CALET

CALET archive

Version 1.0

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1 CALET archive

1.1 Introduction

The CALorimetric Electron Telescope (CALET) is a Japan-led international mission funded by the Japanese Space Agency (JAXA) in collaboration with the Italian Space Agency (ASI) and NASA. The instrument was launched on August 19, 2015 by a Japanese carrier, H2 Transfer Vehi- cle (HTV), and robotically installed on the Japanese Experiment Module-Exposed Facility (JEM- EF) on the International Space Station (ISS) for an initial two-year mission, extendable to five years. Figure 1a shows CALET at the attach point #9 on the JEM-EF. A schematic overview of the CALET instrument is shown in Fig. 1b .

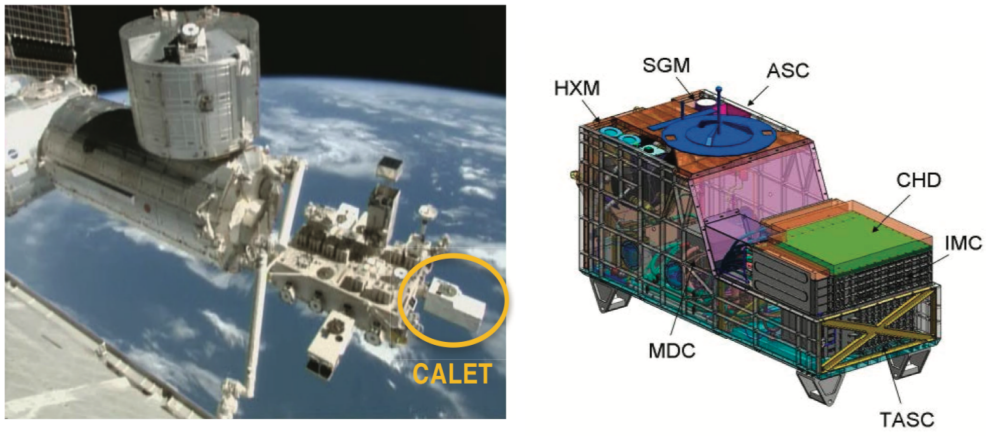

Fig 1 : right (1a) show the Japanese Experiment Module-Exposed Facility and CALET (1b) is a schematic view of CALET where the main instruments and other components are marked.

The CALET payload consists of two main instruments :

- The Calorimeter (CAL) is the primary instrument dedicated to the high –precision measurement of the cosmic-ray total electron spectrum from energy ~1 GEV up to Tev region. The CAL has three main components: a Charge Detector (CHD) placed at the top of the instrument to provide the absolute change of the primary particle passing thought the top of the instrument; a fine granulated pre-shower IMaging Calorimeter (IMC) that allows to (i) reconstruct the incident particle trajectory; (ii) determine the starting point of the shower; (iii) separate the incident particles from backscattered particles; and the Total AbSorption Calorimeter (TASC).
- The CALET Gamma Ray Burst Monitor (CGBM) dedicated to the detection on Gamma Ray Burst and to different type of gamma ray transients: gamma ray repeaters, solar flares, terrestrial flashes and X-ray Binaries. The CGBM is sensitive from the soft X-ray ~7 keV to the Gamma ray ~ 10 MeV and consists of two type of detectors: the Hard X-ray monitor (two identical units) to cover the lower energy (7 keV-1000 keV) and Soft Gamma-ray Monitor (SGM) to cover the higher energy 100 keV - 20 MeV and their combination is sensitive from the soft X-ray ~7 keV to the Gamma ray ~ 10 MeV. The sky is monitored with two modes , TH and PH, and uses EVENT mode if a trigger occurs onboard. The CGBM do not have localization capability.

  In addition there are two other main components. The Advance Stellar Compass located at the top near the CGBM is an autonomous miniature star tracker capable to determine the

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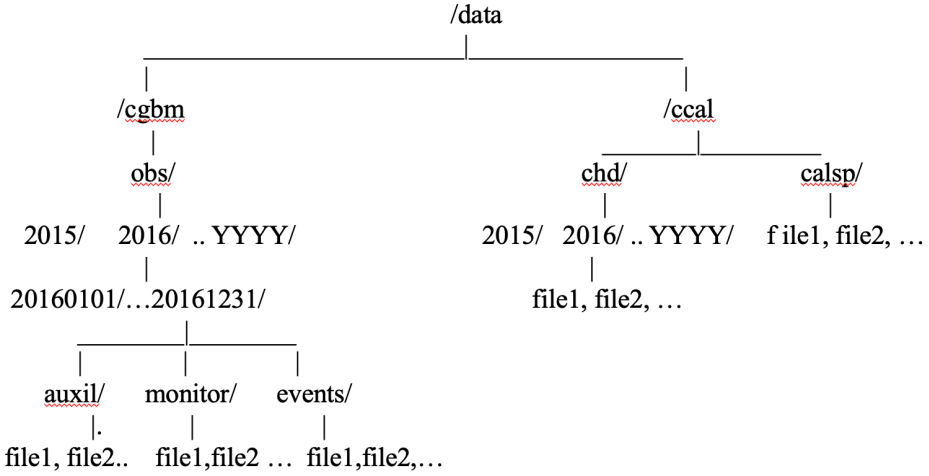
attitude with arcseconds precision and allows to obtain precise determination o the CALET pointing directions. The Mission Data Controller (MDC) capture and format the data from the instruments and send the telemetry to the NASA ground station.

The CALET data archive is hosted by DARTS archive in Japan and HEASARC archive in USA. The two instruments secure in the final archive different data Level. The CAL instrument includes only the Level 3 data (e.g. spectra and particle rates), the CGBM include Level starting from science data close to the original telemetry and their subsequent products as well as the housekeeping parameters necessary for the data analysis. The two archives, HEASARC and DARTS, have identical structure and the same data products.

1.2 Directory structure

The CALET archive includes both data from the CGBM and Calorimeter experiment, however the two experiments populates the public archive at separate times and independently.
The top CALET data directory is divided in the following two directories : cgbm/ and ccal/ containing the gbm and calorimeter data respectively.
Under the cgbm/, the directory obs/ contains the science data. The science data organized in directories named after the observation day and located under the appropriate year. Each observation is organized in three subdirectories : 1) auxil/ containing the auxiliary data; 2) monitor/ containing the TH and PH mode data for all instruments ; 3) event/ for the event data for all instruments. The event/ directory is present only if event data are available (when a trigger occurs). The content of the calorimeter data ccal/ is divided in the directories chd/ and calsp/. The chd/ contains the particle rates from the CHD layer. It is organized in directories divided by year each containing the 1-day rate files. The calsp/ directory contains the flux spectra files for each of the measured species.



