SPECTRAL DATA BASE VERSION 7 DATA STRUCTURE DESCRIPTION

Mark Strickman, NRL

May 22, 1998

NRL Document 0926-227
Rev. 3.00

Contents

1 Scope

The Spectral Database (SDB) format is a format for the storage of OSSE (or other) spectra in a such a manner that all relevant information required to analyze the data is present with the spectrum. The data and related information are organized and stored in a random access file on disk. Data are located through keyed access. This document concerns itself primarily with the format and contents of the various types of data together with descriptive header information.

2 Changes from Version 6

Version 7 incorporates the following changes from the previous version, SDB version 6:

- The selection header has been eliminated. The primary sdb header has been shortened from 1024 bytes to 810 bytes.
- The COMMENT variable has been eliminated. Functionally, it is replaced by the footnote auxiliary data type.
- Auxiliary data type numbering has been changed.
- Several header variables have been eliminated, as outlined in table 1.
- Several header variable names have been changed, as outlined in table 1.
- The organization and order of header variables in the documentation have been changed.

3 Overall Design Considerations

The following overall SDB design considerations influence header structure and contents.

3.1 File Format

The SDB file is a VMS/RMS Indexed Sequential Access Method (ISAM) file with variable record lengths. Access to data in the file is generally performed via keyed reads and writes, although sequential access is also possible.

The SDB format is designed to contain OSSE spectra together with auxiliary data required to analyze those spectra. Spectra are generally referred to as the primary data type and other types of data as auxiliary data types, but both primary and auxiliary data are stored in the same way.

The organization of the file is into header and data records, each of which is identified by a unique key field. Header records contain format information that allows the data records to be read into appropriate structures. In addition, header records may contain descriptive and housekeeping information that describe the data themselves and the environment in which the data were collected.

Version 6	Version 7	Changes
TAGWORD	TAGWORD	4 bytes to 3 bytes
	SPARSEFLG	Added
NUMARRAY		Deleted
CONTFLGS1	AUX1FLD	Redefined
CONTFLGS2	AUX2FLD	Redefined
INST_CNFG_ID		Deleted
FLTID		Deleted
DATAQUAL	DQHAZ	Redefined
DATAQUAL	DQINFO	Redefined
STRTTIM	STRTTIM	TJD to TJS
STOPTIM	STOPTIM	TJD to TJS
DETSIGMA_SCAN	SIG_SCAN	Renamed
DETSIGMA_XSCAN	SIG_XSCAN	Renamed
INTDURAT		Deleted
INTLIVTIM		Deleted
INTDURUNITS		Deleted
NOINTQUANT		Deleted
NOINTPARAM		Deleted
CMD_STATE_ID_1	CMDSTATE_ID	Redefined
CMD_STATE_ID_2		Deleted
DET_CNFG_ID_1	DETCFG_ID	Redefined
DET_CNFG_ID_2		Deleted
	MDPOSTBL_ID	Added
RATE_TIM	SUM_TIM	Renamed
GROX		Deleted
GROY		Deleted
GROZ		Deleted
GROLT		Deleted
	RSC	Added
	ETUT	Added
THIS_ORBITINTEG	ORBIT_TIM	Renamed
CPML_FRAC_ORBIT	CPML_ORBIT_SUM	Renamed
CPMH_FRAC_ORBIT	CPMH_ORBIT_SUM	Renamed
LAST_SAAINTEG	LAST_SAA_TIM	Renamed
ASSOCSPECTW	RELSPECTW	Renamed
FOOTNOTETW	NOTETW	Renamed
	RESPTW	Added
GSHIFT		Deleted
COMMENT		Deleted
LOW_WIDTH	RGAIN	Renamed
	RFWHM	Added
	STDRGAIN	Added
	STDRFWHM	Added

Table 1: Changes to primary sdb header variables between versions 6 and 7. A blank box indicates that the variable is not available in that version.

Data records can contain either simple arrays of data, such as spectra, or structured data. Data records may be any length (the length being documented in the header), but all the data records containing data for a single data entity (e.g. a single spectrum) must be the same length. Different entities in the same file may have different data record lengths.

All data in the SDB file, both primary spectrum data and auxiliary data types referred to below, are organized in this fashion. However, the contents of both header records and data records may vary from data type to data type.

3.1.1 Key Structure

The key field in each record is logically subdivided into the following subfields:

FIELD	VARIABLE	DATA TYPE	BYTES
Record Sequence Number	REC_SEQ	Byte	2
Array Data Type	ARRAY_TYPE	Byte	1
Spare Key Space	SPAREKEY	Integer	1
Tagword	TAGWORD	Integer	3
Sparse/Dense Flag	SPARSEFLG	Byte	1

where the record sequence number occupies the least significant bits. The key fields are used as follows:

- Sparse/Dense Flag
  - Identifies whether AUX type is "Sparse" or "Dense", i.e. whether it resides in a separate tagword from spectral data or accompanies spectral data in the same tagword, respectively. The SPARSEFLG variable takes on a value of 127 for dense AUX types and a value equal to the Array Data Type for sparse AUX types. See section 3.2 for more information concerning sparse and dense AUX types.
- Tagword
  - Identifies a related group of data (typically a spectrum and auxiliary data that go with it)
  - All data and header records in the group have the same tagword
  - Each data type may appear only once with a given tagword
  - Tagwords are unique to a file but may be duplicated from file to file
- Array Data Type
  - Subdivides tagword group into individual pieces of data
  - Each piece of data contains a header, the structure of which is determined by the data type, and, optionally, data records
  - Data types are described in section 3.2 below
- Record Sequence Number

- Sequentially numbers physical records within each tagword and data type
- Header is always zero, first data record always 1, etc.

The key fields are further described in section 4.2.1.1

3.1.2 Headers

All data types begin with a header record. The header record that preceeds AUX data type 0 (spectrum data) is a special case in that it contains a large amount of spectrum descriptive information not present in headers for other data types. This header will be referred to as the "Primary SDB Header" and is described in detail in section 4.

The header key value has a record sequence number of zero in each case. Although the contents of headers is data type dependent, The first 20 bytes of the header, known as the header kernel, shall be the same for all data types. The kernel consists of the following fields:

Description	Name	Type	# bytes
File key	FILE_KEY	Byte	8
Size of header	SIZEHDR	Integer	2
# bytes/record	NBYTES_PER_RECORD	Integer	2
# records	NUMREC	Integer	2
# of entities	NUMENT	Integer	2
# bytes/entity	SIZEENT	Integer	2
Data type version	DATAVERSION	Integer	2

Note that NUMENT*SIZEENT $\leq$ NBYTES_PER_RECORD*NUMREC

This structure shall apply to the first 20 bytes of the primary SDB header (AUX data type 0) as well as all other data types.

An entity is defined as a fundamental unit of the data type. In the case of data types defined by arrays (e.g. spectra, channel edge energies, uncertainties, etc.) the entity is the array element (usually congruent with a spectrum channel) and the number of entities is equal to the number of elements. In the case of data types defined by structures (e.g. calibration line information), the entity is the structure, and the number of entities is the number of structure records corresponding to that structure (e.g. the number of calibration lines). The multi-spectrum data types, which consist of spectrum arrays embedded in structures, are treated as structures in this respect. The number of entities is the number of structures which, in this case, is also the number of spectra (see below for a description of multi-spectrum data types).

Although under some circumstances, there is a one-to-one correspondence between entities and physical records, this is not required. In particular, small structured entities may place multiple entities in a single record. Alternatively, large entities may span multiple physical records.

When writing auxiliary data types, the normal mode of operation is for the application to pass the number of entities and the entity size. The write utility then computes a reasonable record size and number of records. In a few cases (multi-spectrum and response matrices), where the user may want direct control over record size, the user can specify the record size, number of records and number of entities and the write utility will comply if possible. In general, entities do not span physical record boundaries unless their size is larger than one physical record (8197 bytes maximum). Since each auxiliary data type may have a different associated data structure, there shall be no requirements placed on the form of the data in the various types. In particular, they do not have to be the same as the primary data (e.g. all integer*2, etc.).

3.2 Data Types

SDB data types include primary spectrum data and "auxiliary" or "AUX" data.

A single primary spectrum data entity contains a spectrum from a single detector (but possibly multiple spectral memory ranges). Data are written in physical records of arbitrary size (unrelated to the number of spectrum channels available). Storage information such as record size and numbers of channels are stored in the header record, which is fixed in size and structure.

The primary goal of auxiliary data is to optionally include calibration or other information with each spectrum ("local" storage) or to place this information under a single header referred to by some or all spectra in a given file ("remote" storage). The key structure defines a set of auxiliary data types, each of which has its own key space. In this manner, it is possible to index directly into the desired auxiliary type knowing only its type and tagword.

Local storage data types are always (or usually) associated with spectra on a one-to-one basis, whereas remote storage data refer to a large number of spectra. The former are usually accessed with the spectra they accompany, while the latter are usually accessed as a group. To make the access of the latter type faster, local and remote storage data have been implemented as two classes of auxiliary data. Locally stored data (i.e. those accompanying spectra) are referred to as "dense" data types, while remotely stored data (i.e. those not accompanying spectra) are called "sparse" data types. Sparse auxiliary data types are always pointed to by pointer fields in one or more primary SDB headers. In this fashion, a spectrum carries with it pointers to all the sparse information that is relevant to it.

The data types are flagged by value in the one-byte key field "array data type" referred to above. In the header record, they are identified by the two bit-pick variables AUX1FLD and AUX2FLD.

The data types, including an indication of whether they are sparse or dense, are shown in table 2.

The maximum number of auxiliary data types allowed is 64, as limited by the descriptive AUX1FLD and AUX2FLD bit picks in the header. None of the auxiliary types are required and the presence of each is technically independent of the presence of any of the others[1].

[1]Data types 0-4 all depend on information in the primary spectrum header (associated with data type 0) for correct interpretation. In particular, the primary sdb header variables NCHAN, NCHAN1, NCHAN2, NCHANL, NCHANM, and NCHANH all refer to data types 0-4

Word	Bit	No.	S/D	Description
AUX1FLD	0	0	D	Spectrum data
	1	1	D	Spectrum statistical uncertainties (sym. or positive)
	2	2	D	Spectrum negative statistical uncertainties
	3	3	D	Spectrum systematic uncertainties (sym. or positive)
	4	4	D	Spectrum negative systematic uncertainties
	5	5	S	Channel lower edge energies
	6	6	S	Channel lower edge energy uncertainties
	7	7	S	Channel representative energies
	8	8	S	Channel representative energy uncertainties
	9	9	S	Channel widths
	10	10	S	Channel width uncertainties
	11	11	S	PSD efficiency
	12	12	S	PSD efficiency uncertainties
	13	13	S	Detector resolution
	14	14	S	Detector resolution uncertainties
	19	19	S	Multi-spectrum data from DSF
	20	20	S	Multi-spectrum data
	21	21	S	Multi-spectrum statistical uncertainties (sym. or positive)
	22	22	S	Multi-spectrum negative statistical uncertainties
	23	23	S	Multi-spectrum systematic uncertainties (sym. or positive)
	24	24	S	Multi-spectrum negative systematic uncertainties
	25	25	S	Calibration line information
	26	26	S	Detector resolution information
	27	27	S	PSD model information
	28	28	S	Related spectra
	29	29	S	Orbit history
	30	30	D	Footnote (textual comment)
AUX2FLD	0	32	D	Estimated background
	1	33	D	Estimated background uncertainties
	2	34	S	Analyzable unit definition
	3	35	D	Analyzable unit identification
	4	36	S	Selected spectra list
	5	37	D	Compound response coefficients
	6	38	S	Instrument response matrix
	7	39	S	Photopeak response vector
	8	40	D	Reserved for Monte Carlo DB
	9	41	D	Reserved for Monte Carlo DB
	10	42	S	Directory

Table 2: Auxiliary Data Types: S refers to “Sparse” data types while D refers to “Dense” data types (see text for description)

3.3 Data Type Descriptions

3.3.1 Spectrum Data and Uncertainties (AUX1FLD bits 0-4; AUX data types 0-4)

Entity type: i*2 (type 0), i*4 (type 0), r*4 (types 0-4)

A spectrum can include any combination of the three OSSE spectrum ranges concatenated and treated as a single spectrum.

Spectrum +/− uncertainties refer to cases where uncertainties are asymmetric about the best estimate data point. In the case where uncertainties are symmetric, the − uncertainties array shall not be present and the bit pick indicating present arrays shall be zero for − uncertainties.

Systematic uncertainties refer to any uncertainties not related to counting statistics. These are, for the most part, uncertanties in measured instrument quantities such as response, live time, etc.

3.3.2 Channel Lower Edge Energies and Uncertainties (AUX1FLD bits 5-6; AUX data types 5-6)

Entity type: r*4

These represent the energy of the lower edge of each spectrum channel, under the assumption that the channel edge is well-defined. Overlapping channels can be handled by having the lower edge energy plus the width be greater than the next lower edge energy, while gaps can be handled by having the sum be less than the next lower edge energy. Channel edge energies are generally associated with a primary SDB header. The energy in the denominator of the SPECUNITS variable then specifies the units of the edges. If there is no energy in the denominator of SPECUNITS, the edge units are normally taken to be MeV unless context specifies otherwise (i.e. imported X-ray data).

Uncertainties are assumed symmetric.

3.3.3 Channel Representative Energies and Uncertainties (AUX1FLD bits 7-8; AUX data types 7-8)

Entity type: r*4

These represent a representative energy for each spectrum channel. This may be the arithmetic mean of the channel low and high edge energies, the geometric mean, or some other function depending on the shape of the spectrum in question and the application involved. Channel representative energies are generally associated with a primary SDB header. The energy in the denominator of the SPECUNITS variable then specifies the units of the representative energies. If there is no energy in the denominator of SPECUNITS, the units are normally taken to be MeV unless context specifies otherwise (i.e. imported X-ray data).

Uncertainties are assumed symmetric.

3.3.4 Channel Widths and Uncertainties (AUX1FLD bits 9-10; AUX data types 9-10)

Entity type: r*4

These represent the extent of the channel in energy space. Channel widths are generally associated with a primary SDB header. The energy in the denominator of the SPECUNITS variable then specifies the units of the widths. If there is no energy in the denominator of SPECUNITS, the edge units are normally taken to be MeV unless context specifies otherwise (i.e. imported X-ray data). Channels may be asymmetric, but this is handled by a single width and a representative energy, which may not be centered in the channel. This allows representative energies derived from integration of a model over the channel width to be used.

Uncertainties are assumed to be symmetric.

