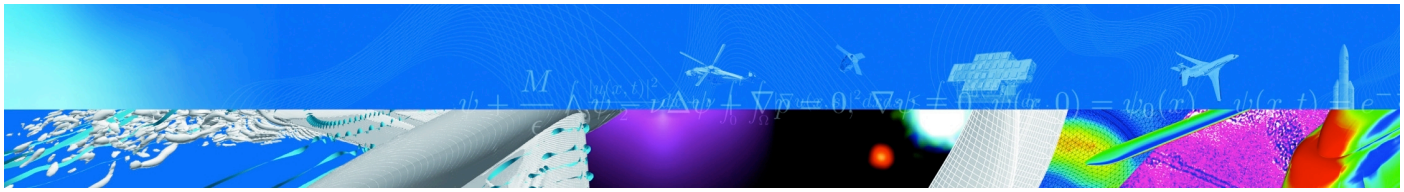

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FINAL REPORT

Jupiter plasma data base for AMDA

Author: A. SICARD-PIET

SPACE ENVIRONMENT DEPARTMENT

FR 1/19291 DESP - March, 2011

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DÉPARTEMENT

SPACE ENVIRONMENT

Final Report FR 1/19291 DESP

Jupiter plasma data base for AMDA

March, 2011

Author

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Approved by :
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Head of
Space Environment Department

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Author abstract

This study aims to recover and put the data of energetic particles measured on-board once the satellite has crossed the magnetosphere of Jupiter (Pioneer 10, Pioneer 11, Ulysses, Voyager 1, Voyager 2 and Galileo HIC) into CDF format.

Keywords

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1. WHAT IS A CDF FILE?

All the public in-situ plasma data of Jovian magnetosphere have been processed and formatted into ISTP CDF (Common Data Files) format, following RERMM study logic [1] and COSPAR IRBEM guidelines, with one file per couple spacecraft/instrument and per day. The guidelines commented here describe the different steps of creating a unified data resource (CDF) in order to perform coherence assessment between various data sources. All these steps have to be performed for data produced by the following satellites and instruments:

- PIONEER 10 (GTT, CRT, CPI)
- PIONEER 11 (GTT, CRT, CPI)
- VOYAGER 1 (LECP, CRS)
- VOYAGER 2 (LECP, CRS)
- ULYSSES (EPAC, COSPIN)
- GALILEO ORBITER (HIC)

The unified data resource to be created is chosen to be an ISTP/IACG guidelines compliant CDF file. For more information about the ISTP/IACG guidelines on Space Physics Use of CDF, refer to http://spdf.gsfc.nasa.gov/sp_use_of_cdf.html. To create a unified data resource, physical quantities are extracted from an input file, and written to an output file. The input files vary considerably across satellites, but the output file format is common. This simplifies any further processing, such as computation of ancillary data, and generation of virtual detector data sets.

Output files naming:
According to the ISTP/IACG guidelines, the name of a file should be of the form:

PIONEER_10_H0_GTT_ELECTRON_FLUX_19731203_V01.cdf

with:

- PIONEER10 => satellite name
- H0 => high resolution data
- GTT_ELECTRON_FLUX => instrument name
- 19791203 => YYYYMMDD (year, month, day: date of the data in the CDF file)
- V01 => version of the CDF file

The two-digit version number is increased by 1 (one) each time an input file is written to an output file that already contains data from that input file (from a previous processing). This ensures that no data is overwritten unintentionally. The file naming guideline suggests that one file contains all data from one particular day. Input files are not necessarily one file per day (one per hour, one per orbit) or files may be split according to mission time instead of UT. This means that one input file can go into one or more output files, and one output file can contain data from one or more input files. Finally the extension (.CDF) is appended to the filename, which identifies it as a Common Data Format file.

Content of a CDF file:
Four kinds of CDF files are provided:

⇒ The first one contains the count rates (s^{-1}) of channels when these data are available (COUNT FILE).

⇒ The second one contains the differential ($cm^{-2}.s^{-1}.sr^{-1}.MeV^{-1}$) and integral ($cm^{-2}.s^{-1}.sr^{-1}$) electron flux, when these data exist (ELECTRON FLUX FILE).

⇒ The third one contains the differential ($cm^{-2}.s^{-1}.sr^{-1}.MeV^{-1}$) and integral ($cm^{-2}.s^{-1}.sr^{-1}$) ion flux, when these data exist (ION FLUX FILE).

⇒ The fourth contains the orbit coordinates of the spacecraft (ORBITO FILE).

A CDF file is always structured in the same way. The four kinds of CDF files contain first a common block of information:

- File header with information on:
  - *Project*
  - *Source name*
  - *Discipline*
  - *Data type*
  - *Descriptor*
  - *Data version*
  - *PI name*
  - *PI affiliation*
  - *Text describing the instrument*
  - *Instrument type*
  - *Mission group*
  - *Time resolution*
  - *Rules of use*
  - *Acknowledgement*

Then the content of the CDF file depends of the kind of CDF:

⇒ **Count CDF file**:

- *Epoch* (array containing time in millisecond since a given reference)
- Count Parameters
  - *CountRate* (array of count rates in s^{-1})
  - *CountRateIndex* (number of channels)
  - *CountRate_LABL_1* (name of channels)

⇒ **Electron flux CDF file**:

- *Epoch* (array containing time in millisecond since a given reference)
- Flux parameters - *FEIO* or *FEDO* (Flux Electron Integral/Differential Omnidirectional):
  - *FEDO*: array of flux
  - *FEDO*_Energy: array of float containing the energy of the channels
  - *FEDO_LABL_1*: array of string containing the energy of the channels
  - *FEDO_Quality*: array of integer containing the quality of the data (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes possible contamination, 3 denotes saturation, 4 denotes any other problem and 5 denotes the background)
  - *FEDO_Crosscalib*: array of integer containing the cross calibration factor (1 by default)

⇒ **Ion flux CDF file**:

- *Epoch* (array containing time in millisecond since a given reference)
- Flux parameters - *FPIO*/*FPDO* or *FADO/FAIO* or *FIDO/FIIO* (Flux Proton, Alpha or Ion Integral/Differential Omnidirectional):
  - *FPDO*: array of flux
  - *FPDO*_Energy: array of float containing the energy of the channels

- *FPDO_LABL_1*: array of string containing the energy of the channels
- *FPDO_Quality*: array of integer containing the quality of the data (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes possible contamination, 3 denotes saturation, 4 denotes any other problem and 5 denotes the background)
- *FPDO_Crosscalib*: array of integer containing the cross calibration factor (1 by default)

By definition, differential omnidirectional fluxes are expressed in $cm^{-2}.s^{-1}.sr^{-1}.MeV^{-1}$ and integral omnidirectional fluxes are expressed in $cm^{-2}.s^{-1}.sr^{-1}$.

