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BIRKELAND CENTRE FOR SPACE SCIENCE

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ASIM Science Data Centre (ASDC)
ASIM Scientific Data Description

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Table 0.1 Change Log

ECR/ECO	Description	Rev	Date
Initial	First Issue for internal review	0.0	2019-10-20
	Fully updated with all Scientic Observations Added SAA box	1.0	2020-02-19
	Updated SAA box section. Added FAST threshold section Added ASW update section	1.1	2020-04-27
	Added brief descriptions to each data sections.	1.2	2024-08-13

0 Document Metadata

0.1 Purpose

The purpose of this document is to give a short description of the ASIM scientific data products downloadable from the ASDC website.

0.2 Scope

This document covers the ASIM scientific data products downloadable from the ASDC website. It is not intended to describe the functioning of the ASIM instruments. For more information on the ASIM instruments see reference documents RD#1, RD#2, and RD#3,

0.3 Applicable Documents

The following documents are applicable to the definitions and activities described within this document.

0.4 Reference Documents

The following documents contain supporting and background information to be considered during the activities specified within this document.

Ref.	Doc. No.	Title	Issue
RD#1	Space Science Reviews, 215(26), March, 2019 Østgaard, N., Balling, J.E., Bjørnsen, T. et al. Space Sci Rev (2019) 215: 23. https://doi.org/10.1007/s11214-018-0573-7	The ASIM Mission on the International Space Station	
RD#2	Space Science Reviews, 215(23), February, 2019 Østgaard, N., Balling, J.E., Bjørnsen, T. et al. Space Sci Rev (2019) 215: 23. https://doi.org/10.1007/s11214-018-0573-7	The Modular X- and Gamma-Ray Sensor (MXGS) of the ASIM Payload on the International Space Station	
RD#3	Space Science Reviews, 215(28), June, 2019 Chanrion, O., Neubert, T., Lundgaard Rasmussen, I. et al. Space Sci Rev (2019) 215: 28. https://doi.org/10.1007/s11214-019-0593-y	The Modular Multispectral Imaging Array (MMIA) of the ASIM Payload on the International Space Station	
RD#4	ASIM-TER-MMIA-ICD-002	ASIM MMIA Software ICD	3D
RD#5	ASIM-TER-MXGS-ICD-001	ASIM MXGS Software ICD	3C

0.5 Abbreviations

ASDC ASIM Science Data Centre

ASIM	Atmosphere-Space Interaction Monitor
BGO	Bismuth Germanium Oxide
B.USOC	Belgian User Science Operations Center
CCSDS	Consultative Committee on Space Data Systems
CDF	Common Data Format (NASA)
CHU	Camera Head Unit (MMIA)
Col-CC	Columbus Control Centre
CZT	Cadmium-Zinc-Telluride
DAU	Detector Assembly Module
DHPU	Data Handling and Power Unit
DK	Denmark
DMI	Danish Meteorological Institute
DPU	Data Processing Unit
DTU	Technical University of Denmark
ER	Event Report
ERM	Energy Response Matrix
ESA	European Space Agency
ESR	Experiment Science Requirements
ESTEC	European Space Technology Centre
EUMETSAT	European Meteorological Satellite Organisation
FITS	Flexible Image Transport System
FOV	Field of View
FST	Facility Science Team
GLPS	Global Lightning Protection Services
HED	High Energy Detector (MXGS)
HK	House Keeping (data)
HSO	Human Spaceflight and Operations
ISS	International Space Station
LED	Low Energy Detector (MXGS)
LEP	Lightning-induced Electron Precipitation
LIS	Lightning Imaging Sensor
MMIA	Modular Multi-spectral Imaging Array
MTG	Meteosat Third Generation
MXGS	Modular X-ray Gamma-ray Sensor
NASA	National Aeronautic and Space Administration
PMC	Polar Mesospheric Clouds
PMT	Photo-multiplier Tube
PRODEX	PROgramme de Développement d'Expériences scientifiques
REP	Relativistic Electron Precipitation
SAA	South Atlantic Anomaly
SDO	Science Data Observation
TARANIS	Tool for the Analysis of RAdiation from lightNIngs and Sprites
TBC	To be confirmed
TBD	To be determined
TC	Tele command
TEA-IS	Thunderstorm Effects on the Atmosphere-Ionosphere System
TGF	Terrestrial Gamma-ray Flash
TLE	Transient Luminous Events
UB	University of Bergen
UV	University of Valencia

0.6 Activities

0.7 List of TBDs

Number	*Section*	*Description*

0.8 List of TBCs

Number	*Section*	*Description*

Contents

1 Introduction

ASIM consists of two scientific instruments, the MXGS and the MMIA instruments, and the Data Handling and Power Unit (DHPU).

The MXGS is comprised of two detector planes, the High Energy Detectors (HED) and the Low Energy Detectors (LED).

The LED detector plane consists of a 128 x 128 array of CZT pixels divided into 4 Detector Assembly Units (DAUs). In front of the LED there is a coded mask used for geolocation purposes.

The HED detector plane consists of 4 BGO DAUs each with 3 Photo Multiplier Tubes (PMTs).

The MMIA is comprised of 2 Camera Head Units (CHUs) and 3 Photometers (PHOTs).

MXGS LED is enabled only during ISS night.

MXGS HED is always enabled except when passing over the South Atlantic Anomaly (SAA), see Section 2.

MMIA is enabled only during ISS night.

Below is first a short description of each type of scientific observation made by ASIM followed by a detailed description of each data product.

1.1 ASIM Science Data Products

The two instruments on ASIM, the MXGS and the MMIA instruments deliver the following types of observation:

MXGS:

- MXGS TGF Observation

  The main product of the MXGS instrument.

  TGF observations are captured when either an internal MXGS trigger is observed, or a cross-trigger is received from the MMIA instrument. All detector counts (photons) from both LED and HED detectors are captured in a time interval of +/- 1 second around the trigger time.

  Internal triggers are caused by the number of *accepted* detector counts exceeding predefined thresholds in any of 4 time windows (Short Window 1: 300 µs, Short Window 2: 1 ms, Short Window 3: 3 ms, Long Window: 25 ms). The predefined thresholds are automatically adjusted according to the background count rates. The trigger algorithm works independently on LED and HED detector counts.

  The nominal operational mode of MXGS is TGF Search Mode. During periods of high ratemeter values, (counts/s) MXGS enters High Background Mode in which no TGF Observations are captured. This happens at high geomagnetic latitudes when ISS passes North America at high latitudes and south of Australia, and when passing over the South Atlantic Anomaly.
- MXGS Background Observation

  At 1-second intervals, summary data is collected on the status of the instrument: ratemeter values (detector counts per second), accepted count rates, calculated (predicted) count rates, trigger thresholds, pulse-height binned data, and time-binned data.
- MXGS Pulse-Height Spectrum Observation

Spectral data for either the 12 PMTs on the HED instrument or the 4 DAUs on the LED instrument.

For the HED instrument, the observations are made with an integration time of 300 second with 1 second between observations.

For the LED instrument, observations are made with an integration time of 600 seconds with 2200 seconds between observations.

- MXGS Sampled Detector Counts Observation

  At 1-second intervals, samples of detector counts are captured.

  During nominal operations, the 1/100 of the total detector counts are captured.

  During calibration campaigns the sampling rate is set to 1, i.e. all detector counts are captured. In this case, no other MXGS observations are captured.

- MXGS Auroral Capture Observation

  During auroral observation campaigns time- and pulseheight binned histograms are collected whenever a configurable auroral capture threshold is exceeded.

  During auroral observation campaigns, no other MXGS observations are captured.

MMIA:

- MMIA Triggered Observation

  The main product of the MMIA instrument

  Triggered observations are captured when either an internal MMIA trigger is observed, or a cross-trigger is received from the MXGS instrument. Triggered observations contain the (cropped) CHU images, CHU metadata (row and column sums) and PHOT data. Data is captured for as long as triggering persists. Data for one additional CHU frame period are also captured before and after the triggering period. A maximum of 8 consecutive CHU frames can be held in one observation. When triggering persists for more than 8 CHU frames, data is split into multiple observations.

  If the onboard triggering algorithm labels the trigger as ‘Lightning’, the observation is split into Priority 1 (PHOT data and CHU meta data) and Priority 3 (CHU images). Priority 3 data may not get downloaded in case MMIA Priority 3 Buffer runs full.

  In addition, CHU images are not downloaded if cropping is not possible, i.e. the images consist of only background.

- MMIA Timed Observation

  During special observation campaigns, Timed Observations are captured. Timed Observations contain uncropped CHU images, collected at a configurable rate defined by CHU Image Data Collection Rate. PHOT data for the corresponding CHU images may or may not be included, defined by the request of the Timed Observation campaign.

1.1.1 MXGS TGF Observation

The table below contains the name, unit, and short explanation for all fields in the MXGS TGF Observation files. The important fields are

#2: Corrected datetime.

#4, 6 and 8: ISS position

#12, 14 and 16: ISS orientation.

#91: 48-bit detector counts (photons) in the +/- 1 s interval around the trigger. The 48-bit detector counts are decoded in the subsequent fields.

A brief description:

Fits files contain TGF observations for 1 hour interval.

CDF files contain 1 TGF observation per file.

Unless stated otherwise, each field contains 1 value per TGF in the file.

- Fields #1-2: raw and corrected datetime of the triggering photon.
- Field #3: Data processing level.
- Fields #4-17: ISS position and orientation.
- Field #18: Quality flag for number LED counts with multihits in the observation.
- Field #21: Flag for ISS position: ISS position determined by either ISS processed parameters (standard) or via position received from the ASIM DHPU.
- Fields #22-23: Observations identifiers.
- Fields #24-30: Timing information collected by the MXGS instrument.
- Fields #31-46: BGO detector temperatures.
- Fields #47-58: Settings for MXGS triggering algorithm, pulseheights and anticoincidence time.
- Fields #59-68: Triggering information, which window triggered the TGF observation
- Fields #69-76: Settings for MXGS triggering algorithm, triggering window durations.
- Fields #77-84: Settings for MXGS triggering algorithm, triggering thresholds. The triggering thresholds are variable, adapted to the current background levels by the MXGS application SW.
- Field #85: 48-bit code for the triggering count, if internal MXGS trigger, see RD#5 for description.
- Fields #86-87: timing information collected by MXGS instrument in case of cross-trigger from MMIA.
- Fields #88-90: number of counts (photons) in the observation (+/- 1 second around the trigger): total, BGO, CZT.
- Field #91: n_{tot} (field #88) values for each TGF; 48 bit detector counts, see RD#5 for description.
- Field #92: n_{CZT} (field #90) values for each TGF; time-ordering of the CZT counts
- Fields #94-101: n_{CZT} (field #90) values for each TGF; CZT detector counts uncoded.
- Fields #102-103: n_{CZT} (field #90) values for each TGF; physical position of CZT pixels in LED detector.
- Fields# 104, 113, 122, 131, 140: n_{norm}, n_{fast_p}, n_{fast_v}, n_{ovf}, n_{samp} values for each TGF; time-ordering of the BGO counts (normal, fast_peak, fast_valley, overflow, sample).
- Fields# n_{norm}, n_{fast_p}, n_{fast_v}, n_{ovf}, n_{samp} values for each TGF; 105-112, 114-121, 123-130, 141-147: BGO detector counts uncoded.
- Field #148: Data end marker, 0 if observation complete.
- Field #149: Accumulated pre-reset counter.
- Field #153: Energy calibration version.

	MXGS TGF Observation Level 1		
	Name	**Unit**	**Explanation**
1	'raw_datetime'	datetime	Datetime of triggering photon. Defined from DPU Time of Latest TCP + microsecond counter of triggering photon.
2	'corrected_datetime_level1'	datetime	raw_datetime + time correction from ISS. Not available in Level 0
3	'level'	Level	ASDC processing level
4	'latitude'	Deg	ISS latitude
5	'latitude_error'	Deg	Interpolation uncertainty of ISS latitude
6	'longitude'	Deg	ISS longitude
7	'longitude_error'	Deg	Interpolation uncertainty of ISS longitude
8	'altitude'	km	ISS altitude
9	'altitude_error'	km	Interpolation uncertainty of ISS altitude
10	'iss_angle_from_meridian'	Deg	ISS orbit angle deviation from meridian
11	'iss_angle_from_meridian_error'	Deg	Interpolation uncertainty of ISS orbit angle deviation from meridian
12	'iss_yaw'	Deg	ISS yaw angle
13	'iss_yaw_error'	Deg	Interpolation uncertainty of ISS yaw angle
14	'iss_pitch'	Deg	ISS pitch angle
15	'iss_pitch_error'	Deg	Interpolation uncertainty of ISS pitch angle
16	'iss_roll'	Deg	ISS roll angle
17	'iss_roll_error'	Deg	Interpolation uncertainty of ISS roll angle
18	'quality_flag_number_of_multihits'	Int	Number of LED counts with multihits in observation
19	'quality_flag_number_of_accepted_counts'		Not used
20	'quality_flag_tbd'		Not used
21	'dhpu_position_used'	Logical	F: ISS position determined from ISS Processed Parameters T: ISS position taken from DHPU HK NULL: unknown
22	'unique_name_string'	Char	Name identifying the observation
23	'observation_id'	Int	Observation number (this may be repeated)
24	'utc_year'	y	Time of Latest TCP, year
25	'utc_seconds'	s	Time of Latest TCP, second of year
26	'utc_msec'	ms	Time of Latest TCP, ms
27	'tcp_count_dhpu'	Int	TCP Count of DHPU
28	'tcp_count_dpu'	Int	TCP Count of DPU
29	'dpu_count'	'µs'	DPU Counter of Triggering Count, close to µs
30	'dpu_count_prereset'	'µs'	DPU Counter at Latest TCP, close to µs
31	'dau_bgo_1_int_tmon_chan1'	DegC Int	BGO 1 internal temperature 1 ADU value in Level 0
32	'dau_bgo_1_int_tmon_chan2'	DegC Int	BGO 1 internal temperature 2 ADU value in Level 0
33	'dau_bgo_1_int_tmon_chan3'	DegC Int	BGO 1 internal temperature 3 ADU value in Level 0
34	'dau_bgo_1_int_tmon_ref'	Int	BGO 1 temperature monitor ADC reference voltage
35	'dau_bgo_2_int_tmon_chan1'	DegC Int	BGO 2 internal temperature 1 ADU value in Level 0
36	'dau_bgo_2_int_tmon_chan2'	DegC Int	BGO 2 internal temperature 2 ADU value in Level 0
37	'dau_bgo_2_int_tmon_chan3'	DegC Int	BGO 2 internal temperature 3 ADU value in Level 0
38	'dau_bgo_2_int_tmon_ref'	Int	BGO 2 temperature monitor ADC reference voltage
39	'dau_bgo_3_int_tmon_chan1'	DegC Int	BGO 3 internal temperature 1 ADU value in Level 0
40	'dau_bgo_3_int_tmon_chan2'	DegC Int	BGO 3 internal temperature 2 ADU value in Level 0
41	'dau_bgo_3_int_tmon_chan3'	DegC Int	BGO 3 internal temperature 3 ADU value in Level 0
42	'dau_bgo_3_int_tmon_ref'	Int	BGO 3 temperature monitor ADC reference voltage
43	'dau_bgo_4_int_tmon_chan1'	DegC Int	BGO 4 internal temperature 1 ADU value in Level 0
44	'dau_bgo_4_int_tmon_chan2'	DegC Int	BGO 4 internal temperature 2 ADU value in Level 0
45	'dau_bgo_4_int_tmon_chan3'	DegC Int	BGO 4 internal temperature 3 ADU value in Level 0
46	'dau_bgo_4_int_tmon_ref'	Int	BGO 4 temperature monitor ADC reference voltage

