Open Data Interface
Database Technical Note

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0.1	2008-10-20	First draft.
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1.0	September 25, 2009	Major revision.

Contents

1 Summary

This document describes the data model of the *Open Database Interface* (ODI) database.

2 Abbreviations

ACE Advanded Composition Explorer

ASCII American Standard Code for Information Interchange

CDF Common Data Format

GOES Geostationary Operational Environment Satellite

HTTP Hypertext Transfer Protocol

ITT/IDL ITT Interactive Data Language

ODI Open Data interface

SAAPS Satellite Anomaly Analysis and Prediction System

SEDAT Space Environment Data Analysis Tool

SOW Statement of Work

SPENVIS Space Environment Information System

SQL Structured Query Language

TSO Time Series Object

3 Introduction

The Open Data Interface (ODI) is a database system that will be accessible and store data from SAAPS, SEDAT, and SPENVIS systems. As ODI is based on MySQL the system is accessible from other systems too. Interfaces to languages like C, Java, PHP, IDL, Matlab exist.

One of the requirements on ODI is that it must be able to store data compliant with the CDF/ISTP/PRBEM guidelines. ISTP defines a set of metadata that must be present to describe solar-terrestrial physics data. ODI is constructed so that it can hold all the ISTP metadata and therefore becomes a general system for storing solar-terrestrial physics data. ODI makes use of the CDF/ISTP metadata definition, seen e.g. in the CDF skeleton files, to populate the ODI data tables holding the metadata. The same approach is also used for non-CDF files, like ASCII files. The PRBEM guidelines extend the ISTP guidelines by defining a set of variables relevant for radiation belt data. The PRBEM extension does not affect the ODI database model.

In the following sections we describe the underlying ISTP metadata, how it is stored in ODI, how tables to hold metadata and data are created, how data are ingested and exported.

4 Analysis of the CDF/ISTP guidelines

The space physics guide lines for CDF[1] state:

> 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 and accessible through the CDAWeb Display and Retrieval system. These guidelines have been adopted by a wide SEC community.

Thus, both the data and the metadata are contained in one file following the CDF standard.

One CDF file contains at most one day of data and thus data spanning over multiple days are distributed over multiple files.

A variable in CDF may be of any dimension, e.g. scalar (0-D), vector (1-D), matrix (2-D), and so on. A variable can be defined to vary from record to record (record variant, RV) or be constant over records (non-record variant, NRV). For each dimension the variable may also be defined to vary or not vary.

A CDF file contains different categories of data. Firstly there are the file specific data like `CDF NAME`, `DATA ENCODING`, `MAJORITY`, and `FORMAT`. Secondly there are the *global attributes* which hold a general description of the data. Then there are definition of the variables that contain the name of the variable, the data type, dimension, and how it varies. To each variable there is a set of *variable attributes* that describes the variable and defines any dependencies with other variables. Each variable is further categorised as *data*, *support_data*, and *metadata* and are defined as follows[2]:

data These are variables of primary importance (e.g., density, magnetic field, 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).

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.

support_data These are variables of secondary importance (e.g., time, energy bands associated with particle flux).

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

[1] http://spdf.gsfc.nasa.gov/sp_use_of_cdf.html
[2] lhttp://spdf.gsfc.nasa.gov/istp_guide/variables.html

metadata These are variables of secondary importance e.g., a variable holding "Bx,By,Bz" to label magnetic field).

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.

The only required variable is `Epoch` (support_data) to hold time. It must be RV and 0-D. All time varying variables will depend on the Epoch variable.

5 The ODI database model

In a MySQL database, and SQL databases in general, all data are stored in tables. Once a table is created the number of columns is fixed while the number of rows increases when data records are added. Of course, the table may be changed to increase or decrease the number of columns if needed. An SQL table can not store dimensional data, instead any dimensional variable must be expanded over a number of columns in the table.

A *dataset* is defined to be the data that are collected over time from e.g. one particular instrument from one spacecraft. A dataset is distributed over multiple files when using CDF/ISTP, where each file contains one day of data. In ODI a dataset will be stored in a single table.

The *metadata* is defined to mean all types of data that are needed to describe a dataset, its variables, and so on. As the metadata is supplied for each CDF/ISTP file it means that it could vary from day to day, although in most cases it will not. In ODI the metadata will be stored once for each dataset, however, it may be changed if needed.

As the CDF/ISTP guidelines contain an extensive description of metadata, and as a majority of the datasets ingested into ODI are CDF files, the ODI system will utilise the CDF/ISTP metadata.

5.1 Metadata

Here follows a description of the seven metadata tables that forms the ODI system. The tables are illustrated in Figure 1 and listed in Appendix A.

5.1.1 `dataset`

The table `dataset` contains global information of all datasets that exist in ODI and is the top level description of a dataset. This includes the name of the table holding the data for a specific dataset. The names of the data tables always start with `dataset_` followed by a unique name, e.g. `dataset_rosetta_srem_pacc`. The file specific information in the CDF file is also stored in `dataset`, namely: `DATA ENCODING`, `MAJORITY`, and `FORMAT`. The `CDF NAME` is not stored as it changes when new files are ingested into the dataset [Check this in the code]. However, `CDF NAME` can be recreated from the information stored in the database.

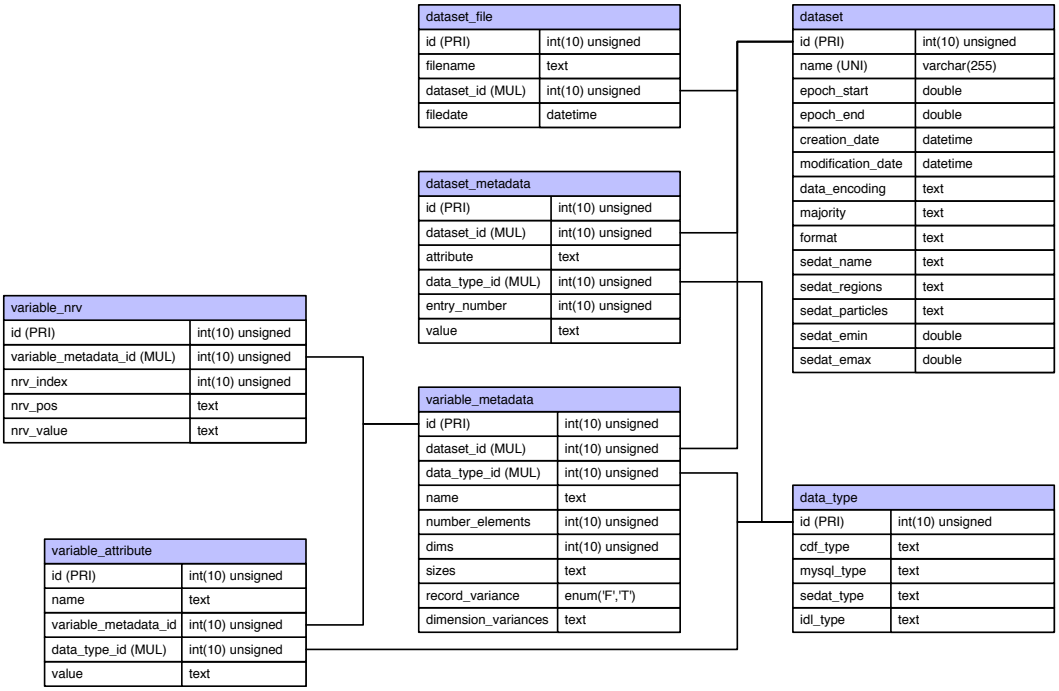

Figure 1: The ODI metadata tables.

5.1.2 `dataset_metadata`

The table `dataset_metadata` contains the next level of metadata for each dataset. The metadata are extracted from the CDF global attributes: `Attribute Name`, `Entry Number`, `Data Type`, and `Value`.

5.2 `variable_metadata`

The table `variable_metadata` contains the metadata for each variable. In the CDF variable is defined by `Variable Name`, `Data Type`, `Number Elements`, `Dims`, `Sizes`, `Record Variance`, and `Dimension Variances`. All this information goes into the table `variable_metadata`.

5.2.1 `variable_attribute`

To each variable in the CDF dataset there are a varying number of associated attributes. The `Attribute Name`, `Data Type`, and `Value` for each attribute are stored in the table `variable_attribute`.

5.2.2 variable_nrv

Any data that does note vary from record to record has the CDF "Record Variance' '= F(alse) and is known as non-record-variant (nrv) data. The nrv data are stored in the table `variable_nrv`.

5.2.3 data_type

The table `data_type` contains all CDF data types and associated MySQL, SEDAT, and IDL data types. Via `data_type` the data type for each variable can be accessed in CDF, MySQL, SEDAT, or IDL format.

5.2.4 dataset_file

The table `dataset_file` stores the names and dates of all raw data files that have been used to ingest data into ODI.

5.3 Data

In addition to the metadata tables one table will be created for each dataset that is ingested into ODI.

The name of each data table is stored in the table `dataset`. The general rule for naming a data table is that it shall start with `dataset_` and then followed by instrument name or something equivalent. The names are always in lower case. Examples are `dataset_xmm_rm` and `dataset_index_dst`.

A data table always contain at least 4 columns: `cdf_epoch`, `epoch`, `millisec`, and `dataset_file_id`. Additional columns will hold the actual data.

There is a redundancy in that time is given both as `cdf_epoch` and `epoch`+`millisec`. The reason for this is that it will simplify the access of the data as one may choose to specify CDF epoch or calendar time. CDF epoch is used by e.g. SEDAT. But if one would like to directly inspect the contents of the data table then calendar time is more readable than CDF epoch. The calendar time is split over two columns, `epoch` and `millisec`. The `epoch` variable is a MySQL `DATETIME` type which has highest resolution of one second.

The `dataset_file_id` column contains a reference to the data source in the `dataset_file` table for each record. This column is used to keep track to which raw data files have been ingested into ODI.

