

Standard file format guidelines

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I. Introduction

The purpose of this document is to provide guidelines to produce standard radiation belt files to facilitate data exchange between different groups involved in the field and tools development that will use these data sets.

Data acquired in different countries/institutes/agencies are usually stored in various format (cdf, hdf, ascii, binary, idl saveset, ...) more or less exotic with no standard header, information, description ... This current status makes life difficult to cross-compare different data sets (it is always necessary to develop dedicated routines usually done several times throughout the world, ...).

Guidelines is needed from the worldwide community of developers of space radiation data bases to permit standardization of data file format and therefore minimise efforts for data user's.

II. File format

An easy to use and flexible file format must be selected. To include data as well as relevant informations attached to the data, self described file format are the most convenient. One widely used by now is cdf (Common Data File). We then strongly suggest to follow ISTP/IACG guidelines (<http://cdf.gsfc.nasa.gov/>). In this section we recall what those guidelines are and we add one more layer to ensure that any cdf file produced will be done along the same philosophy. We concentrate here only on particles measurements in space. Note that all text in italic originates from the NASA ISTP web site: .



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A CDF data set using ISTP/IACG guidelines, by definition forms a logically complete and self-sufficient whole (data and descriptions). The goal is to make the resulting CDF data set correctly and independently usable by the science community. These guidelines have been adopted by a wide SEC community (<http://pwg.gsfc.nasa.gov/istp/collaborating/>).

A CDF file is composed of global attributes which provide descriptions of the whole data set. Then variables have to be defined as well as their attributes.

II.1 File naming convention

The ISTP file naming convention is the following:



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- One file per day is generated
- The file name has to be like:
 SPACECRAFT_**_INSTRUMENT_yyyymmdd_V++.cdf where:
 - o SPACECRAFT is the name of the spacecraft in capital letters
 - o ** can either be "Hn>High Resolution data" for certified data of higher resolution than Key Parameters. n can run from 0 to 9 to allow for more than one kind of data product. For Cluster/CSDS this can either be "SP>Summary Parameter" or "PP>Prime Parameter". Other possible data types may be defined in future. If any of these data sets are modified or used to produce derived products, the data type should be, e.g., "Mn>Modified Data n", where n is from 0 to 9.
 - o INSTRUMENT is the name of the instrument in capital letters
 - o yyyy being the year
 - o mm being two digit month (integer)
 - o dd being two digit day of month
 - o ++ indicates the file version number (two digits) and can run from 00 to 99!

II.2 Global attributes

Global attributes are used to provide information about the data set as an entity. Together with variables and variable attributes, the global attributes make the data correctly and independently usable by someone not connected with the instrument team, and hence, a good archive product. The global attributes can also be used by any software, one popular example being the CDAWeb Display and Retrieval system (<http://cdaweb.gsfc.nasa.gov/cdaweb/>).

The required Global Attributes are listed here with example values. Note that CDF attributes are case-sensitive and must **exactly** follow what is shown here.

| ATTRIBUTE | EXAMPLE VALUE |
|------------------------------|---|
| "Project" | { "ISTP>International " - "Solar-Terrestrial Physics" }. |
| "Source_name" | { "GEOTAIL>Geomagnetic Tail" }. |
| "Discipline" | { "Space Physics>Magnetospheric Science" }. |
| "Data_type" | { "H0>High time resolution" }. |
| "Descriptor" | { "EPI>Energetic Particles" - " and Ion Composition" }. |
| "Data_version" | { "1" }. |
| "Logical_file_id" | { "GE_H0_EPI_19920908_V01" }. |
| "PI_name" | { "D. Williams" }. |
| "PI_affiliation" | { "JHU/APL" }. |
| "TEXT" | { "reference to journal article, URL address" }. |
| "Instrument_type" | { "Magnetic Fields (space)" }. |
| "Mission_group" | { "Geotail" }. |
| "Logical_source" | { "GE_H0_EPI" }. |
| "Logical_source_description" | { "Geotail Magnetic Field Key Parameters" }. |

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The Global Attribute Definitions are provided below in alphabetical order

Acknowledgement--- recommended

Text string at PI disposal allowing for information on expected acknowledgment if data is citable.

ADID_ref --- recommended

This attribute stores the control authority identifier associated with the detached SFDU label. If no control authority identifier has been assigned, then the identifier associated with the ISTP/IACG Guidelines (NSSD0241) or with CDF (NSSD0110) can be used.

Data_type --- required

This attribute identifies the data type of the CDF data set. Both a long name and a short name are given. For ISTP exchangeable data products the values are "Kn>Key Parameter" for approximately minute averaged survey data, and "Hn>High Resolution data" for certified data of higher resolution than Key Parameters. \$n\$ can run from 0 to 9 to allow for more than one kind of data product. For Cluster/CSDS this can either be "SP>Summary Parameter" or "PP>Prime Parameter". Other possible data types may be defined in future. If any of these data sets are modified or used to produce derived products, the data type should be, e.g., "Mn>Modified Data n", where n is from 0 to 9.

Data_version --- required

*This attribute identifies the version of a particular CDF data file for a given date, e.g., the file POLAR_H0_CEPPAD_19960923_V01 is the first version of data for 1996 September 23. **Each time** this particular data file is reproduced - for recalibration or other reasons - the Data_version is incremented by 1. Data_version always starts at `1'.*

Descriptor --- required

This attribute identifies the name of the instrument or sensor that collected the data. Both a long name and a short name are given. An example for ISTP is "EPI>Energetic Particles and Ion Composition". The short name should be limited to from 2 to 4 characters for consistency with ISTP. This attribute should be single valued.

Discipline --- required

This attribute describes both the science discipline and subdiscipline. More than one entry is allowed. The list for space physics is:

- "Space Physics>Magnetospheric Science"
- "Space Physics>Interplanetary Studies"

Generated_by --- recommended

This attribute allows for the generating data center/group to be identified.

Generation_date --- recommended

Date stamps the creation of the file using the syntax yyyyymmdd, e.g., "19920923". This is distinct from the date in "validate" below which records the times of later validation processes.

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HTTP_LINK, LINK_TEXT and LINK_TITLE --- recommended

This attribute stores the URL for the PI or CoI web site holding on-line data. This attribute is used in conjunction with "LINK_TEXT" and "LINK_TITLE". There can be up to 5 entries for each - there **MUST** be a corresponding entry of "LINK_TEXT" and "LINK_TITLE" for each "HTTP_LINK" entry. As an example CDAWeb will then link to the URL given by "HTTP_LINK" using the "LINK_TITLE" and the description in "LINK_TEXT", on the CDAWeb Data Explorer page. For example

- "LINK_TEXT" = 3-sec MGF magnetic field 1 Sep 1993 through 30 Sep 1997 available at
- "LINK_TITLE" = ISAS DARTS
- "HTTP_LINK" = <http://www.darts.isas.ac.jp/spdb/index.html>

will give the following link:

3-sec MGF magnetic field 1 Sep 1993 through 30 Sep 1997 available at ISAS DARTS

Instrument_type --- required

This attribute is used to facilitate making choices of instrument type. More than one entry is allowed. The following list contains the valid values.

- Particles (space)
- Plasma and Solar Wind

Logical_file_id --- required

This attribute stores the name of the CDF file using the ISTP naming convention (source_name / data_type / descriptor / date / data_version), e.g., POLAR_H0_CEPPAD_19960923_V01. This attribute is required (1) to allow storage of the full name on IBM PCs, and (2) to avoid loss of the original source in the case of accidental (or intentional) renaming. For CDFs created on the ISTP CDHF, the correct Logical_file_id will be filled in by an ICSS support routine.

Logical_source --- required

This attribute carries source_name, data_type, and descriptor information.

Logical_source_description --- required

This attribute writes out the full words associated with the encrypted Logical_source above, e.g., "POLAR CEPPAD High resolution particle data".

Mission_group --- required

This attribute has a single value and is used to facilitate making choices of source. Valid values include (but are not restricted to) :

- Geotail
- IMP8
- Wind
- Geosynchronous Investigations

MODS --- recommended

This attribute is an NSSDC standard global attribute which is used to denote the history of modifications made to the CDF data set. The MODS attribute should contain a description of



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all significant changes to the data set. This attribute is not directly tied to Data_version, but each version produced will contain the relevant modifications. This attribute can have as many entries as necessary to contain the desired information.

Parents --- optional

This attribute lists the parent CDF(S) for files of derived and merged data sets. Subsequent entry values are used for multiple parents. The syntax for a CDF parent would be e.g. "CDF>logical_file_id".

PI affiliation --- required

This attribute value should include a recognizable abbreviation.

PI name --- required

This attribute value should include first initial and last name.

Project --- required

This attribute identifies the name of the project and indicates ownership. For ISTP missions and investigations, the value used is "ISTP>International Solar-Terrestrial Physics". For the Cluster mission, the value is "STSP Cluster>Solar Terrestrial Science Programmes, Cluster".

Rules of use --- recommended

Text containing information on, e.g. citability and PI access restrictions. This may point to a World Wide Web page specifying the rules of use.

Skeleton version --- optional

This is a text attribute containing the skeleton file version number. This is a required attribute for Cluster, but for IACG purposes it exists if experimenters want to track it.

Software version --- optional

This is a required attribute for Cluster, but for IACG purposes it exists if experimenters want to track it.

Source name --- required

This attribute identifies the mission or investigation that contains the sensors. For ISTP, this is the mission name for spacecraft missions or the investigation name for ground-based or theory investigations. Both a long name and a short name are provided. This attribute should be single valued. Examples:

- "GEOTAIL>Geomagnetic Tail"
- "WIND>Wind Interplanetary Plasma Laboratory"
- "GOES_7>Geostationary Operational Environmental Satellite 7"
- "IMP-8>Interplanetary Monitoring Platform"
- "LANL1989_046>Los Alamos National Laboratory 1989"
- "C1>Cluster Satellite No 1".

TEXT --- required

This attribute is an NSSDC standard global attribute which is a text description of the experiment whose data is included in the CDF. A reference to a journal article(s) or to a World Wide Web page describing the experiment is essential, and constitutes the minimum



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requirement. A written description of the data set is also desirable. This attribute can have as many entries as necessary to contain the desired information.

Time_resolution --- required

specifies time resolution of the file in seconds, e.g., "3 seconds".

TITLE --- optional

This attribute is an NSSDC standard global attribute which is a title for the data set, e.g., "POLAR CEPPAD High Resolution Data".

Validate --- optional

Details to be specified. This attribute is written by software for automatic validation of features such as the structure of the CDF file on a simple pass/fail criterion. The software will test that all expected attributes are present and, where possible, have reasonable values. The syntax is likely to be of the form "test>result>where-done>date". It is not the same as data validation.

II.3 Variables

In this section we define data variables, support_data variables, and metadata variables including their dimensionality and what is needed for their correct display.

*We have identified three types of variables to be included in ISTP/IACG CDF files: **data** variables of primary importance (e.g., `particle_flux`), **support_data** variables of secondary importance (e.g., `time`, `energy_bands` associated with `particle_flux`) and **metadata** variables (e.g., a variable holding "xGEO,yGEO,xGEO" to label spacecraft position). Variables are defined with CDF specifications and required attributes. Data variables also have attached variables for time and dependencies (`support_data`) and labels (`metadata`). The `support_data` variables can be attached to data variables via `DEPEND_i` variable attributes. Metadata variables can be attached to data variables via `LABL_PTR_i` variable attributes (see below).*

NOTE: *ISTP/IACG now encourages the use of zVariables which carry their own dimensionality.*

The complete variable description is provided next.

II.3.1 Data

These are variables of primary importance (e.g., `particle_flux`). Data variables are completely defined with the combination of CDF specifications, variable attributes, and attached variables such as time and dependencies (`support_data`) and labels (`metadata`).

One of the goal of these guidelines is to use the same variable names across spacecraft/instruments to ease data exchange and software development. Note that having the same data type throughout all spacecraft/instrument is highly recommended, i.e. all real variables are CDF_REAL4 and all integer variables are CDF_INT2. This variable types guaranty enough precision for the quantities stored in the cdf files.



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The following CDF variable specifications are required.

Data is always either Real or Integer type. Data is always time (record) varying, but can be of any dimensionality. Real or Integer data are always defined as having one element. In order to not make huge files, requiring large data space or large memory we suggest to use only REAL4 and INT2 data type. This provides enough precision for particle measurements and associated geographic and magnetic parameters.

The following variable attributes are required. See section II.3 for more details.

- *CATDESC*
- *DEPEND_0 = Epoch*
- *DEPEND_i*
- *DISPLAY_TYPE (time_series, spectrogram, stack_plot,image)*
- *FIELDNAM*
- *FILLVAL*
- *FORMAT/FORM_PTR*
- *LABLAXIS/LABL_PTR_i*
- *UNITS/UNIT_PTR*
- *VALIDMIN*
- *VALIDMAX*
- *VAR_TYPE = data*

The need for DEPEND_i (other than DEPEND_0) and either LABLAXIS or LABL_PTR_i depends on the data itself and how it will be displayed.

The list of variables that must be present in cdf files is the following:

- Position: Position is a three-dimensional variable which provide spacecraft position in geographic cartesian coordinates – Units: km. Var type = CDF_REAL4
- B_Calc: Calculated magnetic field strength where the internal field being DGRF/IGRF and the external field being Olson-Pfitzer quiet magnetic field models – Units: nT. Var type = CDF_REAL4
- B_Eq: Calculated magnetic field strength at magnetic equator where the internal field being DGRF/IGRF and the external field being Olson-Pfitzer quiet magnetic field models – Units: nT. Var type = CDF_REAL4
- L: Calculated L McIlwain's L parameter where the internal field being DGRF/IGRF and the external field being Olson-Pfitzer quiet magnetic field models. Var type = CDF_REAL4
- L star: Calculated Roederer's L* parameter where the internal field being DGRF/IGRF and the external field being Olson-Pfitzer quiet magnetic field models. Var type = CDF_REAL4
- I: Calculated adiabatic invariant (second invariant) where the internal field being DGRF/IGRF and the external field being Olson-Pfitzer quiet magnetic field models. Var type = CDF_REAL4
- MLT: Calculated Magnetic Local Time – Units: hours. Var type = CDF_REAL4



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- Alpha: Local pitch angle the instrument is looking at (often assume to be 90° for large viewing angle – omni-directional instrument) – Units: degrees. Var type = CDF_REAL4
- Alpha Eq: Computed equatorial pitch angle the instrument is looking from Alpha, B_Calc and B_Eq – Units: degrees. Var type = CDF_REAL4

Now depending on what the instrument is measuring the following variables described next have to be present. Note that if directional fluxes are available omni-directional fluxes should

be added and computed from directional fluxes: $J = \frac{\int_0^{\pi} j \cdot \sin \alpha \cdot d\alpha}{\int_0^{\pi} \sin \alpha \cdot d\alpha}$, the resulting omni-flux

being per-steradian to ease inter-comparisons with others instruments which have different field of view.