2 CGBM archive

2.1 CGBM data

The CGBM is composite of three detectors : Soft gamma-ray monitor (SGM), HXM hard X-ray monitor (HXM1 and HXM2 units) that all collect data simultaneously. In addition, the Advance Star Camera (ASC) provide optical images.

The CGBM data are collected, divided and processed as follows:

- Raw data : collected and not intended for archive
- Level 0 : Raw data time ordered and divided in hour [format binary]
- Level 1 : Level 0 organized by mode [format binary]
- Level 1.1 : (for the GCN)
- Level 2 : First version of the FITS files uncalibrated
- Level 3 : Second version of the FITS files for all detectors and modes (see below) data are calibrated and organized by day. The calibration includes the PHA correction to obtain PI; the calculation of the dead time and the time assignment. These data are not cleaned.
- High level products: After calibration of Level 3 data high level products as for lightcurves and plots are created for the event mode data.

The Level 3 data and the high-level products are part of the public archive. For alerts sent to the GCN the data used is Level 1.1 and they are not archived Level 3 includes different type of data files. These files include the auxiliary and science data (see following sections).

Auxiliary data

- 1 ISS attitude file
- 1 attitude file related to CGBM
- 1 HK file of the CGBM
- 1 orbit file
- 1 GTI file with time intervals per instrument to indicate when the high voltage is on
- 1 Timing file with information to calculate the time.
- 1 Dead time file

Science data and high level products

- TH Monitoring data : counts in 4 energy bands sampled every 0.125 sec in low gain and high gain
- PH Monitoring data : counts in low and high gain spectra sampled every 4 sec. Low gain 102 channel spectra: High gain 410 channel spectra.
- Event data: when a trigger occurs, data are transmitted on ground in event mode. For each trigger 1500000 events are collected to span an interval typically 100 sec before the event and ~512 sec after the events. Each event is characterized by a time and an energy. Each event is processed by two different electronics to produce a low gain

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and a high gain pha. Both low gain and gain spectra have 4096 channels ranging from 0-4095 with different channel boundaries.

All PHA and PI spectra for the event and PH modes have the first channel starting with 0. Because of the large field of view the TH and PH files do not contain position information as for the pointing or any other coordinate information. The event files contain the pointing direction of the CALET z-axis and the detector z-axis.

The TH , PH and EVENT data streams are collected by all three instruments (SGM, HXM1 and HXM2) . The science data taken in TH and PH mode and gain are in separate files from each of the instrument while for EVENT mode data file for each instrument contains both high and low gain.
The science files included within an observation are listed in Table 2.1 :

Table 2.1

Number of files	**Description**
5 files for the SGM	The files are: 1 low gain PH mode, 1 high gain PH mode, 1 low gain TH , 1 high gain TH , 1 high/low gain EVENT The TH, PH and EVENT data files have 2 extensions 1-science data, 2- Good Time Interval
5 files for the HXM1 + 5 files for the HXM2	The files for each of the HXM1 or HXM2 are: 1 low gain PH mode, 1 high gain PH mode, 1 low gain TH , 1 high gain TH , 1 high/low gain EVENT The TH, PH and EVENT data files have 2 extensions 1-science data, 2- Good Time Interval
5 files for High level products	The files are: 1 file for the HXM1 and 1 file for HXM2 each with two extensions. Each extension has a lightcurve obtained from the EVENT mode using the PI high gain, channel range 166-4095 (4-98.3 keV), one with 1 sec binning and the other with 0.25sec binning. 1 file for the SGM with two extensions. Each extension has a lightcurve obtained from the EVENT mode using the PI high gain, channel range 174-4095 (40-942 keV) , one with 1 sec binning and the other with 0.25sec binning. 2 files with plots of the lightcurves

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2.2 Files and Naming convention

The filename is a string that includes all the data specification included in the file. The string therefore depends on how the data are stored in the file. The string that define the filename should not exceed 35 characters including the suffix for the file compression (.gz).
The convention for the cgbm files in the obs/ directory is :

cgbm_YYYYMMDD_iii_mmmmmm.yyyy.gz (science file)
or
cgbm_YYYYMMDD.yyyy.gz (auxiliary)

where the first 13 characters are cgbm_YYYYMMDD to indicate the mission/instrument (cgbm) and the unique data identifier (YYYYMMDD). The remaining characters are assigned to additional specification for the file content, extension and compression.
The iii is assigned to the detector specification and uses 3 characters and they are : *sgm* for the SGM; *hx1* for the HXM1; *hx2* for the HXM2; *all* for files containing data for the SGM, HXM1, and HXM2. The 'mmmmmmm" up to 7 characters is reserved to other specifications: 'th' for data taken in TH mode , 'ph' for data taken in PH mode, 'l' is assigned to low gain , 'h' is assigned to high gain and 'dt' for the dead time correction. The suffix yyyy defines the type of data that have a standard format as for 'att', for attitude, 'orb' for orbit, 'evt' for event file, 'gti' for good time interval, 'lc' for lightcurve etc and use 'fits' for files that are BINARY table containing other science data. Table 2.2 list the files within an observation.

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Table 2.2	
obs/<YYYYMMDD>	
Auxiliary filename	**Description**
auxil/	
cgbm_YYYYMMDD.att	Attitude file
cgbm_YYYYMMDD.orb	Orbit file
cgbm_YYYYMMDD.tim	Time info used in processing
cgbm_YYYYMMDD.iat	ISS attitude file
cgbm_YYYYMMDD.hk	GBM housekeeping
cgbm_YYYYMMDD.gti	High voltage on GTI for the detectors
cgbm_YYYYMMDD_dt.fits	Dead time information for all instruments
Science Data	**Description**
monitor/	
cgbm_YYYYMMDD_sgm_hph.fits	SGM PH data high gain
cgbm_YYYYMMDD_sgm_lph.fits	SGM PH data low gain
cgbm_YYYYMMDD_sgm_hth.fits	SGM TH data high gain
cgbm_YYYYMMDD_sgm_lth.fits	SGM TH data low gain
cgbm_YYYYMMDD_hx1_hph.fits	HXM1 PH data high gain
cgbm_YYYYMMDD_hx1_lph.fits	HXM1 PH data low gain
cgbm_YYYYMMDD_hx1_hth.fits	HXM1 TH data high gain