⇒ **Orbito CDF file**:

- *Epoch* (array containing time in millisecond since a given reference)
- Position of the satellite in system III (1965-LH) coordinates:
  - *Position* (xJOV, yJOV, zJOV) in km
  - *Position Quality*: array of integer containing the position quality (0 if good, 1 if there is a problem in position)
- Magnetic parameters:
  - *B_Calc* (magnitude of B local)
  - *B_Eq* (magnitude of B equatorial)
  - *L* (McIlwain parameter)
  - *L** (another way to compute L)
  - *I*
  - *MLT* (Magnetic Local Time)
  - *Alpha* (local pitch angle)
  - *Alpha_Eq* (equatorial pitch angle)

In the next parts, we describe in a comprehensive manner the CDF files created for each satellite/instrument in terms of:

- Data source and data format
- Conversion of data into fluxes
- Energy channels available
- Time and spatial coverage available
- Temporal resolution data
- Notes (problems in data, correction…)

According to the existing in-situ data, and the availability of the data, CDF files are created for the following satellite/instrument:

- PIONEER-10/GTT
- PIONEER-10/CPI
- PIONEER-10/CRT
- PIONEER-11/GTT
- PIONEER-11/CPI
- PIONEER-11/CRT
- VOYAGER-1/LECP
- VOYAGER-1/CRS
- VOYAGER-2/LECP
- VOYAGER-2/CRS
- ULYSSES/COSPIN
- ULYSSES/EPAC
- GALILEO/HIC

Notes:

In the CDF files, presented in the next section, the magnetic parameters (L, Beq, B, MLT…) are calculated with the last version of the magnetic field model of Khurana [2]. In these CDF files, the L* parameter is not calculated because the time needed to calculate it is too long (~20 times longer than L calculation). L* is

another way to calculate the characteristic parameter of the magnetic field line. L* as well as L consider an internal and an external magnetic field. L* is just more accurate when we talk about trapped particle. However, L* parameter would not provide more accurate information than L parameter in the model development. All the parameters calculated in the CDF files are in the System III [1965] coordinate system, Left Handed. The Jupiter system III is a left-handed Jupiter-centered system which rotates with the planet. The z-axis of the system is defined as the spin axis, w, of Jupiter, with the positive direction oriented northward. The x-axis is fixed on the Jovian prime meridian, lIII = 0, as defined by the International Astronomical Union in 1976 [2]. The rotation period is defined as 9 hr 55 min 29.71 sec or 870.536 degrees/day. Longitude is measured clockwise from this prime meridian.

2. PIONEER 10

2.1. Pioneer 10/GTT (Geiger Tube Telescope)

For a description of the GTT instrument, see [4][5][6].

Data source and data format:
The PIONEER_10/GTT data are available on the University of Iowa website at http://www-pw.physics.uiowa.edu/pioneer/data/. All the data measured during the Jupiter encounter are in one file named:"*p10-jup.zip*". This zip file contains (1) "*p10-jup.dat"* a binary file with the data, "*p10_jup_hires.fmt*" a file containing the format of the data and a *README* file. As a matter of usability, the binary source file has been transformed in an ASCII file that we called "*P10_JUP_ASCII.dat*". This file contains spin-averaged data and angular data rates (counts/sec) measured by the GTT instrument, the position of the satellite in several coordinate systems and magnetic field data. Only the spin-averaged data are put in the CDF files.

Counts rates:
The available data are count rates data (s^{-1}) for 10 channels of GTT instrument:
G1,AA,BB,G2,AB,ABC1,CC,DD,ABC2,DEF
Some of those are coincidence channels.

Conversion of data into fluxes and energy channels available:
Then the count rates data have been converted into flux data using geometrical factors (GEF). Several energy channels are available in the data and are put in the CDF files:

Channels	Electrons		Protons	
	Energy (MeV)	GEF (cm^{-2})	Energy (MeV)	GEF (cm^{-2})
G-C	FEIO > 0.06	2600	FPDO 25-80	125
B-C	FEIO > 0.55	830	FPDO 6.6-80	650
A-C	FEIO > 5	600	FPDO 30-80	650
C	FEIO > 21	23	FPIO > 80	8.2
D	FEIO > 31	63	FPIO > 80	23

Spin-averaged data rates have been converted into differential and integral omni directional fluxes, respectively in $cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}$ and in $cm^{-2}.sr^{-1}.s^{-1}$, using geometrical factors found in the literature [4] such as:

$$\text{FPDO} = \frac{rates(counts.s^{-1}).GEF(cm^{-2})}{4\pi.\Delta E(MeV)} \quad \text{and} \quad \text{FEIO or FPIO} = \frac{rates(counts.s^{-1}).GEF(cm^{-2})}{4\pi}$$

Time and spatial coverage available:
The time coverage of the available data and consequently of the CDF files is from 1973/11/24 to 1973/12/18. This period corresponds to a spatial coverage from 130 Rj to the closest approach (2.8 Rj) during the inbound and from the closest approach to 198 Rj during the outbound.

Temporal resolution:
The temporal resolution of the data of about one minute is variable during the Jupiter encounter.

2.2. Pioneer 10/CPI (Charge Particle Instrument)

For a description of the CPI instrument, see [7].

Data source and data format:
The PIONEER_10/CPI data are available on the Planetary Data System website at http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=PN_5001&folder=PIONEER10/CPI&style=full.
The several detector constituting CPI instrument and the particles measured are described in the file "*cpi_p10_15min.sfdu*". All the data measured during the Jupiter encounter are in one ASCII file named: "*P10_CPI_JUP_15MIN.TAB*". This file contains data counts measured by the several detectors constituting CPI instrument (ECD, Fission cell and LET) and the accumulation time (s). The unit for the ECD data is Ampere while the unit for other data is counts.

Count Rates:
Some data are available in counts rates (s^{-1}). This is the case of 5 channels:

- Protons 0.54-18.5 MeV
- Protons >1.85 MeV
- Protons > 35 MeV
- Alpha 0.3-1.82 MeV
- Alpha > 1.82 MeV

These 5 channels are contained in the Count CDF files.

Conversion of data into fluxes and energy channels available
According to the energy channels available in the data and the geometrical factors we have, the energy channels put in the CDF files are:

Electrons		Protons		Alphas	
Energy (MeV)	Conversion factor	*Energy (MeV)*	GEF	*Energy (MeV/Nuc)*	GEF
FEIO > 3	10^{-13} A (el/cm^2.s.sr)$^{-1}$	FPIO > 35	2.5 10^{-5} events/s (proton/cm^2.s)$^{-1}$	FADO 0.30-1.82	0.49 cm^{-2}.sr^{-1}
		FPDO 0.54-1.85	0.49 cm^{-2}.sr^{-1}	FADO 1.82-50	0.49 cm^{-2}.sr^{-1}
		FPIO > 1.85	0.49 cm^{-2}.sr^{-1}		

Original counts rates have been converted into differential and integrated omnidirectional fluxes, respectively in cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1} and in cm^{-2}.sr^{-1}.s^{-1}, using conversion factors found in the literature [7] such as:

$$\text{FEIO } (\text{cm}^{-2}.\text{sr}^{-1}.\text{s}^{-1}) = \frac{ECDrate(A).10^{-9}}{conversionfactor}$$

$$\text{FPIO } (\text{cm}^{-2}.\text{sr}^{-1}.\text{s}^{-1}) = \frac{counts}{conversion\ \ factor.accumulation\ time.4\pi}$$

$$\text{FPIO } (>35\text{ MeV})(\text{cm}^{-2}.\text{sr}^{-1}.\text{s}^{-1}) = \frac{countrates(s^{-1})}{conversionfactor.4\pi}$$

$$\text{FPIO } (>1.85\text{ MeV}) (\text{cm}^{-2}.\text{sr}^{-1}.\text{s}^{-1}) = \frac{counts}{accumulation\ time.GEF.\Delta E}$$

$$\text{FPDO or FADO } (\text{cm}^{-2}.\text{sr}^{-1}.\text{s}^{-1}.\text{MeV}^{-1}) = \frac{counts}{accumulation\ time.GEF.\Delta E}$$

Time and spatial coverage available

The time coverage of the available data and consequently of the CDF files is from 1973/11/26 to 1973/12/17. This period corresponds to a spatial coverage from 118 Rj to the closest approach (2.8 Rj) during the inbound and from the closest approach to 187 Rj during the outbound.