5.4 Database logic

When the ODI system is first set up the metadata tables are created but contain no data. They will get populated when datasets and data are added to the system.

In the following it is described how datasets are created in ODI while in Section 6 the actual implementation is described.

5.4.1 Adding a dataset metadata

The first step to adding a dataset into ODI is to enter a record in `dataset`. The column `name` must be given explicitly and can be any valid MySQL table name, but for ODI the data tables names must always start with `dataset_`. In the `dataset` table the columns `data_encoding`, `majority`, and `format` are either extracted from a CDF file or given explicitly. The columns `sedat_name`, `sedat_regions`, `sedat_particles`, `sedat_emin`, and `sedat_emax` must be given explicitly. The `creation_date` and `modification_date` are generated automatically upon creation and modification, respectively, for the given dataset. The `epoch_start` and `epoch_end` are generated automatically when data is ingested. Finally, the `id` is an automatically generated number that increments for each new row added to `dataset`.

Next, all the global attributes are entered into `dataset_metadata`, where each row has an id that ties each attribute to a specific dataset (`dataset_id`). The attribute name, entry number, and value are stored in the columns `attribute`, `entry_number`, and `value`. The data type is stored in `data_type_id` which is generated from the table `data_type`. All global attributes from all datasets goes into this table.

Then the metadata for each variable are stored in `variable_metadata`. The `id` column is an auto-incremented number. The variable's name, number of elements, dims, sizes, record variance, and dimension variances are stored in the columns `name`, `number_elements`, `dims`, `sizes`, `record_variance`, and `dimension_variances`. As for the global attributes, the data type is stored in `data_type_id` generated from the table `data_type`. The metadata for all variables are stored in this table and tied to a specific dataset with the `dataset_id` column.

To each variable there is an associated set of attributes that are store into the table `variable_attribute`. The attribute's name and value are stored in the columns `name` and `value`, respectively. The data type is stored in `data_type_id` using the table `data_type`. All variable attributes for all variables and datasets are stored in this table and a key to the associated variable is stored in the column `variable_metadata_id`.

Any NRV data are stored into the table `variable_nrv`. All NRV values, for all datasets, are stored into this table and the associated variable is given by the column `variable_metadata_id`. The NRV value is stored in `nrv_value`. In the CDF file each NRV value is associated with a positional index that is either empty (scalar value), or a sequence of n-dimensional numbers depending on the dimension of the variable. The column `nrv_pos` holds this information either as a NULL value (scalar), as a sequence of numbers for 1-D variables, or as a comma separated sequence of numbers for higher-dimensional variables. The column `nrv_index` is an index that starts at 1 and is incremented by one for each NRV value for a specific variable.

After these steps the metadata tables are populated with metadata for each dataset. The next step is to create the tables that will hold the data.

5.4.2 Creating data table

The name of the data table is found in `dataset.name`, where `name` is a column in table `dataset`. In principle `dataset.name` can be any valid MySQL table name, but for ODI the data tables names shall always start with `dataset_`.

The four columns `cdf_epoch`, `epoch`, `millisec`, and `dataset_file_id` are always created in `dataset_*`. The names of the columns that hold data are extracted from `variable_metadata.name`. Only record variant data are stored in `dataset_*` and thus only the variables, for a specific dataset, that have `variable_metadata.record_variance="T"` will have columns in the data table. The only exception is "Epoch" which will not have a column as time is already defined.

The column names are given by the values in `variable_metadata.name`, converted to lower case. If the dimension of the variable is larger than zero (`variable_metadata.dims`> 0), then each element of the variable gets one column with and index appended to the variable name separated by the underscore character. E.g., if there is a 1-dimensional variable of size 3 called `position` then the column names becomes `position_1`, `position_2`, and `position_3`. For 2- or higher-dimensional variables another index is added, and the increment of the indices are controlled by the `MAJORITY` flag. E.g., a 2-D variable `flux` of size 3,2 and `MAJORITY` set to `ROW` will have the columns `flux_1_1`, `flux_2_1`, `flux_3_1`, `flux_1_2`, `flux_2_2`, and `flux_3_2`.

The data type of each data column is given by `variable_metadata.data_type_id` that points to `data_type.id` from which the correct MySQL data type is extracted.

The `dataset_*` table is then created with the following column order

```
cdf_epoch epoch millisec <var 1> <var 2> ... <var n> dataset_file_id
```

where the variables appear in order of increasing `variable_metadata.id`.

After these steps a table has been created to hold data. In contrast to the metadata tables, the number of data tables will increase by one for each new dataset added. The next step is to add data to the data table.

5.4.3 Adding data

To add records to a `dataset_*` table the `cdf_epoch`, `epoch`, `millisec`, data fields, and `dataset_file_id` are given values and stored into the database. The only necessary column is `cdf_epoch` as this is defined as a `PRIMARY KEY`. This also means that there can only be one row with a specific value in `cdf_epoch`. The last column is the `dataset_file_id`, which will be described in Section 6.

6 ODI Database implementation

Here it is described how the ODI system is implemented from first time set-up to data ingestion and what files need to be present.

6.1 First time set-up

Two SQL scripts (`metadata_tables_create.sql`, `metadata_tables_populate.sql`) are executed to create the metadata tables and to populate the `data_type` table. Before this is done all tables should be deleted from the ODI database.

A set of environment variable are also used by the ODI system and they have the following names and definitions:

```
$ODI_HOME    = The home directory of the ODI software
$ODI_RAWDATA = The directory of the ODI raw data
$ODI_HOST    = The host machine of the MySQL server
$ODI_SOCKET  = The socket of the MySQL server
$ODI_PORT    = The port of the MySQL server
$ODI_DB      = The ODI database name on the MySQL server
$ODI_USER_1  = The name of user 1
               (admin user, all privileges to the ODI database)
$ODI_PW_1    = The password of user 1
$ODI_USER_2  = The name of user 2
               (read, write, and update privileges)
$ODI_PW_2    = The password of user 2
$ODI_USER_3  = The name of user 3
               (only read privilege)
$ODI_PW_3    = The password of user 3
```

It is the system administrators responsibility to set up all the variables and access rights.

6.2 Adding datasets

To add a dataset a set of files are needed. Firstly, the *dataset definition file* and the *skeleton file* must exist. Then the *raw data files* must exist, either locally or remotely. If the raw data files are CDF files then there must also exist a CDF *settings file*.

The dataset definition file, named `datasets.txt`, contains information about the dataset not contained in the skeleton file. The structure of the `datasets.txt` file is

```
<ODI data table name>;;; <Data directory>;;; <File name pattern>;;;\
 <Platform>;;; <Platform type>;;; <Instrument>;;; <Skeleton file name>;;;\
 <SEDAT dataset name>;;; <SEDAT region code>;;; <SEDAT particle code>;;;\
 <SEDAT min. energy (MeV)>;;; <SEDAT max. energy (MeV)>
```

where the row has been split over several lines to fit into this document. Each field is separated with a triple-colon (`;;;`) and the text within angle brackets (`<>`) should be replaced with actual values. This file is parsed and the value of the field `<ODI data table name>` is stored in `dataset.name`.

The `<Data directory>` gives the location of the data files relative to `$ODI_RAWDATA`. The actual data files must not necessarily be placed directly under `<Data directory>` but can be placed in subdirectories.

The data files that are to be ingested must match the `<File name pattern>` field. The `<File name pattern>` may contain the %-sign which is treated as a wild card and will match any string.

The `<Platform>`, `<Platform type>`, and `<Instrument>` are stored in the `dataset_metadata` table with

attribute	value
platform	<Platform>
platform_type	<Platform type>
instrument	<Instrument>

together with the other global attributes for the dataset.

The `<Skeleton file name>` field gives the name of the skeleton file that shall be used.

The SEDAT fields are stored in the table `dataset` in the columns `sedat_name`, `sedat_regions`, `sedat_particles`, `sedat_emin`, and `sedat_emax`.

When all files are present the `populate.sh` script is executed, which will create dataset tables when necessary and ingest the data. The work flow is illustrated in Figure 2.

When `populate.php` is executed without any arguments all lines in the `datasets.txt` file that do not start with a #-character are parsed. If arguments like

```
populate.php <dataset 1> <dataset 2> ...
```

are passed only the lines with those datasets will be parsed, irrespective of whether there is a leading #-character.

When the raw data comes from CDF files they are automatically converted to text files with comma-separated fields using the CDFexport program. The text files are ingested into the `dataset_` table. It is **very important to order the data fields correctly** in the text files, which is controlled by the settings file (`.set`), to match the order of the columns in the `dataset_*` table. The columns in the `dataset_*` table have the same order as the variables are defined in the skeleton file.

7 ODI data sets

According to SOW:A.1 the ODI database shall be populated with the contents of the ESTEC SEDAT database as it stands at kick-off. There is considerable overlap between the data sets contained in SAAPS, SEDAT, and SPENVIS. We will therefore populate the ODI database with the data listed in Table 1. The data will be acquired from the existing SAAPS, SEDAT, and SPENVIS databases, or if necessary from the original sources.

Table 1: The table lists all data sets included in ODI. The `dataset_` prefix in the ODI Name is not shown.