3.3.5 PSD Efficiency and Uncertainties (AUX1FLD bits 11-12; AUX data types 11-12)

Entity type: r*4

Array of dimensionless efficiencies (and uncertainties) for each spectrum channel. PSD efficiencies are generally associated with a primary SDB header from which the channel structure of the array may be determined. The efficiencies are the probability, for that channel, that a valid NaI event will be accepted by the pulse shape discrimination system given a set of digital time windows (dtw's). The time spectrum model and dtw information is stored in the PSD Model Information auxiliary data type (section 3.3.9).

Uncertainties are assumed to be symmetric.

3.3.6 Detector Resolution and Uncertainty (AUX1FLD bits 13-14; AUX data types 13-14)

Entity type: r*4

This is the relative spectrum point spread function (expressed as a ratio of the FWHM in energy units of a line caused by incident photons at a given energy to the incident energy). The resolution on a channel-by-channel basis is just this quantity for the representative energy for each channel.

Uncertainties are assumed to be symmetric.

3.3.7 Multi-Spectrum Data and Uncertainties (AUX1FLD bits 19-24; AUX data types 19-24)

Entity type: Structure (includes spectrum array)

The multi-spectrum data type is similar to the spectrum data type except that it supports more than one spectrum (a spectrum, as before, is defined as any combination of the three OSSE spectrum ranges concatenated together) under a single SDB header. The data type consists of an SDB header kernel (top 20 bytes), some additional header information appended to the kernel, and a set of structures, each of which includes a small amount of information specific to that spectrum, and the spectrum itself. The SDB header kernel is identical to that in the spectrum data type, except that the variables referring to data type entities refer to the number of spectrum structures rather than to the number of array elements in the single spectrum.

Multi-spectrum data types are documented in the variable SPECFLGS (see section 4 and include the following:

1. Multi-spectrum data from DSF – SPEC_ARRAY is i*2
2. Multi-spectrum derived data – SPEC_ARRAY is r*4
3. Statistical and systematic uncertainties – Interpreted similarly to matching spectrum data quantities. r*4

3.3.7.1 Header

The multi-spectrum header contains the following information (see section 4 for descriptions):

Description	Name	Type	# bytes
File key	FILE_KEY	Byte	8
Size of header	SIZEHDR	Integer	2
# bytes/record	NBYTES_PER_RECORD	Integer	2
# records	NUMREC	Integer	2
# of entities	NUMENT	Integer	2
# bytes/entity	SIZEENT	Integer	2
Data type version	DATAVERSION	Integer	2
Number of channels	NCHAN	Integer	2
Number of low channels	NCHANL	Integer	2
Number of med. channels	NCHANM	Integer	2
Number of high channels	NCHANH	Integer	2
Accumulation time	ACCUMTIM	Real	4
Seconds/TSAC	TSAC	Real	4
Spectrum flags	SPECFLGS	Bits	2

The multi-spectrum data type shall optionally be combined with a primary SDB header and a summed spectrum under a single tagword. The primary SDB header associated with the summed spectrum will describe averages over the summing interval. Quantities such as SPECSRC, CALR-PHA, SPECUNIT (see section 4 and others that describe the contents of the spectra shall be valid for both the summed spectrum, if present, and the multi-spectra present under that tagword.

Variables in the multi-spectrum header shall apply to all the multi-spectrum entities (i.e. spectra) stored under that header.

3.3.7.2 Structure Description

Description	Name	Type	# bytes
Start time	STRTTIM	Integer	4
Start time fraction	STRT_FRAC	Integer	2
Spec. mem. low live time/ single spectrum live time	LTL	Real	4
Spec. mem. med. live time	LTM	Real	4
Spec. mem. high live time	LTH	Real	4
Low mem. load rate (4/TSAC)	MLL(4)	Integer	8
Med. mem. load rate (4/TSAC)	MLM(4)	Integer	8
High mem. load rate (4/TSAC)	MLH(4)	Integer	8
Shield 1 LLD rate (8/TSAC)	S1LD(8)	Integer	16
Shield 2 LLD rate (8/TSAC)	S2LD(8)	Integer	16
Shield 3 LLD rate (8/TSAC)	S3LD(8)	Integer	16
Shield 4 LLD rate (8/TSAC)	S4LD(8)	Integer	16
Low dead time rate	DTL	Integer	2
Med. dead time rate	DTM	Integer	2
High dead time rate	DTH	Integer	2
Low LLD (4/TSAC)	ELDL(4)	Integer	8
Med. LLD	ELDM	Integer	2
High LLD	ELDH	Integer	2
Spectrum	DAT	I or R	2 or 4

3.3.7.3 Variable Descriptions

The structure variables are all defined in the same fashion as the same variables in the SDB header. Since they are generally single TSAC quantities, the rate variables do not have the _SUM suffix as in the SDB header.

If the multi-spectrum header variables ACCUMTIM and TSAC indicate that more than one TSAC/spectrum accumulation interval is in use, the memory load and shield rates, which are normally collected 4/TSAC and 8/TSAC respectively, will be collected 4 or 8 times per accumulation interval.

The spectrum variable shall contain a variable number of elements as specified by NCHAN and be either I*2 or R*4 as specified by the SPECFLGS in the multi-spectrum header.

3.3.8 Calibration Line Information (AUX1FLD bit 25; AUX data type 25)

Entity Type: Structure

The calibration line information contains data pertaining to gamma ray lines used either in ground based calibration, in-flight calibration (i.e. ^{60}Co), or useful background lines.

3.3.8.1 Structure Description

Description	Name	Type	# bytes
Spectrum Range	RANGE	Integer	2
Width error	WERROR	Real	4
Centroid	CENTROID	Real	4
Width	WIDTH	Real	4
Centroid error	CERROR	Real	4
Energy	ENERGY	Real	4
Calibration line description	CALDESC	Character	6
Calibration line model ID	CALMODEL	Character	20
Calibration line fit χ^2	CALCHI2	Real	4
Calibration line fit number of degrees of freedom	CALNDOF	Integer	2

3.3.8.2 Variable Descriptions

Descriptions of these variables are as follows:

RANGE Integer 2 bytes
Bit pick (bit 0 = low, bit 1 = medium, bit 2 = high) indicating spectral range from which calibration line information was derived.

WERROR Real 4 bytes
Uncertainty (one sigma) in fitted width of calibration line in same channel units as CENTROID.

CENTROID Real 4 bytes
Fitted centroid (in channels out of number appropriate to RANGE) of calibration line.

WIDTH Real 4 bytes
Fitted full width at half maximum (in channels defined by RANGE) of calibration line.

CERROR Real 4 bytes
Uncertainty (one sigma) in fitted centroid of calibration line in same channel units as CENTROID.

ENERGY Real 4 bytes
Energy (in MeV) of calibration line center.

CALDESC Character*6 6 bytes
6 character descriptor of calibration line. Suggested format is EEAAAS where EE is the element, AAA the atomic weight of the isotope and S is a source code (A=atmosphere, D=detector, S=spacecraft, etc.).

CALMODEL	Character*20	20 bytes

Identifies what spectrum model was used to fit calibration line. Compatible with model ID used in FDB and FDR.

CALCHI2	Real*4	4 bytes

Chi-squared per degree of freedom (reduced chi-squared) of calibration line fit.

CALNDOF	Integer*2	2 bytes

Number of degrees of freedom of calibration line fit.

3.3.9 PSD Model Information (AUX1FLD bit 27; AUX data type 27)

Entity Type: Structure

PSD information contains a structure record that describes the results of modeling the RPHA time spectra. Array dimensions may be interpreted as follows:

- Dimensions of size 16 refer to the number of DTW bands
- Dimensions of size 3 refer to the 3 energy ranges
- Dimensions of size 6 refer to the maximum number of parameters allowed for each model

PSD analysis consists of fitting a peak shape to the NaI time peak in the time spectrum for each energy. Time spectra are derived from slices across an RPHA spectrum. The peak shape centroids and widths are then fit by secondary functions of energy. At any desired energy, a peak centroid and width parameter may be derived from these secondary fits and used to reproduce an NaI peak shape. From this, the fraction of valid NaI events accepted by the PSD system given a set of DTW's can be calculated. This is the PSD efficiency discussed section 3.3.5.

3.3.9.1 Structure Description

Description	Name	Type	# bytes
Window low channel	DTW_LO(16,3)	Byte	48
Window high channel	DTW_HI(16,3)	Byte	48
No. of channels/en. band	NC_PER_DTW(3)	Byte	3
NaI peak (prim. fit) model code (fwhm, x0, amp)	NAI_MODEL	Integer	2
Centroid (x0) vs. energy secondary model parameters (max. 6)	X0(6,3)	Real	72
Centroid (x0) vs. energy secondary model param. uncertainties (max. 6)	DX0(6,3)	Real	72
Centroid fit red. chi-sqr	X0_CHI2(3)	Real	12
Width (fwhm) vs. energy secondary model parameters (max. 6)	FWHM(6,3)	Real	72
Width (fwhm) vs. energy secondary model param. uncertainties (max. 6)	DFWHM(6,3)	Real	72
Width fit red. chi-sqr	FWHM_CHI2(3)	Real	12
X0 secondary model code	X0_MODEL	Integer	2
fwhm secondary model code	FWHM_MODEL	Integer	2

3.3.9.2 Variable Descriptions

Descriptions of these variables are as follows:

DTW_LO Byte(16,3) 48 bytes

PSD spectrum channel representing the low edge of the digital time window for each of 16 windows, 3 energy ranges.

DTW_HI Byte(16,3) 48 bytes

PSD spectrum channel representing the high edge of the digital time window for each of 16 windows, 3 energy ranges.

NC_PER_DTW Byte(3) 3 bytes

Number of energy channels per dtw band (assumed the same for all 16 bands), for 3 energy ranges.

NAI_MODEL Integer 2 bytes

Code indicating model used for fitting time peak shapes (i.e. primary fit model). Parameters are x0 (centroid), fwhm (width) and amp (amplitude).

X0 Real(6,3) 72 bytes

Centroid (x0) vs. energy secondary fit model parameters (maximum of 6), for each of 3 energy ranges. Model code is given by X0_MODEL.

DX0	Real(6,3)	72 bytes

Centroid (x0) vs. energy secondary fit model parameter uncertainties (maximum of 6), for each of 3 energy ranges. Model code is given by X0_MODEL.

X0_CHI2	Real(3)	12 bytes

Centroid (x0) vs. energy secondary fit reduced chi-squared, for each of 3 energy ranges.

FWHM	Real(6,3)	72 bytes

Width (fwhm) vs. energy secondary fit model parameters (maximum of 6), for each of 3 energy ranges. Model code is given by FWHM_MODEL.

DFWHM	Real(6,3)	72 bytes

Width (fwhm) vs. energy secondary fit model parameter uncertainties (maximum of 6), for each of 3 energy ranges. Model code is given by FWHM_MODEL.

FWHM_CHI2	Real(3)	12 bytes

Width (fwhm) vs. energy secondary fit reduced chi-squared, for each of 3 energy ranges.

X0_MODEL	Integer	2 bytes

Code indicating model used for fitting centroids vs. energy (i.e. centroid secondary fit model).

FWHM_MODEL	Integer	2 bytes

Code indicating model used for fitting widths vs energy (i.e. width secondary fit model).

3.3.10 Related Spectra (AUX1FLD bit 28; AUX data type 28)

Entity Type: Structure

Each structure record contains a single filespec and tagword along with a short comment. The user may use these records to associate other spectra with any given spectrum.

3.3.10.1 Structure Description

Description	Name	Type	# bytes
File specification	FILESPEC	Character	40
Tagword	TAGWORD	Integer	4
Comment	COMMENT	Character	40

3.3.10.2 Variable Descriptions

Descriptions of these variables are as follows:

FILESPEC Character 40 bytes
Specification of file containing the associated spectrum.

TAGWORD Integer 4 bytes
Tagword of the associated spectrum within the specified file.

COMMENT Character 40 bytes
Comment relevant to the associated spectrum.

3.3.11 Orbit History (AUX1FLG bit 29; AUX data type 29)

Entity Type: Structure

One structure record shall correspond to one orbit. Typically, one orbit history record array should serve an entire SDB file (usually one day's data), in a fashion similar to the calibration data. The SDB header shall have a tagword pointer to the orbit history tagword for the file.

3.3.11.1 Structure Description

Description	Name	Type	# bytes
Orbit number	ORBIT	Integer	4
Orbit start time	ORBITSTART	Integer	4
Orbit stop time	ORBITSTOP	Integer	4
Orbit integration time	ORBITINTEG	Real	4
SAA entry time	SAAENTRY	Integer	4
SAA exit time	SAAEXIT	Integer	4
SAA integration time	SAAINTEG	Real	4
CPM low flux (orbit)	CPML	Real	4
CPM high flux (orbit)	CPMH	Real	4
CPM low dose (SAA)	CPML_SAA	Real	4
CPM high dose (SAA)	CPMH_SAA	Real	4

3.3.11.2 Variable Descriptions

Descriptions of these variables are as follows:

ORBITSTART Integer 4 bytes

PB5 time of the start of the orbit integration. Accurate to the nearest 16 seconds.

ORBITSTOP Integer 4 bytes
PB5 time (to nearest second) of the end of the orbit integration. Accurate to the nearest 16 seconds.

ORBITINTEG Real 4 bytes
Orbit integration time in seconds.

SAAENTRY Integer 4 bytes
PB5 time (to nearest second) of the mode 4 to mode 3 change marking the entry into the SAA.

SAAEXIT Integer 4 bytes
PB5 time (to nearest second) of the mode 3 to mode 4 change marking the exit from the SAA.

SAAINTEG Real 4 bytes
SAA integration time in seconds.

CPML Real 4 bytes
Average CPM low (actually minimum ionizing) flux (1 MeV $<$ E $<$ 8 MeV) in counts per second over the orbit integration period.

CPMH Real 4 bytes
Average CPM high flux (E $>$ 8 MeV) in counts per second over the orbit integration period.

CPML_SAA Real 4 bytes
Summed CPM low dose in counts during SAA period as defined by SAAENTRY and SAAEXIT above.

CPMH_SAA Real 4 bytes
Summed CPM high dose in counts during SAA period as defined by SAAENTRY and SAAEXIT above.

3.3.12 Footnote (AUX1FLD bit 30; AUX data type 30)

Entity Type: c*80

Each footnote record contains a single 80-character string containing a text comment.

3.3.13 Estimated Background (AUX2FLD bit 0; AUX data type 32)

Entity Type: array

Similar to the primary spectrum data (see section 3.3.1 but contains the associated estimated background. Header is minimum 20 byte kernel.

