

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 276
Week 01
07.01.08
Routine Phase

Prepared by: M.J.H. Walker (OPS-OAI) and INTEGRAL FCT

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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 29.12.07 until 04.01.08 (both dates inclusive) and covers the revolutions 637 and 638.

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 a raster dither of 3C 273 (RA 12:29:06.70, DEC +02:03:08.6), two raster dithers of the Galactic Plane Region 3 (RA 13:09:32.98, DEC -62:47:56.4), and a raster dither of Loop I-Loop IV Super (RA 13:57:10.00, DEC +07:34:37.0).

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.

No slews were missed from TL, during the observation period.

The fuel consumption over the period between 28/12/2007 and 03/01/2008 was 0.1240 Kg. The remaining propellant is in the order of 143.0129 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.

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.

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

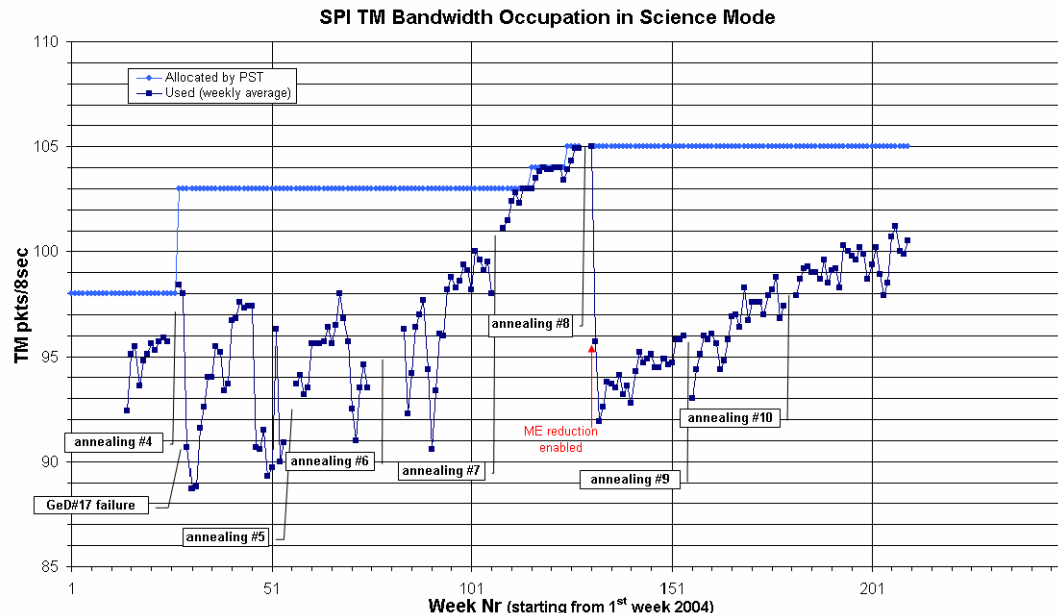
3.2.1 SPI

Following the 10th annealing, which ended on 17th June, the overall status of the gamma-ray spectrometer is nominal, except for the Ge detector #12 which is showing a slightly degraded energy resolution 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 105 packets/cycle, except from 2008-01-02 at 16:35Z until the end of revolution 637, when an over-allocated PST with 108 packets/cycle for SPI was used. The average telemetry occupation in the science windows was 100.5 packets/cycle.

The following plot shows the assigned and the average occupation of the SPI TM bandwidth.



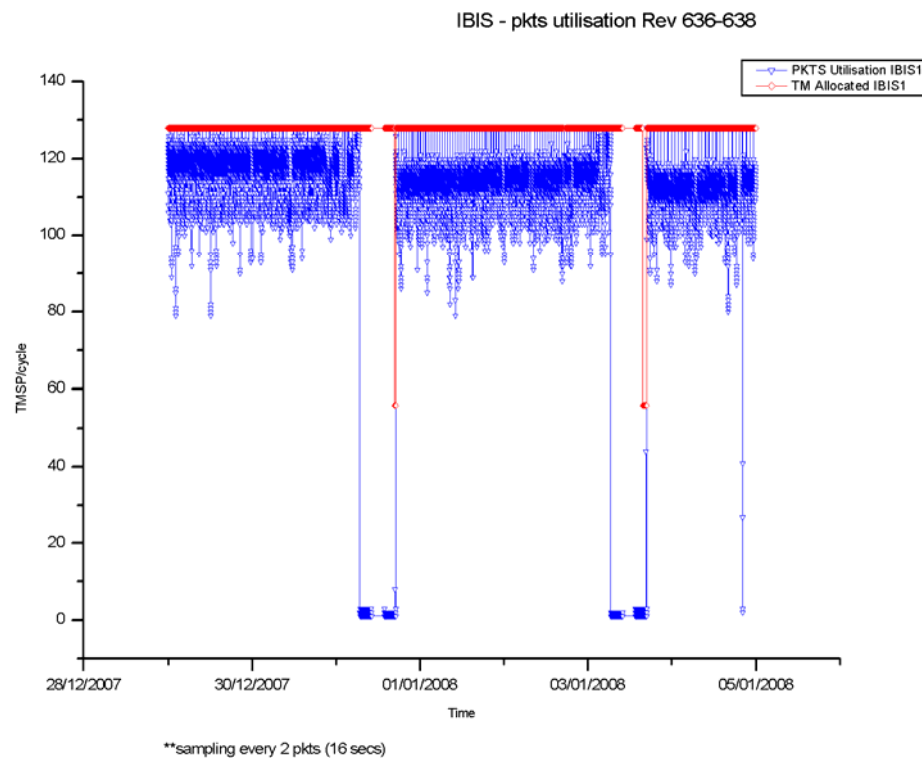
Note: Some more information concerning the SPI operations is provided in the Appendix.

3.2.2 IBIS

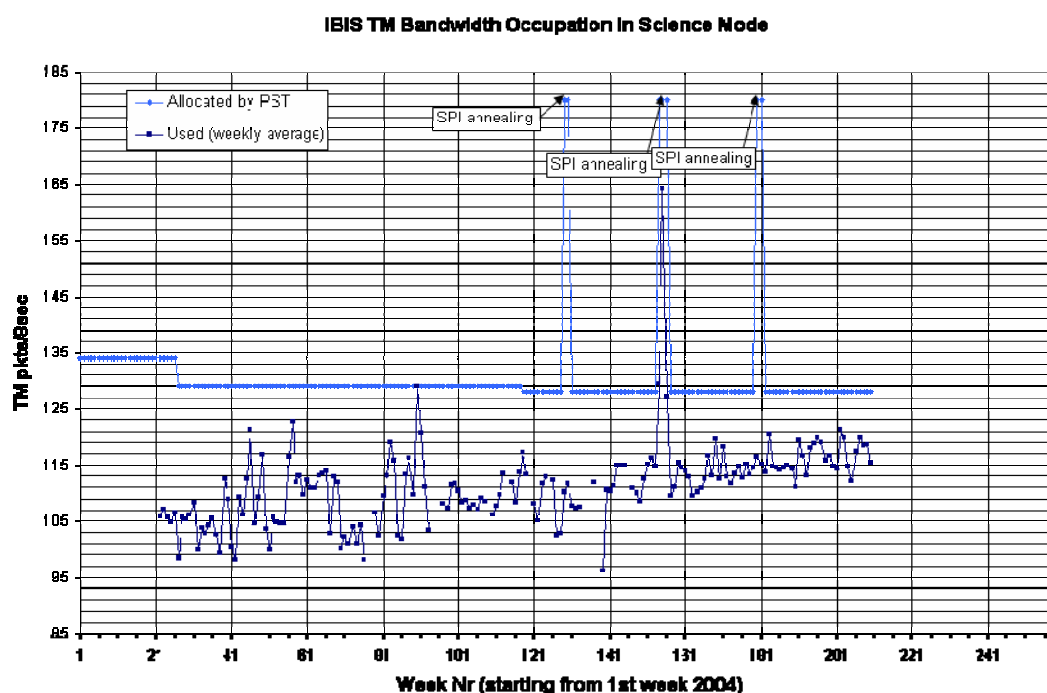
The overall status of the unit is nominal.

During the reporting period, the PST allocation to IBIS was 128 packets/cycle. The IBIS mean bandwidth utilisation during the observation period (when IBIS was in Science mode) was 115.45 packets/cycle, down 3.18 on last week.

A plot of the IBIS TM utilisation during the observation period is shown below:



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, all of the 153 planned science pointings for OMC were executed nominally.

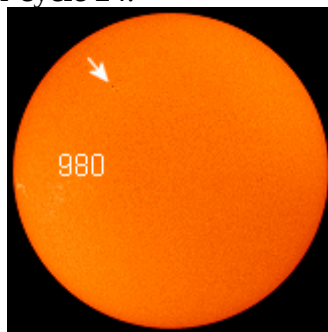
Note: Some more information concerning the OMC operations is provided in the Appendix.

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 until 1st January 2008, when sun spot #980 appeared, probably the remains of spot #978, which posed a risk of C-class solar flares. Also, a high latitude spot emerged marking the beginning of solar cycle 24.



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 excellent this week. The overall performance was nearly 100%.

4.1 Mission Operations Centre

The performance of the MOC was excellent this week. However, there were 2 occasions when the FD slew updates failed to arrive. These were caused by insufficient stars in the field of view. There was no impact

4.2 Ground Stations & Network

The performance of the ground stations and Network was very good this week. There were, however, 3 occasions of TM drops from Redu, all without impact. There were 2 incidences where the link with ISDC dropped, and the NCTRS had to be rebooted to establish a TC link withg DSS-27, also without impact.

4.3 Science Ground Segment

4.3.1 ISOC

Input will be provided next week.

4.3.2 ISDC

Status of ISDC observation processing on 07/01/2008:

- Latest Standard Analysis completed: observation 05200180005 (Gamma Ray Source 1915+105, Revolution 621) on 06/01/2008.

- Latest products archived: observation 05200180005 (Gamma Ray Source 1915+105, Revolution 621) on 07/01/2008.

- Latest observation products sent to the observer: observation 05200180006 (Gamma Ray Source 1915+105, Revolution 623) on 07/01/2008.

5 Special Events

6 Anomalies

There were no problems reported that impacted operations this week.

The following anomaly reports were entered into the ARTS system this week.

AR id	Date Created	Subject	Segment	Status
INT-2974	2008-01-03	Incorrect settings of GESTAN parameters following update of PST for revolution 641	ISOC	Pending
INT_SC-216	2008-01-10	IREM Anomaly: Reset of IREM_CSCI S/W #59, 03/01/2008	Payload	Pending

7 Future Milestones

The following activities are foreseen in the next few weeks.

Doc. Title : INTEGRAL Mission Report #276
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Date : 07/01/08

Issue : 1
Rev. : 0
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- A SPI annealing activity is foreseen to be performed starting with revolution 641.
- A SAS calibration is planned for revolution 644.
- The next On-Board Clock wrap-around is expected during revolution 650.