ODI Name	**SEDAT Name**	**Description**
ace_sis	ACE_SIS	ACE-SIS data
ampte_uks	AMPTE	AMPTE UKS electron data
azur	AZUR	AZUR Proton/Alpha particle telescope data
crres_mea	CRRES	CRRES/MEA data
equator_s_aux	EQUATOR_S_AUX	Equator-S AUX Dataset
equator_s_epi	EQUATOR_S_EPI	Equator-S EPI Dataset
equator_s_mam	EQUATOR_S_MAM	Equator-S MAM Dataset
gioveb_srem_pacc	GIOVEB_SREM_PACC	GIOVE-B/SREM PACC Data
goes_sem_a05_5	SPIDR_GOES_A05_5	SPIDR GOES-5 A dataset 5 Minute resolution
goes_sem_a06_5	SPIDR_GOES_A06_5	SPIDR GOES-6 A dataset 5 Minute resolution
goes_sem_a07_5	SPIDR_GOES_A07_5	SPIDR GOES-7 A dataset 5 Minute resolution
goes_sem_a08_5	SPIDR_GOES_A08_5	SPIDR GOES-8 A dataset 5 Minute resolution
goes_sem_a09_5	SPIDR_GOES_A09_5	SPIDR GOES-9 A dataset 5 Minute resolution
goes_sem_a10_5	SPIDR_GOES_A10_5	SPIDR GOES-10 A dataset 5 Minute resolution
goes_sem_a11_5	SPIDR_GOES_A11_5	SPIDR GOES-11 A dataset 5 Minute resolution
goes_sem_a12_5	SPIDR_GOES_A12_5	SPIDR GOES-12 A dataset 5 Minute resolution
goes_sem_g05_1	SPIDR_GOES_G05_1	SPIDR GOES-5 G dataset 1 Minute resolution
goes_sem_g06_1	SPIDR_GOES_G06_1	SPIDR GOES-6 G dataset 1 Minute resolution
goes_sem_g07_1	SPIDR_GOES_G07_1	SPIDR GOES-7 G dataset 1 Minute resolution
goes_sem_g08_1	SPIDR_GOES_G08_1	SPIDR GOES-8 G dataset 1 Minute resolution
goes_sem_g09_1	SPIDR_GOES_G09_1	SPIDR GOES-9 G dataset 1 Minute resolution
goes_sem_g10_1	SPIDR_GOES_G10_1	SPIDR GOES-10 G dataset 1 Minute resolution

Table 1: (continued)

ODI Name	SEDAT Name	Description
goes_sem_g11_1	SPIDR_GOES_G11_1	SPIDR GOES-11 G dataset 1 Minute resolution
goes_sem_g12_1	SPIDR_GOES_G12_1	SPIDR GOES-12 G dataset 1 Minute resolution
goes_sem_h06_5	SPIDR_GOES_H06_5	SPIDR GOES-6 H dataset 5 Minute resolution
goes_sem_h07_5	SPIDR_GOES_H07_5	SPIDR GOES-7 H dataset 5 Minute resolution
goes_sem_h08_5	SPIDR_GOES_H08_5	SPIDR GOES-8 H dataset 5 Minute resolution
goes_sem_h09_5	SPIDR_GOES_H09_5	SPIDR GOES-9 H dataset 5 Minute resolution
goes_sem_h10_5	SPIDR_GOES_H10_5	SPIDR GOES-10 H dataset 5 Minute resolution
goes_sem_h11_5	SPIDR_GOES_H11_5	SPIDR GOES-11 H dataset 5 Minute resolution
goes_sem_h12_5	SPIDR_GOES_H12_5	SPIDR GOES-12 H dataset 5 Minute resolution
goes_sem_i05_5	SPIDR_GOES_I05_5	SPIDR GOES-5 I dataset 5 Minute resolution
goes_sem_i06_5	SPIDR_GOES_I06_5	SPIDR GOES-6 I dataset 5 Minute resolution
goes_sem_i07_5	SPIDR_GOES_I07_5	SPIDR GOES-7 I dataset 5 Minute resolution
goes_sem_i08_5	SPIDR_GOES_I08_5	SPIDR GOES-8 I dataset 5 Minute resolution
goes_sem_i09_5	SPIDR_GOES_I09_5	SPIDR GOES-9 I dataset 5 Minute resolution
goes_sem_i10_5	SPIDR_GOES_I10_5	SPIDR GOES-10 I dataset 5 Minute resolution
goes_sem_i11_5	SPIDR_GOES_I11_5	SPIDR GOES-11 I dataset 5 Minute resolution
goes_sem_i12_5	SPIDR_GOES_I12_5	SPIDR GOES-12 I dataset 5 Minute resolution
goes_mag_06	SPIDR_GOES06_MAG	SPIDR GOES-6 MAG dataset 5 Minute resolution
goes_mag_07	SPIDR_GOES07_MAG	SPIDR GOES-7 MAG dataset 5 Minute resolution
goes_mag_08	SPIDR_GOES08_MAG	SPIDR GOES-8 MAG dataset 5 Minute resolution

Table 1: (continued)

ODI Name	SEDAT Name	Description
goes_mag_09	SPIDR_GOES09_MAG	SPIDR GOES-9 MAG dataset 5 Minute resolution
goes_mag_10	SPIDR_GOES10_MAG	SPIDR GOES-10 MAG dataset 5 Minute resolution
goes_mag_11	SPIDR_GOES11_MAG	SPIDR GOES-11 MAG dataset 5 Minute resolution
goes_mag_12	SPIDR_GOES12_MAG	SPIDR GOES-12 MAG dataset 5 Minute resolution
goes_z05_5	SPIDR_GOES_Z05_5	SPIDR GOES-5 Z dataset 5 Minute resolution
goes_z06_5	SPIDR_GOES_Z06_5	SPIDR GOES-6 Z dataset 5 Minute resolution
goes_z07_5	SPIDR_GOES_Z07_5	SPIDR GOES-7 Z dataset 5 Minute resolution
goes_z08_5	SPIDR_GOES_Z08_5	SPIDR GOES-8 Z dataset 5 Minute resolution
goes_z09_5	SPIDR_GOES_Z09_5	SPIDR GOES-9 Z dataset 5 Minute resolution
goes_z10_5	SPIDR_GOES_Z10_5	SPIDR GOES-10 Z dataset 5 Minute resolution
goes_z11_5	SPIDR_GOES_Z11_5	SPIDR GOES-11 Z dataset 5 Minute resolution
goes_z12_5	SPIDR_GOES_Z12_5	SPIDR GOES-12 Z dataset 5 Minute resolution
helios_a_e6	HELIOS_A_E6	HELIOS-A E6 Data
helios_a_e7	HELIOS_A_E7	HELIOS-A E7 Data
helios_b_e6	HELIOS_B_E6	HELIOS-B E6 Data
helios_b_e7	HELIOS_B_E7	HELIOS-B E7 Data
imp8_cpme_e_330s	IMP8_CPME_E_330S	IMP-8 CPME e data
imp8_cpme_h_330s	IMP8_CPME_H_330S	IMP-8 CPME H data
imp8_cpme_he_330s	IMP8_CPME_HE_330S	IMP-8 CPME He data
imp8_cpme_mh_330s	IMP8_CPME_MH_330S	IMP-8 CPME heavy ion data
imp8_crnc_phint	IMP8_CRNC_PHINT	IMP-8 CRNC (U. Chicago) PHINT Data Tape
imp8_gme	IMP8_GME	IMP-8 GME (GSFC Instrument)
index_dst	DST	DST index 1957-1997
index_kpap_1d	AP	Ap global geomagnetic index
index_kpap_3h	KPAP	Kp and Ap global geomagnetic index

Table 1: (continued)

ODI Name	SEDAT Name	Description
index_omni2	NSSDC_OMNI2	NSSDC OMNI-2 Dataset
index_ssn_1m	SSN	Monthly sunspot numbers
integral_irem	INTEGRAL_IREM_PACC	INTEGRAL/IREM PACC Data
isee1_hi	ISEE1_HI	ISEE1 high resolution data
isee1_lo	ISEE1_LO	ISEE1 low resolution data
isee1_mepi	ISEE1_MEPI	ISEE1 MEPI data
isee2	ISEE2	ISEE2 data
meteosat_anomalies	METEOSAT_ANOMALIES	METEOSAT anomalies
meteosat_hr	METEOSAT_HR	METEOSAT high resolution data
meteosat_lr	METEOSAT_LR	METEOSAT low resolution data
metop_02	METOP_02	METOP-02 Space Environment Monitor
mir_a	MIR_A	MIR Raw data
mir_b	MIR_B	MIR reduced and supplementary data
ns41_bdd2r	GPS_NS41	GPS NavStar41 - Burst Dosimeter Detector IIR
poes_n15	POES_N15	NOAA POES N15 Space Environment Monitor
poes_n16	POES_N16	NOAA POES N16 Space Environment Monitor
poes_n17	POES_N17	NOAA POES N17 Space Environment Monitor
poes_n18	POES_N18	NOAA POES N18 Space Environment Monitor
proba1_srem_pacc	PROBA1_SREM_PACC	PROBA-1 SREM PACC Data
rosetta_srem_pacc	ROSETTA_SREM	Rosetta SREM Radiation Monitor
sac_c	SAC_C	SAC-C data
sampex_pet	SAMPEX	SAMPEX PET data
soho_erne_a	SOHO_ERNE_A	SOHO-ERNE Alpha Data
soho_erne_p	SOHO_ERNE_P	SOHO-ERNE Proton Data
strv1b_a	STRV1B_A	STRV1B Raw data
strv1b_b	STRV1B_B	STRV1B reduced and supplementary data
swpc_ace_1m		One minute resolution ACE SWEPAM and MAG data.

Table 1: (continued)

ODI Name	SEDAT Name	Description
uars_pem	UARS	UARS Particle Environment Monitor data
xmm_rm	XMM_RM	XMM Radiation Monitor

7.1 Raw data

The raw data exist in many forms and come from different sources. But all data are stored under `$ODI_RAWDATA`.

Data on remote servers are downloaded using the `wget` program. The download scripts are placed under `$ODI_HOME/parsers/download/`. When a download script is executed the raw data is placed under `$ODI_RAWDATA/<platform>/<instrument>/`. If a raw data file already exists and the file date is older than the current system date, no action is taken. When the `populate.sh` script is executed only raw data files previously not ingested, or files which have changed since the last run, are ingested.