3.3.14 Estimated Background Uncertainties (AUX2FLD bit 1; AUX data type 33)

Entity Type: array

Similar to the primary spectrum data (see section 3.3.1 but contains the associated estimated background uncertainties. Header is minimum 20 byte kernel.

3.3.15 Analyzable Unit Definition (AUX2FLD bit 2; AUX data type 34)

Entity Type: Structure

Background interpolation will be accomplished via the combination of various background elements associated with a single source. The minimum set of source and background points that can be analyzed is referred to as an analyzable unit.

The analyzable unit definition specifies how many of each background pointing position measurements are required in order to create a background estimate. Typically, each background estimation model requires its own analyzable unit definition.

The analyzable unit definition structure contains information that allows analyzable units to be identified in the data stream. One analyzable unit definition structure record is all that is required for a given analyzable unit definition.

3.3.15.1 Structure Description

Description	Name	Type	# bytes
Source entry identifiers	SRC_ENTRY(0:7,4)	Logical	32
Bkgd entry identifiers	BKG_ENTRY(0:7,4)	Logical	32
Active det. pointing table	DPTBL	Byte	1
The maximum (optimum) number of points for each pos'n	MAX_PTS_PER_POS(0:7,4)	Integer	64
The minimum allowable number of points for each pos'n	MIN_PTS_PER_POS(0:7,4)	Integer	64
The minimum num. bkgds to one side or other of source	MINBKG(0:7,4)	Integer	64
Max. time betw. source and bkgd	SRC_DT(4)	Real	16
Max. time betw. adjacent bkgds at given position	BKG_DT(0:7,4)	Real	128
Search direction flag	SEARCH_FLAG(0:7,4)	Byte	32
Bkgd estimation model ID	MODEL_TYPE	Character	20

3.3.15.2 Variable Descriptions

Descriptions of these variables are as follows:

SRC_ENTRY	Logical(0:7,4)	32 bytes

Logical flag indicating the detector positioning table indices to be treated as possible source observations. One element for each positioning table entry (0:7) and detector (4). TRUE indicates that that positioning table entry is to be used as the source for the AU. Note that for any given AU, only a single positioning table index will be allowed, i.e. only one of the 0:7 positioning table entries will be TRUE for each of the 4 detectors.

BKG_ENTRY	Logical(0:7,4)	32 bytes

Logical flag indicating the detector positioning table entries to be treated as background observations.

DPTBL	Byte	1 byte

Flag indicating the active detector positioning table(s) to use within the AU. Values are specified by a bit code as described for the SDB header variable DPTBL. Valid detector positioning tables will be a bitwise OR of the DPTBL entries. The bit code definitions are:

Bit 0 Primary Table
1 Secondary Table
2 Solar Table
3 Transient Table

All cleared: No code assigned

MAX_PTS_PER_POS	Integer(0:7,4)	64 bytes

The optimum (maximum) total number of background observations in the AU for the corresponding detector positioning table entry and detector.

MIN_PTS_PER_POS	Integer(0:7,4)	64 bytes

The minimum number of background observations in the AU for the corresponding positioning table entry and detector. Note that this parameter also indicates the maximum order for which time interpolation may be performed.

MINBKG	Integer(0:7,4)	64 bytes

The minimum number of background observations before or after the source observation in the AU for the corresponding positioning table entry and detector, i.e. controls how close the source observation may be to the edge of the AU. Note that this parameter allows the support of a sliding window for the background observations.

SRC_DT	Real(4)	16 bytes

The maximum time in seconds between the source and all of the background accumulations.

BKG_DT	Real(0:7,4)	28 bytes

The maximum time in seconds between adjacent background accumulations for this positioning table entry and detector. In the user interface which generates the AU definition record, this parameter will be specified in units of strategy table cycles and converted into seconds for storage in the AU definition record.

SEARCH_FLAG	Byte(0:7,4)	32 bytes

Flag indicating background observation search method. Currently defined flags are:

Code: 1 Begin search forward in time (DEFAULT)
2 Begin search backward in time
3 Alternate initial search direction

MODEL_TYPE	Character	20 bytes

A character description of the model type to be used in estimating the background. The description will consist of a three character code describing the order and method of estimation (e.g. "2CT1PD" would indicate that the estimation should first be 2nd order Chebychev polynomial in Time and then 1st order Polynomial in DSA.

3.3.16 Analyzable Unit Identification (AUX2FLD bit 3; AUX data type 35)

Entity Type: structure

This structure array identifies the spectra associated with a single analyzable unit. For each spectrum, a file and tag pointer are included. In addition, the background estimation coefficient Aji is also included for each spectrum. Aji is the coefficient for each background pointing position of the analyzable unit in the linear combination of background measurements that form the background estimate:

$$B_{estimi} = \sum_j A_{ij} B_{ij} \tag{1}$$

where the index i identifies the analyzable unit and j identifies the pointing position within the analyzable unit. In the simple case of averaged backgrounds symmetric in step angle about the source, the A_{ij}'s are just 0.5.

The structure records are stored in the array in a definite order. First comes the source spectrum record. Only one source spectrum is allowed in any given analyzable unit. Next come the background pointing positions sorted first in ascending detector step angle order, then, within each position, in ascending time order. For example, in the case of two times and two background positions:

record	1:	tsrc ,	dsasrc
	2:	t1 bkg1,	dsabkg1
	3:	t2 bkg1,	dsabkg1
	4:	t1 bkg2,	dsabkg2
	5:	t2 bkg2,	dsabkg2

3.3.16.1 Structure Description

Description	Name	Type	# bytes
File specification	FILESPEC	Character	20
Tagword	TAGWORD	Integer	4
A_{ij}	AIJ	Real	4
Detector position status	FDET	Bits	1

3.3.16.2 Variable Descriptions

Descriptions of these variables are as follows:

FILESPEC Character 20 bytes
Specification of file containing the spectrum.

TAGWORD Integer 4 bytes
Tagword of the spectrum within the specified file.

AJI Real 4 bytes
Background estimate coefficient (Aji) for this pointing position. In the case of multiple records for a given pointing position, the records shall all contain the same value of Aji for that position j.

FDET Bits 1 byte
Detector positioning status variable. Defined as in SDB header. Applies to spectrum referred to in record.

3.3.17 Selected Spectra List (AUX2FLD bit 4; AUX data type 36)

Entity Type: structure

The selected spectra list includes pointers to all the spectra selected by a data selection criterion. The criterion or a pointer to the criterion is stored in a character variable in the header.

To avoid redundant storage of file specifications, an array of up to 100 file specs is stored in the header. Each entry in the data contains a tagword and an index into the file spec array.

3.3.17.1 Header

The header contains the 20-byte kernel plus the following variables:

Description	Name	Type	# bytes
Selection criterion	SELCRIT	Character	160
File specifications	FILESPEC(100)	Character	2000

3.3.17.2 Structure Description

Description	Name	Type	# bytes
File spec. array index	FILESPECIDX	Integer	2
Tagword	TAGWORD	Integer	4

3.3.17.3 Variable Descriptions

Descriptions of these variables are as follows:

FILESPECIDX Integer 2 bytes
Points to entry in FILESPEC array in header containing file specification for selected spectrum.

TAGWORD Integer 4 bytes
Tagword of selected spectrum.

3.3.18 Compound Response Coefficients (AUX2FLD bit 5; AUX data type 37)

Entity Type: structure

This structure array supports applications which require the weighted sums of A_{ij} (background estimation coefficient) parameters described briefly in section 3.3.16. In addition, all information required to calculate source visibility (i.e. occultation) is included. The A_{ij} information is used in both data summation and compound response matrix coefficient production. The visibility information is used in the latter only.

3.3.18.1 Structure Description

Description	Name	Type	# bytes
A_{ij}	AIJ	Real	4
Associated detector(s)	DETID	Byte	1
Interval start time (tjs)	TJS	Integer	4
Total live time (low)	LTL	Real	4
Total live time (med)	LTM	Real	4
Total live time (high)	LTH	Real	4
Positioning table id	DPTBL	Byte	1
Detector position status and offset	FDET	Bits	1
Detector position	DSA	Integer	2
Source (1) or bkgd (0) flg	SRCFLG	Byte	1
s/c RA; start of interval	GRORA	Real	4
s/c Dec; start of interval	GRODC	Real	4
+ Z Axis RA 2000 epoch	ATTZRA	Real	4
+ Z Axis Dec 2000 epoch	ATTZDC	Real	4
+ X Axis RA 2000 epoch	ATTXRA	Real	4
+ X Axis Dec 2000 epoch	ATTXDC	Real	4
Target id	TARGID	Integer	4
Target scan angle	TARGSCAN	Real	4
Target trans-scan angle	TARGXSCAN	Real	4
Command state database id	CMDSTATE_ID	Character	8

3.3.18.2 Variable Descriptions

Descriptions of these variables are as follows:

AIJ Real 4 bytes

Average background estimate coefficient (A_{ij}) for this pointing position. If record is used to record information for difference spectrum summation, A_{ij}'s are averaged over each individual background observation. If record is used to record information for compound response formation, A_{ij}'s are averaged over a pointing position on the sky.

TJS Integer 4 bytes

Start time of interval over which A_{ij}'s are averaged, in truncated julian seconds.

LTL Real 4 bytes

Low range total livetime for interval (in seconds).

LTM Real 4 bytes

Medium range total livetime for interval (in seconds).

LTH Real 4 bytes

High range total livetime for interval (in seconds).

DPTBL Integer 1 byte
Active positioning table.

FDET Bits 1 byte
Detector positioning status variable. Defined as in SDB header (section 4.2.5.2). Identifies positioning table offset.

DSA Integer 2 bytes
Detector step angle.

SRCFLG Byte 1 byte
Flag that identifies whether record is in reference to source (1) or background (2) position.

GRORA Real 4 bytes
Spacecraft position right ascension (epoch 2000) viewed from geocenter.

GRODC Real 4 bytes
Spacecraft position declination (epoch 2000) viewed from geocenter.

ATTZRA Real 4 bytes
+Z Axis RA, epoch 2000, in units of degrees.

ATTZDC Real 4 bytes
+Z Axis declination, epoch 2000, in units of degrees.

ATTXRA Real 4 bytes
+X Axis RA, epoch 2000, in units of degrees.

ATTXDC Real 4 bytes
+X Axis declination, epoch 2000, in units of degrees.

TARGID Integer 4 bytes
Id of target for visibility and collimator angle calculations.

TARGSCAN Real 4 bytes
Scan angle (degrees) of target identified by TARGID. Used for response matrix production.

TARGXSCAN Real 4 bytes
Trans-scan angle (degrees) of target identified by TARGID. Used for response matrix production.

CMDSTATE_ID Character 8 bytes
Index into command state database. Allows access to command state information.

3.3.19 Instrument Response Matrix (AUX2FLD bit 6; AUX data type 38)

Entity Type: special

The response matrix auxiliary data type holds the instrument response information required to remove the instrument signature from spectra. The interface to the Monte Carlo database from which the responses are derived produces a response matrix for a given set of incident spectrum channels and PHA spectrum channels, for a given veto configuration and instrument resolution function, and for a given incident beam angle. These are referred to as "simple" responses. The processes of estimating background and assessing the effects of sources other than the target ("confusing" sources) require a number of simple responses to be linearly combined into a "compound" response. The compound response represents the response of the instrument to the weighted sum of incident beams from a number of angles. This data type will store both simple and compound response matrices.

Each response under a single tagword (i.e. all responses in the array below) must have the same number of photon channels and the same number of PHA channels. In addition, they must all correspond to the same photon channel and PHA channel energy definitions. These values are stored in the header along with the source ID, which is also required to be the same for all responses under one tagword.

As noted in the entity type above, the structure of the response matrix aux. type is special. This is required by the variable length requirements of the arrays. The header stores the number of rows (NPHACHAN) and number of columns (NPHOTCHAN) for the response matrix. The channel energy and width vectors are of length NPHACHAN for the PHA channel definitions and NPHOTCHAN for the photon channel definitions.

The response aux. data type is different from most in that the first four records are distinct from the rest of the data. They contain the photon channel edge energies, the photon channel edge widths, the PHA channel edge energies and the PHA channel widths. The first two are of size NPHOTCHAN and the last two are of size NPHACHAN. These records will always use record sequence numbers 1–4.

The remainder of the data will be arranged using the record and entity information in the header. One entity will correspond to one response matrix. The variables DPTBL, FDET, SRCSCAN and SRCXSCAN will appear as the first 10 bytes of each response.

3.3.19.1 Header

The header includes the 20-byte kernel plus the following:

Description	Name	Type	# bytes
Detector ID	DETID	Integer	2
Source identification	SRCID	Integer	4
Shield threshold (MeV)	SLD	Real	4
Number of photon channels	NPHOTCHAN	Integer	2
Number of PHA channels	NPHACHAN	Integer	2

3.3.19.2 Data Description

Description	Name	Type	# bytes
Record 1:			
Photon channel edges (MeV)	PHOTEDG	Real	4∗NPHOTCHAN
Record 2:			
Photon channel widths (MeV)	PHOTWID	Real	4∗NPHOTCHAN
Record 3:			
PHA channel edges (MeV)	PHAEDG	Real	4∗NPHACHAN
Record 4:			
PHA channel widths (MeV)	PHAWID	Real	4∗NPHACHAN
Records 5–n:			
Active Position Table	DPTBL	Byte	1
Pointing status	FDET	Byte	1
Source scan angle	SRCSCAN	Real	4
Source transscan angle	SRCXSCAN	Real	4
Response (NPHACHAN,NPHOTCHAN) matrices	RESPONSE	Real	4∗NPHOTCHAN∗NPHACHAN

3.3.19.3 Variable Descriptions

Descriptions of these variables are as follows:

PHOTEDG Real 4∗NPHOTCHAN

The lower edge energies of the channels used to store the model incident photon spectrum, expressed in MeV. The response matrix contains probabilities for photons in these channels to appear in the PHA channels of the data.

PHOTWID Real 4∗NPHOTCHAN

The widths of the channels used to store the model incident photon spectrum, expressed in MeV.

PHAEDG Real 4∗NPHACHAN

The lower edge energies of the PHA channels for the count data, expressed in MeV. These may be the actual PHA channels from the instrument or resampled channels. The response matrix contains probabilities for photons in the photon channels to appear in these PHA channels.

PHAWID Real 4∗NPHACHAN

The widths of the channels used to store the count spectrum, expressed in MeV.