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cgbm_YYYYMMDD_hx1_lth.fits	HXM1 TH data low gain
cgbm_YYYYMMDD_hx2_hph.fits	HXM1 PH data high gain
cgbm_YYYYMMDD_hx2_lph.fits	HXM1 PH data low gain
cgbm_YYYYMMDD_hx2_hth.fits	HXM1 TH data high gain
cgbm_YYYYMMDD_hx2_lth.fits	HXM1 TH data low gain
event/ *	
cgbm_YYYYMMDD_sgm_hhmmss.evt	SGM event data high/low gain
cgbm_YYYYMMDD_hx1_hhmmss.evt	HXM1 event data high/low gain
cgbm_YYYYMMDD_hx2_hhmmss.evt	HXM2 event data high/low gain
* Multiple triggers may be present within a given day. The hhmmss identifies the different triggers.	
products/**	
cgbm_YYYYMMDD_sgm_hhmmss.lc	SGM lightcurve from the event mode
cgbm_YYYYMMDD_hx1_hhmmss.lc	HXI lightcurve from the event mode
cgbm_YYYYMMDD_hx2_hhmmss.lc	HX2 lightcurve from the event mode
cgbm_YYYYMMDD_all_hhmmss_lc.gif	Plot of the lightcurves from all 3 detectors
cgbm_YYYYMMDD_sgm_hhmmss_lc.gif	Plot of SGM lightcurve
** The directory is only present if event data are available. The lightcurve contains two extensions one for each binning. Multiple triggers may be present within a given day. The hhmmss identifies the different triggers	

2.3 Auxiliary files : Header Keywords

The keywords necessary in the primary header and extensions for all files are listed here for each file type. The specific values for keywords are listed at the end of the section. The full header for each of the files in the auxil/ directory is not provided but for the deadtime file (section 2.4).

a) Primary header (Auxiliary): The auxiliary files have a common primary header that contains the minimum header keywords to identify the data set and/or the instrument when necessary. With a small variation the keywords is table 2.3.1 are also for the primary header for the science files:

Table 2.3.1

Keyword	Value	Comment
TELESCOP	'CALET'	/Telescope mission name
INSTRUME *	'CGBM'	/Instrument name *(for the iat file set to ISS)*
OBS_ID	'YYYYMMDD'	/Observation ID
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
ORIGIN	'JAXA, WCOC'	/Origin of the FITS file
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CHECKSUM	'value'	/ data unit checksum updated date

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DATASUM	'value'	/ HDU checksum updated date
CREATOR	'string'	/Software that create 1st the file

NOTE : * For the *iat* file the INSTRUME is set to ISS.

b) Header 1st extension of files in the auxil/ directory : The structure of the files in the auxil/ directory has a the primary header and one extension. The primary header is described in the **2.3.1**. The header for the 1st extension of the *.att, *.orb, *.iat, *. hk, *.tim files have the following keywords in the header) (Table 2.3.2):

Table 2.3.2		
Keyword	**Value**	**Comment**
EXTNAME	'string'	/ name of this HDU
TELESCOP	'CALET'	/Telescope mission name
INSTRUME	'CGBM'	/Instrument name *(for the iat file set to ISS)*
OBS_ID	'YYYYMMDD'	/Observation ID
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
TSTART	0.0	/Start time
TSTOP	0.0	/Start Time
MJDREFI	51544	/MJD reference day 01 Jan 2000 00:00:00
MJDREFF	7.4287037037037E-04	/MDJ reference (fraction of day)
TIMEREF	'LOCAL'	/Reference Frame
TASSIGN	'SATELLITE'	/Time assigned
TIMESYS	'TT'	/ Time System
TIMEUNIT	' s'	/Time unit for timing header keywords
CLOCKAPP	T	/ If clock correction are applied (F/T)
HDUCLASS	'OGIP'	/ format conforms to OGIP standard
HDUCLAS1	'string'	/<hduclass1>
HDUCLAS2	'string'	/ <hduclas2>
CREATOR	'string'	/Software that create 1st the file
PROCVER	'00.00.00'	/Processing version
CALDBVER	'value'	/CALDB version
SEQPNUM	nn	/ Times the dataset has been processed
ORIGIN	'JAXA, WCOC '	/Origin of the FITS files
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date

The keyword PROCVER, SEQNUM, CALDBVER and EXTNAME are explained in section 1.6, **NOTE:** the *.iat file has INSTRUME **keyword is set to ISS.**

c) Header extension of the GTI files in the auxil/ directory : The GTI file structure in the auxil/ directory has an empty primary header and 3 extensions one for each of the instruments HXM1, HXM2 and SGD. The primary header is described in **2.3.1**. The headers of the three extensions includes the following keywords (Table 2.3.4):

Table 2.3.4

Keyword	**Value**	**Comment**
TELESCOP	'CALET'	/Telescope mission name
INSTRUME	'CGBM'	/Instrument name
DETNAM	'string'	/ Detector name
OBS_ID	'YYYYMMDD'	/Observation ID
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
TSTART	0.0	/Start time
TSTOP	0.0	/Start Time
MJDREFI	51544	/MJD reference day 01 Jan 2000 00:00:00
MJDREFF	7.4287037037037E-04	/MDJ reference (fraction of day)
TIMEREF	'LOCAL'	/Reference Frame
TASSIGN	'SATELLITE'	/Time assigned
TIMESYS	'TT'	/ Time System
TIMEUNIT	' s'	/Time unit for timing header keywords
CLOCKAPP	T	/ If clock correction are applied (F/T)
HDUCLASS	'OGIP'	/ format conforms to OGIP standard
HDUCLAS1	'GTI	/<hduclass1>
CREATOR	'string'	/Software that create 1st the file
PROCVER	'00.00.00'	/Processing version
CALDBVER	'value'	/CALDB version
SEQPNUM	nn	/Number of times the dataset has been processed
ORIGIN	'JAXA, WCOC '	/Origin of the FITS files
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date

The possible values for DETNAM are HXM1, or HXM2 or SGM.

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2.4 Auxiliary file : Dead time file

The dead time information for the PH and TH data mode does not depend on the mode or by the gain but is different for each of the instruments. The dead time is stored in one file with a structure that consists of an empty primary header and one extension where columns report in a 3 element array the information for each instrument. Table 2.4.1 contains the keywords for the primary header and table 2.4.2 the columns and keywords for the extensions.

Table 2.4.1

Keyword	Value	Comment
TELESCOP	'CALET'	/Telescope mission name
INSTRUME	'CGBM'	/Instrument name
OBS_ID	'YYYYMMDD'	/Observation ID
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
ORIGIN	'JAXA, WCOC'	/Origin of the FITS file
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CREATOR	'string'	/Software that create 1st the file
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date

The header keywords of the extensions described in table 2.4.2 differ only for the value of the DETNAM keyword and do not contain the DATAMODE keyword.

