length: T1: seNum=4, T2,T3,T4: seNum=1
Affected by setting of DA1. See experiment description.

Ion rates summed over energy ~200-500 keV only for telescope 2 and 3.

Data affected by noise in telescope 3.
Also different noise levels in telescope 1, 2, 4.

- PS

Type: Proton Data, 8 Energy Channels, 8 Sectors
Telescope: 1, 2, 3, 4
Units: particles / (s KeV cm² ster)
Values: ps[se][ch] ((se=0; se<8; se++) (ch=0; ch<8; ch++))
Note: Affected by setting of DA1. Was already taken into account in the computed values.

Proton rates energy ~500-1000 keV. Sectorized into 8 azimuthal sectors in instrument system. Splitted into 8 energy channels.

PS energy channels in keV:

Channel/	1	2	3	4	5	6	7	8
Telescope								
1	508-	520-	541-	574-	629-	768-	990-	1423-1559
2	508-	520-	541-	574-	633-	768-	994-	1431-1559

3 508- 520- 541- 574- 633- 772- 994- 1435-1493
4 508- 520- 541- 574- 633- 768- 990- 1423-1546

Generally only Channels 4,5,6 are clean and unaffected by the DA1 setting. Channels 7 and 8 are not well defined.

Data affected by noise in telescope 3.

- ZS

Type: Ion Data, 8 Energy Channels, 8 Sectors
Telescope: 1, 2, 3, 4
Units: particles / (s cm² ster)
Values: zs[se][ch] ((se=0; se<8; se++) (ch=0; ch<8; ch++))
Note: Affected by setting of DA1. See experiment description.

Ion rates summed over energy ~200-500 keV. Sectorized into 8 azimuthal sectors in instrument system. Split into 8 energy channels.

ZS stands for Z>=1 ion spectral channels, very similar to the PS channels but total ion channels only where thresholds can be set to exclude certain species.

Data affected by noise in telescope 3.

- HR

Type: Heavy Ion Rate, Spin Averages
Telescope: 1,2,3,4
Species: 1,2,3,4
Units: particles / (s cm² ster)
Values: hr
Note: Affected by setting of HMOD.
Affected by changes in PROM setting.

Oxygen rates summed over 8 energy channels and 8 sectors. This category is a sum of all 8 HS channels for each of the 4 selected species: HRS1 is the same as the sum of all 8 channels of HSS1 but with a different time resolution.

Species 1: Helium Ion summed over energy range ~400-2000 keV/N. Affected by protons (>2MeV) and heavy ions (>2MeV/N).
Species 2: Oxygen rates summed over energy range (~400-6000 keV/N).
Species 3: CSiS rates summed over energy range (~400-6000 keV/N). Basically counting Si and S until 1994-01-11, and C from then on.
Species 4: Iron rates summed over energy range (~400-6000 keV/N).

See separate document EPAC-hsenergies.txt for PROM settings over time.

- HS

Type: Heavy Ion Data, 8 Energy Channels,
4 Azimuthal Sectors for Telescope 2 and 3
Telescope: 1,2,3,4
Species: 1,2,3,4
Units: particles / (s cm² ster)
Values: hs[se][ch] ((se=0; se<seNum; se++) (ch=0; ch<8; ch++))
Note: Variable Record Length: T1,T4: seNum=1, T2,T3: seNum=4

Affected by setting of HMOD.
Affected by changes in PROM setting.

EPAC has 4 species x 8 energy channels (HST1S1-HST4S4) which are selectable. EPAC can run in heavy ion mode (H1) or in ion mode (H0). Basically what we do is to put boxes around the tracks for different species. For example the first 4 channels of the selected species 1 (HST1S1H1) contain 4 channels of He. Another example would be that EPAC had 8 sulfur (species 3) channels during the Jupiter flyby (HST1S3H1). We also changed the settings several times during flight. The PROM setting contains a list for all HS channels over time including species and energy of them.

Species 1: Helium Ion rates, 8 channels, energy ~0.4-2.0 MeV/N.
Upper energy for Ch5 He is ~ 12MeV.
Channel 6-8 contain heavier ions (>47MeV).
Affected by protons (>2MeV) in channel 5.

Species 2: Oxygen rates 8 channels energy (~0.4-6 MeV/N).
Top energy (ch 8) ~106MeV.

Species 3: C Si S rates, 8 channels, energy (~400-6000 keV/N).
Basically counting Si and S until 1994-01-11, and C from then on.

Species 4: Iron rates, 8 channels, energy (~0.3-10 MeV/N).
Top energy (ch.8) ~580 MeV.
Lower channels affected by sulphur at Jupiter.

See separate document EPAC-hsenergies.txt for PROM settings over time.

- EV

Type: Heavy Ion Events.
Units: Events
Values: e[i] de[i] "T"<1-4>"S"<1-4> (i=0; i<32; i++)
Note: These values are integers.
The error value or no data indicator: "-1 -1 T0S0"
Affected by setting of HMOD.

Up to 32 heavy ion events per 8min??? interval are stored with high energy resolution. From these the energy-loss matrix can be constructed.

Energies:

e[i] is the energy channel number in B-detector, range 0-511
de[i] is the energy channel number in A-detector, range 0-255
HMOD = 0; for Light Ion Mode (H0)
HMOD = 1; for Heavy Ion Mode (H1)

```
// Energy-Mode factors
// E-range 0, E-range 1, Light Ion Mode, Heavy Ion Mode
facA = {128.60, 2.558, 24.390, 12.0};
facB = { 16.03, 6.500, 7.317, 7.0};
// Energy EA???, EB??? in Mev
EA = (de[i] + 1.0 + facB[2+HMOD]) / facA[2+HMOD];
if (e[i] < 256) EB = (e[i] + 1 + facB[0]) / facA[0];
else EB = (e[i] - 256 + 1 + facB[1]) / facA[1];
```

Note, that the top channels de=255 and e=511 are open for higher energies.