DPTBL Byte 1 byte

Identifies pointing table (primary, secondary, solar, burst) referenced by FDET. If two tables have an identical entry, such that this response could refer to either, either table ID could appear here, as long as the combination of FDET and DPTBL identifies the proper pointing parameters.

FDET	Byte	1 byte

Pointing status byte. Primarily used here to identify entry within pointing table identified in DPTBL.

SRCSCAN	Real	4 bytes

Scan angle of given source, in degrees. Same coordinate system as TARGSCAN in SDB spectrum header.

SRCXSCAN	Real	4 bytes

Transscan angle of given source, in degrees. Same coordinate system as TARGXSCAN in SDB spectrum header.

RESPONSE	Real	4*NPHOTCHAN*NPHACHAN

The response matrix gives the probability of an incident photon with energy in one of the NPHOTCHAN photon spectrum channels appearing as an event in the detector with pulse height (expressed as an energy) in one of the NPHACHAN PHA spectrum channels. The probability is expressed as an effective detector area in cm^2. Each element of the matrix contains the response of one PHA channel to incident photons of one energy. All photons in the photon spectrum channel are approximated to have the same channel representative energy. This representative energy is computed from the channel edges and widths by the response generation application and the applications that use the response. It is important that they use the same algorithm to calculate a representative energy.

3.3.20 Instrument Photopeak Response Vector (AUX2FLD bit 7; AUX data type 39)

Entity Type: special

The photopeak response vector is similar to the response matrix, but consists of only the probabilities for an incident photon of a given energy to produce a pulse height at that same energy, i.e. full energy deposition in the detector. The data structure is similar to the response matrix except that only the first two records contain channel energy information and each photopeak response, with scalar information prepended as in the response matrix, only occupies a single record.

Unlike the response matrix, the photopeak responses do not include instrument energy resolution. In other words, the probability is for occurrence of the event anywhere in the “photopeak” of the PHA spectrum. Since the photopeak response is derived from the Monte Carlo simulation, it represents only “true” photopeak photons, i.e. those that are fully absorbed in the detector. If the photopeak response were derived from the integral over the photopeak in the calibration data, for example, it would also include a contribution from events that were almost fully absorbed and not resolvable from the true photopeak at instrument resolution.

The photopeak response corresponds to the PHA channels. The units of the response are generally cm^2.

3.3.20.1 Header

The header includes the 20-byte kernel plus the following:

Description	Name	Type	# bytes
Detector ID	DETID	Integer	2
Source identification	SRCID	Integer	4
Shield threshold (MeV)	SLD	Real	4
Number of PHA channels	NPHACHAN	Integer	2

3.3.20.2 Data Description

Description	Name	Type	# bytes
Record 1:			
PHA channel edges (MeV)	PHAEDG	Real	4*NPHACHAN
Record 2:			
PHA channel widths (MeV)	PHAWID	Real	4*NPHACHAN
Records 3–n:			
Active Position Table	DPTBL	Byte	1
Pointing status	FDET	Byte	1
Source scan angle	SRCSCAN	Real	4
Source transscan angle	SRCXSCAN	Real	4
Response (NPHACHAN) vector	PPKRESPONSE	Real	4*NPHACHAN

3.3.20.3 Variable Descriptions

Descriptions of these variables are as follows:

PHAEDG Real 4*NPHACHAN

The lower edge energies of the PHA channels for the count data, expressed in MeV. These may be the actual PHA channels from the instrument or resampled channels. The response matrix contains probabilities for photons in the photon channels to appear in these PHA channels.

PHAWID Real 4*NPHACHAN

The widths of the channels used to store the count spectrum, expressed in MeV.

DPTBL Byte 1 byte

Identifies pointing table (primary, secondary, solar, burst) referenced by FDET. If two tables have an identical entry, such that this response could refer to either, either table ID could appear here, as long as the combination of FDET and DPTBL identifies the proper pointing parameters.

FDET Byte 1 byte

Pointing status byte. Primarily used here to identify entry within pointing table identified in DPTBL.

SRCSCAN Real 4 bytes

Scan angle of given source, in degrees. Same coordinate system as TARGSCAN in SDB spectrum header.

SRCXSCAN Real 4 bytes

Transscan angle of given source, in degrees. Same coordinate system as TARGXSCAN in SDB spectrum header.

PPKRESPONSE Real 4*NPHACHAN

See above for description.

3.3.21 Directory (AUX2FLD bit 10; AUX data type 42)

Entity Type: Structure

Each structure record contains a data type, time and tagword information. The user may use these records to point to event data residing in the SDB file. The directory aux type will be used primarily to point to groups of related spectra such as TSAC resolution spectra from a single flare or burst. The first spectrum tagword includes the directory aux type pointing to all the tagwords in the group.

A simple example DIR for a day(TJD=0) with two Burst events would be:

BATSEID	DATATYPE	AUXTYPE	STRTTIM	STOPTIM	STRTTAG	STOPTAG	XRAYCLASS
01408	BURST	0	10	20	105	105	GOES C5.5
01408	SPM	0	10	20	1000001	1000124	GOES C5.5
01408	SLOT	0	10	20	2000001	1000111	GOES C5.5
01408	BURST	0	250	520	205	205	GOES X10.4
01408	SPM	0	250	520	1000131	1000555	GOES X10.4
01408	SLOT	0	250	520	2000121	1000188	GOES X10.4

3.3.21.1 Structure Description

Description	Name	Type	# bytes
BATSE trigger ID	BATSEID	Integer	4
Data type	DATATYPE	Character	10
Aux type	AUXTYPE	Byte	1
Start time(TJS)	STRTTIM	Integer	4
Stop time(TJS)	STOPTIM	Integer	4
Start tag	STRTTAG	Integer	4
Stop tag	STOPTAG	Integer	4
X-ray class	XRAYCLASS	Character	10

3.3.21.2 Variable Descriptions

Descriptions of these variables are as follows:

BATSEID	Integer	4 Bytes

BATSE Trigger ID from BATSE admin messages if available.

DATATYPE	Character	10 Bytes

Specification of the data type pointed to by this record. For example, BURST, SPM, CAL, RPHA1LOW, RPHA1MED,SLOT

AUXTYPE	Byte	1 Byte

Specification of the AUX data type pointed to by this record (usually 0 for Spectrum data)

STRTTIM	Integer	4 Bytes

Start time in truncated julian seconds (TJS) of the data pointed to by this record.

STOPTIM	Integer	4 Bytes

Stop time in truncated julian seconds (TJS) of the data pointed to by this record.

STRTTAG	Integer	4 Bytes

Starting tagword of the data pointed to by this record.

STOPTAG	Integer	4 Bytes

Ending tagword of the data pointed to by this record.

XRAYCLASS	Character	10 Bytes

GOES X-ray classification if available, i.e. GOES X12.2

4 The Primary SDB Header

4.1 Header Structure Overview

A summary of the header variables is included in this section. Detailed descriptions are in the sections that follow.

Header Section	Size (bytes)
KERNEL	20
VERSION DOCUMENTATION	15
INSTRUMENT/DETECTOR CONFIGURATION	16
SPECTRUM DESCRIPTION	96
DETECTOR POSITIONING	36
TARGET POSITION	20
DETECTOR GAIN AND CALIBRATION INFO.	16
DETECTOR RATES	108
DETECTOR ENVIRONMENT AND HISTORY	85
SPACECRAFT POSITION	96
DETECTOR TEMPERATURES	48
RELATED TAGWORDS	24
MISCELLANEOUS	53
DETECTOR BILEVELS AND ANALOGS	140
RESERVE	37
TOTAL	810

4.1.1 Kernel

VARIABLE	NAME	DATA TYPE	BYTES
UNION			
MAP			
File key	FILE_KEY	Real	8
END MAP			
MAP			
Record sequence number	REC_SEQ	Byte	2
Array Data Type	ARRAY_TYPE	Byte	1
Spare key space	SPAREKEY	Byte	1
Tagword	TAGWORD	Integer	3
Sparse/Dense flag	SPARSEFLG	Byte	1
END MAP			
END UNION			
Size of header	SIZEHDR	Integer	2
# bytes/record	NBYTES_PER_RECORD	Integer	2
# records	NUMREC	Integer	2
# of entities	NUMENT	Integer	2
# bytes/entity	SIZEENT	Integer	2
Data type version	DATAVERSION	Integer	2
Total Kernel			20

4.1.2 Version Documentation

VARIABLE	NAME	DATA TYPE	BYTES
Header version number	HDRVERS	Integer	2
Header revision number	HDRREV	Byte	1
Creation software index	SOFTINDEX	Integer	4
Creation s/w major vers.	SOFTMAJOR	Integer	4
Creation s/w minor vers.	SOFTMINOR	Integer	4
Total Version Documentation			15

4.1.3 Instrument/Detector Configuration

VARIABLE	NAME	DATA TYPE	BYTES
Command state table ID, end	CMDSTATE_ID	Character	8
Det. cfg. table ID, end	DETCFG_ID	Integer	4
Motor drive postion table, end	MDPOSTBL_ID	Integer	4
Total Instrument/Detector Configuration			15

4.1.4 Spectrum Description

VARIABLE	NAME	DATA TYPE	BYTES
Creation date and time, VAX format	CREDATE	Real*8	8
Detector ID	DETID	Bit	2
Target Name Code	TARGID	Integer	4
Source/Background Offset	TARGOFF	Byte	1
Telemetry format ID	TLMID	Byte	1
Reactor event code	REACTOR	Bit	1
DSF stop/event status code	DSFSTAT	Bit	4
Data quality **HAZARD** flags	DQHAZ	Integer	4
Data quality **INFO** flags	DQINFO	Integer	4
User spectrum screening flags	USRSCRNFLG	Bits	4
Spectrum Source Code	SPECSRC	Byte	1
Spectral Category Code	SPECCAT	Byte	1
Units Code	SPECUNIT	Integer	2
Spectrum format and processing flags	SPECFLGS	Bits	2
CALPHA/RPHA Mux	CALRPHA	Byte	1
Spec. mem. low live time/ single spectrum live time (seconds)	LTL	Real	4
Spec. mem. med. live time (seconds)	LTM	Real	4
Spec. mem. high live time (seconds)	LTH	Real	4
Accumulation Time (seconds)	ACCUMTIM	Real	4
Start Time (TJS)	STRTTIM	Integer	4
Start Time Fraction ($\frac{1}{8}$ msec)	STRT_FRAC	Integer	2
Stop Time (TJS)	STOPTIM	Integer	4
Stop Time Fraction ($\frac{1}{8}$ msec)	STOP_FRAC	Integer	2
Orbit Number	ORBIT	Integer	4
Source Count (beginning/end)	SRCCT(2)	Integer	4
Total # of spectrum channels	NCHAN	Integer	2
# of low range channels	NCHANL	Integer	2
# of med. range channels	NCHANM	Integer	2
# of high range channels	NCHANH	Integer	2
Number of ch.s, param. 1	NCHAN1	Integer	2
Number of ch.s, param. 2	NCHAN2	Integer	2
AUX field flags (1st 32)	AUX1FLD	Integer	4
AUX field flags (2nd 32)	AUX2FLD	Integer	4
Total Spectrum Description			96

4.1.5 Detector Positioning

VARIABLE	NAME	DATA TYPE	BYTES
Active Position Table	DPTBL	Byte	1
Detector Posit. Status	FDET	Bits	1
Detector position, end	DSA	Integer	2
Detector RA epoch 2000	DETRA	Real	4
Detector decl epoch 2000	DETDC	Real	4
Target Latitude (scan angle)	TARGSCAN	Real	4
Target Longitude (transscan)	TARGXSCAN	Real	4
Earth azimuth in detector coordinates (begin/end)	EARTHAZ(2)	Real	8
Earth/collimator separation (begin/end)	EARTHSEP(2)	Real	8
Total Detector Positioning			36

4.1.6 Target Position

VARIABLE	NAME	DATA TYPE	BYTES
Target RA 2000 epoch	TARGRA	Real	4
Target Dec 2000 epoch	TARGDC	Real	4
Collimator Position Angle	COLLPOSANG	Real	4
Mean scan pointing uncertainty (sigma)	SIG_SCAN	Real	4
Mean transscan pointing uncertainty (sigma)	SIG_XSCAN	Real	4
Total Target Position			20

4.1.7 Detector Gain and Calibration Information

VARIABLE	NAME	DATA TYPE	BYTES
Detector relative gain	RGAIN	Real	4
Detector relative FWHM	RFWHM	Real	4
Detector standard RGAIN	STDRGAIN	Real	4
Detector standard RFWHM	STDRFWHM	Real	4
Total Detector Gain and Calibration Info			16

4.1.8 Detector Rates

VARIABLE	NAME	DATA TYPE	BYTES
Rate Collection Time	SUM_TIM	Real	4
Low Range ULD Energy Rate	EUDL_SUM	Real	4
Low Range Memory Load Rate	MLL_SUM	Real	4
Low Range SML Dead Time	DTL_SUM	Real	4
Med Range ULD Energy Rate	EUDM_SUM	Real	4
Med Range Memory Load Rate	MLM_SUM	Real	4
Med Range SMM Dead Time	DTM_SUM	Real	4
Hi Range ULD Energy Rate	EUDH_SUM	Real	4
Hi Range Memory Load Rate	MLH_SUM	Real	4
Hi Range SMH Dead Time	DTH_SUM	Real	4
Shield MLD Rate	SMD_SUM	Real	4
Shield ULD Rate	SUD_SUM	Real	4
CPD LLD Rate	CPD_SUM	Real	4
Shield 1 LLD Thresh. Rate	S1LD_SUM	Real	4
Shield 2 LLD Thresh. Rate	S2LD_SUM	Real	4
Shield 3 LLD Thresh. Rate	S3LD_SUM	Real	4
Shield 4 LLD Thresh. Rate	S4LD_SUM	Real	4
Low Energy LLD Thresh. Rate	ELDL_SUM	Real	4
Low Analog Window Rate	ATWL_SUM	Real	4
Low Time ULD Thresh. Rate	TUDL_SUM	Real	4
Med Energy LLD Thresh. Rate	ELDM_SUM	Real	4
Med Analog Window Rate	ATWM_SUM	Real	4
Med Time ULD Thresh. Rate	TUDM_SUM	Real	4
Hi Energy LLD Thresh. Rate	ELDH_SUM	Real	4
Hi Analog Window Rate	ATWH_SUM	Real	4
Hi Time ULD Thresh. Rate	TUDH_SUM	Real	4
^{60}Co LLD Thresh.	C6LD_SUM	Real	4
Total Detector Rates			108