	MXGS TGF Observation Level 1		
47	'led_short_win_lr_pulse_height'	Int	Lower pulse height bin limit for accepted LED counts, short windows
48	'led_short_win_upr_pulse_height'	Int	Upper pulse height bin limit for accepted LED counts, short windows
49	'led_long_win_lr_pulse_height'	Int	Lower pulse height bin limit for accepted LED counts, long window
50	'led_long_win_upr_pulse_height'	Int	Upper pulse height bin limit for accepted LED counts, long window
51	'hed_short_win_lr_pulse_height'	Int	Lower pulse height bin limit for accepted HED counts, short windows
52	'hed_short_win_upr_pulse_height'	Int	Upper pulse height bin limit for accepted HED counts, short windows
53	'hed_long_win_lr_pulse_height'	Int	Lower pulse height bin limit for accepted HED counts, long window
54	'hed_long_win_upr_pulse_height'	Int	Upper pulse height bin limit for accepted HED counts, long window
55	'led_short_win_anticoin_time'	µs	Anticoincidence time for accepted counts LED, short windows
56	'led_long_win_anticoin_time'	µs	Anticoincidence time for accepted counts LED, long window
57	'hed_short_win_anticoin_time'	µs 1/36 µs	Anticoincidence time for accepted counts HED, short windows Before SW update After SW update
58	'hed_long_win_anticoin_time'	µs 1/36 µs	Anticoincidence time for accepted counts HED, long windows Before SW update After SW update
59	'led_short_win_flag1'	Logical	T = LED Short Window 1 triggered
60	'led_short_win_flag2'	Logical	T = LED Short Window 2 triggered
61	'led_short_win_flag3'	Logical	T = LED Short Window 3 triggered
62	'led_long_win_flag'	Logical	T = LED Long Window triggered
63	'hed_short_win_flag1'	Logical	T = HED Short Window 1 triggered
64	'hed_short_win_flag2'	Logical	T = HED Short Window 2 triggered
65	'hed_short_win_flag3'	Logical	T = HED Short Window 3 triggered
66	'hed_long_win_flag'	Logical	T = HED Long Window triggered
67	'trig_mmia_enabled'	Logical	T = cross-triggers from MMIA enabled
68	'trig_mmia_recd'	Logical	T = cross-trigger from MMIA received
69	'led_short_win_dur_1'	µs	LED Short Window 1 duration
70	'led_short_win_dur_2'	µs	LED Short Window 2 duration
71	'led_short_win_dur_3'	µs	LED Short Window 3 duration
72	'led_long_win_dur'	µs	LED Long Window duration
73	'hed_short_win_dur_1'	µs	HED Short Window 1 duration
74	'hed_short_win_dur_2'	µs	HED Short Window 2 duration
75	'hed_short_win_dur_3'	µs	HED Short Window 3 duration
76	'hed_long_win_dur'	µs	HED Long Window duration
77	'led_short_win_thresh_1'	Int	LED Short Window 1 trigger thresholds, number of accepted counts
78	'led_short_win_thresh_2'	Int	LED Short Window 2 trigger thresholds, number of accepted counts
79	'led_short_win_thresh_3'	Int	LED Short Window 3 trigger thresholds, number of accepted counts
80	'led_long_win_thresh'	Int	LED Long Window trigger thresholds, number of accepted counts
81	'hed_short_win_thresh_1'	Int	HED Short Window 1 trigger thresholds, number of accepted counts
82	'hed_short_win_thresh_2'	Int	HED Short Window 2 trigger thresholds, number of accepted counts
83	'hed_short_win_thresh_3'	Int	HED Short Window 3 trigger thresholds, number of accepted counts
84	'hed_long_win_thresh'	Int	HED Long Window trigger thresholds, number of accepted counts
85	'mxgs_trig_count'		48 bit code for triggering count (photon), 0 if MMIA cross-trigger
86	'mmia_trig_tcp_count'	Int	MXGS DPU TCP Count at time of MMIA cross-trigger, 0 if internal trigger
87	'mmia_trig_dpu_count'	Int (µs)	MXGS DPU Counter at time of MMIA cross-trigger, 0 if internal trigger

	MXGS TGF Observation Level 1		
88	'num_counts'	Int	Number of counts in +/- 1 second interval
89	'num_counts_bgo'	Int	Number of HED counts in +/- 1 second interval
90	'num_counts_czt'	Int	Number of LED counts in +/- 1 second interval
91	'detector_counts'		48 bit code for detector counts (photons)
92	'czt_order'	Int	Time-ordered index of LED counts
93	'czt_flag'	Int	Not used
94	'czt_asic_address'	Int	Internal pixel address component
95	'czt_asic_channel'	Int	Internal pixel address component
96	'czt_dau_address'	Int	Internal pixel address component
97	'czt_pixel_address'	Int	Internal pixel address component
98	'czt_pulse_height'	Int	Photon energy bin
99	'czt_pulse_height_energy'	keV	Photon energy Not available in level 0
100	'czt_multi_hit'	Int	Multihit of photons included in readout. If not 0, pixel address and pulse height are incorrect.
101	'czt_timestamp'	Int (µs)	DPU Counter of photon
102	'czt_x_location'	mm	x-axis Location of pixel wrt to center of LED detector
103	'czt_y_location'	mm	y-axis Location of pixel wrt to center of LED detector
104	'bgo_normal_order'	Int	Time-ordered index of HED normal counts
105	'bgo_normal_flag'	Int	Always 2
106	'bgo_normal_ovf'	Int	HED normal counts overflow flag, always 0
107	'bgo_normal_address'	Int	HED counts address BGO 1 = 0-2, BGO 2 = 4-6, BGO 3 = 8-10, BGO 4 = 12-14
108	'bgo_normal_fast'	Int	HED normal counts fast flag, always 0
109	'bgo_normal_valley'	Int	HED normal counts valley flag, always 0
110	'bgo_normal_fast_stamp'	1/36 µs	HED count fast time stamp
111	'bgo_normal_pulse_height'	Int	HED count pulse height bin number (0-4095)
112	'bgo_normal_timestamp'	Int (µs)	DPU Counter of photon
113	'bgo_fast_peak_order'	Int	Time-ordered index of HED fast peak counts
114	'bgo_fast_peak_flag'	Int	BGO fast count peak flag, always 2
115	'bgo_fast_peak_ovf'	int	BGO fast count overflow flag, always 0
116	'bgo_fast_peak_address'	Int	HED counts address BGO 1 = 0-2, BGO 2 = 4-6, BGO 3 = 8-10, BGO 4 = 12-14
117	'bgo_fast_peak_fast'	1/36 µs	HED count fast time stamp
118	'bgo_fast_peak_valley'	Int	HED fast count peak valley flag, always 1
119	'bgo_fast_peak_fast_stamp'	1/36 µs	HED count fast time stamp
120	'bgo_fast_peak_pulse_height'	Int	HED count pulse height bin number (0-4095)
121	'bgo_fast_peak_timestamp'	Int (µs)	DPU Counter of photon
122	'bgo_fast_valley_order'	Int	Time-ordered index of HED fast valley counts
123	'bgo_fast_valley_flag'	Int	BGO fast count valley flag, always 2
124	'bgo_fast_valley_ovf'	int	BGO fast count valley overflow flag, always 1
125	'bgo_fast_valley_address'	Int	HED counts address BGO 1 = 0-2, BGO 2 = 4-6, BGO 3 = 8-10, BGO 4 = 12-14
126	'bgo_fast_valley_fast'	Int	HED count valley fast flag, always 0
127	'bgo_fast_valley_valley'	int	BGO fast count valley valley flag, always 1
128	'bgo_fast_valley_fast_stamp'	1/36 µs	HED count fast time stamp
129	'bgo_fast_valley_pulse_height'	Int	HED count pulse height bin number (0-4095)
130	'bgo_fast_valley_timestamp'	Int (µs)	DPU Counter of photon
131	'bgo_overflow_order'	Int	Time-ordered index of HED overflow counts
132	'bgo_overflow_flag'	Int	HED overflow count flag, always 1
133	'bgo_overflow_ovf'	Int	HED overflow count flag, always 1
134	'bgo_overflow_address'	Int	HED overflow count flag, always 1 HED counts address BGO 1 = 0-2, BGO 2 = 4-6, BGO 3 = 8-10, BGO 4 = 12-14
135	'bgo_overflow_fast'	Int	HED overflow count fast flag, always 0
136	'bgo_overflow_valley'	Int	HED overflow count valley flag, always 0
137	'bgo_overflow_fast_stamp'	Int	HED overflow count fast time stamo, always 0
138	'bgo_overflow_overflow_duration'	Int	Number of clock cycles the overflow lasts
139	'bgo_overflow_timestamp'	Int (µs)	DPU Counter of photon
140	'bgo_adc_sample_order'	Int	Time-ordered index of HED ADC Sample counts
141	'bgo_adc_sample_flag'	Int	HED adc count flag, always 1
142	'bgo_adc_sample_ovf'	Int	HED adc count overflow flag, always 1
143	'bgo_adc_sample_address'	Int	HED overflow count flag, always 1 HED counts address BGO 1 = 0-2, BGO 2 = 4-6, BGO 3 = 8-10, BGO 4 = 12-14
144	'bgo_adc_sample_fast'		Not used
145	'bgo_adc_sample_sample_no'	Int	HED adc count sample number

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146	'bgo_adc_sample_adc_value'	Int	HED adc count adc value
147	'bgo_adc_sample_timestamp'	Int (µs)	DPU Counter of photon
148	'data_end_marker'	Int	0 = data complete, 0xffffffff = data incomplete
149	'accumulated_pre_reset_count'	Int (µs)	Accumulated DPU prereset counter at Time of Latest TCP Only available after SW update
150	'detector_count_quality_flag_channel_pulse_height_windows'		Quality flags for accepted counts pulse height bins. 0 = accepted. Please note, slightly outdated. Not available in Level 0
151	'detector_count_quality_flag_energy_pulse_height_windows'		Quality flags for accepted counts pulse height energies. 0 = accepted. Please note, slightly outdated. Not available in Level 0
152	'detector_count_quality_flag_anticoincidence_windows'		Quality flags for accepted counts anti-conincidende. 0 = accepted. Please note, slightly outdated. Not available in Level 0
153	'energy_calibration_version'	Version	Calibration version Not available in Level 0

1.1.2 MXGS Background Observation

The table below contains the name, unit, and short explanation for all fields in the MXGS Background Observation files. The important fields are

#2: Corrected datetime.

#4, 6 and 8: ISS position

#12, 14 and 16: ISS orientation.

#28-29: Mode and Submode of the on-board Application Software: Operational Mode and TGF Search Submode is the standard operational mode. Auroral Submode is specifically applied for auroral observations.

#31-33: Ratemeter values.

#34-48: Accepted counts per second and thresholds for triggering. The thresholds are set by the Application Software according to background levels.

#78-79: Binned energy histogram for each second (10 bins).

#80-81: Time binned histogram for each second (31 bins).

A brief description:

Unless stated otherwise, each field contains 1 value per second.

CDF files contain 1 value per minute for fields #82-142.

- Fields #1-2: raw and corrected datetime of the triggering photon.
- Field #3: Data processing level.
- Fields #4-17: ISS position and orientation.
- Field #18: Quality flag for number LED counts with multihits in the observation.
- Fields #22-27: Timing information collected by the MXGS instrument.
- Fields #28-29: Mode and Submode of Application SW.
- Fields #30-33: Data reduction factor and ratemeter values.
- Fields #34-41: Accepted counts for the 8 TGF search windows.
- Fields #42-49: Triggering thresholds for the 8 TGF search windows.

- Fields #50-77: Diagnostic information.
- Fields #78-79: 10 values per second; Energy Histogram.
- Fields #80-81: 31 values per second; Time histogram.
- Field #83: Observation ID.
- Fields #84-99: BGO detector temperatures.
- Fields #100-111: Energy bin and anti-coincidence settings for accepted counts.
- Fields #112-133: Energy bin limits for energy histogram.
- Fields #134-141: Trigger window durations.
- Field #142: End field marker.

