Suzaku WAM archive

Version 1.4

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Table of Contents

1 WAM archive Version Sep 2018 (version2) 4
2 WAM archive Version 3 (2019) 6
2.1 WAM data future release : List of changes 6
2.2 Header keywords 8
2.3 List of files 10
2.4 Database table 11

CHANGE RECORD PAGE (1 of 2)

DOCUMENT TITLE : WAM Archive			
ISSUE	DATE	PAGES AFFECTED	DESCRIPTION
Version 1.0	NOV 2018	All	First draft
Version 1.1	Dec 2018	All	Include Kazutaka comments: remove/add/change some of the header keywords, fix description for the classification field in the database and fix typos.
Version 1.2	Dec 2018	Header	Ass the second to the OBS_ID
Version 1.3	Jan 2019	All	Propagate the 12 digits OBS_ID in all the part of the document
Version 1.4	Feb 2019	Table	Fix the parameters name for the db table to reflect the names used

1 WAM archive Version Sep 2018 (version2)

The WAM data products were generated at Saitima and Nagoya Universites .
Event detected by the WAM have always data with the TRN regardless if they are triggered or not triggered event. BURST data are only for trigger events.
The original structure has two directories one for the trn/ and one for the bst/ and if the event was detected in both data were in the two separated.
Under each directory there are the data. The content is the following :

- Burst directory

ae<seq>_<time>_wamK_bst_4band_16bin.png
ae<seq>_<time>_wamK_bst_4band_nobin.png
ae<seq>hxd_bst01_uf.evt.gz
ae<seq>_<time>_bst_lc.tar.gz

The *.png files are also included in the tar file, the ae<seq>hxd_bst01_uf.evt.gz
is a copy of what is the main SUZAKU archive.

The tar file contains 64 files and they are

a) FITS lightcurves for each wam there are 8 lightcurves 4 not deadtime corrected and 4 deadtime corrected.
Total 32 files. Naming :
ae<seq>_<time>_wamK_bst_thL.lc.gz
ae<seq>_<time>_wamK_bst_thL_ndts.lc.gz

b) QDP lightcurves for each wam there are 4 lightcurves
Total 16 files. Naming :
ae<seq>_<time>_wamK_bst_4band_16bin_ndtc.qdp
ae<seq>_<time>_wamK_bst_4band_16bin.qdp
ae<seq>_<time>_wamK_bst_4band_nobin_ndtc.qdp
ae<seq>_<time>_wamK_bst_4band_nobin.qdp

c) PNG plot lightcurves for each wam there are 4 lightcurves
Total 16 files. Naming :
ae<seq>_<time>_wamK_bst_4band_16bin_ndtc.png
ae<seq>_<time>_wamK_bst_4band_16bin.png
ae<seq>_<time>_wamK_bst_4band_nobin_ndtc.png
ae<seq>_<time>_wamK_bst_4band_nobin.png

where K= 0,1,2,3 is the index for the WAM and L=0,1,2,3 in the index for the th.

- TRN directory

ae<seq>_<time>_wamK_trn_4band_long.png

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ae<seq>_<time>_wamK_bst_4band_short.png
ae<seq>hxd_trn_long_evt.gz
ae<seq>hxd_trn_short_evt.gz
ae<seq>_<time>_trn_lc.tar.gz

The *.png files are also included in the tar file and the *.evt files are derived from files that are in the SUZAKU archive. The tar file ae<seq>_<time>_trn_lc.tar.gz there are 96 files

a) FITS lightcurves for each wam there are 16 lightcurves
4 deadtime corrected long th 0, 1, 2 ,3
4 deadtime correctetd short th 0, 1, 2, 3
4 deadtime corrected long th 0, 1, 2, 3
4 deadtime correctetd short th 0, 1, 2, 3

The total number of lightcurves is 64 files since there are 4 wams.
The lightcurves are named :

ae<seq>_<time>_wamK_trn_thL_short.lc.gz
ae<seq>_<time>_wamK_trn_thL_short_ndts.lc.gz
ae<seq>_<time>_wamK_trn_thL_long.lc.gz
ae<seq>_<time>_wamK_trn_thL_long_ndts.lc.gz

b) QDP lightcurve for each wam there are 4 lightcurves
Total 16 files. Naming :
ae<seq>_<time>_wamK_trn_4band_long_ndtc.qdp
ae<seq>_<time>_wamK_trn_4band_long.qdp
ae<seq>_<time>_wamK_trn_4band_short_ndtc.qdp
ae<seq>_<time>_wamK_trn_4band_short.qdp

c) PNG for each wam there are 4 lightcurves
Total 16 files. Naming :
ae<seq>_<time>_wamK_trn_4band_long_ndtc.png
ae<seq>_<time>_wamK_trn_4band_long.png
ae<seq>_<time>_wamK_trn_4band_short_ndtc.png
ae<seq>_<time>_wamK_trn_4band_short.png

