

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 279
Week 04
28.01.08
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 19.01.08 until 25.01.08 (both dates inclusive) and covers the revolutions 644 and 645.

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 three raster dithers of PKS 1510-089 (RA 15:12:50.53, DEC -09:05:59.8), and a SAS calibration exercise at attitude (RA 15:12:00.00, DEC -09:00:00.0).

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.

1 slew was missed from TL, during the observation period due to loss of guide star.

On the 22/01/2008 a SAS1 calibration was performed to evaluate the SAS cells degradation over the last 12 months.

The fuel consumption over the period between 19/01/2008 and 24/01/2008 was 0.0883 Kg. The remaining propellant is in the order of 142.5976 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

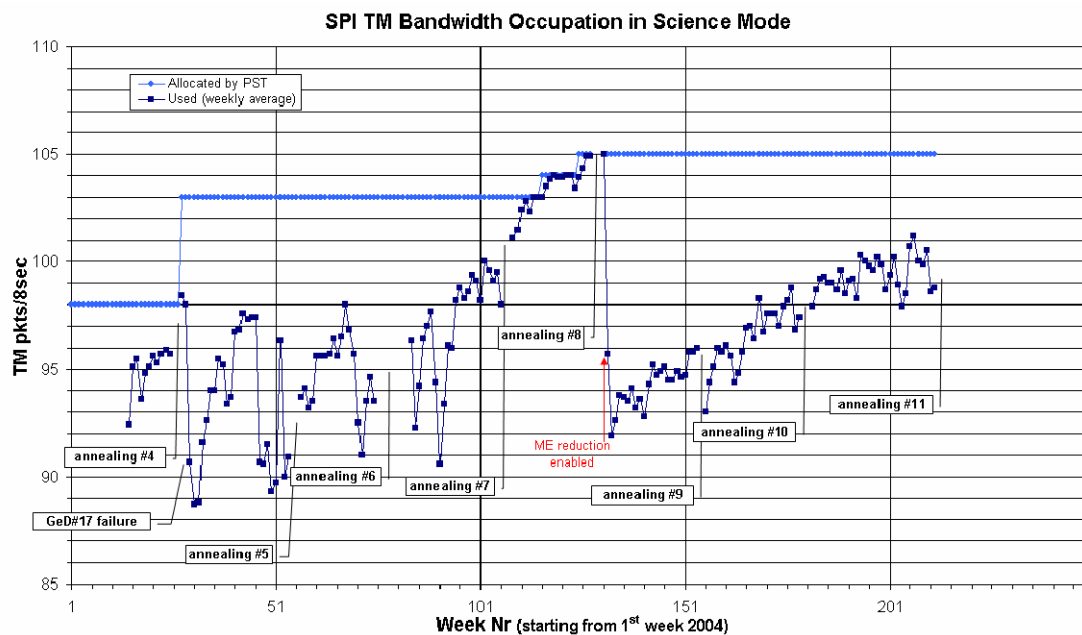
The overall status of the gamma-ray spectrometer is nominal. The 11th annealing started on 12th January and this annealing is progressing nominally. The summary annealing timeline is included in the future activities section of this report. The following table reports the major events/steps performed so far (i.e. up to 25th January) since the start of the annealing:

Date/Time	Activity
12/01/2008 06:11Z	Configure SPI for start of Annealing and stop SPI active cooling
12/01/2008 07:12Z	Annealing Heater Main ON
12/01/2008 09:12Z	Annealing Heater Redundant ON
13/01/2008 18:25Z	Cold plate temperature reached 373K (100degC)
21/01/2008 21:40Z	Stop SPI Annealing: Annealing Heater Main and Redundant OFF; Heat Pipe Heater Main and Redundant OFF; Antifreeze Heater 1A ON
22/01/2008 09:40Z	ACS switch-on and calibration start (FEE#57 and FEE#81 ON)
24/01/2008 13:38Z	Thermal braids temperature TM EU0398A reached 308K
24/01/2008 13:47Z	Start of cryo-cooler switch-on
24/01/2008 15:04Z	Cryo-cooler switch-on complete and stroke set to 4x45

The Stirling compressors are working nominally. The cryo-cooler was in Standby mode until the start of active cooling on 24/01/2008 at 13:47Z.

Throughout the reporting period SPI was in CONF mode due to the annealing and the assigned TM bandwidth was 46 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

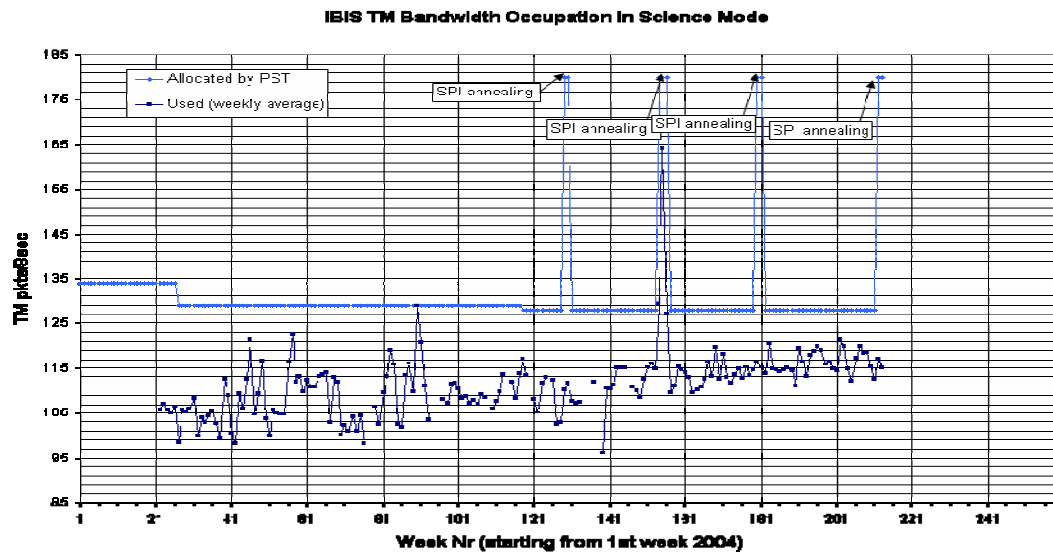
The overall status of the unit is nominal.

During the reporting period, the PST allocation to IBIS was 180 packets/cycle (due to the ongoing SPI Annealing). The IBIS mean bandwidth utilisation during the observation period (when IBIS was in Science mode) was 114.87 packets/cycle, down 2.44 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 15 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 146 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 all week, with very low risk of solar flares.



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 very good this week. No pointings were lost to ground problems. The overall performance was nearly 100%.

4.1 Mission Operations Centre

The performance of the MOC was good this week. However, there was an occasion where the available disk space on the iddb machine was close to zero. Software support came in, and resolved the issue, without impact.

4.2 Ground Stations & Network

The performance of the ground stations and Network was good this week. There was, however, 2 occasions of TM drops from Redu, without impact.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 651-654.
Revolutions have been planned up to revolution 653.

The TSFs for revolution 645 and 646 have been received.

2. Observation status

New ECSs have been received and processed for revolutions 632 and 634-636. The ECS for revolution 633 is missing.

3. ISOC Science Data Archive

No news.

4. ISOC system

Work is further progressing on version 18.0 according to schedule.

5. Problems

None.