Temporal resolution

The temporal resolution of the data is 15 minutes during the Jupiter encounter.

2.3. Pioneer 10/CRT (Cosmic Ray Telescope)

For a description of the CRT instrument, see [8].

Data source and data format

The detectors constituting CRT instrument and the particles measured are described in the file "P10_CRT_JUP_15MIN_DS.CAT" in the catalogue at the following address: http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=PN_5001&folder=CATALOG&style=full.

The PIONEER_10/CRT data are available on the Planetary Data System website at http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=PN_5001&folder=PIONEER10/CRT&style=full.

The data are stored in 5 ASCII table files (.TAB), according to the detector where they come from:

-"*P10_CRT_JUP_15MIN_HET.TAB*"
-"*P10_CRT_JUP_15MIN_LET_I.TAB*"
-"*P10_CRT_JUP_15MIN_LET_IIA.TAB*"
-"*P10_CRT_JUP_15MIN_LET_IIB.TAB*"
-"*P10_CRT_JUP_15MIN_LET_IIC.TAB*"

Each of these ASCII files is accompanied by a PDS label file (.LBL) which describes the properties of the data file.

The data files contain fluxes ($\text{cm}^{-2}.\text{sr}^{-1}.\text{s}^{-1}$) measured by the several detectors constituting CRT instrument and the uncertainties associated to each flux.

Count rates

There are no count rates in these data, only fluxes.

Conversion of data into fluxes and energy channels available
According to the energy channels available in the data and the energy channels put in the CDF files are:

Electrons	Protons
Energy (MeV)	Energy (MeV)
FEIO >0.16	FPIO >0.2
FEIO >0.43	FPIO >0.53
FEDO 0.8-2.0	FPIO >0.74
FEDO 1.1-2.0	FPIO >0.84
FEDO 1.8-2.0	FPIO >1.11
FEDO 3.2-5.1	FPIO >1.6
FEDO 5.1-8.0	FPIO >3.13
	FPIO >5.65
	FPDO 1.24-2.15
	FPDO 2.3-3.6
	FPDO 10.3-21

Data have been converted into differential omnidirectional fluxes, in $cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}$ such as:

$$\text{FEDO or FPDO } (cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}) = \frac{data\ \ fluxes}{\Delta E(MeV)}$$

Time and spatial coverage available
The time coverage of the available data and consequently of the CDF files is from 1973/11/26 to 1973/12/15. This period corresponds to a spatial coverage from 118 Rj to the closest approach (2.8 Rj) during the inbound and from the closest approach to 161 Rj during the outbound.

Temporal resolution
The temporal resolution of the data is 15 minutes during the Jupiter encounter.

2.4. Trajectory data

The position of the Pioneer 10 spacecraft which can be found in the Orbito CDF files is derived from original file of GTT measurements mentioned in part 2.1. Magnetic parameters linked to the position of the spacecraft (L, B, Beq,…) have been calculated with a library developed at ONERA and using Khurana magnetic field model [2].

3. PIONEER 11

3.1. Pioneer 11/GTT (Geiger Tube Telescope)

For a description of the CPI instrument, see [4][5][6].

Data source and data format
The PIONEER_11/GTT data are available on the University of Iowa website at http://www-pw.physics.uiowa.edu/pioneer/data/. All the data measured during the Jupiter encounter are in one file named: "*p11-jup.zip*". This zip file contains (1) "*p11-jup.dat*" a binary file with the data, "*p11_jup_hires.fmt*" a file containing the format of the data and a *README* file. As a matter of usability, the binary source file has been transformed in an ASCII file that we called "*P11_JUP_ASCII.dat*". This file

contains spin-averaged data and angular data rates (counts/sec) measured by the GTT instrument, the position of the satellite in several coordinate systems and magnetic field data. Only the spin-averaged count rates have been converted in omnidirectional fluxes and put in CDF files.

Count rates:
The available data are count rates data (s^{-1}) for 10 channels of GTT instrument:
G1,AA,BB,G2,AB,ABC1,CC,DD,ABC2,DEF
Some of those are coincidence channels.

Conversion of data into fluxes and energy channels available
Several energy channels are available in the data and are put in the CDF files:

Channels	Electrons		Protons	
	Energy (MeV)	GEF (cm^{-2})	Energy (MeV)	GEF (cm^{-2})
A-C	FEIO > 0.04	730	FPDO 0.61-80	650
B-C	FEIO > 0.56	785	FPDO 9-80	650
G	Insensitive to electrons		FPDO 0.61-3.4	285
C	FEIO > 21	23	FPIO > 80	8.2
D	FEIO > 31	63	FPIO > 80	23

Spin-averaged data rates have been converted into differential and integral omnidirectional fluxes, respectively in $cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}$ and in $cm^{-2}.sr^{-1}.s^{-1}$, using geometrical factors found in the literature [4] such as:

$$\text{FPDO} = \frac{rates(counts.s^{-1}).GEF(cm^{-2})}{4\pi.\Delta E(MeV)} \quad \text{and} \quad \text{FEIO or FPIO} = \frac{rates(counts.s^{-1}).GEF(cm^{-2})}{4\pi}$$

Time and spatial coverage available
The time coverage of the available data and consequently of the CDF files is from 1974/11/22 to 1974/12/12. This period corresponds to a spatial coverage from 198 Rj to the closest approach (1.6 Rj) during the inbound and from the closest approach to 143 Rj during the outbound.

Temporal resolution
The temporal resolution of the data of about one minute is variable during the Jupiter encounter.

3.2. Pioneer 11/CPI (Charge Particle Instrument)

For a description of the CPI instrument, see [7].

Data source and data format
The PIONEER_11/CPI data are available on the Planetary Data System website at http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=PN_5001&folder=PIONEER11/CPI&style=full.
The several detector constituting CPI instrument and the particles measured are described in the file "*cpi_p11_15min.sfdu*". All the data measured during the Jupiter encounter are in one ASCII file named: "*P11_CPI_JUP_15MIN.TAB*". This file contains data counts measured by the several detectors constituting CPI instrument (ECD, Fission cell and LET) and the accumulation time (s). The unit for the ECD data is Ampere while the unit for other data is counts.

Count Rates:
Some data are available in counts rates (s^{-1}). This is the case of 5 channels:

- Protons 0.54-18.5 MeV
- Protons >1.85 MeV
- Protons > 35 MeV
- Alpha 0.3-1.82 MeV
- Alpha > 1.82 MeV

These 5 channels are contained in the Count CDF files.