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2 WAM archive Version 3 (2019)

2.1 WAM data future release : List of changes

The changes for the new version include the following:

- New directory structure is the following:

```
                                wam/
        2005/                    2006/      2007/ ….. 2015/
          |
    YYMMDDHHMM/
   bst_lc/     trn_lc/   bst_pha/  trn_pha/
```

  - First directory is by year to contain the directories all the events occurring that year
  - Directories for each event are named after the event id and contain the data both in for the Transient and Burst mode
  - Directories of the events are named using a 12 digits YYMMDDHHMMSS number representing the time of the event
  - Below the event directories there are subdirectories dedicated to the transient light curves and the burst subdirectories and named trn_lc/ and bst_lc/. If spectra and responses will be generated in the future the data files are placed in dedicated subdirectories trn_pha/ and bst_pha/

- Filenames use the event id number as identifier and other specification if needed.
  For the light curves , events qdp and gif the filename are the following :
  aeYYMMDDHHMMSS_wamN_XXX.lc
  ae YYMMDDHHMMSS_wamN_XXX.evt
  ae YYMMDDHHMMSS_wamN_XXX.qdp
  ae YYMMDDHHMMSS_wamN_XXX.gif

  where N is wam number (0,1,2,3) and XXX is either bst or trn
  If spectra and responses are generated should follow the same convention

- Lightcurves are combined in the same file. All data related to a specific WAM are all in one file. The file has two extensions one for dead time corrected data and the second not dead time corrected. Each extension has rates and errors for each of the th.
  For example the lightcurves aeYYMMDDHHMMSS_wamN_XXX.lc has the first extension with the information from

  ae<seq>_<time>_wam0_bst_th0.lc.gz
  ae<seq>_<time>_wam0_bst_th1.lc.gz
  ae<seq>_<time>_wam0_bst_th2.lc.gz
  ae<seq>_<time>_wam0_bst_th3.lc.gz

The second extension contain the information from :

ae<seq>_<time>_wam0_bst_th0_ndtc.lc.gz
ae<seq>_<time>_wam0_bst_th1_ndtc.lc.gz
ae<seq>_<time>_wam0_bst_th2_ndtc.lc.gz
ae<seq>_<time>_wam0_bst_th3_ndtc.lc.gz

The structure of each extension is the following :

Data from *	**Columns Burst**	**Columns TRN**
ae<seq>_<time>_wam0_XXX_th0	TIME	TIME
ae<seq>_<time>_wam0_XXX_th0	RATE_TH0 ERROR_TH0	RATE_TH0 ERROR_TH0
ae<seq>_<time>_wam0_XXX_th1	RATE_TH1 ERROR_TH1	RATE_TH1 ERROR_TH1
ae<seq>_<time>_wam0_XXX_th2	RATE_TH2 ERROR_TH2	RATE_TH2 ERROR_TH2
ae<seq>_<time>_wam0_XXX_th3	RATE_TH3 ERROR_TH3	RATE_TH3 ERROR_TH3
ae<seq>_<time>_wam0_XXX_th0	FRACEXP	FRACEXP
ae<seq>_<time>_wam0_XXX_th0		DEADC

The information from the the TIME FRACEXP and DEADC are taken from the th0 since these columns are identical in all files. The RATE_THn, ERROR_THn , where n is 0,1,2,3 are taken from the respective light curve for a given wam dead time and not dead time corrected . The first extension is for dead time corrected data the second extension is for the non dead time corrected data.

- The header of the lightcurves and primary header has been remade (see below the table 1 and 2)
- For the Transient data only the **long** data are kept, since the short are only a subinterval of the long
- Only a subset of qdp and picture files are kept. Specifically are kept the qdp containing the light curves for each wam of the th0,1,2,3 and th0123 and the picture files (gif) derived from them
- The qdp files are modified adding the correct binning time and adding the qdp command to make the line ticker
- To the Burst events have been added the gti, remade the primary, changed the OBD_ID and added a keyword to contains the SUZAKU original id.
  (Not yet done : all the HIERARCH keywords will be removed and substitute with normal keywords EVTCLASS , see note below.)
- To the TRN event files have been remade the primary (identical to the Burst), changed the OBS_ID and added a keyword to contain the SUZAKU original id.