Raw data that are published on the web and that only exist for the current hour, day, or month are parsed directly from code sections in `$ODI_HOME/lib/odi.library.php`. To give an example, the following code section in `odi.parsers.php` ingests real time Dst data from Kyoto and Lund.

```
// Add the Kyoto HTML pages and Lund forecast page to the file list for Dst
    if ($filepattern == "%dst%")
    {
      $dbasedir = "http://swdc234.kugi.kyoto-u.ac.jp/dst_realtime";
      $findex = file($dbasedir . "/index.html");
      foreach ($findex as $dumstr)
      {
        if (($di = strpos($dumstr, "/index.html")) &&
            (strpos($dumstr, "month") === FALSE) &&
            (strpos($dumstr, "dst") === FALSE))
        {
          $file = $dbasedir . substr($dumstr, $di-7, 18);
          $dum = file($file);
          foreach ($dum as $line)
          {
            $offset = strpos($line, "[Updated");
            if ($offset !== FALSE)
            {
              $date = explode("UT", substr($line, $offset+11));
              $date = date("Y/m/d H:i:s", strtotime($date[0] . ":00"));
              break;
```

```
          }
        }
        $dfiles[] = array($file, $date, $file);
      }
    }
    $dfiles[] = array("http://rwc.lund.irf.se/rwc/dst/dst1.txt",
                      date("Y/m/d H:i:s"),
                      "http://rwc.lund.irf.se/rwc/dst/dst1.txt");
  }
```

In the `datasets.txt` file `%dst%` file pattern is used, and when the `populate.php` program is run any new data will be downloaded and ingested.

7.2 Updating live datasets

Live datasets are automatically updated using cron jobs. The file `cronjobs.txt` in the `parsers` directory contains a list of all jobs to be executed and the cadence. This file shall not be installed directly using `crontab`, instead the `cronjobs_install.php` program should be used. The program ensures that the environment variables gets correctly expanded. An example of the `cronjobs.txt` file is:

```
# Do not install this file directly using crontab as
# the environment variables will not be expanded correctly.
# Use instead cronjobs_install.php.

# * * * * * command to be executed
# |||| |
# |||| +----- day of week (0 - 6) (Sunday=0)
# |||+------- month (1 - 12)
# ||+--------- day of month (1 - 31)
# |+----------- hour (0 - 23)
# +------------- min (0 - 59)

# Download Dst final the first of every month.
* * 1 * * source $HOME/.profile; cd $ODI_HOME/parsers/download/; \\
  ./wget_index_Dst.sh > /dev/null

# Ingest Dst every 10 minutes.
*/10 * * * * source $HOME/.profile; cd $ODI_HOME/parsers/; \\
  ./populate.php index_dst > /dev/null

# Ingest Kp every hour.
*/60 * * * * source $HOME/.profile; cd $ODI_HOME/parsers/; \\
  ./populate.php index_kpap_3h > /dev/null
```

This example illustrates the use of `wget` script archive type data, and the `populate.php <dataset>` program for real time data. It is assumed that all the environment variables are defined in `$HOME/.profile`.

8 ODI tools

8.1 Exploring the database

The command

```
show_datasets.php [<dataset>]
```

shows the SEDAT name, ODI name, number of records, and epoch range for the selected dataset, where `<dataset>` is the SEDAT name. If `<dataset>` is omitted all datasets are listed. The `<dataset>` may contain the MySQL wild card character `%`.

All metadata of a dataset and its variables are listed with the command

```
show_metadata.php <dataset>
```

where `<dataset>` is the SEDAT name of the dataset.

8.2 Deleting a dataset

A dataset along with all its metadata is deleted with the command

```
delete_dataset.php <dataset>
```

where `<dataset>` is the SEDAT name of the dataset. One has to confirm the delete before it is actually deleted.

The algorithm for deleting the dataset is executed in two steps. First the `dataset_*` is removed, then the entry in the `dataset` table is deleted. As the table keys are constructed using the mysql `ON DELETE CASCADE` all associated metadata will also be deleted.

8.3 Checking the skeleton file

The skeleton file contains counts of the number of variables and global attributes. It also lists the used attributes. This information is not actually used by the ODI parser but it may be useful when inspecting the skeleton file. The script

```
check_skeleton.php <skeleton file>
```

checks that the variable and attribute counts, and the listed attributes, match the used variables and attributes.

8.4 Interface for reading data

To access data from the ODI database a standard interface is defined. This interface can then be implemented in different languages. To read data from ODI involves the following steps:

1. Connect to the database.
2. Select a dataset.
3. Specify variables.
4. Specify an epoch range or a record range.
5. Read data.
6. Read metadata.

The following generic parameters must be specified:

```
[user],[password],[host],[port],[socket]
odi_dataset_name | sedat_dataset_name
epoch_start,epoch_end | record_start,record_end
variable_array
```

where "`[]`" indicates optional arguments, and "`|`" means that just one should be specified. Whether the `user`, `password`, etc. must be specified depends on how the system is set up.

To connect to ODI and read data and metadata the following generic functions are needed:

```
connectToOdi(user,password,host,port,socket)
readData(dataset,range,variables)
readMetadata(dataset,variables)
```

where the argument and return parameters depends on the language.

8.5 Exporting data to text file

To export a dataset the epoch range and variables must be specified. This information is given in an XML settings file. A template settings file can be generated with the command

```
export_build_xml.php <dataset>
```

which will create the file `<dataset>.set.xml`. This file may then be edited. Here one can change the name of the output file, the epoch range, what variables to export and the order of the variables. They are given within the XML tags `<export_file></export_file>`, `<epoch_start></epoch_start>`, `<epoch_end></epoch_end>`, and `<variable></variable>`, respectively. The next step is to run

```
export_to_xml.php <settings file>
```

which will produce the export file, which is also an XML file. The file contains a header section with the field names and a data section with each field separated by commas.

8.6 Exporting data to CDF file

The ODI data and metadata can be exported to a CDF file using the IDL program

```
odicdf, cdf_name, dataset_name, varnames=varnames, $   \\
        epochrange=epochrange, recordrange=recordrange
```

where the name for the cdf file, the SEDAT dataset name, the variables to be extracted (all variables if this keyword is not specified), and epoch or record range is given (one and only one of epoch or record range).

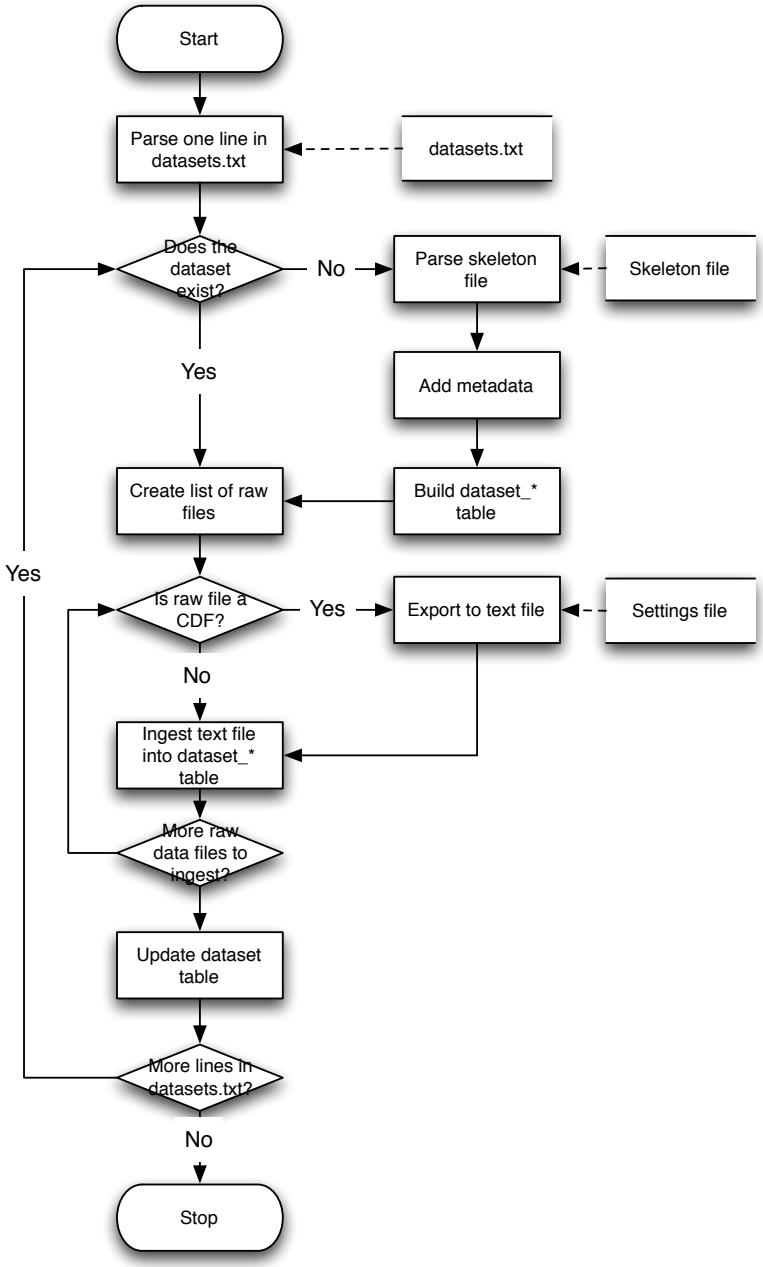

Figure 2: The work flow of the populate.sh program.