MXGS Background Observation			
	Name	**Unit**	**Explanation**
1	'raw_datetime'	datetime	Datetime of start of observation. Defined from DPU Time of Latest TCP + microsecond counter of triggering photon.
2	'corrected_datetime_level1'	datetime	raw_datetime + time correction from ISS. Not available in Level 0
3	'level'	Level	ASC processing level
4	'latitude'	Deg	ISS latitude
5	'latitude_error'	Deg	Interpolation uncertainty of ISS latitude
6	'longitude'	Deg	ISS longitude
7	'longitude_error'	Deg	Interpolation uncertainty of ISS longitude
8	'altitude'	km	ISS altitude
9	'altitude_error'	km	Interpolation uncertainty of ISS altitude
10	'iss_angle_from_meridian'	Deg	ISS orbit angle deviation from meridian
11	'iss_angle_from_meridian_error'	Deg	Interpolation uncertainty of ISS orbit angle deviation from meridian
12	'iss_yaw'	Deg	ISS yaw angle
13	'iss_yaw_error'	Deg	Interpolation uncertainty of ISS yaw angle
14	'iss_pitch'	Deg	ISS pitch angle
15	'iss_pitch_error'	Deg	Interpolation uncertainty of ISS pitch angle
16	'iss_roll'	Deg	ISS roll angle
17	'iss_roll_error'	Int	Interpolation uncertainty of ISS roll angle
18	'quality_flag_number_of_multihits'	Int	Number of LED counts with multihits in observation
19	'quality_flag_number_of_accepted_counts'		Not used
20	'quality_flag_tbd'		Not used
21	'background_observation'		
22	'utc_year'	y	Time of Latest TCP, year
23	'utc_seconds'	s	Time of Latest TCP, second of year
24	'utc_msec'	ms	Time of Latest TCP, ms
25	'tcp_count_dhpu'	Int	TCP Count of DHPU
26	'tcp_count_dpu'	Int	TCP Count of DPU
27	'dpu_count_prereset'	'µs'	DPU Counter at Latest TCP, close to µs
28	'sw_mode'	Int	0=Boot Mode 1=Configuration Mode 2=Operational Mode
29	'sw_submode'	Int	1=TGF Search SubMode 2=High Background SubMode 3=Auroral Submode
30	'dau_data_reduc_factor'	Int	Reduction factor for detector counts download from detectors
31	'led_count_ratemeter'	Int	Counts/s received from LEDs by DPU
32	'hed_count_ratemeter'	Int	Counts/s received from hEDs by DPU
33	'dau_total_rate'	Int	Total counts/s as reported by detectors
34	'led_accept_count_rate_short'	Int	Accepted counts/s in LED short windows
35	'led_accept_count_rate_long'	Int	Accepted counts/s in LED long window
36	'hed_accept_count_rate_short'	Int	Accepted counts/s in HED short windows
37	'hed_accept_count_rate_long'	Int	Accepted counts/s in HED long windows
38	'led_calc_background_rate_short'	Int	Predicted counts/s in LED short windows
39	'led_calc_background_rate_long'	Int	Predicted counts/s in LED long windows
40	'hed_calc_background_rate_short'	Int	Predicted counts/s in HED short windows
41	'hed_calc_background_rate_long'	Int	Predicted counts/s in HED long windows
42	'led_short_win_thresh_1'	Int	LED Short Window 1 trigger thresholds, number of accepted counts
43	'led_short_win_thresh_2'	Int	LED Short Window 2 trigger thresholds, number of accepted counts
44	'led_short_win_thresh_3'	Int	LED Short Window 3 trigger thresholds, number of accepted counts
45	'led_long_win_thresh'	Int	LED Long Window trigger thresholds, number of accepted counts

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46	'hed_short_win_thresh_1'	Int	HED Short Window 1 trigger thresholds, number of accepted counts
47	'hed_short_win_thresh_2'	Int	HED Short Window 2 trigger thresholds, number of accepted counts
48	'hed_short_win_thresh_3'	Int	HED Short Window 3 trigger thresholds, number of accepted counts
49	'hed_long_win_thresh'	Int	HED Long Window trigger thresholds, number of accepted counts
50	'dau1_dm_if_1_current_offset'		Diagnostic information
51	'dau1_dm_if_2_current_offset'		Diagnostic information
52	'dau1_dm_if_3_current_offset'		Diagnostic information
53	'dau1_dm_if_4_current_offset'		Diagnostic information
54	'dau2_dm_if_1_current_offset'		Diagnostic information
55	'dau2_dm_if_2_current_offset'		Diagnostic information
56	'dau2_dm_if_3_current_offset'		Diagnostic information
57	'dau2_dm_if_4_current_offset'		Diagnostic information
58	'dau3_dm_if_1_current_offset'		Diagnostic information
59	'dau3_dm_if_2_current_offset'		Diagnostic information
60	'dau3_dm_if_3_current_offset'		Diagnostic information
61	'dau3_dm_if_4_current_offset'		Diagnostic information
62	'dau4_dm_if_1_current_offset'		Diagnostic information
63	'dau4_dm_if_2_current_offset'		Diagnostic information
64	'dau4_dm_if_3_current_offset'		Diagnostic information
65	'dau4_dm_if_4_current_offset'		Diagnostic information
66	'dau1_pmt_if_1_current_offset'		Diagnostic information
67	'dau1_pmt_if_2_current_offset'		Diagnostic information
68	'dau1_pmt_if_3_current_offset'		Diagnostic information
69	'dau2_pmt_if_1_current_offset'		Diagnostic information
70	'dau2_pmt_if_2_current_offset'		Diagnostic information
71	'dau2_pmt_if_3_current_offset'		Diagnostic information
72	'dau3_pmt_if_1_current_offset'		Diagnostic information
73	'dau3_pmt_if_2_current_offset'		Diagnostic information
74	'dau3_pmt_if_3_current_offset'		Diagnostic information
75	'dau4_pmt_if_1_current_offset'		Diagnostic information
76	'dau4_pmt_if_2_current_offset'		Diagnostic information
77	'dau4_pmt_if_3_current_offset'		Diagnostic information
78	'led_pulse_height_bin'	Int	LED pulse height binned histogram
79	'hed_pulse_height_bin'	Int	HED pulse height binned histogram
80	'led_time_bin_values'	Int	LED time height binned histogram
81	'hed_time_bin_values'	Int	HED time height binned histogram
82	'level0data'		Not used
83	'observation_id'	Int	Observation number (this may be repeated)
84	'dau_bgo_1_int_tmon_chan1'	DegC Int	BGO 1 internal temperature 1 ADU value in Level 0
85	'dau_bgo_1_int_tmon_chan2'	DegC Int	BGO 1 internal temperature 2 ADU value in Level 0
86	'dau_bgo_1_int_tmon_chan3'	DegC Int	BGO 1 internal temperature 3 ADU value in Level 0
87	'dau_bgo_1_int_tmon_ref'	Int	BGO 1 temperature monitor ADC reference voltage
88	'dau_bgo_2_int_tmon_chan1'	DegC Int	BGO 2 internal temperature 1 ADU value in Level 0
89	'dau_bgo_2_int_tmon_chan2'	DegC Int	BGO 2 internal temperature 2 ADU value in Level 0
90	'dau_bgo_2_int_tmon_chan3'	DegC Int	BGO 2 internal temperature 3 ADU value in Level 0
91	'dau_bgo_2_int_tmon_ref'	Int	BGO 2 temperature monitor ADC reference voltage
92	'dau_bgo_3_int_tmon_chan1'	DegC Int	BGO 3 internal temperature 1 ADU value in Level 0
93	'dau_bgo_3_int_tmon_chan2'	DegC Int	BGO 3 internal temperature 2 ADU value in Level 0
94	'dau_bgo_3_int_tmon_chan3'	DegC Int	BGO 3 internal temperature 3 ADU value in Level 0
95	'dau_bgo_3_int_tmon_ref'	Int	BGO 3 temperature monitor ADC reference voltage
96	'dau_bgo_4_int_tmon_chan1'	DegC Int	BGO 4 internal temperature 1 ADU value in Level 0
97	'dau_bgo_4_int_tmon_chan2'	DegC Int	BGO 4 internal temperature 2 ADU value in Level 0
98	'dau_bgo_4_int_tmon_chan3'	DegC Int	BGO 4 internal temperature 3 ADU value in Level 0
99	'dau_bgo_4_int_tmon_ref'	Int	BGO 4 temperature monitor ADC reference voltage
100	'led_short_win_lr_pulse_height'	Int	Lower pulse height bin limit for accepted LED counts, short windows

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101	'led_short_win_upr_pulse_height'	Int	Upper pulse height bin limit for accepted LED counts, short windows
102	'led_long_win_lr_pulse_height'	Int	Lower pulse height bin limit for accepted LED counts, long window
103	'led_long_win_upr_pulse_height'	Int	Upper pulse height bin limit for accepted LED counts, long window
104	'hed_short_win_lr_pulse_height'	Int	Lower pulse height bin limit for accepted HED counts, short windows
105	'hed_short_win_upr_pulse_height'	Int	Upper pulse height bin limit for accepted HED counts, short windows
106	'hed_long_win_lr_pulse_height'	Int	Lower pulse height bin limit for accepted HED counts, long window
107	'hed_long_win_upr_pulse_height'	Int	Upper pulse height bin limit for accepted HED counts, long window
108	'led_short_win_anticoin_time'	µs	Anticoincidence time for accepted counts LED, short windows
109	'led_long_win_anticoin_time'	µs	Anticoincidence time for accepted counts LED, long window
110	'hed_short_win_anticoin_time'	µs 1/36 µs	Anticoincidence time for accepted counts HED, short windows Before SW update After SW update
111	'hed_long_win_anticoin_time'	µs 1/36 µs	Anticoincidence time for accepted counts HED, long windows Before SW update After SW update
112	'led_bin0_lr_boundary'	keV Int	Lower energy boundary for LED energy bin 0 Level 0: Pulse Height bin number
113	'led_bin1_lr_boundary'	keV Int	Lower energy boundary for LED Pulse Height bin 1 Level 0: Pulse Height bin number
114	'led_bin2_lr_boundary'	keV Int	Lower energy boundary for LED Pulse Height bin 2 Level 0: Pulse Height bin number
115	'led_bin3_lr_boundary'	keV Int	Lower energy boundary for LED Pulse Height bin 3 Level 0: Pulse Height bin number
116	'led_bin4_lr_boundary'	keV Int	Lower energy boundary for LED Pulse Height bin 4 Level 0: Pulse Height bin number
117	'led_bin5_lr_boundary'	keV Int	Lower energy boundary for LED Pulse Height bin 5 Level 0: Pulse Height bin number
118	'led_bin6_lr_boundary'	keV Int	Lower energy boundary for LED Pulse Height bin 6 Level 0: Pulse Height bin number
119	'led_bin7_lr_boundary'	keV Int	Lower energy boundary for LED Pulse Height bin 7 Level 0: Pulse Height bin number
120	'led_bin8_lr_boundary'	keV Int	Lower energy boundary for LED Pulse Height bin 8 Level 0: Pulse Height bin number
121	'led_bin9_lr_boundary'	keV Int	Lower energy boundary for LED Pulse Height bin 9 Level 0: Pulse Height bin number
122	'led_bin9_upr_boundary'	keV Int	Upper energy boundary for LED Pulse Height bin 9 Level 0: Pulse Height bin number
123	'hed_bin0_lr_boundary'	keV Int	Lower energy boundary for HED Pulse Height bin 0 Level 0: Pulse Height bin number
124	'hed_bin1_lr_boundary'	keV Int	Lower energy boundary for HED Pulse Height bin 1 Level 0: Pulse Height bin number
125	'hed_bin2_lr_boundary'	keV Int	Lower energy boundary for HED Pulse Height bin 2 Level 0: Pulse Height bin number
126	'hed_bin3_lr_boundary'	keV Int	Lower energy boundary for HED Pulse Height bin 3 Level 0: bin number
127	'hed_bin4_lr_boundary'	keV Int	Lower energy boundary for HED Pulse Height bin 4 Level 0: Pulse Height bin number
128	'hed_bin5_lr_boundary'	keV Int	Lower energy boundary for HED Pulse Height bin 5 Level 0: Pulse Height bin number
129	'hed_bin6_lr_boundary'	keV Int	Lower energy boundary for HED Pulse Height bin 6 Level 0: Pulse Height bin number
130	'hed_bin7_lr_boundary'	keV Int	Lower energy boundary for HED Pulse Height bin 7 Level 0: Pulse Height bin number
131	'hed_bin8_lr_boundary'	keV Int	Lower energy boundary for HED Pulse Height bin 8 Level 0: Pulse Height bin number
132	'hed_bin9_lr_boundary'	keV Int	Lower energy boundary for HED Pulse Height bin 9 Level 0: Pulse Height bin number
133	'hed_bin9_upr_boundary'	keV Int	Upper energy boundary for HED Pulse Height bin 9 Level 0: Pulse Height bin number
134	'led_short_win_dur_1'	µs	LED Short Window 1 duration
135	'led_short_win_dur_2'	µs	LED Short Window 2 duration
136	'led_short_win_dur_3'	µs	LED Short Window 3 duration
137	'led_long_win_dur'	µs	LED Long Window duration
138	'hed_short_win_dur_1'	µs	HED Short Window 1 duration
139	'hed_short_win_dur_2'	µs	HED Short Window 2 duration
140	'hed_short_win_dur_3'	µs	HED Short Window 3 duration
141	'hed_long_win_dur'	µs	HED Long Window duration
142	'data_end_marker'	Int	0 = data complete, 0xffffffff = data incomplete

1.1.3 MXGS Pulse-Height Spectrum

The table below contains the name, unit, and short explanation for all fields in the MXGS Pulse-Height Spectrum Observation files. The important fields are

#2: Corrected datetime.

#4, 6 and 8: ISS position

#12, 14 and 16: ISS orientation.

#45: Data provided, CZT or BGO.