- FPDO: Omni-directional Differential Proton Flux – units: MeV⁻¹ cm⁻² s⁻¹ sr⁻¹. Var type = CDF_REAL4
- FPIO: Omni-directional Integral Proton Flux – units: cm⁻² s⁻¹ sr⁻¹. Var type = CDF_REAL4
- FEDO: Omni-directional Differential Electron Flux – units: MeV⁻¹ cm⁻² s⁻¹ sr⁻¹. Var type = CDF_REAL4
- FEIO: Omni-directional Integral Electron Flux – units: cm⁻² s⁻¹ sr⁻¹. Var type = CDF_REAL4
- FADO: Omni-directional Differential Alpha Flux – units: MeV⁻¹ cm⁻² s⁻¹ sr⁻¹. Var type = CDF_REAL4
- FAIO: Omni-directional Integral Alpha Flux – units: cm⁻² s⁻¹ sr⁻¹. Var type = CDF_REAL4
- FIDO: Omni-directional Differential Heavy Ion Flux – units: MeV⁻¹ cm⁻² s⁻¹ sr⁻¹. Var type = CDF_REAL4
- FIIO: Omni-directional Integral Heavy Ion Flux – units: cm⁻² s⁻¹ sr⁻¹. Var type = CDF_REAL4
- FPDU: Directional Differential Proton Flux – units: MeV⁻¹ cm⁻² s⁻¹ sr⁻¹. Var type = CDF_REAL4
- FPIU: Directional Integral Proton Flux – units: cm⁻² s⁻¹ sr⁻¹. Var type = CDF_REAL4
- FEDU: Directional Differential Electron Flux – units: MeV⁻¹ cm⁻² s⁻¹ sr⁻¹. Var type = CDF_REAL4



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- FEIU: Directional Integral Electron Flux – units: $\text{cm}^{-2} \text{s}^{-1} \text{sr}^{-1}$. Var type = CDF_REAL4
- FADU: Directional Differential Alpha Flux – units: $\text{MeV}^{-1} \text{cm}^{-2} \text{s}^{-1} \text{sr}^{-1}$. Var type = CDF_REAL4
- FAIU: Directional Integral Alpha Flux – units: $\text{cm}^{-2} \text{s}^{-1} \text{sr}^{-1}$. Var type = CDF_REAL4
- FIDU: Directional Differential Heavy Ion Flux – units: $\text{MeV}^{-1} \text{cm}^{-2} \text{s}^{-1} \text{sr}^{-1}$. Var type = CDF_REAL4
- FIU: Directional Integral Heavy Ion Flux – units: $\text{cm}^{-2} \text{s}^{-1} \text{sr}^{-1}$. Var type = CDF_REAL4

To make things even more general, flux for any measurements can be provided from a fit function which can depend on several parameters. Then the logic to store such measurements into common cdf file format is only composed of metadata and support data. So in this case the corresponding guidelines are provided in the support data and metadata sections.

II.3.2 Support_Data

These are variables of secondary importance (e.g., time, energy_bands associated with particle_flux, Quality_flags).

The following CDF variable specifications are required.

Support_data is always either Real or Integer type. Support_data is usually time invariant, but can be time varying.

If a support_data variable is attached to a data variable via DEPEND_i, then it must be of the same size as the dimension i. Real or Integer data are always defined as having one element.

The following variable attributes are required.

- CATDESC
- DEPEND_0 = Epoch (if time varying)
- FIELDNAM
- FILLVAL (if time varying)
- FORMAT/FORM_PTR
- UNITS/UNIT_PTR
- VALIDMIN (if time varying)
- VALIDMAX (if time varying)
- VAR_TYPE = support_data

The list of support data that must be present in cdf files is the following:



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- **Epoch:** *"Epoch" should be the first variable in each CDF data set. All time varying variables in the CDF data set will depend on the "Epoch" variable (or on a CDF_EPOCH type variable) - more than one CDF_EPOCH type variable is allowed in a data set to allow for more than one time resolution. For ISTP the time value of a record refers to the center of the accumulation period for the record if the measurement is not an instantaneous one. Epoch allows for a scalar representation of time which provides for seamless crossings of day and year boundaries. Epoch time is simply the time in milliseconds A.D. CDF toolkit programs will display and expect CDF_EPOCH values in the format dd-mmm-yyyy hh:mm:ss.ccc where dd is the day of the month, mmm is the month, yyyy is the year, hh is the hour, mm is the minute, ss is the second and ccc is the millisecond (e.g., 01-Aug-1992 10:30:05.025). "Epoch" will be monotonically increasing so that the attribute MONOTON should be defined as "INCREASE". (Note: All CDF data sets using the Epoch variable should use the subroutines provided in the CDF toolkit for making the conversion between this value and year, month, day, etc. These routines are available as black boxes from NSSDC. To determine Epoch time it is only necessary to call the subroutine compute_Epoch(year, month, day, hour, minute, second, msec, Epoch) with arguments as shown. for making the conversion between this value and year, month, day, etc. This ensures that all users use the same conversion when generating their CDF data sets and will therefore have the same view of the effects of the various calendar changes that have occurred over the last two thousand years.)* . Var type = CDF_EPOCH
- **Position Quality:** Position Quality Flag – time dependent (0 means highest quality, 1 means bad quality) . Var type = CDF_INT2
- **FPDO Energy:** Energy levels for FPDO fluxes – Units: MeV. Var type = CDF_REAL4
- **FPDO Quality:** Quality Flag for FPDO fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2
- **FPDO Crosscalib:** Intercalibration values for FPDO fluxes. Var type = CDF_REAL4
- **FPIO Energy:** Energy levels for FPIO fluxes – Units: MeV. Var type = CDF_REAL4
- **FPIO Quality:** Quality Flag for FPIO fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2
- **FPIO Crosscalib:** Intercalibration values for FPIO fluxes. Var type = CDF_REAL4
- **FEDO Energy:** Energy levels for FEDO fluxes – Units: MeV. Var type = CDF_REAL4
- **FEDO Quality:** Quality Flag for FEDO fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes



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saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2

- FEDO_Crosscalib: Intercalibration values for FEDO fluxes. Var type = CDF_REAL4
- FEIO_Energy: Energy levels for FEIO fluxes – Units: MeV. Var type = CDF_REAL4
- FEIO_Quality: Quality Flag for FEIO fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2
- FEIO_Crosscalib: Intercalibration values for FEIO fluxes. Var type = CDF_REAL4
- FADO_Energy: Energy levels for FADO fluxes – Units: MeV. Var type = CDF_REAL4
- FADO_Quality: Quality Flag for FADO fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2
- FADO_Crosscalib: Intercalibration values for FADO fluxes. Var type = CDF_REAL4
- FAIO_Energy: Energy levels for FAIO fluxes – Units: MeV. Var type = CDF_REAL4
- FAIO_Quality: Quality Flag for FAIO fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2
- FAIO_Crosscalib: Intercalibration values for FAIO fluxes. Var type = CDF_REAL4
- FIDO_Energy: Energy levels for FIDO fluxes – Units: MeV. Var type = CDF_REAL4
- FIDO_Quality: Quality Flag for FIDO fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2
- FIDO_Crosscalib: Intercalibration values for FIDO fluxes. Var type = CDF_REAL4
- FPDU_Energy: Energy levels for FPDU fluxes – Units: MeV. Var type = CDF_REAL4
- FPDU_Alpha: Local pitch-angles for FPDU fluxes – Units: Degree. Var type = CDF_REAL4
- FPDU_Alpha Eq: Equatorial pitch-angles for FPDU fluxes, computed from FPDU_Alpha, B_Calc and B_Eq- Time dependent – Units: Degree. Var type = CDF_REAL4



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- F_{PDU} Quality: Quality Flag for F_{PDU} fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2
- F_{PDU} Crosscalib: Intercalibration values for F_{PDU} fluxes. Var type = CDF_REAL4
- F_{FPU} Energy: Energy levels for F_{FPU} fluxes – Units: MeV. Var type = CDF_REAL4
- F_{FPU} Alpha: Local pitch-angles for F_{FPU} fluxes – Units: Degree. Var type = CDF_REAL4
- F_{FPU} Alpha Eq: Equatorial pitch-angles for F_{FPU} fluxes, computed from F_{FPU} Alpha, B_Calc and B_Eq- Time dependent – Units: Degree. Var type = CDF_REAL4
- F_{FPU} Quality: Quality Flag for F_{FPU} fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2
- F_{FPU} Crosscalib: Intercalibration values for F_{FPU} fluxes. Var type = CDF_REAL4
- F_{FEDU} Energy: Energy levels for F_{FEDU} fluxes – Units: MeV. Var type = CDF_REAL4
- F_{FEDU} Alpha: Local pitch-angles for F_{FEDU} fluxes – Units: Degree. Var type = CDF_REAL4
- F_{FEDU} Alpha Eq: Equatorial pitch-angles for F_{FEDU} fluxes, computed from F_{FEDU} Alpha, B_Calc and B_Eq- Time dependent – Units: Degree. Var type = CDF_REAL4
- F_{FEDU} Quality: Quality Flag for F_{FEDU} fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2
- F_{FEDU} Crosscalib: Intercalibration values for F_{FEDU} fluxes. Var type = CDF_REAL4
- F_{FEIU} Energy: Energy levels for F_{FEIU} fluxes – Units: MeV. Var type = CDF_REAL4
- F_{FEIU} Alpha: Local pitch-angles for F_{FEIU} fluxes – Units: Degree. Var type = CDF_REAL4
- F_{FEIU} Alpha Eq: Equatorial pitch-angles for F_{FEIU} fluxes, computed from F_{FEIU} Alpha, B_Calc and B_Eq- Time dependent – Units: Degree. Var type = CDF_REAL4
- F_{FEIU} Quality: Quality Flag for F_{FEIU} fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes

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saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2

- FEIU_Crosscalib: Intercalibration values for FEIU fluxes. Var type = CDF_REAL4
- FADU_Energy: Energy levels for FADU fluxes – Units: MeV. Var type = CDF_REAL4
- FADU_Alpha: Local pitch-angles for FADU fluxes – Units: Degree. Var type = CDF_REAL4
- FADU_Alpha Eq: Equatorial pitch-angles for FADU fluxes, computed from FADU_Alpha, B_Calc and B_Eq- Time dependent – Units: Degree. Var type = CDF_REAL4
- FADU_Quality: Quality Flag for FADU fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2
- FADU_Crosscalib: Intercalibration values for FADU fluxes. Var type = CDF_REAL4
- FAIU_Energy: Energy levels for FAIU fluxes – Units: MeV. Var type = CDF_REAL4
- FAIU_Alpha: Local pitch-angles for FAIU fluxes – Units: Degree. Var type = CDF_REAL4
- FAIU_Alpha Eq: Equatorial pitch-angles for FAIU fluxes, computed from FAIU_Alpha, B_Calc and B_Eq- Time dependent – Units: Degree. Var type = CDF_REAL4
- FAIU_Quality: Quality Flag for FAIU fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2
- FAIU_Crosscalib: Intercalibration values for FAIU fluxes. Var type = CDF_REAL4
- FIDU_Energy: Energy levels for FIDU fluxes – Units: MeV. Var type = CDF_REAL4
- FIDU_Alpha: Local pitch-angles for FIDU fluxes – Units: Degree. Var type = CDF_REAL4
- FIDU_Alpha Eq: Equatorial pitch-angles for FIDU fluxes, computed from FIDU_Alpha, B_Calc and B_Eq- Time dependent – Units: Degree. Var type = CDF_REAL4
- FIDU_Quality: Quality Flag for FIDU fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2



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- FIDU_Crosscalib: Intercalibration values for FIDU fluxes. Var type = CDF_REAL4
- FIIU_Energy: Energy levels for FIIU fluxes – Units: MeV. Var type = CDF_REAL4
- FIIU_Alpha: Local pitch-angles for FIIU fluxes – Units: Degree. Var type = CDF_REAL4
- FIIU_Alpha_Eq: Equatorial pitch-angles for FIIU fluxes, computed from FIIU_Alpha, B_Calc and B_Eq- Time dependent – Units: Degree. Var type = CDF_REAL4
- FIIU_Quality: Quality Flag for FIIU fluxes – time dependent (0 denotes highest quality, 1 denotes problem with time resolution, 2 denotes contamination, 3 denotes saturation, 4 denotes any other problem and 10 is the default values while data have not been yet filtered). Var type = CDF_INT2
- FIIU_Crosscalib: Intercalibration values for FIIU fluxes. Var type = CDF_REAL4

When flux for any measurements are computed from a fit function which can depend on several parameters the following support data must be present (note that FFEDO stands for Omnidirectional Differential Electron Flux Fit, FFEIO stands for Omnidirectional Integral Electron Flux Fit, FFPDO stands for Omnidirectional Differential Proton Flux Fit, FFPIO stands for Omnidirectional Integral Proton Flux Fit):

- FFEDO_Energy_Range: Energy range within which the fit function (provided in the metadata FFEDO) can be evaluated – Units: MeV. Var type = CDF_REAL4
- FFEDO_Parameter: Parameters to evaluate the fit function FFEDO – time dependent (this is an array where the number of dimension as the size of the number of input parameters for the fit function). Var type = CDF_REAL4
- FFEDO_Quality: Quality flag for the fit function FFEDO. The use of the quality flag must be precised in the VAR_NOTES attribute. Var type = CDF_REAL4
- FFEIO_Energy_Range: Energy range within which the fit function (provided in the metadata FFEIO) can be evaluated – Units: MeV. Var type = CDF_REAL4
- FFEIO_Parameter: Parameters to evaluate the fit function FFEIO – time dependent (this is an array where the number of dimension as the size of the number of input parameters for the fit function). Var type = CDF_REAL4
- FFEIO_Quality: Quality flag for the fit function FFEIO. The use of the quality flag must be precised in the VAR_NOTES attribute. Var type = CDF_REAL4
- FFPDO_Energy_Range: Energy range within which the fit function (provided in the metadata FFPDO) can be evaluated – Units: MeV. Var type = CDF_REAL4
- FFPDO_Parameter: Parameters to evaluate the fit function FFPDO – time dependent (this is an array where the number of dimension as the size of the number of input parameters for the fit function) . Var type = CDF_REAL4



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- **FFPDO Quality:** Quality flag for the fit function FFPDO. The use of the quality flag must be precised in the VAR_NOTES attribute. Var type = CDF_REAL4
- **FFPIO Energy Range:** Energy range within which the fit function (provided in the metadata FFPIO) can be evaluated – Units: MeV. Var type = CDF_REAL4
- **FFPIO Parameter:** Parameters to evaluate the fit function FFPIO – time dependent (this is an array where the number of dimension as the size of the number of input parameters for the fit function) . Var type = CDF_REAL4
- **FFPIO Quality:** Quality flag for the fit function FFPIO. The use of the quality flag must be precised in the VAR_NOTES attribute. Var type = CDF_REAL4

II.3.3 Metadata

These are variables of secondary importance e.g., a variable holding "xGEO,yGEO,zGEO" to label spacecraft position.