A Data tables

dataset	**A table holding the names of each dataset_* table together with some key information.**
id	A unique identifier.
name	The name of the dataset table in the ODI database.
epoch_start	The first epoch in the dataset.
epoch_end	The last epoch in the dataset.
creation_date	The date when the dataset_* table was created.
modification_date	The last date when the dataset was modified.
data_encoding	The CDF header attribute DATA ENCODING.
majority	The CDF header attribute MAJORITY.
format	The CDF header attribute FORMAT.
sedat_name	SEDAT datset name without SYSTEM! prefix.
sedat_regions	SEDAT region code.
sedat_particles	SEDAT particle code.
sedat_emin	SEDAT min. energy (MeV).
sedat_emax	SEDAT max. energy (MeV).

dataset_file	**A table to hold the file names of all ingested data files.**
id	A unique identifier.
filename	The file name of the ingested file.
dataset_id	A key to the associated dataset in table dataset.
filedate	The date when the file was ingested.

dataset_metadata	**Metadata for each dataset.**
id	A unique identifier.
dataset_id	A key to the associated dataset in table dataset.
attribute	The attribute name. This corresponds to the CDF global attribute.
data_type_id	A key to the associated data type in table data_type.
entry_number	The CDF global parameter entry number.
value	The value (or contents) of the dataset attribute.

data_type	**CDF data types together with associated MySQL and SEDAT data types.**
id	A unique identifier.
cdf_type	The CDF data type.
mysql_type	The MySQL data type.
sedat_type	The SEDAT data type.

variable_attribute	**The attributes for each variable.**
id	A unique identifier.
name	The name of the variable attribute.
variable_metadata_id	A key to the associated variable in table variable_metadata.
data_type_id	A key to the associated data type in table data_type.
value	The value (or contents) of the variable attribute.

variable_metadata	**The metadata for each variable.**
id	A unique identifier.
dataset_id	A key to the associated dataset in table dataset.
data_type_id	A key to the associated data type in table data_type.
name	The name of the variable.
number_elements	The CDF variable parameter Number Elements.
dims	The CDF variable parameter Dims.
sizes	The CDF variable parameter Sizes.
record_variance	The CDF variable parameter Record Variance.
dimension_variances	The CDF variable parameter Dimension Variances.

variable_nrv	**The values of the non-record-variant data.**
id	A unique identifier.
variable_metadata_id	A key to the associated variable in table variable_metadata.
nrv_index	An index to the nrv variable. It goes from 1 to dims.
nrv_value	The value of the nrv variable.

B An example skeleton file

The skeleton file follows the same syntax as the CDF/ISTP skeleton files.

The skeleton table consists of five blocks, with each block starting with one of the key words `#header`, `#GLOBALattributes`, `#VARIABLEattributes`, `#variables`, or `#zVariables`.

The items in the `#header` block goes into the `dataset` table. The information in this block is not necessary for ODI to work, but it is stored so that CDF files may be created from the ODI database.

The last line in the `#header` block shows the number of variables, attributes, and so on that exist in the CDF file. This information is not stored in ODI but the it is used to check for consistency in the skeleton table.

The `#GLOBALattributes` block contains a description of the dataset as a whole. Each attribute name, together with entry number, data type, and value are stored in `dataset_metadata`. The routine that parses the skeleton file is flexible enough to handle attribute descriptions that extend over multiple lines.

The `#VARIABLEattributes` block is only used to check for consistency in the skeleton table.

The `#variables` block contains the definitions of the CDF r-Variables. In ODI all variables are treated as z-Variables as they are a generalisation of r-Variables. Any variables in this block will become z-Variables if a CDF file is generated from ODI.

The `#zVariables` block contains a definition of each variable together with the variables attributes. The variable name, data type, number elements, dims, sizes, record variance, and dimension variances are stored in the `variable_metadata` table. The variable attribute names, data types, and values are stored in `variable_attribute`.

For CDF non-record-variant (NRV) data the values are given after the attributes for each NRV-variable. If this data exist in the skeleton table they are parsed and stored in the `variable_nrv` table.

```
! Skeleton table for the "i8_h0_gme_19740101_v01" CDF.
! Generated: Monday, 9-Jun-2008 14:30:46
! CDF created/modified by CDF V2.5.21
! Skeleton table created by CDF V3.1.1

#header

                     CDF NAME: i8_h0_gme_19740101_v01
                DATA ENCODING: NETWORK
                     MAJORITY: COLUMN
                       FORMAT: SINGLE

! Variables  G.Attributes  V.Attributes  Records  Dims  Sizes
! ---------  ------------  ------------  -------  ----  -----
    0/24          18            22         0/z      1     1
```

```
#GLOBALattributes

! Attribute         Entry       Data
! Name              Number      Type       Value
! ---------         ------      ----       -----

  "Project"             1:    CDF_CHAR     { "ISTP" } .

  "Discipline"          1:    CDF_CHAR     { "Space Physics>Particles" } .

  "Source_name"         1:    CDF_CHAR     { "I8>IMP-8" } .

  "Data_type"           1:    CDF_CHAR     { "H0>Higher Resolution Data" } .

  "Descriptor"          1:    CDF_CHAR     { "GME>Goddard Medium  Energy" -
                                             " Investigation" } .

  "Data_version"        1:    CDF_CHAR     { "1" } .

  "TITLE"               1:    CDF_CHAR     { "IMP-8 GME Flux Data" } .

  "TEXT"                1:    CDF_CHAR     { "30-min avg flex I8 GME" } .

  "MODS"                1:    CDF_CHAR     { "v0.3  24-July-1998" } .

  "ADID_ref"            1:    CDF_CHAR     { "TBD" } .

  "Logical_file_id"     1:    CDF_CHAR     { "I8_H0_GME_19740101_V01" } .

  "Logical_source"      1:    CDF_CHAR     { "I8_H0_GME" } .

  "Logical_source_description"
                        1:    CDF_CHAR     { "IMP-8 GME Fluxes" } .

  "PI_name"             1:    CDF_CHAR     { "R.E. McGuire" } .

  "PI_affiliation"      1:    CDF_CHAR     { "SPDF(c632), NASA's GSFC" } .

  "Mission_group"       1:    CDF_CHAR     { "IMP-8" } .

  "Instrument_type"     1:    CDF_CHAR     { "Particles (space)" } .
```

```
  "Time_resolution"     1:    CDF_CHAR     { "1800 seconds" } .


#VARIABLEattributes

  "FIELDNAM"
  "CATDESC"
  "VALIDMIN"
  "VALIDMAX"
  "SCALEMIN"
  "SCALEMAX"
  "SCALETYP"
  "UNITS"
  "SI_conversion"
  "LABLAXIS"
  "LABL_PTR_1"
  "FORMAT"
  "DEPEND_0"
  "DEPEND_1"
  "DELTA_PLUS_VAR"
  "DELTA_MINUS_VAR"
  "MONOTON"
  "DICT_KEY"
  "VAR_TYPE"
  "FILLVAL"
  "DISPLAY_TYPE"
  "VAR_NOTES"


#variables

! No rVariables.


#zVariables

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

  "Epoch"         CDF_EPOCH      1       0             T
```

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

    "FIELDNAM"    CDF_CHAR     { "Time" }
    "CATDESC"     CDF_CHAR     { "Time, centered,in NSSDC EPOCH format" }
    "VALIDMIN"    CDF_EPOCH    { 29-Oct-1973 00:00:00.000 }
    "VALIDMAX"    CDF_EPOCH    { 31-Dec-2020 23:59:59.000 }
    "SCALEMIN"    CDF_EPOCH    { 29-Oct-1973 00:00:00.000 }
    "SCALEMAX"    CDF_EPOCH    { 31-Dec-2020 23:59:59.000 }
    "UNITS"       CDF_CHAR     { "ms" }
    "SI_conversion"
                  CDF_CHAR     { "1.0e3>s" }
    "LABLAXIS"    CDF_CHAR     { "Epoch" }
    "DELTA_PLUS_VAR"
                  CDF_CHAR     { "Epoch_delta_time" }
    "DELTA_MINUS_VAR"
                  CDF_CHAR     { "Epoch_delta_time" }
    "MONOTON"     CDF_CHAR     { "INCREASE" }
    "DICT_KEY"    CDF_CHAR     { "time>NSSDC_Epoch" }
    "VAR_TYPE"    CDF_CHAR     { "support_data" }
    "FILLVAL"     CDF_REAL8    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! RV values were not requested.


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

  "Epoch_delta_time"
                  CDF_REAL4      1       0              F

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

    "FIELDNAM"    CDF_CHAR     { "Delta_time" }
    "CATDESC"     CDF_CHAR     { "Delta_time" }
    "VALIDMIN"    CDF_REAL4    { 0.0 }
    "VALIDMAX"    CDF_REAL4    { 3.6e+06 }
```

```
    "SCALEMIN"    CDF_REAL4    { 0.0 }
    "SCALEMAX"    CDF_REAL4    { 3.6e+06 }
    "UNITS"       CDF_CHAR     { "ms" }
    "SI_conversion"
                  CDF_CHAR     { "1.0e3>s" }
    "LABLAXIS"    CDF_CHAR     { "Delta_time" }
    "FORMAT"      CDF_CHAR     { "E12.2" }
    "DICT_KEY"    CDF_CHAR     { "uncertainty>time" }
    "VAR_TYPE"    CDF_CHAR     { "support_data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! NRV values follow...

    [] =     9.00e+05


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

  "Proton_DIntn"
                  CDF_REAL4      1       1     30       T         T

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

    "FIELDNAM"    CDF_CHAR     { "Proton DIntn (GME)" }
    "CATDESC"     CDF_CHAR     { "Proton Differential Intensity, at 30 " -
                                 "energies 1-500 MeV, spin-avg (I8 GME)" }
    "VALIDMIN"    CDF_REAL4    { 1.0e-08 }
    "VALIDMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALEMIN"    CDF_REAL4    { 0.0001 }
    "SCALEMAX"    CDF_REAL4    { 100000.0 }
    "SCALETYP"    CDF_CHAR     { "log" }
    "UNITS"       CDF_CHAR     { "1/[cm2-s-sr-MeV]" }
    "SI_conversion"
                  CDF_CHAR     { "1.602e-17>m^-2 s^-1 sr^-1 J^-1" }
    "LABLAXIS"    CDF_CHAR     { "dJ/dE" }
    "FORMAT"      CDF_CHAR     { "E10.3" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
```

```
    "DEPEND_1"    CDF_CHAR     { "Proton_DIntn_Engy" }
    "DELTA_PLUS_VAR"
                  CDF_CHAR     { "Proton_DIntn_Unc" }
    "DELTA_MINUS_VAR"
                  CDF_CHAR     { "Proton_DIntn_Unc" }
    "DICT_KEY"    CDF_CHAR     { "particle_flux>ion_differential" }
    "VAR_TYPE"    CDF_CHAR     { "data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "stack_plot>y=Proton_DIntn,z=Proton_DIn" -
                                 "tn_Engy" } .