4.3.2 ISDC

Status of ISDC observation processing on 28/01/2008:

- Latest Standard Analysis completed: observation 05200260002 (mid-latitude 2, Revolutions 621-622) on 09/01/2008.
- Latest products archived: observation 05200260002 (mid-latitude 2, Revolutions 621-622) on 09/01/2008.
- Latest observation products sent to the observer: observation 05200310002 (3C 454.3, Revolutions 623-624) on 11/01/2008.

5 Special Events

6 Anomalies

There were no problems this week reported that impacted operations:

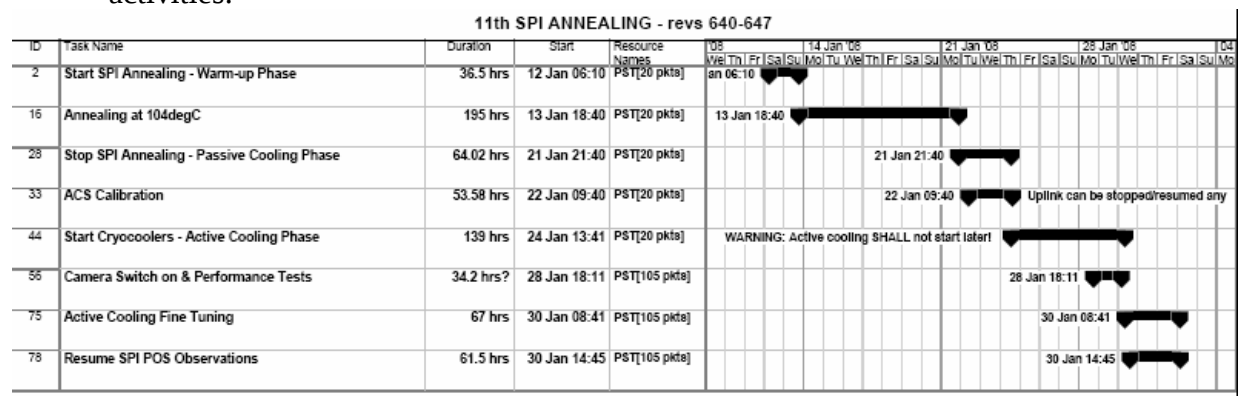
The following anomaly report was entered into the ARTS system this week.

AR id	Date Created	Subject	Segment	Status
INT-2975	2008-01-24	Problems with sun127 Following move to Halley LAN	IMCS	Pending

7 Future Milestones

The following activities are foreseen in the next few weeks.

- The 11th annealing operations started on 12th January at radiation belt entry of revolution 640. Below is the summary timeline of the planned annealing activities:



- 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 644

The observations in revolution 644 began with of a raster dither of PKS 1510-089 (RA 15:12:50.53, DEC -09:05:59.8), lasting ~17.1 hours. They continued with a SAS calibration exercise at attitude (RA 15:12:00.00, DEC -09:00:00.0) for ~2.9 hours, finally a return to the raster dither of PKS 1510-089 (RA 15:12:50.53, DEC -09:05:59.8) for a further ~36.2 hours was performed until the end of the revolution.

Revolution 645

The observations in revolution 645 consisted entirely of a raster dither of PKS 1510-089 (RA 15:12:50.53, DEC -09:05:59.8), lasting ~56.2 hours.

Throughout these observations, all instruments were in their nominal science modes, except JEM-X2, which is switched off and SPI, which was undergoing annealing. The TM allocation was IBIS 180; SPI 46; JEM-X1 15; JEM-X2 0; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

2008-01-04T19:19:24.000Z	142.9786	F	Automatic TM processing.
2008-01-06T14:09:05.000Z	142.9520	F	Automatic TM processing.
2008-01-07T17:56:12.000Z	142.9236	F	Automatic TM processing.
2008-01-09T13:57:44.000Z	142.9099	F	Automatic TM processing.
2008-01-10T19:08:44.000Z	142.8140	F	Automatic TM processing.
2008-01-12T08:42:00.000Z	142.7945	F	Automatic TM processing.
2008-01-12T13:43:04.000Z	142.7789	F	Automatic TM processing.
2008-01-13T23:41:56.000Z	142.7519	F	Automatic TM processing.
2008-01-15T13:31:36.000Z	142.7354	F	Automatic TM processing.
2008-01-16T22:51:08.000Z	142.7038	F	Automatic TM processing.
2008-01-18T13:15:05.000Z	142.6859	F	Automatic TM processing.
2008-01-19T22:57:48.000Z	142.6543	F	Automatic TM processing.
2008-01-21T13:06:08.000Z	142.6385	F	Automatic TM processing.
2008-01-22T22:23:16.000Z	142.6286	F	Automatic TM processing.
2008-01-24T12:52:56.000Z	142.5976	F	Automatic TM processing.

This report was generated Fri Jan 25 08:00:25 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, 19/01/2008 – 25/01/2008

The AOCS operations were executed from the Automatic Timeline.

During this period, 74 Open Loop Slews, 79 Closed Loop Slews and 4 Momentum Biases were executed.

1 slew (CSL) was missed from TL, during the observation period, due to loss of guide star.

This is equivalent to $\sim 0.7\%$ of the total number of slews planned (153).

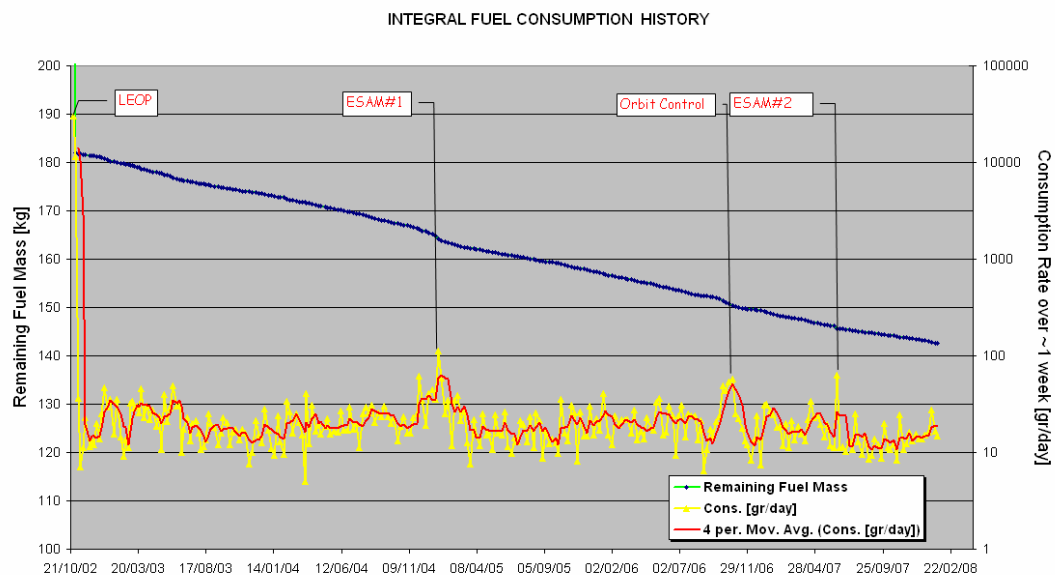
The OTF for PID 06440041 and 06450018 was not reached.

Orbit Control

No update.