Table 2.4.2 *Structure of the DEADTIME extension*

Keyword	Value	Comment
EXTNAME	'DEADTIME'	/name of the HDU
TTYPE1	'TIME'	/Time in sec since 01 Jan 2000 00:00:00
TFORM1	'1D'	/data format of field: 8-byte DOUBLE
TUNIT1	's'	/physical unit of field
TTYPE2	'MDCTIME'	/Local Time counter
TFORM2	'1D'	/data format of field: 8-byte DOUBLE
TUNIT2	's'	/physical unit of field
TTYPE3	'DT'	/Measured dead time
TFORM3	'3I'	/data format of field: 2-byte INTEGER
TUNIT3	'us'	/physical unit of field
TZERO3	32768	/offset for column
TTYPE4	'LD'	/Lower Discriminator counts
TFORM4	'3I'	/data format of field: 2-byte INTEGER

TUNIT4	'count'	/physical unit of field
TZERO4	32768	/offset for column
TTYPE5	'UD'	/Upper Discriminator counts
TFORM5	'3I'	/data format of field
TUNIT5	'count'	/physical unit of field
TZERO5	32768	/offset for column
TELESCOP	'CALET'	/Telescope mission name
INSTRUME	'CGBM'	/Instrument name
DETNAM	'ALL'	/ Detector
OBS_ID	'YYYYMMDD'	/Observation ID
MJDREFI	51544	/MJD reference day 01 Jan 2000 00:00:00
MJDREFF	7.4287037037037E-04	/MDJ reference (fraction of day)
TIMEREF	'LOCAL'	/Reference Frame
TASSIGN	'SATELLITE'	/Time assigned
TIMESYS	'TT'	/Time system used to define time
TIMEUNIT	' s'	/Time unit for timing header keywords
TIMEPIXR	1	/Time stamps refer to end of each bin
CLOCKAPP	T	/ If clock correction are applied (F/T)
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
TSTART	0.0	/Start time
TSTOP	0.0	/Start Time
TIMEDEL	0.125	/Integration time
HDUCLASS	'OGIP'	/ format conforms to OGIP standard
HDUCLAS1	'string'	/<hduclass1>
HDUCLAS2	'string'	/ <hduclas2>
ORIGIN	'JAXA, WCOC'	/Origin of the fits file
CREATOR	'string'	/Software that create 1st the file
PROCVER	'00.00.00'	/Processing version
CALDBVER	'string'	/CALDB version
SEQPNUM	nn	/Number of times the dataset has been processed
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date

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2.5 Science files: Structure/Header Keywords for TH/PH and EVENT modes

The science data files in the monitor directory are for the TH and PH modes. Each file has one with different layout. The 1st extension contains the science data, the 2nd information necessary to calculate the deadtime and the 3rd contains the mapping channel-energy.

a) Primary header
All science files include in the primary header the following keywords. Note the primary header for the science data in table 2.5.1 differs from the primary header of the auxiliary data (Table 2.3.1) for the keyword DETNAM and DATAMODE.

Table 2.5.1		
Keyword	**Value**	**Comment**
TELESCOP	'CALET'	/Telescope mission name
INSTRUME	'CGBM'	/Instrument name
DETNAM **	'string'	/ Detector subsystem (SGM, HXM1, HXM2. ALL for SGM, HXM1, HXM2. Other ASC)
DATAMODE **	'string'	/Datamode
OBS_ID	'YYYYMMDD'	/Observation ID
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
ORIGIN	'JAXA, WCOC'	/Origin of the FITS file
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CREATOR	'string'	/Software that create 1st the file
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date

NOTE : The string for DETNAM has the following values HXI1 HXI2 and SGD. The keyword DATAMODE has the following values : PH_HIGH , PH_LOW , TH_HIGH , TH_LOW.

In all extensions of the Science file the keyword L3CORR set to T or F indicates that some cosmetic corrections were applied to the files after the processing. The CALDB version is set to an internal version used in the processing that do not correspond to the calibration version stored in the HEASARC CALDB.

b) Header of PH science data in the monitor directory: The PH data are spectra collected every 4 sec and are stored in files with 1 extension. There are two PH science data files for each of the HXI1, HXM2 and SGM instruments: one for the low gain and one for the high gain. The file structure of the low and high gain data is identical and described in Table 2.5.2. The low and high gain data differ only for the number of channels.

Table 2.5.2
1st Extension *Structure PH data high or low*

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Keyword	Value	Comment
EXTNAME	'CGBM_PH'	/name of the HDU
TTYPE1	'TIME'	/Time in sec since 01 Jan 2000 00:00:00
TFORM1	'1D'	/data format of field: 8-byte DOUBLE
TUNIT1	's'	/physical unit of field
TTYPE2	'MDCTIME'	/Local Time counter
TFORM2	'1D'	/data format of field: 8-byte DOUBLE
TUNIT2	's'	/physical unit of field
TTYPE3	'COUNTS_PHA'	/Pulse height amplitude for this gain
TFORM3	'xI'	/data format of field: 2-byte INTEGER
TUNIT3	'count'	/physical unit of field
TZERO3	32768	/offset for column
TTYPE4	'COUNTS_PI'	/Pulse invariant gain corrected
TFORM4	'xI'	/data format of field: 2-byte INTEGER
TUNIT4	'count'	/physical unit of field
TZERO4	32768	/offset for column
TTYPE5	'EXPOSURE'	/Exposure for this row
TFORM5	'1E'	/data format of field
TUNIT5	's'	/physical unit of field
1CDLT3	1	/Pixel increment along CTYP axes
1CDPX3	1	/reference pixel of the CTYP axes
1CRVL3	0	/Value of the CTYP axes reference pixel
1CUNI3	'chan'	/ Unit of the pixel along the CTYP axes
1CTYP3	'CHANNEL'	/CTYP axis name
1CDLT4	1	/Pixel increment along CTYP axes
1CDPX4	1	/reference pixel of the CTYP axes
1CRVL4	0	/Value of the CTYP axes reference pixel
1CUNI4	'chan'	/ Unit of the pixel along the CTYP axes
1CTYP4	'CHANNEL'	/CTYP axis name
TELESCOP	'CALET'	/Telescope mission name
INSTRUME	'CGBM'	/Instrument name
DETNAM	'string'	/ Detector
DATAMODE	'string'	/Data mode
GAIN	'string'	/Gain
OBS_ID	'YYYYMMDD'	/Observation ID
MJDREFI	51544	/MJD reference day 01 Jan 2000 00:00:00

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MJDREFF	7.4287037037037E-04	/MDJ reference (fraction of day)
TIMEREF	'LOCAL'	/Reference Frame
TASSIGN	'SATELLITE'	/Time assigned
TIMESYS	'TT'	/Time system used to define time
TIMEUNIT	' s'	/Time unit for timing header keywords
TIMEPIXR	1	/Time stamps refer to end of each bin
CLOCKAPP	T	/ If clock correction are applied (F/T)
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
TSTART	0.0	/Start time
TSTOP	0.0	/Start Time
TIMEDEL	value	/Integration time
DEADAPP	F	/if deadtime applied
TELAPSE	value	/Stop-Start
HDUCLASS	'OGIP'	/ format conforms to OGIP standard
HDUCLAS1	'string'	/<hduclass1>
HDUCLAS2	'string'	/ <hduclas2>
ORIGIN	'JAXA, WCOC'	/Origin of the fits file
CREATOR	'string'	/Software that create 1st the file
L3CORR	T	/Is L3 correction applied
PROCVER	'00.00.00'	/Processing version
CALDBVER	'string'	/CALDB version
SEQPNUM	nn	/Number of times the dataset has been processed
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date
2nd Extension *GTI*		
Keyword	**Value**	**Comment**
EXTNAME	'STDGTI'	/name of this hDU
TTYPE1	'START'	/start time
TFORM1	'1D'	/data format of field: 8-byte DOUBLE
TUNIT1	's'	/physical unit of field
TTYPE2	'STOP'	/stop time
TFORM2	'1D'	/data format of field: 8-byte DOUBLE
TUNIT2	's'	/physical unit of field
TELESCOP	'CALET'	/Telescope mission name
INSTRUME	'CGBM'	/Instrument name

.