  ! RV values were not requested.


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

  "Proton_DIntn_Unc"
                  CDF_REAL4      1       1     30       T         T

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

    "FIELDNAM"    CDF_CHAR     { "Unc, Proton DIntn (GME)" }
    "CATDESC"     CDF_CHAR     { "Uncertainty, Proton Differential  " -
                                 "Intensity (I8 GME)" }
    "VALIDMIN"    CDF_REAL4    { 1.0e-08 }
    "VALIDMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALEMIN"    CDF_REAL4    { 0.0001 }
    "SCALEMAX"    CDF_REAL4    { 100000.0 }
    "SCALETYP"    CDF_CHAR     { "log" }
    "UNITS"       CDF_CHAR     { "1/[cm2-s-sr-MeV]" }
    "SI_conversion"
                  CDF_CHAR     { "1.602e-17>m^-2 s^-1 sr^-1 J^-1" }
    "LABLAXIS"    CDF_CHAR     { "Delta dJ/dE" }
    "FORMAT"      CDF_CHAR     { "E10.3" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DEPEND_1"    CDF_CHAR     { "Proton_DIntn_Engy" }
    "DICT_KEY"    CDF_CHAR     { "uncertainty>absolute" }
    "VAR_TYPE"    CDF_CHAR     { "data" }
```

```
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! RV values were not requested.


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

  "Proton_DIntn_Engy"
                  CDF_REAL4      1       1     30       F         T

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

    "FIELDNAM"    CDF_CHAR     { "Proton Energy (GME)" }
    "CATDESC"     CDF_CHAR     { "Proton Energy (I8 GME) " }
    "VALIDMIN"    CDF_REAL4    { 0.5 }
    "VALIDMAX"    CDF_REAL4    { 600.0 }
    "SCALEMIN"    CDF_REAL4    { 0.1 }
    "SCALEMAX"    CDF_REAL4    { 1000.0 }
    "UNITS"       CDF_CHAR     { "MeV" }
    "SI_conversion"
                  CDF_CHAR     { "6.242e12>J" }
    "LABLAXIS"    CDF_CHAR     { "Proton Energy" }
    "FORMAT"      CDF_CHAR     { "F7.1" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DELTA_PLUS_VAR"
                  CDF_CHAR     { "Proton_DIntn_EngyPls" }
    "DELTA_MINUS_VAR"
                  CDF_CHAR     { "Proton_DIntn_EngyMns" }
    "DICT_KEY"    CDF_CHAR     { "energy>ion" }
    "VAR_TYPE"    CDF_CHAR     { "support_data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! NRV values follow...

    [1] =     1.0
```

```
    [2] =     1.3
    [3] =     1.6
    [4] =     2.0
    [5] =     2.6
    [6] =     3.6
    [7] =     4.6
    [8] =     5.4
    [9] =     6.6
    [10] =     7.9
    [11] =     9.8
    [12] =    12.3
    [13] =    14.8
    [14] =    17.4
    [15] =    20.5
    [16] =    21.9
    [17] =    26.4
    [18] =    31.8
    [19] =    38.9
    [20] =    46.8
    [21] =    56.8
    [22] =    71.6
    [23] =    89.7
    [24] =    99.5
    [25] =   113.8
    [26] =   136.5
    [27] =   165.6
    [28] =   202.3
    [29] =   274.2
    [30] =   398.2


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

  "Proton_DIntn_EngyPls"
                  CDF_REAL4      1       1     30       F         T

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

    "FIELDNAM"    CDF_CHAR     { "Delta+, Proton Energy (GME)" }
```

```
  "CATDESC"     CDF_CHAR     { "Delta+, Proton Energy (I8 GME)" }
  "VALIDMIN"    CDF_REAL4    { 0.1 }
  "VALIDMAX"    CDF_REAL4    { 100.0 }
  "SCALEMIN"    CDF_REAL4    { 0.1 }
  "SCALEMAX"    CDF_REAL4    { 100.0 }
  "UNITS"       CDF_CHAR     { "MeV" }
  "SI_conversion"
                CDF_CHAR     { "6.242e12>J" }
  "LABLAXIS"    CDF_CHAR     { "Proton Energy" }
  "FORMAT"      CDF_CHAR     { "F7.1" }
  "DICT_KEY"    CDF_CHAR     { "uncertainty>energy" }
  "VAR_TYPE"    CDF_CHAR     { "support_data" }
  "FILLVAL"     CDF_REAL4    { -1.0e+31 }
  "DISPLAY_TYPE"
                CDF_CHAR     { "time_series " } .

! NRV values follow...

  [1] =     0.1
  [2] =     0.2
  [3] =     0.2
  [4] =     0.2
  [5] =     0.4
  [6] =     0.6
  [7] =     0.4
  [8] =     0.5
  [9] =     0.7
  [10] =     0.7
  [11] =     1.3
  [12] =     1.3
  [13] =     1.3
  [14] =     1.4
  [15] =     2.0
  [16] =     2.3
  [17] =     2.3
  [18] =     3.4
  [19] =     4.0
  [20] =     4.2
  [21] =     6.4
  [22] =     9.4
  [23] =     2.8
  [24] =     7.5
  [25] =     7.2
```

```
    [26] =    17.5
    [27] =    12.4
    [28] =    27.7
    [29] =    52.8
    [30] =    86.8


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

  "Proton_Dintn_EngyMns"
                  CDF_REAL4      1       1     30       F         T

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

    "FIELDNAM"    CDF_CHAR     { "Delta-, Proton Energy (GME)" }
    "CATDESC"     CDF_CHAR     { "Delta-, Proton Energy (I8 GME) " }
    "VALIDMIN"    CDF_REAL4    { 0.1 }
    "VALIDMAX"    CDF_REAL4    { 100.0 }
    "SCALEMIN"    CDF_REAL4    { 0.1 }
    "SCALEMAX"    CDF_REAL4    { 100.0 }
    "UNITS"       CDF_CHAR     { "MeV" }
    "SI_conversion"
                  CDF_CHAR     { "6.242e12>J" }
    "LABLAXIS"    CDF_CHAR     { "Proton Energy" }
    "FORMAT"      CDF_CHAR     { "F7.1" }
    "DICT_KEY"    CDF_CHAR     { "uncertainty>energy" }
    "VAR_TYPE"    CDF_CHAR     { "support_data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! NRV values follow...

    [1] =     0.1
    [2] =     0.1
    [3] =     0.2
    [4] =     0.2
    [5] =     0.3
    [6] =     0.5
```

```
    [7] =     0.3
    [8] =     0.5
    [9] =     0.6
    [10] =     0.7
    [11] =     1.1
    [12] =     1.2
    [13] =     1.2
    [14] =     1.2
    [15] =     1.8
    [16] =     2.1
    [17] =     2.2
    [18] =     3.1
    [19] =     3.7
    [20] =     3.9
    [21] =     5.8
    [22] =     8.4
    [23] =     2.7
    [24] =     7.0
    [25] =     6.8
    [26] =    15.5
    [27] =    11.6
    [28] =    24.3
    [29] =    44.2
    [30] =    71.2


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

  "Alpha_DIntn"   CDF_REAL4      1       1     21       T         T

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

    "FIELDNAM"    CDF_CHAR     { "Alpha DIntn (GME)" }
    "CATDESC"     CDF_CHAR     { "Alpha Differential Intensity, at 21 " -
                                 "energies 1-80 MeV/nuc, spin-avg (I8 " -
                                 "GME)" }
    "VALIDMIN"    CDF_REAL4    { 1.0e-08 }
    "VALIDMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALEMIN"    CDF_REAL4    { 0.0001 }
```

```
    "SCALEMAX"    CDF_REAL4    { 100000.0 }
    "SCALETYP"    CDF_CHAR     { "log" }
    "UNITS"       CDF_CHAR     { "1/[cm2-s-sr-MeV/nuc]" }
    "SI_conversion"
                  CDF_CHAR     { "4.005e-18>m^-2 s^-1 sr^-1 J^-1" }
    "LABLAXIS"    CDF_CHAR     { "dJ/dE" }
    "FORMAT"      CDF_CHAR     { "E10.3" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DEPEND_1"    CDF_CHAR     { "Alpha_DIntn_Engy" }
    "DELTA_PLUS_VAR"
                  CDF_CHAR     { "Alpha_DIntn_Unc" }
    "DELTA_MINUS_VAR"
                  CDF_CHAR     { "Alpha_DIntn_Unc" }
    "DICT_KEY"    CDF_CHAR     { "particle_flux>ion_differential" }
    "VAR_TYPE"    CDF_CHAR     { "data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "stack_plot>y=Alpha_DIntn,z=Alpha_DIntn" -
                                 "_Engy" } .

  ! RV values were not requested.


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

  "Alpha_DIntn_Unc"
                  CDF_REAL4      1       1     21       T         T

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

    "FIELDNAM"    CDF_CHAR     { "Unc, Alpha DIntn (GME)" }
    "CATDESC"     CDF_CHAR     { "Uncertainty, Alpha Differential " -
                                 "Intensity (I8 GME)" }
    "VALIDMIN"    CDF_REAL4    { 1.0e-08 }
    "VALIDMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALEMIN"    CDF_REAL4    { 0.0001 }
    "SCALEMAX"    CDF_REAL4    { 100000.0 }
    "SCALETYP"    CDF_CHAR     { "log" }
    "UNITS"       CDF_CHAR     { "1/[cm2-s-sr-MeV/nuc]" }
```

```
    "SI_conversion"
                  CDF_CHAR     { "4.005e-18>m^-2 s^-1 sr^-1 J^-1" }
    "LABLAXIS"    CDF_CHAR     { "Delta dJ/dE" }
    "FORMAT"      CDF_CHAR     { "E10.3" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DEPEND_1"    CDF_CHAR     { "Alpha_DIntn_Engy" }
    "DICT_KEY"    CDF_CHAR     { "uncertainty>absolute" }
    "VAR_TYPE"    CDF_CHAR     { "data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! RV values were not requested.