Fuel consumption

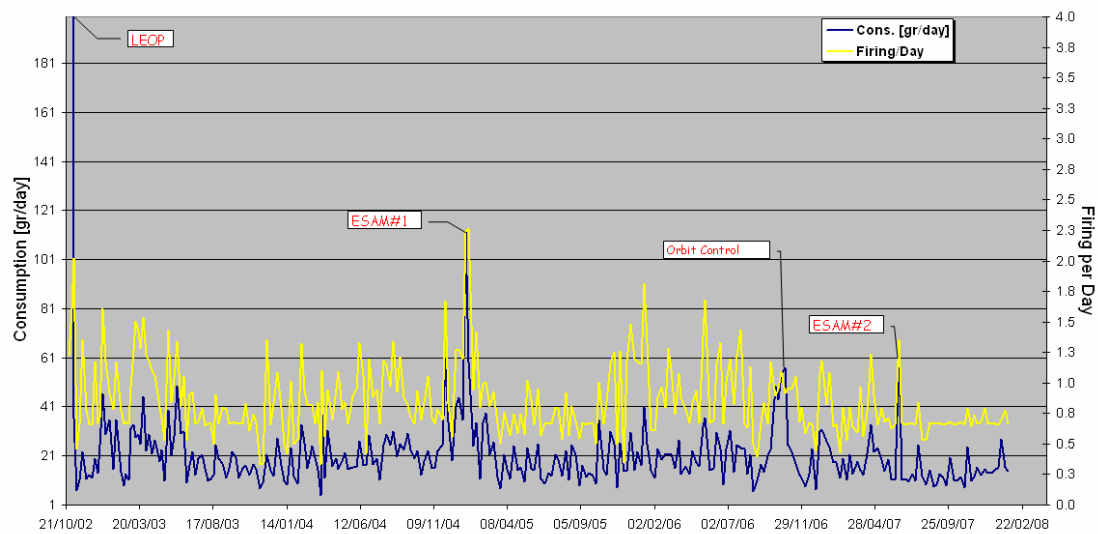
The fuel consumption (total, grams per day) over the period between 01/11/2002 and 24/01/2008 is reported in the plot below.



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 24/01/2008 is reported in the plot below.

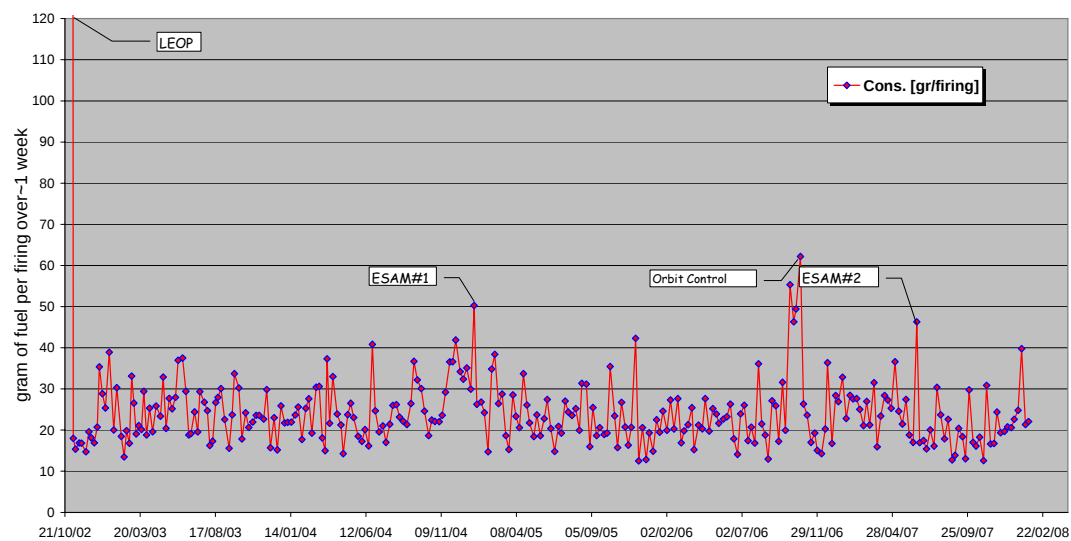
INTEGRAL FIRING PER DAY HISTORY



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

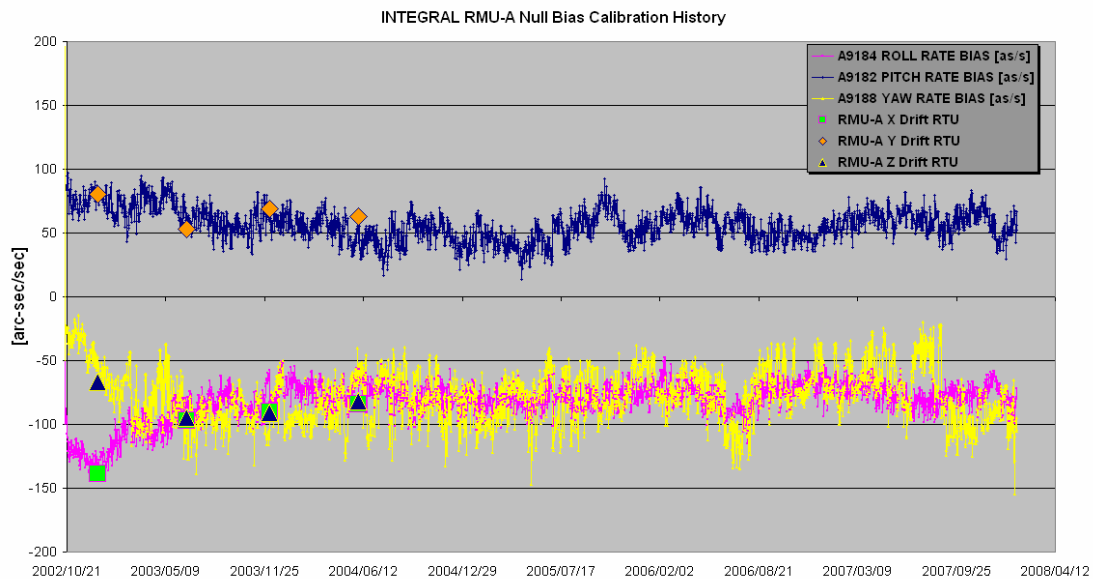
The fuel per firing over the period between 01/11/2002 and 24/01/2008 is reported in the plot below.