The following CDF variable specifications are required.

Metadata is always character type. Metadata is always time invariant if it is used to label a data variable. Metadata can be time varying if it is NOT used as a label.

If a metadata variable is attached to a data variable via LABEL_PTR_i, then it must be of the same size as the dimension i.

Character metadata must define the number of elements to be the same as the number of characters used in its value.

The following variable attributes are required.

- CATDESC
- DEPEND_0 = Epoch (if time varying)
- FIELDNAM
- FILLVAL (if time varying)
- FORMAT/FORM_PTR
- VAR_TYPE = support_data

The list of metadata that must be present in cdf files is the following:

- **Position LABEL_1:** Position variable labels. Var type = CDF_CHAR
- **FPDO LABEL_1:** Energy labels for FPDO fluxes. Var type = CDF_CHAR
- **FPIO LABEL_1:** Energy labels for FPIO fluxes. Var type = CDF_CHAR
- **FEDO LABEL_1:** Energy labels for FEDO fluxes. Var type = CDF_CHAR
- **FEIO LABEL_1:** Energy labels for FEIO fluxes. Var type = CDF_CHAR
- **FADO LABEL_1:** Energy labels for FADO fluxes. Var type = CDF_CHAR
- **FAIO LABEL_1:** Energy labels for FAIO fluxes. Var type = CDF_CHAR



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- FIDO_LABL_1: Energy labels for FIDO fluxes. Var type = CDF_CHAR
- FIIO_LABL_1: Energy labels for FIIO fluxes. Var type = CDF_CHAR
- FPDU_LABL_1: Energy labels for FPDU fluxes. Var type = CDF_CHAR
- FPDU_LABL_2: Local pitch-angle labels for FPDU fluxes. Var type = CDF_CHAR
- FPIU_LABL_1: Energy labels for FPIU fluxes. Var type = CDF_CHAR
- FPIU_LABL_2: Local pitch-angle labels for FPIU fluxes. Var type = CDF_CHAR
- FEDU_LABL_1: Energy labels for FEDU fluxes. Var type = CDF_CHAR
- FEDU_LABL_2: Local pitch-angle labels for FEDU fluxes. Var type = CDF_CHAR
- FEIU_LABL_1: Energy labels for FEIU fluxes. Var type = CDF_CHAR
- FEIU_LABL_2: Local pitch-angle labels for FEIU fluxes. Var type = CDF_CHAR
- FADU_LABL_1: Energy labels for FADU fluxes. Var type = CDF_CHAR
- FADU_LABL_2: Local pitch-angle labels for FADU fluxes. Var type = CDF_CHAR
- FAIU_LABL_1: Energy labels for FAIU fluxes. Var type = CDF_CHAR
- FAIU_LABL_2: Local pitch-angle labels for FAIU fluxes. Var type = CDF_CHAR
- FIDU_LABL_1: Energy labels for FIDU fluxes. Var type = CDF_CHAR
- FIDU_LABL_2: Local pitch-angle labels for FIDU fluxes. Var type = CDF_CHAR
- FIIU_LABL_1: Energy labels for FIIU fluxes. Var type = CDF_CHAR
- FIIU_LABL_2: Local pitch-angle labels for FIIU fluxes. Var type = CDF_CHAR

When flux for any measurements are computed from a fit function which can depend on several parameters the following metadata must be present (note that FFEDO stands for Omnidirectional Differential Electron Flux Fit, FFEIO stands for Omnidirectional Integral Electron Flux Fit, FFPDO stands for Omnidirectional Differential Proton Flux Fit, FFPIO stands for Omnidirectional Integral Proton Flux Fit):

- FFEDO: Omnidirectional Differential Electron Flux Fit. This metadata has the string type and describe in IDL language the fit function. The use in the formula of E_k for the kinetic energy in MeV is highly recommended and also the variable name `FFEDO_Parameter(0)`, `FFEDO_Parameter(1)`, ... Note that the flux unit should be provided in $\#/(MeV\ cm^2\ s\ sr)$. Var type = CDF_CHAR
- FFEIO: Omnidirectional Integral Electron Flux Fit. This metadata has the string type and describe in IDL language the fit function. The use in the formula of E_k for the kinetic energy in MeV is highly recommended and also the variable name



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FFEIO_Parameter(0), FFEIO_Parameter(1), ... Note that the flux unit should be provided in $\#/(cm^2 s sr)$. Var type = CDF_CHAR

- **FFPDO:** Omnidirectional Differential Proton Flux Fit. This metadata has the string type and describe in IDL language the fit function. The use in the formula of Ek for the kinetic energy in MeV is highly recommended and also the variable name FFPDO_Parameter(0), FFPDO_Parameter(1), ... Note that the flux unit should be provided in $\#/(MeV cm^2 s sr)$. Var type = CDF_CHAR
- **FFPIO:** Omnidirectional Integral Proton Flux Fit. This metadata has the string type and describe in IDL language the fit function. The use in the formula of Ek for the kinetic energy in MeV is highly recommended and also the variable name FFPIO_Parameter(0), FFPIO_Parameter(1), ... Note that the flux unit should be provided in $\#/(cm^2 s sr)$. Var type = CDF_CHAR

III. Reading the cdf files

In this section, the logic to read the cdf files, and to take advantages of all information in there is provided. The logic is provided here for Omni-directional Differential Electron Flux but it can be easily extended to any type of flux provided in the files.

- 1- Retrieve FEDO flux variables. This variable should contain original data provided by the PI and should not have been modified at all. This guaranty that anyone can re-plot the data as the has provided then without any extra modification. Retrieve the UNITS attribute for FEDO will provide the flux units.
- 2- Retrieve FEDO_Energy. This support_data should contain the energy ranges for all channels provided in FEDO. Retrieve the UNITS attribute for FEDO_Energy will provide the energy units.
- 3- Retrieve FEDO_LABL_1. This metadata should contain the energy labels provided as strings.
- 4- Retrieve FEDO_Quality. This support_data should contain quality information for the data (FEDO) and allows any future user to filter the data according to the data quality he wants. Note that the safer being to filter the data when FEDO_Quality is set to 0.
- 5- Retrieve FEDO_Crosscalib. This support_data should contain inter-calibration factor to apply to each FEDO in order to ensure that all data accross all spacecraft/instrument are consistent. $Flux = FEDO * FEDO_Crosscalib$.

Now the logic is provided for Omni-directional Differential Electron Flux Fit (FFEDO) but it can be easily extended to any type of flux fit provided in the files.

- 1- Retrieve FFEDO flux fit function. This metadata should contain the IDL fit function. Retrieve the UNITS attribute for FFEDO will provide the flux units.
- 2- Retrieve FFEDO_Energy_Range. This support_data should contain the energy ranges within which the fit function can be evaluated. Retrieve the UNITS attribute for FFEDO_Energy_Range will provide the energy units.
- 3- Retrieve FFEDO_Parameter. This support_data should contain the parameters needed to evaluate the fit function. It is recommended to retrieve this support data under the name FFEDO_Parameter as it should appear in the FFEDO formula.



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- 4- Retrieve FFEDO_Quality. This support_data should contain information on how far can we believe in the fit function. This support_data should allow to filter only times when the fit is accurate and therefore ensure a good use of the evaluated flux.
- 5- If step 1 to 4 have been followed properly then it should be straightforward to evaluate FFEDO fit function with IDL just setting an array of energy at which the fluxes have to be computed (Ek).

IV. Exemple

In this exemple we provide a skeleton table for POLAR CEPPAD data where there are electron and proton data, omni-directional and directional data.

```
! Skeleton table for the "POLAR_H0_CEPPAD_19990101_V01" CDF.
! Generated: Friday, 05-May-2006 01:14:09
! CDF created/modified by CDF V2.7.1
! Skeleton table created by CDF V2.7.2

#header

                CDF NAME: POLAR_H0_CEPPAD_19990101_V01
DATA ENCODING: NETWORK
MAJORITY: ROW
                FORMAT: SINGLE

! Variables  G.Attributes  V.Attributes  Records  Dims  Sizes
! -----
!          0/38           25           24         0/z     0

#GLOBALattributes

! Attribute      Entry      Data      Value
! Name           Number     Type
! -----
!
! "Project"      1:        CDF_UCHAR { "ISTP>International " -
!                                     "Solar-Terrestrial Physics" }
!
! "Source_name"  1:        CDF_UCHAR { "POLAR>Polar" } .
!
! "Discipline"   1:        CDF_UCHAR { "Space " -
!                                     "Physics>Magnetospheric " -
!                                     "Physics" } .
!
! "Data_type"    1:        CDF_UCHAR { "H0>High Time Resolution" } .
!
! "Descriptor"   1:        CDF_UCHAR { "CEPPAD>Comprehensive " -
!                                     "Energetic Particle and " -
!                                     "Pitch Angle Distribution" } .
!
! "Data_version" 1:        CDF_UCHAR { "01" } .
```

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```
"PI_name"          1:    CDF_UCHAR    { "J. Bernard Blake " -  
                                "(JBernard.Blake@aero.org)" }  
.  
"PI_affiliation"   1:    CDF_UCHAR    { "The Aerospace Corporation" }  
.  
"TEXT"            1:    CDF_UCHAR    { "CEPPAD is the energetic " -  
                                "particle suite flown on " -  
                                "the NASA POLAR satellite " -  
                                "consisting of the IES, IPS " -  
                                "and HIST detectors, " -  
                                "covering electrons and " -  
                                "protons from 10s of Kev to" -  
                                " several MEV. Details are " -  
                                "given in J. B Blake et " -  
                                "al., CEPPAD: Comprehensive" -  
                                "energetic particle and " -  
                                "pitch angle distribution " -  
                                "experiment on Polar. Space" -  
                                " Sci. Rev., 71, 531-562, " -  
                                "1995. The instruments are " -  
                                "Solid State Energetic " -  
                                "Particle Telescopes " -  
                                "(space)" } .  
  
"Instrument_type"  1:    CDF_UCHAR    { "Particles (space)" } .  
"Mission_group"   1:    CDF_UCHAR    { "POLAR" } .  
"Logical_source"  1:    CDF_UCHAR    { "POLAR_H0_CEPPAD" } .  
"Logical_file_id" 1:    CDF_UCHAR    { "POLAR_H0_CEPPAD_19990101_V01"  
} .  
"Logical_source_description"  
1:    CDF_UCHAR    { "High resolution energetic " -  
                                "particle data from the " -  
                                "CEPPAD instrument onboard " -  
                                "the NASA Polar satellite" } .  
  
"Time_resolution" 1:    CDF_UCHAR    { "24 seconds" } .  
"Rules_of_use"    1:    CDF_UCHAR    { "Distribute freely." } .  
"Generated_by"    1:    CDF_UCHAR    { "LANL" } .  
"Generation_date" 1:    CDF_UCHAR    { "20060504" } .  
"Acknowledgement" 1:    CDF_UCHAR    { "acknowledge PAPCO and " -  
                                "ONERA/DESP Mag Library " -  
                                "(Reiner Friedel, Josef " -  
                                "Koller at LANL; Sebastien " -  
                                "Bourdarie at ONER) and " -  
                                "original PI. Please " -  
                                "contact PI before any " -  
                                "publication or " -  
                                "presentation of data." } .
```

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```
"MODS"          1:    CDF_UCHAR    { "20060504 Automatic " -
                    "generation" } .

"ADID_ref"      1:    CDF_UCHAR    { "NSSD0110" } .

"LINK_TEXT"     1:    CDF_UCHAR    { "Cammice, Ceppad and Rapid " -
                    "Web Page" } .

"LINK_TITLE"    1:    CDF_UCHAR    { "CCR Home Page" } .

"HTTP_LINK"     1:    CDF_UCHAR    { "http://leadbelly.lanl.gov/" -
                    "ccr/" } .

"Parents"       1:    CDF_UCHAR    { "none" } .
```

#VARIABLEattributes

```
"AVG_TYPE"
"CATDESC"
"DEPEND_0"
"DEPEND_1"
"DEPEND_2"
"DICTIONARY_KEY"
"DISPLAY_TYPE"
"V_PARENT"
"FIELDNAM"
"FILLVAL"
"FORM_PTR"
"FORMAT"
"LABLAXIS"
"LABL_PTR_1"
"QUALITY_VAR"
"SCAL_PTR"
"SCALETYP"
"SI_conversion"
"UNITS"
"UNIT_PTR"
"VALIDMIN"
"VALIDMAX"
"VAR_TYPE"
"VAR_NOTES"
```

#variables

! No rVariables.

#zVariables

| ! Variable ! Name ! ----- | Data Type ---- | Number Elements ----- | Dims ---- | Sizes ----- | Record Variance ----- | Dimension Variances ----- |
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|
| "Epoch" | CDF_EPOCH | 1 | 0 | | T | |
| ! Attribute ! Name | Data Type | Value | | | | |

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```
! -----          -----          -----

"CATDESC"          CDF_UCHAR          { "Default time" }
"DICT_KEY"         CDF_UCHAR          { "time>Epoch" }
"FIELDNAM"        CDF_UCHAR          { "Epoch" }
"FILLVAL"         CDF_UCHAR          { "-1.0E31" }
"SCALETYP"        CDF_UCHAR          { "linear" }
"SI_conversion"   CDF_UCHAR          { "1.0e3>s" }
"UNITS"           CDF_UCHAR          { "ms" }
"VALIDMIN"        CDF_UCHAR          { "CDF_PARSE_EPOCH(01-Jan-1950 " -
                    "00::00::00.000)" }
"VALIDMAX"        CDF_UCHAR          { "CDF_PARSE_EPOCH(31-Dec-9999 " -
                    "23::59::59.999)" }
"VAR_TYPE"        CDF_UCHAR          { "support_data" }
"VAR_NOTES"       CDF_UCHAR          { "Epoch, UT" } .
```

! RV values were not requested.