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

  "Alpha_DIntn_Engy"
                  CDF_REAL4      1       1     21       F         T

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

    "FIELDNAM"    CDF_CHAR     { "Alpha Energy (GME)" }
    "CATDESC"     CDF_CHAR     { "Alpha Energy (I8 GME) " }
    "VALIDMIN"    CDF_REAL4    { 0.5 }
    "VALIDMAX"    CDF_REAL4    { 600.0 }
    "SCALEMIN"    CDF_REAL4    { 0.1 }
    "SCALEMAX"    CDF_REAL4    { 1000.0 }
    "UNITS"       CDF_CHAR     { "MeV/nuc" }
    "SI_conversion"
                  CDF_CHAR     { "2.497e13>J" }
    "LABLAXIS"    CDF_CHAR     { "Alpha Energy" }
    "FORMAT"      CDF_CHAR     { "F7.1" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DELTA_PLUS_VAR"
                  CDF_CHAR     { "Alpha_DIntn_EngyPls" }
    "DELTA_MINUS_VAR"
                  CDF_CHAR     { "Alpha_DIntn_EngyMns" }
    "DICT_KEY"    CDF_CHAR     { "energy>ion" }
```

```
    "VAR_TYPE"    CDF_CHAR     { "support_data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! NRV values follow...

    [1] =     1.2
    [2] =     1.6
    [3] =     2.1
    [4] =     2.7
    [5] =     3.5
    [6] =     4.4
    [7] =     5.4
    [8] =     6.6
    [9] =     7.9
    [10] =     9.7
    [11] =    12.2
    [12] =    14.8
    [13] =    17.4
    [14] =    20.5
    [15] =    21.7
    [16] =    26.3
    [17] =    31.7
    [18] =    38.9
    [19] =    46.8
    [20] =    56.8
    [21] =    71.6


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

  "Alpha_DIntn_EngyPls"
                  CDF_REAL4      1       1     21       F         T

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

    "FIELDNAM"    CDF_CHAR     { "Delta+, Alpha Energy (GME)" }
    "CATDESC"     CDF_CHAR     { "Delta+, Alpha Energy, (I8 GME) " }
```

```
    "VALIDMIN"    CDF_REAL4    { 0.1 }
    "VALIDMAX"    CDF_REAL4    { 100.0 }
    "SCALEMIN"    CDF_REAL4    { 0.1 }
    "SCALEMAX"    CDF_REAL4    { 100.0 }
    "UNITS"       CDF_CHAR     { "MeV/nuc" }
    "SI_conversion"
                  CDF_CHAR     { "2.497e13>J" }
    "LABLAXIS"    CDF_CHAR     { "Alpha Energy" }
    "FORMAT"      CDF_CHAR     { "F7.1" }
    "DICT_KEY"    CDF_CHAR     { "uncertainty>energy" }
    "VAR_TYPE"    CDF_CHAR     { "support_data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! NRV values follow...

    [1] =     0.1
    [2] =     0.3
    [3] =     0.3
    [4] =     0.4
    [5] =     0.5
    [6] =     0.5
    [7] =     0.5
    [8] =     0.7
    [9] =     0.7
    [10] =     1.3
    [11] =     1.4
    [12] =     1.3
    [13] =     1.4
    [14] =     2.0
    [15] =     2.5
    [16] =     2.3
    [17] =     3.5
    [18] =     4.1
    [19] =     4.2
    [20] =     6.5
    [21] =     9.4


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

```
"Alpha_DIntn_EngyMns"
                CDF_REAL4       1       1     21       F         T

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

  "FIELDNAM"    CDF_CHAR     { "Delta-, Alpha Energy (GME)" }
  "CATDESC"     CDF_CHAR     { "Delta-, Alpha Energy, (I8 GME) " }
  "VALIDMIN"    CDF_REAL4    { 0.1 }
  "VALIDMAX"    CDF_REAL4    { 100.0 }
  "SCALEMIN"    CDF_REAL4    { 0.1 }
  "SCALEMAX"    CDF_REAL4    { 100.0 }
  "UNITS"       CDF_CHAR     { "MeV/nuc" }
  "SI_conversion"
                CDF_CHAR     { "2.497e13>J" }
  "LABLAXIS"    CDF_CHAR     { "Alpha Energy" }
  "FORMAT"      CDF_CHAR     { "F7.1" }
  "DICT_KEY"    CDF_CHAR     { "uncertainty>energy" }
  "VAR_TYPE"    CDF_CHAR     { "support_data" }
  "FILLVAL"     CDF_REAL4    { -1.0e+31 }
  "DISPLAY_TYPE"
                CDF_CHAR     { "time_series " } .

! NRV values follow...

  [1] =     0.1
  [2] =     0.2
  [3] =     0.2
  [4] =     0.3
  [5] =     0.4
  [6] =     0.4
  [7] =     0.5
  [8] =     0.6
  [9] =     0.7
  [10] =     1.1
  [11] =     1.2
  [12] =     1.2
  [13] =     1.2
  [14] =     1.8
  [15] =     2.2
  [16] =     2.1
```

```
    [17] =     3.1
    [18] =     3.7
    [19] =     3.8
    [20] =     5.8
    [21] =     8.3


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

  "Elec_Intn"     CDF_REAL4      1       0              T

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

    "FIELDNAM"    CDF_CHAR     { "Elec DIntn (GME)" }
    "CATDESC"     CDF_CHAR     { "Electron Intensity, 0.3-18 MeVspin-avg" -
                                 " (I8 GME)" }
    "VALIDMIN"    CDF_REAL4    { 0.001 }
    "VALIDMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALEMIN"    CDF_REAL4    { 0.1 }
    "SCALEMAX"    CDF_REAL4    { 1.0e+07 }
    "SCALETYP"    CDF_CHAR     { "log" }
    "UNITS"       CDF_CHAR     { "1/[cm2-s-sr-MeV]" }
    "SI_conversion"
                  CDF_CHAR     { "1.602e-17>m^-2 s^-1 sr^-1 J^-1" }
    "LABLAXIS"    CDF_CHAR     { "Electrn .3-18 MeV" }
    "FORMAT"      CDF_CHAR     { "E10.3" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DELTA_PLUS_VAR"
                  CDF_CHAR     { "EIec_Intn_Unc" }
    "DELTA_MINUS_VAR"
                  CDF_CHAR     { "EIec_Intn_Unc" }
    "DICT_KEY"    CDF_CHAR     { "particle_flux>electron" }
    "VAR_TYPE"    CDF_CHAR     { "data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! RV values were not requested.
```

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

  "Elec_Intn_Unc"
                  CDF_REAL4      1       0              T

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

    "FIELDNAM"    CDF_CHAR     { "Unc, Elec Intn (GME)" }
    "CATDESC"     CDF_CHAR     { "Unc, Electron Intensity, 0.3-18 MeV" }
    "VALIDMIN"    CDF_REAL4    { 1.0e-08 }
    "VALIDMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALEMIN"    CDF_REAL4    { 0.1 }
    "SCALEMAX"    CDF_REAL4    { 1.0e+07 }
    "SCALETYP"    CDF_CHAR     { "log" }
    "UNITS"       CDF_CHAR     { "1/[cm2-s-sr-MeV]" }
    "SI_conversion"
                  CDF_CHAR     { "1.602e-17>m^-2 s^-1 sr^-1 J^-1" }
    "LABLAXIS"    CDF_CHAR     { "Delta Elec" }
    "FORMAT"      CDF_CHAR     { "E10.3" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DICT_KEY"    CDF_CHAR     { "uncertainty>absolute" }
    "VAR_TYPE"    CDF_CHAR     { "data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! RV values were not requested.