#46-49: Energy spectra for the 4 CZT detectors for 10-minute observations.

#50-61: Energy spectra for the 12 BGO PMTs for 5-minute observations.

A brief description:

Each file contains spectra collected within 1 hour. Each spectrum is either for CZT or BGO.

Unless stated otherwise, each field contains 1 value per spectrum.

- Fields #1-2: raw and corrected datetime of the triggering photon.
- Field #3: Data processing level.
- Fields #4-17: ISS position and orientation.
- Field #18: Quality flag for number LED counts with multihits in the observation.
- Field #19: Quality flag for number of accepted counts.
- Fields #21-22: Unique name of observation and observation ID.
- Fields #23-27: Timing information collected by the MXGS instrument.
- Fields #28-43: BGO detector temperatures, start of observation.
- Field #44: Integration period.
- Field #45: Data provided, CZT or BGO.
- Fields #46-49: 1024 values per spectrum; CZT Pulse-Height spectra.
- Fields #50-61: 1024 values per spectrum; BGO Pulse-Height spectra.
- Fields #62-65: 1024 values per spectrum; Energy conversion for CZT Pulse-Height bins.
- Fields #78-93: BGO detector temperatures, end of observation.
- Field #94: Energy calibration version.

	MXGS PulseHeight Observation Level 1		
	Name	**Unit**	**Explanation**
1	'raw_datetime'	datetime	Datetime of start of observation. Defined from DPU Time of Latest TCP + microsecond counter of triggering photon.
2	'corrected_datetime_level1'	datetime	raw_datetime + time correction from ISS. Not available in Level 0
3	'level'	Level	
4	'latitude'	Deg	ISS latitude
5	'latitude_error'	Deg	Interpolation uncertainty of ISS latitude
6	'longitude'	Deg	ISS longitude
7	'longitude_error'	Deg	Interpolation uncertainty of ISS longitude
8	'altitude'	km	ISS altitude
9	'altitude_error'	km	Interpolation uncertainty of ISS altitude

	MXGS PulseHeight Observation Level 1		
10	'iss_angle_from_meridian'	Deg	ISS orbit angle deviation from meridian
11	'iss_angle_from_meridian_error'	Deg	Interpolation uncertainty of ISS orbit angle deviation from meridian
12	'iss_yaw'	Deg	ISS yaw angle
13	'iss_yaw_error'	Deg	Interpolation uncertainty of ISS yaw angle
14	'iss_pitch'	Deg	ISS pitch angle
15	'iss_pitch_error'	Deg	Interpolation uncertainty of ISS pitch angle
16	'iss_roll'	Deg	ISS roll angle
17	'iss_roll_error'	Deg	Interpolation uncertainty of ISS roll angle
18	'quality_flag_number_of_multihits'		
19	'quality_flag_number_of_accepted_counts'		
20	'quality_flag_tbd'		
21	'unique_name_string'	Char	Name identifying the observation
22	'observation_id'	Int	Observation number (this may be repeated)
23	'utc_year'	y	Time of Latest TCP, year
24	'utc_msec'	ms	Time of Latest TCP, ms
25	'utc_seconds'	s	Time of Latest TCP, second of year
26	'tcp_count_dhpu'	Int	TCP Count of DHPU
27	'tcp_count_dpu'	Int	TCP Count of DPU
28	'start_dau_bgo_1_int_tmon_chan1'	DegC Int	BGO 1 internal temperature 1 – start of observation ADU value in Level 0
29	'start_dau_bgo_1_int_tmon_chan2'	DegC Int	BGO 1 internal temperature 2 – start of observation ADU value in Level 0
30	'start_dau_bgo_1_int_tmon_chan3'	DegC Int	BGO 1 internal temperature 3 – start of observation ADU value in Level 0
31	'start_dau_bgo_1_int_tmon_ref'	Int	BGO 1 temperature monitor ADC reference voltage
32	'start_dau_bgo_2_int_tmon_chan1'	DegC Int	BGO 2 internal temperature 1 – start of observation ADU value in Level 0
33	'start_dau_bgo_2_int_tmon_chan2'	DegC Int	BGO 2 internal temperature 2 – start of observation ADU value in Level 0
34	'start_dau_bgo_2_int_tmon_chan3'	DegC Int	BGO 2 internal temperature 3 – start of observation ADU value in Level 0
35	'start_dau_bgo_2_int_tmon_ref'	Int	BGO 2 temperature monitor ADC reference voltage
36	'start_dau_bgo_3_int_tmon_chan1'	DegC Int	BGO 3 internal temperature 1 – start of observation ADU value in Level 0
37	'start_dau_bgo_3_int_tmon_chan2'	DegC Int	BGO 3 internal temperature 2 – start of observation ADU value in Level 0
38	'start_dau_bgo_3_int_tmon_chan3'	DegC Int	BGO 3 internal temperature 3 – start of observation ADU value in Level 0
39	'start_dau_bgo_3_int_tmon_ref'	Int	BGO 3 temperature monitor ADC reference voltage
40	'start_dau_bgo_4_int_tmon_chan1'	DegC Int	BGO 4 internal temperature 1 – start of observation ADU value in Level 0
41	'start_dau_bgo_4_int_tmon_chan2'	DegC Int	BGO 4 internal temperature 2 – start of observation ADU value in Level 0
42	'start_dau_bgo_4_int_tmon_chan3'	DegC Int	BGO 4 internal temperature 3 – start of observation ADU value in Level 0
43	'start_dau_bgo_4_int_tmon_ref'	Int	BGO 4 temperature monitor ADC reference voltage
44	'integration_period'	s	Integration period in seconds
45	'data_provided'	Int	0: The 4 CZT DAU spectra in the CZTDAU Pulse-Height Spectra Data field 1: The 12 BGO DAU spectra in the BGO DAU Pulse-Height Spectra Data field
46	'czt_dau_1_spectrum_counts'	Int	Total counts accumulated in 1024 CZT 1 PulseHeight bins
47	'czt_dau_2_spectrum_counts'	Int	Total counts accumulated in 1024 CZT 2 PulseHeight bins
48	'czt_dau_3_spectrum_counts'	Int	Total counts accumulated in 1024 CZT 3 PulseHeight bins
49	'czt_dau_4_spectrum_counts'	Int	Total counts accumulated in 1024 CZT 4 PulseHeight bins
50	'bgo_dau_1_spectrum_counts'	Int	Total counts accumulated in 1024 BGO 1 PMT1 PulseHeight bins BGO PulseHeight bins are downsampled by a factor of 4.
51	'bgo_dau_2_spectrum_counts'	Int	Total counts accumulated in 1024 BGO 1 PMT2 PulseHeight bins BGO PulseHeight bins are downsampled by a factor of 4.
52	'bgo_dau_3_spectrum_counts'	Int	Total counts accumulated in 1024 BGO 1 PMT3 PulseHeight bins BGO PulseHeight bins are downsampled by a factor of 4.
53	'bgo_dau_4_spectrum_counts'	Int	Total counts accumulated in 1024 BGO 2 PMT1 PulseHeight bins BGO PulseHeight bins are downsampled by a factor of 4.
54	'bgo_dau_5_spectrum_counts'	Int	Total counts accumulated in 1024 BGO 2 PMT2 PulseHeight bins BGO PulseHeight bins are downsampled by a factor of 4.
55	'bgo_dau_6_spectrum_counts'	Int	Total counts accumulated in 1024 BGO 2 PMT3 PulseHeight bins BGO PulseHeight bins are downsampled by a factor of 4.

	MXGS PulseHeight Observation Level 1		
56	'bgo_dau_7_spectrum_counts'	Int	Total counts accumulated in 1024 BGO 3 PMT1 PulseHeight bins BGO PulseHeight bins are downsampled by a factor of 4.
57	'bgo_dau_8_spectrum_counts'	Int	Total counts accumulated in 1024 BGO 3 PMT2 PulseHeight bins BGO PulseHeight bins are downsampled by a factor of 4.
58	'bgo_dau_9_spectrum_counts'	Int	Total counts accumulated in 1024 BGO 3 PMT3 PulseHeight bins BGO PulseHeight bins are downsampled by a factor of 4.
59	'bgo_dau_10_spectrum_counts'	Int	Total counts accumulated in 1024 BGO 4 PMT1 PulseHeight bins BGO PulseHeight bins are downsampled by a factor of 4.
60	'bgo_dau_11_spectrum_counts'	Int	Total counts accumulated in 1024 BGO 4 PMT2 PulseHeight bins BGO PulseHeight bins are downsampled by a factor of 4.
61	'bgo_dau_12_spectrum_counts'	Int	Total counts accumulated in 1024 BGO 4 PMT3 PulseHeight bins BGO PulseHeight bins are downsampled by a factor of 4.
62	'czt_dau_1_spectrum_energy'	keV	Photon energy of PulseHeight bin CZT 1 Not available in Level 0
63	'czt_dau_2_spectrum_energy'	keV	Photon energy of PulseHeight bin CZT 2 Not available in Level 0
64	'czt_dau_3_spectrum_energy'	keV	Photon energy of PulseHeight bin CZT 3 Not available in Level 0
65	'czt_dau_4_spectrum_energy'	keV	Photon energy of PulseHeight bin CZT 4 Not available in Level 0
66	'bgo_dau_1_spectrum_energy'		Not used
67	'bgo_dau_2_spectrum_energy'		Not used
68	'bgo_dau_3_spectrum_energy'		Not used
69	'bgo_dau_4_spectrum_energy'		Not used
70	'bgo_dau_5_spectrum_energy'		Not used
71	'bgo_dau_6_spectrum_energy'		Not used
72	'bgo_dau_7_spectrum_energy'		Not used
73	'bgo_dau_8_spectrum_energy'		Not used
74	'bgo_dau_9_spectrum_energy'		Not used
75	'bgo_dau_10_spectrum_energy'		Not used
76	'bgo_dau_11_spectrum_energy'		Not used
77	'bgo_dau_12_spectrum_energy'		Not used
78	'end_dau_bgo_1_int_tmon_chan1'	DegC Int	BGO 1 internal temperature 1 – end of observation ADU value in Level 0
79	'end_dau_bgo_1_int_tmon_chan2'	DegC Int	BGO 1 internal temperature 2 – end of observation ADU value in Level 0
80	'end_dau_bgo_1_int_tmon_chan3'	DegC Int	BGO 1 internal temperature 3 – end of observation ADU value in Level 0
81	'end_dau_bgo_1_int_tmon_ref'	Int	BGO 1 temperature monitor ADC reference voltage
82	'end_dau_bgo_2_int_tmon_chan1'	DegC Int	BGO 2 internal temperature 1 – end of observation ADU value in Level 0
83	'end_dau_bgo_2_int_tmon_chan2'	DegC Int	BGO 2 internal temperature 2 – end of observation ADU value in Level 0
84	'end_dau_bgo_2_int_tmon_chan3'	DegC Int	BGO 2 internal temperature 3 – end of observation ADU value in Level 0
85	'end_dau_bgo_2_int_tmon_ref'	Int	BGO 2 temperature monitor ADC reference voltage
86	'end_dau_bgo_3_int_tmon_chan1'	DegC Int	BGO 3 internal temperature 1 – end of observation ADU value in Level 0
87	'end_dau_bgo_3_int_tmon_chan2'	DegC Int	BGO 3 internal temperature 2 – end of observation ADU value in Level 0
88	'end_dau_bgo_3_int_tmon_chan3'	DegC Int	BGO 3 internal temperature 3 – end of observation ADU value in Level 0
89	'end_dau_bgo_3_int_tmon_ref'	Int	BGO 3 temperature monitor ADC reference voltage
90	'end_dau_bgo_4_int_tmon_chan1'	DegC Int	BGO 4 internal temperature 1 – end of observation ADU value in Level 0
91	'end_dau_bgo_4_int_tmon_chan2'	DegC Int	BGO 4 internal temperature 2 – end of observation ADU value in Level 0
92	'end_dau_bgo_4_int_tmon_chan3'	DegC Int	BGO 4 internal temperature 3 – end of observation ADU value in Level 0
93	'end_dau_bgo_4_int_tmon_ref'	Int	BGO 4 temperature monitor ADC reference voltage
94	'energy_calibration_version'	Version	Energy Calibration Version used Not available in Level 0

1.1.4 MXGS Sampled Detector Counts Observation

The table below contains the name, unit, and short explanation for all fields in the MXGS Sampled Detector Counts Observation files. The important fields are

#2: Corrected datetime.

#4, 6 and 8: ISS position

#12, 14 and 16: ISS orientation.

#60: Sampled detector counts.

A brief description:

Each file contains 1 second values for sampled detector counts within 1 hour.

Unless stated otherwise, each field contains 1 value per second.

- Fields #1-2: raw and corrected datetime of the triggering photon.
- Field #3: Data processing level.
- Fields #4-17: ISS position and orientation.
- Field #18: Quality flag for number LED counts with multihits in the observation.
- Field #23: n_{CZT} (field #59) values for each second; CZT photon energies
- Fields #24-26: n_{norm}, n_{fast_p}, n_{fast_v}, values for each second; BGO photon energies for normal, fast-peak and fast-valley detector counts.
- Fields #27-29: n_{tot} (field #57) values for each second; Quality flags for accepted counts.
- Field #30: Energy calibration version.
- Field #31: Observation ID.
- Fields #32-47: BGO detector temperatures.
- Field #48: Data end marker.
- Fields #49-54: Timing information collected by the MXGS instrument.
- Field #55: Sample ratio.
- Field #56: Data reduction factor.
- Fields #57-59: number of sampled detector counts; total, BGO and CZT.
- Field #60: n_{tot} (field #57) values for each second; sampled detector counts – 48 bit.
- Fields #61-111: n_{czt} (field #59), n_{norm}, n_{fast_p}, n_{fast_v}, n_{ovf} or n_{fsamp} values for each second; sampled detector counts decoded.