```
! Variable          Data          Number          Record          Dimension
! Name             Type           Elements  Dims  Sizes  Variance  Variances
! -----          -----          -----          -----          -----          -----          -----
```

```
"Position"         CDF_REAL4          1           1       3           T           T
```

```
! Attribute          Data          Value
! Name              Type           -----
! -----          -----          -----
```

```
"AVG_TYPE"         CDF_UCHAR          { "standard" }
"CATDESC"          CDF_UCHAR          { "Position of the satellite in " -
                    "geographic coordinates" }
"DEPEND_0"         CDF_UCHAR          { "Epoch" }
"DICT_KEY"         CDF_UCHAR          { "position>geographic" }
"DISPLAY_TYPE"    CDF_UCHAR          { "time_series" }
"FIELDNAM"        CDF_UCHAR          { "Satellite position (GEO)" }
"FILLVAL"         CDF_UCHAR          { "-1.0E31" }
"FORMAT"          CDF_UCHAR          { "F6.3" }
"LABL_PTR_1"      CDF_UCHAR          { "Position_LABL_1" }
"SCALETYP"        CDF_UCHAR          { "linear" }
"SI_conversion"   CDF_UCHAR          { "1.0e-3>m" }
"UNITS"           CDF_UCHAR          { "km" }
"VALIDMIN"        CDF_UCHAR          { "[-1.0E31, -1.0E31, -1.0E31]" }
"VALIDMAX"        CDF_UCHAR          { "[1.0E31, 1.0E31, 1.0E31]" }
"VAR_TYPE"        CDF_UCHAR          { "data" }
"VAR_NOTES"       CDF_UCHAR          { "Origin = Earths center of mass. X = " -
                    "Intersection of Greenwich meridian and" -
                    " geographic equator. Z = Geographic " -
                    "North Pole. Y = completes a " -
                    "right-handed Cartesian triad" } .
```

! RV values were not requested.

```
! Variable          Data          Number          Record          Dimension
```

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```
! Name          Type          Elements  Dims  Sizes  Variance  Variances
! -----
```

```
"Position_LABL_1"
CDF_CHAR          4          1          3          F          T
```

```
! Attribute      Data
! Name           Type           Value
! -----
```

```
"CATDESC"        CDF_UCHAR      { "Position labels" }
"DICTIONARY_KEY" CDF_UCHAR      { "label>position" }
"FIELDNAM"       CDF_UCHAR      { "Position_LABL_1" }
"FORMAT"         CDF_UCHAR      { "A4" }
"VAR_TYPE"       CDF_UCHAR      { "metadata" } .
```

! NRV values follow...

```
[1] = { "Xgeo" }
[2] = { "Ygeo" }
[3] = { "Zgeo" }
```

```
! Variable      Data          Number      Record      Dimension
! Name          Type          Elements    Dims  Sizes  Variance  Variances
! -----
```

```
"Position_Quality"
CDF_INT2          1          0          T
```

```
! Attribute      Data
! Name           Type           Value
! -----
```

```
"CATDESC"        CDF_UCHAR      { "Position Quality flag" }
"DEPEND_0"       CDF_UCHAR      { "Epoch" }
"DICTIONARY_KEY" CDF_UCHAR      { "flag>quality" }
"FIELDNAM"       CDF_UCHAR      { "Position_Quality" }
"FILLVAL"        CDF_UCHAR      { "-32767" }
"FORMAT"         CDF_UCHAR      { "I11" }
"LABLAXIS"       CDF_UCHAR      { "Quality" }
"UNITS"          CDF_UCHAR      { "none" }
"VALIDMIN"       CDF_UCHAR      { "-32767" }
"VALIDMAX"       CDF_UCHAR      { "32767" }
"VAR_TYPE"       CDF_UCHAR      { "support_data" }
"VAR_NOTES"      CDF_UCHAR      { "0 denotes highest quality." } .
```

! RV values were not requested.

```
! Variable      Data          Number      Record      Dimension
! Name          Type          Elements    Dims  Sizes  Variance  Variances
! -----
```

```
"B_Calc"         CDF_REAL4      1          0          T
```

```
! Attribute      Data
! Name           Type           Value
! -----
```


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```
"AVG_TYPE"      CDF_UCHAR      { "standard" }
"CATDESC"       CDF_UCHAR      { "Calculated magnetic field strength" }
"DEPEND_0"      CDF_UCHAR      { "Epoch" }
"DICT_KEY"       CDF_UCHAR      { "magnetic_field>amplitude" }
"DISPLAY_TYPE"  CDF_UCHAR      { "time_series" }
"FIELDNAM"      CDF_UCHAR      { "Magnetic field strength" }
"FILLVAL"       CDF_UCHAR      { "-1.0E31" }
"FORMAT"        CDF_UCHAR      { "E10.3" }
"LABLAXIS"      CDF_UCHAR      { "B" }
"SCALETYP"      CDF_UCHAR      { "linear" }
"SI_conversion" CDF_UCHAR      { "1.0e9>T" }
"UNITS"         CDF_UCHAR      { "nT" }
"VALIDMIN"      CDF_UCHAR      { "0.0" }
"VALIDMAX"      CDF_UCHAR      { "1.0E31" }
"VAR_TYPE"      CDF_UCHAR      { "data" }
"VAR_NOTES"     CDF_UCHAR      { "Calculated using ONERA-DESP library " -
    "Internal field: DGRF/IGRF External " -
    "field: Olson & Pfitzer quiet" } .
```

! RV values were not requested.

| ! Variable ! Name ! ----- | Data Type ---- | Number Elements ----- | Dims ---- | Sizes ----- | Record Variance ----- | Dimension Variances ----- |
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|

| | | | | | | |
|--------|-----------|---|---|--|---|--|
| "B_Eq" | CDF_REAL4 | 1 | 0 | | T | |
|--------|-----------|---|---|--|---|--|

| ! Attribute ! Name ! ----- | Data Type ---- | Value ----- |
|----------------------------------|----------------------|----------------|
|----------------------------------|----------------------|----------------|

```
"AVG_TYPE"      CDF_UCHAR      { "standard" }
"CATDESC"       CDF_UCHAR      { "Calculated magnetic field strength at " -
    "magnetic equator" }
"DEPEND_0"      CDF_UCHAR      { "Epoch" }
"DICT_KEY"       CDF_UCHAR      { "magnetic_field>amplitude" }
"DISPLAY_TYPE"  CDF_UCHAR      { "time_series" }
"FIELDNAM"      CDF_UCHAR      { "Equatorial magnetic field strength" }
"FILLVAL"       CDF_UCHAR      { "-1.0E31" }
"FORMAT"        CDF_UCHAR      { "E10.3" }
"LABLAXIS"      CDF_UCHAR      { "B_Eq" }
"SCALETYP"      CDF_UCHAR      { "linear" }
"SI_conversion" CDF_UCHAR      { "1.0e9>T" }
"UNITS"         CDF_UCHAR      { "nT" }
"VALIDMIN"      CDF_UCHAR      { "0.0" }
"VALIDMAX"      CDF_UCHAR      { "1.0E31" }
"VAR_TYPE"      CDF_UCHAR      { "data" }
"VAR_NOTES"     CDF_UCHAR      { "Calculated using ONERA-DESP library " -
    "Internal field: DGRF/IGRF External " -
    "field: Olson & Pfitzer quiet" } .
```

! RV values were not requested.

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```
! Variable      Data      Number      Record      Dimension
! Name         Type      Elements    Dims        Sizes        Variance    Variances
! -----      -
!
"L"            CDF_REAL4      1          0          T

! Attribute      Data
! Name          Type          Value
! -----
"AVG_TYPE"      CDF_UCHAR     { "standard" }
"CATDESC"       CDF_UCHAR     { "Calculated McIlwains L parameter " -
                    "(Earths radii)" }
"DEPEND_0"     CDF_UCHAR     { "Epoch" }
"DISPLAY_TYPE" CDF_UCHAR     { "time_series" }
"FIELDNAM"     CDF_UCHAR     { "McIlwains L parameter" }
"FILLVAL"      CDF_UCHAR     { "-1.0E31" }
"FORMAT"       CDF_UCHAR     { "E10.3" }
"LABLAXIS"    CDF_UCHAR     { "L" }
"SCALETYP"    CDF_UCHAR     { "linear" }
"SI_conversion" CDF_UCHAR     { "1.5696e-7>m" }
"UNITS"        CDF_UCHAR     { "R_E" }
"VALIDMIN"     CDF_UCHAR     { "0.0" }
"VALIDMAX"     CDF_UCHAR     { "1.0E31" }
"VAR_TYPE"     CDF_UCHAR     { "data" }
"VAR_NOTES"    CDF_UCHAR     { "Calculated using ONERA-DESP library " -
                    "Internal field: DGRF/IGRF External " -
                    "field: Olson & Pfitzer quiet" } .
```

! RV values were not requested.

```
! Variable      Data      Number      Record      Dimension
! Name         Type      Elements    Dims        Sizes        Variance    Variances
! -----      -
!
"L_star"       CDF_REAL4      1          0          T

! Attribute      Data
! Name          Type          Value
! -----
"AVG_TYPE"      CDF_UCHAR     { "standard" }
"CATDESC"       CDF_UCHAR     { "Calculated Roederers L* parameter " -
                    "(Earths radii)" }
"DEPEND_0"     CDF_UCHAR     { "Epoch" }
"DISPLAY_TYPE" CDF_UCHAR     { "time_series" }
"FIELDNAM"     CDF_UCHAR     { "Roederers L* parameter" }
"FILLVAL"      CDF_UCHAR     { "-1.0E31" }
"FORMAT"       CDF_UCHAR     { "E10.3" }
"LABLAXIS"    CDF_UCHAR     { "L*" }
"SCALETYP"    CDF_UCHAR     { "linear" }
"SI_conversion" CDF_UCHAR     { "1.5696e-7>m" }
"UNITS"        CDF_UCHAR     { "R_E" }
```

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Standard file format guidelines

```
"VALIDMIN"    CDF_UCHAR    { "0.0" }
"VALIDMAX"    CDF_UCHAR    { "1.0E31" }
"VAR_TYPE"    CDF_UCHAR    { "data" }
"VAR_NOTES"   CDF_UCHAR    { "Calculated using ONERA-DESP library " -
    "Internal field: DGRF/IGRF External " -
    "field: Olson & Pfitzer quiet" } .
```

! RV values were not requested.

| ! Variable ! Name ! ----- | Data Type ---- | Number Elements ----- | Dims ---- | Sizes ----- | Record Variance ----- | Dimension Variances ----- |
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|

| | | | | | | |
|-----|-----------|---|---|--|---|--|
| "I" | CDF_REAL4 | 1 | 0 | | T | |
|-----|-----------|---|---|--|---|--|

| ! Attribute ! Name ! ----- | Data Type ---- | Value ----- |
|----------------------------------|----------------------|----------------|
|----------------------------------|----------------------|----------------|

```
"AVG_TYPE"    CDF_UCHAR    { "standard" }
"CATDESC"     CDF_UCHAR    { "Adiabatic invariant (bounce)" }
"DEPEND_0"    CDF_UCHAR    { "Epoch" }
"DISPLAY_TYPE" CDF_UCHAR    { "time_series" }
"FIELDNAM"    CDF_UCHAR    { "Adiabatic invariant (bounce)" }
"FILLVAL"     CDF_UCHAR    { "-1.0E31" }
"FORMAT"      CDF_UCHAR    { "E10.3" }
"LABLAXIS"    CDF_UCHAR    { "I" }
"SCALETYP"    CDF_UCHAR    { "linear" }
"SI_conversion" CDF_UCHAR    { "none" }
"UNITS"       CDF_UCHAR    { "none" }
"VALIDMIN"    CDF_UCHAR    { "0.0" }
"VALIDMAX"    CDF_UCHAR    { "1.0E31" }
"VAR_TYPE"    CDF_UCHAR    { "data" }
"VAR_NOTES"   CDF_UCHAR    { "Calculated using ONERA-DESP library " -
    "Internal field: DGRF/IGRF External " -
    "field: Olson & Pfitzer quiet" } .
```

! RV values were not requested.

| ! Variable ! Name ! ----- | Data Type ---- | Number Elements ----- | Dims ---- | Sizes ----- | Record Variance ----- | Dimension Variances ----- |
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|

| | | | | | | |
|-------|-----------|---|---|--|---|--|
| "MLT" | CDF_REAL4 | 1 | 0 | | T | |
|-------|-----------|---|---|--|---|--|

| ! Attribute ! Name ! ----- | Data Type ---- | Value ----- |
|----------------------------------|----------------------|----------------|
|----------------------------------|----------------------|----------------|

```
"AVG_TYPE"    CDF_UCHAR    { "angle_hour" }
"CATDESC"     CDF_UCHAR    { "Calculated Magnetic Local Time (hours)" }
"DEPEND_0"    CDF_UCHAR    { "Epoch" }
"DISPLAY_TYPE" CDF_UCHAR    { "time_series" }
"FIELDNAM"    CDF_UCHAR    { "Magnetic Local Time" }
```

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Standard file format guidelines

```
"FILLVAL"      CDF_UCHAR      { "-1.0E31" }
"FORMAT"       CDF_UCHAR      { "E10.3" }
"LABLAXIS"     CDF_UCHAR      { "MLT" }
"SCALETYP"     CDF_UCHAR      { "linear" }
"SI_conversion"
                CDF_UCHAR      { "2.778e-4>s" }
"UNITS"        CDF_UCHAR      { "h" }
"VALIDMIN"     CDF_UCHAR      { "0.0" }
"VALIDMAX"     CDF_UCHAR      { "24.0" }
"VAR_TYPE"     CDF_UCHAR      { "data" }
"VAR_NOTES"    CDF_UCHAR      { "Calculated using ONERA-DESP library " -
                "Internal field: DGRF/IGRF External " -
                "field: Olson & Pfitzer quiet" } .
```

! RV values were not requested.