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 637

The observations in revolution 637 began with of a raster dither of 3C 273 (RA 12:29:06.70, DEC +02:03:08.6), lasting ~54.8 hours. They continued with a raster dither of the Galactic Plane Region 3 (RA 13:09:32.98, DEC -62:47:56.4) lasting ~1.0 hours, until the end of the revolution.

Revolution 638

The observations in revolution 638 began with of a raster dither of Loop I-Loop IV Super (RA 13:57:10.00, DEC +07:34:37.0), lasting ~24.2 hours. They continued with a raster dither of the Galactic Plane Region 3 (RA 13:09:32.98, DEC -62:47:56.4) lasting ~30.9 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 105; JEM-X1 8; JEM-X2 0; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

2007-12-13T15:47:29.000Z	143.3304	F	Automatic TM processing.
2007-12-15T01:20:13.000Z	143.3054	F	Automatic TM processing.
2007-12-16T15:35:53.000Z	143.3004	F	Automatic TM processing.
2007-12-18T01:12:12.000Z	143.2567	F	Automatic TM processing.
2007-12-19T15:22:57.000Z	143.2454	F	Automatic TM processing.
2007-12-21T01:11:56.000Z	143.2274	F	Automatic TM processing.
2007-12-22T15:08:40.000Z	143.2027	F	Automatic TM processing.
2007-12-24T00:43:32.000Z	143.1854	F	Automatic TM processing.
2007-12-25T14:56:56.000Z	143.1557	F	Automatic TM processing.
2007-12-27T00:43:48.000Z	143.1369	F	Automatic TM processing.
2007-12-28T14:44:00.000Z	143.1194	F	Automatic TM processing.
2007-12-30T00:19:08.000Z	143.0722	F	Automatic TM processing.
2007-12-31T14:31:45.000Z	143.0581	F	Automatic TM processing.
2008-01-02T00:20:21.000Z	143.0246	F	Automatic TM processing.
2008-01-03T14:17:29.000Z	143.0129	F	Automatic TM processing.

This report was generated Fri Jan 4 08:00:21 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, 29/12/2007 – 04/01/2008

The AOCS operations were executed from the Automatic Timeline.

During this period, 85 Open Loop Slews, 83 Closed Loop Slews and 5 Momentum Biases were executed.

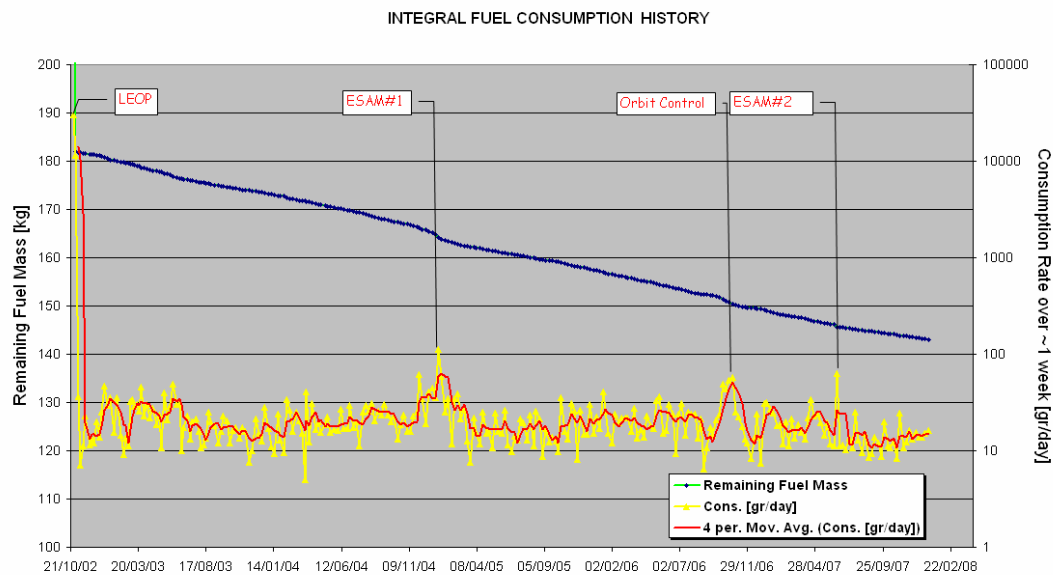
No slews were missed from TL, during the observation period.

Orbit Control

No update.

Fuel consumption

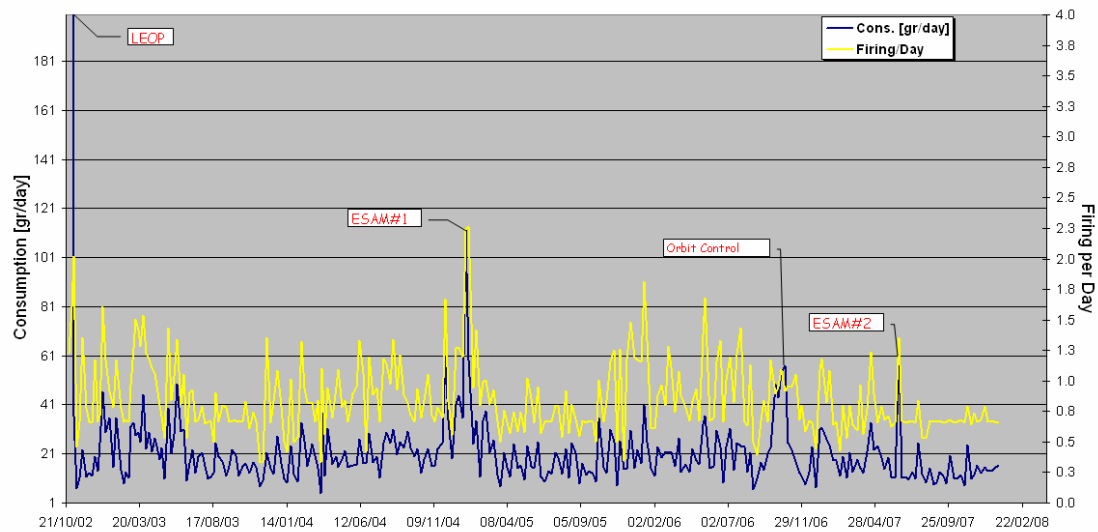
The fuel consumption (total, grams per day) over the period between 01/11/2002 and 03/01/2008 is reported in the plot below.



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

The firing per day over the period between 01/11/2002 and 03/01/2008 is reported in the plot below.

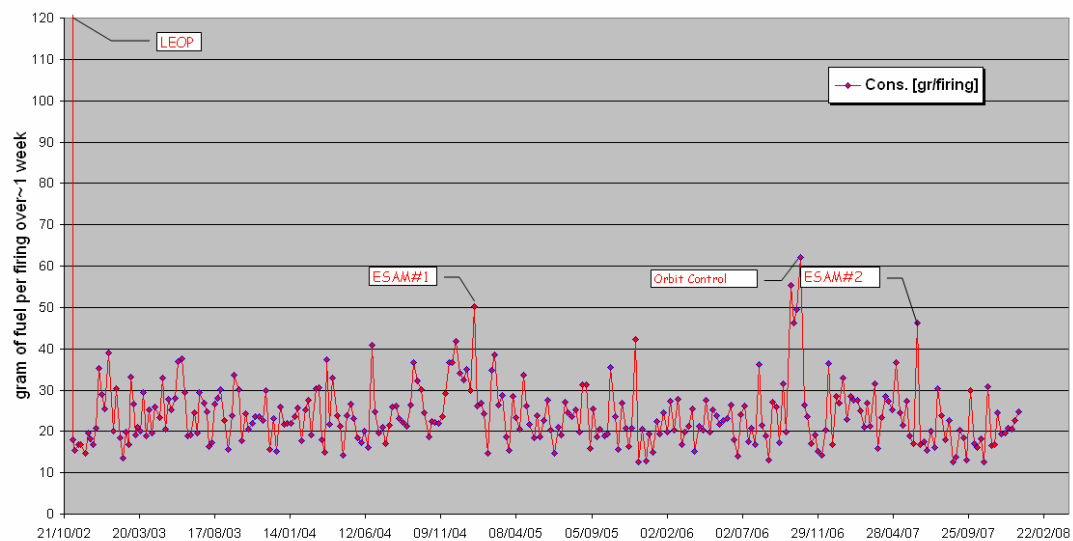
INTEGRAL FIRING PER DAY HISTORY



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

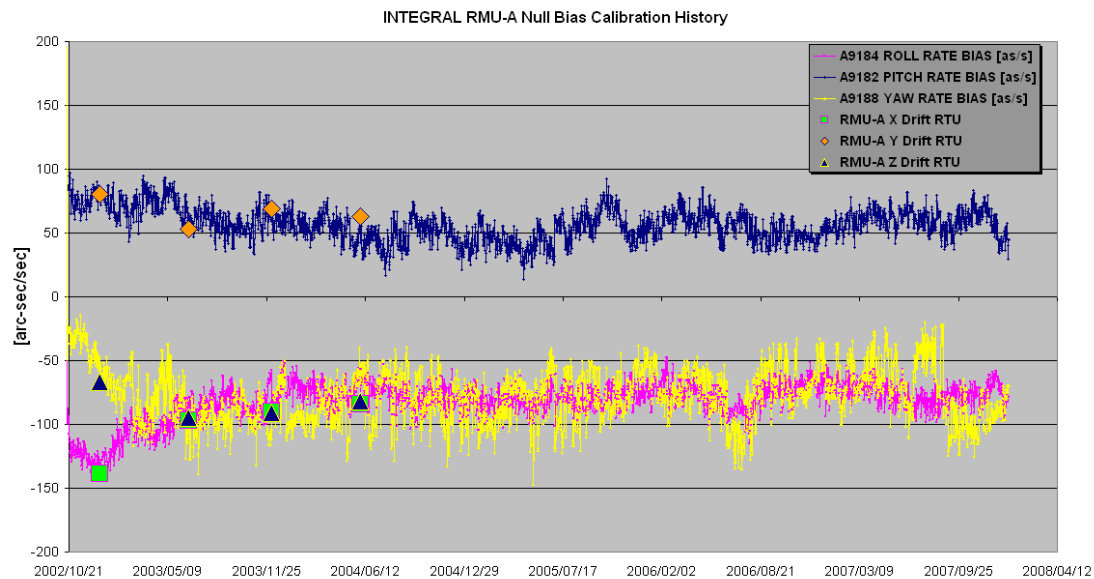
The fuel per firing over the period between 01/11/2002 and 03/01/2008 is reported in the plot below.

