

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 303
Week 28
14.07.08
Routine Phase

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1 General

The Flight Control Team at MOC has compiled this report with some input provided by the Flight Dynamics Team, ISOC and ISDC.

It addresses the activities from 05.07.08 until 11.07.08 (both dates inclusive) and covers the revolutions 700 and 701.

2 Summary of Activities

The operations were performed according to the planning inputs from ISOC combined with some manual commanding by MOC.

The targets of these revolutions consisted of two raster dithers of XMM-LSS (RA 02:18:00.00, DEC -07:00:00.0), and two raster dithers of the Galactic Plane Region 3 (RA 13:09:32.98, DEC -62:47:56.4).

Note: Some further information concerning the activities is provided in the Appendix.

3 Satellite Status

3.1 Platform

The performance of the platform was good. No new unexpected behaviour / malfunction was identified.

3.1.1 AOCS

The AOCS operations were performed from the timeline during this period.

One slew was missed from TL, during the observation period, due to a problem on the links with REDU station.

The fuel consumption over the period between 05/07/2008 and 11/07/2008 was 0.1358 Kg. The remaining propellant is in the order of 139.7218 Kg.

Note: Some more information concerning the AOCS operations and the fuel budget is provided in the Appendix.

3.1.2 Power

The EPS is working nominally; available power from the arrays is of the order of 2100W.

From the EPS point of view the eclipse passage was entirely nominal.

3.1.3 Thermal

The thermal control of the satellite is working well. The temperatures are currently all within the specified operational limits.

3.1.4 OBDH

The OBDH subsystem is working flawlessly. No on-board communications problem has been identified.

The PST was over-subscribed by 3 packets, which were allocated to SPI during the Instrument window for the entire reporting period.

3.1.5 RFS

The RF subsystem is working properly. The link margin is sufficient to ensure proper TM reception and execution of commands with the ranging channel enabled.

3.2 Payload

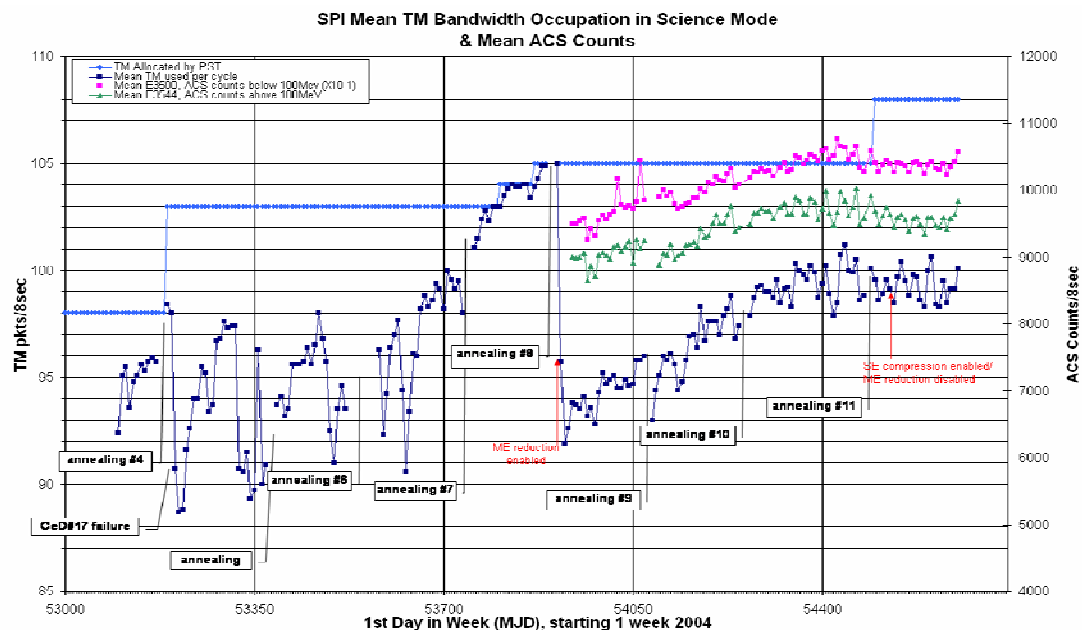
3.2.1 SPI

Following the 11th annealing, which ended on 30th January, the overall status of the gamma-ray spectrometer is nominal, except for the Ge detector #12 which, although its energy resolution improved since the previous annealing, is still showing a slightly degraded energy resolution compared to the other detectors and is therefore operating at a lower HV setting of 3.5kV (instead of 4kV). Detector #2 is failed since 06/12/2003 and detector #17 since 17/07/2004.

The Stirling compressors are working nominally, maintaining the Germanium detectors at 80 +/-1K.

During science operations, the instrument was kept in photon-by-photon mode with spectra TM enabled. The assigned TM bandwidth in the science observation windows was 108 packets/cycle and the average telemetry occupation in the science window was 100.1 packets/cycle.

The following plot shows the evolution of the assigned and the average occupation of the SPI TM bandwidth along with the mean ACS count rate evolution (since July 2006). As can be seen, there is a strong correlation between the evolution of the background as measured by the ACS and the overall TM bandwidth usage.



Note: Some more information concerning the SPI operations is provided in the Appendix.

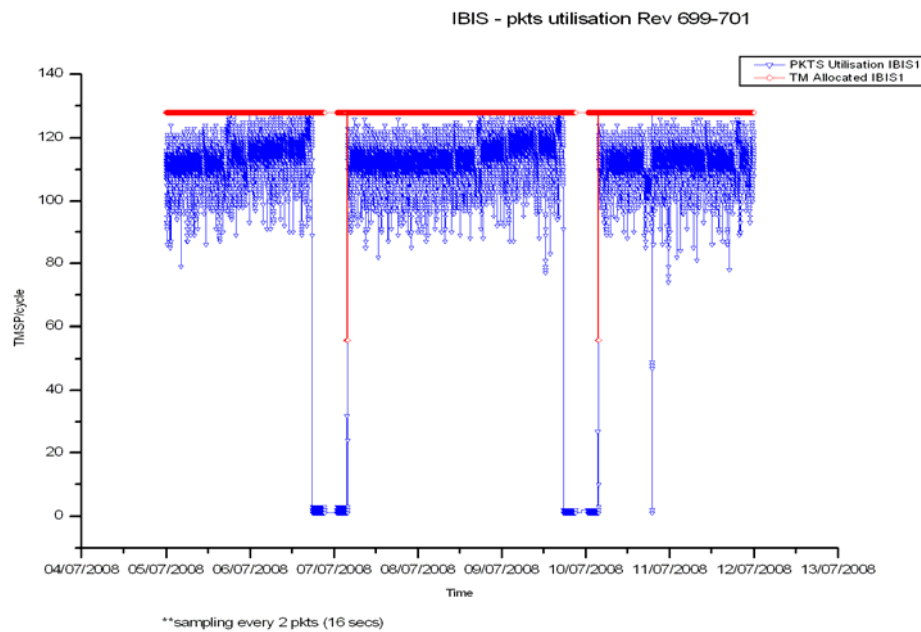
3.2.2 IBIS

The overall status of the unit is nominal.

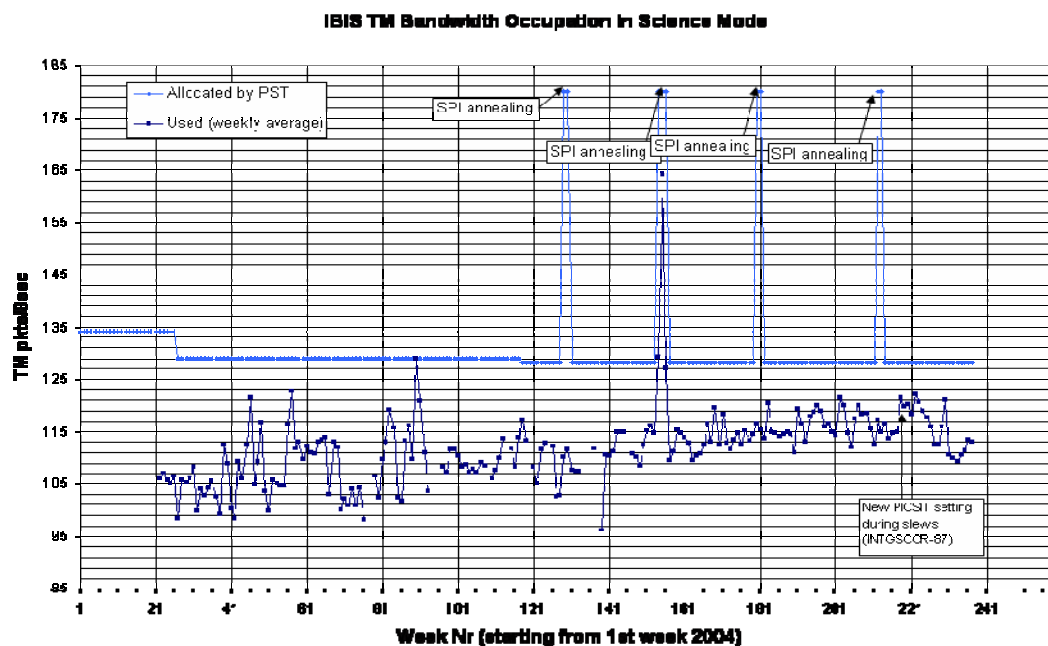
During the reporting period, the TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 128 packets/cycle.
- IBIS mean bandwidth utilisation in science mode: 113.04 packets/cycle (down 0.34 on last week)
- Percentage of TM cycles in which full bandwidth was used: 0.49%

The plot below shows the IBIS TM utilisation during the observation period.



A plot of the IBIS weekly bandwidth utilisation since 2004 is shown below:



Note: Some more information concerning the IBIS operations is provided in the Appendix.

3.2.3 JEM-X

The status of both JEM-X units is nominal.

JEM-X operations were performed by the automatic Timeline.

JEM-X1 was operated in Data Taking mode with a TM allocation of 8 packets/cycle. JEM-X2 was dormant (DPE OFF) with no TM slots allocated.

Note: Some more information concerning the JEM-X operations is provided in the Appendix.

3.2.4 OMC

The status of OMC is nominal.

OMC operations were performed by the automatic Timeline. OMC was operated in Science Normal mode during science observations, with a TM allocation of 5 packets/cycle.

During this reporting period, 138 of the 139 planned science pointings were executed nominally, one pointing was lost.

Note: Some more information concerning the OMC operations is provided in the Appendix.

3.2.5 IREM

The overall status of the unit is nominal.

Solar Activity

The observation period was characterised by low solar activity. The Sun was blank all week. The risk of solar flares was very low.



Reference: www.spaceweather.com

Note: Some more information concerning the IREM operations is provided in the Appendix Section 8.3.6.

4 Ground Facilities

The Operational ground facilities performance was good this week. A pointing was lost due to a TM drop, but that was all. The overall performance was well over the 95% requirement.

4.1 Mission Operations Centre

The performance of the MOC was excellent this week. No problems were reported..

4.2 Ground Stations & Network

The performance of the ground stations and Network was very good this week. A pointing was lost when the TM from Redu dropped, due to a hit on the line.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 708 to 711 on Friday 11 July. No new observations have been planned.

A new TSF has been received for revolution 702.

2. Observation status

No new ECS files were received. This is caused by a delay in distribution of consolidated data from MOC to ISDC.

3. ISOC Science Data Archive

With the new disks installed, ingestion has begun again and Science Window data up to revolution 687 has been ingested. Work is ongoing on the inclusion of newer source data products.

4. ISOC system

ISOC system V19.3 has been successfully tested after some minor updates of issues found in the first test round and will be installed.

5. Problems

None.