DETNAM	'string'	/ Detector name
DATAMODE	'string'	/Datamode
OBS_ID	'YYYYMMDD'	/Observation ID
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
TSTART	value	/Start time
TSTOP	value	/Start Time
MJDREFI	51544	/MJD reference day 01 Jan 2000 00:00:00
MJDREFF	7.4287037037037E-04	/MDJ reference (fraction of day)
TIMEREF	'LOCAL'	/Reference Frame
TASSIGN	'SATELLITE'	/Time assigned
TIMESYS	'TT'	/ Time System
TIMEUNIT	' s'	/Time unit for timing header keywords
CLOCKAPP	T	/ If clock correction are applied (F/T)
HDUCLASS	'OGIP'	/ format conforms to OGIP standard
HDUCLAS1	'GTI	/<hduclass1>
CREATOR	'string'	/Software that create 1st the file
PROCVER	'00.00.00'	/Processing version
L3CORR	T	/Is L3 correction applied
CALDBVER	'value'	/CALDB version
SEQPNUM	nn	/Number of times the dataset has been processed
ORIGIN	'JAXA, WCOC '	/Origin of the FITS files
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date

The TIMEDEL values is 4 sec for the PH data.

c) Header of TH science data in the monitor directory:
The TH data are rates taken with different energy band every 0.125 sec are stored in files with 1 extension. There are two TH science data file for each of the HXI1, HXM2 and SDM instruments: one for the low gain and one for the high gain. The file structure of the low and high gain data is identical and described in Table 2.5.3. The rates are calculated in four energy bands for both low and high gain.

Table 2.5.3		
1st Extension *Structure TR data high or low*		
Keyword	**Value**	**Comment**
EXTNAME	'CGBM_TH'	/name of the HDU
TTYPE1	'TIME'	/Time in sec since 01 Jan 2000 00:00:00
TFORM1	'1D'	/data format of field: 8-byte DOUBLE

.

TUNIT1	‘s’	/physical unit of field
TTYPE2	‘MDCTIME’	/Local Time counter
TFORM2	‘1D’	/data format of field: 8-byte DOUBLE
TUNIT2	‘s’	/physical unit of field
TTYPE3	‘COUNTS’	/Pulse height amplitude for this gain
TFORM3	‘4I’	/data format of field
TZERO3	32768	/ offset for column
TUNIT3	‘count’	/physical unit of field
TTYPE4	‘EXPOSURE’	/Exposure for this row
TFORM4	‘1E’	/data format of field
TUNIT4	‘s’	/physical unit of field
TTYPE5	‘SEQNUM’	/field name
TFORM5	‘I’	/data format of field: 2-byte INTEGER
TZERO5	32768	/ offset for column
1CUNI3	‘chan’	/ Unit of the pixel along the CTYP axes
1CTYP3	‘CHANNEL’	/CTYP axis name
TELESCOP	‘CALET’	/Telescope mission name
INSTRUME	‘CGBM’	/Instrument name
DETNAM	‘string’	/ Detector
DATAMODE	‘string’	/Data mode
GAIN	‘string’	/Gain
OBS_ID	‘YYYYMMDD’	/Observation ID
MJDREFI	51544	/MJD reference day 01 Jan 2000 00:00:00
MJDREFF	7.4287037037037E-04	/MDJ reference (fraction of day)
TIMEREF	‘LOCAL’	/Reference Frame
TASSIGN	‘SATELLITE’	/Time assigned
TIMESYS	‘TT’	/Time system used to define time
TIMEUNIT	‘ s’	/Time unit for timing header keywords
TIMEPIXR	1	/Time stamps refer to end of each bin
CLOCKAPP	T	/ If clock correction are applied (F/T)
DATE-OBS	‘yyyy-mm ddThh:mm:ss’	/Start Date
DATE-END	‘yyyy-mm ddThh:mm:ss’	/Stop Date
TSTART	0.0	/Start time
TSTOP	0.0	/Start Time
TIMEDEL	value	/Integration time
TELAPSE	value	/Stop-Start
DEADAPP	F	/if deadtime applied
HDUCLASS	‘OGIP’	/ format conforms to OGIP standard

.

HDUCLAS1	'string'	/<hduclass1>
HDUCLAS2	'string'	/ <hduclas2>
ORIGIN	'JAXA, WCOC'	/Origin of the fits file
CREATOR	'string'	/Software that create 1st the file
PROCVER	'00.00.00'	/Processing version
L3CORR	T	/Is L3 correction applied
CALDBVER	'string'	/CALDB version
SEQPNUM	nn	/Number of times the dataset has been processed
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date
2nd ext GTI		
Keyword	**Value**	**Comment**
EXTNAME	'STDGTI'	/name of this hDU
TTYPE1	'START'	/start time
TFORM1	'1D'	/data format of field: 8-byte DOUBLE
TUNIT1	's'	/physical unit of field
TTYPE2	'STOP'	/stop time
TFORM2	'1D'	/data format of field: 8-byte DOUBLE
TUNIT2	's'	/physical unit of field
TELESCOP	'CALET'	/Telescope mission name
INSTRUME	'CGBM'	/Instrument name
DETNAM	'string'	/ Detector name
DATAMODE	'string'	/Datamode
OBS_ID	'YYYYMMDD'	/Observation ID
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
TSTART	value	/Start time
TSTOP	value	/Start Time
MJDREFI	51544	/MJD reference day 01 Jan 2000 00:00:00
MJDREFF	7.4287037037037E-04	/MDJ reference (fraction of day)
TIMEREF	'LOCAL'	/Reference Frame
TASSIGN	'SATELLITE'	/Time assigned
TIMESYS	'TT'	/ Time System
TIMEUNIT	' s'	/Time unit for timing header keywords
CLOCKAPP	T	/ If clock correction are applied (F/T)
HDUCLASS	'OGIP'	/ format conforms to OGIP standard
HDUCLAS1	'GTI	/<hduclass1>
CREATOR	'string'	/Software that create 1st the file
PROCVER	'00.00.00'	/Processing version

.