INTEGRAL FUEL MASS PER FIRING HISTORY



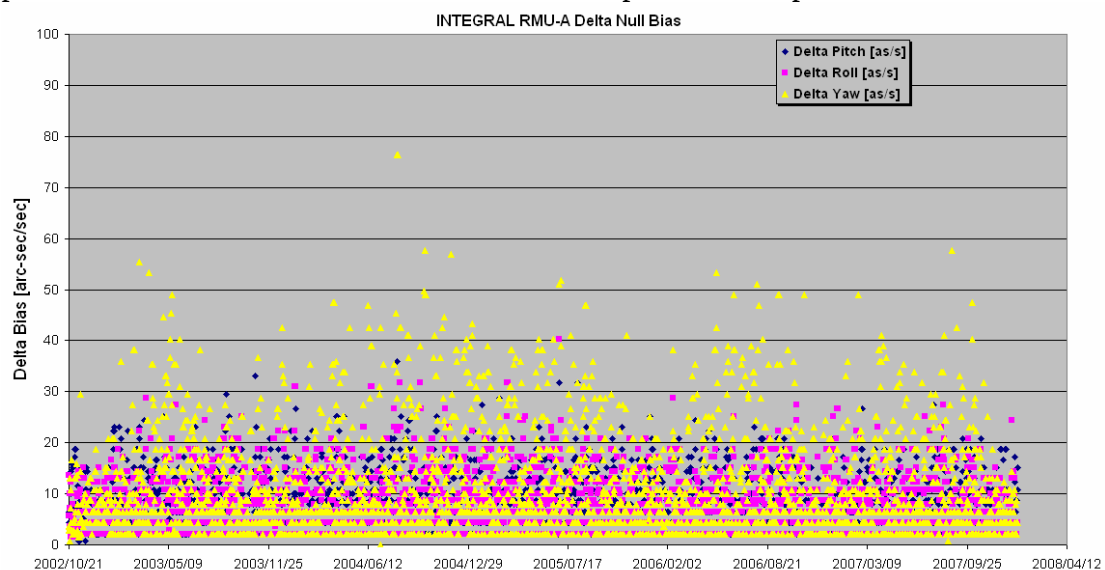
The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 04/01/2008 is reported in the plot below.



The evolution of the drift on yaw channel is under constant monitoring.

The RMU-A delta null bias calibration history, on pitch, roll and yaw channel over period between 01/11/2002 and 04/01/2008 is reported in the plot below.



29/12/2007 (Day of Year 363, Revolution 636)

Nothing to report.

30/12/2007 (Day of Year 364, Revolution 636)

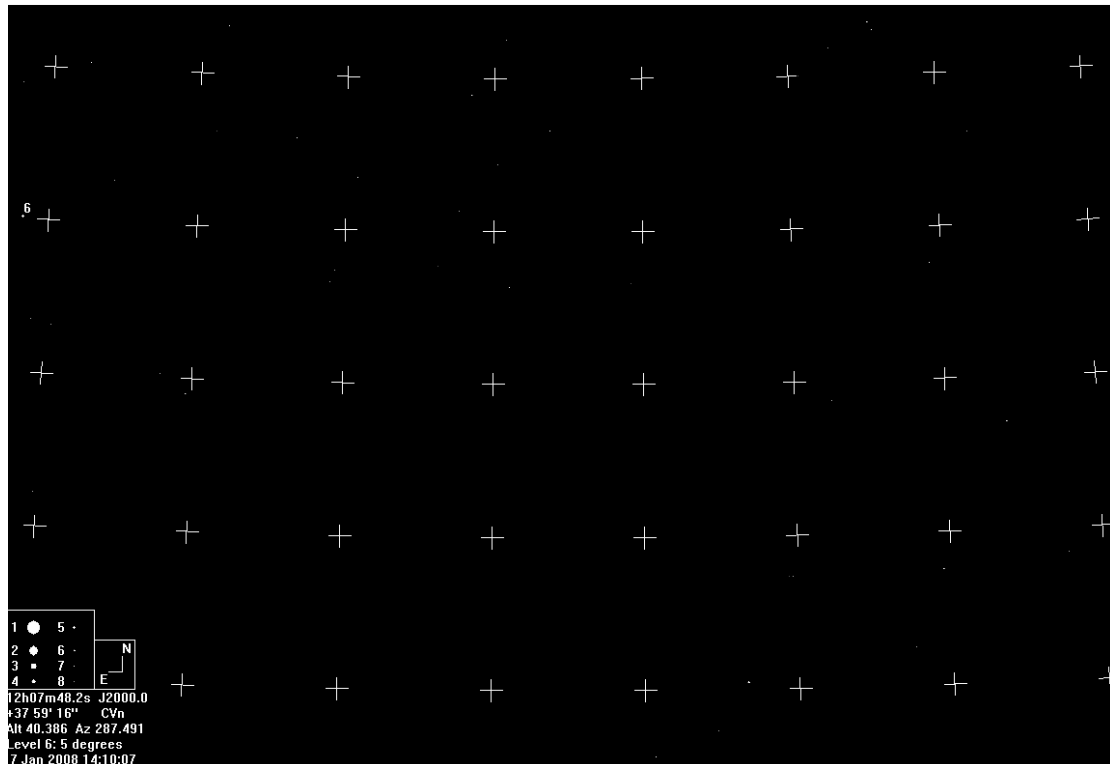
FDS failed update generation: at 08:52z the automatic update of the slew 06360041 failed: this was caused again by the sparse stellar field at the selected attitude for PID 06360040 (RA 12:10:06, Dec +36:17:42) and no suitable stars were found for the update of the next slew.

After indication from FD on-call, the next slew ID 06360041 was left executing with default parameters from TL.

No impact on TL.

Below is reported the mentioned sparse stellar field, between the constellation of Ursa Major and Canis Venatici, as extracted from the star catalogue.

The Mi threshold is set to 8.5 Mi, i.e. the nominal limit for STR operations and is evident the scarceness of bright stars.



FDS failed update generation: at 17:01z the automatic update of the slew 06360048 failed: this was caused again by the sparse stellar field at the selected attitude for PID 06360047 (RA 12:08:39, Dec +37:26:57) and no suitable stars were found for the update of the next slew.

After indication from FD on-call, the next slew ID 06360048 was left executing with default parameters from TL.

No impact on TL.

31/12/2007 (Day of Year 365, Revolution 636-637)

Nothing to report.

01/01/2008 (Day of Year 001, Revolution 637)

Nothing to report.

02/01/2008 (Day of Year 002, Revolution 637)

Nothing to report.

03/01/2008 (Day of Year 003, Revolution 637-638)

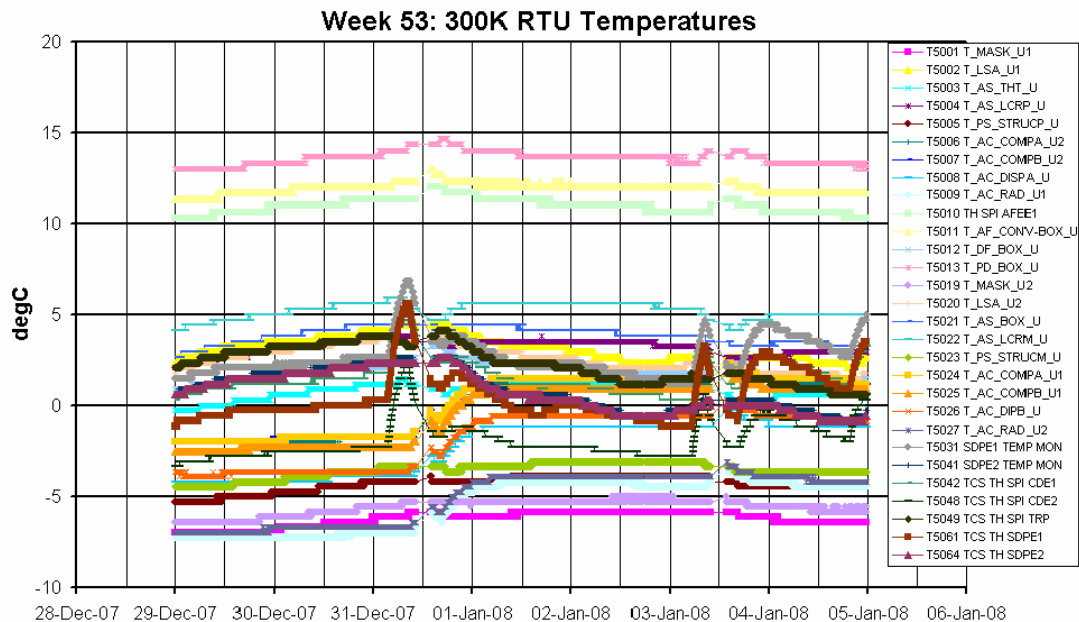
Nothing to report.

04/01/2008 (Day of Year 004, Revolution 638)

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.

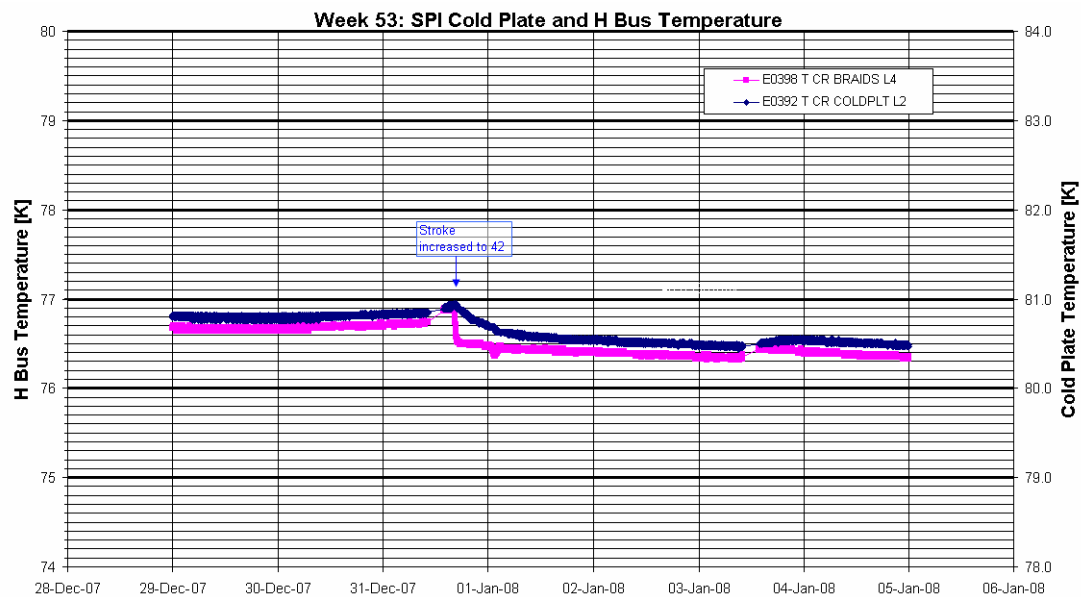


Stirling Compressors and Cryostat: The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K.