4.3.2 ISDC

Status of ISDC observation processing on 14/07/2008:

- Latest Standard Analysis completed: observation 05200260004 (mid-latitude 2, Revolutions 680 & 681) on 26/06/2008.
- Latest products archived: observation 05200260004 (mid-latitude 2, Revolutions 680-681) on 26/06/2008.
- Latest observation products sent to the observer: observation 05200510009 (Mrk 421, Revolutions 679) on 16/06/2008.

5 Special Events

6 Anomalies

The following problem was reported this week that impacted operations.

- On DoY 190 at 02:00, the TM from Redu dropped, the cause was given as a hit on the line. The Timeline was suspended, and a recovery performed. Normal service was resumed at 02:35. The impact was the loss of pointing 07000025.

There were no new anomaly reports entered into the ARTS system this week.

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 700

The observations in revolution 700 began with a raster dither of XMM-LSS (RA 02:18:00.00, DEC -07:00:00.0), lasting ~35.2 hours. They continued with a raster dither of the Galactic Plane Region 3 (RA 13:09:32.98, DEC -62:47:56.4), lasting ~20.2 hours, until the end of the revolution.

Revolution 701

The observations in revolution 701 began with a raster dither of XMM-LSS (RA 02:18:00.00, DEC -07:00:00.0), lasting ~36.1 hours. They continued with a raster dither of the Galactic Plane Region 3 (RA 13:09:32.98, DEC -62:47:56.4), lasting ~18.3 hours, until the end of the revolution.

Throughout these observations, all instruments were in their nominal science modes, except JEM-X2, which is switched off. The TM allocation was IBIS 128; SPI 108; JEM-X1 8; JEM-X2 0; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

2008-06-19T02:41:35.000Z	140.0320	F	Automatic TM processing.
2008-06-20T12:16:11.000Z	140.0171	F	Automatic TM processing.
2008-06-22T02:30:55.000Z	140.0110	F	Automatic TM processing.
2008-06-23T11:52:02.000Z	139.9857	F	Automatic TM processing.
2008-06-25T02:18:38.000Z	139.9678	F	Automatic TM processing.
2008-06-26T11:59:22.000Z	139.9435	F	Automatic TM processing.
2008-06-28T02:07:42.000Z	139.9309	F	Automatic TM processing.
2008-06-29T11:44:25.000Z	139.9025	F	Automatic TM processing.
2008-07-01T01:54:53.000Z	139.8979	F	Automatic TM processing.
2008-07-02T11:14:18.000Z	139.8716	F	Automatic TM processing.
2008-07-04T01:39:26.000Z	139.8576	F	Automatic TM processing.
2008-07-05T11:01:53.000Z	139.8229	F	Automatic TM processing.
2008-07-07T01:27:57.000Z	139.8135	F	Automatic TM processing.
2008-07-08T10:47:05.000Z	139.7851	F	Automatic TM processing.
2008-07-10T01:16:53.000Z	139.7750	F	Automatic TM processing.

This report was generated Fri Jul 11 08:00:15 GMT 2008

8.3 Detailed Satellite Information

This section contains some detailed information concerning the various subsystems of the satellite and instruments.

8.3.1 AOCS SUMMARY OPERATIONS REPORT, 05/07/2008 – 11/07/2008

The AOCS operations were executed from the Automatic Timeline.

During this period, 86 Open Loop Slews, 72 Closed Loop Slews and 5 Momentum Biases were executed (as reported by ACC).

1 slew (CSL) was missed from TL, during the observation period, due to a problem on the TM & TC links with REDU station.

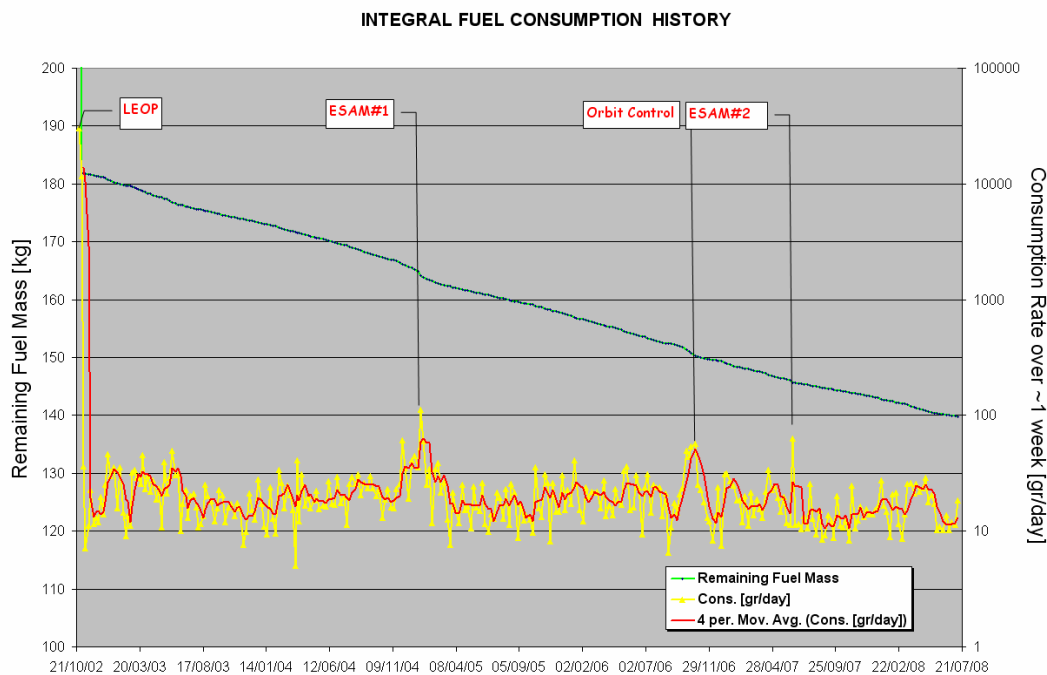
This is equivalent to $\sim 0.6\%$ of the total number of slews planned (158).

Orbit Control

No update

Fuel consumption

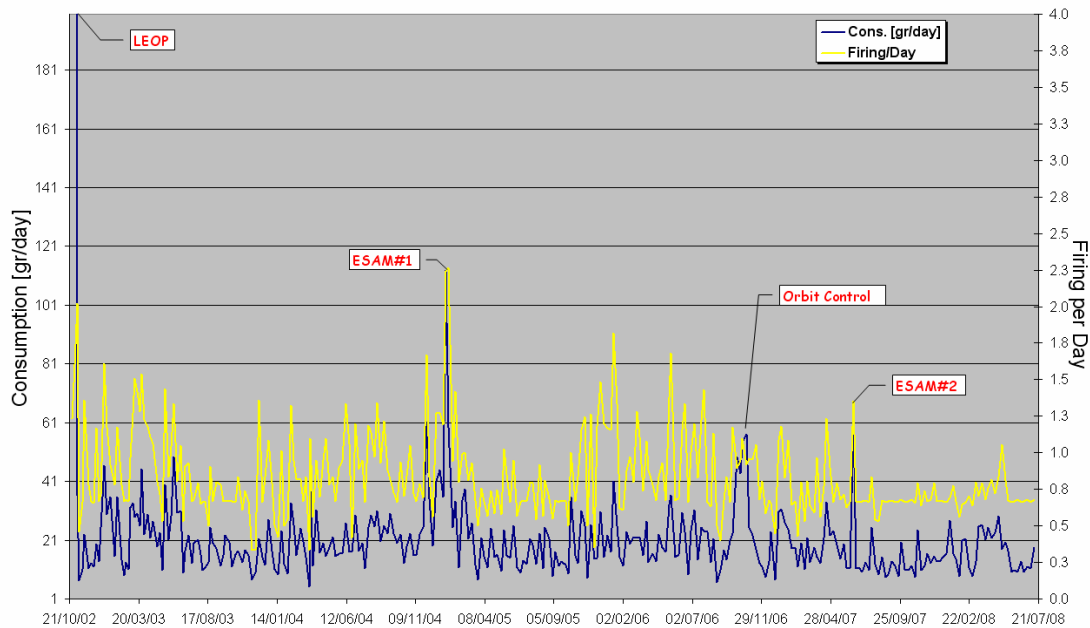
The fuel consumption (total, grams per day) over the period between 01/11/2002 and 11/07/2008 is reported in the plot below.



The above plot considers the ESAM fuel consumption spread over period of ~ 1 week.

The firing per day over the period between 01/11/2002 and 11/07/2008 is reported in the plot below.

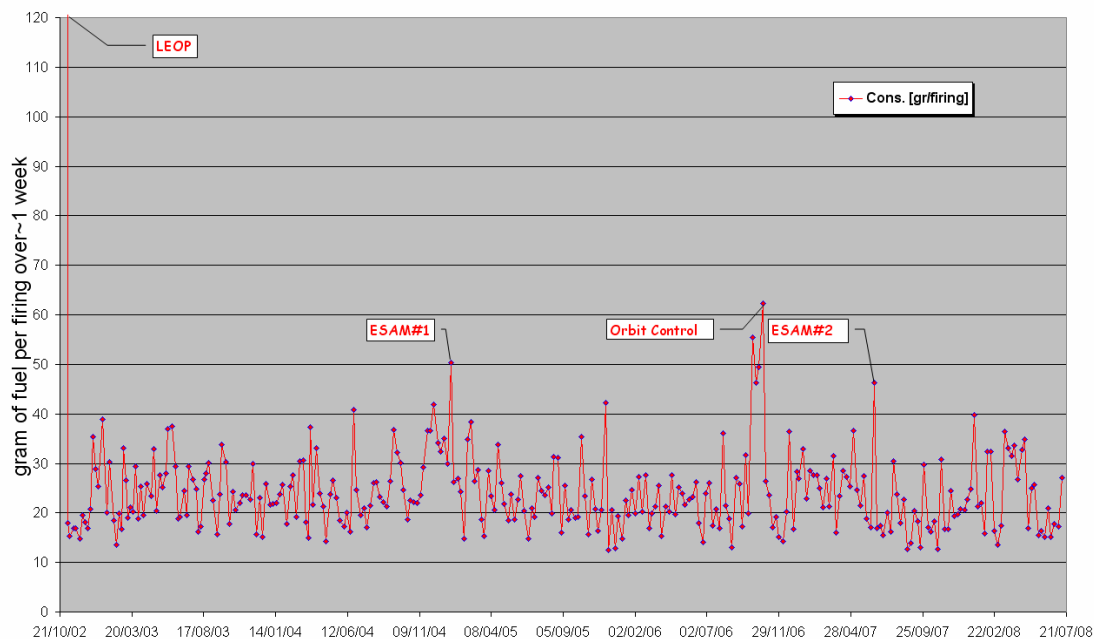
INTEGRAL FIRING PER DAY HISTORY



The above plot considers the ESAM fuel consumption spread over period of ~1 week.

The fuel per firing over the period between 01/11/2002 and 11/07/2008 is shown in the plot below.