	MXGS Sampled Detector Counts Observation Level 1		
	Name	**Unit**	**Explanation**
1	'raw_datetime'	datetime	Datetime of start of observation. Defined from DPU Time of Latest TCP + microsecond counter of triggering photon.
2	'corrected_datetime_level1'	datetime	raw_datetime + time correction from ISS. Not available in Level 0
3	'level'	Level	
4	'latitude'	Deg	ISS latitude
5	'latitude_error'	Deg	Interpolation uncertainty of ISS latitude
6	'longitude'	Deg	ISS longitude
7	'longitude_error'	Deg	Interpolation uncertainty of ISS longitude
8	'altitude'	km	ISS altitude
9	'altitude_error'	km	Interpolation uncertainty of ISS altitude
10	'iss_angle_from_meridian'	Deg	ISS orbit angle deviation from meridian
11	'iss_angle_from_meridian_error'	Deg	Interpolation uncertainty of ISS orbit angle deviation from meridian
12	'iss_yaw'	Deg	ISS yaw angle

	MXGS Sampled Detector Counts Observation Level 1		
13	'iss_yaw_error'	Deg	Interpolation uncertainty of ISS yaw angle
14	'iss_pitch'	Deg	ISS pitch angle
15	'iss_pitch_error'	Deg	Interpolation uncertainty of ISS pitch angle
16	'iss_roll'	Deg	ISS roll angle
17	'iss_roll_error'	Deg	Interpolation uncertainty of ISS roll angle
18	'quality_flag_number_of_multihits'	Int	Number of LED counts with multihits in observation
19	'quality_flag_number_of_accepted_counts'		Not used
20	'quality_flag_tbd'		Not used
21	'mxgs_sampled_detector_counts'		Not used
22	'level0data'		Not used
23	'czt_pulse_height_energy'	keV	Photon energy Not available in level 0
24	'bgo_normal_pulse_height_energy'	keV	Photon energy – BGO normal detector count Not available in level 0
25	'bgo_fast_peak_pulse_height_energy'	keV	Photon energy – BGO peak detector count Not available in level 0
26	'bgo_fast_valley_pulse_height_energy'	keV	Photon energy– BGO valley detector count Not available in level 0
27	'detector_count_quality_flag_channel_pulse_height_windows'		Quality flags for accepted counts pulse height bins. 0 = accepted. Please note, slightly outdated. Not available in Level 0
28	'detector_count_quality_flag_energy_pulse_height_windows'		Quality flags for accepted counts pulse height energies. 0 = accepted. Not available in Level 0
29	'detector_count_quality_flag_anticoincidence_windows'		Quality flags for accepted counts anti-conincidende. 0 = accepted. Please note, slightly outdated. Not available in Level 0
30	'energy_calibration_version'	Version	Calibration version Not available in Level 0
31	'observation_id'	Int	Observation number (this may be repeated)
32	'dau_bgo_1_int_tmon_chan1'	DegC Int	BGO 1 internal temperature 1 ADU value in Level 0 Covers 60 seconds of sampled detector counts
33	'dau_bgo_1_int_tmon_chan2'	DegC Int	BGO 1 internal temperature 2 ADU value in Level 0 Covers 60 seconds of sampled detector counts
34	'dau_bgo_1_int_tmon_chan3'	DegC Int	BGO 1 internal temperature 3 ADU value in Level 0 Covers 60 seconds of sampled detector counts
35	'dau_bgo_1_int_tmon_ref'	Int	BGO 1 temperature monitor ADC reference voltage Covers 60 seconds of sampled detector counts
36	'dau_bgo_2_int_tmon_chan1'	DegC Int	BGO 2 internal temperature 1 ADU value in Level 0 Covers 60 seconds of sampled detector counts
37	'dau_bgo_2_int_tmon_chan2'	DegC Int	BGO 2 internal temperature 2 ADU value in Level 0 Covers 60 seconds of sampled detector counts
38	'dau_bgo_2_int_tmon_chan3'	DegC Int	BGO 2 internal temperature 3 ADU value in Level 0 Covers 60 seconds of sampled detector counts
39	'dau_bgo_2_int_tmon_ref'	Int	BGO 2 temperature monitor ADC reference voltage Covers 60 seconds of sampled detector counts
40	'dau_bgo_3_int_tmon_chan1'	DegC Int	BGO 3 internal temperature 1 ADU value in Level 0 Covers 60 seconds of sampled detector counts
41	'dau_bgo_3_int_tmon_chan2'	DegC Int	BGO 3 internal temperature 2 ADU value in Level 0 Covers 60 seconds of sampled detector counts
42	'dau_bgo_3_int_tmon_chan3'	DegC Int	BGO 3 internal temperature 3 ADU value in Level 0 Covers 60 seconds of sampled detector counts
43	'dau_bgo_3_int_tmon_ref'	Int	BGO 3 temperature monitor ADC reference voltage Covers 60 seconds of sampled detector counts
44	'dau_bgo_4_int_tmon_chan1'	DegC Int	BGO 4 internal temperature 1 ADU value in Level 0 Covers 60 seconds of sampled detector counts
45	'dau_bgo_4_int_tmon_chan2'	DegC	BGO 4 internal temperature 2

	MXGS Sampled Detector Counts Observation Level 1		
		Int	ADU value in Level 0 Covers 60 seconds of sampled detector counts
46	'dau_bgo_4_int_tmon_chan3'	DegC Int	BGO 4 internal temperature 3 ADU value in Level 0 Covers 60 seconds of sampled detector counts
47	'dau_bgo_4_int_tmon_ref'	Int	BGO 4 temperature monitor ADC reference voltage Covers 60 seconds of sampled detector counts
48	'data_end_marker'	Int	0 = data complete, 0xffffffff = data incomplete Covers 60 seconds of sampled detector counts
49	'utc_year'	y	Time of Latest TCP, year
50	'utc_msec'	s	Time of Latest TCP, second of year
51	'utc_seconds'	ms	Time of Latest TCP, ms
52	'tcp_count_dhpu'	Int	TCP Count of DHPU
53	'tcp_count_dpu'	Int	TCP Count of DPU
54	'dpu_count_prereset'	'µs'	DPU Counter at latest TCP, close to µs
55	'dpu_count_sample_ratio'	Int	Sampling ratio (100 for nominal operations)
56	'grey_mode_data_reduc_factor'	Int	Data reduction factor (1 in TGF Search Mode)
57	'num_counts'	Int	Number of sampled detector counts in TCP interval
58	'num_counts_bgo'	Int	Number of HED sampled detector counts in TCP interval
59	'num_counts_czt'	Int	Number of LED sampled detector counts in TCP interval
60	'detector_counts'		48 bit code for detector counts (photons)
61	'czt_order'	Int	Time-ordered index of LED counts
62	'czt_flag'	Int	Not used
63	'czt_asic_address'	Int	Internal pixel address component
64	'czt_asic_channel'	Int	Internal pixel address component
65	'czt_pulse_height'	Int	Photon energy bin
66	'czt_multi_hit'	Int	Multihit of photons included in readout. If not 0, pixel address and pulse height are incorrect.
67	'czt_timestamp'	Int (µs)	DPU Counter of photon
68	'bgo_normal_order'	Int	Time-ordered index of HED normal counts
69	'bgo_normal_flag'	Int	Always 2
70	'bgo_normal_ovf'	Int	HED normal counts overflow flag, always 0
71	'bgo_normal_address'	Int	HED counts address BGO 1 = 0-2, BGO 2 = 4-6, BGO 3 = 8-10, BGO 4 = 12-14
72	'bgo_normal_fast'	Int	HED normal counts fast flag, always 0
73	'bgo_normal_valley'	Int	HED normal counts valley flag, always 0
74	'bgo_normal_fast_stamp'	1/36 µs	HED count fast time stamp
75	'bgo_normal_pulse_height'	Int	HED count pulse height bin number (0-4095)
76	'bgo_normal_timestamp'	Int (µs)	DPU Counter of photon
77	'bgo_fast_peak_order'	Int	Time-ordered index of HED fast peak counts
78	'bgo_fast_peak_flag'	Int	BGO fast count peak flag, always 2
79	'bgo_fast_peak_ovf'	int	BGO fast count overflow flag, always 0
80	'bgo_fast_peak_address'	Int	HED counts address BGO 1 = 0-2, BGO 2 = 4-6, BGO 3 = 8-10, BGO 4 = 12-14
81	'bgo_fast_peak_fast'	1/36 µs	HED count fast time stamp
82	'bgo_fast_peak_valley'	Int	HED fast count peak valley flag, always 1
83	'bgo_fast_peak_fast_stamp'	1/36 µs	HED count fast time stamp
84	'bgo_fast_peak_pulse_height'	Int	HED count pulse height bin number (0-4095)
85	'bgo_fast_peak_timestamp'	Int (µs)	DPU Counter of photon
86	'bgo_fast_valley_order'	Int	Time-ordered index of HED fast valley counts
87	'bgo_fast_valley_flag'	Int	BGO fast count valley flag, always 2
88	'bgo_fast_valley_ovf'	int	BGO fast count valley overflow flag, always 1
89	'bgo_fast_valley_address'	Int	HED counts address BGO 1 = 0-2, BGO 2 = 4-6, BGO 3 = 8-10, BGO 4 = 12-14
90	'bgo_fast_valley_fast'	Int	HED count valley fast flag, always 0
91	'bgo_fast_valley_valley'	int	BGO fast count valley valley flag, always 1
92	'bgo_fast_valley_fast_stamp'	1/36 µs	HED count fast time stamp
93	'bgo_fast_valley_pulse_height'	Int	HED count pulse height bin number (0-4095)
94	'bgo_fast_valley_timestamp'	Int (µs)	DPU Counter of photon
95	'bgo_overflow_order'	Int	Time-ordered index of HED overflow counts
96	'bgo_overflow_flag'	Int	HED overflow count flag, always 1
97	'bgo_overflow_ovf'	Int	HED overflow count flag, always 1
98	'bgo_overflow_address'	Int	HED overflow count flag, always 1 HED counts address BGO 1 = 0-2, BGO 2 = 4-6, BGO 3 = 8-10, BGO 4 = 12-14

	MXGS Sampled Detector Counts Observation Level 1		
99	'bgo_overflow_fast'	Int	HED overflow count fast flag, always 0
100	'bgo_overflow_valley'	Int	HED overflow count valley flag, always 0
101	'bgo_overflow_fast_stamp'	Int	HED overflow count fast time stamo, always 0
102	'bgo_overflow_overflow_duration'	Int	Number of clock cycles the overflow lasts
103	'bgo_overflow_timestamp'	Int (µs)	DPU Counter of photon
104	'bgo_adc_sample_order'	Int	Time-ordered index of HED ADC Sample counts
105	'bgo_adc_sample_flag'	Int	HED adc count flag, always 1
106	'bgo_adc_sample_ovf'	Int	HED adc count overflow flag, always 1
107	'bgo_adc_sample_address'	Int	HED overflow count flag, always 1 HED counts address BGO 1 = 0-2, BGO 2 = 4-6, BGO 3 = 8-10, BGO 4 = 12-14
108	'bgo_adc_sample_fast'		Not used
109	'bgo_adc_sample_sample_no'	Int	HED adc count sample number
110	'bgo_adc_sample_adc_value'	Int	HED adc count adc value
111	'bgo_adc_sample_timestamp'	Int (µs)	DPU Counter of photon

1.1.5 MXGS Auroral Capture Observation

The table below contains the name, unit, and short explanation for all fields in the MXGS Auroral Capture Observation files. The important fields are

#2: Corrected datetime.

#4, 6 and 8: ISS position

#12, 14 and 16: ISS orientation.

#66: Threshold for auroral capture. Only when total number counts per second exceed this value data is captures.

#70-71: CZT and HED binned values, 10 energy bins and 250 time bins per second. Data is stored as a vector: 10 energy bins for t_0, 10 energy bins for t_0 + 4 ms, 10 energy bins for t_0 + 8 ms, etc.

A brief description:

Each file contains auroral observations made within 1 hour.

Unless stated otherwise, each field contains 1 value per auroral observation.

- Fields #1-2: raw and corrected datetime of the triggering photon.
- Field #3: Data processing level.
- Fields #4-17: ISS position and orientation.
- Fields #21-22: Unique name and observation ID.
- Fields #23-27: Timing information collected by the MXGS instrument.
- Fields #28-43: BGO detector temperatures, start of observation.
- Fields #44-63: Energy bin boundaries.
- Fields #64-65: Time bin sizes.
- Field #66: Ratemeter threshold for data capture.
- Field #67: Maximum duration of an observation.
- Fields #68-69: Number of binned values per second.
- Fields #70-71: 2500 x length of observation (seconds) values per second; Histograms.
- Field #72: Data end marker.
- Fields 73-88: BGO detector temperatures, end of observation.