4.1.9 Detector Environment and History

VARIABLE	NAME	DATA TYPE	BYTES
McIlwain L (begin/end)	MCL(2)	Real	8
McIlwain B (begin/end)	MCB(2)	Real	8
Rigidity (begin/end)	RIGID(2)	Real	8
Radial Component of Mag. Field Vector (begin/end)	BRAD(2)	Real	8
Polar Angle Component of Mag. Field Vector (begin/end)	BPOL(2)	Real	8
Azimuthal Angle Component of Mag. Field Vector (begin/end)	BAZ(2)	Real	8
Day/Night Code (mean)	DAY_NIGHT	Byte	1
CPM low rate (mean)	CPML_RATE	Real	4
CPM high rate (mean)	CPMH_RATE	Real	4
Time From Start of Orbit	ORBIT_TIM	Real	4
Total CPML CTS for Orbit	CPML_ORBIT_SUM	Real	4
Total CPMH CTS for Orbit	CPMH_ORBIT_SUM	Real	4
Time since last SAA exit	LAST_SAA_EXIT	Real	4
CPM integration time during last SAA	LAST_SAA_TIM	Real	4
CPM low dose during last SAA	CPML_LAST_SAA	Real	4
CPM high dose during last SAA	CPMH_LAST_SAA	Real	4
Total Detector Environment and History			85

4.1.10 Spacecraft Position

VARIABLE	NAME	DATA TYPE	BYTES
RA of s/c in earth cent inert. epoch 2000 (begin/end)	GRORA(2)	Real	8
Decl. of s/c in earth cent inert. epoch 2000 (begin/end)	GRODC(2)	Real	8
Longitude of sub-s/c point (begin/end)	GROLG(2)	Real	8
+ Z Axis RA 2000 epoch (begin/end)	ATTZRA(2)	Real	8
+ Z Axis Dec 2000 epoch (begin/end)	ATTZDC(2)	Real	8
+ X Axis RA 2000 epoch (begin/end)	ATTXRA(2)	Real	8
+ X Axis Dec 2000 epoch (begin/end)	ATTXDC(2)	Real	8
Altitude of s/c above earth (begin/end)	GRORAD(2)	Real	8
Barycenter vector	RSC(3)	Real	24
Ephemeris - UTC time	ETUT	Real	8
Total Spacecraft Position			96

4.1.11 Detector Temperatures

VARIABLE	NAME	DATA TYPE	BYTES
PMT Mount Plate Temp.	PTMP1	Real	4
Coll./ ^{60}Co Temp.	C6TMP	Real	4
Xtal Housing Cover Temp.	S1TMP	Real	4
CPD Temp.	CPDTM	Real	4
Mag. Shield −Z Temp.	PTMP2	Real	4
Elect. A1 Temp.	ETMP1	Real	4
Elect. A4 Temp.	ETMP2	Real	4
High Voltage Supply Temp.	HVTMP	Real	4
Low Voltage Supply Temp.	LVTMP	Real	4
Outboard Spider Temp.	TCTMP	Real	4
Mag. Shield Out. Temp.	S2TMP	Real	4
A3 Temp.	A3TMP	Real	4
Total Detector Temperatures			48

4.1.12 Related Tagwords

VARIABLE	NAME	DATA TYPE	BYTES
Calibration Tagword	CALTW	Integer	4
Standard Calib Tagword	STDCALTW	Integer	4
Orbit History Tagword	ORBITTW	Integer	4
Related Spectra Tagword	RELSPECTW	Integer	4
Footnote Tagword	NOTETW	Integer	4
Response Tagword	RESPTW	Integer	4
Total Related Tagwords			24

4.1.13 Miscellaneous

VARIABLE	NAME	DATA TYPE	BYTES
Acquisition Hdr	ACHD(25)	Byte	25
Time of Slot Header Packet	HSKPTIM	Integer	4
Seconds/TSAC	TSAC	Real	4
Average Pot Main	AM	Real	4
Average Pot Redn	AR	Real	4
Effective area	EFFECAREA	Real	4
Divisor	DIVISOR	Real	4
Phase Bin No.	PHBINNUM	Integer	2
Total No. of Phase Bins	NUMPHBIN	Integer	2
Total Miscellaneous			53

4.1.14 Detector Bilevels and Analogs

VARIABLE	NAME	DATA TYPE	BYTES
Bilevels 0–4 (Start of acquisition)	STRTBILVL(5)	Bits	10
Bilevels 0–4 (End of acquisition)	ENDBILVL(5)	Bits	10
Shield 1 LLD Thresh.	S1LD	Real	4
Shield 2 LLD Thresh.	S2LD	Real	4
Shield 3 LLD Thresh.	S3LD	Real	4
Shield 4 LLD Thresh.	S4LD	Real	4
^{60}Co LLD Thresh.	C6LD	Real	4
CPD LLD Thresh.	CPD	Real	4
Low Energy LLD Thresh.	ELDL	Real	4
Low Time LLD Thresh.	TLDL	Real	4
Low Time ULD Thresh.	TUDL	Real	4
Med Energy LLD Thresh.	ELDM	Real	4
Med Time LLD Thresh.	TLDM	Real	4
Med Time ULD Thresh.	TUDM	Real	4
Hi Energy LLD Thresh.	ELDH	Real	4
Hi Time LLD Thresh.	TLDH	Real	4
Hi Time ULD Thresh.	TUDH	Real	4
Cal. PHA LLD Thresh.	CLLD	Real	4
HV/DAC PMT 1	HVP1	Real	4
HV/DAC PMT 2	HVP2	Real	4
HV/DAC PMT 3	HVP3	Real	4
HV/DAC PMT 4	HVP4	Real	4
HV/DAC PMT 5	HVP5	Real	4
HV/DAC PMT 6	HVP6	Real	4
HV/DAC PMT 7	HVP7	Real	4
Shield 1 HV	HVS1	Real	4
Shield 2 HV	HVS2	Real	4
Shield 3 HV	HVS3	Real	4
Shield 4 HV	HVS4	Real	4
^{60}Co/CPD HV	HVC6	Real	4
Pin Diode Thresh.	PIN	Real	4
LED Level	LED	Real	4
Total Detector Bilevels and Analogs			140

4.2 Header Variable Descriptions

The following descriptions include the variable summary, a description and any applicable codes or bit assignments.

Several of the SDB header variables are codes that must be defined externally. A few of these coded variables involve bit assignments (i.e., each bit is assigned an independent meaning), while the rest are numerical codes or mixed bit and numerical.

The definitions of code values are stored in an .ICL (`CM_DEV:[PDA.ICL]SDB_HEADER_CODES.ICL`) file that may be compiled with code. The code structure is described in the comments in the .ICL file.

4.2.1 Header Kernel

4.2.1.1 FILE_KEY

```
UNION
MAP
  FILE_KEY     Real     8 bytes
END MAP
MAP
  REC_SEQ      Byte     2 bytes
  ARRAY_TYPE   Byte     1 byte
  SPAREKEY     Integer  1 byte
  TAGWORD      Integer  3 bytes
  SPARSEFLG    Byte     1 byte
END MAP
END UNION
```

The primary key is composed of 8 bytes divided into five fields. The uppermost byte is a flag that identifies the record as belonging to a "sparse" or "dense" data type, as described in section 3.2. The next three bytes are the spectrum tagword, which uniquely identifies the spectrum within the file and also may be encoded such as to do spectrum bookkeeping within a file. The next byte is spare key space reserved for future use and currently zeroed. The lowest two bytes are the data type (ARRAY_TYPE) and record sequence number. Data types refer to the primary spectrum data (aux. type 1) and all the auxiliary data that may be stored in the SDB format. The aux. type specifies which of the (64 maximum) data types the record contains. It is the same for all records of that data type. The most significant bit of the array type is a flag that, if set (i.e. if byte is negative), indicates that the record is in an alternate key space projected for use for an audit trail. The spare bytes may be used in this mode as well. The least significant byte is the record sequence number. It counts sequentially from zero to the number of records for each array. It is always one for the first data record of a data type and zero for the header.

In summary, records referred to by a single SDB tagword can contain one or more data types. All data types have a header preceding them, as described in a previous section. The key values are summarized in the following table:

Item	Tagword	Spare	Array Type	Sequence #
SDB Header	TW	0	0	0
Data Array Header	TW	0	N	0
Data Array Records	TW	0	N	1–M

where TW is the tagword in question, N is the data array type and M is the number of records in the data array.

4.2.1.2 SIZEHDR **Integer** **2 bytes**

Size of the header in bytes.

4.2.1.3 NBYTES_PER_RECORD **Integer** **2 bytes**

Number of bytes in a single data record.

4.2.1.4 NUMREC **Integer** **2 bytes**

Number of data records in this data array.

4.2.1.5 NUMENT **Integer** **2 bytes**

Number of entities, in the case of spectrum data, channels, in this data array.

4.2.1.6 SIZEENT **Integer** **2 bytes**

Size in bytes of each entity. In the case of spectrum data, the number of bytes per spectrum channel.

4.2.1.7 DATAVERSION **Integer** **2 bytes**

Version number of the entity structure of this type of data (not expected to change for spectrum data).

4.2.2 Version Documentation

4.2.2.1 HDRVERS — Integer — 2 bytes

Physical version of header. Headers with different version numbers are not necessarily software compatible.

4.2.2.2 HDRREV — Byte — 1 byte

Header revision number. Incremented each time interpretation of information in header is changed without change of physical version (see HDRVERS).

4.2.2.3 SOFTINDEX — Integer — 4 bytes

Index into table containing types of software products used to create and/or modify spectra.

4.2.2.4 SOFTMAJOR — Integer — 4 bytes

Major version number of software specified in SOFTINDEX.

4.2.2.5 SOFTMINOR — Integer — 4 bytes

Minor version number of software specified in SOFTINDEX.

4.2.3 Instrument/Detector Configuration

4.2.3.1 CMDSTATE_ID Character 8 bytes

An index into the Vector Table of the Command State Database, specifying the command state vector valid at the start of the first DSF-summed interval of the accumulation. This table contains the command state vector, a collection of pointers into a table of strategy table file names (the Strategy Table Table). The individual strategy table files contain the actual instrument configurations.

4.2.3.2 DETCFG_ID Integer 4 bytes

An index into the Strategy Table Table of the Command State Database, specifying the detector configuration strategy table valid at the end of the first DSF-summed interval of the accumulation.

4.2.3.3 MDPOSTBL_ID Integer 4 bytes

An index into the Strategy Table Table of the Command State Database, specifying the motor drive positioning strategy table valid at the end of the first DSF-summed interval of the accumulation.

4.2.4 Spectrum Description

4.2.4.1 CREDATE Real*8 8 bytes

Date and time of creation of header (8-byte VAX time format).

4.2.4.2 DETID Bit 2 bytes

Identifies detector(s) that produced spectra. In a number of calibration cases, default value of zero gives false indication of engineering model detector when variable was not filled in.

```
DETID          Bit  0          DETECTOR 1            ALL CLEARED
                    1          DETECTOR 2
                    2          DETECTOR 3
                    3          DETECTOR 4
                    4          BCU
                    5          DETECTOR SIMULATOR
                    6          ENGINEERING MODEL
                    7          SCIENCE MODEL
               ALL CLEARED     NOT SPECIFIED
```

4.2.4.3 TARGID Integer 4 bytes

Index into the configuration managed target planning catalog. This is found in file PLANNING_CATALOG.CAT, which contains the target id, target name, coordinates and other target information.

4.2.4.4 TARGOFF Integer 1 byte

TARGOFF contains the angle, truncated to integer quarter degrees, from the designated target (of which one or more shall be defined for each pointing table; designated by TARGID) to the current pointing position (i.e. negative of TARGSCAN truncated to integer quarter degrees). This shall be defined such that an offset from the target in the direction of the spacecraft x-axis is positive and an offset in the direction of the spacecraft z-axis is negative. In either case, the variable TARGID shall identify the target from which the offset is referenced.

4.2.4.5 TLMID Byte 1 byte

Telemetry format ID of first TSAC summed into spectrum.

4.2.4.6 REACTOR Bit 1 byte

Bit flags indicating that a reactor event was predicted and/or found during the data accumulation.

```
Bit  none       No reactor event        none
     0          predicted
     1          observed
     2          positron event
     3          electron event
     4          gamma event
```

4.2.4.7 DSFSTAT Bits 4 bytes

Bit flags indicating the conditions under which DSF produced the spectrum. In particular, the accumulation stop mode and whether any events occurred that caused data to be shifted out of primary data will be indicated. In addition, user-defined events may be recorded. The MSbit will be set (allowing sign tests) if bits 2-8 or any user bits have been set.

```
                            EVENT                   RESULT

DSFSTAT        Bit  0       DETECTOR MOTION         INFORMATIONAL
                             INCLUDED IN (PRIMARY)
                             ACCUMULATION
                    1       TIMEOUT                 STOP ALL DETS
                    2       DETECTOR MOTION         REROUTE IF
                             OCCURRED                DESIRED
                    3       ORBITAL EVENT           STOP ALL DETS
                                                     AND REROUTE
                                                     IF DESIRED
                    4       TM FORMAT CHANGE        STOP ALL DETS
                            (SYSTEM EVENT)
                    5       OPMODE NOT EQUAL TO 4   STOP ALL DETS
                            (SYSTEM EVENT)
                    6       LVLy$Px CHANGES         STOPS THAT DET
                            (DETECTOR EVENT)
                    7       LOW/HIGH DEAD TIMES     STOPS THAT DET
                            (DETECTOR EVENT)
                    8       DETECTOR POSITIONING    STOPS THAT DET
                            DISABLED (DETECTOR EVENT)
                    9       POSITION INDEX CHANGE   STOP ALL DETS
                    10      OPMODE RETURNED TO 4    INFORMATIONAL
                    11      FDET MODIFIED           INFORMATIONAL
                    12      COSMIC RAY EVENT(S)        INFORMATIONAL
                            SCREENED
                    13      C60 data unavailable INFORMATIONAL
                    14      SLOT PROCESSES CONTAIN  INFORMATIONAL
```

```
                    SOME HEADER FIELDS WHICH
                    CONTAIN APPROXIMATIONS
         15         BAD SLOT BUFFER        INFORMATIONAL
         16         OVERFLOW IN LOW RANGE   INFORMATIONAL
                    SPECTRA
         17         OVERFLOW IN MED RANGE   INFORMATIONAL
                    SPECTRA
         18         OVERFLOW IN HIGH RANGE  INFORMATIONAL
                    SPECTRA
         19 LONG PACKET GAP INFORMATIONAL
         20-31      USER-DEFINED EVENTS
    all cleared     NO EVENTS DURING SPECTRUM, DEFAULT
```

For the DSFSTAT variable stored in Pulsar Data Files, only bits 1, 4, 5, 9, and 10 are used.