INTEGRAL FUEL MASS PER FIRING HISTORY



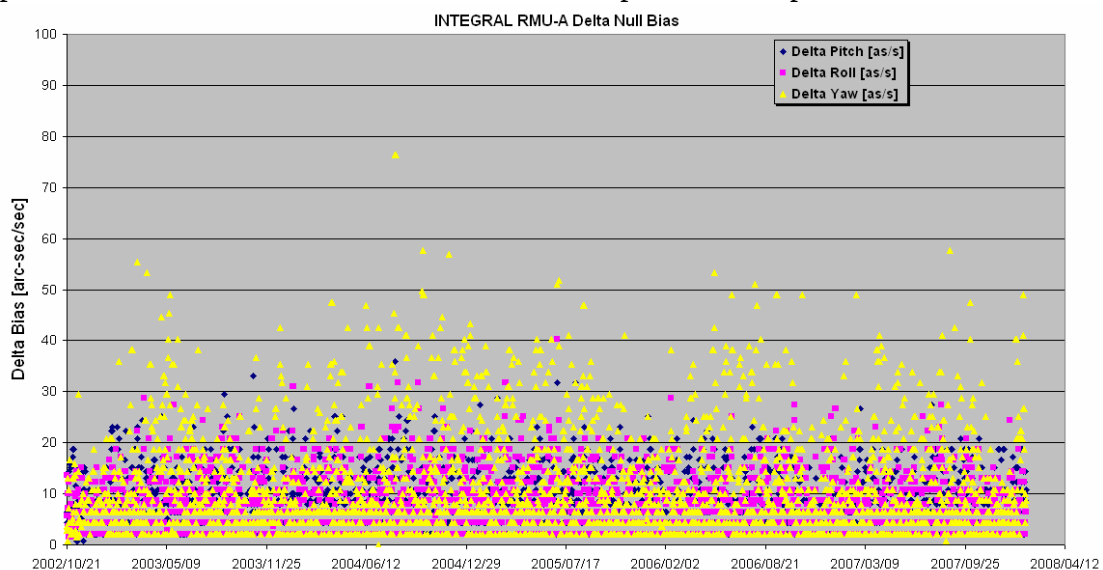
The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 25/01/2008 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 25/01/2008 is reported in the plot below.



19/01/2008 (Day of Year 019, Revolution 643)

FDS failed update: at 14:29:53z the FDS failed the generation of the TPF for the daily RMU calibration.

The drift correction on Yaw axis exceeded the limit set in FDS, causing the abortion of the TPF generation.

After consultation with FCT and FD was agreed to relax the current limit in yaw drift, being the drift well inside the mission specifications.

FCT is constantly monitoring the drift evolution on Yaw axis (see plot in the section above)

No impact on TL

20/01/2008 (Day of Year 020, Revolution 643)

Nothing to report.

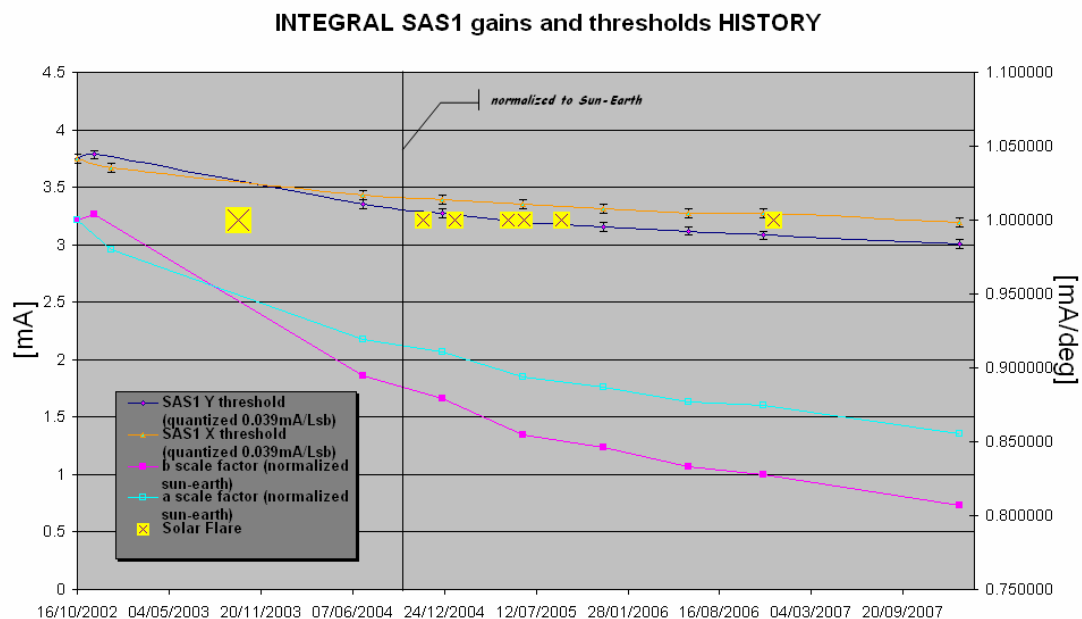
21/01/2008 (Day of Year 021, Revolution 643-644)

Nothing to report.

22/01/2008 (Day of Year 022, Revolution 644)

SAS calibration: the periodic assessment of the SAS1-X and Y thresholds degradation, as result of the SAS calibration performed on the 22/01/2007, give an indication of poor degradation ($\sim 2.2\%$ /12 months) for the SAS-Y threshold and ($\sim 2.0\%$ /12 months) for the SAS-X threshold wrt the last evaluation on winter 2006, consistent wrt the parameter history and the relatively quiet solar activity.

Below is reported the X and Y thresholds history:



23/01/2008 (Day of Year 023, Revolution 644)

Loss of guide star: at 02:11:55z a loss of the selected guide star (STR SEU filter exceeded) occurred during PID 06400041.

As foreseen by the IPS logic, the ACC switched ON the IMU 1, a new automatic mapping was commanded and a new guide star picked.

The next slew in TL for PID 06440042 was manually updated.

The OTF for PID 06440041 was not reached.

24/01/2008 (Day of Year 024, Revolution 644-645)

Nothing to report.

25/01/2008 (Day of Year 025, Revolution 645)

Loss of guide star: at 08:45:40z a loss of the selected guide star (STR SEU filter exceeded) occurred during the last part of PID 06400018.

As foreseen by the IPS logic, the ACC switched ON the IMU 1, a new automatic mapping was commanded and a new guide star picked.

A manual recovery was performed from attitude of PID 06450018 to the attitude of PID 06450019. The next slew in TL for PID 06440020 was manually updated.

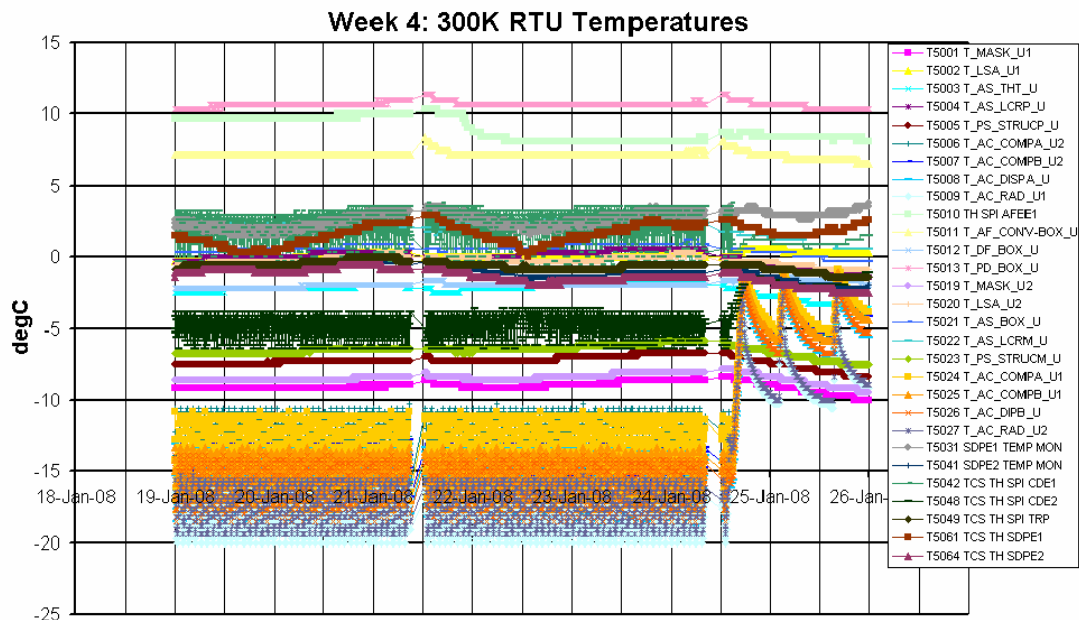
The AOCS s/s was enabled in TL at 09:40:00z.