| ! Variable ! Name | Data Type | Number Elements | Dims | Sizes | Record Variance | Dimension Variances |
|----------------------|--------------|--------------------|------|-------|--------------------|------------------------|
|----------------------|--------------|--------------------|------|-------|--------------------|------------------------|

| | | | | | | |
|---------|-----------|---|---|--|---|--|
| "Alpha" | CDF_REAL4 | 1 | 0 | | T | |
|---------|-----------|---|---|--|---|--|

| ! Attribute ! Name | Data Type | Value |
|-----------------------|--------------|-------|
|-----------------------|--------------|-------|

```
"AVG_TYPE"     CDF_UCHAR      { "angle_degrees" }
"CATDESC"      CDF_UCHAR      { "Pitch angle" }
"DEPEND_0"     CDF_UCHAR      { "Epoch" }
"DICT_KEY"     CDF_UCHAR      { "angle>pitch" }
"DISPLAY_TYPE"
                CDF_UCHAR      { "time_series" }
"FIELDNAM"     CDF_UCHAR      { "Pitch angle" }
"FILLVAL"      CDF_UCHAR      { "-1.0E31" }
"FORMAT"       CDF_UCHAR      { "E10.3" }
"LABLAXIS"     CDF_UCHAR      { "Alpha" }
"SCALETYP"     CDF_UCHAR      { "linear" }
"SI_conversion"
                CDF_UCHAR      { "57.296>rad" }
"UNITS"        CDF_UCHAR      { "degrees" }
"VALIDMIN"     CDF_UCHAR      { "0.0" }
"VALIDMAX"     CDF_UCHAR      { "180.0" }
"VAR_TYPE"     CDF_UCHAR      { "data" }
"VAR_NOTES"    CDF_UCHAR      { "Calculated using ONERA-DESP library " -
                "Internal field: DGRF/IGRF External " -
                "field: Olson & Pfitzer quiet" } .
```

! RV values were not requested.

| ! Variable ! Name | Data Type | Number Elements | Dims | Sizes | Record Variance | Dimension Variances |
|----------------------|--------------|--------------------|------|-------|--------------------|------------------------|
|----------------------|--------------|--------------------|------|-------|--------------------|------------------------|

| | | | | | | |
|------------|-----------|---|---|--|---|--|
| "Alpha_Eq" | CDF_REAL4 | 1 | 0 | | T | |
|------------|-----------|---|---|--|---|--|

| ! Attribute ! Name | Data Type | Value |
|-----------------------|--------------|-------|
|-----------------------|--------------|-------|



Standard file format guidelines

```

! -----          -----          -----

"AVG_TYPE"      CDF_UCHAR      { "angle_degrees" }
"CATDESC"      CDF_UCHAR      { "Equatorial pitch angle" }
"DEPEND_0"     CDF_UCHAR      { "Epoch" }
"DICT_KEY"     CDF_UCHAR      { "angle>pitch" }
"DISPLAY_TYPE"
                CDF_UCHAR      { "time_series" }
"FIELDNAM"     CDF_UCHAR      { "Equat. Pitch angle" }
"FILLVAL"      CDF_UCHAR      { "-1.0E31" }
"FORMAT"       CDF_UCHAR      { "E10.3" }
"LABLAXIS"     CDF_UCHAR      { "Alpha(Eq)" }
"SCALETYP"     CDF_UCHAR      { "linear" }
"SI_conversion"
                CDF_UCHAR      { "57.296>rad" }
"UNITS"        CDF_UCHAR      { "degrees" }
"VALIDMIN"     CDF_UCHAR      { "0.0" }
"VALIDMAX"     CDF_UCHAR      { "180.0" }
"VAR_TYPE"     CDF_UCHAR      { "data" }
"VAR_NOTES"    CDF_UCHAR      { "Calculated using ONERA-DESP library " -
                                "Internal field: DGRF/IGRF External " -
                                "field: Olson & Pfitzer quiet" } .
    
```

! RV values were not requested.

| ! Variable ! Name ! ----- | Data Type ---- | Number Elements ----- | Dims ---- | Sizes ----- | Record Variance ----- | Dimension Variances ----- |
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|

| | | | | | | |
|--------|-----------|---|---|----|---|---|
| "FPDO" | CDF_REAL4 | 1 | 1 | 32 | T | T |
|--------|-----------|---|---|----|---|---|

| ! Attribute ! Name ! ----- | Data Type ---- | Value ----- |
|----------------------------------|----------------------|----------------|
|----------------------------------|----------------------|----------------|

```

}
"AVG_TYPE"      CDF_UCHAR      { "log" }
"CATDESC"      CDF_UCHAR      { "Omnidirectional Differential Proton Flux"
}
"DEPEND_0"     CDF_UCHAR      { "Epoch" }
"DEPEND_1"     CDF_UCHAR      { "FPDO_Energy" }
"DICT_KEY"     CDF_UCHAR      { "particle_flux>proton-differential-omni" -
                                "-directional" }
"DISPLAY_TYPE"
                CDF_UCHAR      { "time_series" }
"V_PARENT"     CDF_UCHAR      { "FPDU" }
"FIELDNAM"     CDF_UCHAR      { "FPDO" }
"FILLVAL"      CDF_UCHAR      { "-1.0E31" }
"FORMAT"       CDF_UCHAR      { "E10.3" }
"LABL_PTR_1"   CDF_UCHAR      { "FPDO_LABL_1" }
"QUALITY_VAR"  CDF_UCHAR      { "FPDO_Quality" }
"SCALETYP"     CDF_UCHAR      { "log" }
"SI_conversion"
                CDF_UCHAR      { "1.602e-17>m^-2 s^-1 sr^-1 J^-1" }
"UNITS"        CDF_UCHAR      { "cm^-2 s^-1 sr^-1 MeV^-1" }
"VALIDMIN"     CDF_UCHAR      { "-1.0E31" }
"VALIDMAX"     CDF_UCHAR      { "1.0E31" }
    
```

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Standard file format guidelines

```
"VAR_TYPE"    CDF_UCHAR    { "data" }
"VAR_NOTES"   CDF_UCHAR    { "Dimension 1 holds channels." } .
```

! RV values were not requested.

```
! Variable      Data      Number      Record      Dimension
! Name          Type      Elements    Dims      Sizes      Variance    Variances
! -----      ----      -
```

```
"FPDO_Energy"  CDF_REAL4    1          2          32 2        F           T T
```

```
! Attribute      Data
! Name           Type           Value
! -----      ----      -
```

```
"CATDESC"      CDF_UCHAR    { "Energy levels for FPDO" }
"DICT_KEY"     CDF_UCHAR    { "energy>band" }
"FIELDNAM"     CDF_UCHAR    { "FPDO Energy" }
"FILLVAL"      CDF_UCHAR    { "-1.0E31" }
"FORMAT"       CDF_UCHAR    { "F8.3" }
"LABLAXIS"     CDF_UCHAR    { "Energy" }
"SI_conversion" CDF_UCHAR    { "6.242e12>J" }
"UNITS"        CDF_UCHAR    { "MeV" }
"VALIDMIN"     CDF_UCHAR    { "0.0" }
"VALIDMAX"     CDF_UCHAR    { "1.0E31" }
"VAR_TYPE"     CDF_UCHAR    { "support_data" }
"VAR_NOTES"    CDF_UCHAR    { "Energy levels are a combination of IPS" -
" and HISTp" } .
```

! NRV values follow...

```
[1,1] = 0.017
[1,2] = 0.021
[2,1] = 0.021
[2,2] = 0.028
[3,1] = 0.028
[3,2] = 0.037
[4,1] = 0.037
[4,2] = 0.050
[5,1] = 0.050
[5,2] = 0.066
[6,1] = 0.066
[6,2] = 0.088
[7,1] = 0.088
[7,2] = 0.118
[8,1] = 0.118
[8,2] = 0.161
[9,1] = 0.161
[9,2] = 0.221
[10,1] = 0.221
[10,2] = 0.303
[11,1] = 0.303
[11,2] = 0.417
[12,1] = 0.417
[12,2] = 0.574
[13,1] = 0.574
[13,2] = 0.791
```



Standard file format guidelines

```
[14,1] = 0.791
[14,2] = 1.091
[15,1] = 1.091
[15,2] = 1.505
[16,1] = 1.505
[16,2] = 2.000
[17,1] = 1.000
[17,2] = 3.000
[18,1] = 3.000
[18,2] = 3.740
[19,1] = 3.740
[19,2] = 4.650
[20,1] = 4.650
[20,2] = 5.790
[21,1] = 5.790
[21,2] = 7.210
[22,1] = 7.210
[22,2] = 8.970
[23,1] = 8.970
[23,2] = 11.170
[24,1] = 11.170
[24,2] = 13.910
[25,1] = 13.910
[25,2] = 17.320
[26,1] = 17.320
[26,2] = 21.560
[27,1] = 21.560
[27,2] = 26.850
[28,1] = 26.850
[28,2] = 33.430
[29,1] = 33.430
[29,2] = 41.620
[30,1] = 41.620
[30,2] = 51.820
[31,1] = 51.820
[31,2] = 64.510
[32,1] = 64.510
[32,2] = 80.320
```

```
! Variable      Data      Number
! Name          Type      Elements Dims  Sizes  Record  Dimension
! -----      ----      -
!              "FPDO_LABL_1"  CDF_CHAR  21    1    32    F      T
```

"FPDO_LABL_1"

CDF_CHAR

21

1

32

F

T

! Attribute

Data

! Name

Type

Value

! -----

```
"CATDESC"      CDF_UCHAR  { "Energy labels for FPDO" }
"DICT_KEY"     CDF_UCHAR  { "label>energy" }
"FIELDNAM"     CDF_UCHAR  { "FPDO_LABL_1" }
"FORMAT"       CDF_UCHAR  { "A21" }
"VAR_TYPE"     CDF_UCHAR  { "metadata" } .
```

! NRV values follow...

```
[1] = { " 0.017 - 0.021 MeV" }
```



Standard file format guidelines

```
[2] = { " 0.021 - 0.028 MeV" }
[3] = { " 0.028 - 0.037 MeV" }
[4] = { " 0.037 - 0.050 MeV" }
[5] = { " 0.050 - 0.066 MeV" }
[6] = { " 0.066 - 0.088 MeV" }
[7] = { " 0.088 - 0.118 MeV" }
[8] = { " 0.118 - 0.161 MeV" }
[9] = { " 0.161 - 0.221 MeV" }
[10] = { " 0.221 - 0.303 MeV" }
[11] = { " 0.303 - 0.417 MeV" }
[12] = { " 0.417 - 0.574 MeV" }
[13] = { " 0.574 - 0.791 MeV" }
[14] = { " 0.791 - 1.091 MeV" }
[15] = { " 1.091 - 1.505 MeV" }
[16] = { " 1.505 - 2.000 MeV" }
[17] = { " 1.000 - 3.000 MeV" }
[18] = { " 3.000 - 3.740 MeV" }
[19] = { " 3.740 - 4.650 MeV" }
[20] = { " 4.650 - 5.790 MeV" }
[21] = { " 5.790 - 7.210 MeV" }
[22] = { " 7.210 - 8.970 MeV" }
[23] = { " 8.970 - 11.170 MeV" }
[24] = { " 11.170 - 13.910 MeV" }
[25] = { " 13.910 - 17.320 MeV" }
[26] = { " 17.320 - 21.560 MeV" }
[27] = { " 21.560 - 26.850 MeV" }
[28] = { " 26.850 - 33.430 MeV" }
[29] = { " 33.430 - 41.620 MeV" }
[30] = { " 41.620 - 51.820 MeV" }
[31] = { " 51.820 - 64.510 MeV" }
[32] = { " 64.510 - 80.320 MeV" }
```

```
! Variable      Data      Number      Record      Dimension
! Name          Type      Elements    Dims      Sizes      Variance    Variances
! -----
```

"FPDO_Quality"

```
CDF_INT2      1      1      32      T      T
```

```
! Attribute
```

```
! Name          Data      Value
! -----
```

```
"CATDESC"      CDF_UCHAR  { "FPDO Quality flag" }
"DEPEND_0"     CDF_UCHAR  { "Epoch" }
"DEPEND_1"     CDF_UCHAR  { "FPDO_Energy" }
"DICTIONARY"   CDF_UCHAR  { "flag>quality" }
"FIELDNAM"     CDF_UCHAR  { "FPDO_Quality" }
"FILLVAL"      CDF_UCHAR  { "-32767" }
"FORMAT"       CDF_UCHAR  { "I11" }
"LABLAXIS"     CDF_UCHAR  { "Quality" }
"LABL_PTR_1"   CDF_UCHAR  { "FPDO_LABL_1" }
"UNITS"        CDF_UCHAR  { "none" }
"VALIDMIN"     CDF_UCHAR  { "-32767" }
"VALIDMAX"     CDF_UCHAR  { "32767" }
"VAR_TYPE"     CDF_UCHAR  { "support_data" }
"VAR_NOTES"    CDF_UCHAR  { "0 denotes highest quality. 1 denotes " -
```




Standard file format guidelines

"problem with time resolution. 2 " -
 "denotes possible contamination. 3 " -
 "denotes saturation. 4 denotes any " -
 "other problem and 10 denotes that data" -
 " have not been qualified" } .

! RV values were not requested.

| ! Variable ! Name ! ----- | Data Type ---- | Number Elements ----- | Dims ---- | Sizes ----- | Record Variance ----- | Dimension Variances ----- |
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|

"FPDO_Crosscalib"

| | | | | | |
|-----------|---|---|----|---|---|
| CDF_REAL4 | 1 | 1 | 32 | F | T |
|-----------|---|---|----|---|---|

| ! Attribute ! Name ! ----- | Data Type ---- | Value ----- |
|----------------------------------|----------------------|----------------|
|----------------------------------|----------------------|----------------|

| | | |
|-----------------|-----------|---|
| "CATDESC" | CDF_UCHAR | { "Crosscalibration factors for FPDO" } |
| "DEPEND_0" | CDF_UCHAR | { "FPDO_Energy" } |
| "DICT_KEY" | CDF_UCHAR | { "ratio>particle_flux" } |
| "FIELDNAM" | CDF_UCHAR | { "FPDO Crosscalib" } |
| "FILLVAL" | CDF_UCHAR | { "-1.0E31" } |
| "FORMAT" | CDF_UCHAR | { "F5" } |
| "LABLAXIS" | CDF_UCHAR | { "Crosscalibration factors" } |
| "SI_conversion" | CDF_UCHAR | { "none" } |
| "UNITS" | CDF_UCHAR | { "none" } |
| "VALIDMIN" | CDF_UCHAR | { "0.0" } |
| "VALIDMAX" | CDF_UCHAR | { "1.0E31" } |
| "VAR_TYPE" | CDF_UCHAR | { "support_data" } |
| "VAR_NOTES" | CDF_UCHAR | { "none" } . |

! NRV values follow...