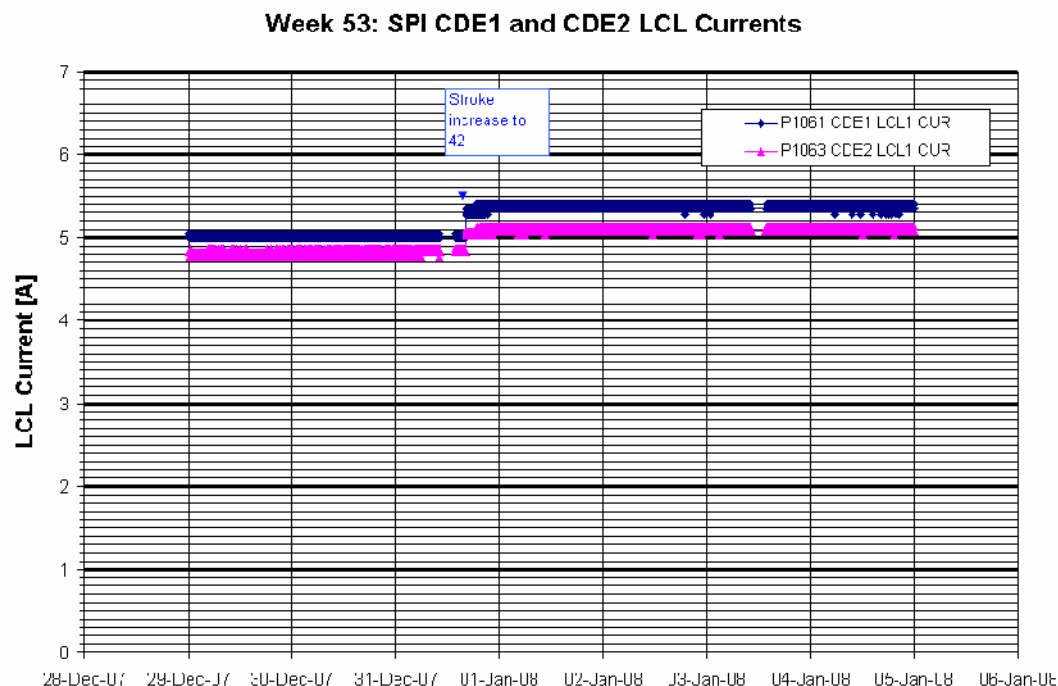
The stroke of all four compressors was set to 41 until 2007-12-31 at 16:27Z, when the stroke of all four compressors was increased to 42 as the cold plate temperature had reached 80.9K. The average CDE LCL currents for the period when the stroke was 42 were as follows:

- CDE1 LCL Current = 5.37A
- CDE2 LCL Current = 5.09A

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



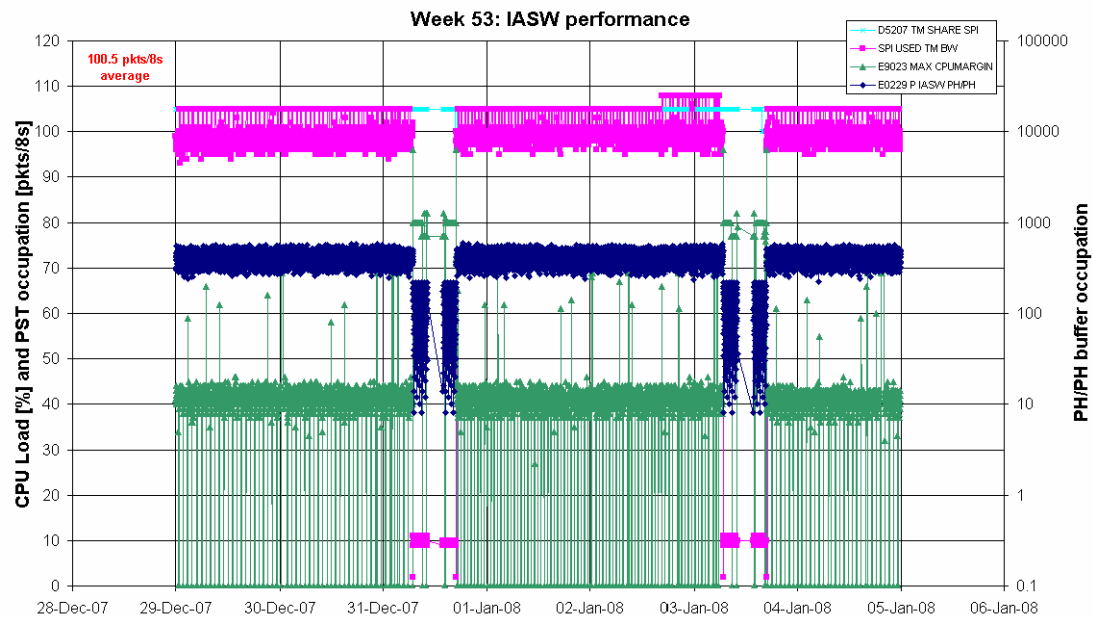
The following plot shows the evolution of the CDE LCL currents during the reporting period.



DPE & IASW: The DPE health and IASW performance is nominal. The IASW version installed is v433 patch #1 with the spectra scaling factor set to 8/19 SE.

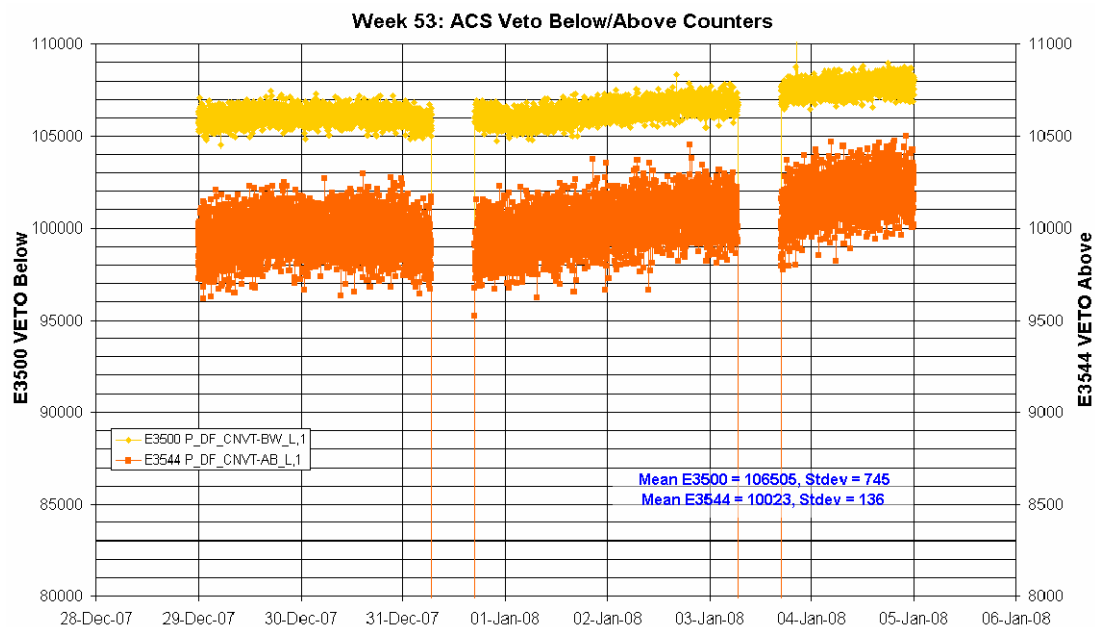
The average TM bandwidth occupation of SPI was 100.5 packets/cycle over the science window. The TM allocation in the science window was 105 packets/cycle, except from 2008-01-02 at 16:35Z until the end of revolution 637, when the over-allocated PST with 108 packets/cycle for SPI was used. Note that the Broadcast Packet TM allocation was not updated. This did not cause any problems and SPI used the additional TM bandwidth during spectra transmission.

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



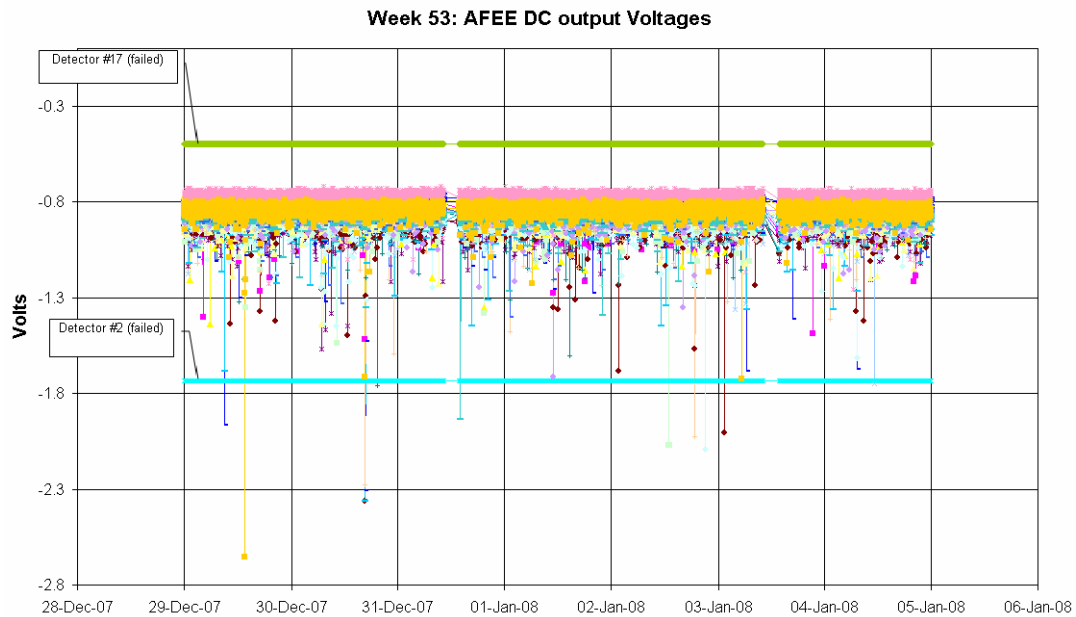
ACS: The performance of the ACS is nominal, except for FEE #81 which remains switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is still OFF due to the anomaly on 5/8/2003 (INT_SC-61).