The OTF was not reached for the last part of PID 06450018.

The following slew was missed in TL: 06450019 (CSL).

8.3.2 SPI Operations

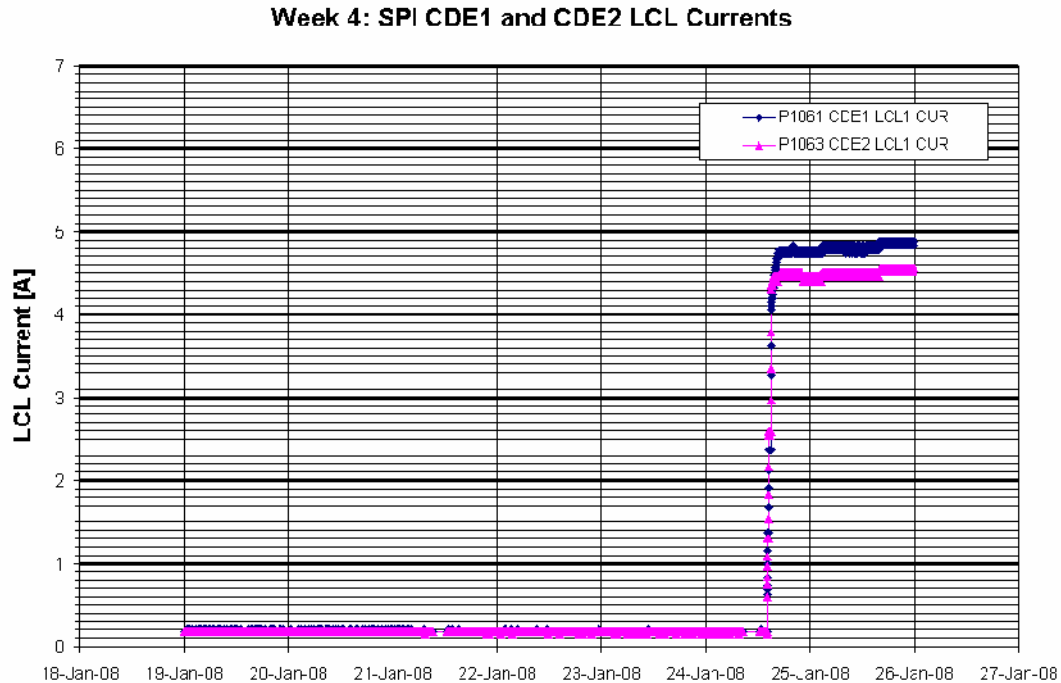
Unit Temperatures: All the equipment temperatures are inside the operational limits. The following plot shows their evolution during the reporting period.



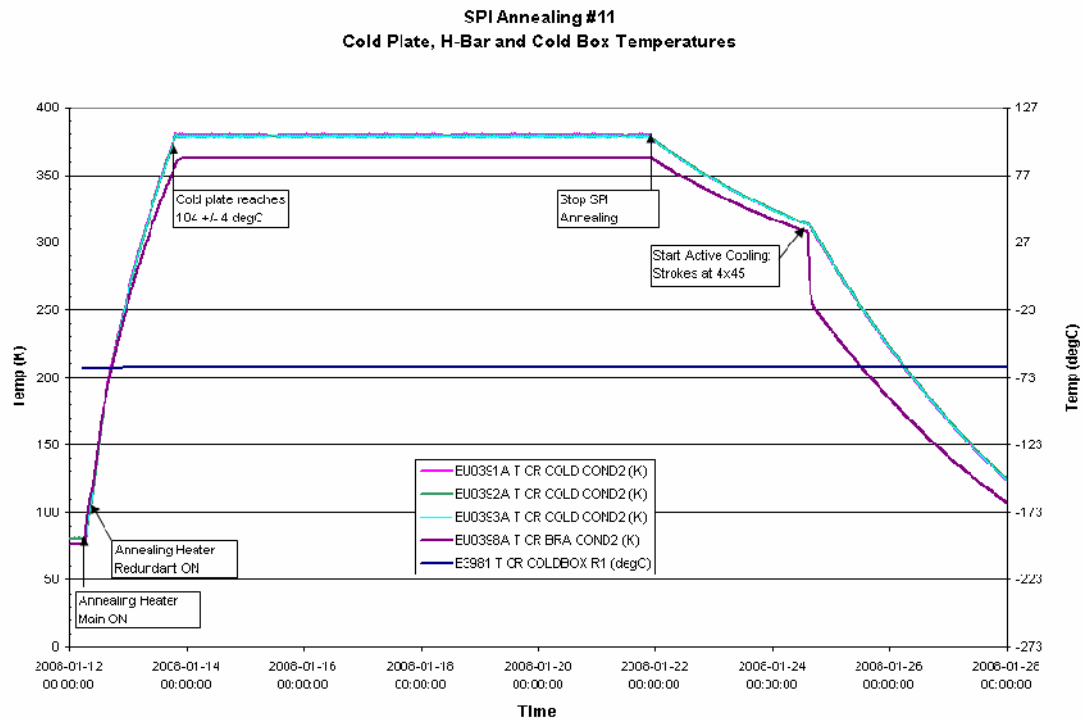
Stirling Compressors and Cryostat: Due to the ongoing annealing operations, the cryo-cooler was in Standby until the start of cryo-cooler switch-on on 24/01/2008 at 13:47Z. The cryo-cooler switch-on was completed on 24/01/2008 at 15:04Z, with the

stroke of all four compressors set to 45. The stroke of the compressors remained at 45 for the rest of the reporting period.