INTEGRAL FUEL MASS PER FIRING HISTORY

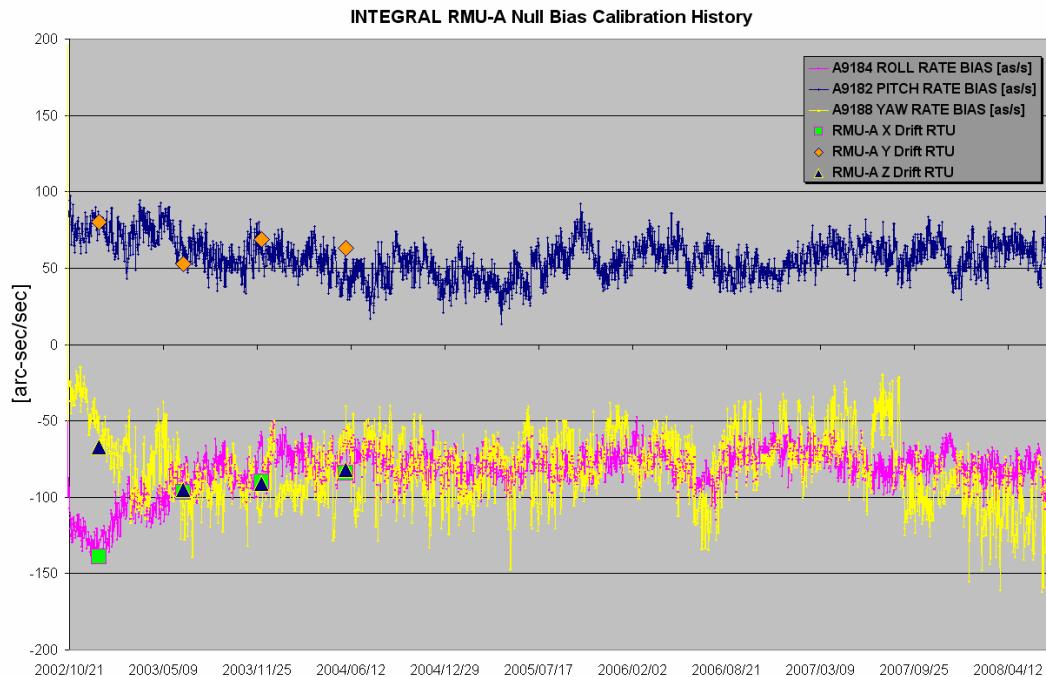


The RMU-A null bias calibration

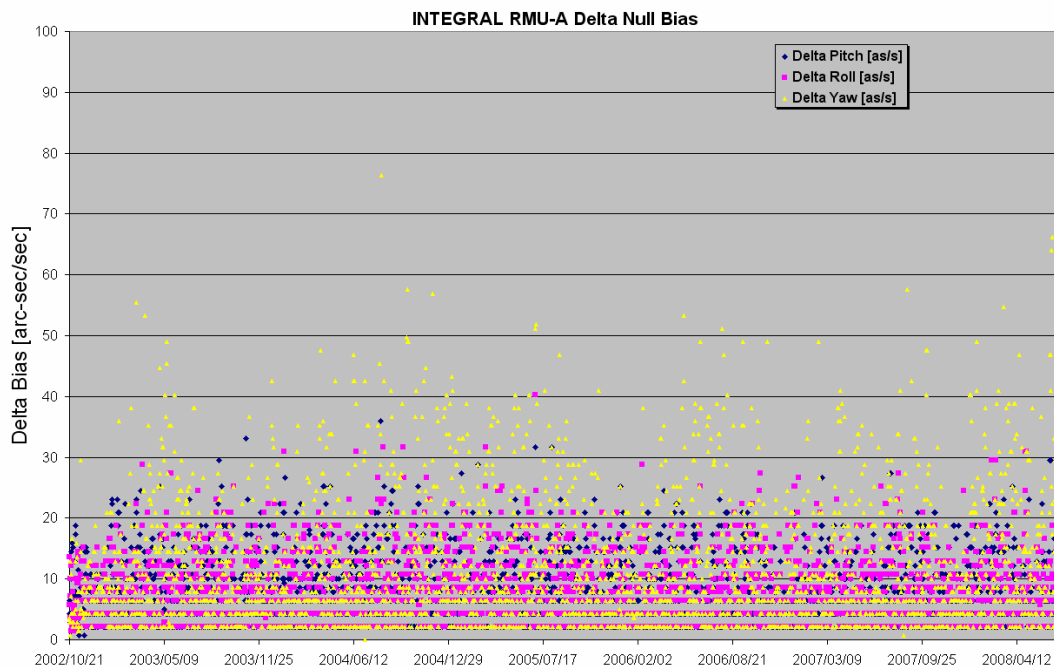
The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 11/07/2008 is reported in the plot below.

Problems have been reported during the last period on FDS when generating the drift update for the RMU-A Yaw channel: the limits set on FDS have been violated few times. The evolution of the drift on yaw channel is under constant monitoring but the

values are still well within the specs. At moment the current constraints (for drift update generation) on the FDS have been relaxed to cope with the current situation.



The RMU-A delta null bias calibration history, on pitch, roll and yaw channel over period between 01/11/2002 and 11/07/2008 is reported in the plot below.



05/07/2008 (Day of Year 187, Revolution 699)

Nothing to report.

06/07/2008 (Day of Year 188, Revolution 699)

Nothing to report.

07/07/2008 (Day of Year 189, Revolution 699-700)

Nothing to report.

08/07/2008 (Day of Year 190, Revolution 700)

Problem at REDU station: at 02:00z, due to a drop on the TM and TC links with REDU station the slew ID 07000025 failed release.

A manual recovery was then performed at 02:20z by generating a Close Loop Slew to the attitude of PID 07000025. The slew ID 07000026 was manually updated in TL.

The following pointing was missed in TL: ID 07000025(CSL).

09/07/2008 (Day of Year 191, Revolution 700)

Nothing to report.

10/07/2008 (Day of Year 192, Revolution 700-701)

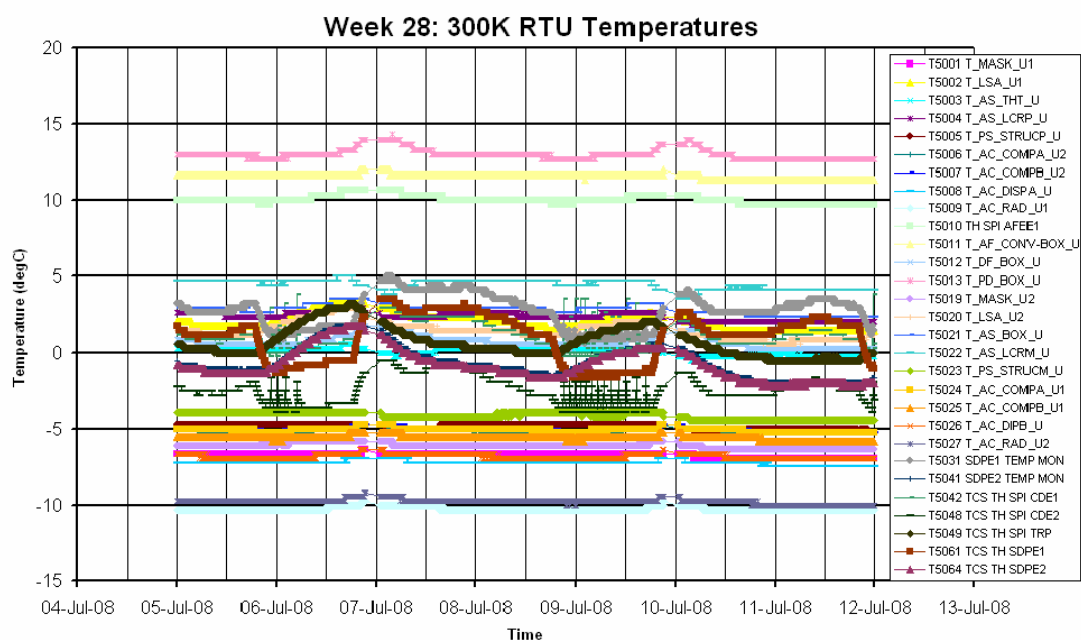
Nothing to report.

11/07/2008 (Day of Year 193, Revolution 701)

Nothing to report.

8.3.2 SPI Operations

Unit Temperatures: All the equipment temperatures are inside the operational limits. The following plot shows their evolution during the reporting period.

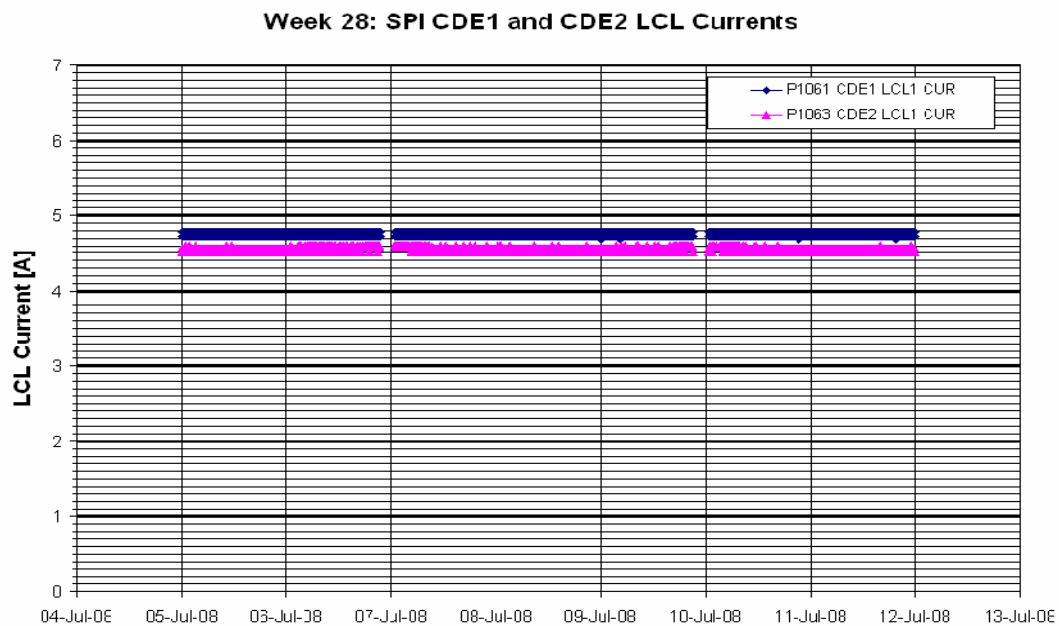


Stirling Compressors and Cryostat: The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K.

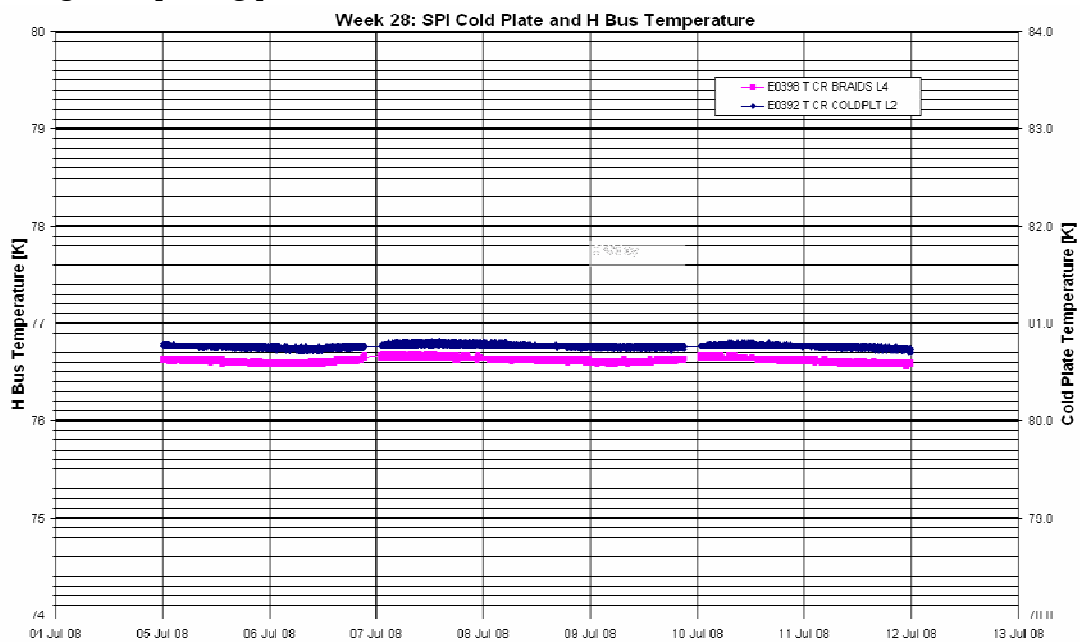
The stroke of all four compressors was set to 40 throughout the week. The average CDE LCL currents were as follows:

- CDE1 LCL Current = 4.75A
- CDE2 LCL Current = 4.55A

The following plot shows the evolution of the CDE LCL currents during the reporting period.