	MXGS Auroral Capture Observation Level 1		
	Name	**Name**	**Name**
1	'raw_datetime'	datetime	Datetime of start of observation. Defined from DPU Time of Latest TCP + microsecond counter of triggering photon.
2	'corrected_datetime_level1'	datetime	raw_datetime + time correction from ISS. Not available in Level 0
3	'level'	Level	
4	'latitude'	Deg	ISS latitude
5	'latitude_error'	Deg	Interpolation uncertainty of ISS latitude
6	'longitude'	Deg	ISS longitude
7	'longitude_error'	Deg	Interpolation uncertainty of ISS longitude
8	'altitude'	km	ISS altitude
9	'altitude_error'	km	Interpolation uncertainty of ISS altitude
10	'iss_angle_from_meridian'	Deg	ISS orbit angle deviation from meridian
11	'iss_angle_from_meridian_error'	Deg	Interpolation uncertainty of ISS orbit angle deviation from meridian
12	'iss_yaw'	Deg	ISS yaw angle
13	'iss_yaw_error'	Deg	Interpolation uncertainty of ISS yaw angle
14	'iss_pitch'	Deg	ISS pitch angle
15	'iss_pitch_error'	Deg	Interpolation uncertainty of ISS pitch angle
16	'iss_roll'	Deg	ISS roll angle
17	'iss_roll_error'	Deg	Interpolation uncertainty of ISS roll angle
18	'quality_flag_number_of_multihits'		Not used
19	'quality_flag_number_of_accepted_counts'		Not used
20	'quality_flag_tbd'		Not used
21	'unique_name_string'	Char	Name identifying the observation
22	'observation_id'	Int	Observation number (this may be repeated)
23	'utc_year'	y	Time of Latest TCP, year
24	'utc_msec'	ms	Time of Latest TCP, ms
25	'utc_seconds'	s	Time of Latest TCP, second of year
26	'tcp_count_dhpu'	Int	TCP Count of DHPU
27	'tcp_count_dpu'	Int	TCP Count of DPU
28	'start_dau_bgo_1_int_tmon_chan1'	DegC Int	BGO 1 internal temperature 1 – start of observation ADU value in Level 0
29	'start_dau_bgo_1_int_tmon_chan2'	DegC Int	BGO 1 internal temperature 2 – start of observation ADU value in Level 0
30	'start_dau_bgo_1_int_tmon_chan3'	DegC Int	BGO 1 internal temperature 3 – start of observation ADU value in Level 0
31	'start_dau_bgo_1_int_tmon_ref'	Int	BGO 1 temperature monitor ADC reference voltage
32	'start_dau_bgo_2_int_tmon_chan1'	DegC Int	BGO 2 internal temperature 1 – start of observation ADU value in Level 0
33	'start_dau_bgo_2_int_tmon_chan2'	DegC Int	BGO 2 internal temperature 2 – start of observation ADU value in Level 0
34	'start_dau_bgo_2_int_tmon_chan3'	DegC Int	BGO 2 internal temperature 3 – start of observation ADU value in Level 0
35	'start_dau_bgo_2_int_tmon_ref'	Int	BGO 2 temperature monitor ADC reference voltage
36	'start_dau_bgo_3_int_tmon_chan1'	DegC Int	BGO 3 internal temperature 1 – start of observation ADU value in Level 0
37	'start_dau_bgo_3_int_tmon_chan2'	DegC Int	BGO 3 internal temperature 2 – start of observation ADU value in Level 0
38	'start_dau_bgo_3_int_tmon_chan3'	DegC Int	BGO 3 internal temperature 3 – start of observation ADU value in Level 0
39	'start_dau_bgo_3_int_tmon_ref'	Int	BGO 3 temperature monitor ADC reference voltage
40	'start_dau_bgo_4_int_tmon_chan1'	DegC Int	BGO 4 internal temperature 1 – start of observation ADU value in Level 0
41	'start_dau_bgo_4_int_tmon_chan2'	DegC Int	BGO 4 internal temperature 2 – start of observation ADU value in Level 0
42	'start_dau_bgo_4_int_tmon_chan3'	DegC Int	BGO 4 internal temperature 3 – start of observation ADU value in Level 0
43	'start_dau_bgo_4_int_tmon_ref'	Int	BGO 4 temperature monitor ADC reference voltage
44	'led_bin0_lr_boundary'	Int	LED PulseHeight lower boundary – bin 0
45	'led_bin1_lr_boundary'	Int	LED PulseHeight lower boundary – bin 1
46	'led_bin2_lr_boundary'	Int	LED PulseHeight lower boundary – bin 2
47	'led_bin3_lr_boundary'	Int	LED PulseHeight lower boundary – bin 3
48	'led_bin4_lr_boundary'	Int	LED PulseHeight lower boundary – bin 4
49	'led_bin5_lr_boundary'	Int	LED PulseHeight lower boundary – bin 5
50	'led_bin6_lr_boundary'	Int	LED PulseHeight lower boundary – bin 6
51	'led_bin7_lr_boundary'	Int	LED PulseHeight lower boundary – bin 7
52	'led_bin8_lr_boundary'	Int	LED PulseHeight lower boundary – bin 8

	MXGS Auroral Capture Observation Level 1		
53	'led_bin9_lr_boundary'	Int	LED PulseHeight lower boundary – bin 9
54	'led_bin9_upr_boundary'	Int	LED PulseHeight lower boundary – bin 9
55	'hed_bin0_lr_boundary'	Int	HED PulseHeight lower boundary – bin 0
56	'hed_bin1_lr_boundary'	Int	HED PulseHeight lower boundary – bin 1
57	'hed_bin2_lr_boundary'	Int	HED PulseHeight lower boundary – bin 2
58	'hed_bin3_lr_boundary'	Int	HED PulseHeight lower boundary – bin 3
59	'hed_bin4_lr_boundary'	Int	HED PulseHeight lower boundary – bin 4
60	'hed_bin5_lr_boundary'	Int	HED PulseHeight lower boundary – bin 5
61	'hed_bin6_lr_boundary'	Int	HED PulseHeight lower boundary – bin 6
62	'hed_bin7_lr_boundary'	Int	HED PulseHeight lower boundary – bin 7
63	'hed_bin8_lr_boundary'	Int	HED PulseHeight lower boundary – bin 8
64	'led_temporal_bin_size'	Int	LED temporal bin size (in units of 80 µs).
65	'hed_temporal_bin_size'	Int	HED temporal bin size (in units of 80 µs).
66	'auroral_capture_thresh'	Counts/s	Total ratemeter value above which histograms are acquired
67	'auroral_capture_dur'	s	Maximum duration (in seconds) of a single Auroral Capture Observation
68	'led_binned_vals'	Int	Number of LED binned values per second
69	'hed_binned_vals'	Int	Number of HED binned values per second
70	'led_bin_vals'	Int	LED histograms
71	'hed_bin_vals'	Int	HED histograms
72	'data_end_marker'	Int	0 = data complete, 0xffffffff = data incomplete Covers 60 seconds of sampled detector counts
73	'end_dau_bgo_1_int_tmon_chan1'	DegC Int	BGO 1 internal temperature 1 – end of observation ADU value in Level 0
74	'end_dau_bgo_1_int_tmon_chan2'	DegC Int	BGO 1 internal temperature 2 – end of observation ADU value in Level 0
75	'end_dau_bgo_1_int_tmon_chan3'	DegC Int	BGO 1 internal temperature 3 – end of observation ADU value in Level 0
76	'end_dau_bgo_1_int_tmon_ref'	Int	BGO 1 temperature monitor ADC reference voltage
77	'end_dau_bgo_2_int_tmon_chan1'	DegC Int	BGO 2 internal temperature 1 – end of observation ADU value in Level 0
78	'end_dau_bgo_2_int_tmon_chan2'	DegC Int	BGO 2 internal temperature 2 – end of observation ADU value in Level 0
79	'end_dau_bgo_2_int_tmon_chan3'	DegC Int	BGO 2 internal temperature 3 – end of observation ADU value in Level 0
80	'end_dau_bgo_2_int_tmon_ref'	Int	BGO 2 temperature monitor ADC reference voltage
81	'end_dau_bgo_3_int_tmon_chan1'	DegC Int	BGO 3 internal temperature 1 – end of observation ADU value in Level 0
82	'end_dau_bgo_3_int_tmon_chan2'	DegC Int	BGO 3 internal temperature 2 – end of observation ADU value in Level 0
83	'end_dau_bgo_3_int_tmon_chan3'	DegC Int	BGO 3 internal temperature 3 – end of observation ADU value in Level 0
84	'end_dau_bgo_3_int_tmon_ref'	Int	BGO 3 temperature monitor ADC reference voltage
85	'end_dau_bgo_4_int_tmon_chan1'	DegC Int	BGO 4 internal temperature 1 – end of observation ADU value in Level 0
86	'end_dau_bgo_4_int_tmon_chan2'	DegC Int	BGO 4 internal temperature 2 – end of observation ADU value in Level 0
87	'end_dau_bgo_4_int_tmon_chan3'	DegC Int	BGO 4 internal temperature 3 – end of observation ADU value in Level 0
88	'end_dau_bgo_4_int_tmon_ref'	Int	BGO 4 temperature monitor ADC reference voltage

1.1.6 MMIA Triggered Observation

The table below contains the name, unit, and short explanation for all fields in the MMIA Triggered Observation files. The important fields are

#75: Corrected datetime, start of observation.

#77, 79 and 81: ISS position, start of observation

#85, 87 and 89: ISS orientation, start of observation.

#3-9: Which data was captured.

#61-67: PHOT data, CHU data and CHU metadata.

#68-73: Chu latitude, longitude and zenith angle for each pixel in cropped image.

#129-132: Cropping information.

A brief description:

Each file contains one observation consisting of a number of frames.

Unless stated otherwise, each field contains one value per frame.

- Fields #1: Frame number.
- Fields #2: Twice the number of phot samples in each frame.
- Fields #3-9: Which data was captured.
- Fields #10-33: ISS position, velocity and orientation, mid frame.
- Field #34: Datetime of first phot sample in frame
- Field #35: Datetime of chu frame.
- Fields #37-45: Identification of triggers.
- Field #46: Category of trigger.
- Fields #47-52: Phots peak and integrated values.
- Fields #53-60: Chu metadata peak and integrated values.
- Fields #61-63: 1 value per 10 µs; Phot photon fluxes.
- Fields #64,66: 2082 (1026 rows, 1056 columns) values per frame; Chu metadata photon fluxes.
- Fields #65,67: (max_row - min_row + 1)*(max_col - min_col + 1) values per frame; Chu photon fluxes.
- Fields #68-73: (max_row - min_row + 1)*(max_col - min_col + 1) values per frame; Chu latitude, longitude and zenith angle for each pixel in cropped image.
- Fields #74-75: Raw and corrected datetime, start of observation.
- Field #76: Processing level.
- Field #77-100: ISS position, velocity and orientation, start of observation.
- Field #101: Flag for use of position from DHPU.
- Field #102: Flag for conversion of photon flux.
- Fields #103-104: Unique name and observation ID.
- Fields #105-111: Timing information collected by the MMIA instrument.
- Field #112: Chu framerate.
- Fields #113-117: Flags for sensors used.
- Field #118: Priority for download.
- Fields #119-121: Trigger categorization method.
- Fields #122-126: Sensor temperatures.
- Fields #127-128: Chu voltages.
- Fields #129-132: Chu cropping information.
- Field #133: Chu data size.
- Field #134: Flag for TLE.
- Field #135: Number of phot samples offset from first phot sample to start of CHU frame.
- Field #136: Accumulated pre-reset counter.

	MMIA Triggered Observation Level 1		
	Name	**Unit**	**Explanation**
1	'frame_number'	Int	Frame number within Observation
2	'number_of_octets_phot'	Int	Twice the number of phot samples corresponding to each frame

	MMIA Triggered Observation Level 1		
3	'PHOT1Data_exists'	Logical	T = data exists
4	'PHOT2Data_exists'	Logical	T = data exists
5	'PHOT3Data_exists'	Logical	T = data exists
6	'CHU1Meta_exists'	Logical	T = data exists
7	'CHU1Data_exists'	Logical	T = data exists
8	'CHU2Meta_exists'	Logical	T = data exists
9	'CHU2Data_exists'	Logical	T = data exists
10	'frame_latitude'	Deg	ISS Latitude – mid frame Not available in Level 0
11	'frame_latitude_error'	Deg	Uncertainty of ISS Latitude Not available in Level 0
12	'frame_longitude'	Deg	ISS Longitude – mid frame Not available in Level 0
13	'frame_longitude_error'	Deg	Uncertainty of ISS Longtitude Not available in Level 0
14	'frame_altitude'	km	ISS Altitude – mid frame Not available in Level 0
15	'frame_altitude_error'	km	Uncertainty of ISS Altitude Not available in Level 0
16	'frame_iss_angle_from_meridian'	Deg	ISS orbit angle deviation from meridian – mid frame Not available in Level 0
17	'frame_iss_angle_from_meridian_error'	Deg	Uncertainty of ISS orbit angle deviation from meridian Not available in Level 0
18	'frame_iss_yaw'	Deg	ISS yaw angle – mid frame Not available in Level 0
19	'frame_iss_yaw_error'	Deg	Uncertainty of ISS yaw angle Not available in Level 0
20	'frame_iss_pitch'	Deg	ISS pitch angle – mid frame Not available in Level 0
21	'frame_iss_pitch_error'	Deg	Uncertainty of ISS pitch angle Not available in Level 0
22	'frame_iss_roll'	Deg	ISS roll angle – mid frame Not available in Level 0 Not available in Level 0
23	'frame_iss_roll_error'	Deg	Uncertainty of ISS roll angle
24	'frame_bad_gnc_ctrs_pos_x'	feet	ISS x position from ISS broadcast data – mid frame Not available in Level 0
25	'frame_bad_gnc_ctrs_pos_y'	feet	ISS y position from ISS broadcast data – mid frame Not available in Level 0
26	'frame_bad_gnc_ctrs_pos_z'	feet	ISS z position from ISS broadcast data – mid frame Not available in Level 0
27	'frame_bad_gnc_ctrs_velocity_x'	feet/s	ISS x velocity from ISS broadcast data – mid frame Not available in Level 0
28	'frame_bad_gnc_ctrs_velocity_y'	feet/s	ISS y velocity from ISS broadcast data – mid frame Not available in Level 0
29	'frame_bad_gnc_ctrs_velocity_z'	feet/s	ISS z velocity from ISS broadcast data – mid frame Not available in Level 0
30	'frame_bad_gnc_lvlh_attitude_q0'		ISS attitude quaternion q0 from ISS broadcast data – mid frame Not available in Level 0
31	'frame_bad_gnc_lvlh_attitude_q1'		ISS attitude quaternion q0 from ISS broadcast data – mid frame Not available in Level 0
32	'frame_bad_gnc_lvlh_attitude_q2'		ISS attitude quaternion q0 from ISS broadcast data – mid frame Not available in Level 0
33	'frame_bad_gnc_lvlh_attitude_q3'		ISS attitude quaternion q0 from ISS broadcast data – mid frame Not available in Level 0
34	'frame_time_phot'	Datetime	Datetime of first phot sampling period corresponding to CHU frame Not available in Level 0
35	'frame_time_chu'	Datetime	Datetime of CHU frame Not available in Level 0
36	'mmia_observation'		
37	'PHOT1DataTrigger'	Logical	T = Trigger in Phot 1 data
38	'PHOT2DataTrigger'	Logical	T = Trigger in Phot 2 data
39	'PHOT3DataTrigger'	Logical	T = Trigger in Phot 3 data
40	'CHU1RowMetaTrigger'	Logical	T = Trigger in CHU 1 Row metadata
41	'CHU1ColumnMetaTrigger'	Logical	T = Trigger in CHU 1 Column metadata
42	'CHU2RowMetaTrigger'	Logical	T = Trigger in CHU 2 Row metadata
43	'CHU2ColumnMetaTrigger'	Logical	T = Trigger in CHU 2 Column metadata
44	'MXGSTrigger'	Logical	T = MXGS cross-trigger