Conversion of data into fluxes and energy channels available
According to the energy channels available in the data and the geometrical factors we have, the energy channels put in the CDF files are:

Electrons		Protons		Alphas	
Energy (MeV)	Conversion factor	*Energy (MeV)*	GEF	*Energy (MeV/Nuc)*	GEF
FEIO > 3	10^{-13} A $(el/cm^2.s.sr)^{-1}$	FPIO > 35	2.5 10^{-5} events/s $(proton/cm^2.s)^{-1}$	FADO 0.30-1.82	0.49 $cm^{-2}.sr^{-1}$
		FPDO 0.54-1.85	0.49 $cm^{-2}.s^{-1}$	FADO 1.82-50	0.49 $cm^{-2}.sr^{-1}$
		FPDO 1.85-8.8	0.49 $cm^{-2}.s^{-1}$		

Data have been converted into differential and integral omnidirectional fluxes, respectively in $cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}$ and in $cm^{-2}.sr^{-1}.s^{-1}$, using conversion factors found in the literature [7] such as:

$$\text{FEIO } (cm^{-2}.sr^{-1}.s^{-1}) = \frac{ECDrate(A).10^{-9}}{conversionfactor}$$

$$\text{FPIO } (cm^{-2}.sr^{-1}.s^{-1}) = \frac{counts}{conversion\ \ factor.accumulation\ time.4\pi}$$

$$\text{FPIO } (>35\text{ MeV})(cm^{-2}.sr^{-1}.s^{-1}) = \frac{countrates(s^{-1})}{conversionfactor.4\pi}$$

$$\text{FPIO } (>1.85\text{ MeV}) (cm^{-2}.sr^{-1}.s^{-1}) = \frac{counts}{accumulation\ time.GEF.\Delta E}$$

$$\text{FPDO or FADO } (cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}) = \frac{counts}{accumulation\ time.GEF.\Delta E}$$

Time and spatial coverage available
The time coverage of the available data and consequently of the CDF files is from 1974/11/23 to 1974/12/11. This period corresponds to a spatial coverage from 149 Rj to the closest approach (1.6 Rj) during the inbound and from the closest approach to 131 Rj during the outbound.

Temporal resolution
The temporal resolution of the data is 15 minutes during the Jupiter encounter.

3.3. Pioneer 11/CRT (Cosmic Ray Telescope)

For a description of the CPI instrument, see [8].

Data source and data format
The several detector constituting CRT instrument and the particles measured are described in the file "P11_CRT_JUP_15MIN_DS.CAT" in the catalogue at the following address: http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=PN_5001&folder=CATALOG&style=full.
The PIONEER_11/CRT data are available on the Planetary Data System website at http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=PN_5001&folder=PIONEER11/CRT&style=full.
The data are stored in 5 ASCII table files (.TAB), according to the detector where they come from:

-"*P11_CRT_JUP_15MIN_HET.TAB*"
-"*P11_CRT_JUP_15MIN_LET_I.TAB*"
-"*P11_CRT_JUP_15MIN_LET_IIA.TAB*"
-"*P11_CRT_JUP_15MIN_LET_IIB.TAB*"
-"*P11_CRT_JUP_15MIN_LET_IIC.TAB*"

Each of these ASCII files is accompanied by a PDS label file (.LBL) which describes the properties of the data file.
The data files contain fluxes ($cm^{-2}.sr^{-1}.s^{-1}$) measured by the several detectors constituting CRT instrument and the uncertainties associated to each flux.

Count rates
There are no count rates in these data, only fluxes.

Conversion of data into fluxes and energy channels available
According to the energy channels available in the data, the energy channels put in the CDF files are:

Electrons	Protons
Energy (MeV)	Energy (MeV)
FEDO 0.16-2.0	FPDO 0.2-2.17
FEDO 0.43-2.0	FPDO 0.53-2.17
FEDO 0.8-2.0	FPDO 0.74-2.17
FEDO 1.1-2.0	FPDO 0.84-15.1
FEDO 1.8-2.0	FPDO 1.11-8.1
FEDO 3.2-5.1	FPDO 1.24-2.17
FEDO 5.1-8.0	FPDO 1.6-5.1
	FPDO 2.1-3.8
	FPDO 3.19-14.9
	FPDO 5.68-14.9
	FPDO 11-21

Data have been converted into differential omnidirectional fluxes, in $cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}$ such as:

$$\text{FEDO or FPDO } (cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}) = \frac{data\ \ fluxes}{\Delta E(MeV)}$$

Time and spatial coverage available
The time coverage of the available data and consequently of the CDF files is from 1974/11/26 to 1974/12/09. This period corresponds to a spatial coverage from 112 Rj to the closest approach (1.6 Rj) during the inbound and from the closest approach to 97 Rj during the outbound.

Temporal resolution
The temporal resolution of the data is 15 minutes during the Jupiter encounter.

3.4. Trajectory data

The position of the Pioneer 11 spacecraft which can be found in the Orbito CDF files is derived from original file of GTT measurements mentioned in part 3.1. Magnetic parameters linked to the position of the spacecraft (L, B, Beq,…) have been calculated with a library developed at ONERA and using Khurana magnetic field model [2].

4. VOYAGER 1

4.1. Voyager 1/LECP (Low Energy Charged Particle)

For a description of the LECP instrument, see [9].

Data source and data format
The VOYAGER_1/LECP data measured during the Jupiter encounter are available on the Fundamental Technologies Voyager LECP Pages at
http://data.ftecs.com/archive/voyager_lecp/Voyager_1_Data/V1_1979/.
The data are stored in 35 ASCII table files (.CSV) named "*V179DDDGSGG.CSV*", according to the detector where they come from (GG), for each day of the year 1979 (DDD).

The data files contain count rates (s^{-1}) measured by the several detectors constituting LECP instrument and the uncertainties associated to each rate. Each acquisition time in the files corresponds to an angular sector of measurements (from 1 to 8), due to the fact that the main detector looks within a single scan plane that is rotated 360°, stopping at 8 different look sectors.

The particles measured by LECP and the geometrical factor associated are described in the file at the following addresses: http://voyager.ftecs.com/calibrations-chandefs/v1newgen.html

Count rates
All LECP data are count rates data in (s^{-1}). Thus Count CDF files exist for this instrument and content all the count rates data defined below:

- Electrons 0.015-0.037 MeV
- Electrons 0.037-0.061 MeV
- Electrons 0.07-0.112 MeV
- Electrons 0.13-0.183 MeV
- Electrons 0.2-0.5 MeV
- Electrons > 0.015 MeV
- Electrons > 0.037 MeV
- Electrons > 0.07 MeV
- Electrons > 0.13 MeV
- Electrons > 0.853 MeV
- Electrons > 2.1 MeV
- Protons 0.03-0.053 MeV
- Protons 0.053-0.085 MeV
- Protons 0.085-0.139 MeV
- Protons 0.139-0.2 MeV
- Protons 0.2-0.55 MeV
- Protons 0.54-1.05 MeV
- Protons 1.05-2.03 MeV

- Electrons > 0.2 MeV
- Electrons > 0.252 MeV
- Electrons > 0.48 MeV
- Protons 2.03-4.01 MeV
- Alphas 0.98-1.77 MeV
- Alphas 1.77-4.22 MeV

Conversion of data into fluxes and energy channels available

Being given it is very difficult to determine an easy link between the angular sectors looked by the detector and indicated in the data files and the pitch angle of the particles measured, we have decided to calculate a sector-averaged count rates and to convert this average into fluxes. The sector-averaged is calculated only if there are 75 % of the 8 sectors and if uncertainty associated to each count rate is lower than the count rate.