The following plot shows the evolution of the cold plate and H bus temperatures during the reporting period.

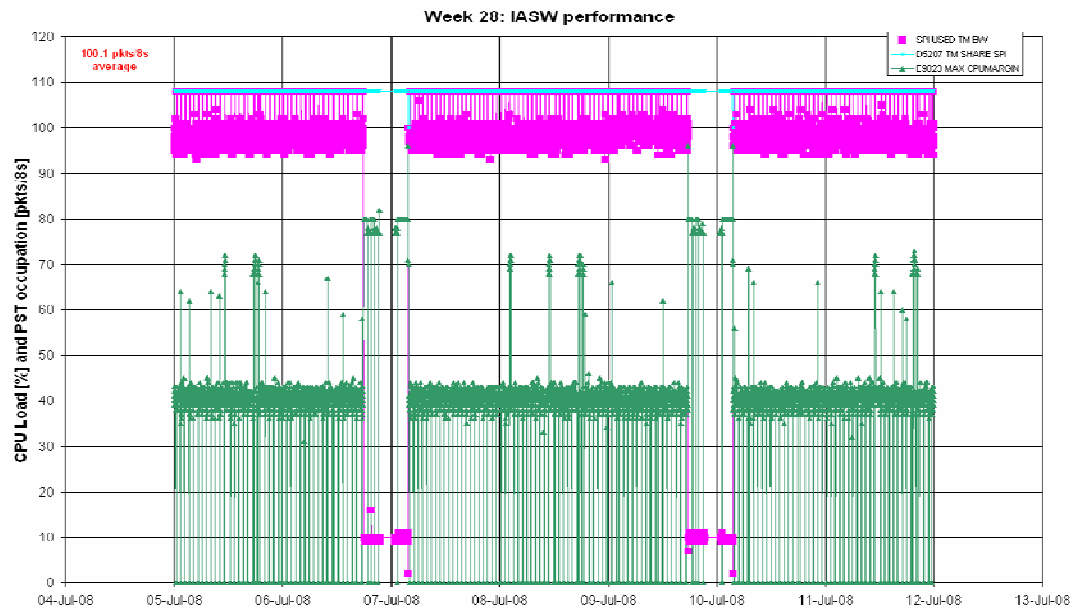


DPE & IASW: The DPE health and IASW performance is nominal.

The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling factor set to 8/19 SE.

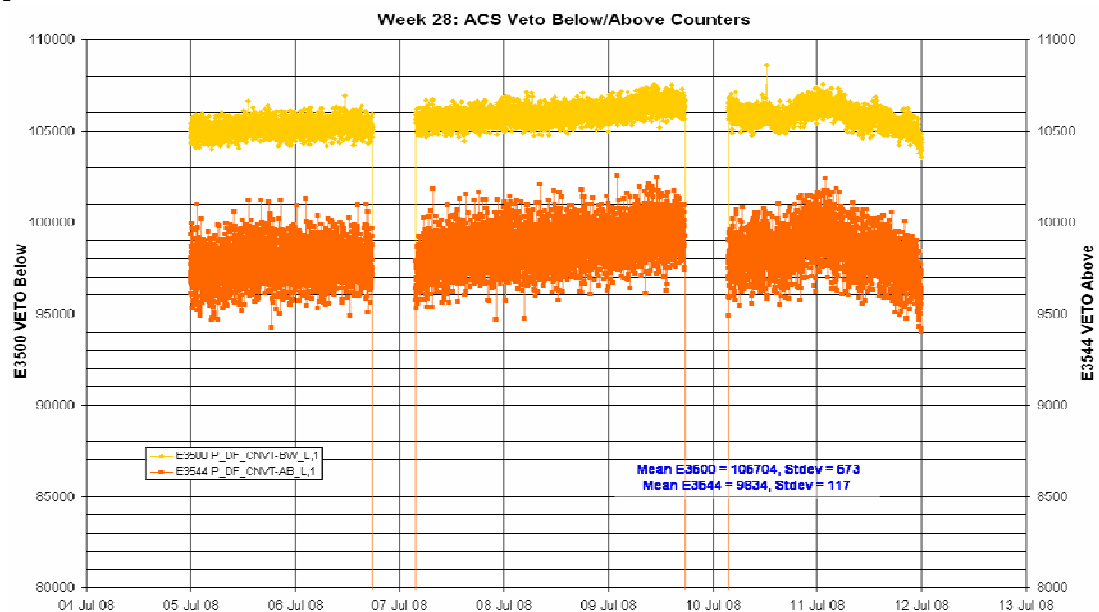
The average TM bandwidth occupation of SPI was 100.1 packets/cycle over the science window. The TM allocation in the science window was 108 packets/cycle.

The following plot shows the IASW performance in terms of TM bandwidth occupation and DPE CPU load during the reporting period.

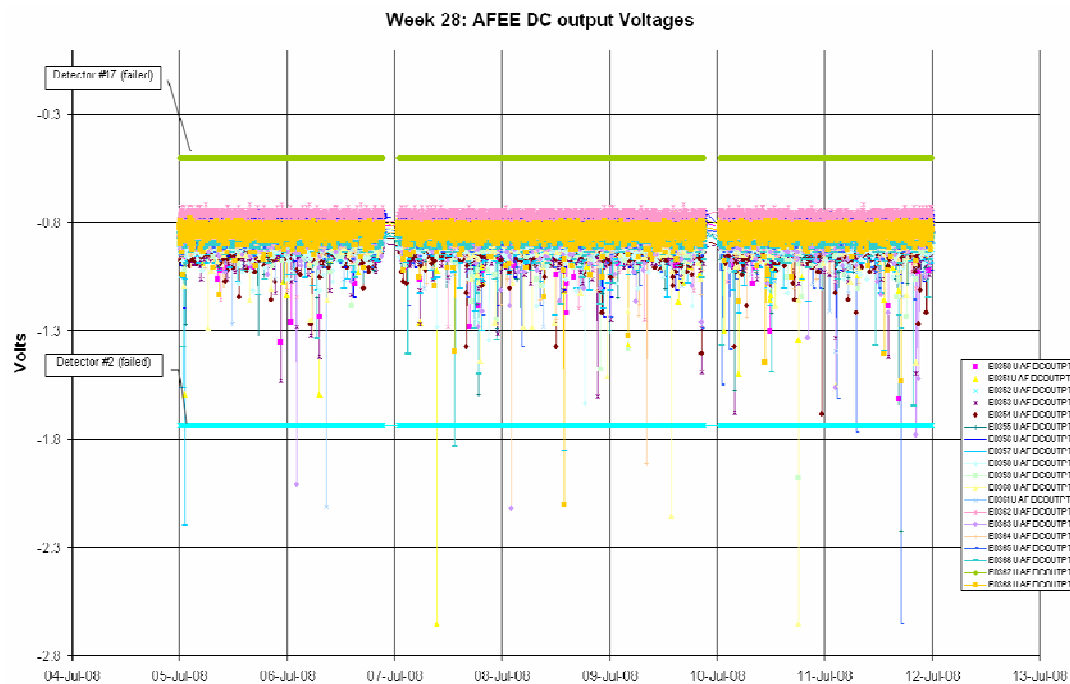


ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61).

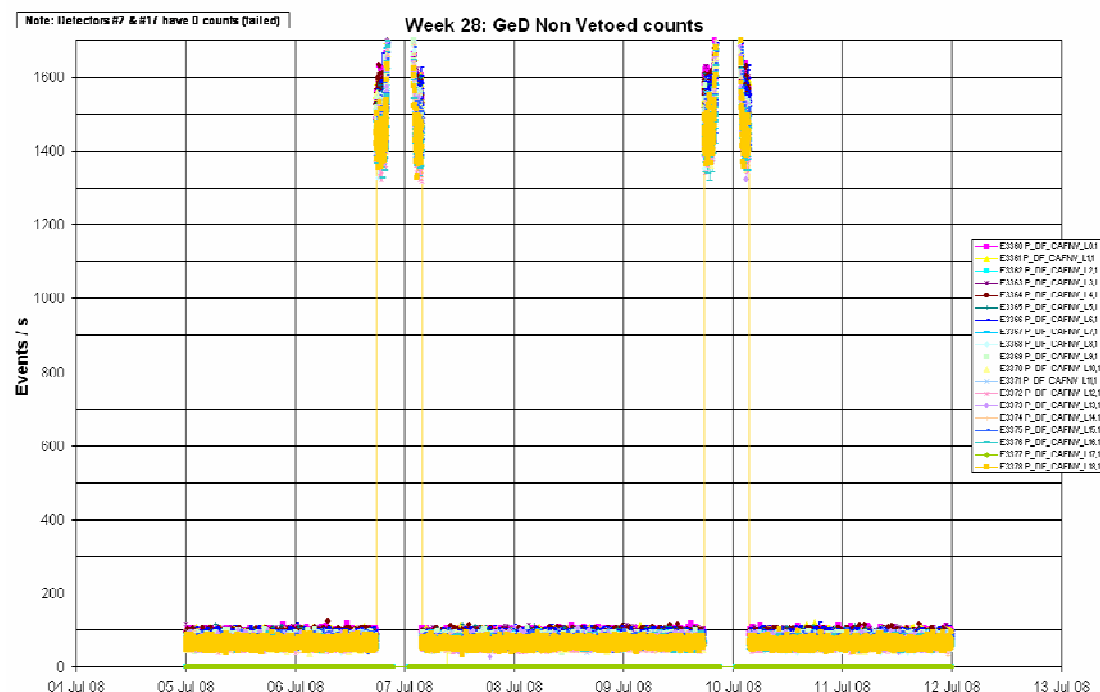
The following plot shows the ACS overall count rate evolution during the reporting period:

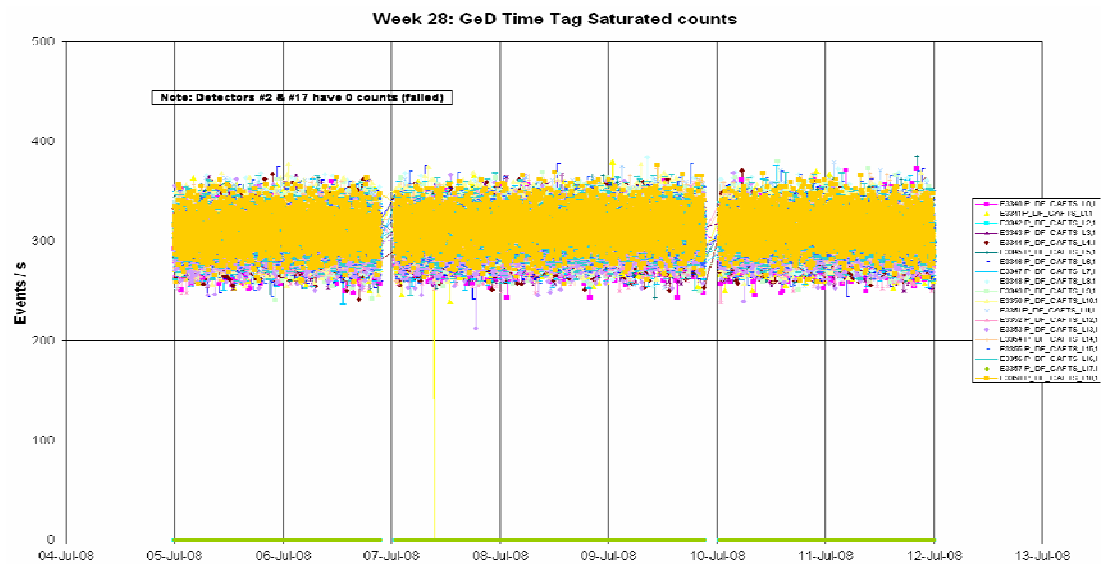
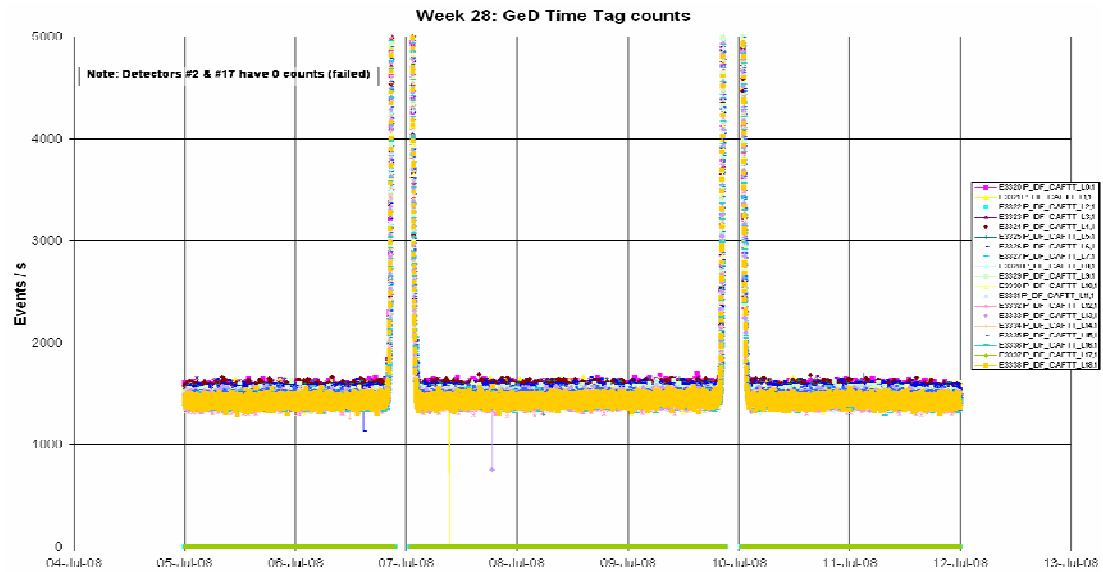


AFEE: The health of the AFEE is nominal. The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06/12/2003 and detector #17 is failed since 17/07/2004.

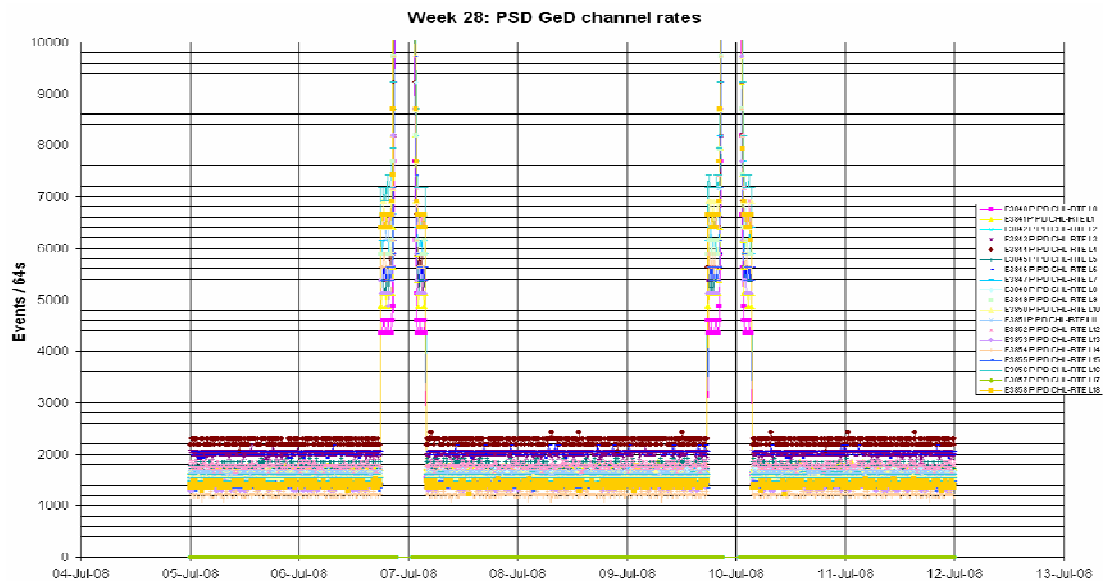


DFEE: The performance of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event count rates during the reporting period.





PSD: The health of the unit is nominal. The following plot shows the PSD channel rates during the reporting period.



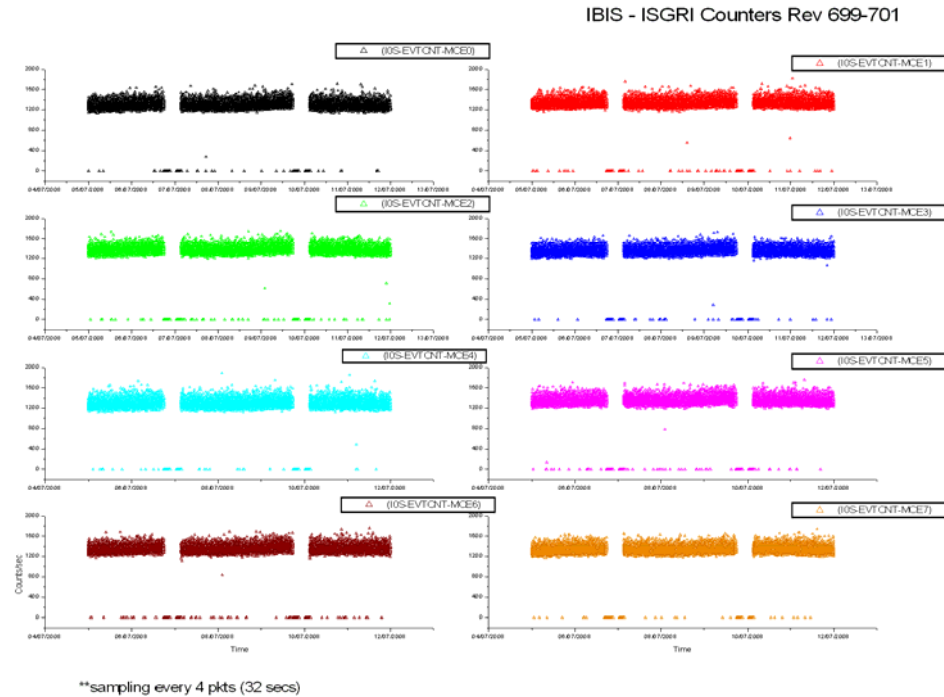
Event Log:

- No non-nominal events occurred on SPI over the reporting period.

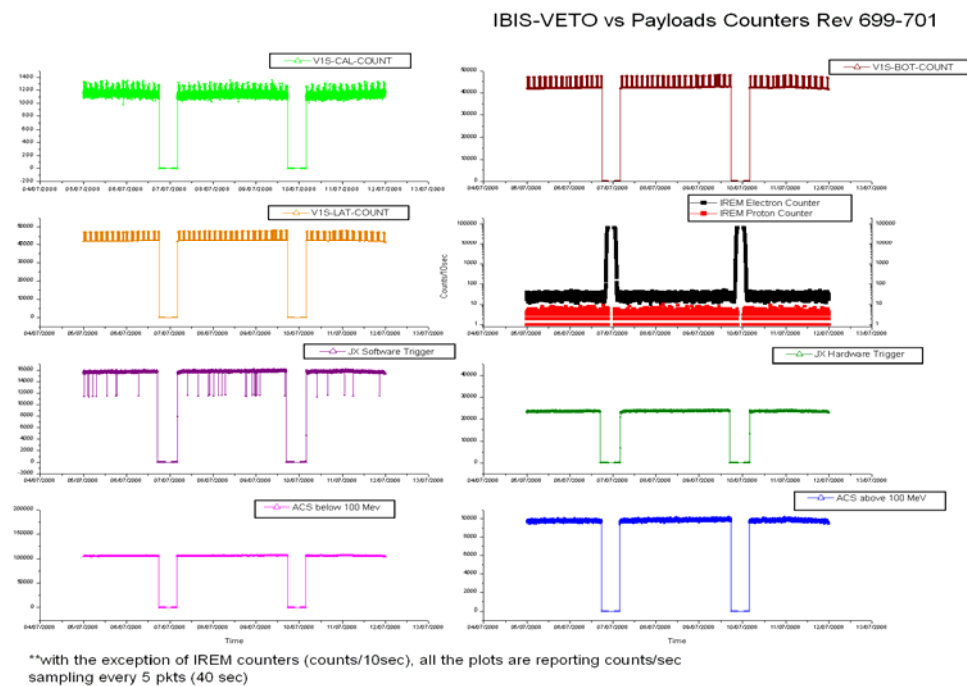
8.3.3 IBIS Operations

IBIS Event Counters Plots

ISGRI Counters:

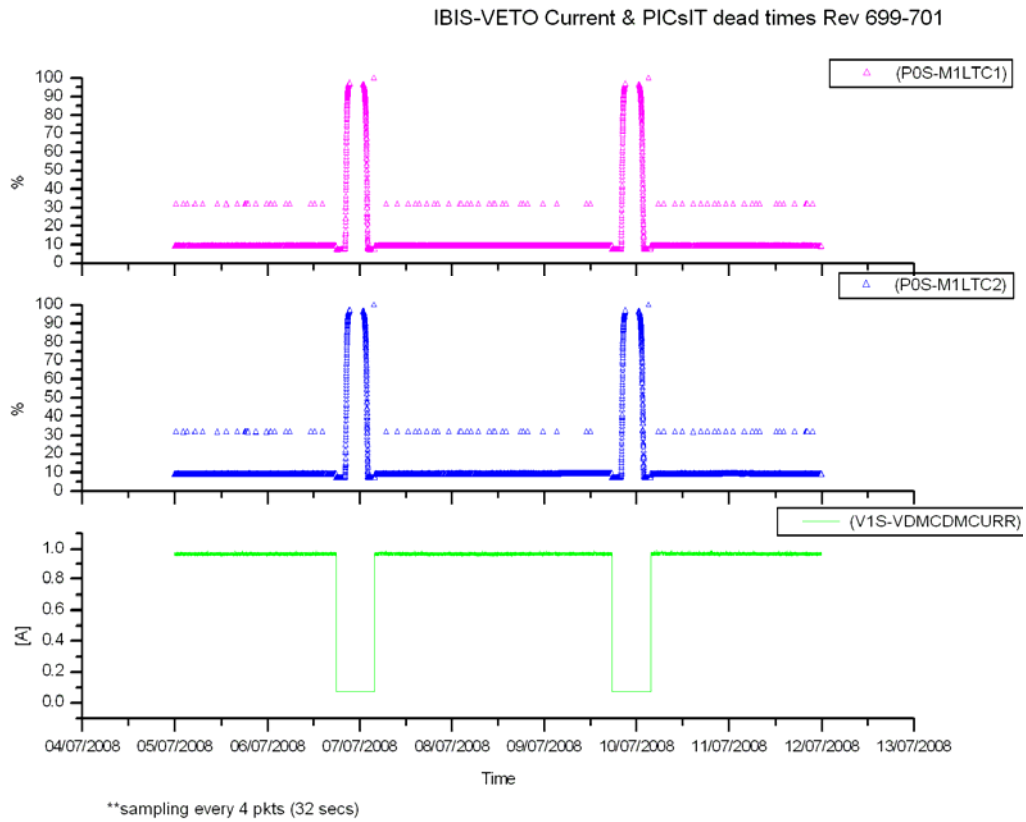


VETO vs Payload Counters:

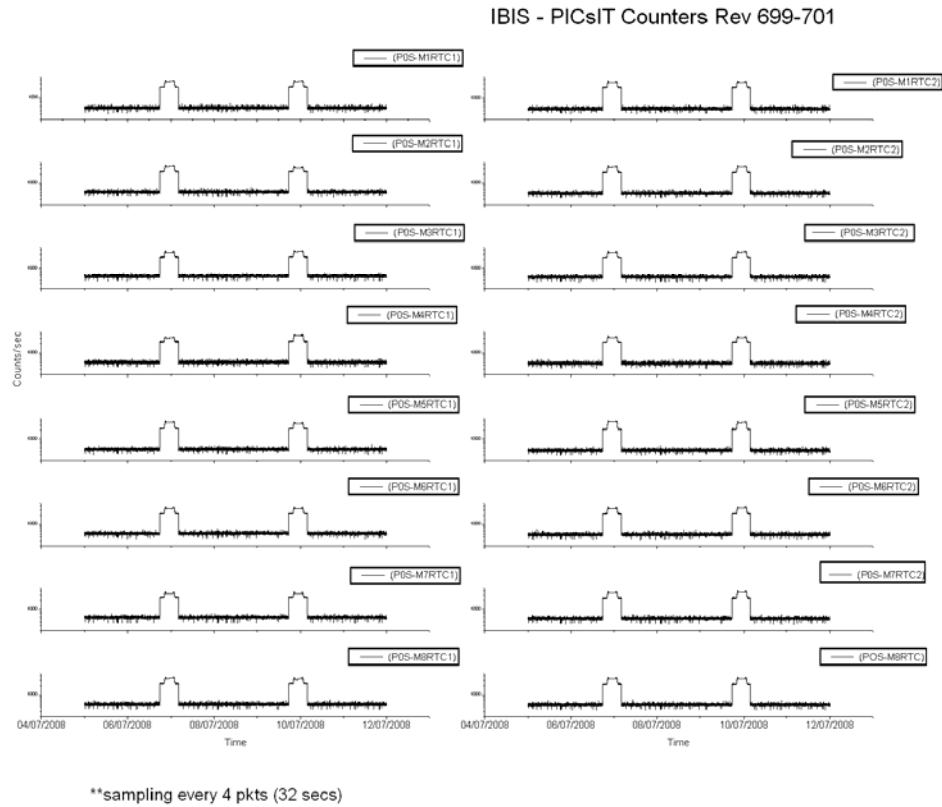


The week was characterised by low radiation as reported by the payload.

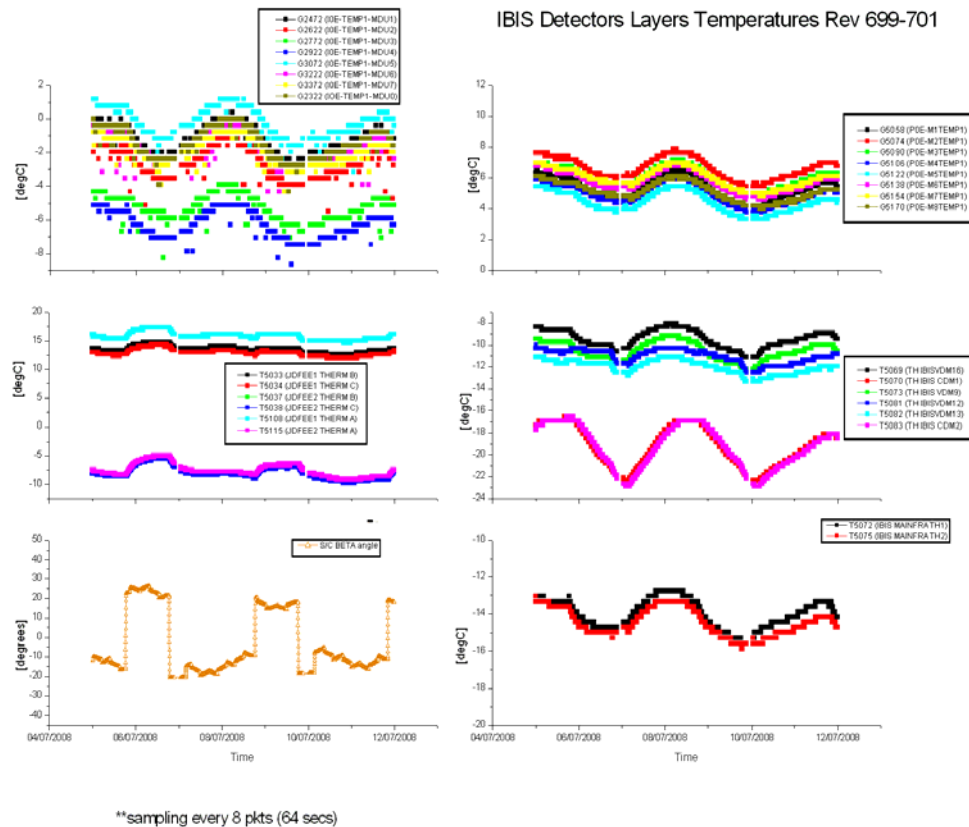
VETO Current:



PICsIT Counters:



IBIS Detectors Layers Temperatures:



IBIS daily report:

The usual Out Of Limits on TM parameter G8015 (S1E-A2_PMT_V), G5002 (P0S-Mi_RTC1) and G5003 (P0S-Mi_RTC2) families and G2000 family (IOE-OVFWPXADD-Mi) were received during the radiation belt passages.

2008-07-05 (DOY 187, Rev 699) to 2008-07-09 (DOY 191, Rev 700-701)

IBIS operations executed nominally.

2008-07-10 (DOY 192, Rev 701)

At 18:30Z, following a ground station handover, TM parameter X7500 went OOL, indicating a problem with the histogram process. The following recovery procedure was then executed to force the histogram accumulation and download process to resume:

- 19:02:02Z FCP_IBIS1_0312
 - 19:03:42Z TC G0129 uplinked to return IBIS to Science Standard mode.
- IBIS operations continued nominally.

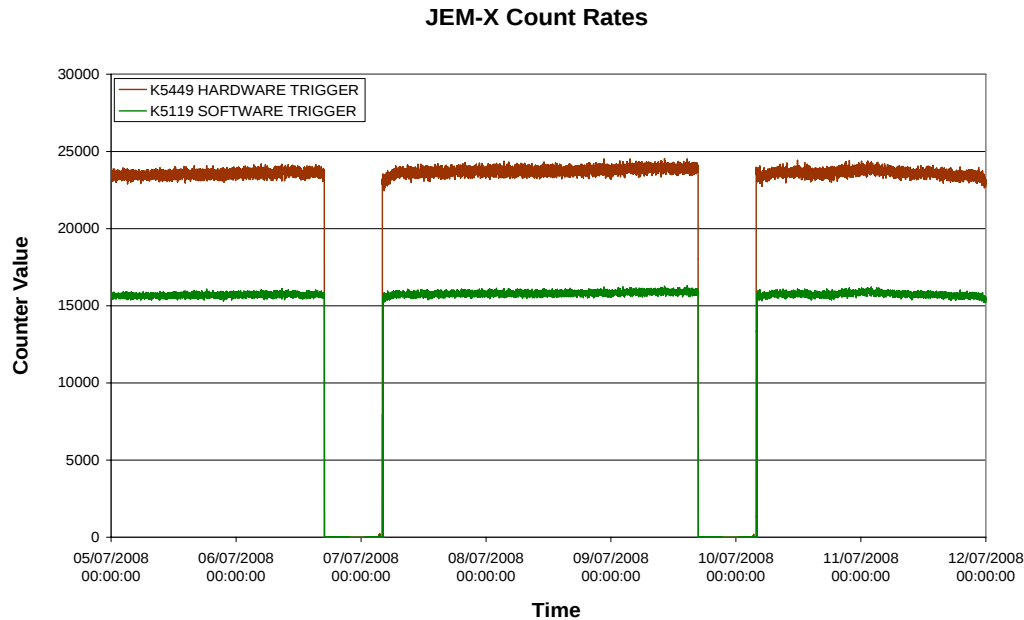
2008-07-11 (DOY 193, Rev 701)

IBIS operations executed nominally.

8.3.4 JEM-X Operations

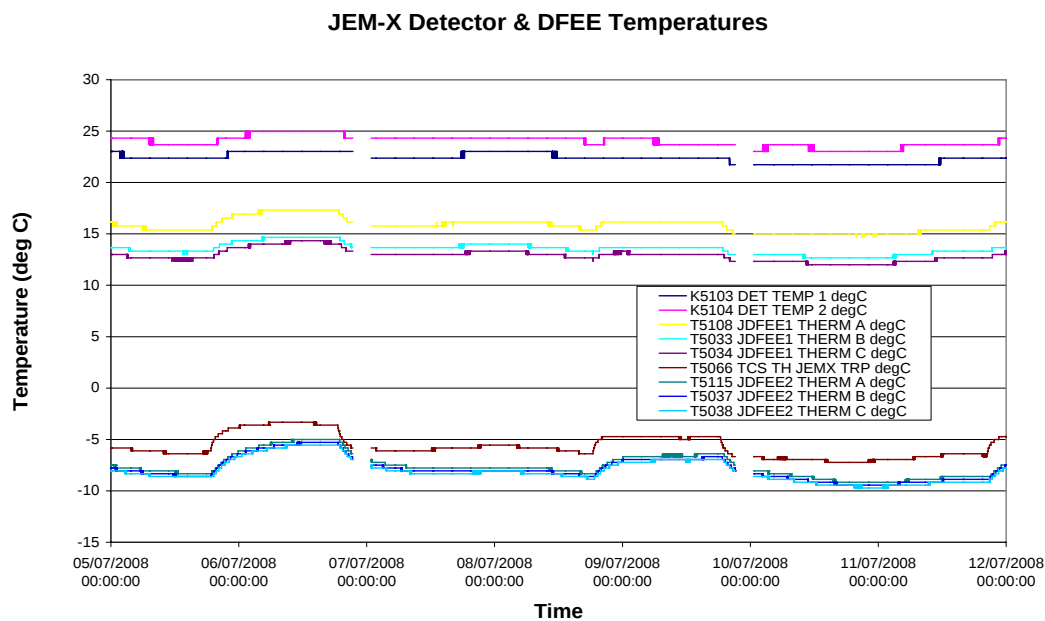
JEM-X Count Rates

JEM-X count rates over the reporting period are displayed in the following graph¹.



JEM-X Temperatures

JEM-X Detector and DFEE temperatures, along with the temperature on the detector bench between the two units, over the reporting period are displayed in the following graph².



¹ Data sampled (1 frame in 4) and smoothed to remove spikes in S/W Trigger due to flushing of buffer after slews.

² Data sampled (1 frame in 8)

JEM-X Daily Report

2008-07-05 (DoY 187, Rev 699) to 2008-07-08 (DoY 190, Rev 700)

JEM-X1 operations executed nominally.