	MMIA Triggered Observation Level 1		
45	'accumulated_flag'		
46	'Frame_Trigger_Category'	Char	Category of trigger
47	'PHOT1_peak_value'	Int	Phot 1 peak value
48	'PHOT1_integral_value'	Int	Phot 1 integrated value
49	'PHOT2_peak_value'	Int	Phot 2 peak value
50	'PHOT2_integral_value'	Int	Phot 2 integrated value
51	'PHOT3_peak_value'	Int	Phot 3 peak value
52	'PHOT3_integral_value'	Int	Phot 3 integrated value
53	'CHU1_row_peak_value'	Int	CHU 1 row sum peak value
54	'CHU1_row_integral_value'	Int	CHU 1 row sum integrated value
55	'CHU2_row_peak_value'	Int	CHU 2 row sum peak value
56	'CHU2_row_integral_value'	Int	CHU 2 row sum integrated value
57	'CHU1_column_peak_value'	Int	CHU 1 column sum peak value
58	'CHU1_column_integral_value'	Int	CHU 1 column sum integrated value
59	'CHU2_column_peak_value'	Int	CHU 2 column sum peak value
60	'CHU2_column_integral_value'	Int	CHU 2 column sum integrated value
61	'PHOT1_photon_flux'	ph/cm^2 Int	Phot 1 photon flux for each 10 µs sampling interval Level 0: Phot 1 number of photons for each 10 µs sampling interval
62	'PHOT2_photon_flux'	ph/cm^2 Int	Phot 2 photon flux for each 10 µ sampling interval Level 0: Phot 2 number of photons for each 10 µs sampling interval
63	'PHOT3_photon_flux'	ph/cm^2 Int	Phot 3 photon flux for each 10 µ sampling interval Level 0: Phot 3 number of photons for each 10 µs sampling interval
64	'CHU1Meta_photon_flux'	ph/cm^2 Int	CHU 1 photon flux from row and column sums Level 0: CHU 1 number of photons row and column sums
65	'CHU1_photon_flux'	ph/cm^2 Int	CHU 1 photon flux from each pixel in cropped image Level 0: CHU 1 number of photons from each pixel in cropped image
66	'CHU2Meta_photon_flux'	ph/cm^2 Int	CHU 2 photon flux from row and column sums Level 0: CHU 1 number of photons row and column sums
67	'CHU2_photon_flux'	ph/cm^2 Int	CHU 2 photon flux from each pixel in cropped image Level 0: CHU 1 number of photons from each pixel in cropped image
68	'CHU1_pixel_latitude'	Deg	CHU 1 geolocation latitude from each pixel in cropped image Not available in Level 0
69	'CHU1_pixel_longitude'	Deg	CHU 1 geolocation longitude from each pixel in cropped image Not available in Level 0
70	'CHU2_pixel_latitude'	Deg	CHU 2 geolocation latitude from each pixel in cropped image Not available in Level 0
71	'CHU2_pixel_longitude'	Deg	CHU 2 geolocation longitude from each pixel in cropped image Not available in Level 0
72	'CHU1_zenith_angle'	Deg	CHU 1 zenith angle from each pixel in cropped image Not available in Level 0
73	'CHU2_zenith_angle'	Deg	CHU 2 zenith angle from each pixel in cropped image Not available in Level 0
74	'raw_datetime'	Datetime	Datetime defined from DPU Time of Latest TCP + microsecond counter of first frame
75	'corrected_datetime_level1'	Datetime	raw_datetime + time correction from ISS. Not available in Level 0
76	'level'	Level	ASDC processing level
77	'latitude'	Deg	ISS Latitude – start of observation
78	'latitude_error'	Deg	Uncertainty of ISS Latitude
79	'longitude'	Deg	ISS Longitude – start of observation
80	'longitude_error'	Deg	Uncertainty of ISS Longtitude
81	'altitude'	km	ISS Altitude – start of observation
82	'altitude_error'	km	Uncertainty of ISS Altitude
83	'iss_angle_from_meridian'	Deg	ISS orbit angle deviation from meridian – start of observation
84	'iss_angle_from_meridian_error'	Deg	Uncertainty of ISS orbit angle deviation from meridian
85	'iss_yaw'	Deg	ISS yaw angle – start of observation
86	'iss_yaw_error'	Deg	Uncertainty of ISS yaw angle
87	'iss_pitch'	Deg	ISS pitch angle – start of observation
88	'iss_pitch_error'	Deg	Uncertainty of ISS pitch angle
89	'iss_roll'	Deg	ISS roll angle – start of observation
90	'iss_roll_error'	Deg	Uncertainty of ISS roll angle
91	'bad_gnc_ctrs_pos_x'	feet	ISS x position from ISS broadcast data – start of observation
92	'bad_gnc_ctrs_pos_y'	feet	ISS y position from ISS broadcast data – start of observation
93	'bad_gnc_ctrs_pos_z'	feet	ISS z position from ISS broadcast data – start of observation
94	'bad_gnc_ctrs_velocity_x'	feet/s	ISS x velocity from ISS broadcast data – start of observation
95	'bad_gnc_ctrs_velocity_y'	feet/s	ISS y velocity from ISS broadcast data – start of observation
96	'bad_gnc_ctrs_velocity_z'	feet/s	ISS z velocity from ISS broadcast data – start of observation

	MMIA Triggered Observation Level 1		
97	'bad_gnc_lvlh_attitude_q0'		ISS attitude quaternion q0 from ISS broadcast data – start of observation
98	'bad_gnc_lvlh_attitude_q1'		ISS attitude quaternion q0 from ISS broadcast data – start of observation
99	'bad_gnc_lvlh_attitude_q2'		ISS attitude quaternion q0 from ISS broadcast data – start of observation
100	'bad_gnc_lvlh_attitude_q3'		ISS attitude quaternion q0 from ISS broadcast data – start of observation
101	'dhpu_position_used'	logical	F: ISS position determined from ISS Processed Parameters T: ISS position taken from DHPU HK NULL: Unknown
102	'photon_flux_converted'	logical	T: photon flux converted Not available in Level 0
103	'unique_name_string'	Char	Name identifying the observation
104	'observation_id'	Int	Observation number (this may be repeated)
105	'utc_year'	y	Time of Latest TCP, year
106	'utc_seconds'	s	Time of Latest TCP, second of year
107	'utc_msec'	ms	Time of Latest TCP, ms
108	'tcp_count_dhpu'	Int	TCP Count of DHPU
109	'tcp_count_internal'	Int	TCP Count of DPU
110	'dpu_counter_current'	'µs'	DPU Counter of Trigger, close to µs
111	'dpu_timer_pre_reset'	'µs'	DPU Counter at Latest TCP, close to µs
112	'frame_rate'	Int	Number of frames per second
113	'sensor_usage_phot1'	Logical	T = PHOT 1 used
114	'sensor_usage_phot2'	Logical	T = PHOT 2 used
115	'sensor_usage_phot3'	Logical	T = CHU 1 used
116	'sensor_usage_chu1'	Logical	T = CHU 2 used
117	'sensor_usage_chu2'	Logical	T = CHU 3 used
118	'priority'	Int	Priority for data download
119	'sensor_A_tle_categorization'		
120	'sensor_B_tle_categorization'		
121	'categorization_method'		
122	'phot1_temp'	DegC Int	PHOT 1 temperature Level 0: ADU units
123	'phot2_temp'	DegC Int	PHOT 2 temperature Level 0: ADU units
124	'phot3_temp'	DegC Int	PHOT 3 temperature Level 0: ADU units
125	'chu1_temp'	DegC Int	CHU 1 temperature Level 0: ADU units
126	'chu2_temp'	DegC Int	CHU 2 temperature Level 0: ADU units
127	'chu1_20v_45v'	V Int	CHU 1 voltage Level 0: ADU units
128	'chu2_20v_45v'	V Int	CHU 2 voltage Level 0: ADU units
129	'chu_minimum_row'	Int	CHU cropping parameter minimum row
130	'chu_maximum_row'	Int	CHU cropping parameter maximum row
131	'chu_minimum_column'	Int	CHU cropping parameter minimum column
132	'chu_maximum_column'	Int	CHU cropping parameter maximum column
133	'chu_pixel_data_size'	Int	Approximately 1.5 times the number of pixels in cropped CHU images
134	'is_tle'	Logical	T = Transient Luminous Event
135	'phot_sample_tcp_offset'	Int	Offset in PHOT sampling periods (10 µs) between start of PHOT samples and first CHU frame Only available after SW update
136	'accumulated_pre_reset_count'	Int (µs)	Accumulated DPU prereset counter at Time of Latest TCP Only available after SW update

1.1.7 MMIA Timed Observation

The table below contains the name, unit, and short explanation for all fields in the MMIA Timed Observation files. The important fields are

#50: Corrected datetime, start of observation.

#52, 54 and 56: ISS position, start of observation

#60, 62 and 64: ISS orientation, start of observation.

#3-9: Which data was captured.

#37-42: PHOT data, CHU data and CHU metadata.

A brief description:

Each file contain data from 1 frame.

Unless stated otherwise, each field contains 1 value.

- Fields #1: Frame number.
- Fields #2: Twice the number of phot samples in each frame.
- Fields #3-9: Which data was captured.
- Fields #10-33: ISS position, velocity and orientation, mid frame.
- Field #34: Datetime of chu frame.
- Fields #36-38: 1 value per 10 µs; Phot photon fluxes.
- Fields #39,41: 2082 (1026 rows, 1056 columns) values: Chu metadata photon fluxes.
- Fields #40,42: 1083456 (1026 x 1056) values: Chu metadata photon fluxes.
- Fields #43-48: 1083456 (1026 x 1056) values: Chu latitude, longitude and zenith angle for each pixel.
- Fields #49-50: Raw and corrected datetime, start of observation.
- Field #51: Processing level.
- Field #52-75: ISS position, velocity and orientation, start of observation.
- Field #76: Flag for use of position from DHPU,
- Field #77: Flag for conversion of photon flux.
- Fields #78-79: Unique name and observation ID.
- Fields #80-86: Timing information collected by the MMIA instrument.
- Field #87: Chu framerate.
- Fields #88-92: Flags for sensors used.
- Field #93: Duration of observation.
- Fields #94: Images per second.
- Fields #95-99: Sensor temperatures.
- Fields #100-101: Chu voltages.
- Fields #102-106: Compression information.
- Field #107: Accumulated pre-reset counter.

	MMIA Timed Observation Level 1		
	Name	**Unit**	**Explanation**
1	'frame_number'	Int	Frame number within Observation
2	'number_of_octets_phot'	Int	Twice the number of phot samples corresponding to each frame
3	'PHOT1Data_exists'	Logical	T = data exists
4	'PHOT2Data_exists'	Logical	T = data exists
5	'PHOT3Data_exists'	Logical	T = data exists
6	'CHU1Meta_exists'	Logical	T = data exists
7	'CHU1Data_exists'	Logical	T = data exists
8	'CHU2Meta_exists'	Logical	T = data exists
9	'CHU2Data_exists'	Logical	T = data exists
10	'frame_latitude'	Deg	ISS Latitude – mid frame Not available in Level 0
11	'frame_latitude_error'	Deg	Uncertainty of ISS Latitude Not available in Level 0
12	'frame_longitude'	Deg	ISS Longitude – mid frame Not available in Level 0
13	'frame_longitude_error'	Deg	Uncertainty of ISS Longtitude Not available in Level 0
14	'frame_altitude'	km	ISS Altitude – mid frame