Thus, data have been converted into differential omnidirectional fluxes, in $cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}$ such as:

$$\text{FEDO or FPDO or FADO } (cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}) = \frac{countrates(s^{-1})}{GEF(cm^2 sr).\Delta E(MeV)}$$

According to the energy channels available in the data and the information on geometrical factors we dispose, the energy channels put in the CDF files are:

Electrons		**Protons**		**Alphas**	
Energy (MeV)	GEF (cm^2sr)	Energy (MeV)	GEF (cm^2sr)	*Energy (MeV/Nuc)*	GEF (cm^2sr)
FEDO 0.015-0.037	0.006	FPDO 0.03-0.053	0.04020	FADO 0.98-1.77	0.04020
FEDO 0.037-0.061	0.006	FPDO 0.053-0.085	0.04020	FADO 1.77-4.22	0.04020
FEDO 0.07-0.112	0.006	FPDO 0.085-0.139	0.04020		
FEDO 0.13-0.183	0.006	FPDO 0.139-0.2	0.04020		
FEDO 0.2-0.5	0.006	FPDO 0.2-0.55	0.04020		
FEIO >0.015	0.00012	FPDO 0.54-1.05	0.04020		
FEIO >0.037	0.00012	FPDO 1.05-2.03	0.04020		
FEIO >0.07	0.00012	FPDO 2.03-4.01	0.04020		
FEIO >0.13	0.00012				
FEIO > 0.2	0.00012				
FEIO >0.252	0.002				
FEIO >0.48	0.002				
FEIO >0.853	0.002				
FEIO >2.1	0.002				

Time and spatial coverage available

The time coverage of the available data and consequently of the CDF files is from 1979/02/28 to 1979/03/16. This period corresponds to a spatial coverage from 80 Rj to the closest approach (4.89 Rj) during the inbound and from the closest approach to 180 Rj during the outbound.

Temporal resolution

The temporal resolution of the data is less than 2 minutes during the closest approach until more than 5 minutes at the beginning or at the end of the time period studied.

4.2. Voyager 1/CRS (Cosmic Ray Subsystem)

For a description of the CRS instrument, see [10] [11].

Data source and data format
The VOYAGER_1/CRS data measured during the Jupiter encounter are available on the Planetary Data System website at http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=VG_1501&folder=DATA/CRS&style=full.
The content of the data files is described in "VG1_JUP_CRS_DS.CAT" at http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=VG_1501&folder=CATALOG&style=full.

According to the data set overview done in the description file mentioned above, 7 ASCII files, corresponding to different detectors are available and interesting:
- "BS2EDAT.TAB"
- "BS3EDAT.TAB"
- "BS4EDAT.TAB"
- "FPHADAT.TAB"
- "LD1DAT.TAB"
- "LDDAT.TAB"
- "LDTRPDAT.TAB"

The data files contain fluxes ($cm^{-2}.sr^{-1}.s^{-1}$) measured by the several detectors constituting CRS instrument and the uncertainty associated to each flux.

Count rates
There are no count rates in these data, only fluxes.

Conversion of data into fluxes and energy channels available

According to the energy channels available in the data, the energy channels put in the CDF files are:

Electrons	Protons
Energy (MeV)	Energy (MeV)
FEDO 2.6-5.1	FPIO >0.43
FEDO 5.1-8.0	FPIO > 1.8
FEDO 8.0-12.0	FPIO >3.0

Thus, data have been converted into differential and integral omni directional fluxes, in $cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}$ such as:

$$\text{FEDO } (cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}) = \frac{flux(cm^{-2}.s^{-1}.sr^{-1})}{\Delta E(MeV)} \quad \text{and} \quad \text{FPIO } (cm^{-2}.sr^{-1}.s^{-1}) = \text{flux}$$

Remark: As mentioned in the description file of the data, LD1 rate gives the nominal > 0.43 MeV proton flux. Heavy ions, such as oxygen and sulphur, are also detected but their contribution is believed to be relatively small. Due to this heavy ions detection, a correction has to be applied. The true flux F[t] can be calculated from the data:

$$F[t] = \frac{F}{1 - 1.26.10^{-4} F}$$

and corrections are small for F < 1000 $cm^{-2}.s^{-1}$.

Time and spatial coverage available
The time coverage of the available data and consequently of the CDF files is from 1979/02/28 to 1979/03/16. This period corresponds to a spatial coverage from 80 Rj to the closest approach (4.89 Rj) during the inbound and from the closest approach to 180 Rj during the outbound.

Temporal resolution
The temporal resolution of the data is 15 minutes during the Jupiter encounter.

4.3. Trajectory data

In order to obtain the position of the satellite along its trajectory in the Jovian magnetosphere, two kinds of files have been used.
The first batch of files comes from Fundamental Technologies Voyager LECP Pages at the following address: http://data.ftecs.com/archive/voyager_lecp/SEDR/CSV_SEDR/v1_jup/cor_files/ under the form "V179DDDCOR.CSV" (with DDD the day of year). The format of these files is described at:
http://data.ftecs.com/archive/voyager_lecp/SEDR/CSV_SEDR/v1_jup/JUPITERSEDRNAV.CSV
These files contain Voyager 1 position in many coordinates systems of which the SIII (1965-LH) coordinate system.
The second batch of files completes the first one and is available on Planetary Data System Website at: http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=VG_1501&folder=DATA/EPHEM/S3&style=full under the form "SPICEDDD.TAB" (with DDD the day of year). The format of these files is described at the same address in the file "SPICES3.FMT". As previously, these files contain Voyager 1 position in SIII (1965-LH) coordinate system.
Magnetic parameters linked to the position of the spacecraft (L, B, Beq,…) have been calculated with a library developed at ONERA and using Khurana magnetic field model [2].

5. VOYAGER 2

5.1. Voyager 2/LECP (Low Energy Charged Particle)

For a description of the LECP instrument, see [9].

Data source and data format
The VOYAGER_2/LECP data measured during the Jupiter encounter are available on the Fundamental Technologies Voyager LECP Pages at
http://data.ftecs.com/archive/voyager_lecp/Voyager_2_Data/V2_1979/.
The data are stored in 35 ASCII table files (.CSV) named "*V179DDDGSGG.CSV*", according to the detector where they come from (GG), for each day of the year 1979 (DDD).

The data files contain count rates (s^{-1}) measured by the several detectors constituting LECP instrument and the uncertainties associated to each rate. Each acquisition time in the files corresponds to an angular sector of measurements (from 1 to 8), due to the fact that the main detector looks within a single scan plane that is rotated 360°, stopping at 8 different look sectors.

The particles measured by LECP and the geometrical factor associated are described in the file at the following addresses: http://voyager.ftecs.com/calibrations-chandefs/v2newgen.html

Count rates

All LECP data are count rates data in (s^{-1}). Thus Count CDF files exist for this instrument and content all the count rates data defined below:

- Electrons 0.013-0.035 MeV
- Electrons 0.035-0.061 MeV
- Electrons 0.061-0.112 MeV
- Electrons 0.112-0.183 MeV
- Electrons 0.183-0.5 MeV
- Electrons > 0.013 MeV
- Electrons > 0.037 MeV
- Electrons > 0.061 MeV
- Electrons > 0.112 MeV
- Electrons > 0.183 MeV
- Electrons > 0.252 MeV
- Electrons > 0.48 MeV
- Electrons > 0.853 MeV
- Electrons > 2.1 MeV
- Protons 0.024-0.048 MeV
- Protons 0.048-0.080 MeV
- Protons 0.080-0.137 MeV
- Protons 0.137-0.215 MeV
- Protons 0.215-0.54 MeV
- Protons 0.54-0.99 MeV
- Protons 0.99-2.14 MeV
- Protons 2.14-3.5 MeV
- Alphas 1.040-1.85 MeV
- Alphas 1.85-3.7 MeV

Conversion of data into fluxes and energy channels available

According to the energy channels available in the data and the information on geometrical factors we dispose, the energy channels put in the CDF files are:

Electrons		**Protons**		**Alphas**	
Energy (MeV)	GEF (cm^2sr)	Energy (MeV)	GEF (cm^2sr)	*Energy (MeV/Nuc)*	GEF (cm^2sr)
FEDO 0.013-0.035	0.006	FPDO 0.024-0.048	0.12	FADO 1.040-1.85	0.12
FEDO 0.035-0.061	0.006	FPDO 0.048-0.080	0.12	FADO 1.85-3.7	0.12
FEDO 0.061-0.112	0.006	FPDO 0.080-0.137	0.12		
FEDO 0.112-0.183	0.006	FPDO 0.137-0.215	0.12		
FEDO 0.183-0.5	0.006	FPDO 0.215-0.54	0.12		
FEIO >0.013	0.00012	FPDO 0.54-0.99	0.12		
FEIO >0.037	0.00012	FPDO 0.99-2.14	0.12		
FEIO >0.061	0.00012	FPDO 2.14-3.5	0.12		
FEIO >0.112	0.00012				
FEIO > 0.183	0.00012				
FEIO >0.252	0.002				
FEIO >0.48	0.002				
FEIO >0.853	0.002				
FEIO >2.1	0.002				

Being given it is very difficult to determine an easy link between the angular sectors looked by the detector and indicated in the data files and the pitch angle of the particles measured, we have decided to calculate a sector-averaged count rates and to convert this average into fluxes. The sector-averaged is calculated only if there are 75 % of the 8 sectors and if uncertainty associated to each count rate is lower than the count rate.