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2.2 Header keywords

The primary header of the FITS files both lightcurves or events contain the keywords in table 1.
The header keywords in first and second extensions of the lightcurves are in table 2.
The header of the 1st and 2nd extensions of the lightcurves has been cleanup by unnecessary history. The keywords in RED are either new of the content modified.
The keyword OBS_ID and SUZAOBSID have been either modified or added to the header of the event files.

Table 1

Primary header applied to lightcurves and events files

Keyword	Value	Comment
TELESCOP	'SUZAKU'	/Telescope mission name
INSTRUME	'HXD'	/Instrument name
DETNAM	'string'	/ Detector subsystem (WAM or WAM_ANTIn)
DATAMODE	'string'	/Data mode (TRANSIENT or BURST)
OBS_ID	'YYMMDDHHMMSS'	/Observation ID
SUZOBSID	'Sequence'	/SUZAKU OBS_ID; slew if 999999xxx
TRIG_ID	'XXXX'	/ Trigger ID
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
DATE-END	'yyyy-mm ddThh:mm:ss'	/Stop Date
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date

Table 2

First/ Second extension lightcurves

Keyword	Value	Comment
EXTNAME	'XXXXX'	/ name of this binary table extension RATE or RATE_NDT
TELESCOP	'SUZAKU'	/Telescope mission name
INSTRUME	'HXD'	/Instrument name
DETNAM	'string'	/ Detector subsystem (WAM or WAM_ANTIn)
DATAMODE	'string'	/Data mode (TRANSIENT or BURST)
OBS_MODE	'POINTING'	/Observation mode
OBS_ID	'YYMMDDHHMMSS'	/Observation ID
SUZOBSID	'Sequence'	/SUZAKU OBS_ID; slew if 999999xxx
TRIG_ID	'XXXX'	/ Trigger ID
EVTCLASS *	value	/Event Classification

DETWAM **	'XXXX'	/Which WAM detect the event 1=det 0=nodet
TRIGTIME	value	/Trigger time in Astro-E time
OBJECT***	'XXXXXX'	/Event name or set to NONAME
RA_OBJ***	value	/ Event R.A. (deg); no R.A. set to -999.99
DEC_OBJ***	value	/ Event Dec. (deg); no Dec set to -999.99
RADESYS	'FK5'	/World coordinates system
EQUINOX	2000	/Equinox for coordinates system
DATE-OBS	'yyyy-mm ddThh:mm:ss'	/Start Date
TIME-OBS	'hh:mm:ss'	/Start time
DATE-END	'yyyy-mm dd'	/Stop Date
TIME-END	'hh:mm:ss'	/Stop time
TSTART	0.0	/Start time
TSTOP	0.0	/Start Time
TIMESYS	'TT'	/ Time System
TELAPSE	value	/ elapsed time : TSTOP-TSTART
ONTIME	value	/ ontime : sum of all gti
MJDREFI	51544	/MJD reference day 01 Jan 2000 00:00:00
MJDREFF	7.4287037037037E-04	/MJD reference (fraction of day)
TIMEREF	'LOCAL'	/Reference Frame
TIMEUNIT	' s'	/Time unit for timing header keywords
TASSIGN	'SATELLITE'	/TASSIGN
CLOCKAPP	T	/If clock correction are applied (F/T)
TIMEDEL ****	value	/Integration time
TIMEPIXR	0.5	/ 0:times refer to the beginning of bin, 0.5:mid
TIERRELA	-9.99e2	/short term clock stability
TIERABSO	-9.99e2	/absolute clock stability
HDUCLASS	'OGIP'	/format conforms to OGIP standard
HDUCLAS1	'LIGHTCURVE'	/Extension containing light curve
HDUCLAS2	'TOTAL'	/Extension contains source + background
HDUCLAS3	'RATE'	/Extension contains count/time interval data
HDUVERS1	'1.1.0'	/Version number of the format
TLM_FILE	'telemetry_file'	/name of the telemetry file
TIM_FILE	'time_file'	/name of the time assignment file
ATT_FILE	'attitude_file'	/name of the satellite assignment file
ORB_FILE	'orbit_file'	/ name of the satellite orbit file
LEAPFILE	'leap_file'	/name of the leap second file
TELDEF	'teldef_file'	/name of the telescope definition file