Bit 10 is defined here solely for compatibility with the PDF DSFSTAT variable and should never be set in SDB.

When defining events, users should start with bit 31 and work down.

4.2.4.8 DQHAZ Bit 4 bytes

Bit flags indicating that a serious anomaly, background or transient event was found during automatic or visual scanning of the data. If no bits are set, no event was found. DQHAZ flags indicate data likely to be eliminated from routine analysis. The flags, as set by PDA, are as follows:

```
DQHAZ          Bit   0         Orbital ephemeris anomaly
                     1         Spacecraft pointing anomaly
                     2         UTC error
                     3         Flare detected in phoswich data
                     4         Burst detected in phoswich data
                     5         OSSE pointing anomaly
                     6         Gain anomaly
                     7         Phoswich electron precipitation event
                                (includes concurrent shield event)
                     8         AGC anomaly -- high voltage glitch
                     9         Uncatagorized phoswhich transient
                    10         Reactor event detected in data
                    11         Cosmic ray event in data (must eliminate
                                entire accumulation)
                    12         Suspect region -- Currently not used
                    13         Unknown state (Hazard)
```

4.2.4.9 DQINFO Bit 4 bytes

Bit flags indicating that an informational event was found during automatic or visual scanning of the data. If no bits are set, no event was found. DQINFO flags do not indicate data likely to be eliminated from routine analysis. The flags, as set by PDA, are as follows:

```
DQINFO          Bit   0          Missing packets during accumulation
                      1          Bad packets during accumulation
                      2          OSSE pointing guess (usually short sum)
                      3          OSSE in unknown state (informational)
                      4          Spacecraft reorientation
                      5          Burst trigger
                      6          Flare trigger
                      7          Uncategorized other transient
                      8          Unused
                      9          Reactor event detected and eliminated
                                  from data
                     10          Pulsar UTC error
                     11          Flare detected in shields
                     12          Burst detected in shields
                     13          OSSE pointing anomaly (correctable)
                     14          SAA dosage unavailable (>25% SAA dosage
                                 missing;  time duration of SAA put into
                                 LAST_SAA_TIME and CPML_LAST_SAA and
                                 CPMH_LAST_SAA are zeroed)
                     15          Shield electron precipitation
                                  (exclusive -- no phoswich event)
                     16          Cosmic ray glitchlett (35-50 keV)
```

4.2.4.10 USRSCRNFLG Bits 4 bytes

User controlled bit flags indicating screening of spectrum. Bits 0–31 can be assigned by users for screening purposes. Specifically, any queries that result in a subset of spectra being selected may cause bits in USRSCRNFLG to be set. Future programs may then determine which spectra to process by examining a single bit.

```
USRSCRNFLG      Bit  0-31        USER SCREENING FLAGS    All Cleared
                ALL CLEARED      NO FLAGS SET
```

4.2.4.11 SPECSRC Byte 1 byte

Unsigned byte variable indicating PHA/Data channel from which data were taken. The first three bits are reserved for spectral memory low, medium and high ranges. The remaining bits, with the first three bits masked to zero, form a code. Science processes are encoded by their process ID (SPECSRC = PID∗8 to allow for first three bits being masked off). The only other science process that makes use of the low three bits is ^{60}Co, which has low and medium range options. These should be represented by the base code (64 for ^{60}Co) summed with the appropriate range bits. In the case of low and medium range being present in the same spectrum either the base code plus 3 (low and medium bits set) or the base code alone are allowable.

For use in applications, this variable must be zero-extended into an i∗2.

Other allowable values include vertical (energy spectrum) or horizontal (time spectrum) cuts across two parameter RPHA spectra, and various external data sources.

The data channel is further identified by CALRPHA described below.

```
SPECSRC         Bit  0          SPEC_LOW                 7 (BITS 0,1,2)
                     1          SPEC_MED
                     2          SPEC_HIGH

                Code 0          SPEC_ALL                    (PROCESS ID
                                                                    *8)
                     1          SPEC_LOW
                     2          SPEC_MED
                     3          SPEC_L+M
                     4          SPEC_HIGH
                     5          SPEC_L+H
                     6          SPEC_M+H
                     7          SPEC_L+M+H
                     8          CAL
                     16         BURST
                     24         RPHA2
                     48         RPHA1
                     65         CO60_LOW |
                     66         CO60_MED |-- basic Co60 process ID
                     67         CO60_L+M |    + range bits
                     72         PULSAR
                     80         CANBERRA
                     88         CANRPHA1
                     96         CANRPHA2
                     104        EXTERNAL
                     112        MCD1
                     120        MCD2
                     128        VERTICAL CUT RPHA2      |
                     136        HORIZONTAL CUT RPHA2    |--Assume
                     144        VERTICAL CUT RPHA1      |  unsigned
                     152        HORIZONTAL CUT RPHA1    |  i*1;  must
                                                           zero-extend
                                                           into i*2
                     160+1st 3  FLAG TO INDICATE RANGES
                      bits       CONCATENATED WITH OVERLAP REMOVED
```

4.2.4.12 SPECCAT — Byte — 1 byte

Type of data in the spectrum data array referred to by the header (i.e. PHA spectrum, incident photon spectrum, time series data, etc.). In the case of raw data, all will be PHA spectra.

```
SPECCAT         Code   0        NO CODE ASSIGNED        0
                       1        ENERGY/PHA SPECTRUM
                       2        DIFFERENCE PHA SPECTRUM
                       3        ESTIMATED INCIDENT PHOTON SPECTRUM
                       4        ESTIMATED BACKGROUND
                      20        DIFLIN
                      21        DIFLINC (CLEANED DIFLIN)
                      40        TIME  (PSD SPECTRUM)
                      41        TIMDIF (DIFFERENCE PSD
                                SPECTRUM)
                      60        THIST (TIME OR PHASE HISTOGRAM)
                     100        FOUR (FOURIER)
                     120        CHI2_MAP
```

4.2.4.13 SPECUNIT — Integer — 2 bytes

Bit flags that specify units of data. Raw data from archives will almost always be in counts. The most significant bit of the 2-byte word is a flag that indicates that the data have been resampled into a new bin structure. In general, the low order byte (bits 0–7) represents the denominator of the units, while the high order byte (bits 8–15) represents the numerator and the resample flag.

```
SPECUNIT        Bit  0          1/SEC                   bits 0,8 set
                     1          1/CM2 (effective)
                     2          1/MEV
                     3          1/KEV
                     4          1/DIVISOR (SEE DIVISOR VARIABLE)
                     5          1/RADIAN
                     6          1/STERADIAN
                     7          RESERVED FOR EXPANSION
                     8          COUNTS
                     9          PHOTONS
                     10         MEV
                     11         KEV
                     12         ERG
                     13         DTW Corrected Counts
                     14         RESERVED FOR EXPANSION
                     15         =0  DATA NOT RESAMPLED
                                =1  DATA RESAMPLED
```

4.2.4.14 SPECFLGS **Bits** **2 bytes**

Bit flags indicating various spectrum information as indicated in the codes section above, including real or integer data, 2-byte or 4-byte data, spectra or time history, glitch information, and whether or not the spectrum has been flagged for deletion. The latter may be tested by testing for a negative value of the variable. [2]

```
SPECFLGS          Bit 0          0 = REAL DATA           0
                                 1 = INTEGER DATA
                      1          0 = 2 BYTE              0
                                 1 = 4 BYTE
                      2          0 = SDB                 0
                                 1 = TIME SERIES DB
                      3          0 = DSF PRODUCT         0
                                 1 = DERIVED PRODUCT
                      4          0 = ENVIRONMENT DATA    0
                                     NOT FILLED
                                 1 = ENVIRONMENT DATA
                                     FILLED
                      5          0 = AUTOMATIC DEGLITCH  0
                                     NOT RUN
                                 1 = AUTOMATIC DEGLITCH
                                     RUN
                      6          0 = VISUAL DEGLITCH NOT 0
                                     RUN
                                 1 = VISUAL DEGLITCH RUN
                      8          1 = POST-MERGE PROCESS RUN
                                 0 = POST-MERGE PROCESS NOT RUN
                      9          1 = SPECTRUM GAIN-NORMALIZED  0
                                 0 = SPECTRUM NOT GAIN-NORMALIZED
                      15         0 = DATA NOT FLAGGED    0
                                     FOR DELETION
                                 1 = DATA FLAGGED FOR
                                     DELETION
```

4.2.4.15 CALRPHA **Byte** **1 byte**

In the case of SPECSRC indicating CALPHA, RPHA1, CANRPHA1, or vertical or horizontal RPHA1 cuts, further information concerning data is required. This variable contains a code indicating the CAL MUX address (but not equal to that address—see SDB Header Codes) in the case

[2] The variable type codes (first two bits) can be translated as follows:

0 ⇒ Real*4
1 ⇒ Integer*2
2 ⇒ Real*4
3 ⇒ Integer*4

of CALPHA or a code indicating RPHA mode (low, medium or CAL MUX address if RPHA is pointing at CALPHA). For details, see codes section.

```
CALRPHA (SPECSRC = 8 = CAL)
                Code 0          NOT APPLICABLE          0
                     1          SPEC MEM LOW
                     2          SPEC MEM MEDIUM
                     3          SPEC MEM HIGH
                     4          PIN
                     5          SHIELD 1
                     6          SHIELD 2
                     7          SHIELD 3
                     8          SHIELD 4
                     9          PMT
                     10         CO 60 BETA
                     11         CPD

CALRPHA (SPECSRC = 48,88,144,152 = RPHA1 AND DERIVATIVES)
                Code 0          NOT APPLICABLE          0
                     1          RPHA1 LOW
                     2          RPHA1 MEDIUM
                THE FOLLOWING APPLY TO RPHA POINTING TO CAL:
                     4          PIN
                     5          SHIELD 1
                     6          SHIELD 2
                     7          SHIELD 3
                     8          SHIELD 4
                     9          PMT
                     10         CO 60 BETA
                     11         CPD
```

4.2.4.16 LTL — Real — 4 bytes

Live time seconds. In the case of spectral memory this is the live time for low range.

In the case of all other data, this is the best estimate available of the live time regardless of range. In general, best estimate means that spectral memory dead times for the appropriate time period have been applied to the relevant acquisition time. However, DSF uses unadjusted accumulation times for many quantities.

Precision of live time is seven significant digits maximum, as dictated by VAX real*4. This should be adequate under any conditions. However, this means that precision of dead time subtraction may be lost under some circumstances (this should never be significant, though).

4.2.4.17 LTM Real 4 bytes

Live time seconds. In the case of spectral memory and ^{60}Co data, this is the live time for medium range.

In the case of all other data, this is set to 0.

4.2.4.18 LTH Real 4 bytes

Live time seconds. In the case of spectral memory data, this is the live time for high range.

In the case of all other data, this is set to 0.

4.2.4.19 ACCUMTIM Real 4 bytes

Accumulation time for spectrum in seconds of wall clock time. Equal to TSAC times the number of TSAC's summed into the accumulation. This may not reflect LTL, LTM, or LTH due to missing/bad packets.

4.2.4.20 STRTTIM Integer 4 bytes

Start time of actual spectrum acquisition expressed in truncated julian seconds (tjs = integer(truncated julian day number) * 86400 + seconds of day) not including leap seconds.

For other forms of data (e.g. burst, cal, C60, RPHA1, RPHA2), the intent is that this time represents as closely as possible the start time of acquisition of the data at the detector (as opposed to the time the data were telemetered).

For burst data in particular, this time shall represent the burst trigger time tag.

In order to compute an interval between two time so specified, the number of spacecraft leap seconds introduced during that interval must be added to the interval. This can be done via IGORE utilities.

4.2.4.21 STRT_FRAC Integer 2 bytes

This shall be the fractional seconds of day corresponding to STRTTIM in units of $\frac{1}{8}$ msec.

4.2.4.22 STOPTIM Integer 4 bytes

Stop time of spectrum acquisition expressed in truncated julian seconds (see discussion under STRTTIM above).

For other forms of data (e.g. burst, time series), the intent is that this time represents as closely as possible the stop time of acquisition of the data at the detector (as opposed to the time the data were telemetered).

For burst data in particular, this time shall represent the burst trigger time tag plus the number of burst channels minus prehistory channels times the channel duration.

4.2.4.23 STOP_FRAC Integer 2 bytes

This shall be the fractional seconds of day corresponding to STOPTIM in units of $\frac{1}{8}$ msec.

4.2.4.24 ORBIT Integer 4 bytes

Orbit number as defined by FOT. Also in orbit history auxilliary data structure.

4.2.4.25 SRCCT Integer(2) 8 bytes

Packet source count measured for first and last packet of accumulation.

4.2.4.26 NCHAN Integer 2 bytes

Total number of spectrum channels for all ranges present. This is valid for all spectrum data types.

4.2.4.27 NCHANL Integer 2 bytes

Number of spectrum channels for low range only. This is valid for spectral memory and ^{60}Co data only.

4.2.4.28 NCHANM Integer 2 bytes

Number of spectrum channels for medium range only. This is valid for spectral memory and ^{60}Co data only.

4.2.4.29 NCHANH Integer 2 bytes

Number of spectrum channels for high range only. This is valid for spectral memory and ^{60}Co data only.

4.2.4.30 NCHAN1 — Integer — 2 bytes

In the case of a two-parameter spectrum, equal to the number of channels in parameter 1, where parameter 1 is defined as the most rapidly changing address (i.e. the spectrum may be viewed as NCHAN2 spectra, each of length NCHAN1, concatenated).

In the case of a one-parameter spectrum, equal to the number of channels (NCHAN).

4.2.4.31 NCHAN2 — Integer — 2 bytes

In the case of a two-parameter spectrum, equal to the number of channels in parameter 2.

4.2.4.32 AUX1FLD — Bits — 4 bytes

Bit flags indicating which data types are present, 1st 32 data types.

```
AUX1FLD         Bit  n          0 = DATA ARRAY TYPE n NOT PRESENT
                                1 = DATA ARRAY TYPE n PRESENT

                where n = 0-31
```

4.2.4.33 AUX2FLD — Bits — 4 bytes

Bit flags indicating which data types are present, 2nd 32 data types.

```
AUX2FLD         Bit  n          0 = DATA ARRAY TYPE n+32 NOT PRESENT
                                1 = DATA ARRAY TYPE n+32 PRESENT

                where n = 0-31
```

4.2.5 Detector Positioning

4.2.5.1 DPTBL — Byte — 1 byte

Integer code indicating which positioning table was active for accumulation.