[1] = 1.0
 [2] = 1.0
 [3] = 1.0
 [4] = 1.0
 [5] = 1.0
 [6] = 1.0
 [7] = 1.0
 [8] = 1.0
 [9] = 1.0
 [10] = 1.0
 [11] = 1.0
 [12] = 1.0
 [13] = 1.0
 [14] = 1.0
 [15] = 1.0
 [16] = 1.0
 [17] = 1.0
 [18] = 1.0
 [19] = 1.0
 [20] = 1.0
 [21] = 1.0
 [22] = 1.0



Standard file format guidelines

```
[23] = 1.0
[24] = 1.0
[25] = 1.0
[26] = 1.0
[27] = 1.0
[28] = 1.0
[29] = 1.0
[30] = 1.0
[31] = 1.0
[32] = 1.0
```

```
! Variable      Data      Number      Record      Dimension
! Name          Type      Elements    Dims        Sizes        Variance    Variances
! -----      -
"FPDU"          CDF_REAL4  1           2           9 32         T           T T

! Attribute      Data
! Name          Type      Value
! -----      -
"AVG_TYPE"      CDF_UCHAR { "log" }
"CATDESC"       CDF_UCHAR { "Unidirectional Differential Proton Flux"
}
"DEPEND_0"      CDF_UCHAR { "Epoch" }
"DEPEND_1"      CDF_UCHAR { "FPDU_Energy" }
"DEPEND_2"      CDF_UCHAR { "FPDU_Alpha" }
"DICT_KEY"      CDF_UCHAR { "particle_flux>proton-differential-dire" -
"ctional" }
"DISPLAY_TYPE"  CDF_UCHAR { "time_series" }
"FIELDNAM"     CDF_UCHAR { "FPDU" }
"FILLVAL"       CDF_UCHAR { "-1.0E31" }
"FORMAT"        CDF_UCHAR { "E10.3" }
"LABL_PTR_1"    CDF_UCHAR { "FPDU_LABL_1" }
"QUALITY_VAR"   CDF_UCHAR { "FPDU_Quality" }
"SCALETYP"     CDF_UCHAR { "log" }
"SI_conversion" CDF_UCHAR { "1.602e-17>m^-2 s^-1 sr^-1 J^-1" }
"UNITS"         CDF_UCHAR { "cm^-2 s^-1 sr^-1 MeV^-1" }
"VALIDMIN"     CDF_UCHAR { "-1.0E31" }
"VALIDMAX"     CDF_UCHAR { "1.0E31" }
"VAR_TYPE"     CDF_UCHAR { "data" }
"VAR_NOTES"    CDF_UCHAR { "Dimension 1 holds channels." } .
```

! RV values were not requested.

```
! Variable      Data      Number      Record      Dimension
! Name          Type      Elements    Dims        Sizes        Variance    Variances
! -----      -
"FPDU_Energy"   CDF_REAL4  1           2           32 2         F           T T

! Attribute      Data
! Name          Type      Value
```



Standard file format guidelines

```
! -----          -----          -----

"CATDESC"          CDF_UCHAR          { "Energy levels for FPDU" }
"DICT_KEY"         CDF_UCHAR          { "energy>band" }
"FIELDNAM"        CDF_UCHAR          { "FPDU Energy" }
"FILLVAL"         CDF_UCHAR          { "-1.0E31" }
"FORMAT"          CDF_UCHAR          { "F8.3" }
"LABLAXIS"        CDF_UCHAR          { "Energy" }
"SI_conversion"   CDF_UCHAR          { "6.242e12>J" }
"UNITS"           CDF_UCHAR          { "MeV" }
"VALIDMIN"        CDF_UCHAR          { "0.0" }
"VALIDMAX"        CDF_UCHAR          { "1.0E31" }
"VAR_TYPE"        CDF_UCHAR          { "support_data" }
"VAR_NOTES"       CDF_UCHAR          { "Energy levels are a combination of IPS" -
                                     " and HISTp" } .
```

! NRV values follow...

```
[1,1] = 0.017
[1,2] = 0.021
[2,1] = 0.021
[2,2] = 0.028
[3,1] = 0.028
[3,2] = 0.037
[4,1] = 0.037
[4,2] = 0.050
[5,1] = 0.050
[5,2] = 0.066
[6,1] = 0.066
[6,2] = 0.088
[7,1] = 0.088
[7,2] = 0.118
[8,1] = 0.118
[8,2] = 0.161
[9,1] = 0.161
[9,2] = 0.221
[10,1] = 0.221
[10,2] = 0.303
[11,1] = 0.303
[11,2] = 0.417
[12,1] = 0.417
[12,2] = 0.574
[13,1] = 0.574
[13,2] = 0.791
[14,1] = 0.791
[14,2] = 1.091
[15,1] = 1.091
[15,2] = 1.505
[16,1] = 1.505
[16,2] = 2.000
[17,1] = 1.000
[17,2] = 3.000
[18,1] = 3.000
[18,2] = 3.740
[19,1] = 3.740
[19,2] = 4.650
[20,1] = 4.650
[20,2] = 5.790
```



Standard file format guidelines

```
[21,1] = 5.790
[21,2] = 7.210
[22,1] = 7.210
[22,2] = 8.970
[23,1] = 8.970
[23,2] = 11.170
[24,1] = 11.170
[24,2] = 13.910
[25,1] = 13.910
[25,2] = 17.320
[26,1] = 17.320
[26,2] = 21.560
[27,1] = 21.560
[27,2] = 26.850
[28,1] = 26.850
[28,2] = 33.430
[29,1] = 33.430
[29,2] = 41.620
[30,1] = 41.620
[30,2] = 51.820
[31,1] = 51.820
[31,2] = 64.510
[32,1] = 64.510
[32,2] = 80.320
```

```
! Variable      Data      Number      Record      Dimension
! Name         Type      Elements    Dims      Sizes      Variance    Variances
! -----      ----      -
```

```
"FPDU_Alpha"   CDF_REAL4      1      2      9 2      F      T T
```

```
! Attribute    Data
! Name         Type      Value
! -----      ----      -
```

```
"CATDESC"      CDF_UCHAR      { "Local pitch angle bins for FPDU" }
"DICT_KEY"     CDF_UCHAR      { "angle>pitch" }
"FIELDNAM"     CDF_UCHAR      { "FPDU Alpha" }
"FILLVAL"      CDF_UCHAR      { "-1.0E31" }
"FORMAT"       CDF_UCHAR      { "F5" }
"LABLAXIS"     CDF_UCHAR      { "Local pitch angle" }
"SI_conversion" CDF_UCHAR      { "0.0174533>rad" }
"UNITS"        CDF_UCHAR      { "degrees" }
"VALIDMIN"     CDF_UCHAR      { "0.0" }
"VALIDMAX"     CDF_UCHAR      { "180.0" }
"VAR_TYPE"     CDF_UCHAR      { "support_data" }
"VAR_NOTES"    CDF_UCHAR      { "10 degree pitch angle bins based on " -
"the assumption of gyrotropy." } .
```

```
! NRV values follow...
```

```
[1,1] = 0.0
[1,2] = 20.0
[2,1] = 20.0
[2,2] = 40.0
[3,1] = 40.0
[3,2] = 60.0
```



Standard file format guidelines

```
[4,1] = 60.0
[4,2] = 80.0
[5,1] = 80.0
[5,2] = 100.0
[6,1] = 100.0
[6,2] = 120.0
[7,1] = 120.0
[7,2] = 140.0
[8,1] = 140.0
[8,2] = 160.0
[9,1] = 160.0
[9,2] = 180.0
```

```
! Variable      Data      Number      Record      Dimension
! Name          Type      Elements    Dims      Sizes      Variance    Variances
! -----      -
```

```
"FPDU_Alpha_Eq"
CDF_REAL4      1      2      9 2      T      T T
```

```
! Attribute      Data
! Name           Type           Value
! -----
```

```
"CATDESC"      CDF_UCHAR      { "Equatorial pitch angle bins for FPDU" }
"DEPEND_0"     CDF_UCHAR      { "Epoch" }
"DICT_KEY"     CDF_UCHAR      { "angle>pitch" }
"FIELDNAM"    CDF_UCHAR      { "FPDU Alpha Eq" }
"FILLVAL"     CDF_UCHAR      { "-1.0E31" }
"FORMAT"      CDF_UCHAR      { "F5" }
"LABLAXIS"    CDF_UCHAR      { "Equatorial pitch angle" }
"SI_conversion"
CDF_UCHAR      { "0.0174533>rad" }
"UNITS"       CDF_UCHAR      { "degrees" }
"VALIDMIN"    CDF_UCHAR      { "0.0" }
"VALIDMAX"    CDF_UCHAR      { "180.0" }
"VAR_TYPE"    CDF_UCHAR      { "support_data" }
"VAR_NOTES"   CDF_UCHAR      { "10 degree pitch angle bins based on " -
"the assumption of gyrotropy." } .
```

! RV values were not requested.

```
! Variable      Data      Number      Record      Dimension
! Name          Type      Elements    Dims      Sizes      Variance    Variances
! -----      -
```

```
"FPDU_LABL_1"  CDF_CHAR      21      1      32      F      T
```

```
! Attribute      Data
! Name           Type           Value
! -----
```

```
"CATDESC"      CDF_UCHAR      { "Energy labels for FPDU" }
"DICT_KEY"     CDF_UCHAR      { "label>energy" }
"FIELDNAM"    CDF_UCHAR      { "FPDU_LABL_1" }
"FORMAT"      CDF_UCHAR      { "A21" }
"VAR_TYPE"    CDF_UCHAR      { "metadata" } .
```



Standard file format guidelines

! NRV values follow...

```
[1] = { " 0.017 - 0.021 MeV" }
[2] = { " 0.021 - 0.028 MeV" }
[3] = { " 0.028 - 0.037 MeV" }
[4] = { " 0.037 - 0.050 MeV" }
[5] = { " 0.050 - 0.066 MeV" }
[6] = { " 0.066 - 0.088 MeV" }
[7] = { " 0.088 - 0.118 MeV" }
[8] = { " 0.118 - 0.161 MeV" }
[9] = { " 0.161 - 0.221 MeV" }
[10] = { " 0.221 - 0.303 MeV" }
[11] = { " 0.303 - 0.417 MeV" }
[12] = { " 0.417 - 0.574 MeV" }
[13] = { " 0.574 - 0.791 MeV" }
[14] = { " 0.791 - 1.091 MeV" }
[15] = { " 1.091 - 1.505 MeV" }
[16] = { " 1.505 - 2.000 MeV" }
[17] = { " 1.000 - 3.000 MeV" }
[18] = { " 3.000 - 3.740 MeV" }
[19] = { " 3.740 - 4.650 MeV" }
[20] = { " 4.650 - 5.790 MeV" }
[21] = { " 5.790 - 7.210 MeV" }
[22] = { " 7.210 - 8.970 MeV" }
[23] = { " 8.970 - 11.170 MeV" }
[24] = { " 11.170 - 13.910 MeV" }
[25] = { " 13.910 - 17.320 MeV" }
[26] = { " 17.320 - 21.560 MeV" }
[27] = { " 21.560 - 26.850 MeV" }
[28] = { " 26.850 - 33.430 MeV" }
[29] = { " 33.430 - 41.620 MeV" }
[30] = { " 41.620 - 51.820 MeV" }
[31] = { " 51.820 - 64.510 MeV" }
[32] = { " 64.510 - 80.320 MeV" }
```

| ! Variable ! Name ! ----- | Data Type ---- | Number Elements ----- | Dims ---- | Sizes ----- | Record Variance ----- | Dimension Variances ----- |
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|

| | | | | | | |
|---------------|----------|----|---|---|---|---|
| "FPDU_LABL_2" | CDF_CHAR | 12 | 1 | 9 | F | T |
|---------------|----------|----|---|---|---|---|

| ! Attribute ! Name ! ----- | Data Type ---- | Value ----- |
|----------------------------------|----------------------|----------------|
|----------------------------------|----------------------|----------------|

| | | |
|------------|-----------|-----------------------------------|
| "CATDESC" | CDF_UCHAR | { "Pitch-angle labels for FPDU" } |
| "DICT_KEY" | CDF_UCHAR | { "label>angle" } |
| "FIELDNAM" | CDF_UCHAR | { "FPDU_LABL_2" } |
| "FORMAT" | CDF_UCHAR | { "A12" } |
| "VAR_TYPE" | CDF_UCHAR | { "metadata" } . |

! NRV values follow...

```
[1] = { "PA 0 - 20" }
[2] = { "PA 20 - 40" }
[3] = { "PA 40 - 60" }
[4] = { "PA 60 - 80" }
```



Standard file format guidelines

```
[5] = { "PA 80 - 100" }
[6] = { "PA 100 - 120" }
[7] = { "PA 120 - 140" }
[8] = { "PA 140 - 160" }
[9] = { "PA 160 - 180" }
```

```
! Variable      Data      Number      Record      Dimension
! Name         Type      Elements    Dims      Sizes      Variance    Variances
! -----      ----      -
```

```
"FPDU_Quality"
CDF_INT2      1      2      9 32      T      T T
```

```
! Attribute     Data
! Name         Type      Value
! -----      ----      -
```

```
"CATDESC"      CDF_UCHAR  { "FPDU Quality flag" }
"DEPEND_0"     CDF_UCHAR  { "Epoch" }
"DEPEND_1"     CDF_UCHAR  { "FPDU_Energy" }
"DICT_KEY"     CDF_UCHAR  { "flag>quality" }
"FIELDNAM"     CDF_UCHAR  { "FPDU_Quality" }
"FILLVAL"      CDF_UCHAR  { "-32767" }
"FORMAT"       CDF_UCHAR  { "I11" }
"LABLAXIS"     CDF_UCHAR  { "Quality" }
"LABL_PTR_1"   CDF_UCHAR  { "FPDU_LABL_1" }
"UNITS"        CDF_UCHAR  { "none" }
"VALIDMIN"     CDF_UCHAR  { "-32767" }
"VALIDMAX"     CDF_UCHAR  { "32767" }
"VAR_TYPE"     CDF_UCHAR  { "support_data" }
"VAR_NOTES"    CDF_UCHAR  { "0 denotes highest quality. 1 denotes " -
    "problem with time resolution. 2 " -
    "denotes possible contamination. 3 " -
    "denotes saturation. 4 denotes any " -
    "other problem and 10 denotes that data" -
    " have not been qualified" } .
```