CREATOR	'ANL: HXDmkbstlc: 2.2.3'	/by HXD team
ORIGIN	'hxdmkbstlc'	/origin of fits file
CHANBIN	'value'	/ WAM channel binning type (TH or PH)
BACKAPP	F	/background is subtracted
DEADAPP	value	/deadtime correction applied
VIGNAPP	F	/vignetting or collimator applied
GAINAPP	F	/gain applied
DATE	'yyyy-mm-ddThh:mm:ss'	/File creation date
CHECKSUM	'value'	/ data unit checksum updated date
DATASUM	'value'	/ HDU checksum updated date

Note * : The EVTCLASS will contain the classification written in the database table and will be included in all file lightcurve and event. The trigger time is kept only in the form of SUZAKU time.
Note **: The DETWAM will contain which WAM detected the event. This is encoded as a 4 digits string each digits is either 0 for not detection and 1 for detection. The value are written in the database.
Note ***: The values for the keywords OBJECT, RA_OBJ and DEC_OBJ are taken from the database. If any of these values are not set in the database they are set to NONAME , -999.99 and -999.99 for OBJECT, RA_OBJ DEC _OBJ respectively.
Note **** :The integration time in the lightcurve for the Transient data is always set to 1 sec. Instead for the Burst mode this is set to 1/32s before march 20 2006 and 1/64s after march 20 2006.

2.3 List of files

The directory for each event contains the following files. Here is an example for the event 058241157.

Table 3

Filename	**Description**	**Directory**
ae050824115700_wam0_bst.lc	Lightcurve wam0 in fits	/bst_lc
ae050824115700_wam1_bst.lc	Lightcurve wam1 in fits	/bst_lc
ae050824115700_wam2_bst.lc	Lightcurve wam2 in fits	/bst_lc
ae050824115700_wam3_bst.lc	Lightcurve wam3 in fits	/bst_lc
ae050824115700_wam0_bst.qdp	Lightcurve wam0 in ascii	/bst_lc
ae050824115700_wam1_bst.qdp	Lightcurve wam1 in ascii	/bst_lc
ae050824115700_wam2_bst.qdp	Lightcurve wam2 in ascii	/bst_lc
ae050824115700_wam3_bst.qdp	Lightcurve wam3 in ascii	/bst_lc
ae050824115700_wam0_bst.gif	Plot of wam0 lightcurves	/bst_lc
ae050824115700_wam1_bst.gif	Plot of wam1 lightcurves	/bst_lc

ae050824115700_wam2_bst.gif	Plot of wam2 lightcurves	/bst_lc
ae050824115700_wam3_bst.gif	Plot of wam3 lightcurves	/bst_lc
ae050824115700_wam_bst.evt	Event data	/bst_lc
ae050824115700_wam0_trn.lc	Lightcurve wam0 in fits	/trn_lc
ae050824115700_wam1_trn.lc	Lightcurve wam1 in fits	/trn_lc
ae050824115700_wam2_trn.lc	Lightcurve wam2 in fits	/trn_lc
ae050824115700_wam3_trn.lc	Lightcurve wam3 in fits	/trn_lc
ae050824115700_wam0_trn.qdp	Lightcurve wam0 in ascii	/trn_lc
ae050824115700_wam1_trn.qdp	Lightcurve wam1 in ascii	/trn_lc
ae050824115700_wam2_trn.qdp	Lightcurve wam2 in ascii	/trn_lc
ae050824115700_wam3_trn.qdp	Lightcurve wam3 in ascii	/trn_lc
ae050824115700_wam0_trn.gif	Plot of wam0 lightcurves	/trn_lc
ae050824115700_wam1_trn.gif	Plot of wam1 lightcurves	/trn_lc
ae050824115700_wam2_trn.gif	Plot of wam2 lightcurves	/trn_lc
ae0508241157_wam3_trn.gif	Plot of wam3 lightcurves	/trn_lc
ae050824115700_wam_trn.evt	Event data	/trn_lc

2.4 Database table

The database table named suzakuwam records information related to each event id. Each entry in the database table has a unique identifier, standard format for time and other specification. The times listed in all tables use the ISO convention, e.g., YYYY-MM-DD HH:MM:SS.sss, specified in one field. Sky positions, Right Ascension and Declination, are given in the table as decimal degrees in the J2000 equinox. The database content has one row for each event id and has associated a number of parameters (EVENT_ID, OBS_ID, TRIG_ID, Date,Time(UT), Type, Classification, Name, WAM0, WAM1, WAM2, WAM3, Incidentangle Theta, Incidentangle Phi, RA(J2000), DEC(J2000), T90, Fluence, WAM Reference, Other Detection, Redshift, Position Reference, GOES Class, Comments).
The meaning of the parameters are the following together with the comment whether or not the name has been changed compared to the above list :