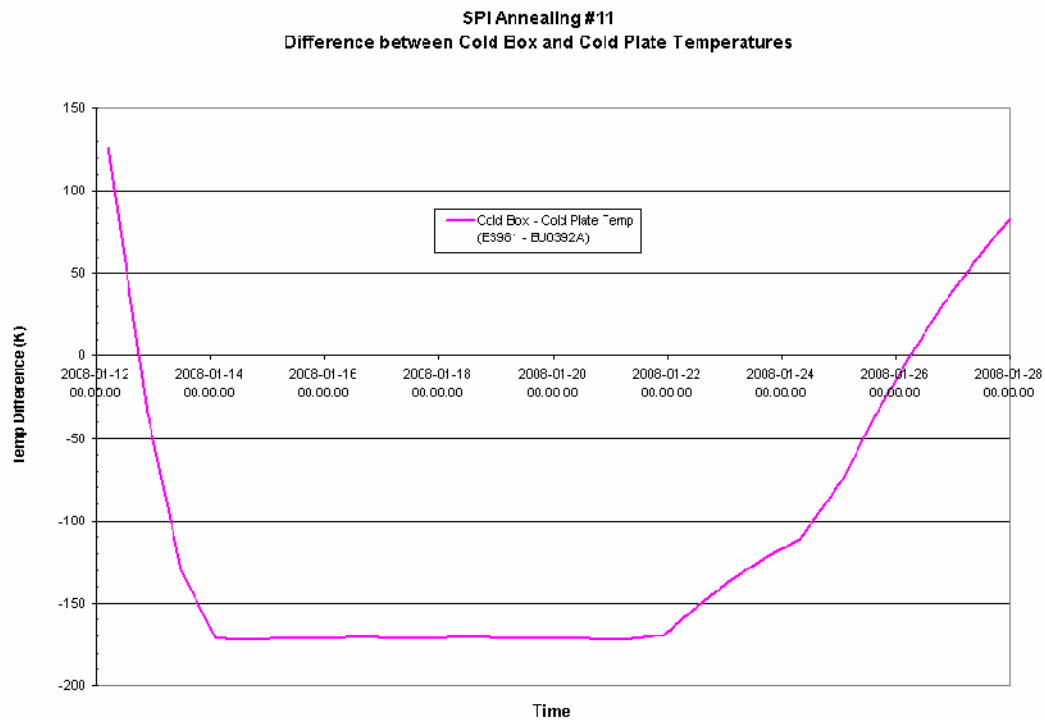
The following plot shows the evolution of the CDE LCL currents during the reporting period.



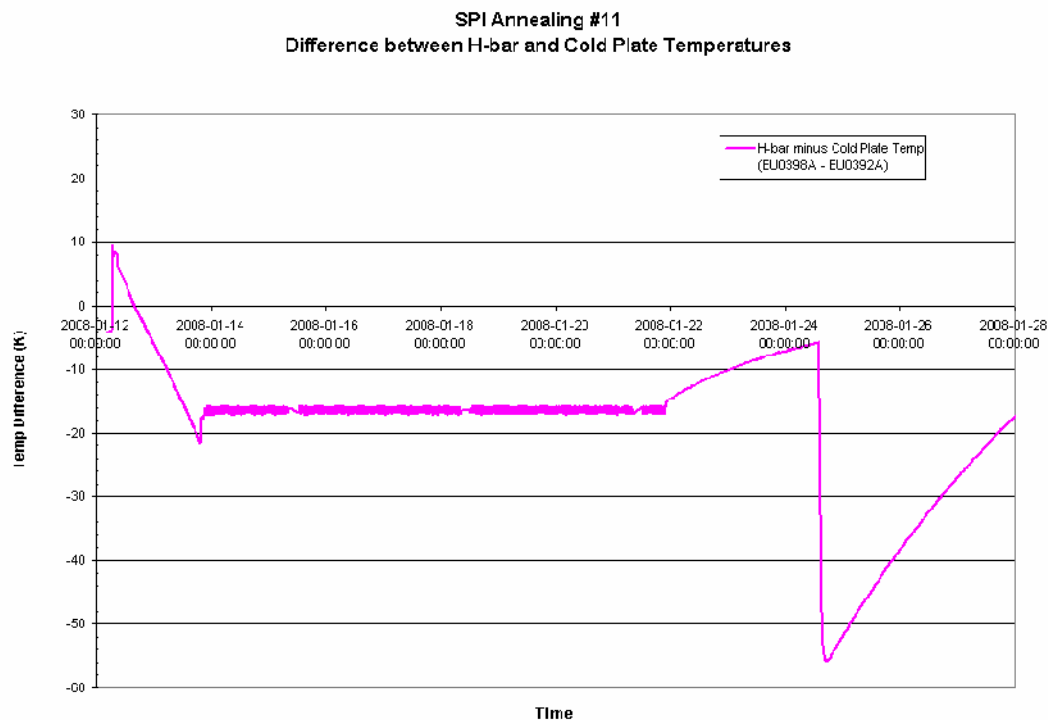
The following plot shows the evolution of the cold plate, cold box and H bar temperatures since the start of annealing.



The following plot shows the difference between the cold box and cold plate temperatures since the start of annealing.



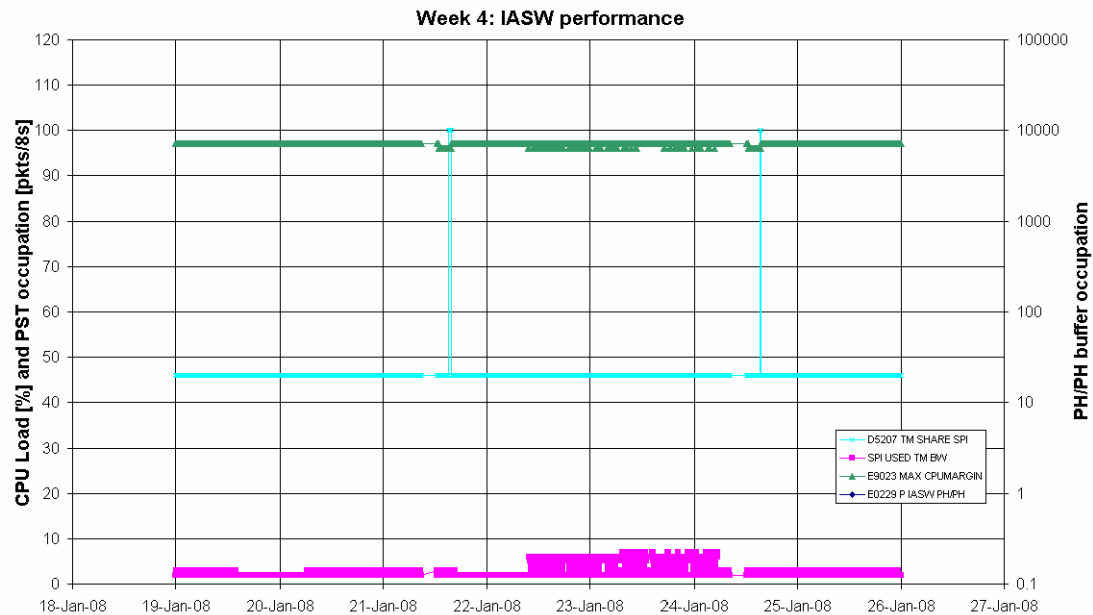
The following plot shows the difference between the H-bar and cold plate temperatures since the start of annealing.



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.

Throughout the reporting period the IASW was in CONF mode due to the ongoing annealing.