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

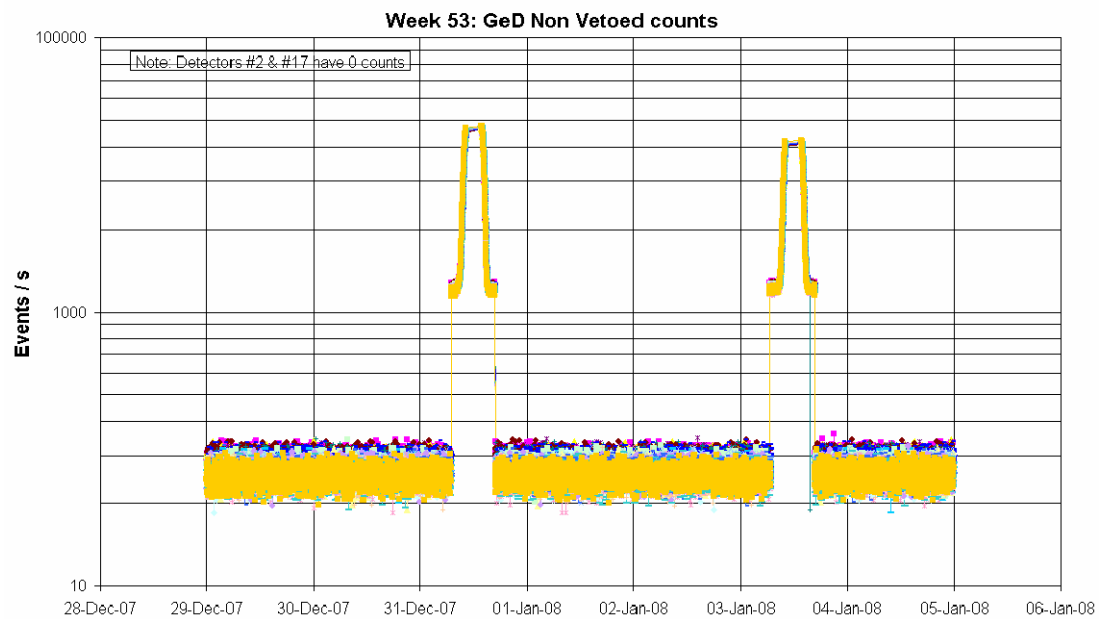


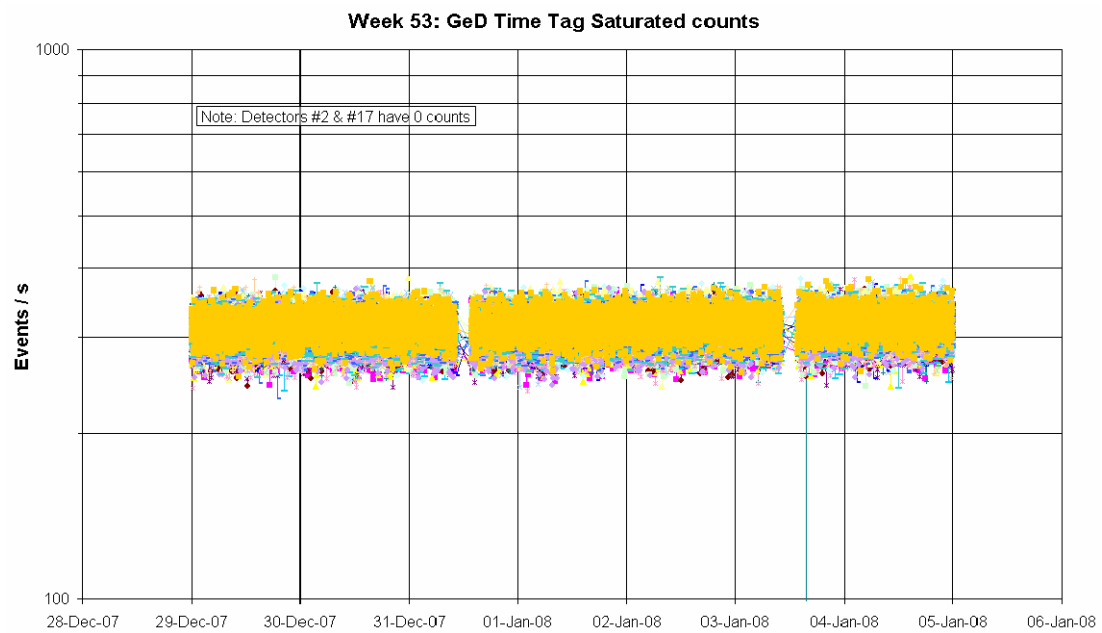
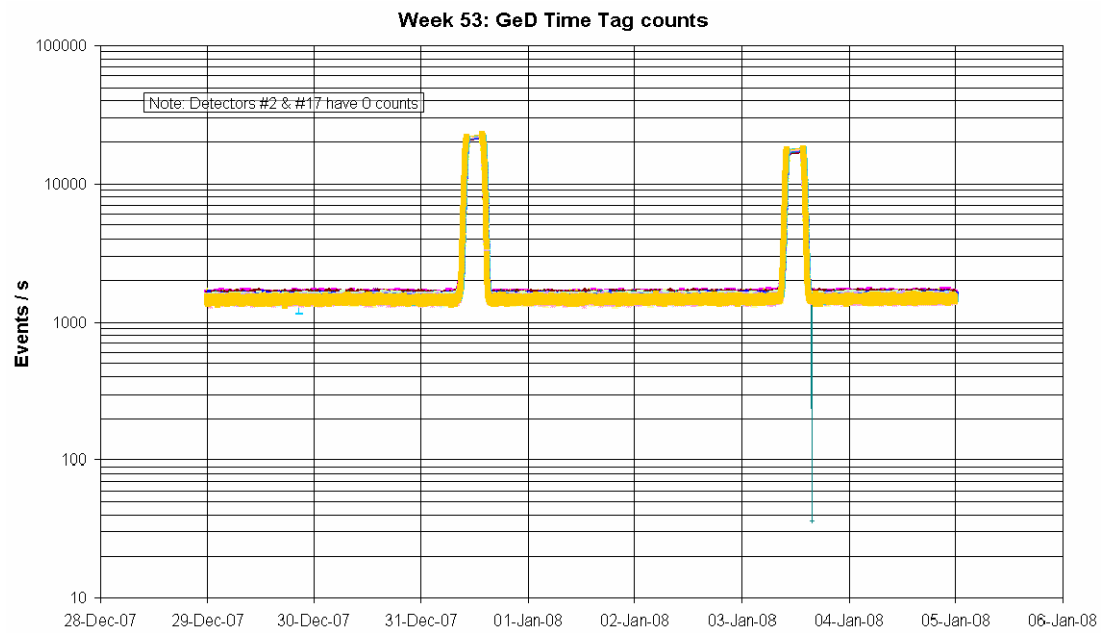
AFEE: The health of the AFEE is nominal. The performance of the AFEE and the detectors is nominal, except for the Ge detector #12 which is showing a slightly degraded energy resolution and is therefore operated at a lower HV setting of 3.5kV (instead of 4kV).

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.

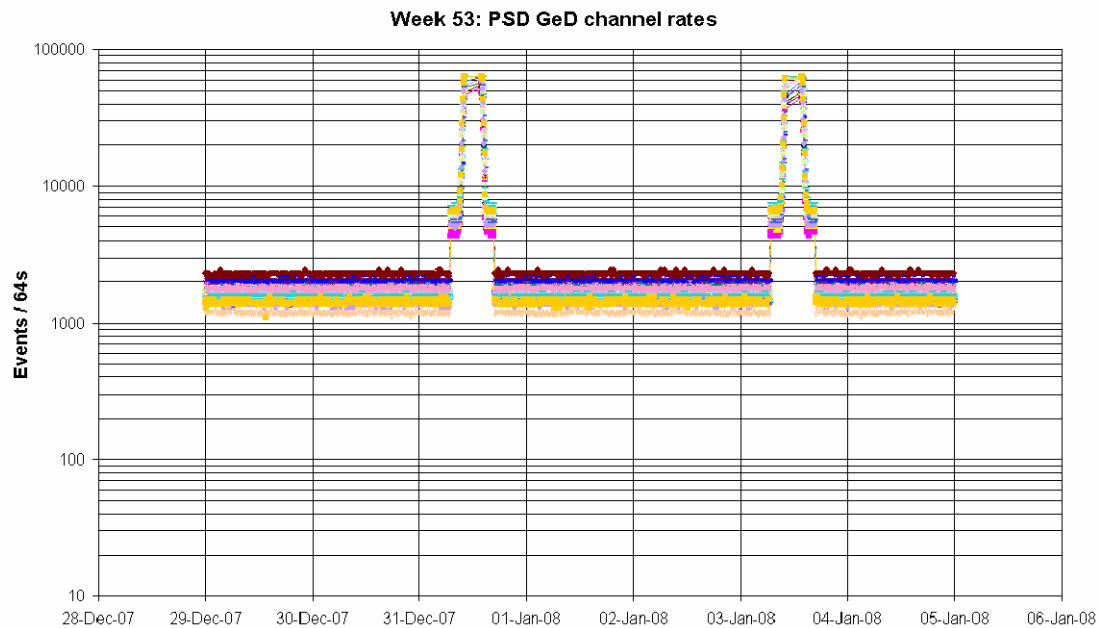


DFEE: The performance of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event Count Rates during the reporting period.





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



Event Log:

The following non-nominal events occurred on SPI during the reporting period:

- 16 occurrences of OEM APID 1024 ID 243 EXCEPTION SPI1 SPECTRA BUILDING NOT COMPLETED were received during the week. As they were all single occurrences, no action was taken.
- On 2007-12-30 at 06:11:10Z TM parameter E3127 went OOL (value = PARAM > SPEC). This is the ACS FEE analogue status -5 V #56. It returned within limits when the next packet was received at 06:21:50Z and no action was taken.

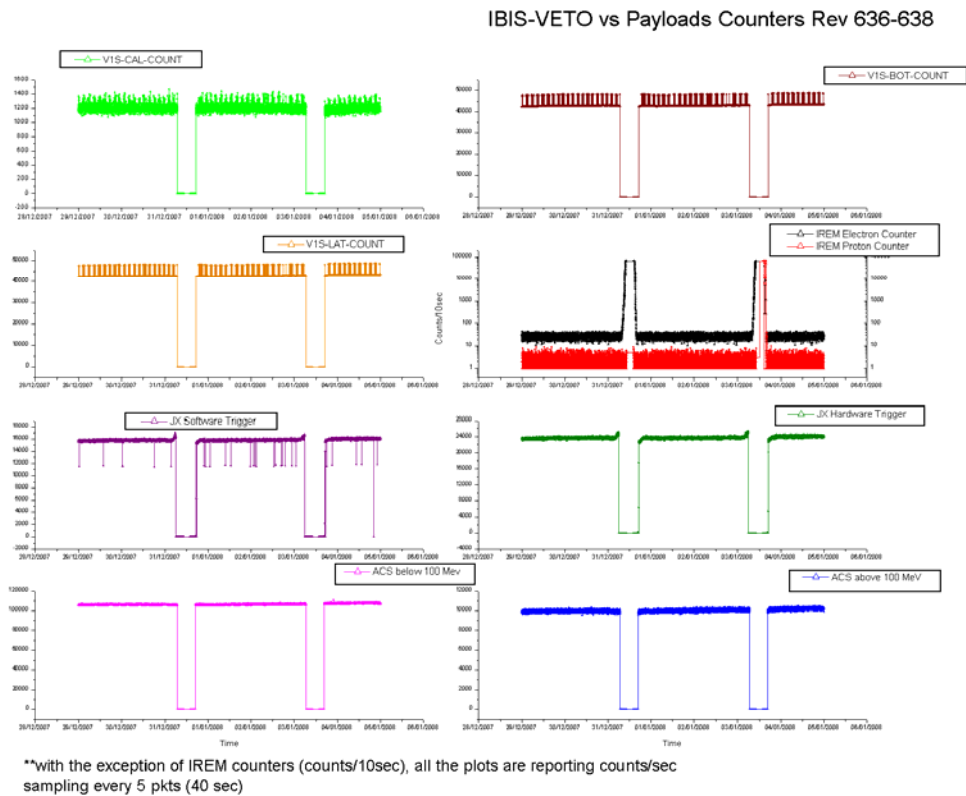
8.3.3 IBIS Operations

IBIS Event Counters Plots

ISGRI Counters:

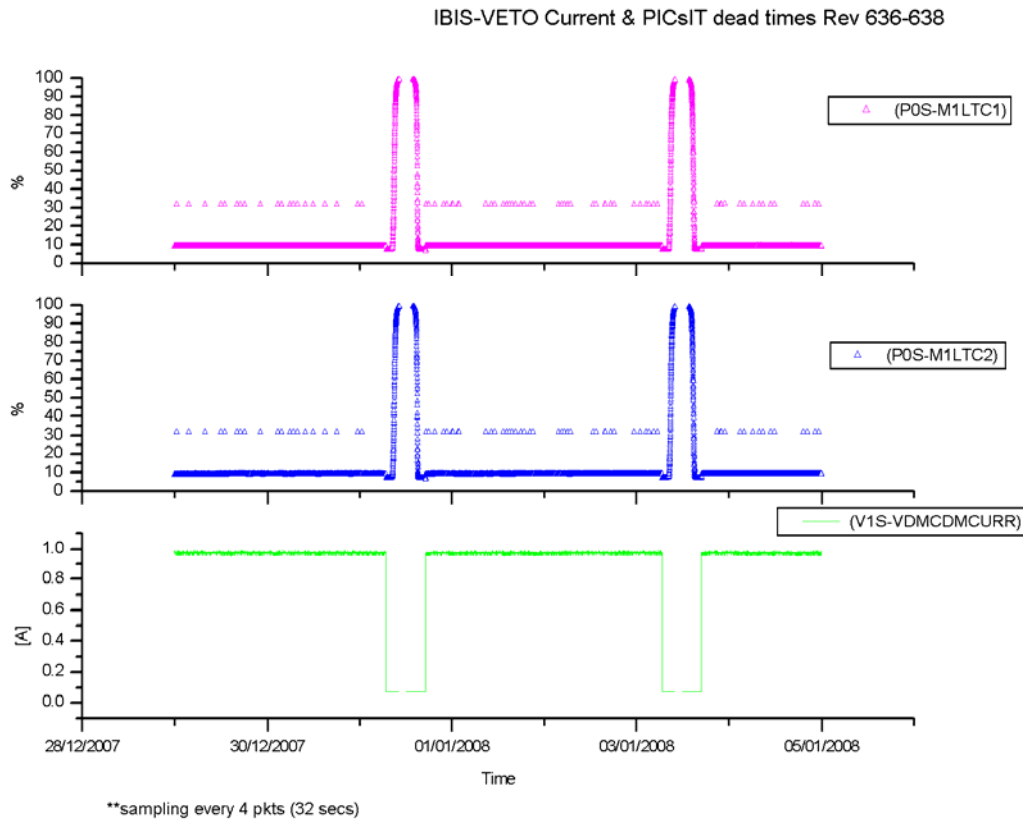


VETO vs Payloads Counters:

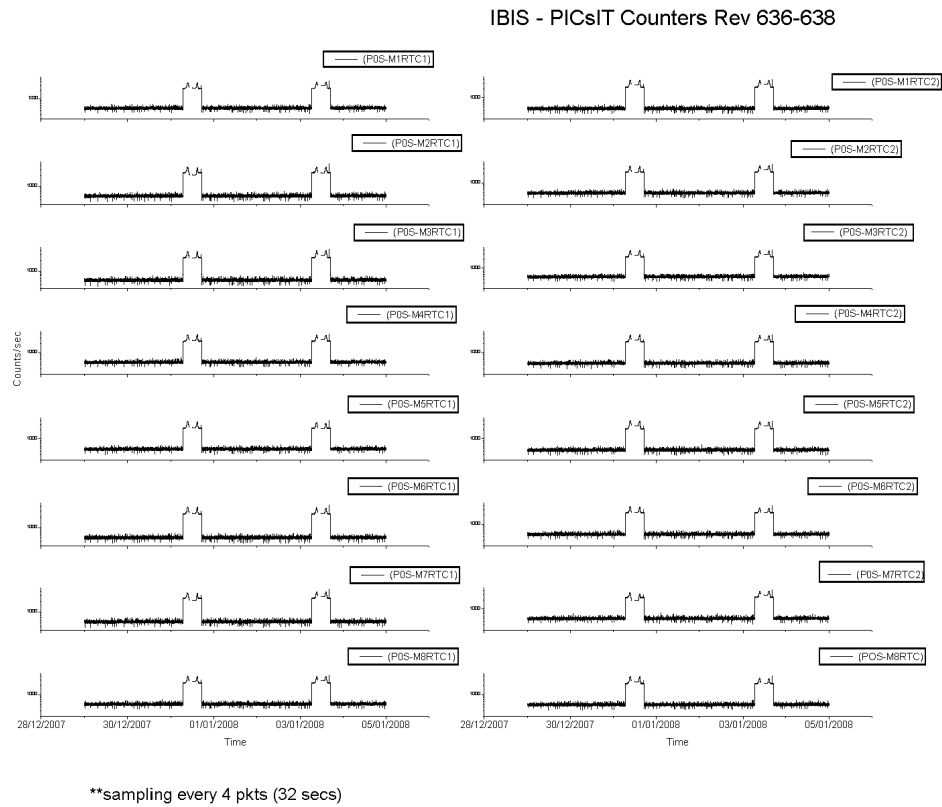


The week was characterised by low radiation as reported by the payload.

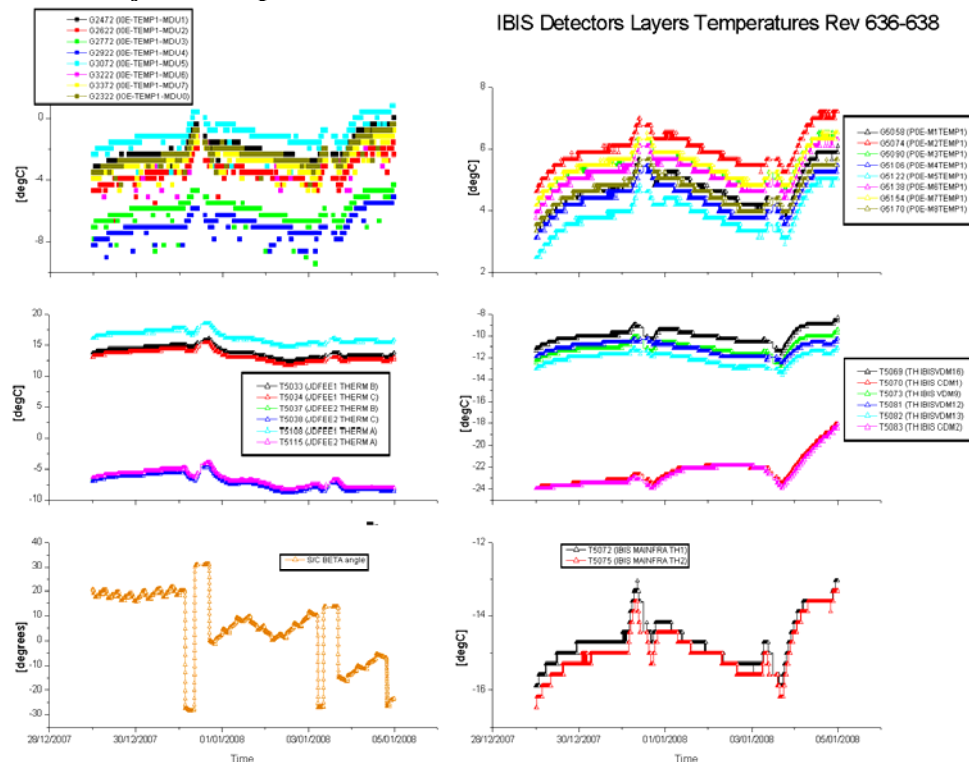
VETO Current:



PICsIT Counters:



IBIS Detectors Layers Temperatures:



**sampling every 8 pkts (64 secs)

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 (I0E-OVFWPXADD-Mi) were received during the radiation belt passages.

In addition, throughout the week, TM parameter G8080 went OOL Warning High several times. This is the Valid event rate on HBRA. As at each occurrence it remained OOL for only 1 TM cycle, no action was taken. This indicates an overflow in the counters and affects only the quality of the scientific data but not the safety of the instrument.

2007-12-29 (DOY 363, Rev 636) to 2007-12-30 (DOY 364, Rev 636)

IBIS operations executed nominally.

2007-12-31 (DOY 365, Rev 636-637)

At 16:44:48Z, during the execution of the ED GEISCL03 before radiation belt exit of revolution 637, TM parameter G2111 went OOL Low (value =0). This is the number of events triggering the MCE7 per second. As it returned within limits at 16:45:12Z, no action was taken.

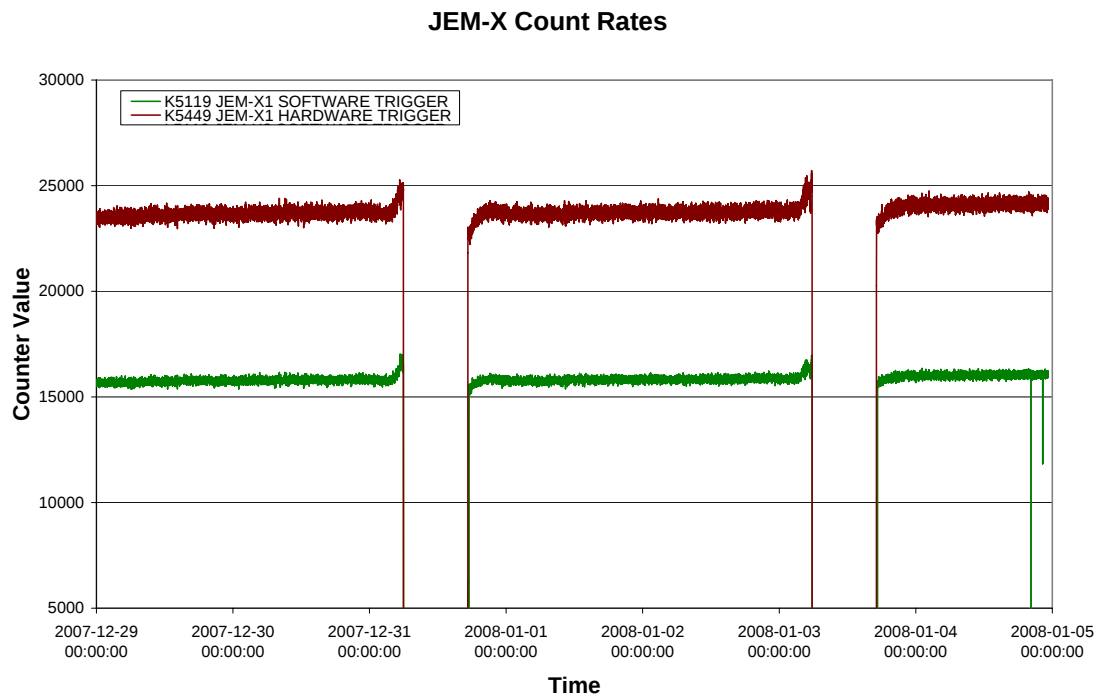
2008-01-01 (DOY 001, Rev 637) to 2008-01-04 (DOY 004, Rev 638)

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.