- *event_id :* this is a unique identifier based on the time of the event. It s 12 digits corresponding to YYMMDDHHMMSS. This value is stored in the keyword OBS_ID in the fits files *{correspond to EVENT_ID in original table}*
- *suzaobsid:* This is the SUZAKU sequence number. This value is not unique in this database because more than one event could be detected in the same SUZAKU sequence number. This value is stored in the keyword SUZAOBSID in the fits files. Since the slew data are not included in the public SUZAKU archive, event identified during the slew have this value set to 999999xxx. *{correspond to OBS_ID in original table}*

- *trigger_id :* the is a sequential number unique identifier for the events. It is a four digit number where value 0001-3000 are events triggered onboard and 4000-9000 are event not triggered on board *{correspond to TRIG_ID in original Table}*
- *Time :* This contains the Date and Time of the trigger *{correspond to Date and Time in table}*
- *evttype :* String that identify if the event was triggered on board or discovered in the ground analysis. Values are *trigger* or *untrigger {correspond to type in original table}*
- *evtclass* : String that classify the events. The possible values are : operation , solarflare , confirmed GRB, possibleGRB, possibleAXP/SGR, confirmedAXP/SGR, noise/spike, particle/SAA. If the event is classified as Operation this is no real event but caused by different operation-related issues as turning-on the high voltages and checking the WAM health condition using a special mode named WAMscan. If the event is classified confirmedGRB or confirmedAXP/SGR, the event was also seen by other satellites. If the event is classified as possibleGRB or possibleAXP/SGR , the event was not confirmed by other satellites. If the event is classified as noise/spike, the event has a rate increase in 1 sec in the Transient mode but not increase in the Burst mode. If the event is classified as particle/SAA, the event is due either to high latitude event (Canada) probably due to electron trapped in the geomagnetic poles or event associated to the SAA passage (Note the WAM was turned off in the SAA but still the WAM see the initial onset of the SAA) *{correspond to Classification in the original table}*
- *name :* If the event is identified with a GRB or a celestial source, this field contains the name of the object
- *WAM0:* Whether or not if the event has been detected by the WAM0 (yes/no). This field is set to N/A to all the event that were not triggered on board
- *WAM1:* Whether or not if the event has been detected by the WAM0 (yes/no). This field is set to N/A to all the event that were not triggered on board
- *WAM2:* Whether or not if the event has been detected by the WAM0 (yes/no). This field is set to N/A to all the event that were not triggered on board
- *WAM3:* Whether or not if the event has been detected by the WAM0 (yes/no). This field is set to N/A to all the event that were not triggered on board
- *Theta :* This is the event incident theta angle (direction of the event with the Z-axis of the satellite. This is only set for localized event with R.A. and Dec.. *{correspond to Incidentangle Theta in the original table}*
- *Phi :* This is the event incident phi angle (direction of the event projected on the XY plan with the X-axis of the satellite. This is only set for localized event with R.A. and Dec.. *{correspond to Incidentangle Phi in the original table}*
- *RA:* R.A. of the object . This is the position reported either by other satellites that detect the event or in catalog for celestial sources. This is not derived by the WAM
- *DEC:* Dec of the object . This is the position reported either by other satellites that detect the event or in catalog for celestial sources. This is not derived from the WAM.
- *T90:* measures the duration of the time interval during which 90% of the total observed counts have been detected. The start and stop of the T90 interval are

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defined by the time at which 5% and 95% of the total counts have been detected. This value, given in seconds, is derived for the energy band 50-5000 keV.

- *Fluence:* the flux derived by the WAM spectra (using the best fit model) and turned into fluence in erg cm-2 using the T100
- *Wamref:* provide the WAM data reference published in the GCN {*{correspond to wam reference in the original table}*
- *Other :* provide the list of satellite that also detected the event *{correspond to other detection in the original table}*
- *Redshift:* provide the redshift taken from http://www.mpe.mpg.de/~jcg/grbgen.html
- *Posref:* provide the reference from where the position of the event was derived *{correspond to position reference in the original table}*
- *Goesclass:* If the event is a solar flare, this field contains the goes classification http://spaceweather.com/glossary/flareclasses.html
- *Comment:* additional comment on the event