Thus, data have been converted into differential omni directional fluxes, in $cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}$ such as:

$$\text{FEDO or FPDO or FADO } (cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}) = \frac{countrates(s^{-1})}{GEF(cm^2 sr).\Delta E(MeV)}$$

Time and spatial coverage available
The time coverage of the available data and consequently of the CDF files is from 1979/06/17 to 1979/10/10. This period corresponds to a spatial coverage from 265 Rj to the closest approach (4.89 Rj) during the inbound and from the closest approach to 300 Rj during the outbound.

Temporal resolution
The temporal resolution of the data is less than 2 minutes during the closest approach until more than 5 minutes at the beginning or at the end of the time period studied.

5.2. Voyager 2/CRS (Cosmic Ray Subsystem)

For a description of the CRS instrument, see [10][11]

Data source and data format
The VOYAGER_2/CRS data measured during the Jupiter encounter are available on the Planetary Data System website at http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=VG_1502&folder=DATA/CRS&style=full.
The content of the data files is described in "VG1_JUP_CRS_DS.CAT" at http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=VG_1501&folder=CATALOG&style=full.

According to the data set overview done in the description file mentioned above, 7 ASCII files, corresponding to different detectors are available and interesting:

- "BS2EDAT.TAB"
- "BS3EDAT.TAB"
- "BS4EDAT.TAB"
- "FPHADAT.TAB"
- "LD1DAT.TAB"
- "LDDAT.TAB"
- "LDTRPDAT.TAB"

The data files contain fluxes ($cm^{-2}.sr^{-1}.s^{-1}$) measured by the several detectors constituting CRS instrument and the uncertainty associated to each flux.

Count rates
There are no count rates in these data, only fluxes.

Conversion of data into fluxes and energy channels available
According to the energy channels available in the data, the energy channels put in the CDF files are:

Electrons	Protons
Energy (MeV)	Energy (MeV)
FEDO 2.6-5.1	FPIO >0.43
FEDO 5.1-8.0	FPIO >1.8
FEDO 8.0-12.0	FPIO >3.0

Thus, data have been converted into differential and integral omnidirectional fluxes, in $cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}$ such as:

FEDO or FPDO ($cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}$) = $\frac{flux(cm^{-2}.s^{-1}.sr^{-1})}{\Delta E(MeV)}$ and FPIO ($cm^{-2}.sr^{-1}.s^{-1}$) = flux

Remark: As mentioned in the description file of the data, LD1 rate gives the nominal > 0.43 MeV proton flux. Heavy ions, such as oxygen and sulphur, are also detected but their contribution is believed to be relatively small. Due to this heavy ions detection, a correction has to be applied. The true flux F[t] can be calculated from the data:

$$F[t] = \frac{F}{1 - 1.26.10^{-4} F}$$

and corrections are small for F < 1000 $cm^{-2}.s^{-1}$.

Time and spatial coverage available

The time coverage of the available data and consequently of the CDF files is from 1979/07/03 to 1979/08/03. This period corresponds to a spatial coverage from 94 Rj to the closest approach (10.1 Rj) during the inbound and from the closest approach to 286 Rj during the outbound.

Temporal resolution

The temporal resolution of the data is 15 minutes during the Jupiter encounter.

5.3. Trajectory data

In order to obtain the position of the satellite along its trajectory in the Jovian magnetosphere, two kinds of files have been used.

The first batch of files comes from Fundamental Technologies Voyager LECP Pages at the following address: http://data.ftecs.com/archive/voyager_lecp/SEDR/CSV_SEDR/v2_jup/ under the form "V279DDD.CSV" (with DDD the day of year). The format of these files is described at:
http://data.ftecs.com/archive/voyager_lecp/SEDR/CSV_SEDR/v2_jup/JUPITERSEDRNAV.CSV
These files contain Voyager 1 position in many coordinates systems of which the SIII (1965-LH) coordinate system.

The second batch of files completes the first one and is available on Planetary Data System Website at: http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=VG_1502&folder=DATA/TRAJECT&style=full under the form "SPICE_S3_48S.TAB" (with DDD the day of year). The format of these files is described at the same address in the file "SPICE_S3_48S.LBL". As previously, these files contain Voyager 2 position in SIII (1965-LH) coordinate system (radial distance, latitude, east longitude).
Magnetic parameters linked to the position of the spacecraft (L, B, Beq,…) have been calculated with a library developed at ONERA and using Khurana magnetic field model [2].

6. ULYSSES

6.1. Ulysses/EPAC (Energetic PArticle Composition)

For a description of the EPAC instrument, see [12].

Data source and data format

The ULYSSES/EPAC data measured during the Jupiter encounter are available on an ESA website:
http://helio.estec.esa.nl/ulysses/ftp/data/epac/

According to the User Notes found on the same website, 3 ASCII files, corresponding to omnidirectional fluxes measured by different detectors are available and interesting:

- "ulykep-1992-el.dat"
- "ulykep-1992-er.dat"
- "ulykep-1992-op.dat"

The first and the last data files contain fluxes in $cm^{-2}.sr^{-1}.s^{-1}$ for integrated channels and in $cm^{-2}.sr^{-1}.s^{-1}$. keV^{-1} for differential channels. The second data file contains count rates in s^{-1}, which has to be converted in flux by using the geometric factor 0.08 cm².sr [12]. Moreover, the three ASCII files referenced above have not the same time resolution and it is not constant during the trajectory of the spacecraft. There are some time periods with high time resolution (128 s, 256 s and 512 s according to the detector) and other time periods with lower time resolution (256 s, 512 s and 1024 s according to the detector). Consequently, it has been decided to homogenize the time resolution in the Ulysses/EPAC CDF data and the time resolution of 512 s and 1024 s according to the time period (high or low resolution) have been chosen.

Count Rates

Only electron channels are available in count rates. Thus Count CDF files contain two electrons channels defined such as:

- Electrons 0.-0.38 MeV
- Electrons > 0.18 MeV

Conversion of data into fluxes and energy channels available

According to the energy channels available in the data, the energy channels put in the CDF files are:

Electrons	Protons
Energy (MeV)	Energy (MeV)
FEDO 0.1-0.38 FEIO > 0.18	FPDO 0.52-1.423 FPIO > 0.43

Thus, some data have been converted from count rates into differential and integral omni directional fluxes such as:

$$\text{FEDO } (cm^{-2}.sr^{-1}.s^{-1}.MeV^{-1}) = \frac{count\ rate(s^{-1})}{\Delta E(MeV).GEF(cm^2 sr)} \quad \text{and} \quad \text{FEIO } (cm^{-2}.sr^{-1}.s^{-1}) = \frac{count\ rate(s^{-1})}{GEF(cm^2 sr)}$$

Time and spatial coverage available

The time coverage of the available data and consequently of the CDF files is from 1992/02/03 to 1992/02/13. This period corresponds to a spatial coverage from 108 Rj to the closest approach (6 Rj) during the inbound and from the closest approach to 108 Rj during the outbound.