L3CORR	T	/Is L3 correction applied
CALDBVER	'value'	/CALDB version
SEQPNUM	nn	/Number of times the dataset has been processed
ORIGIN	'JAXA, WCOC '	/Origin of the FITS files
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date

The TIMEDEL keyword is set to 0.125 sec. The SEQNUM is a counter ranging from 0-7 and resets every time is reached 7. The exposure column contains the exposure corrected by deadtime, however if the correction was not possible is set to TIMEDEL.

d) Event mode data

The event data are generated when a trigger occurs. For each trigger pha data are collected in low and high gain. The low and high gain data for a given instrument are all included into one file. The event data file has two extensions: the 1st is the EVENT extension (Table 2.5.4), the second is the GTI extension (Table 2.5.5)

Table 2.5.4 *Structure event data*

Keyword	**Value**	**Comment**
EXTNAME	'EVENTS'	/name of the HDU
TTYPE1	'TIME'	/ Time in sec since 01 Jan 2000 00:00:00
TFORM1	'1D'	/data format of field
TUNIT1	's'	/physical unit of field
TTYPE2	'MDCTIME'	/Local Time counter
TFORM2	'1D'	/data format of field
TUNIT2	's'	/physical unit of field
TTYPE3	'EBOXTIME'	/Actual onboard clock
TFORM3	'1D'	/data format of field
TUNIT3	's'	/physical unit of field
TTYPE4	'PHA_LOW'	/ Pulse height amplitude for this gain
TFORM4	'1I'	/data format of field
TZERO4	32768	/ offset for column
TUNIT4	'chan'	/physical unit of field
TTYPE5	'PHA_HIGH'	/Pulse invariant for this gain
TFORM5	'1I'	/data format of field
TZERO5	32768	/ offset for column

.

TUNIT5	'chan'	/physical unit of field
TTYPE6	'PI_LOW'	/ Pulse height amplitude for this gain
TFORM6	'1I'	/data format of field
TZERO6	32768	/ offset for column
TUNIT7	'chan'	/physical unit of field
TTYPE7	'PI_HIGH'	/Pulse invariant for this gain
TFORM7	'1I'	/data format of field: 2-byte INTEGER
TZERO7	32768	/ offset for column
TUNIT7	'chan'	/physical unit of field
TTYPE8	'UD'	/Upper discriminator
TFORM8	'1B'	/data format of field
TTYPE9	'PILEUP'	/field name
TFORM9	'1B'	/data format of field
TZERO9	32768	/ offset for column
TTYPE10	'ENERGY'	/ Energy either from PI_LOW or PI_HIGH
TFORM10	'1E'	/data format of field: REAL
TTYPE11	'QUALITY'	/Data quality (0 is good)
TFORM11	'1B'	/data format of field
TLMIN4	Int value	/ minimum legal value
TLMAX4	Int value	/ maximum legal value
TLMIN5	Int value	/ minimum legal value
TLMAX5	Int value	/ maximum legal value
TLMIN6	Int value	/ minimum legal value
TLMAX6	Int value	/ maximum legal value
TLMIN7	Int value	/ minimum legal value
TLMAX7	Int value	/ maximum legal value
TELESCOP	'CALET'	/Telescope mission name
INSTRUME	'CGBM'	/Instrument name
DETNAM	'string'	/ Detector
DATAMODE	'string'	/Data mode
OBS_ID	'YYYYMMDD'	/Observation ID
OBJECT	'string'	/Object name
RA_PNT	value	/ISS R.A. pointing
DEC_PNT	value	/ISS Dec pointing
RA_INS	value	/R.A. instrument
DEC_INS	value	/Dec instrument
RA_SC	value	/R.A. from Geocenter at the trigger time

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DEC_SC	value	/Dec from Geocenter at the trigger time
DIST_SC	value	/Distance from Geocenter at the trigger time [km]
LON_SC	value	/Long of CALET at the trigger time [deg]
LAT_SC	value	/Lat of CALET at the trigger time [deg]
MJDREFI	51544	/MJD reference day 01 Jan 2000 00:00:00
MJDREFF	7.4287037037037E-04	/MDJ reference (fraction of day)
TIMEREF	'LOCAL'	/Reference Frame
TASSIGN	'SATELLITE'	/Time assigned
TIMESYS	'TT'	/Time system used to define time
TIMEUNIT	' s'	/Time unit for timing header keywords
CLOCKAPP	T	/ If clock correction are applied (F/T)
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
TSTART	0.0	/Start time
TSTOP	0.0	/Start Time
TIMEDEL	value	/Integration time
TELAPSE	value	/Stop-Start
ONTIME	value	/GTI sum
EXPOSURE	value	/Exposure
DEADAPP	F	/if deadtime applied
TRIGGER	'string'	/ Trigger number
PI2ENEL	value	/PI to Energy low gain
PI2ENEH	value	/PI to Energy High gain
TRIGPAT	'XXXX'	/ Flag to indicate on which time scale trigger.
SRCHDU	Int value	/ in which telemetered events these data are located
TRIGEBOX	Real value	/EBOXTIME of Trigger time
TRIGMDC	Real value	/MDCTIME of Trigger Time
TRIGTIME	Real value	/TIME of Trigger Time
TRIGUTC	'yyyy-mm ddThh:mm:ss'	/TIME of Trigger Time in UTC
ENDPOINT	Int value	/ring buffer end point
HDUCLASS	'OGIP'	/ format conforms to OGIP standard
HDUCLAS1	'string'	/<hduclass1>
HDUCLAS2	'string'	/ <hduclas2>
ORIGIN	'JAXA, WCOC'	/Origin of the fits file
CREATOR	'string'	/Software that create 1st the file

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PROCVER	’00.00.00’	/Processing version
CALDBVER	‘string’	/CALDB version
SEQPNUM	nn	/Number of times the dataset has been processed
DATE	‘yyyy-mm-ddThh:mm:ss’	/File creation date
CHECKSUM	‘value’	/ data unit checksum updated date
DATASUM	‘value’	/ HDU checksum updated date

Note the OBJECT RA_PNT and DEC_PNT keyword contains the name of the object and the pointing at the trigger time. The OBJECT is set to the integer part of the onboard trigger. The RA_INS and DEC_INS are related to the zenit of the instrument and maybe be different between SGM and HXI as well as the pointing.