DPTBL	Code 0	PRIMARY TABLE	ALL CLEARED
	1	SECONDARY TABLE	
	2	SOLAR TABLE	
	3	TRANSIENT TABLE	
	ALL CLEARED	NO CODE ASSIGNED	

4.2.5.2 FDET — Bits — 1 byte

Detector positioning status. Offset index and active pot are those in effect at the end of the accumulation. The positioning error flag is set if a positioning error occurred anytime during the accumulation. The calibrated flag is cleared if the drive is not calibrated anytime during the accumulation. The slewing flag is set if slewing occurred anytime during the accumulation, and the positioning enabled flag is set if positioning was enabled anytime during the accumulation.

FDET	Bit 0-2	OFFSET # (0-7)	SAME AS TM
	3	ACTIVE POTENTIOMETER	VARIABLE
	4	POSITIONING ERROR	
	5	CALIBRATED	
	6	SLEWING	
	7	POSITIONING DISABLED	

4.2.5.3 DSA — Integer — 2 bytes

Detector step angle at the end of the accumulation. Step angle units are 18 per degree.

4.2.5.4 DETRA — Real — 4 bytes

Detector Right Ascension (epoch 2000) measured from gamma-ray axis. For pointing interval spectra from production analysis, measured as of end of the interval (generally guaranteed constant over the interval). In degrees.

4.2.5.5 DETDC — Real — 4 bytes

Detector Declination (epoch 2000) measured from gamma-ray axis. For pointing interval spectra from production analysis, measured as of end of the interval (generally guaranteed constant over the interval). In degrees.

4.2.5.6 TARGSCAN **Real** **4 bytes**

Position of the target in detector collimator coordinates. This is equivalent to the scan angle. The origin of the coordinate system is defined as the geometric center of the detector. The latitude angle is defined as the angle between the target vector and the detector x-y plane (where the detector x-axis is the gamma-ray axis and the y-axis is the detector pointing axis). TARGSCAN increases in the counterclockwise direction when viewing the detectors from the spacecraft +y axis (i.e. increases away from the spacecraft +z axis when the detector is between spacecraft +z and +x). In units of degrees.

4.2.5.7 TARGXSCAN **Real** **4 bytes**

Position of the target in detector collimator coordinates (see TARGSCAN for coordinate system origin definition). This is equivalent to the transscan angle. The longitude is defined as the angle between the projection of the target vector on the detector x-y plane and the detector x-axis. TARGXSCAN increases in the counterclockwise direction when viewed from the detector +z axis (see coordinate system definition under TARGSCAN). In units of degrees.

4.2.5.8 EARTHAZ **Real(2)** **8 bytes**

Rotation (azimuth) angle between the FOV center-earth direction plane and the FOV center-scan direction plane ("x-z plane", see EARTHSEP below). Zero when the earth is on the +x-z plane and increases CCW when viewed from the detector FOV center (z axis). Sampled during the first and last packets of the accumulation. In degrees.

4.2.5.9 EARTHSEP **Real(2)** **8 bytes**

Separation angle between the center of the FOV and the center of the earth, in degrees. EARTHSEP and EARTHAZ are in a coordinate system where the center of the FOV is on the z-axis with the scan direction along the x-z plane. Sampled during the first and last packets of the accumulation. In degrees

4.2.6 Target Position

4.2.6.1 TARGRA Real 4 bytes

Right Ascension (epoch 2000) of the current target location in degrees. In the case of point source observations, the target location is the position of the primary source of interest in the field of view (as indicated by TARGID) and is not necessarily the pointing direction. For example, in the case of observations attempting to position a source, several observations at offset angles will be made. The value of TARGRA and TARGDC shall be the same, namely the RA and DEC of the source of interest, for all of these spectra. Similarly, in a normal chopping observation, the value of TARGRA and TARGDC shall be the same for all source and background pointed spectra since they all reference the same source of interest.

In the case of diffuse source mapping observations, the target location shall coincide with the pointing direction for target points and the target pointing direction for background points.

Target position (TARGRA, TARGDC) in the archived SDB files is current as of the time of archiving (normally within a week of the observation). Since it is possible that target positions will be refined subsequently, the user should be aware that the target position in the OSSE Planning Catalog is the current best estimate and should supersede the value in the archived files. Standard analysis software uses the catalog value and places that value in processed spectra (e.g. difference spectra), overwriting the archived value.

4.2.6.2 TARGDC Real 4 bytes

Declination (epoch 2000) of the current target location in degrees. In the case of point source observations, the target location is the position of the primary source of interest in the field of view (as indicated by TARGID) and is not necessarily the pointing direction. For example, in the case of observations attempting to position a source, several observations at offset angles will be made. The target location should be the same for both source and background pointings.

In the case of diffuse source mapping observations, the target location shall coincide with the pointing direction for target points and the target pointing direction for background points.

Target position (TARGRA, TARGDC) in the archived SDB files is current as of the time of archiving (normally within a week of the observation). Since it is possible that target positions will be refined subsequently, the user should be aware that the target position in the OSSE Planning Catalog is the current best estimate and should supersede the value in the archived files. Standard analysis software uses the catalog value and places that value in processed spectra (e.g. difference spectra), overwriting the archived value.

4.2.6.3 COLLPOSANG Real 4 bytes

Collimator position angle. The angle between the north celestial pole and the long axis of the collimator. Increases CW from the pole as viewed from the detector (i.e. increases from north through east). Range is 0-180 degrees.

4.2.6.4 SIG_SCAN **Real** **4 bytes**

Mean pointing uncertainty in the detector scan direction. May be higher than normal if spacecraft using other than star trackers for aspect solution. One standard deviation in degrees.

4.2.6.5 SIG_XSCAN **Real** **4 bytes**

Mean pointing uncertainty in the detector transscan direction. May be higher than normal if spacecraft using other than star trackers for aspect solution. One standard deviation in degrees.

4.2.7 Detector Gain and Calibration Information

4.2.7.1 RGAIN **Real** **4 bytes**

Detector relative gain averaged over a single ^{60}Co accumulation (typically 1000 sec). Value for nominal gain ~ 1, value for x2 gain ~ 2, etc. Computed from ^{60}Co 1332 keV line center.

4.2.7.2 RFWHM **Real** **4 bytes**

Detector relative line FWHM averaged over a single ^{60}Co accumulation (typically 1000 sec). Value from calibration ~ 1. Computed from ^{60}Co 1332 keV line width.

4.2.7.3 STDRGAIN **Real** **4 bytes**

Detector relative gain averaged over a many ^{60}Co accumulations (typically $\sim$ one day). Value for nominal gain ~ 1, value for x2 gain ~ 2, etc. Computed from ^{60}Co 1332 keV line center.

4.2.7.4 STDRFWHM **Real** **4 bytes**

Detector relative line FWHM averaged over a many ^{60}Co accumulations (typically $\sim$ one day). Value from calibration ~ 1. Computed from ^{60}Co 1332 keV line width.

4.2.8 Detector Rates

Descriptions of all the rates are found in the OSSE Command and Telemetry Document (NRL Document 0926-001). Rates are stored in counts. Divide by SUM_TIM to obtain actual rates. Exceptions are DTx_SUM, the dead times, which are in units of 0.000250 seconds. Rates are summed over the same interval as the spectra.

4.2.8.1 SUM_TIM **Real** **4 bytes**

Acquisition time appropriate to header rates (which are not stored as rates but as count sums). This is computed from the number of TSAC's in the rate summation times TSAC.

4.2.9 Detector Environment and History

4.2.9.1 MCL Real(2) 8 bytes

McIlwain L parameter. Computed from ephemeris data from first and last packets of accumulation.

4.2.9.2 MCB Real(2) 8 bytes

McIlwain B parameter. Computed from ephemeris data from first and last packets of accumulation.

4.2.9.3 RIGID Real(2) 8 bytes

Magnetic vertical cutoff rigidity. Computed from ephemeris data from the first and last packets of accumulation.

4.2.9.4 BRAD Real(2) 8 bytes

Component of the Earth's magnetic field vector in an earth-centered polar coordinate system radial direction. The coordinate system is the same as that used in the GEOMAG_GRID package. Sampled during the first and last packets of the accumulation.

4.2.9.5 BPOL Real(2) 8 bytes

Component of the Earth's magnetic field vector in the polar direction. Sampled during the first and last packets of the accumulation.

4.2.9.6 BAZ Real(2) 8 bytes

Component of the Earth's magnetic field vector in the azimuthal direction. Sampled during the first and last packets of the accumulation.

4.2.9.7 DAY_NIGHT Byte 1 byte

Code indicating whether the sun was above or below the horizon during the accumulation.

```
DAY_NIGHT       Code 0          ALL NIGHT
                     1          DAY AT START OF ACCUMULATION
                     2          DAY AT END OF ACCUMULATION
                     3          DAY FOR ENTIRE ACCUMULATION
```

4.2.9.8 CPML_RATE Real 4 bytes

CPM low rate averaged over accumulation.

4.2.9.9 CPMH_RATE Real 4 bytes

CPM high rate averaged over accumulation.

4.2.9.10 ORBIT_TIM Real 4 bytes

Integration time from start of current orbit to end of this accumulation (seconds). Excludes time for which no telemetry was available.

4.2.9.11 CPML_ORBIT_SUM Real 4 bytes

CPM low dose from the start of the current orbit to the end of the accumulation (counts).

4.2.9.12 CPMH_ORBIT_SUM Real 4 bytes

CPM high dose from the start of the current orbit to the end of the accumulation (counts).

4.2.9.13 LAST_SAA_EXIT Real 4 bytes

Time (in seconds) since the last mode 3 to mode 4 transition marking the exit from SAA.

4.2.9.14 LAST_SAA_TIM Real 4 bytes

Integration time of last SAA period (seconds). Excludes time for which no telemetry was available.

4.2.9.15 CPML_LAST_SAA Real 4 bytes

Summed CPM low (minimum ionizing) dose (1 MeV $< E <$ 8 MeV) in counts during the last SAA period, as defined by the period during which the instrument was in mode 3.

4.2.9.16 CPMH_LAST_SAA Real 4 bytes

Summed CPM high dose ($E <$ 8 MeV) in counts during the last SAA period, as defined by the period during which the instrument was in mode 3.

4.2.10 Spacecraft Position

4.2.10.1 GRORA Real(2) 8 bytes

RA of s/c in earth-centered inertial coordinates, epoch 2000, sampled during the first and last packets of the accumulation.

4.2.10.2 GRODC Real(2) 8 bytes

Declination of s/c in earth-centered inertial coordinates, epoch 2000, sampled during the first and last packets of the accumulation.

4.2.10.3 GROLG Real(2) 8 bytes

Geographic longitude of sub-spacecraft point, in degrees, sampled during the first and last packets of the accumulation.

4.2.10.4 ATTZRA Real(2) 8 bytes

+Z Axis RA, epoch 2000, sampled during the first and last packets of the accumulation. In units of degrees.

4.2.10.5 ATTZDC Real(2) 8 bytes

+Z Axis declination, epoch 2000, sampled during the first and last packets of the accumulation. In units of degrees.

4.2.10.6 ATTXRA Real(2) 8 bytes

+X Axis RA, epoch 2000, sampled during the first and last packets of the accumulation. In units of degrees.

4.2.10.7 ATTXDC Real(2) 8 bytes

+X Axis declination, epoch 2000, sampled during the first and last packets of the accumulation. In units of degrees.

4.2.10.8 GRORAD **Real(2)** **8 bytes**

Altitude of spacecraft from origin of earth-centered inertial coordinate system used above, sampled during the first and last packets of the accumulation, in km.

4.2.10.9 RSC **Real(3)** **24 bytes**

Vector from the solar system barycenter to the spacecraft in units of light seconds and in the coordinate system defined by the JPL DE200 ephemeris. Three real*8 cartesian components. Measured at the end of the accumulation.

4.2.10.10 ETUT **Real** **8 bytes**

Difference between ephemeris time (TDB) and UTC time scales, in seconds. Measured at the end of the accumulation.

4.2.11 Detector Temperatures

4.2.11.1 PTMP1 Real 4 bytes

PMT Mount Plate Temperature in degrees Celsius.

4.2.11.2 C6TMP Real 4 bytes

Collimator/ ^{60}Co Temperature in degrees Celsius.

4.2.11.3 S1TMP Real 4 bytes

Xtal Housing Cover Temperature in degrees Celsius.

4.2.11.4 CPDTM Real 4 bytes

CPD Temperature in degrees Celsius.

4.2.11.5 PTMP2 Real 4 bytes

Magnetic Shield $-$Z Temperature in degrees Celsius.

4.2.11.6 ETMP1 Real 4 bytes

Electronics A1 Temperature in degrees Celsius.

4.2.11.7 ETMP2 Real 4 bytes

Electronics A4 Temperature in degrees Celsius.

4.2.11.8 HVTMP Real 4 bytes

High Voltage Supply Temperature in degrees Celsius.

4.2.11.9 LVTMP Real 4 bytes

Low Voltage Supply Temperature in degrees Celsius.

4.2.11.10 TCTMP **Real** **4 bytes**

Outboard Spider Temperature in degrees Celsius.

4.2.11.11 S2TMP **Real** **4 bytes**

Magnetic Shield Out. Temperature in degrees Celsius.

4.2.11.12 A3TMP **Real** **4 bytes**

A3 Temperature in degrees Celsius.

4.2.12 Related Tagwords

Each spectrum header shall be able to point to several data types located under another tagword in the same file. These are referred to as "remote" data. Remote data are generally superseded by "local" data, i.e. arrays located in the same tagword as the spectrum header in question. Remote data are intended to reduce redundant storage of data that do not change rapidly from spectrum to spectrum.

4.2.12.1 CALTW Integer 4 bytes

Tagword of a spectrum containing "remote" calibration data, that is, calibration data valid for multiple spectra and not located under the same header as those spectra. The calibration spectrum must be in the same file as the current spectrum. If CALTW is less than or equal to zero, no remote calibration data is referenced (however calibration data may still be present under the same headers as the data).

Generally, a "remote" calibration data tagword may contain the following data types:

- Detector resolution
- Channel lower edge energies
- Channel lower edge energy uncertainties
- Channel widths
- Channel width uncertainties
- Channel representative energies
- Channel representative energy uncertainties
- Calibration line information
- PSD efficiency
- PSD efficiency uncertainty
- PSD model information

Normally, production analysis outputs calibration line information and PSD information. The remaining quantities are computed by the user using IGORE utilitiles such as ENERGY_CAL.