Temporal resolution

The temporal resolution of the data is 512 seconds or 1024 seconds during the Jupiter encounter.

6.2. Ulysses/COSPIN (COSmic ray and Solar Particle Investigation)

For a description of the COSPIN instrument, see [13].

Data source and data format
The ULYSSES/COSPIN data measured during the Jupiter encounter are available on an ESA website: http://helio.estec.esa.nl/ulysses/ftp/data/cospin/

According to the User Notes found on the same website, data coming from 5 different detectors (AT, HET, HFT, KET, LET) are available and interesting. These data are regrouped in ASCII files, with one file per day and per detector, such as:

- "ucosat2r92doy.uly" (doy = day of year)
- "ucoshetr92doy.uly"
- "ucoshfta92doy.uly"
- "ucosletr92doy.uly"
- "ucosketr92doy.uly"

The difficulty with these data coming from several detectors is that the format of these ASCII files is not the same. Indeed, some of them contain count rates (s^{-1}) while other files contain fluxes ($cm^{-2}.sr^{-1}.s^{-1}$).

Count Rates
Only channels coming from HET and KET are in count rates (s^{-1}). Thus only these data can be put into Count CDF files. These channels are:

Electrons	Protons	Alphas	Ions
Energy (MeV)	Energy (MeV)	Energy (MeV/Nuc)	Energy (MeV)
(KET) K11 : > 7	(KET) P4: > 5.4	(KET) K2: > 6	(HET) H10: 26-36
(KET) H9: > 16 *	(KET) K3: > 34.1	(KET) K33: > 34.2	(HET) H11: 44-127
(KET) K32: > 170	(HET) H9: > 92 *	(KET) K29: > 125	(HET) H12: 127-173
(HET) H1: 0.35-1.0	(KET) K34: > 125	(KET) K31: > 320	(HET) H13: >173
(HET) H6: 1.0-3.0	(KET) K12: > 320	(KET) K30: > 2100	
(HET) E4: 2.5-7.0	(KET) K10: > 2100		
(HET) H8: 3.0-5.0	(KET) K1: 2.7-5.4		
(HET) H3: 3.0-5.0*	(HET) H1: 5-14 *		
(HET) H7: 5.0-10.0	(HET) H2: 14-19		
(HET) H4: 5.0-10.0*	(HET) H3: 24-31 *		
(HET) H5: 10.0-16.0*	(HET) H4: 34-68 *		
	(HET) H5: 68-92 *		

Conversion of data into fluxes and energy channels available
According to the User Notes of HET telescope found on the ESA website (http://helio.estec.esa.nl/ulysses), we know that some protons channels are also sensitive to electrons. Consequently, in the CDF files, these channels have been duplicated in proton channels in one hand and electron channels in another hand. In the data analysis, we will conclude if these channels measured proton or electron.

According to the energy channels available in the data, the energy channels put in the flux CDF files are (the * indicate the duplicated channels):

Electrons	Protons	Alphas	Ions
Energy (MeV)	Energy (MeV)	Energy (MeV/Nuc)	Energy (MeV)
(KET) FEIO > 7	(HFT) FPIO > 0.28	(HFT) FAIO > 0.31	(HET) FIIO >173
(HET) FEIO > 16 *	(HFT) FPIO > 0.29	(HFT) FAIO > 0.38	
(KET) FEIO > 170	(HFT) FPIO > 0.5	(HFT) FAIO > 0.45	(HET) FIDO 26-36
	(HFT) FPIO > 0.55	(HFT) FAIO > 0.51	(HET) FIDO 44-127
(LET) FEDO 0.3-1.0 *	(HFT) FPIO > 0.76	(HFT) FAIO > 0.58	(HET) FIDO 127-173
(HET) FEDO 0.35-1.0	(KET) FPIO > 5.4	(KET) FAIO > 6	
(HET) FEDO 1.0-3.0	(KET) FPIO > 34.1	(KET) FAIO > 34.2	
(KET) FEDO 2.5-7.0	(HET) FPIO > 92 *	(KET) FAIO > 125	
(HET) FEDO 3.0-5.0	(KET) FPIO > 125	(KET) FAIO > 320	
(HET) FEDO 3.0-5.0*	(KET) FPIO > 320	(KET) FAIO > 2100	
(HET) FEDO 5.0-10.0	(KET) FPIO > 2100		
(HET) FEDO 5.0-10.0*		(HFT) FADO 0.64-1.66	
(HET) FEDO 10.0-16.0*	(AT) FPDO 0.7-0.9	(HFT) FADO 0.68-1.56	
	(LET) FPDO 0.9-1.2	(HFT) FADO 0.71-1.5	
	(AT) FPDO 0.9-1.3	(HFT) FADO 0.78-1.35	
	(LET) FPDO 1.2-3.0	(HFT) FADO 0.85-1.25	
	(AT) FPDO 1.3-2.2	(HFT) FADO 0.91-1.17	
	(LET) FPDO 1.8-3.8	(HFT) FADO 0.98-1.12	
	(AT) FPDO 2.2-3.6	(LET) FADO 1.0-5.0	
	(KET) FPDO 2.7-5.4	(LET) FADO 1.9-3.7	
	(AT) FPDO 3.6-6.5	(AT) FADO 3.1-7.2	
	(LET) FPDO 3.8-8.0	(LET) FADO 3.7-8.4	
	(HET) FPDO 5-14 *		
	(LET) FPDO 8-19		
	(HET) FPDO 14-19		
	(HET) FPDO 24-31 *		
	(HET) FPDO 34-68 *		
	(HET) FPDO 68-92 *		

Some data have been converted from count rates into differential and integral omnidirectional fluxes using the geometric factors found in the literature:

Electrons	Protons	Alphas	Ions
GEF (cm²sr)	GEF (cm²sr)	GEF (cm²sr)	GEF (cm²sr)
(KET) K11: 0.4	(KET) P4: 6.5	(KET) K2: 6.5	(HET) H10: 87
(KET) H9: 3.6	(KET) K3: 0.72	(KET) K33: 0.72	(HET) H11: 16.2-5.5
(KET) K32: 0.38	(HET) H9: 3.6	(KET) K29: 1.0	(HET) H12: 5.2-3.6
(HET) H1: 94.0	(KET) K34: 1.2	(KET) K31: 1.4	(HET) H13: 3.6
(HET) H6: 87.0	(KET) K12: 1.7	(KET) K30: 1.4	
(HET) E4: 0.26	(KET) K10: 1.7		
(HET) H8: 16.2-14.9	(KET) K1: 6.5		
(HET) H3: 16.2-14.9	(HET) H1: 94.0		
(HET) H7: 8.2-5.5	(HET) H2: 87.0		
(HET) H4: 8.2-5.5	(HET) H3: 16.2-14.9		
(HET) H5: 10.0-16.0*	(HET) H4: 8.2-5.5		
	(HET) H5: 5.2-3.6		

Note that when two values of GEF are mentioned for a channel, the mean of the two values have been used in the conversion of counts to flux.