The keyword TRIGPAT is a 4 digits string set to either 0 or 1 to indicate on which trigger time scale the event was triggered. The time scales are : 1^{st} =4s, 2^{nd}=1s $3^{rd=}$ 0.5 4^{th}=0.25

Table 2.5.5		
Keyword	**Value**	**Comment**
EXTNAME	‘STDGTI’	/name of this hDU
TTYPE1	‘START’	/start time
TFORM1	‘1D’	/data format of field: 8-byte DOUBLE
TUNIT1	‘s’	/physical unit of field
TTYPE2	‘STOP’	/stop time
TFORM2	‘1D’	/data format of field: 8-byte DOUBLE
TUNIT2	‘s’	/physical unit of field
TELESCOP	‘CALET’	/Telescope mission name
INSTRUME	‘CGBM’	/Instrument name
DETNAM	‘string’	/ Detector name
OBS_ID	‘YYYYMMDD’	/Observation ID
DATE-OBS	‘yyyy-mm ddThh:mm:ss’	/Start Date
DATE-END	‘yyyy-mm ddThh:mm:ss’	/Stop Date
TSTART	0.0	/Start time
TSTOP	0.0	/Start Time
MJDREFI	51544	/MJD reference day 01 Jan 2000 00:00:00
MJDREFF	7.4287037037037E-04	/MDJ reference (fraction of day)
TIMEREF	‘LOCAL’	/Reference Frame
TASSIGN	‘SATELLITE’	/Time assigned
TIMESYS	‘TT’	/ Time System
TIMEUNIT	‘ s’	/Time unit for timing header keywords

CLOCKAPP	T	/ If clock correction are applied (F/T)
HDUCLASS	'OGIP'	/ format conforms to OGIP standard
HDUCLAS1	'GTI	/<hduclass1>
CREATOR	'string'	/Software that create 1st the file
PROCVER	'00.00.00'	/Processing version
CALDBVER	'value'	/CALDB version
SEQPNUM	nn	/Number of times the dataset has been processed
ORIGIN	'JAXA, WCOC '	/Origin of the FITS files
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date

2.6 Setting for Header Keywords

The header of the science and auxiliary data contains keywords which content

a) PROCVER, CALDBVER, SEQPNUM

- PROCVER contains the value of the processing version specified as MM.XX.YY.NN, where MM, XX, YY, and NN are digits whose values are set as follows:
  - MM.XX are assigned to the pipeline processing changes, MM major changes, XX small changes. This is a string.
  - YY is for new version of maxi software used in the processing (not that released within HEAsoft).
  - NN is for new version of CALDB in the pipeline.

- SEQPNUM contains the number of times a sequence has been processed within a processing version. This is a numerical value with no leading zeros.

- CALDBVER containing the version of the calibration used during the processing of a given observation. This is defined as follows: hxmYYYYMMDD_sgdYYYYMMDD where the YYYYMMDD referenced. The calibration information used in the processing is not in the public CALDB.

b) HDUCLASS HDUCLAS1 HDUCLAS2

All files include the HDUCLAS family keywords only in the extension appropriate for that HDUCLAS. The table 2.6.1 defines the value and what HDUCLAS family keywords should appear in each of the extensions:

Table 2.6.1		
Keyword	**Value**	**Comment**

.

All files that have HDUCLASS		
HDUCLASS	'OGIP'	/format conforms to OGIP standard
Attitude files extension		
HDUCLAS1	'TEMPORALDATA'	/Temporaldata
HDUCLAS2	'ASPECT'	/ Attitude
Housekeeping file extension		
HDUCLAS1	'TEMPORALDATA'	/Temporaldata
HDUCLAS2	'HKP'	/ Housekeeping
Orbit file		
HDUCLAS1	'TEMPORALDATA'	/Temporaldata
HDUCLAS2	'EPHEM'	/Orbit
Deadtime file extension		
HDUCLAS1	'TEMPORALDATA'	/Temporaldata
HDUCLAS2	'COMBINED '	/ Combined data
GTI file or extension		
HDUCLAS1	'GTI'	/Good time interval
Event file extension		
HDUCLAS1	'EVENTS'	/Temporaldata
HDUCLAS2	'ALL'	/ Housekeeping
TH and PH extensions		
HDUCLAS1	'ARRAY'	/Array of bin data
HDUCLAS2	'TOTAL'	/ Total counts
Ebounds extension		
HDUCLAS1	'RESPONSE'	/
HDUCLAS2	'EBOUNDS'	/ Housekeeping
Image extension		
HDUCLAS1	'IMAGE'	/Image
HDUCLAS2	'TOTAL'	/Total counts

Primary header in all files should include the following keywords :

b) EXTNAME, TELESCOP, DETNAM and DATAMODE

Table for EXTNAME strings**:**

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Table 2.6.2		
Keyword	**Value**	**Comment**
Auxiliary files		
*Attitude *.att *.iat*		
EXTNAME	'ATTITUDE'	/ name of this HDU
*Orbit *.orb*		
EXTNAME	'ORBIT'	/ name of this HDU
*Housekeeping file *.hk*		
EXTNAME	'HK'	/ name of this HDU
*Timing *.tim*		
EXTNAME	'TIME'	/ name of this HDU
*GTI *.gti*		
EXTNAME	'STDGTI'	/ name of this HDU
Science data files		
String for 1st extension on EVENT data		
EXTNAME	'EVENT'	/ name of this HDU
String for 1st extension PH data(structure identical for PH data of the different instruments)		
EXTNAME	'CGBM_PH'	/ name of this HDU
String for 1st extension TR data (structure identical for TR data of the different instruments)		
EXTNAME	'CGBM_TH'	/name of this HDU
String for 2nd extension science data		
EXTNAME	'DEADTIME'	/name of this HDU
String for 3rd extension science data		
EXTNAME	'EBOUNDS'	/name of this HDU

Table for TELESCOP strings :

Table 2.6.3		
Keyword	**Value**	**Comment**
*String valid for all cgbm file but for the *.iat*		
TELESCOP	'CGBM '	/ telescope
*String for only *.iat file*		
TELESCOP	'ISS '	/ telescope

Table for DETNAM strings **:**

Table 2.6.4 *applicable to science and auxiliary if necessary*		
Keyword	**Value**	**Comment**
String for only SGD data		
DETNAM	'SGD '	/ Detector name
String for only HXM1 data		
DETNAM	'HXM1'	/Detector name
String for only HXM2 data		

.

DETNAM	'HXM2'	/Detector name
String for common to the HXM1 and HXM2 data		
DETNAM	'HXM'	/Detector name
String for common to the SGD, HXM1 and HXM2 data		
DETNAM	'ALL'	/Detector name
String for ASC data		
DETNAM	'ASC'	/Detector name

Table for DATAMODE strings **:**

Table 2.6.5 ***applicable to science data only***		
Keyword	**Value**	**Comment**
String for only PH HIGH gain data		
DATAMODE	'PH_HIGH '	/ Datamode
String for only PH LOW gain		
DATAMODE	'PH_LOW '	/ Datamode
String for only TH HIGH gain		
DATAMODE	'TH_HIGH '	/ Datamode
String for only TH LOW gain data		
DATAMODE	'TH_LOW'	/ Datamode
String for event mode		
DATAMODE	'EVENT'	/ Datamode

Additional keywords :

- The event data (extension EVENT) includes the keyword TRIGGER containing a string that identify the trigger .