2008-07-09 (DoY 191, Rev 700)

At 16:46:19, TCs K0021 & KU0014 terminated with status unknown. No action was taken, and there was no impact.

2008-07-10 (DoY 192, Rev 701)

At 03:17:25, TC K0021 terminated with status uncertain_failed.

At 04:03:24, TC KU0014 terminated with status affected, and 4 seconds later this changed to status unverified.

At 04:03:55, TCs K0021 & KU0014 terminated with status unknown.

No action was taken on any of the above events, and there was no impact.

2008-07-11 (DoY 193, Rev 701)

At 11:12:58, TC K0021 terminated with status uncertain_failed. No action was taken, and there was no impact.

8.3.5 OMC Operations

2008-07-05 (DoY 187, Rev 699) to 2008-07-07 (DoY 189, Rev 700)

Nothing to report.

2008-07-08 (DoY 190, Rev 700)

At 02:00, a TM drop forced the suspension of the Timeline. A recovery was performed, and the Timeline rejoined at 02:35. The impact was the loss of pointing 07000025. It was at this time the following OEMs were received:

2008.190.02.02.47.815	2008.190.02.02.53.170	1792	RealTime	131	TC REJECT
REJECTED TC1			0	0	65535 PR N
E E					
2008.190.02.02.54.065	2008.190.02.03.06.852	1792	RealTime	131	TC REJECT
REJECTED TC1			0	0	65535 PR N
E E					

These correspond to the M1130 (RESET IM) and MU1310 (IMAGING-A) commands for that pointing.

2008-07-09 (DoY 191, Rev 700) to 2008-07-11 (DoY 193, Rev 701)

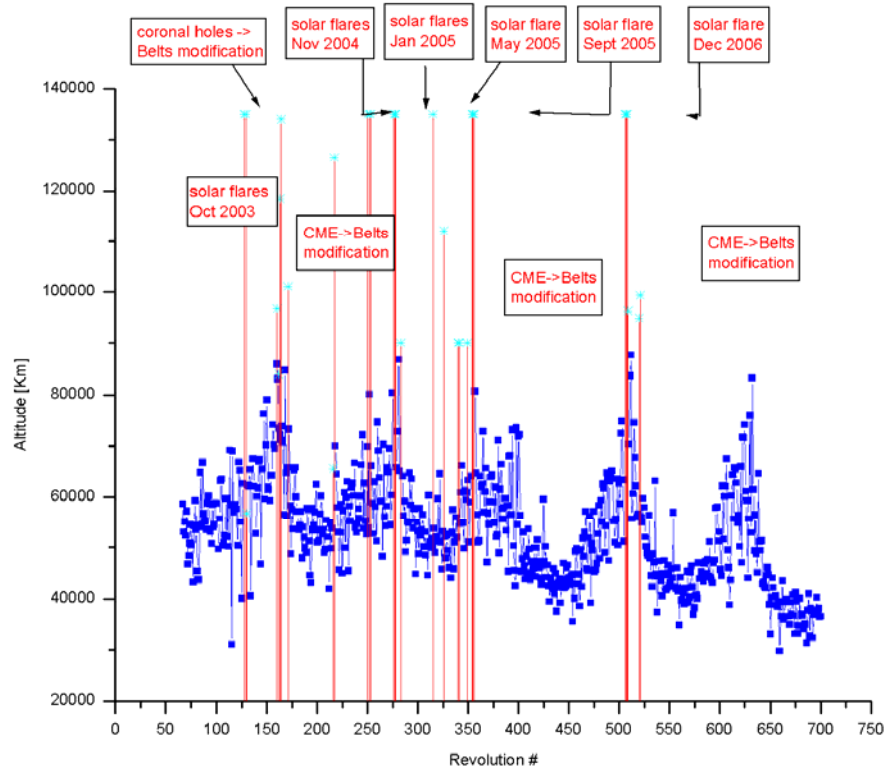
Nothing to report.

On DoY 188 at 17:50:37 and DoY 191 at 17:38:29 OMC went to SAFE mode nominally, at the radiation belt entry time as set in the Broadcast Packet.

8.3.6 IREM Operations

Radiation Belts Entry

Evolution of Radiation Belt Entry 2003-2008



IREM daily report

Nothing to report.

Electron Belts

REV	S/C BCPKT (electron)	Electron CUT-OFF Observed Entry/Exit	Observed Entry/Exit Altitude [Km]	Electron CUT-OFF Predicted Entry/Exit	Predicted Entry/Exit Altitude [Km]
699	RAD_ENTR R 2008-07-06T17:50:30Z	06/07/2008 20:03:08	36430.9	06-Jul-2008 19:46:08	38960.51
700	RAD_EXIT R 2008-07-07T03:44:22Z	07/07/2008 02:17:32	>>33532.8	07-Jul-2008 02:56:08	45837.48
700	RAD_ENTR R 2008-07-09T17:38:22Z	09/07/2008 19:54:04	36549.4	09-Jul-2008 19:34:22	39188.9
701	RAD_EXIT R 2008-07-10T03:31:59Z	10/07/2008 02:09:16	33541.7	10-Jul-2008 02:44:22	45679.55

Reference

High radiation

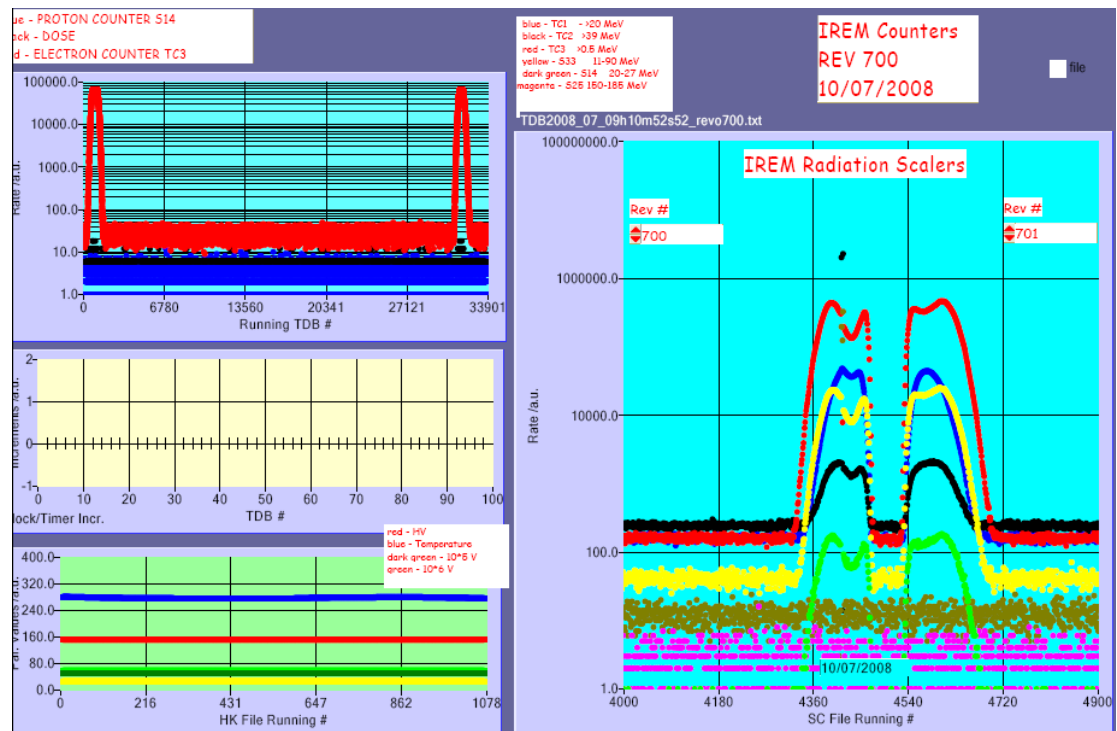
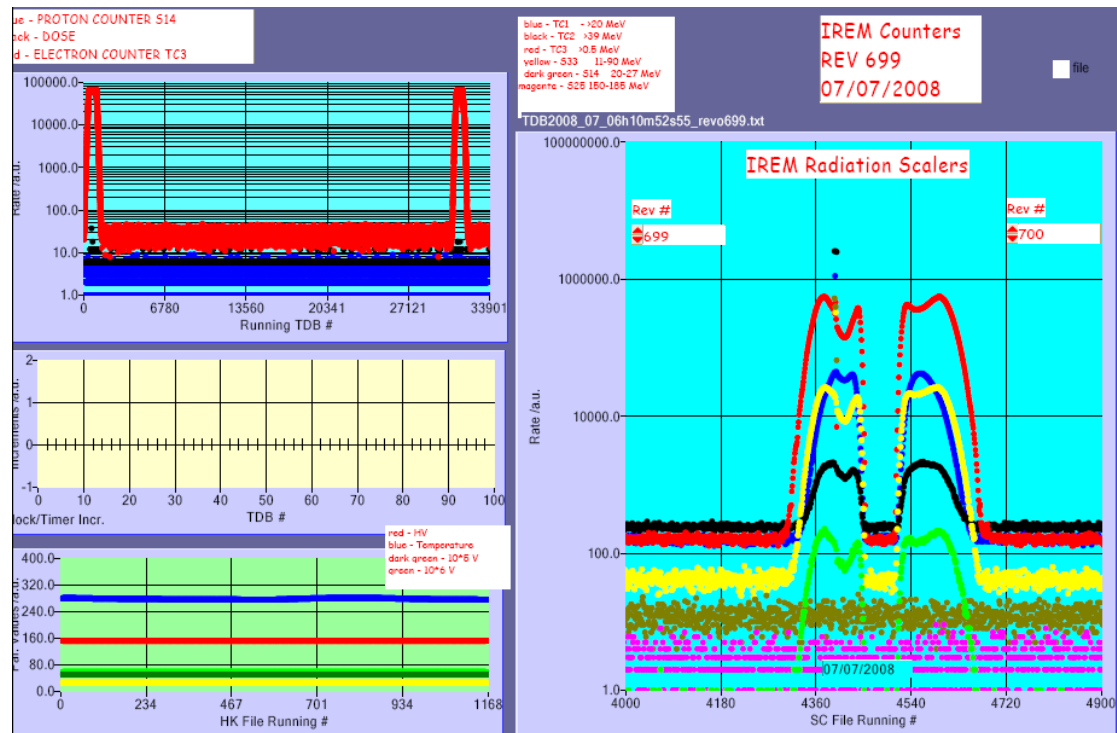
Very small error vs reference (less than 10 minutes)

Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

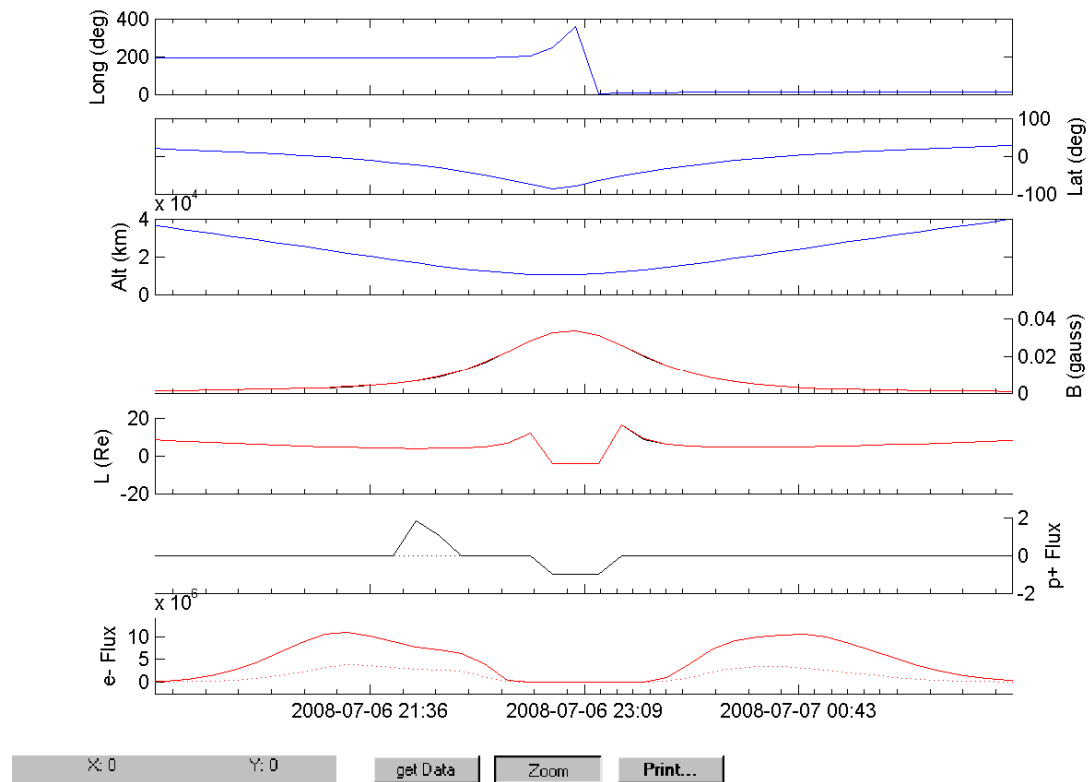
* Rad belt entry time ignoring previous threshold crossings where a gap of more than 30 minutes is present.