Time and spatial coverage available
The time coverage of the available data and consequently of the CDF files is from 1992/02/03 to 1992/02/13. This period corresponds to a spatial coverage from 108 Rj to the closest approach (6 Rj) during the inbound and from the closest approach to 108 Rj during the outbound.

Temporal resolution
The temporal resolution of the data is 10 minutes during the Jupiter encounter.

6.3. Trajectory data

There is no position data available in the ASCII files described above. Thus, in order to obtain the position of the satellite at each time of EPAC measurements for the while time period mentioned above, we have used an ephemeris file SPK28_45.TAB found on Planetary Data System website at the following address: http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=ULY_5001&folder=DATA/EPHEM&file=SPK28_45
This file contains Ulysses position in SIII coordinate system in terms of radial distance, latitude and west longitude. From this ephemeris file, we are able to calculate the position of Ulysses at each acquisition time of EPAC by interpolating.
Magnetic parameters linked to the position of the spacecraft (L, B, Beq,…) have been calculated with a library developed at ONERA and using Khurana magnetic field model [2].

7. GALILEO

7.1. Galileo/HIC

For a description of the HIC instrument, see [14].

Data source and data format
The GALILEO/HIC data measured during the Jupiter encounter are available on PDS website:
http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=GOMW_5001&folder=DATA/HIC/COMPOSITION&style=full
Three ASCII files are available, one for each species measured by the instrument:

- “CARBON.TAB”
- “OXYGEN.TAB”
- “SULFUR.TAB”

These data files contain fluxes in $cm^{-2}.sr^{-1}.s^{-1}$. In order to obtain differential fluxes in $cm^{-2}.sr^{-1}.s^{-1}.(MeV/Nuc)^{-1}$, which is the unit of the ions flux in the CDF files, we have divided by ΔE for each energy channel.

Energy channels available

According to the energy channels available in the data, the energy channels put in the CDF files are:

Carbon	Oxygen	Sulfur
Energy (MeV/Nuc)	Energy (MeV)	Energy (MeV/Nuc)
FIDO 1.51-3.65	FIDO 2.4-4.8	FIDO 2.65-6.08
FIDO 3.65-5.08	FIDO 4.8-6.5	FIDO 6.08-8.36
FIDO 5.08-15.0	FIDO 6.4-17.5	FIDO 8.36-24.22
FIDO 14.55-15.45	FIDO 17-18	FIDO 23.5-24.93
FIDO 15.45-20.8	FIDO 18-24	FIDO 24.93-33.51
FIDO 16.18-42.27	FIDO 30-48	FIDO 42.08-67.8
FIDO 16.18-42.27	FIDO 30-48	FIDO 42.08-67.8
FIDO 42.27-164.75	FIDO 48-185	FIDO 67.8-263.51
FIDO 42.27-164.75	FIDO 48-185	FIDO 67.8-263.51

Time coverage

The time coverage of the available data and consequently of the CDF files is from 1995/12/07 to 2002/11/04 with very sporadic data (only 55 measurements for all this time period).

7.2. Trajectory data

There is no position data available in the ASCII files described above. Thus, in order to obtain the position of the satellite for the while time period mentioned above, we have used ephemeris files found on Planetary Data System website at the following address: http://www.igpp.ucla.edu/cgi-bin/ditdos?volume=GOMW_5001&folder=DATA/TRAJECT/SURVEY&style=full

This file contains Galileo position in SIII coordinate system in terms of radial distance, latitude and west longitude.

Magnetic parameters linked to the position of the spacecraft (L, B, Beq,…) have been calculated with a library developed at ONERA and using Khurana magnetic field model [2].

8. REFERENCES

[1] S. Bourdarie and D. Boscher,

Radiation environment research from multiple monitors (RERMM),

Technical Note 300 (TN300) - ISSUE 1.0, ESA/ESTEC Contract No.16709/02/NL/EC, 2006.

[2] K. Khurana and H.K. Schwarzl,

Global structure of Jupiter's magnetospheric current sheet,

Journal of Geophysical Research, vol. 110, A07227, doi: 10.1029/2004JA010757, 2005.

[3] P.K. Seidelman and N. Devine,

Evaluation of Jupiter Longitudes in System III(1965),

Geophysical Research Letters, 4, 65-68, 1977.

[4] D.N. Baker and J.A. Van Allen,

Energetic Electrons in the Jovian Magnetosphere,

Journal of Geophysical Research, vol. 81, pp 617-632, 1976.

[5] D.N. Baker and J.A. Van Allen,

Revised Pioneer 10 Absolute Electron Intensities in the Inner Jovian Magnetosphere,

Journal of Geophysical Research, vol. 82, pp 681-683, 1977.

[6] J.A. Van Allen, B.A. Randall, D.N. Baker, C.K. Goertz, D.D. Sentman, M.F. Thomsen, H.R. Flindt,

Pioneer 11 Observations of Energetic Particles in the Jovian Magnetosphere,

Science, vol. 188, pp 459-462, 1975.

[7] J.A. Simpson, D.C. Hamilton, R.B. McKibben, A.Mogro-Campero, K.R. Pyle, and A.J. Tuzzolino,

The Protons and Electrons Trapped in the Jovian Dipole Magnetic Field Region and Their Interaction with Io,

Journal of Geophysical Research, vol. 79, pp 3522-3544, 1974.

[8] J.H. Trainor, F.B. McDonald, B.J. Teegarden, W.R. Webber, E.C. Roelof,

Energetic Particles in the Jovian Magnetosphere,

Journal of Geophysical Research, vol. 79, pp 3600-3613, 1974.

[9] S.M. Krimigis, T.P. Armstrong, W. Axford, C.O. Bostrom, C.Y. Fan, G. Gloeckler, and L.J. Lanzerotti,

The low energy charged particle (LECP) experiment on the Voyager spacecraft,

Space Science Review, vol. 21, pp 329-354, 1977.

[10] E.C. Stone, R.E. Vogt, F.B. McDonald, B.J. Teegarden, J.H. Trainor, J.R. Jokipii and W.R. Webber,

Cosmic ray investigation for the Voyager missions; energetic particle studies in the outer heliosphere—and beyond,

Space Science Review, vol. 21, pp 355-376, 1977.

[11] D.E. Stiwell, W.D. Davis, R.M. Joyce, F.B. McDonald, J.H. Trainor, W.E. Athouse, A.C. Cummingd, T.L. Garrard, E.C. Stone, and R.E. Vogt,

The Voyager Cosmic Ray Experiment,

IEEE Trans. On Nuclear Science, vol. 26, pp 513-520, 1979.

[12] E. Keppler, J.B. Blake, D. Hovestadt, A. Korth, J. Quenby, G. Umlauft and J. Woch,

The ULYSSES energetic particle composition experiment EPAC,

Astronomy & Astrophysics Supplement, vol. 92, p 317-331, 1992.

[13] J.A. Simpson, J.D. Anglin, A. Balogh, M. Bercovitch, J.M. Bouman, E.E. Budzinski, J.R. Burrows, R. Carvell, J.J. Connell, R. Ducros, P. Ferrando, J. Firth, M. Garcia-Munoz, J. Henrion, R.J. Hynds, B. Iwers, R. Jacquet, H. Kunow, G. Lentz, R.G. Marsden, R.B. McKibben, R. Mueller-Mellin, K.-P. Wenzel and G. Wibberenz,

The ULYSSES cosmic ray and solar particle investigation,

Astronomy & Astrophysics Supplement, vol. 92, p 365-399, 1992.

[14] T.L. Garrard, N. Gehrels and E.C. Stone,

The Galileo Heavy Element Monitor,

Space Science Reviews 60, pp 305-315, 1992.