TRIGGER	'XXXXXXXXXX'	/Trigger number

- The EBOUNDS extension includes the keyword GAIN to distinguish the low and high gain. The XXXX is set either to LOW or HIGH.

GAIN	'XXXX'	/Gain of the data

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3 Calorimeter data

The calorimeter data includes the rate particles derived from the Charge Detector and the spectra obtained from the entire calorimeter.

3.1 Space weather data

The rate particle data are collected using the first layer of the calorimeter the Charge Detector (CHD). These are counts in the X and Y directions collected every one sec. The data are divided in files each containing information for 1 single day.
The filename convention is :
ccal_YYYYMMDD_chd.lc
where YYYYMMDD is the day of the data collection.
The file structure includes a primary header and one extension. Table 3.1.1 lists the keywords for the primary header:

Table 3.1.1

Keyword	Value	Comment
TELESCOP	'CALET'	/Telescope mission name
INSTRUME	'CCAL'	/Instrument name
DETNAM	'CHD'	/ Detector subsystem
OBS_ID	'YYYYMMDD'	/Observation ID
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
ORIGIN	'JAXA, WCOC'	/Origin of the FITS file
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CREATOR	'string'	/Software that create 1st the file
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date

The 1st extensions contains the actual data. The original files have the following column :

- Time provided in unix time in seconds
- Duration corresponding to exposure for each bin in seconds
- Counts in the X and Y direction
- Latitude, longitude in deg
- Altitude in km
- Flag

The FITS files maintained the original information but to use the OGIP standard the following information has been derived and added :

- Time column containing second since 2000 Jan 1st 00:00:00 as for the CALET GBM
- Rate in the X and Y direction calculated from Counts/Duration
- Error on rates in the X and Y direction calculated as SQRT(Counts) /Duration

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- Fractional exposure calculated as the Duration /Timedel

Table 3.1.2 contains the columns and keywords for the 1st extension.

Table 3.1.2 Rate CHD extension		
Keyword	**Value**	**Comment**
EXTNAME	'CCAL_CHD'	/name of the HDU
TTYPE1	'TIME'	/Time in sec since 01 Jan 2000 00:00:00
TFORM1	'1D'	/data format of field
TUNIT1	's'	/physical unit of field
TTYPE2	'UNIXTIME'	/Original time
TFORM2	'1D'	/data format of field
TUNIT2	's'	/physical unit of field
TTYPE3	'DURATION'	/duration of bin exposure
TFORM3	'1D'	/data format of field
TUNIT2	's'	/physical unit of field
TTYPE4	'COUNT_CHDX'	/ Counts for CHDY
TFORM4	'J'	/data format of field
TUNIT4	'count'	/physical unit of field
TTYPE5	'COUNT_CHDY'	/ Counts for CHDZ
TFORM5	'J'	/data format of field
TUNIT5	'count'	/physical unit of field
TTYPE6	'RATE_CHDX'	/ Rate for CHDY
TFORM6	'1E'	/data format of field
TUNIT6	'count/s'	/physical unit of field
TTYPE7	'RATE_CHDY'	/ Rate for CHDZ
TFORM7	'1E'	/data format of field
TUNIT7	'count/s'	/physical unit of field
TTYPE8	'ERROR_CHDX'	/ Error Rate for CHDY
TFORM8	'1E'	/data format of field
TUNIT8	'count/s'	/physical unit of field
TTYPE9	'ERROR_CHDY'	/ Error Rate for CHDZ
TFORM9	'1E'	/data format of field
TUNIT9	'count/s'	/physical unit of field
TTYPE10	'FRACEXP'	/ Fractional exposure
TFORM10	'1E'	/data format of field
TTYPE11	'LATITUDE'	/ Latitude
TFORM11	'1E'	/data format of field
TUNIT11	'deg'	/physical unit of field
TTYPE12	'LONGITUDE'	/ Longitude
TFORM12	'1E'	/data format of field
TUNIT12	'deg'	/physical unit of field

.

TTYPE13	'ALTITUDE'	/ Altitude
TFORM13	'1E'	/data format of field
TUNIT13	'km '	/physical unit of field
TTYPE14	'FLAG'	/Data flag
TFORM14	'1I'	/data format of field
TELESCOP	'CALET'	/Telescope mission name
INSTRUME	'CCAL'	/Instrument name
DETNAM	'CHD'	/ Detector
OBS_ID	'YYYYMMDD'	/Observation ID
MJDREFI	51544	/MJD reference day 01 Jan 2000 00:00:00
MJDREFF	7.4287037037037E-04	/MDJ reference (fraction of day)
TIMEREF	'LOCAL'	/Reference Frame
TASSIGN	'SATELLITE'	/Time assigned
TIMESYS	'TT'	/Time system used to define time
TIMEUNIT	' s'	/Time unit for timing header keywords
TIMEPIXR	1	/Time stamps refer to end of each bin
CLOCKAPP	F	/ If clock correction are applied (F/T)
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
TSTART	0.0	/Start time
TSTOP	0.0	/Start Time
TIMEDEL	1.	/Integration time
TELAPSE	value	/Stop-Start
ONTIME	Value	/Ontime
EXPOSURE	value	/Exposure
DEADAPP	F	/if deadtime applied
HDUCLASS	'OGIP'	/ format conforms to OGIP standard
HDUCLAS1	'LIGHTCURVE'	/<hduclass1>
ORIGIN	'JAXA, WCOC'	/Origin of the fits file
CREATOR	'chdfitscurve_v1.pl'	/Software that create the fits file
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date

3.2 Spectra and time variable rates

The calorimeter measure spectra or rates for different particle species. The files in the archive have an empty primary header and one extension or two extensions. The extensions are either for flux measurements as function of energy or ratio flux as function of energy or flux as function of time. The file with two extensions have flux measurement as function of energy in the first extension and function of rigidity as second extension.
The filename convention is :
ccal_<species>_XXXXX_YYMMDD.fits

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where <species> is the element or combination of elements; XXXXX represent the file content and is set to flux, ratio or rates; YYMMDD is the publication date.
The original files do not always contain the energy column and/or flux x energy**[a]
The HEASARC add these extra columns to have to make easier to compare the data.

4 Database tables

The CGRB data, the CHD data and the CCAL spectra/rate data have each associated a database table. These are named **calgbmmstr, calchdmstr** and **ccalspec** respectively. Each record in the database has a unique identifier and the time corresponding to the observation and/or publication. Each database has additional parameters specific to the data.

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