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

  "Elec_BackIntn"
                  CDF_REAL4      1       0              T

  ! Attribute       Data
  ! Name            Type       Value
```

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

    "FIELDNAM"    CDF_CHAR     { "Elec Background (GME)" }
    "CATDESC"     CDF_CHAR     { "Electron Background Intensity, 0.3-18 " -
                                 "MeV, spin-avg (I8 GME" }
    "VALIDMIN"    CDF_REAL4    { 1.0e-08 }
    "VALIDMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALEMIN"    CDF_REAL4    { 0.1 }
    "SCALEMAX"    CDF_REAL4    { 1.0e+07 }
    "SCALETYP"    CDF_CHAR     { "log" }
    "UNITS"       CDF_CHAR     { "1/[cm2-s-sr-MeV]" }
    "SI_conversion"
                  CDF_CHAR     { "1.602e-17>m^-2 s^-1 sr^-1 J^-1" }
    "LABLAXIS"    CDF_CHAR     { "EBckgrd .3-18 MeV" }
    "FORMAT"      CDF_CHAR     { "E10.3" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DELTA_PLUS_VAR"
                  CDF_CHAR     { "EIec_BackIntn_Unc" }
    "DELTA_MINUS_VAR"
                  CDF_CHAR     { "EIec_BackIntn_Unc" }
    "DICT_KEY"    CDF_CHAR     { "particle_flux>electron" }
    "VAR_TYPE"    CDF_CHAR     { "data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! RV values were not requested.


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

  "Elec_BackIntn_Unc"
                  CDF_REAL4      1       0              T

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

    "FIELDNAM"    CDF_CHAR     { "Unc, Elec Background (GME)" }
    "CATDESC"     CDF_CHAR     { "Uncertainty, Electron Background  " -
                                 "Intensity 0.3-18 MeV (I8 GME)" }
```

```
    "VALIDMIN"    CDF_REAL4    { 1.0e-08 }
    "VALIDMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALEMIN"    CDF_REAL4    { 0.1 }
    "SCALEMAX"    CDF_REAL4    { 1.0e+07 }
    "SCALETYP"    CDF_CHAR     { "log" }
    "UNITS"       CDF_CHAR     { "1/[cm2-s-sr-MeV]" }
    "SI_conversion"
                  CDF_CHAR     { "1.602e-17>m^-2 s^-1 sr^-1 J^-1" }
    "LABLAXIS"    CDF_CHAR     { "Delta Elec" }
    "FORMAT"      CDF_CHAR     { "E10.3" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DICT_KEY"    CDF_CHAR     { "uncertainty>absolute" }
    "VAR_TYPE"    CDF_CHAR     { "data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! RV values were not requested.


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

  "Event_Rates"   CDF_REAL4      1       1     11       T         T

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

    "FIELDNAM"    CDF_CHAR     { "GME Event Rates" }
    "CATDESC"     CDF_CHAR     { "GME Event Type Rates " }
    "VALIDMIN"    CDF_REAL4    { 1.0e-08 }
    "VALIDMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALEMIN"    CDF_REAL4    { 0.0001 }
    "SCALEMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALETYP"    CDF_CHAR     { "log" }
    "UNITS"       CDF_CHAR     { "cts/sec" }
    "SI_conversion"
                  CDF_CHAR     { "1.0>s^-1" }
    "LABL_PTR_1"
                  CDF_CHAR     { "labels_EvRates" }
    "FORMAT"      CDF_CHAR     { "E9.2" }
```

```
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DEPEND_1"    CDF_CHAR     { "labels_EvRates" }
    "DELTA_PLUS_VAR"
                  CDF_CHAR     { "Event_Rates_Unc" }
    "DELTA_MINUS_VAR"
                  CDF_CHAR     { "Event_Rates_Unc" }
    "MONOTON"     CDF_CHAR     { "FALSE" }
    "DICT_KEY"    CDF_CHAR     { "particles>rate" }
    "VAR_TYPE"    CDF_CHAR     { "data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! RV values were not requested.


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

  "Event_Rates_Unc"
                  CDF_REAL4      1       1     11       T         T

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

    "FIELDNAM"    CDF_CHAR     { "Unc, Event Rates" }
    "CATDESC"     CDF_CHAR     { "Uncertainty, GME Event Type Rates" }
    "VALIDMIN"    CDF_REAL4    { 1.0e-08 }
    "VALIDMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALEMIN"    CDF_REAL4    { 0.0001 }
    "SCALEMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALETYP"    CDF_CHAR     { "log" }
    "UNITS"       CDF_CHAR     { "cts/sec" }
    "SI_conversion"
                  CDF_CHAR     { "1.0>s^-1" }
    "LABL_PTR_1"
                  CDF_CHAR     { "d_labels_EvRates" }
    "FORMAT"      CDF_CHAR     { "E9.2" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DEPEND_1"    CDF_CHAR     { "d_labels_EvRates" }
    "MONOTON"     CDF_CHAR     { "FALSE" }
```

```
    "DICT_KEY"    CDF_CHAR     { "uncertainty>absolute" }
    "VAR_TYPE"    CDF_CHAR     { "data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! RV values were not requested.


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

  "labels_EvRates"
                  CDF_CHAR      30       1     11       F         T

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

    "FIELDNAM"    CDF_CHAR     { "Event Rate Labels" }
    "CATDESC"     CDF_CHAR     { "Event Type Rates" }
    "LABLAXIS"    CDF_CHAR     { "Rate Labels" }
    "FORMAT"      CDF_CHAR     { "A30" }
    "DICT_KEY"    CDF_CHAR     { "label>rate" }
    "VAR_TYPE"    CDF_CHAR     { "metadata" } .

  ! NRV values follow...

    [1] = { "A-B-C (P 0.5-4 MeV)           " }
    [2] = { "A&B1-B-C                      " }
    [3] = { "A&B2-B-C                      " }
    [4] = { "A.B-C (P 4-20 MeV)            " }
    [5] = { "A&B1.B-C                      " }
    [6] = { "A&B2.B-C                      " }
    [7] = { "DEF                           " }
    [8] = { "DE-F-G (P 20-80 MeV)          " }
    [9] = { "DEF-G (I >80 MeV)             " }
    [10] = { "D&E1-F-G (A 20-80 MeV/n)      " }
    [11] = { "D&E2-F-G (Z>6 20-80 MeV/n     " }


! Variable          Data      Number                 Record   Dimension
```

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

  "d_labels_EvRates"
                  CDF_CHAR      30       1     11       F         T

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

    "FIELDNAM"    CDF_CHAR     { "D_EvRate labels" }
    "CATDESC"     CDF_CHAR     { "D_EvRates" }
    "LABLAXIS"    CDF_CHAR     { "Rates" }
    "FORMAT"      CDF_CHAR     { "A30" }
    "DICT_KEY"    CDF_CHAR     { "label>rate" }
    "VAR_TYPE"    CDF_CHAR     { "metadata" } .

  ! NRV values follow...

    [1] = { "A-B-C (P 0.5-4 MeV)           " }
    [2] = { "A&B1-B-C                      " }
    [3] = { "A&B2-B-C                      " }
    [4] = { "A.B-C (P 4-20 MeV)            " }
    [5] = { "A&B1.B-C                      " }
    [6] = { "A&B2.B-C                      " }
    [7] = { "DEF                           " }
    [8] = { "DE-F-G (P 20-80 MeV)          " }
    [9] = { "DEF-G (I >80 MeV)             " }
    [10] = { "D&E1-F-G (A 20-80 MeV/n)      " }
    [11] = { "D&E2-F-G (Z>6 20-80 MeV/n     " }


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

  "Singles_Rates"
                  CDF_REAL4      1       1     7        T         T

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

```
    "FIELDNAM"    CDF_CHAR     { "GME Singles Rates" }
    "CATDESC"     CDF_CHAR     { "GME Singles Type Rates " }
    "VALIDMIN"    CDF_REAL4    { 1.0e-08 }
    "VALIDMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALEMIN"    CDF_REAL4    { 0.0001 }
    "SCALEMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALETYP"    CDF_CHAR     { "log" }
    "UNITS"       CDF_CHAR     { "cts/sec" }
    "SI_conversion"
                  CDF_CHAR     { "1.0>s^-1" }
    "LABL_PTR_1"
                  CDF_CHAR     { "labels_SRates" }
    "FORMAT"      CDF_CHAR     { "E9.2" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DEPEND_1"    CDF_CHAR     { "labels_SRates" }
    "DELTA_PLUS_VAR"
                  CDF_CHAR     { "Singles_Rates_Unc" }
    "DELTA_MINUS_VAR"
                  CDF_CHAR     { "Singles_Rates_Unc" }
    "MONOTON"     CDF_CHAR     { "FALSE" }
    "DICT_KEY"    CDF_CHAR     { "particles>rate" }
    "VAR_TYPE"    CDF_CHAR     { "data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! RV values were not requested.


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

  "Singles_Rates_Unc"
                  CDF_REAL4      1       1     7        T         T

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

    "FIELDNAM"    CDF_CHAR     { "Unc, Singles Rates" }
    "CATDESC"     CDF_CHAR     { "Uncertainty, GME Singles Rates" }
    "VALIDMIN"    CDF_REAL4    { 1.0e-08 }
```

```
    "VALIDMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALEMIN"    CDF_REAL4    { 0.0001 }
    "SCALEMAX"    CDF_REAL4    { 1.0e+10 }
    "SCALETYP"    CDF_CHAR     { "log" }
    "UNITS"       CDF_CHAR     { "cts/sec" }
    "SI_conversion"
                  CDF_CHAR     { "1.0>s^-1" }
    "LABL_PTR_1"
                  CDF_CHAR     { "d_labels_SRates" }
    "FORMAT"      CDF_CHAR     { "E9.2" }
    "DEPEND_0"    CDF_CHAR     { "Epoch" }
    "DEPEND_1"    CDF_CHAR     { "d_labels_SRates" }
    "MONOTON"     CDF_CHAR     { "FALSE" }
    "DICT_KEY"    CDF_CHAR     { "uncertainty>absolute" }
    "VAR_TYPE"    CDF_CHAR     { "data" }
    "FILLVAL"     CDF_REAL4    { -1.0e+31 }
    "DISPLAY_TYPE"
                  CDF_CHAR     { "time_series " } .

  ! RV values were not requested.


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

  "labels_SRates"
                  CDF_CHAR      30       1     7        F         T

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

    "FIELDNAM"    CDF_CHAR     { "Single Rate Labels" }
    "CATDESC"     CDF_CHAR     { "Single Type Rates" }
    "LABLAXIS"    CDF_CHAR     { "Rate Labels" }
    "FORMAT"      CDF_CHAR     { "A30" }
    "DICT_KEY"    CDF_CHAR     { "label>rate" }
    "VAR_TYPE"    CDF_CHAR     { "metadata" } .

  ! NRV values follow...

    [1] = { "A                              " }
```

```
    [2] = { "B                              " }
    [3] = { "C                              " }
    [4] = { "D                              " }
    [5] = { "E                              " }
    [6] = { "F                              " }
    [7] = { "G                              " }


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

  "d_labels_SRates"
                   CDF_CHAR      30       1     7        F         T

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

    "FIELDNAM"    CDF_CHAR     { "D_SRate labels" }
    "CATDESC"     CDF_CHAR     { "D_SRates" }
    "LABLAXIS"    CDF_CHAR     { "Rates" }
    "FORMAT"      CDF_CHAR     { "A30" }
    "DICT_KEY"    CDF_CHAR     { "label>rate" }
    "VAR_TYPE"    CDF_CHAR     { "metadata" } .

  ! NRV values follow...

    [1] = { "A                              " }
    [2] = { "B                              " }
    [3] = { "C                              " }
    [4] = { "D                              " }
    [5] = { "E                              " }
    [6] = { "F                              " }
    [7] = { "G                              " }


#end
```