IREM radiation counters:

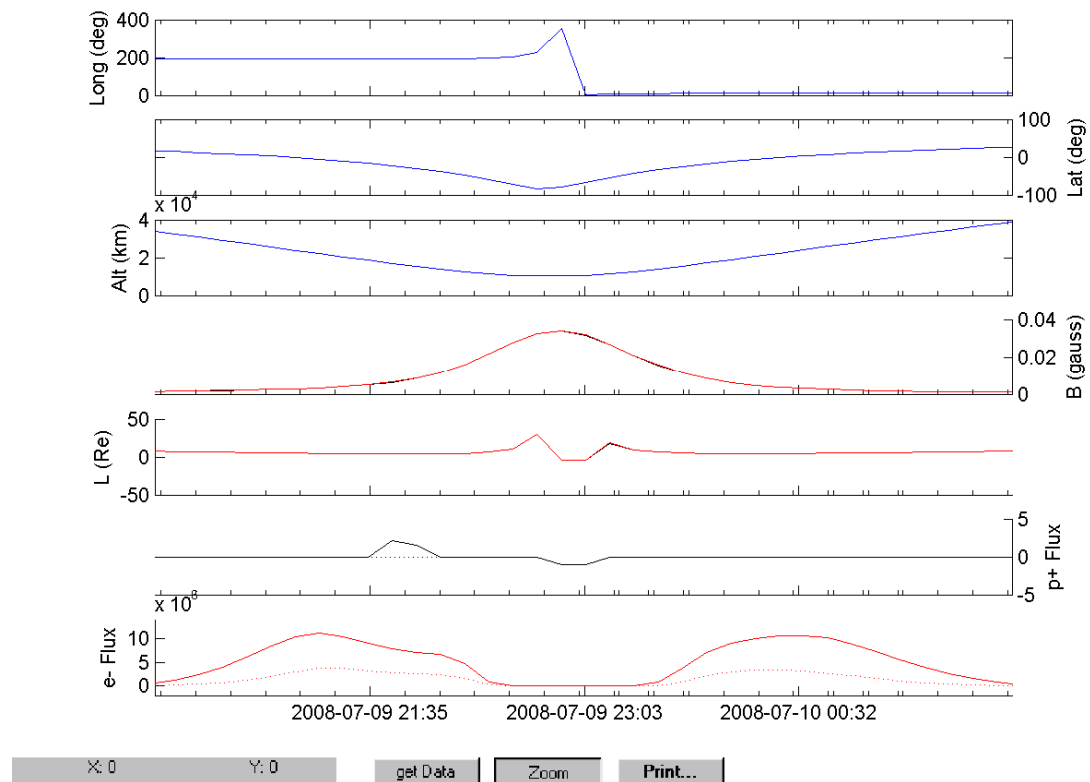


IREM Predicted Radiation Belt Passages

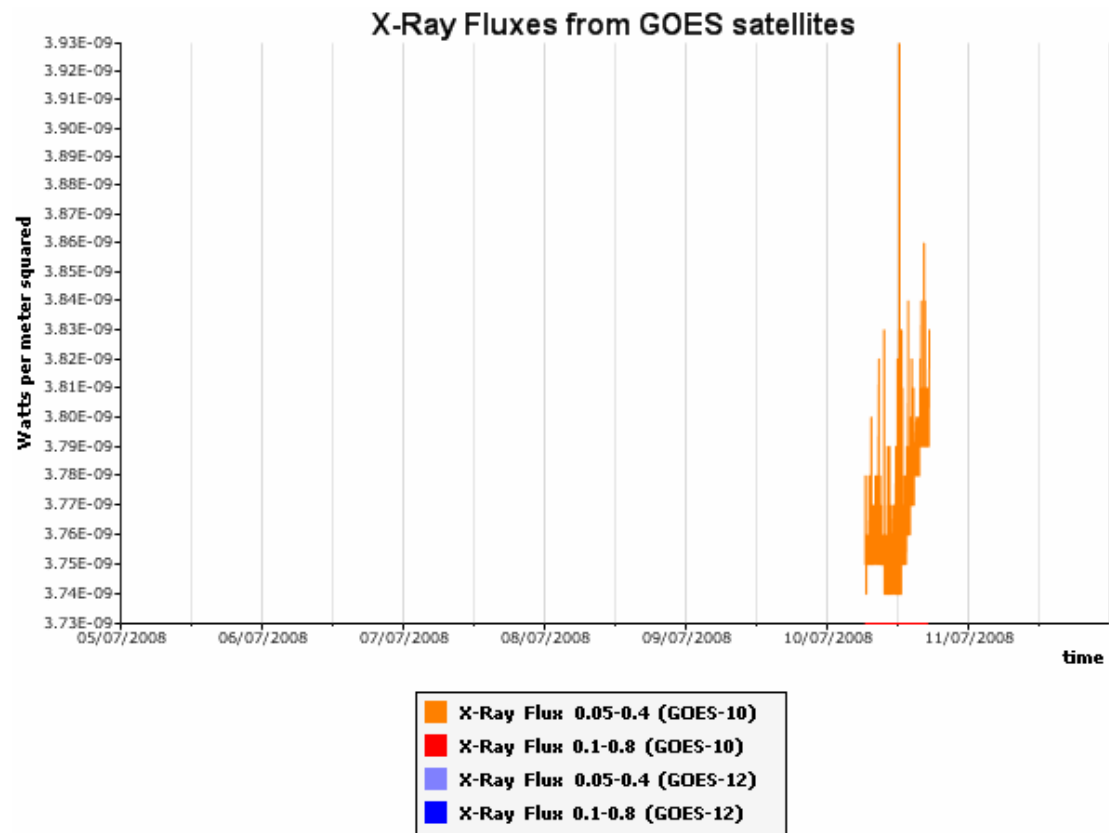
Rev 699



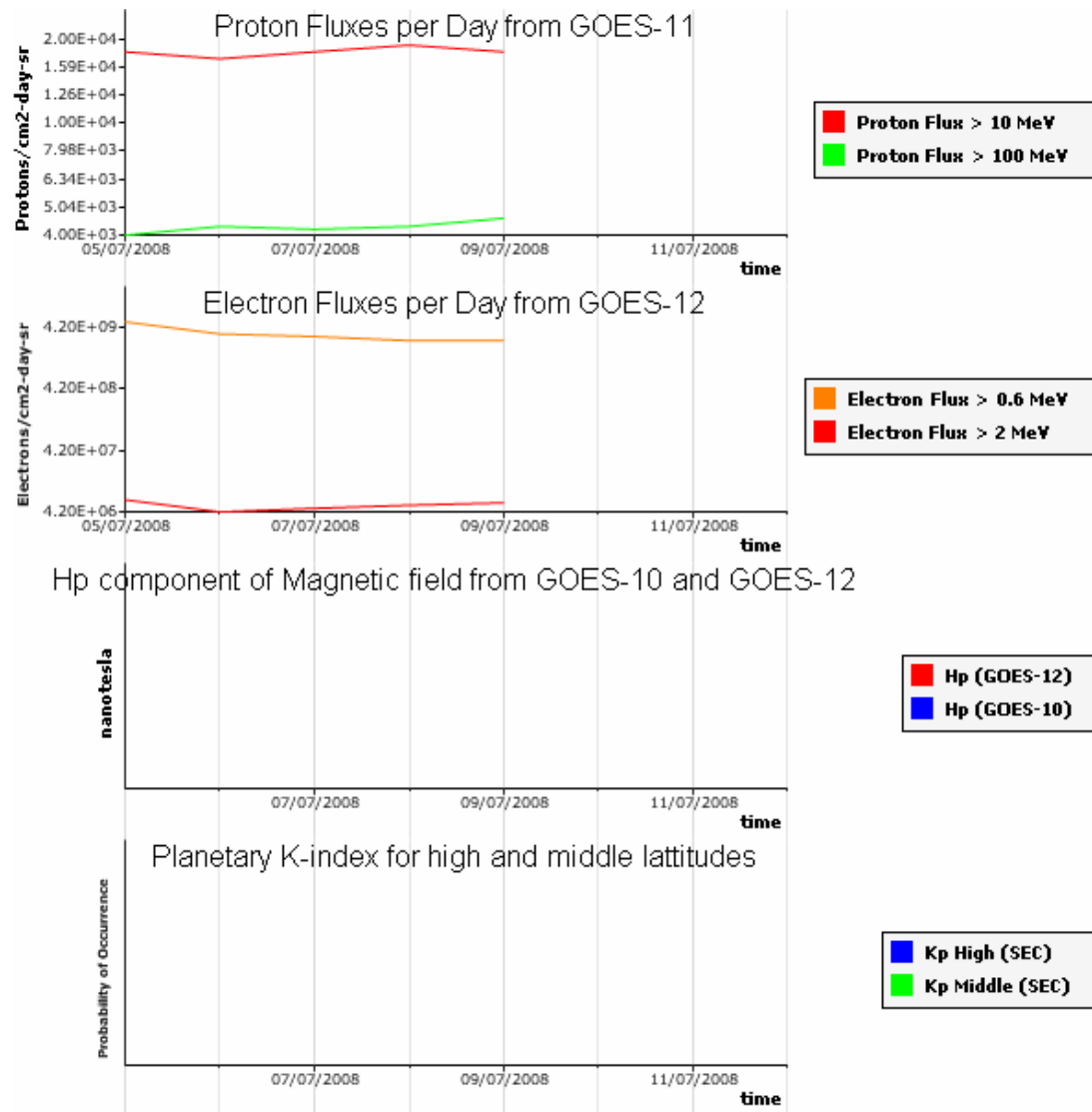
Rev 700



SEC-GOES Observed Particles Fluxes (using SEIS/RAT tool):



X-Ray fluxes start to be significant over 10^{-5} W/m^2 (corresponding to M-class flares). Above 10^{-4} W/m^2 , they correspond to strong X-class flares.



Proton and electron flux report low radiation background.

Hp component of the Geomagnetic Field is essentially parallel to the Earth's rotation axis. A drop near 0 nT is associated with a significant variation in the magnetic field. Kp index is based on ground magnetometers. Kp ≥ 5 features storm-level geomagnetic activity.