	MMIA Timed Observation Level 1		
			Not available in Level 0
15	'frame_altitude_error'	km	Uncertainty of ISS Altitude Not available in Level 0
16	'frame_iss_angle_from_meridian'	Deg	ISS orbit angle deviation from meridian – mid frame Not available in Level 0
17	'frame_iss_angle_from_meridian_error'	Deg	Uncertainty of ISS orbit angle deviation from meridian Not available in Level 0
18	'frame_iss_yaw'	Deg	ISS yaw angle – mid frame Not available in Level 0
19	'frame_iss_yaw_error'	Deg	Uncertainty of ISS yaw angle Not available in Level 0
20	'frame_iss_pitch'	Deg	ISS pitch angle – mid frame Not available in Level 0
21	'frame_iss_pitch_error'	Deg	Uncertainty of ISS pitch angle Not available in Level 0
22	'frame_iss_roll'	Deg	ISS roll angle – mid frame Not available in Level 0 Not available in Level 0
23	'frame_iss_roll_error'	Deg	Uncertainty of ISS roll angle
24	'frame_bad_gnc_ctrs_pos_x'	feet	ISS x position from ISS broadcast data – mid frame Not available in Level 0
25	'frame_bad_gnc_ctrs_pos_y'	feet	ISS y position from ISS broadcast data – mid frame Not available in Level 0
26	'frame_bad_gnc_ctrs_pos_z'	feet	ISS z position from ISS broadcast data – mid frame Not available in Level 0
27	'frame_bad_gnc_ctrs_velocity_x'	feet/s	ISS x velocity from ISS broadcast data – mid frame Not available in Level 0
28	'frame_bad_gnc_ctrs_velocity_y'	feet/s	ISS y velocity from ISS broadcast data – mid frame Not available in Level 0
29	'frame_bad_gnc_ctrs_velocity_z'	feet/s	ISS z velocity from ISS broadcast data – mid frame Not available in Level 0
30	'frame_bad_gnc_lvlh_attitude_q0'		ISS attitude quaternion q0 from ISS broadcast data – mid frame Not available in Level 0
31	'frame_bad_gnc_lvlh_attitude_q1'		ISS attitude quaternion q0 from ISS broadcast data – mid frame Not available in Level 0
32	'frame_bad_gnc_lvlh_attitude_q2'		ISS attitude quaternion q0 from ISS broadcast data – mid frame Not available in Level 0
33	'frame_bad_gnc_lvlh_attitude_q3'		ISS attitude quaternion q0 from ISS broadcast data – mid frame Not available in Level 0
34	'frame_time'	Datetime	Datetime of CHU frame Not available in Level 0
35	'mmia_observation'		
36	'PHOT1_photon_flux'	ph/cm^2 Int	Phot 1 photon flux for each 10 µs sampling interval Level 0: Phot 1 number of photons for each 10 µs sampling interval
37	'PHOT2_photon_flux'	ph/cm^2 Int	Phot 2 photon flux for each 10 µ sampling interval Level 0: Phot 2 number of photons for each 10 µs sampling interval
38	'PHOT3_photon_flux'	ph/cm^2 Int	Phot 3 photon flux for each 10 µ sampling interval Level 0: Phot 3 number of photons for each 10 µs sampling interval
39	'CHU1Meta_photon_flux'	ph/cm^2 Int	CHU 1 photon flux from row and column sums Level 0: CHU 1 number of photons row and column sums
40	'CHU1_photon_flux'	ph/cm^2 Int	CHU 1 photon flux from each pixel in cropped image Level 0: CHU 1 number of photons from each pixel in cropped image
41	'CHU2Meta_photon_flux'	ph/cm^2 Int	CHU 2 photon flux from row and column sums Level 0: CHU 1 number of photons row and column sums
42	'CHU2_photon_flux'	ph/cm^2 Int	CHU 2 photon flux from each pixel in cropped image Level 0: CHU 1 number of photons from each pixel in cropped image
43	'CHU1_pixel_latitude'	Deg	CHU 1 geolocation latitude from each pixel in cropped image Not available in Level 0
44	'CHU1_pixel_longitude'	Deg	CHU 1 geolocation longitude from each pixel in cropped image Not available in Level 0
45	'CHU2_pixel_latitude'	Deg	CHU 2 geolocation latitude from each pixel in cropped image Not available in Level 0
46	'CHU2_pixel_longitude'	Deg	CHU 2 geolocation longitude from each pixel in cropped image Not available in Level 0
47	'CHU1_zenith_angle'	Deg	CHU 1 zenith angle from each pixel in cropped image Not available in Level 0
48	'CHU2_zenith_angle'	Deg	CHU 2 zenith angle from each pixel in cropped image Not available in Level 0

	MMIA Timed Observation Level 1		
49	'raw_datetime'	Datetime	Datetime defined from DPU Time of Latest TCP + microsecond counter of first frame
50	'corrected_datetime_level1'	Datetime	raw_datetime + time correction from ISS. Not available in Level 0
51	'level'	Level	ASDC processing level
52	'latitude'	Deg	ISS Latitude – start of observation
53	'latitude_error'	Deg	Uncertainty of ISS Latitude
54	'longitude'	Deg	ISS Longitude – start of observation
55	'longitude_error'	Deg	Uncertainty of ISS Longtitude
56	'altitude'	km	ISS Altitude – start of observation
57	'altitude_error'	km	Uncertainty of ISS Altitude
58	'iss_angle_from_meridian'	Deg	ISS orbit angle deviation from meridian – start of observation
59	'iss_angle_from_meridian_error'	Deg	Uncertainty of ISS orbit angle deviation from meridian
60	'iss_yaw'	Deg	ISS yaw angle – start of observation
61	'iss_yaw_error'	Deg	Uncertainty of ISS yaw angle
62	'iss_pitch'	Deg	ISS pitch angle – start of observation
63	'iss_pitch_error'	Deg	Uncertainty of ISS pitch angle
64	'iss_roll'	Deg	ISS roll angle – start of observation
65	'iss_roll_error'	Deg	Uncertainty of ISS roll angle
66	'bad_gnc_ctrs_pos_x'	feet	ISS x position from ISS broadcast data – start of observation
67	'bad_gnc_ctrs_pos_y'	feet	ISS y position from ISS broadcast data – start of observation
68	'bad_gnc_ctrs_pos_z'	feet	ISS z position from ISS broadcast data – start of observation
69	'bad_gnc_ctrs_velocity_x'	feet/s	ISS x velocity from ISS broadcast data – start of observation
70	'bad_gnc_ctrs_velocity_y'	feet/s	ISS y velocity from ISS broadcast data – start of observation
71	'bad_gnc_ctrs_velocity_z'	feet/s	ISS z velocity from ISS broadcast data – start of observation
72	'bad_gnc_lvlh_attitude_q0'		ISS attitude quaternion q0 from ISS broadcast data – start of observation
73	'bad_gnc_lvlh_attitude_q1'		ISS attitude quaternion q0 from ISS broadcast data – start of observation
74	'bad_gnc_lvlh_attitude_q2'		ISS attitude quaternion q0 from ISS broadcast data – start of observation
75	'bad_gnc_lvlh_attitude_q3'		ISS attitude quaternion q0 from ISS broadcast data – start of observation
76	'dhpu_position_used'	logical	F: ISS position determined from ISS Processed Parameters T: ISS position taken from DHPU HK NULL: Unknown
77	'photon_flux_converted'	logical	T: photon flux converted Not available in Level 0
78	'unique_name_string'	Char	Name identifying the observation
79	'observation_id'	Int	Observation number (this may be repeated)
80	'utc_year'	y	Time of Latest TCP, year
81	'utc_seconds'	s	Time of Latest TCP, second of year
82	'utc_msec'	ms	Time of Latest TCP, ms
83	'tcp_count_dhpu'	Int	TCP Count of DHPU
84	'tcp_count_internal'	Int	TCP Count of DPU
85	'dpu_counter_current'	'µs'	DPU Counter of Trigger, close to µs
86	'dpu_timer_pre_reset'	'µs'	DPU Counter at Latest TCP, close to µs
87	'frame_rate'	Int	Number of frames per second
88	'sensor_usage_phot1'	Logical	T = PHOT 1 used
89	'sensor_usage_phot2'	Logical	T = PHOT 2 used
90	'sensor_usage_phot3'	Logical	T = CHU 1 used
91	'sensor_usage_chu1'	Logical	T = CHU 2 used
92	'sensor_usage_chu2'	Logical	T = CHU 3 used
93	'observation_duration'	s	Duration of observation in seconds
94	'chu_collection_rate'	Int	Images per second
95	'phot1_temp'	DegC Int	PHOT 1 temperature Level 0: ADU units
96	'phot2_temp'	DegC Int	PHOT 2 temperature Level 0: ADU units
97	'phot3_temp'	DegC Int	PHOT 3 temperature Level 0: ADU units
98	'chu1_temp'	DegC Int	CHU 1 temperature Level 0: ADU units
99	'chu2_temp'	DegC Int	CHU 2 temperature Level 0: ADU units
100	'chu1_20v_45v'	V Int	CHU 1 voltage Level 0: ADU units
101	'chu2_20v_45v'	V Int	CHU 2 voltage Level 0: ADU units
102	'compression_enabled'	Logical	

	MMIA Timed Observation Level 1		
103	'wavelet_transformation_level'	Int	Compression information
104	'chu_image_slice_max_target_size'	Int	Compression information
105	'chu_image_slice_min_target_size'	Int	Compression information
106	'chu_image_slice_max_bitplanes'	Int	Compression information
107	'accumulated_pre_reset_count'	Int (µs)	Accumulated DPU prereset counter at Time of Latest TCP Only available after SW update

2 Operational Changes after Commissioning Phase

2.1 Application Software Update

On March 25, 2019, the onboard Application Software on both MXGS and MMIA were upgraded to make corrections for issues discovered during the Operational Phase and to enhance the performance of the instruments.

The major points were:

- A running accumulative microsecond counter is included in the Instrument Summary HK and triggered observations on both instruments. Up to the ASW upgrade, only prereset counters (the microsecond count between consecutive TCPs) were included.

  The accumulated counter is reset at instruments reboots.

  (Note: the microsecond counter does not correspond to actual microseconds; it is off by approximate 4 µs per second varying with temperature.)
- Corrections to the trigger algorithms for both instrument.
- MMIA: the number of photometer samples belonging to the previous TCP cycle (out of a block of 16 samples) is included in MMIA triggered data allowing for more accurate timing.
- MXGS: the maximum throughput of photon counts on the Data Processing Unit is increased.

  The threshold for going from TGF Search Mode to High Background Mode was subsequently increases from 19,000 counts/s to 30,000 counts/s.
- MXGS: full 36 MHz time resolution on HED is used for anti-coincidence tests for accepting photon counts in the trigger algorithm.

  After upgrade, anti-coincidence time was lowered from 1 µs to 0.5 µs (it remains at 1 µs for LED).
- Spurious triggers after going from High Background Mode to TGF Search Mode is suppressed.

After the ASW upgraded, trigger thresholds were adjusted to account for the effect of the changes on the triggering algorithms.

2.2 South Atlantic Anomaly

The ASIM MXGS High Energy Detectors would suffer from exposure to the strong radiation over the South Atlantic Anomaly. For this reason, the HED High Voltage is switched off in a rectangular (lat/lon) box surrounding the SAA.

The SAA box was at the beginning of mission set conservatively to latitude = 5ºS - 60ºS and longitude = 80ºE - 40ºW.

6 months into the mission the eastern border was moved from 40ºW to 0º in steps of 10º.

Early 2020 ASIM experienced problems with gaps in positioning data received from ISS. For instrument safety reasons, the western border was moved from 80ºW to 86ºW on Jan 30.

Stale positioning data problem was solved, but has re-occurred on several occasions. The SAA western boundary has been moved between 80ºW and 86ºW accordingly.

In Table 1 and Figure 1, the changes of the SAA are shown.

Table 1: SAA box changes

Effectice from date	Latitude	Longitude
Beginning of mission	-5 to -60	-80 to 40
2018-12-06 11:50	-5 to -60	-80 to 30
2018-12-19 09:49	-5 to -60	-80 to 20
2019-01-04 09:55	-5 to -60	-80 to 10
2019-01-31 10:40	-5 to -60	-80 to 0
2020-01-30 09:45	-5 to -60	-86 to 0
2020-02-13 09:30	-5 to -60	-80 to 0
2020-02-18 10:46	-5 to -60	-86 to 0
2020-04-03 09:00	-5 to -60	-80 t0 0
2020-04-17 11:00	-5 to -60	-86 to 0
2020-04-26 07:59	-5 to -60	-80 to 0

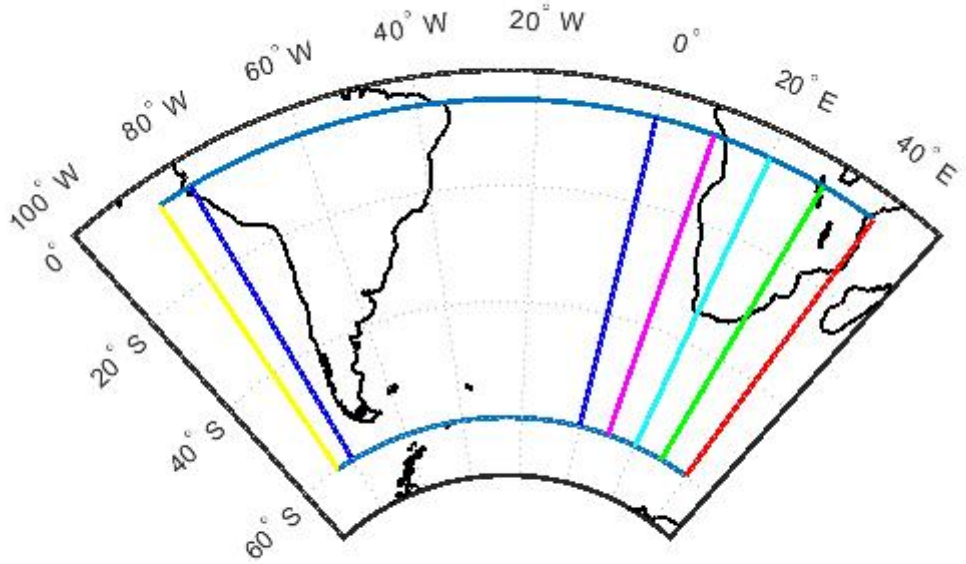

Figure 1: SAA Box

2.3 High Energy Detector FAST Trigger Threshold

The High Energy Detector photon counts are categorized as Normal, FAST, Valley (and overflow). The FAST photon counts, photons detected within a short time period after a Normal photon, have higher PulseHeight thresholds for being passed from the detectors to the Data Processing Unit due to 'ringing' of the HEDs' Photo Multiplier Tubes.

At commissioning this threshold was set conservatively at a PulseHeight of 200 for HED detectors BGO 1, 2 and 4, while a lower noise level of BGO 3 allowed for a FAST threshold of 64.

On 09:07 April 1, 2020, the FAST thresholds were set to 140 (BGO 1), 120 (BGO 2), 64 (BGO 3), and 140 (BGO 4).

This change allowed considerably more FAST photons to be passed to the Data Processing Unit, particularly during TGFs, without increasing the number of false TGF triggers significantly.

For conversion of FAST PulseHeights to physical energy units, please see https://asdc.space.dtu.dk/known_inssues/ item 3, or contact University of Bergen.