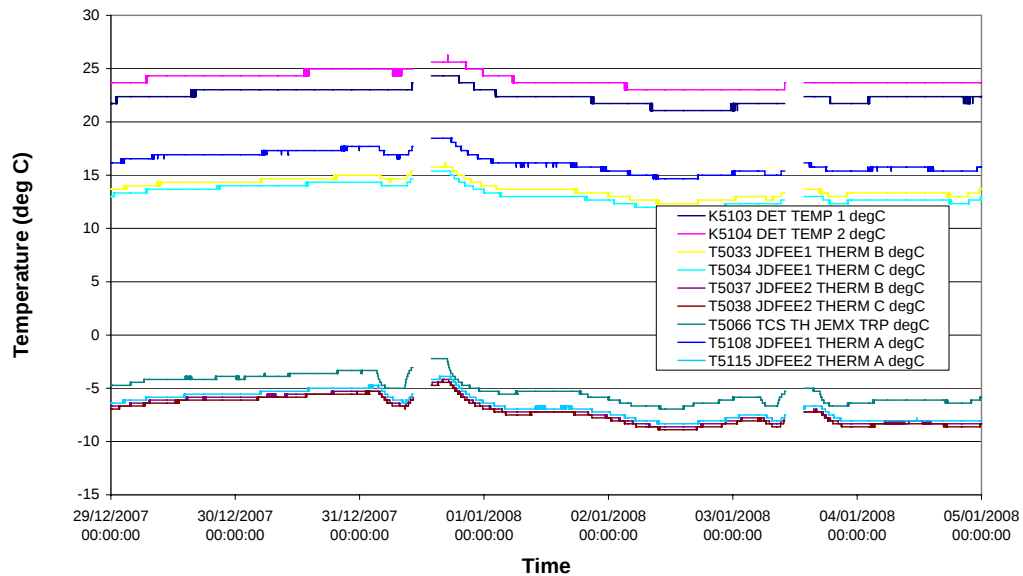
JEM-X Temperatures

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)

JEMX Detector & DFEE Temperatures



JEM-X Daily Report

2007-12-29 (DoY 363, Rev 636) to 2007-12-30 (DoY 364, Rev 636)

JEM-X1 operations executed nominally

2007-12-31 (DoY 365, Rev 636-637)

On this day, the following group of anomalous OEMs were received, at the indicated times:

2007.365.18.44.01.583	2007.365.18.44.04.251	1536	RealTime	5
ANOMALY JEM-X1 CSSW INT ER EXCEPTIO				
0	0	65535	PR	N E E
FIX6				0
K9079	MESS CLASS			2
K9080	MESS ID			5
K9074	TASK ID 16			12
K9067	LOGICAL ADDRESS			4989
2007.365.18.44.01.583	2007.365.18.44.04.316	1536	RealTime	5
ANOMALY JEM-X1 CSSW INT ER EXCEPTIO				
0	0	65535	PR	N E E
FIX6				0
K9079	MESS CLASS			2
K9080	MESS ID			5
K9074	TASK ID 16			12
K9067	LOGICAL ADDRESS			4989
2007.365.18.44.01.583	2007.365.18.44.04.318	1536	RealTime	5
ANOMALY JEM-X1 CSSW INT ER EXCEPTIO				
0	0	65535	PR	N E E
FIX6				0
K9079	MESS CLASS			2
K9080	MESS ID			5
K9074	TASK ID 16			12
K9067	LOGICAL ADDRESS			4989

2007.365.18.44.01.583	2007.365.18.44.04.320	1536	RealTime	5
ANOMALY	JEM-X1 CSSW INT ER EXCEPTIO			
0	0 65535 PR N E E			
FIX6		0		
K9079	MESS CLASS	2		
K9080	MESS ID	5		
K9074	TASK ID 16	12		
K9067	LOGICAL ADDRESS	4989		
2007.365.18.44.01.583	2007.365.18.44.04.346	1536	RealTime	5
ANOMALY	JEM-X1 CSSW INT ER EXCEPTIO			
0	0 65535 PR N E E			
FIX6		0		
K9079	MESS CLASS	2		
K9080	MESS ID	5		
K9074	TASK ID 16	12		
K9067	LOGICAL ADDRESS	4989		
2007.365.18.44.01.583	2007.365.18.44.04.348	1536	RealTime	5
ANOMALY	JEM-X1 CSSW INT ER EXCEPTIO			
0	0 65535 PR N E E			
FIX6		0		
K9079	MESS CLASS	2		
K9080	MESS ID	5		
K9074	TASK ID 16	12		
K9067	LOGICAL ADDRESS	4989		
2007.365.18.44.01.583	2007.365.18.44.04.350	1536	RealTime	5
ANOMALY	JEM-X1 CSSW INT ER EXCEPTIO			
0	0 65535 PR N E E			
FIX6		0		
K9079	MESS CLASS	2		
K9080	MESS ID	5		
K9074	TASK ID 16	12		
K9067	LOGICAL ADDRESS	5336		

No action was taken and the messages did not reappear. There was no impact.

2008-01-01 (DoY 001, Rev 637) to 2008-01-04 (DoY 004, Rev 638)

JEM-X1 operations executed nominally

8.3.5 OMC Operations

2007-12-29 (DoY 363, Rev 636) to 2008-01-04 (DoY 004, Rev 638)

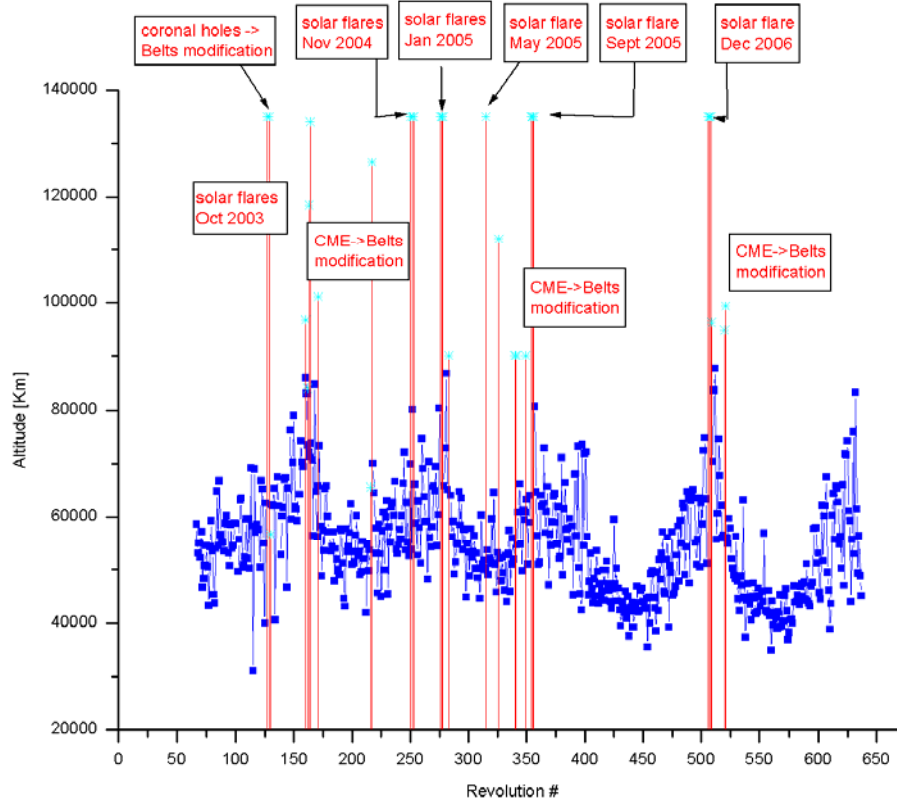
Nothing to Report.

On DoY 365 at 06:52:19, DoY 003 at 06:40:43 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 2003-2007



IREM daily report

DoY 2008.003 (03/01/2008):

At AOS Redu 13.43.51Z, it was observed that a local reset of the IREM CSCI S/W (SEU #59) had occurred. The status of the unit, before the local reset of the IREM CSCI S/W, was nominal, here is a summary:

- 1) The temperatures were nominal;
- 2) The LCL current was nominal;
- 3) The last HK before the anomaly showed HV, 5V and 6V voltages inside limits;
- 4) The anomaly occurred before 2008.003.13.43:51Z, below 30447.6 km. The unit had performed an automatic transition to Standard Mode (ie. no block counter increasing, all the TM words= FFFF hex); just before the anomaly, radiation counters reported nominal values considering the position of the S/C along the orbit;
- 5) The recovery of the unit started at 13:50Z using procedure CRP_SYS_2570.
- 6) The patch was performed successfully with the correct re-starting of the S/W following procedure FCP_RM_0081. The operation was completed at 16:05Z.

The IREM automatic transition to Standard Mode did not affected the instruments as the anomaly occurred inside the radiation belts, when the instruments were already in Safe mode.

The cause of these S/W resets is apparently due to the unit's memory device that is sensitive to high energy radiation, as proved during test campaign on-ground.