In general, local calibration data overrides data pointed to by CALTW.

4.2.12.2 STDCALTW Integer 4 bytes

The standard calibration tagword is similar in function to the calibration tagword but points to arrays that are derived for a standard channel set into which a spectrum is resampled via gain normalization or via the computation of an average gain for some time interval. The tagword to which STDCALTW points will contain the data types similar to CALTW.

In general, local calibration data overrides data pointed to by CALTW.

4.2.12.3 ORBITTW — Integer — 4 bytes

Tagword containing "remote" orbit history data.

4.2.12.4 RELSPECTW — Integer — 4 bytes

Tagword containing "remote" related spectra data.

4.2.12.5 NOTETW — Integer — 4 bytes

Tagword containing "remote" footnotes.

4.2.12.6 RESPTW — Integer — 4 bytes

Tagword containing "remote" detector responses.

4.2.13 Miscellaneous

4.2.13.1 ACHD Byte(25) 25 bytes

The Acquisition Header variable contains the following information:

```
a.  CALPHA Acquisition Header (12 bytes)

    Bytes

    0,1    ACQ ENTRY NUMBER, OVERFLOW INDICATOR
    2,3    CAL_RECORD_CONTROL (INCLUDES COMPRESSION MODE)
    4,5    CLAD$S (CAL MUX ADDRESS)
    6,7    CLLD$S (LEVEL COMMAND)
    8,9    CLLR$S,CLONE$S,CLOVE$S (CAL MODE DATA)
    10,11  CALTS$S (ACQUISITION TSAC COUNT)

b.  Cobalt 60 Strategy Table (14 bytes)

    Bytes

    0,1    ACQUISITION MODE (DETECTOR SYNCH. OR FREE RUNNING),
    NUMBER OF CONSECUTIVE SLOTS
    2,3    ACQUISITION TSAC COUNT
    4,5    NUMBER OF ACQUISITION CYCLES (DET. SYNCH. MODE ONLY)
    6      LOW RANGE ENABLE FLAG
    7      LOW RANGE COMPRESSION MODE
    8      LOW RANGE NUMBER OF CHANNELS
    9      LOW RANGE START CHANNEL
    10     MEDIUM RANGE ENABLE FLAG
    11     MEDIUM RANGE COMPRESSION MODE
    12     MEDIUM RANGE NUMBER OF CHANNELS
    13     MEDIUM RANGE START CHANNEL

c.  RPHA1/RPHA2 Strategy Table (20 bytes)

    Bytes

    0,1    DETECTOR ID/GOVERNOR SETTING
    2,3    ACCUMULATION MODE
    4,5    ACQUISITION TSAC COUNT OR SMS TIME INTERVAL
    6,7    COMPRESSION MODE
    8,9    FULL COUNT TERMINATION FLAG
    10,11  UPPER THRESHOLD (EXPANDED MODES)
    12,13  LOWER THRESHOLD (EXPANDED MODES)
    14,15  BUFFER ADDR
    16,17  DATA SOURCE COMMAND
    18,19  CAL SELECT COMMAND
```

d. Burst Strategy Table (16 bytes)

Bytes	
0,1	BURST CONTROL WORD
2,3	RATE THRESHOLD
4,5	SUCCESSIVE SAMPLE THRESHOLD
6,7	PRETRIGGER LENGTH
8,9	TIME OF TRIGGER (LO WORD)
10,11	TIME OF TRIGGER (HI WORD)
12,13	TRIGGER LOCATION IN BUFFER
14,15	TYPE OF TRIGGER

e. Spectral Memory Strategy Table (6 bytes)

Bytes	
0,1	LOW RANGE START CHANNEL/COMPRESSION CODE
2,3	MEDIUM RANGE START CHANNEL/COMPRESSION CODE
4,5	HIGH RANGE START CHANNEL/COMPRESSION CODE

f. Pulsar (25 bytes)

Bytes		
0-2	WINDOW 0 EMIN, EMAX, SCNT	
3-5	WINDOW 1 EMIN, EMAX, SCNT	
6-8	WINDOW 2 EMIN, EMAX, SCNT	
9-11	WINDOW 3 EMIN, EMAX, SCNT	
12-14	WINDOW 4 EMIN, EMAX, SCNT	
15-17	WINDOW 5 EMIN, EMAX, SCNT	
18-20	WINDOW 6 EMIN, EMAX, SCNT	
21-23	WINDOW 7 EMIN, EMAX, SCNT	
24	STATUS FLAGS	(BIT 0 = PULSAR MODE BIT 1 = EBE MODE BIT 2-4 = RATE INTERVAL BIT 5-6 = RATE COMPRESS

4.2.13.2 HSKPTIM — Integer — 4 bytes

UT time representative of housekeeping data in header. This is important for slot data since the housekeeping data are not necessarily sampled at the same time as the slot data. In general, housekeeping data for summations is taken from the last acquisition of the summation.

For Spectral Memory spectra, HSKPTIM is the time of the last TSAC of acquisition.

For slot data, HSKPTIM is the telemetered (i.e. not offset) time of the first slot header of a summation.

4.2.13.3 TSAC Real 4 bytes

Number of seconds comprising a single TSAC.

4.2.13.4 AM Real 4 bytes

Average pot value for main pot.

4.2.13.5 AR Real 4 bytes

Average pot value for redundant pot.

4.2.13.6 EFFECAREA Real 4 bytes

The effective area is the projected geometric area times the efficiency for detection in the photopeak. Dividing the count rate under a line photopeak by the effective area results in units of photons cm^{-2} sec^{-1}.

4.2.13.7 DIVISOR Real 4 bytes

In some cases, it is useful to be able to roll a processed spectrum (i.e. one no longer represented by raw counts) back to a count spectrum. DIVISOR is the value the raw spectrum was divided by to obtain the processed spectrum. This is only valid in cases where all channels were divided by the same constant value.

DIVISOR may also be a user-supplied unit denominator in which the spectrum is expressed (i.e. counts/divisor). See SPECUNIT.

4.2.13.8 PHBINNUM Integer 2 bytes

Pulsar pulse phase bin number.

4.2.13.9 NUMPHBIN Integer 2 bytes

Number of current pulse phase bins.

4.2.14 Detector Bilevels and Analogs

4.2.14.1 STRTBILVL Bits 10 bytes

Bilevels 0–4, sampled at the end of the first TSAC of the accumulation.

4.2.14.2 ENDBILVL Bits 10 bytes

Bilevels 0–4, sampled at the end of the last TSAC of the accumulation.

4.2.14.3 Analogs

For Spectral Memory data, these are sampled at the end of the last TSAC of the accumulation.

For slot data, these are sampled at the end of the first acquisition (i.e. first dump) of the accumulation.

4.3 STANDARD APPLICATION PROCESSING OF HEADER QUANTITIES

The following table indicates how various SDB header quantities are to be treated by several standard OSSE analysis applications.

Table 3: OSSE SDB Version 7 Header Processing

SDB V7 Header		Process				
SDB Variable	Description	PDA	BEst	Write	Sum	Sub
nbytes_per_record	size of data records	r	r	r	r	r
numrec	Number of records	r	r	r	r	r
nument	Number of entities	r	r	r	r	r
sizeent	Number of bytes per entity	r	r	r	r	r
dataversion	Data type version number	r	r	r	r	r
hdrvers	Header version number	u	u		1	1
hdrrev	Header revision number	u	u		1	1
softindex	Creation software index	u	u		1	1
softmajor	Creation s/w major version	u	u		1	1
softminor	Creation s/w minor version	u	u		1	1
cmdstate_id	Cmd state table ID	b	S		b	1
detcfg_id	Det cfg table ID	b	S		b	1
mdpostbl_id	MD Pos. table ID	b	S		b	1
credate	Creation date/time, VAX format	u	u		u	u
detid	Detector ID	u	S		or	1
targid	Target name code	u	S		1	1
targoff	Source/background offset	u	S		1	1
tlmid	Telemetry format ID	u	S		1	1
reactor	Reactor event code	u	or		or	or
dsfstat	DSF stop/event status code	u	or		or	or
dqhaz	Data quality flags hazardous	u	or		or	or
dqinfo	Data quality flags info	u	or		or	1
usrscrnflg	User spectrum screening flags		or		or	or
specsrc	Spectrum source code	u	S		1	1
speccat	Spectral category code	u	S		1	1,u
specunit	Units code	r	r		1,r	1,r
specflgs	Spectrum flags	r	r	r	1,r	1,r
calrpha	CALPHA/RPHA Mux	u			1	1
ltl	SPM low live time	u	S		$\sum$	1
ltm	SPM med live time	u	S		$\sum$	1
lth	SPM high live time	u	S		$\sum$	1
accumtim	Accumulation time	u	S		$\sum$	1
strttim	Start time (in TJS)	u	S		min	1
strt_frac	Start time fraction	u	S		min	1
stoptim	Stop time (in TJS)	u	S		max	1
stop_frac	Stop time fraction	u	S		max	1
orbit	Orbit number	u	S		min	1
srcct(2)	TLM Source Cnt	u	S		1	1
nchan	Total # of spectrum channels	r	r	r	1,r	1,r
nchanl	# of low range channels	r	r	r	1,r	1,r
nchanm	# of medium range channels	r	r	r	1,r	1,r
nchanh	# of high range channels	r	r	r	1,r	1,r
nchan1	# of channels, parameter 1	r	r	r	1,r	1,r
nchan2	# of channels, parameter 2	r	r	r	1,r	1,r
aux1flg	AUX field flags (1st 32)	r	r	r	0,r	0,r
aux2flg	AUX field flags (2nd 32)	r	r	r	0,r	0,r

SDB V7 Header (continued)		Process				
SDB Variable	Description	PDA	BEst	Write	Sum	Sub
dptbl	Active positioning table	u	S		1	1
fdet	Detector positioning status	u	S		1	1
dsa	Detector position, end	u	S		1	1
detra	Detector RA	u	S		1	1
detdc	Detector declination	u	S		1	1
targscan	Target latitude (scan angle)	u	S		1	1
targxscan	Target longitude (transscan)	u	S		1	1
earthaz(2)	Earth azmiuth in det. coord.	ss	S		mm	1
earthsep(2)	Earth/collimator seperation	ss	S		mm	1
targra	Target RA 2000 epoch	u	S		1	1
targdc	Target declination 2000 epoch	u	S		1	1
collposang	Collimator position angle	u	S		1	1
sig_scan	Mean scan ptg error (sigma)	0				
sig_xscan	Mean xscan ptg error (sigma)	0				
rgain	Actual Relative Gain Ratio	u	S		1	1
rfwhm	Actual Relative Full Width Half Max	u	S		1	1
stdrgain	Standard Relative Gain Ratio	u	S		1	1
stdrfwhm	Standard Relative Full Width Half Max	u	S		1	1
sum_tim	Rate collection time	u	S		$\sum$	1
"det rate sums"	26 det rate sums (counts)	u	S		$\sum$	1
mcl(2)	McIlwain L	ss	S		mm	1
mcb(2)	McIlwain B	ss	S		mm	1
rigid(2)	Rigidity	ss	S		mm	1
brad(2)	Radial component of mag fld vec	ss	S		mm	
bpol(2)	Polar component of mag fld vec	ss	S		mm	
baz(2)	Az component of mag fld vec	ss	S		mm	
day_night	Day/Night code	u	S		or	1
cpml_rate	CPM low rate	u	S		A	1
cpmh_rate	CPM high rate	u	S		A	1
orbit_tim	Accum time from strt of orb (sec)	u	S		1	1
cpml_orbit_sum	CPML dose since strt of orb (cnt)	u	S		1	1
cpmh_orbit_sum	CPMH dose since strt of orb (cnt)	u	S		1	1
last_saa_exit	Time since last SAA exit (sec)	u	S		1	1
last_saa_tim	CPM accum time for last SAA (sec)	u	S		1	1
cpml_last_saa	CPM low dose during last SAA (cnts)	u	S		1	1
cpmh_last_saa	CPM high dose during last SAA (cnts)	u	S		1	1
grora(2)	RA of s/c	ss	S		mm	1
grodc(2)	Dec of s/c	ss	S		mm	1
grolg(2)	Longitude of sub-s/c point	ss	S		mm	1
attzra(2)	Axis RA 2000 epoch	ss	S		mm	
attzdc(2)	Z Axis Dec 2000 epoch	ss	S		mm	
attxra(2)	X Axis RA 2000 epoch	ss	S		mm	
attxdc(2)	X Axis Dec 2000 epoch	ss	S		mm	
grorad(2)	Alt of s/c above earth	ss	S		mm	
rsc(3)	Barycenter vectors (sec)	u	S		1	1
etut	Barycenter time	u	S		1	1
strtbilvl(5)	Bilevels 0-4, start of acq.	u	S		1	1
endbilvl(5)	Bilevels 0-4, end of acq.	u	S		1	1

SDB V7 Header (continued)		Process				
SDB Variable	Description	PDA	BEst	Write	Sum	Sub
ptmp1	PMT mount plate temperature	u	S		1	1
c6tmp	Coll./Co-60 temperature	u	S		1	1
s1tmp	Xtal housing cover temperature	u	S		1	1
cpdtm	CPD temperature	u	S		1	1
“det analogs”	Various analog housekeeping (30)	u	S		1	1
caltw	Calibration tagword	u	C	r	1	1
stdcaltw	Standard calibration tagword	u	C	r	1	1
orbittw	Orbit history tagword	u	C	r	1	1
relspectw	Associated spectra tagword			1	1	1
notetw	Footnote tagword			1	1	1
resptw	Response tagword			1	1	1
achd(25)	Acquisition header	u			1	1
hskptim	Time of slot header packet	u			1	1
tsac	Seconds/TSAC	u	S		1	1
am	Average pot main	u	S		1	1
ar	Average pot redn	u	S		1	1
effecarea	Effective area	u	S		1	1
divisor	Divisor					
phbinnum	Phase bin number					
numphbin	Total number of phase bins					
reserve(37)	Reserve					

Notes:

- $\sum$: value is sum of associated headers
- 0: values initialized to zero
- 1: values copied from 1st header of array
- b: value at the start time of the collection interval
- C: values from “source” header, data copied from input to output
- min: values copied from header with minimum time
- max: values copied from header with maximum time
- mm: 1st is min as defined above, 2nd is max as defined above
- or: value is logical “or” of associated headers
- r: required for correct structure intrepretation or analysis (implies “u”)
- S: values copied from “source” header
- ss: elements are start and stop of interval
- u: updated or assigned by process