! RV values were not requested.

```
! Variable      Data      Number      Record      Dimension
! Name         Type      Elements    Dims      Sizes      Variance    Variances
! -----      ----      -
```

```
"FPDU_Crosscalib"
CDF_REAL4      1      1      32      F      T
```

```
! Attribute     Data
! Name         Type      Value
! -----      ----      -
```

```
"CATDESC"      CDF_UCHAR  { "Crosscalibration factors for FPDO" }
"DEPEND_0"     CDF_UCHAR  { "FPDU_Energy" }
"DICT_KEY"     CDF_UCHAR  { "ratio>particle_flux" }
"FIELDNAM"     CDF_UCHAR  { "FPDU_Crosscalib" }
"FILLVAL"      CDF_UCHAR  { "-1.0E31" }
"FORMAT"       CDF_UCHAR  { "F5" }
```



Standard file format guidelines

```
"LABLAXIS"      CDF_UCHAR      { "Crosscalibration factors" }
"SI_conversion" CDF_UCHAR      { "none" }
"UNITS"         CDF_UCHAR      { "none" }
"VALIDMIN"     CDF_UCHAR      { "0.0" }
"VALIDMAX"     CDF_UCHAR      { "1.0E31" }
"VAR_TYPE"     CDF_UCHAR      { "support_data" }
"VAR_NOTES"    CDF_UCHAR      { "none" } .
```

! NRV values follow...

```
[1] = 1.0
[2] = 1.0
[3] = 1.0
[4] = 1.0
[5] = 1.0
[6] = 1.0
[7] = 1.0
[8] = 1.0
[9] = 1.0
[10] = 1.0
[11] = 1.0
[12] = 1.0
[13] = 1.0
[14] = 1.0
[15] = 1.0
[16] = 1.0
[17] = 1.0
[18] = 1.0
[19] = 1.0
[20] = 1.0
[21] = 1.0
[22] = 1.0
[23] = 1.0
[24] = 1.0
[25] = 1.0
[26] = 1.0
[27] = 1.0
[28] = 1.0
[29] = 1.0
[30] = 1.0
[31] = 1.0
[32] = 1.0
```

| ! Variable ! Name ! ----- | Data Type ---- | Number Elements ----- | Dims ---- | Sizes ----- | Record Variance ----- | Dimension Variances ----- |
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|

| | | | | | | |
|--------|-----------|---|---|----|---|---|
| "FEDO" | CDF_REAL4 | 1 | 1 | 24 | T | T |
|--------|-----------|---|---|----|---|---|

| ! Attribute ! Name ! ----- | Data Type ---- | Value ----- |
|----------------------------------|----------------------|----------------|
|----------------------------------|----------------------|----------------|

| | | |
|------------|-----------|--|
| "AVG_TYPE" | CDF_UCHAR | { "log" } |
| "CATDESC" | CDF_UCHAR | { "Omnidirectional Differential Electron " - "Flux" } |
| "DEPEND_0" | CDF_UCHAR | { "Epoch" } |



Standard file format guidelines

```
"DEPEND_1"      CDF_UCHAR      { "FEDO_Energy" }
"DICTIONARY_KEY" CDF_UCHAR      { "particle_flux>electron-differential-om" -
"ni-directional" }

"DISPLAY_TYPE"
CDF_UCHAR      { "time_series" }
"V_PARENT"      CDF_UCHAR      { "FEDU" }
"FIELDNAM"      CDF_UCHAR      { "FEDO" }
"FILLVAL"       CDF_UCHAR      { "-1.0E31" }
"FORMAT"        CDF_UCHAR      { "E10.3" }
"LABEL_PTR_1"   CDF_UCHAR      { "FEDO_LABEL_1" }
"QUALITY_VAR"   CDF_UCHAR      { "FEDO_Quality" }
"SCALE_TY"      CDF_UCHAR      { "log" }
"SI_conversion" CDF_UCHAR      { "1.602e-17>m^-2 s^-1 sr^-1 J^-1" }
"UNITS"         CDF_UCHAR      { "cm^-2 s^-1 sr^-1 MeV^-1" }
"VALIDMIN"      CDF_UCHAR      { "-1.0E31" }
"VALIDMAX"      CDF_UCHAR      { "1.0E31" }
"VAR_TYPE"      CDF_UCHAR      { "data" }
"VAR_NOTES"     CDF_UCHAR      { "FEDO, Dimension 1 holds channels." } .
```

! RV values were not requested.

| ! Variable Name | Data Type | Number Elements | Dims | Sizes | Record Variance | Dimension Variances |
|-----------------|-----------|-----------------|------|-------|-----------------|---------------------|
|-----------------|-----------|-----------------|------|-------|-----------------|---------------------|

| | | | | | | |
|---------------|-----------|---|---|------|---|-----|
| "FEDO_Energy" | CDF_REAL4 | 1 | 2 | 24 2 | F | T T |
|---------------|-----------|---|---|------|---|-----|

| ! Attribute Name | Data Type | Value |
|------------------|-----------|-------|
|------------------|-----------|-------|

```
"CATDESC"      CDF_UCHAR      { "Energy levels for FEDO" }
"DICTIONARY_KEY" CDF_UCHAR      { "energy>band" }
"FIELDNAM"      CDF_UCHAR      { "FEDO Energy" }
"FILLVAL"       CDF_UCHAR      { "-1.0E31" }
"FORMAT"        CDF_UCHAR      { "F5" }
"LABLAXIS"      CDF_UCHAR      { "Energy" }
"SI_conversion" CDF_UCHAR      { "6.242e12>J" }
"UNITS"         CDF_UCHAR      { "MeV" }
"VALIDMIN"      CDF_UCHAR      { "0.0" }
"VALIDMAX"      CDF_UCHAR      { "1.0E31" }
"VAR_TYPE"      CDF_UCHAR      { "support_data" }
"VAR_NOTES"     CDF_UCHAR      { "Energy levels are a combination of IES" -
" and HISTe" } .
```

! NRV values follow...

```
[1,1] = 0.0185
[1,2] = 0.0305
[2,1] = 0.0305
[2,2] = 0.0425
[3,1] = 0.0425
[3,2] = 0.0585
[4,1] = 0.0585
```



Standard file format guidelines

```
[4,2] = 0.0805
[5,1] = 0.0805
[5,2] = 0.1105
[6,1] = 0.1105
[6,2] = 0.1525
[7,1] = 0.1525
[7,2] = 0.2125
[8,1] = 0.2125
[8,2] = 0.2945
[9,1] = 0.2945
[9,2] = 0.4065
[10,1] = 0.4065
[10,2] = 0.4265
[11,1] = 0.656734
[11,2] = 0.700186
[12,1] = 0.700186
[12,2] = 0.743639
[13,1] = 0.743639
[13,2] = 0.980043
[14,1] = 0.980042
[14,2] = 1.15826
[15,1] = 1.15826
[15,2] = 1.42174
[16,1] = 1.42174
[16,2] = 1.69826
[17,1] = 1.69826
[17,2] = 2.10174
[18,1] = 2.10174
[18,2] = 2.77826
[19,1] = 2.77826
[19,2] = 3.48174
[20,1] = 3.48174
[20,2] = 4.57826
[21,1] = 4.57826
[21,2] = 5.68174
[22,1] = 5.68174
[22,2] = 7.17825
[23,1] = 7.17826
[23,2] = 8.94174
[24,1] = 8.94174
[24,2] = 11.2783
```

```
! Variable      Data      Number      Record      Dimension
! Name         Type      Elements    Dims      Sizes      Variance    Variances
! -----      ----      -
```

```
"FEDO_LABL_1"  CDF_CHAR      21          1          24          F           T
```

```
! Attribute    Data
! Name         Type      Value
! -----      ----      -
```

```
"CATDESC"     CDF_UCHAR    { "Energy labels for FEDO" }
"DICT_KEY"    CDF_UCHAR    { "label>energy" }
"FIELDNAM"    CDF_UCHAR    { "FEDO_LABL_1" }
"FORMAT"      CDF_UCHAR    { "A21" }
"VAR_TYPE"    CDF_UCHAR    { "metadata" } .
```



Standard file format guidelines

! NRV values follow...

- [1] = { " 0.019 - 0.030 MeV" }
- [2] = { " 0.031 - 0.042 MeV" }
- [3] = { " 0.042 - 0.059 MeV" }
- [4] = { " 0.059 - 0.080 MeV" }
- [5] = { " 0.081 - 0.111 MeV" }
- [6] = { " 0.111 - 0.152 MeV" }
- [7] = { " 0.152 - 0.213 MeV" }
- [8] = { " 0.212 - 0.294 MeV" }
- [9] = { " 0.295 - 0.406 MeV" }
- [10] = { " 0.406 - 0.426 MeV" }
- [11] = { " 0.657 - 0.700 MeV" }
- [12] = { " 0.700 - 0.744 MeV" }
- [13] = { " 0.744 - 0.980 MeV" }
- [14] = { " 0.980 - 1.158 MeV" }
- [15] = { " 1.158 - 1.422 MeV" }
- [16] = { " 1.422 - 1.698 MeV" }
- [17] = { " 1.698 - 2.102 MeV" }
- [18] = { " 2.102 - 2.778 MeV" }
- [19] = { " 2.778 - 3.482 MeV" }
- [20] = { " 3.482 - 4.578 MeV" }
- [21] = { " 4.578 - 5.682 MeV" }
- [22] = { " 5.682 - 7.178 MeV" }
- [23] = { " 7.178 - 8.942 MeV" }
- [24] = { " 8.942 - 11.278 MeV" }

| ! Variable ! Name ! ----- | Data Type ---- | Number Elements ----- | Dims ---- | Sizes ----- | Record Variance ----- | Dimension Variances ----- |
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|

"FEDO_Quality"

| | | | | | |
|----------|---|---|----|---|---|
| CDF_INT2 | 1 | 1 | 24 | T | T |
|----------|---|---|----|---|---|

! Attribute

| ! Name ! ----- | Data Type ---- | Value ----- |
|-------------------|----------------------|----------------|
|-------------------|----------------------|----------------|

- "CATDESC" CDF_UCHAR { "FEDO Quality flag" }
- "DEPEND_0" CDF_UCHAR { "Epoch" }
- "DEPEND_1" CDF_UCHAR { "FEDO_Energy" }
- "DICT_KEY" CDF_UCHAR { "flag>quality" }
- "FIELDNAM" CDF_UCHAR { "FEDO_Quality" }
- "FILLVAL" CDF_UCHAR { "-32767" }
- "FORMAT" CDF_UCHAR { "I11" }
- "LABLAXIS" CDF_UCHAR { "Quality" }
- "LABL_PTR_1" CDF_UCHAR { "FEDO_LABL_1" }
- "UNITS" CDF_UCHAR { "none" }
- "VALIDMIN" CDF_UCHAR { "-32767" }
- "VALIDMAX" CDF_UCHAR { "32767" }
- "VAR_TYPE" CDF_UCHAR { "support_data" }
- "VAR_NOTES" CDF_UCHAR { "0 denotes highest quality. 1 denotes " -
"problem with time resolution. 2 " -
"denotes possible contamination. 3 " -
"denotes saturation. 4 denotes any " -
"other problem and 10 denotes that data" -
" have not been qualified" } .

Panel on Radiation Belt Environment Modeling (PRBEM)



V1.0

Standard file format guidelines

! RV values were not requested.

| ! Variable ! Name ! ----- | Data Type ----- | Number Elements ----- | Dims ----- | Sizes ----- | Record Variance ----- | Dimension Variances ----- |
|---------------------------------|-----------------------|-----------------------------|---------------|----------------|-----------------------------|---------------------------------|
|---------------------------------|-----------------------|-----------------------------|---------------|----------------|-----------------------------|---------------------------------|

"FEDO_Crossscalib"

| | | | | | |
|-----------|---|---|----|---|---|
| CDF_REAL4 | 1 | 1 | 24 | F | T |
|-----------|---|---|----|---|---|

! Attribute

| ! Name ! ----- | Data Type ----- | Value ----- |
|-------------------|-----------------------|----------------|
|-------------------|-----------------------|----------------|

| | | |
|-----------------|-----------|---|
| "CATDESC" | CDF_UCHAR | { "Crosscalibration factors for FEDO" } |
| "DEPEND_0" | CDF_UCHAR | { "FEDO_Energy" } |
| "DICT_KEY" | CDF_UCHAR | { "ratio>particle_flux" } |
| "FIELDNAM" | CDF_UCHAR | { "FEDO Crossscalib" } |
| "FILLVAL" | CDF_UCHAR | { "-1.0E31" } |
| "FORMAT" | CDF_UCHAR | { "F5" } |
| "LABLAXIS" | CDF_UCHAR | { "Crosscalibration factors" } |
| "SI_conversion" | CDF_UCHAR | { "none" } |
| "UNITS" | CDF_UCHAR | { "none" } |
| "VALIDMIN" | CDF_UCHAR | { "0.0" } |
| "VALIDMAX" | CDF_UCHAR | { "1.0E31" } |
| "VAR_TYPE" | CDF_UCHAR | { "support_data" } |
| "VAR_NOTES" | CDF_UCHAR | { "none" } . |

! NRV values follow...

```
[1] = 1.0
[2] = 1.0
[3] = 1.0
[4] = 1.0
[5] = 1.0
[6] = 1.0
[7] = 1.0
[8] = 1.0
[9] = 1.0
[10] = 1.0
[11] = 1.0
[12] = 1.0
[13] = 1.0
[14] = 1.0
[15] = 1.0
[16] = 1.0
[17] = 1.0
[18] = 1.0
[19] = 1.0
[20] = 1.0
[21] = 1.0
[22] = 1.0
[23] = 1.0
[24] = 1.0
```

| ! Variable | Data | Number | Record | Dimension |
|------------|------|--------|--------|-----------|
|------------|------|--------|--------|-----------|

Panel on Radiation Belt Environment Modeling (PRBEM)



V1.0

Standard file format guidelines

```

! Name          Type          Elements  Dims  Sizes  Variance  Variances
! -----
" FEDU "       CDF_REAL4      1         2     9 24     T       T T

! Attribute     Data
! Name          Type          Value
! -----
"AVG_TYPE"     CDF_UCHAR     { "log" }
"CATDESC"     CDF_UCHAR     { "Unidirectional Differential Electron " -
"Flux" }
"DEPEND_0"    CDF_UCHAR     { "Epoch" }
"DEPEND_1"    CDF_UCHAR     { "FEDU_Energy" }
"DEPEND_2"    CDF_UCHAR     { "FEDU_Alpha" }
"DICT_KEY"    CDF_UCHAR     { "particle_flux>electron-differential-di" -
"rectional" }
"DISPLAY_TYPE"
CDF_UCHAR     { "time_series" }
"FIELDNAM"    CDF_UCHAR     { "FEDU" }
"FILLVAL"     CDF_UCHAR     { "-1.0E31" }
"FORMAT"      CDF_UCHAR     { "E10.3" }
"LABL_PTR_1"  CDF_UCHAR     { "FEDU_LABL_1" }
"QUALITY_VAR"
CDF_UCHAR     { "FEDU_Quality" }
"SCALETYP"    CDF_UCHAR     { "log" }
"SI_conversion"
CDF_UCHAR     { "1.602e-17>m^-2 s^-1 sr^-1 J^-1" }
"UNITS"       CDF_UCHAR     { "cm^-2 s^-1 sr^-1 KeV^-1" }
"VALIDMIN"    CDF_UCHAR     { "-1.0E31" }
"VALIDMAX"    CDF_UCHAR     { "1.0E31" }
"VAR_TYPE"    CDF_UCHAR     { "data" }
"VAR_NOTES"   CDF_UCHAR     { "FEDU, Dimension 1 holds channels, " -
"Dimension 2 holds pitch angles." } .

! RV values were not requested.