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]
636	RAD_ENTR R 2007-12-31T06:52:17Z	31/12/2007 07:44:18	48825.0	31-Dec-2007 08:18:32	43275.64
637	RAD_EXIT R 2007-12-31T16:56:10Z	31/12/2007 15:23:46	>>33225.4	31-Dec-2007 15:58:32	45191.26
637	RAD_ENTR R 2008-01-03T06:40:38Z	03/01/2008 08:00:34	45068.2	03-Jan-2008 08:07:11	43404.67
638	RAD_EXIT R 2008-01-03T16:43:51Z	Not Available	-	03-Jan-2008 15:47:11	45155.69

Reference

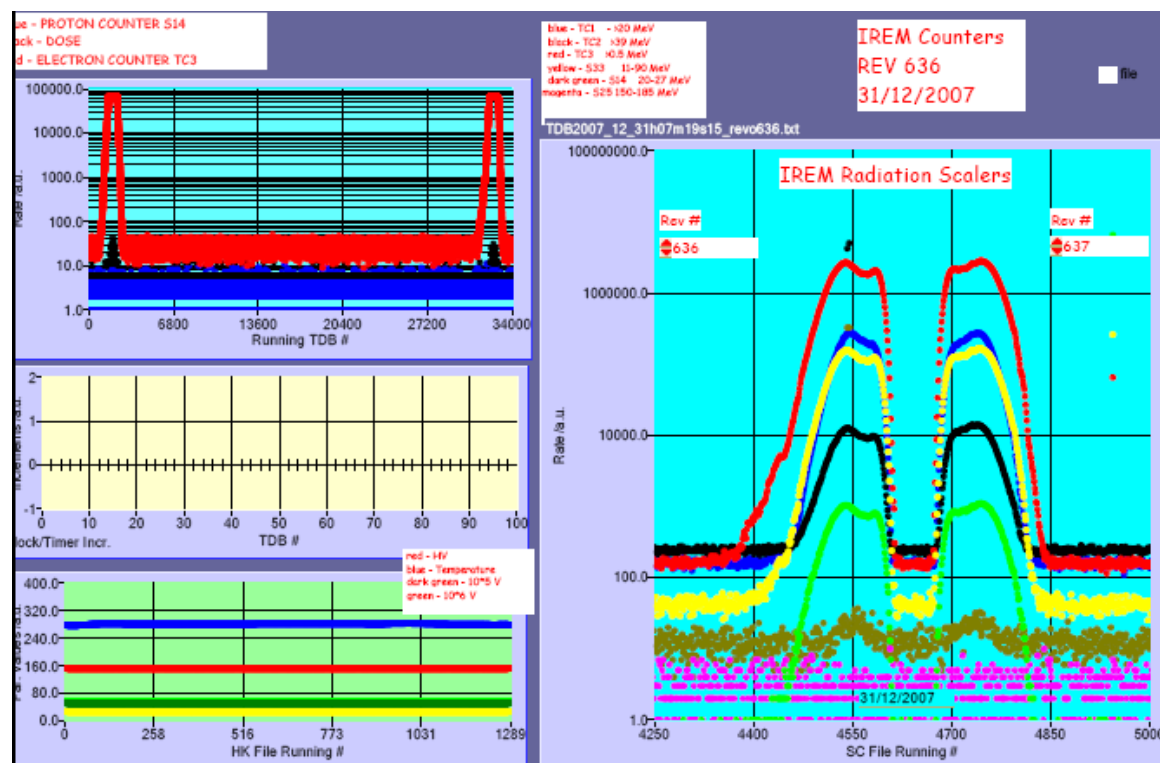
High radiation

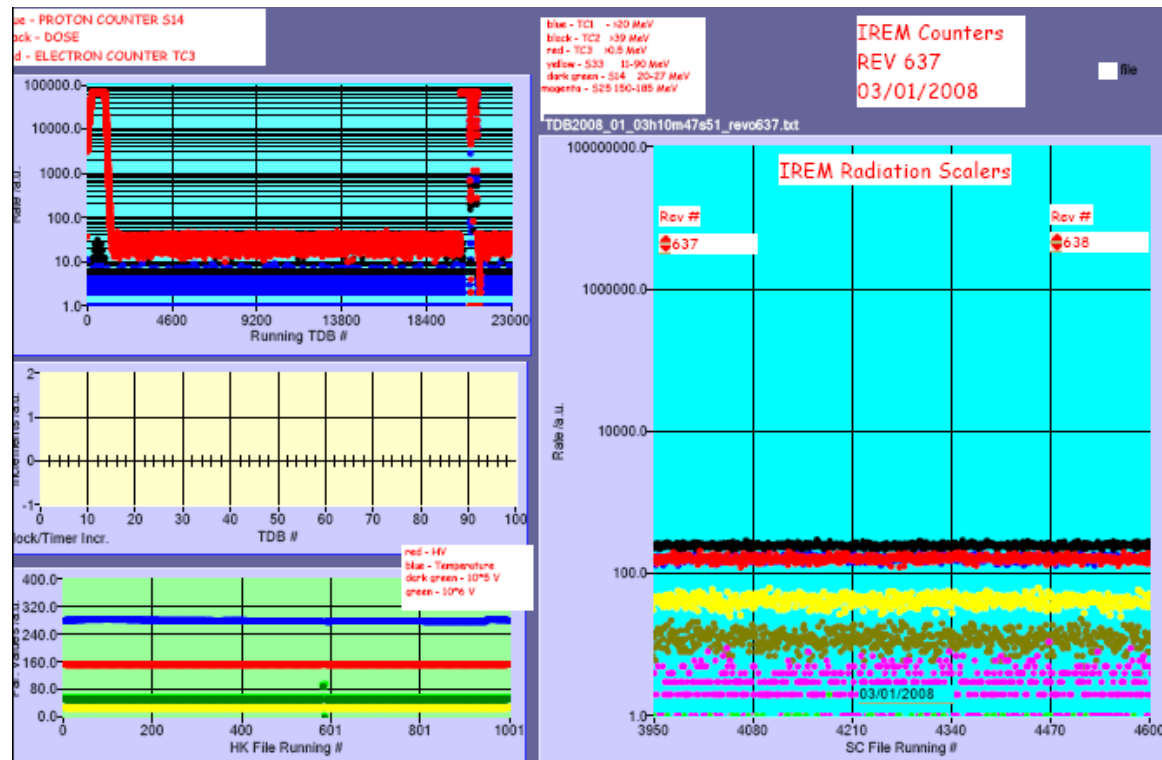
Very small error vs reference (less than 10 minutes)

Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

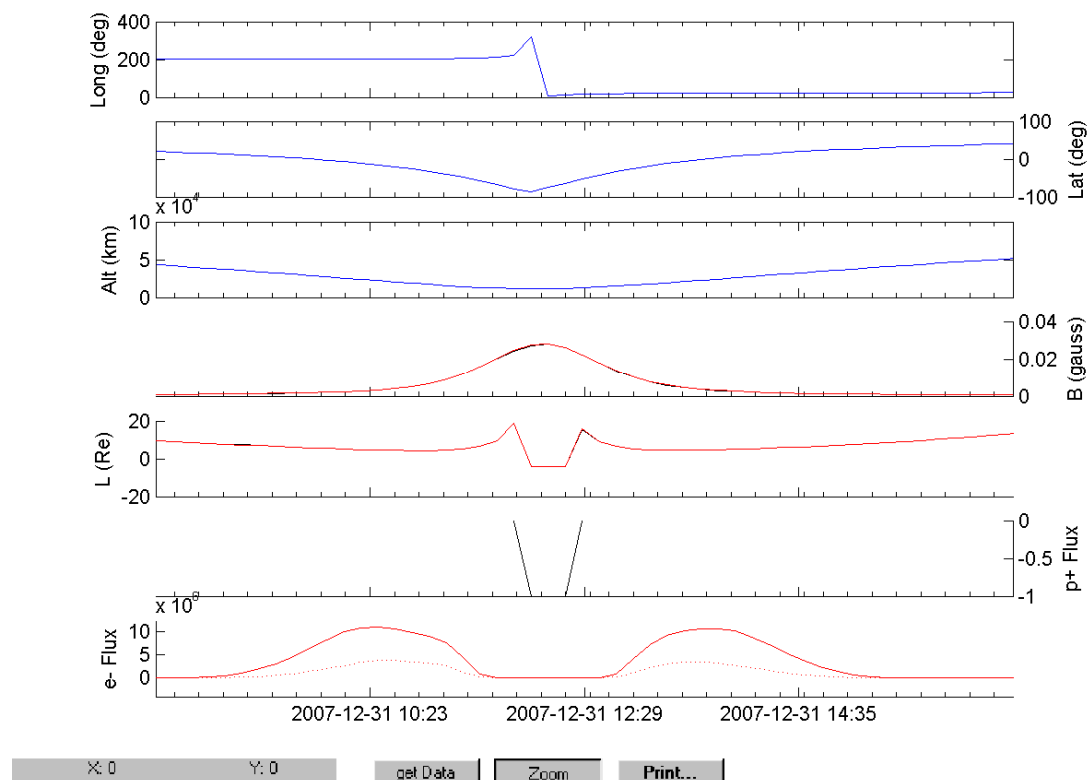
IREM radiation counters:



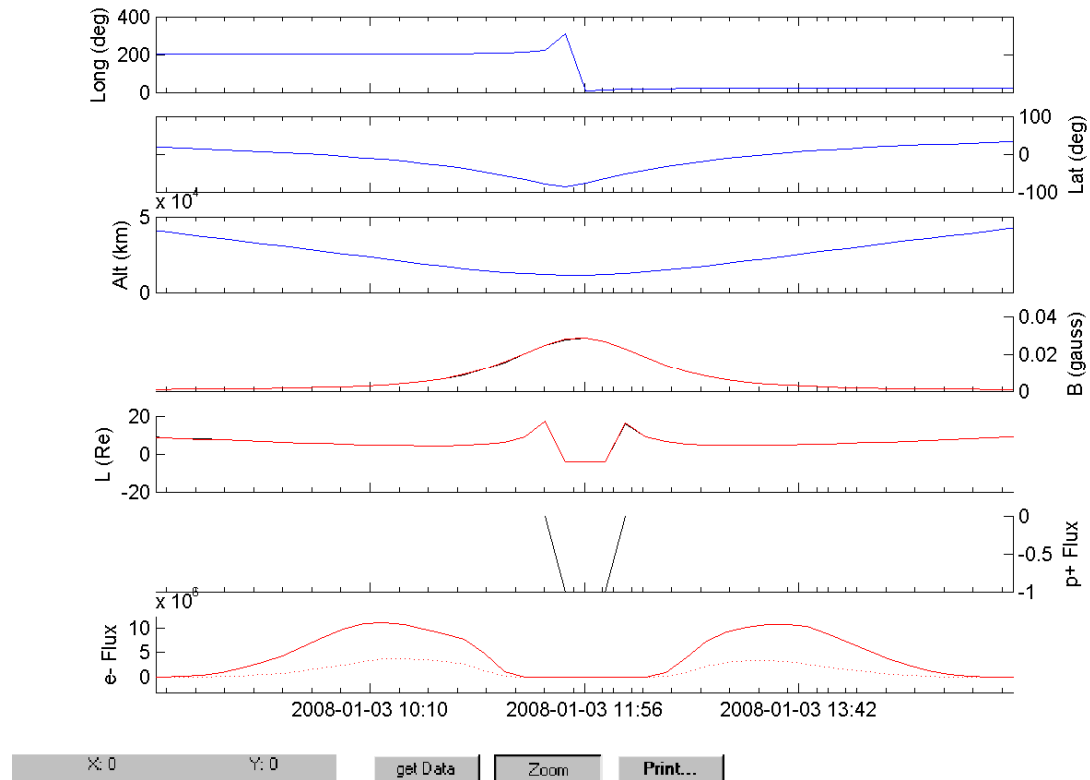


IREM Predicted Radiation Belt Passages

Rev 636



Rev 637



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

Due to a problem on the SEISOP server, no data are available this week. However, the week was very quiet and no radiation was reported.