```

```

! Variable     Data      Number      Record  Dimension
! Name         Type      Elements  Dims  Sizes  Variance  Variances
! -----
" FEDU_Energy " CDF_REAL4  1         2     24 2     F       T T

! Attribute     Data
! Name          Type          Value
! -----
"CATDESC"     CDF_UCHAR     { "Energy levels for FEDU" }
"DICT_KEY"    CDF_UCHAR     { "energy>band" }
"FIELDNAM"    CDF_UCHAR     { "FEDU Energy" }
"FILLVAL"     CDF_UCHAR     { "-1.0E31" }
"FORMAT"      CDF_UCHAR     { "F5" }
"LABLAXIS"    CDF_UCHAR     { "Energy" }
"SI_conversion"
CDF_UCHAR     { "6.242e12>J" }
"UNITS"       CDF_UCHAR     { "MeV" }
"VALIDMIN"    CDF_UCHAR     { "0.0" }

```

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```
"VALIDMAX"    CDF_UCHAR    { "1.0E31" }
"VAR_TYPE"    CDF_UCHAR    { "support_data" }
"VAR_NOTES"   CDF_UCHAR    { "Energy levels are a combination of IES" -
                             " and HISTe" } .
```

! NRV values follow...

```
[1,1] = 0.0185
[1,2] = 0.0305
[2,1] = 0.0305
[2,2] = 0.0425
[3,1] = 0.0425
[3,2] = 0.0585
[4,1] = 0.0585
[4,2] = 0.0805
[5,1] = 0.0805
[5,2] = 0.1105
[6,1] = 0.1105
[6,2] = 0.1525
[7,1] = 0.1525
[7,2] = 0.2125
[8,1] = 0.2125
[8,2] = 0.2945
[9,1] = 0.2945
[9,2] = 0.4065
[10,1] = 0.4065
[10,2] = 0.4265
[11,1] = 0.656734
[11,2] = 0.700186
[12,1] = 0.700186
[12,2] = 0.743639
[13,1] = 0.743639
[13,2] = 0.980043
[14,1] = 0.980042
[14,2] = 1.15826
[15,1] = 1.15826
[15,2] = 1.42174
[16,1] = 1.42174
[16,2] = 1.69826
[17,1] = 1.69826
[17,2] = 2.10174
[18,1] = 2.10174
[18,2] = 2.77826
[19,1] = 2.77826
[19,2] = 3.48174
[20,1] = 3.48174
[20,2] = 4.57826
[21,1] = 4.57826
[21,2] = 5.68174
[22,1] = 5.68174
[22,2] = 7.17825
[23,1] = 7.17826
[23,2] = 8.94174
[24,1] = 8.94174
[24,2] = 11.2783
```

```
! Variable      Data      Number      Record      Dimension
! Name          Type      Elements    Dims      Sizes      Variance    Variances
```

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```

! -----
" FEDU_Alpha "      CDF_REAL4      1      2      9 2      F      T T

! Attribute      Data
! Name          Type          Value
! -----
"CATDESC"       CDF_UCHAR      { "Local pitch angle bins for FEDU" }
"DICT_KEY"      CDF_UCHAR      { "angle>pitch" }
"FIELDNAM"     CDF_UCHAR      { "FEDU Alpha" }
"FILLVAL"      CDF_UCHAR      { "-1.0E31" }
"FORMAT"       CDF_UCHAR      { "F5" }
"LABLAXIS"     CDF_UCHAR      { "Local pitch angle" }
"SI_conversion" CDF_UCHAR      { "0.0174533>rad" }
"UNITS"        CDF_UCHAR      { "degrees" }
"VALIDMIN"     CDF_UCHAR      { "0.0" }
"VALIDMAX"     CDF_UCHAR      { "180.0" }
"VAR_TYPE"     CDF_UCHAR      { "support_data" }
"VAR_NOTES"    CDF_UCHAR      { "10 degree pitch angle bins based on " -
                    "the assumption of gyrotropy." } .

! NRV values follow...

[1,1] = 0.0
[1,2] = 20.0
[2,1] = 20.0
[2,2] = 40.0
[3,1] = 40.0
[3,2] = 60.0
[4,1] = 60.0
[4,2] = 80.0
[5,1] = 80.0
[5,2] = 100.0
[6,1] = 100.0
[6,2] = 120.0
[7,1] = 120.0
[7,2] = 140.0
[8,1] = 140.0
[8,2] = 160.0
[9,1] = 160.0
[9,2] = 180.0

! Variable      Data      Number      Record      Dimension
! Name         Type      Elements    Dims      Sizes      Variance    Variances
! -----
" FEDU_Alpha_Eq " CDF_REAL4      1      2      9 2      T      T T

! Attribute      Data
! Name          Type          Value
! -----
"CATDESC"       CDF_UCHAR      { "Equatorial pitch angle bins for FEDU" }
"DEPEND_0"      CDF_UCHAR      { "Epoch" }
"DICT_KEY"      CDF_UCHAR      { "angle>pitch" }

```

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```
"FIELDNAM"    CDF_UCHAR    { "FEDU Alpha Eq" }
"FILLVAL"     CDF_UCHAR    { "-1.0E31" }
"FORMAT"      CDF_UCHAR    { "F5" }
"LABLAXIS"    CDF_UCHAR    { "Equatorial pitch angle" }
"SI_conversion"
                CDF_UCHAR    { "0.0174533>rad" }
"UNITS"       CDF_UCHAR    { "degrees" }
"VALIDMIN"    CDF_UCHAR    { "0.0" }
"VALIDMAX"    CDF_UCHAR    { "180.0" }
"VAR_TYPE"    CDF_UCHAR    { "support_data" }
"VAR_NOTES"   CDF_UCHAR    { "10 degree pitch angle bins based on " -
                                "the assumption of gyrotropy." } .
```

! RV values were not requested.

```
! Variable      Data      Number      Record      Dimension
! Name          Type      Elements    Dims        Sizes        Variance    Variances
! -----
```

```
"FEDU_LABL_1"  CDF_CHAR      21          1           24           F           T
```

```
! Attribute     Data
! Name          Type          Value
! -----
```

```
"CATDESC"      CDF_UCHAR    { "Energy labels for FEDU" }
"DICT_KEY"     CDF_UCHAR    { "label>energy" }
"FIELDNAM"     CDF_UCHAR    { "FEDU_LABL_1" }
"FORMAT"       CDF_UCHAR    { "A21" }
"VAR_TYPE"     CDF_UCHAR    { "metadata" } .
```

! NRV values follow...

```
[1] = { " 0.019 - 0.030 MeV" }
[2] = { " 0.031 - 0.042 MeV" }
[3] = { " 0.042 - 0.059 MeV" }
[4] = { " 0.059 - 0.080 MeV" }
[5] = { " 0.081 - 0.111 MeV" }
[6] = { " 0.111 - 0.152 MeV" }
[7] = { " 0.152 - 0.213 MeV" }
[8] = { " 0.212 - 0.294 MeV" }
[9] = { " 0.295 - 0.406 MeV" }
[10] = { " 0.406 - 0.426 MeV" }
[11] = { " 0.657 - 0.700 MeV" }
[12] = { " 0.700 - 0.744 MeV" }
[13] = { " 0.744 - 0.980 MeV" }
[14] = { " 0.980 - 1.158 MeV" }
[15] = { " 1.158 - 1.422 MeV" }
[16] = { " 1.422 - 1.698 MeV" }
[17] = { " 1.698 - 2.102 MeV" }
[18] = { " 2.102 - 2.778 MeV" }
[19] = { " 2.778 - 3.482 MeV" }
[20] = { " 3.482 - 4.578 MeV" }
[21] = { " 4.578 - 5.682 MeV" }
[22] = { " 5.682 - 7.178 MeV" }
[23] = { " 7.178 - 8.942 MeV" }
[24] = { " 8.942 - 11.278 MeV" }
```


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```
! Variable      Data      Number      Record      Dimension
! Name          Type      Elements    Dims      Sizes      Variance    Variances
! -----      ----      -
```

```
"FEDU_LABL_2"  CDF_CHAR      12          1          9          F          T
```

```
! Attribute      Data
! Name           Type           Value
! -----      ----
```

```
"CATDESC"      CDF_UCHAR      { "Pitch-angle labels for FEDU" }
"DICT_KEY"      CDF_UCHAR      { "label>angle" }
"FIELDNAM"      CDF_UCHAR      { "FEDU_LABL_2" }
"FORMAT"        CDF_UCHAR      { "A12" }
"VAR_TYPE"      CDF_UCHAR      { "metadata" } .
```

! NRV values follow...

```
[1] = { "PA 0 - 20" }
[2] = { "PA 20 - 40" }
[3] = { "PA 40 - 60" }
[4] = { "PA 60 - 80" }
[5] = { "PA 80 - 100" }
[6] = { "PA 100 - 120" }
[7] = { "PA 120 - 140" }
[8] = { "PA 140 - 160" }
[9] = { "PA 160 - 180" }
```

```
! Variable      Data      Number      Record      Dimension
! Name          Type      Elements    Dims      Sizes      Variance    Variances
! -----      ----      -
```

```
"FEDU_Quality"  CDF_INT2      1          2          9 24      T          T T
```

```
! Attribute      Data
! Name           Type           Value
! -----      ----
```

```
"CATDESC"      CDF_UCHAR      { "FEDU Quality flag" }
"DEPEND_0"      CDF_UCHAR      { "Epoch" }
"DEPEND_1"      CDF_UCHAR      { "FEDU_Energy" }
"DICT_KEY"      CDF_UCHAR      { "flag>quality" }
"FIELDNAM"      CDF_UCHAR      { "FEDU_Quality" }
"FILLVAL"       CDF_UCHAR      { "-32767" }
"FORMAT"        CDF_UCHAR      { "I11" }
"LABLAXIS"      CDF_UCHAR      { "Quality" }
"LABL_PTR_1"    CDF_UCHAR      { "FEDU_LABL_1" }
"UNITS"         CDF_UCHAR      { "none" }
"VALIDMIN"      CDF_UCHAR      { "-32767" }
"VALIDMAX"      CDF_UCHAR      { "32767" }
"VAR_TYPE"      CDF_UCHAR      { "support_data" }
"VAR_NOTES"     CDF_UCHAR      { "0 denotes highest quality. 1 denotes " -
"problem with time resolution. 2 " -
"denotes possible contamination. 3 " -
"denotes saturation. 4 denotes any " -
```

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"other problem and 10 denotes that data" -
 " have not been qualified" } .

! RV values were not requested.

| ! Variable ! Name ! ----- | Data Type ---- | Number Elements ----- | Dims ---- | Sizes ----- | Record Variance ----- | Dimension Variances ----- |
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|
|---------------------------------|----------------------|-----------------------------|--------------|----------------|-----------------------------|---------------------------------|

"FEDU_Crossscalib"

| | | | | | |
|-----------|---|---|----|---|---|
| CDF_REAL4 | 1 | 1 | 24 | F | T |
|-----------|---|---|----|---|---|

| ! Attribute ! Name ! ----- | Data Type ---- | Value ----- |
|----------------------------------|----------------------|----------------|
|----------------------------------|----------------------|----------------|

| | | |
|-----------------|-----------|---|
| "CATDESC" | CDF_UCHAR | { "Crosscalibration factors for FEDU" } |
| "DEPEND_0" | CDF_UCHAR | { "FEDU_Energy" } |
| "DICT_KEY" | CDF_UCHAR | { "ratio>particle_flux" } |
| "FIELDNAM" | CDF_UCHAR | { "FEDU Crossscalib" } |
| "FILLVAL" | CDF_UCHAR | { "-1.0E31" } |
| "FORMAT" | CDF_UCHAR | { "F5" } |
| "LABLAXIS" | CDF_UCHAR | { "Crosscalibration factors" } |
| "SI_conversion" | CDF_UCHAR | { "none" } |
| "UNITS" | CDF_UCHAR | { "none" } |
| "VALIDMIN" | CDF_UCHAR | { "0.0" } |
| "VALIDMAX" | CDF_UCHAR | { "1.0E31" } |
| "VAR_TYPE" | CDF_UCHAR | { "support_data" } |
| "VAR_NOTES" | CDF_UCHAR | { "none" } . |

! NRV values follow...

[1] = 1.0
 [2] = 1.0
 [3] = 1.0
 [4] = 1.0
 [5] = 1.0
 [6] = 1.0
 [7] = 1.0
 [8] = 1.0
 [9] = 1.0
 [10] = 1.0
 [11] = 1.0
 [12] = 1.0
 [13] = 1.0
 [14] = 1.0
 [15] = 1.0
 [16] = 1.0
 [17] = 1.0
 [18] = 1.0
 [19] = 1.0
 [20] = 1.0
 [21] = 1.0
 [22] = 1.0
 [23] = 1.0
 [24] = 1.0

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#end