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

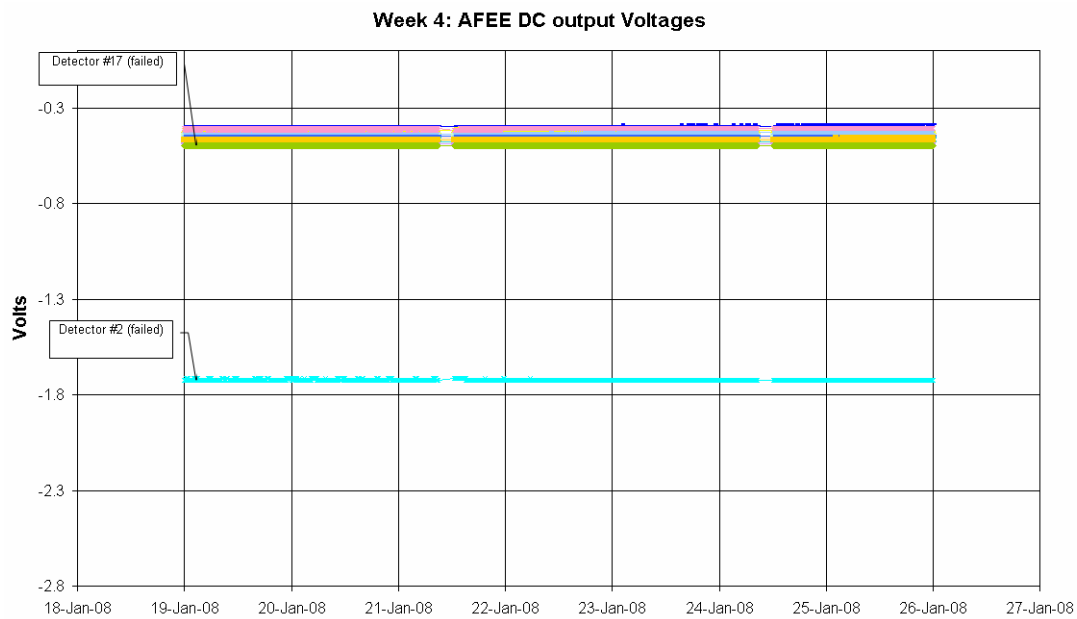


ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61).

For the 11th annealing operations, started on 12th January, the ACS has remained in CONF mode. The High Voltages were set to the minimum voltage (~980V) until the start of the ACS Calibration on 22/01/2008 at 09:40Z. For the ACS Calibration, FEE #57 and FEE #81 were switched on and the ACS HVs were set to nominal. The ACS Calibration consisted of 50 runs of procedure FCP_SPI1_0250, executed 5 times consecutively (total of 250 runs). The last 12 runs of the final set could not be executed due to entry into the radiation belts.

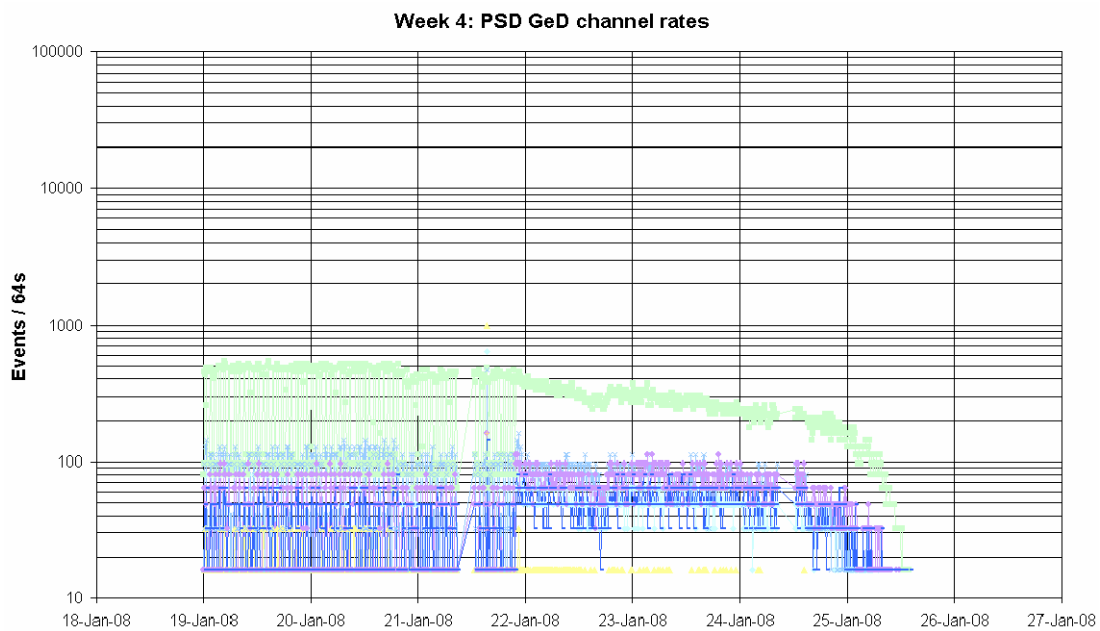
AFEE: The health of the AFEE is nominal. For the 11th annealing operations, started on 12th January, all detector HVPSs were switched off and only the LVPSs are left on.

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. For the 11th annealing operations, started on 12th January, the DFEE is in CONF mode.

PSD: The health of the unit is nominal. For the 11th annealing operations, started on 12th January, the PSD is in CONF mode. The following plot shows the PSD channel rates during the reporting period.

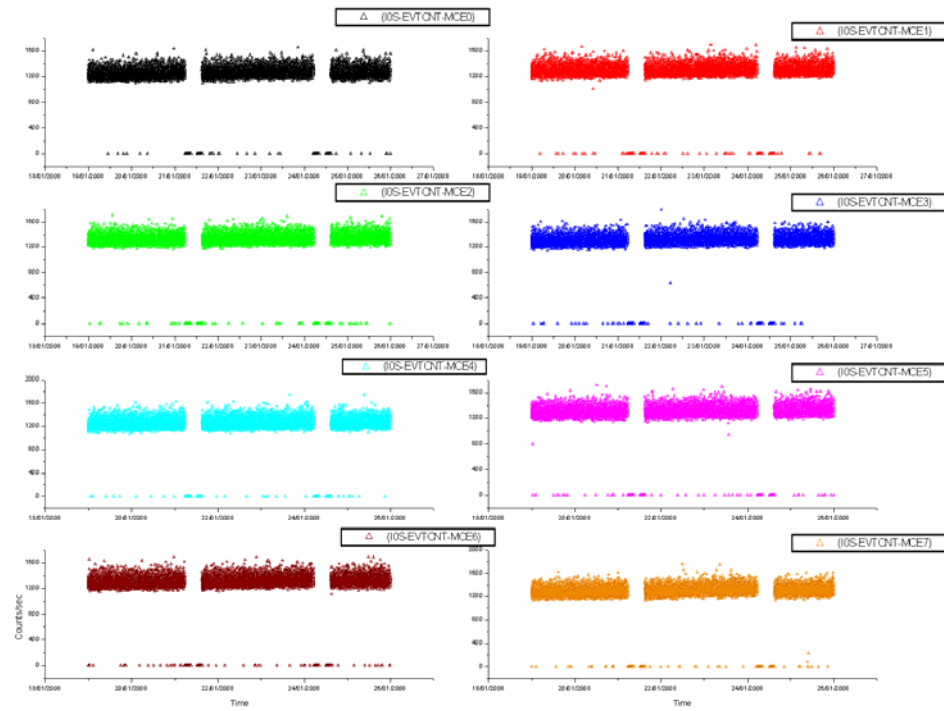


8.3.3 IBIS Operations

IBIS Event Counters Plots

ISGRI Counters:

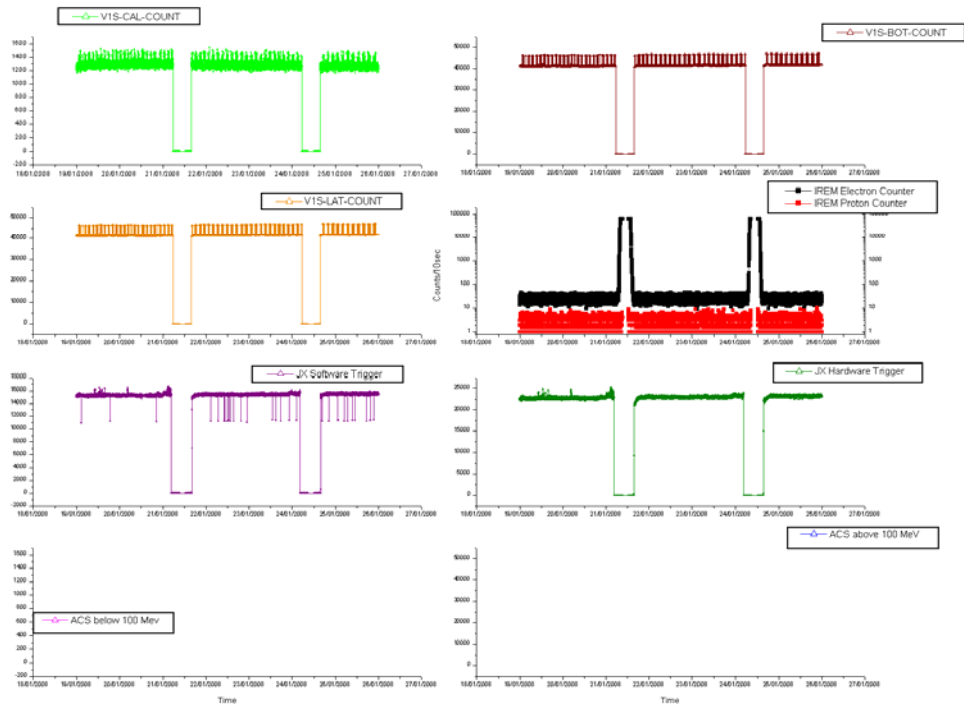
IBIS - ISGRI Counters Rev 643-645



**sampling every 4 pkts (32 secs)

VETO vs Payloads Counters:

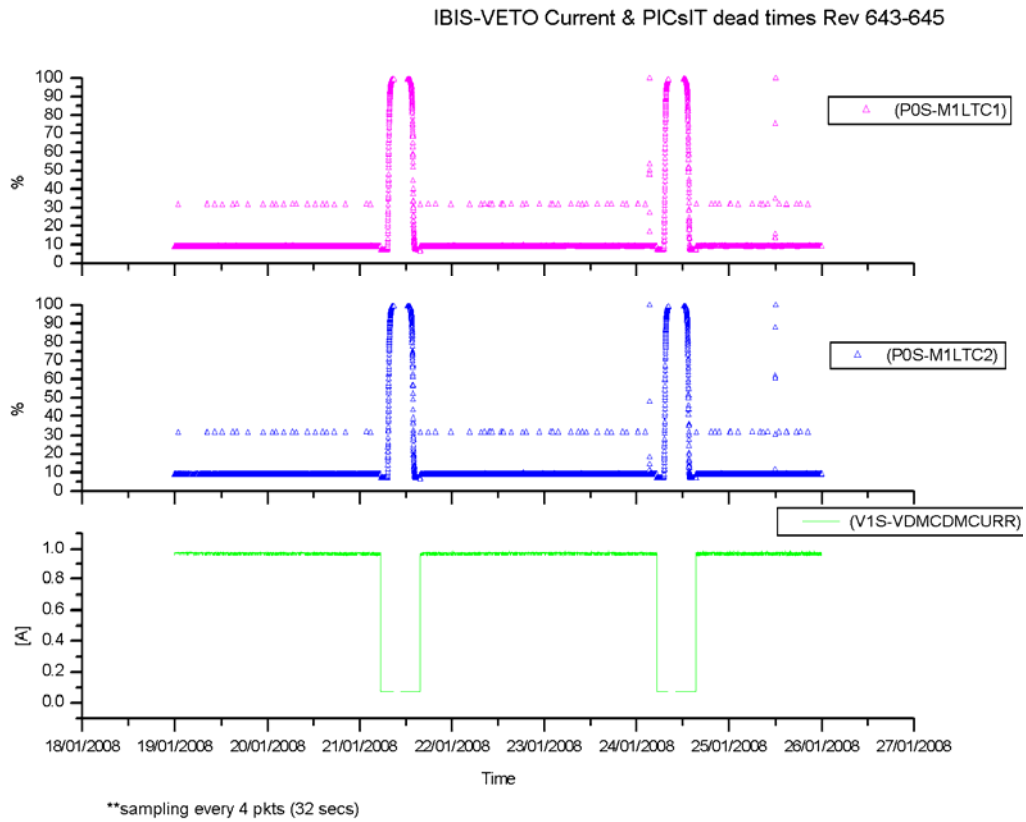
IBIS-VETO vs Payloads Counters Rev 643-645



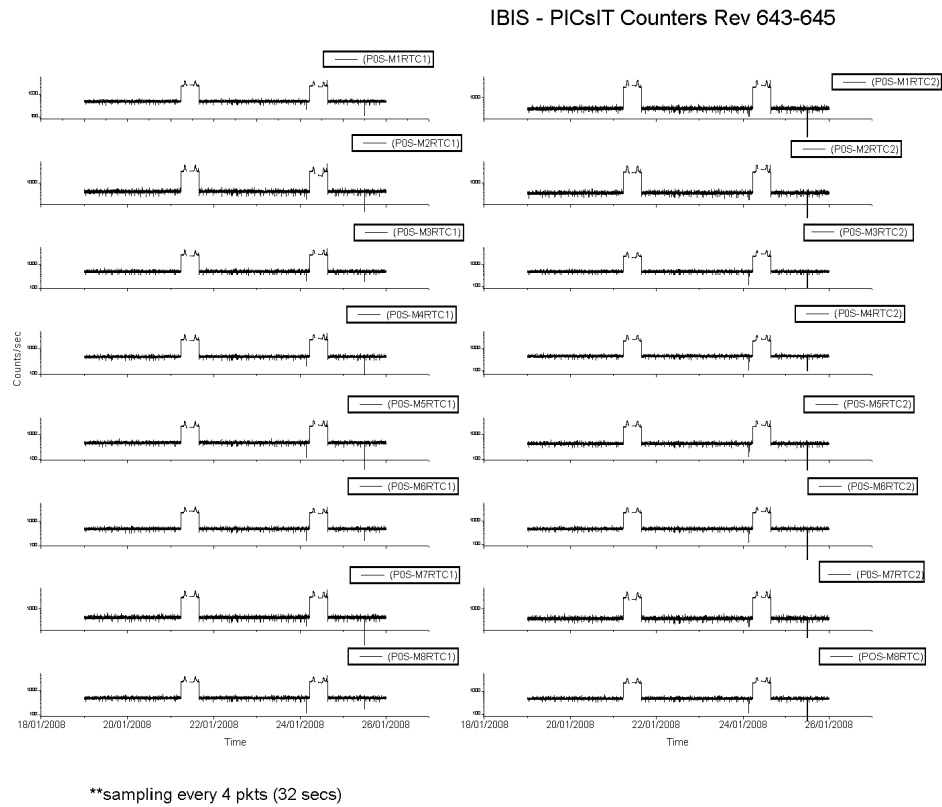
**with the exception of IREM counters (counts/10sec), all the plots are reporting counts/sec sampling every 5 pkts (40 sec)

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

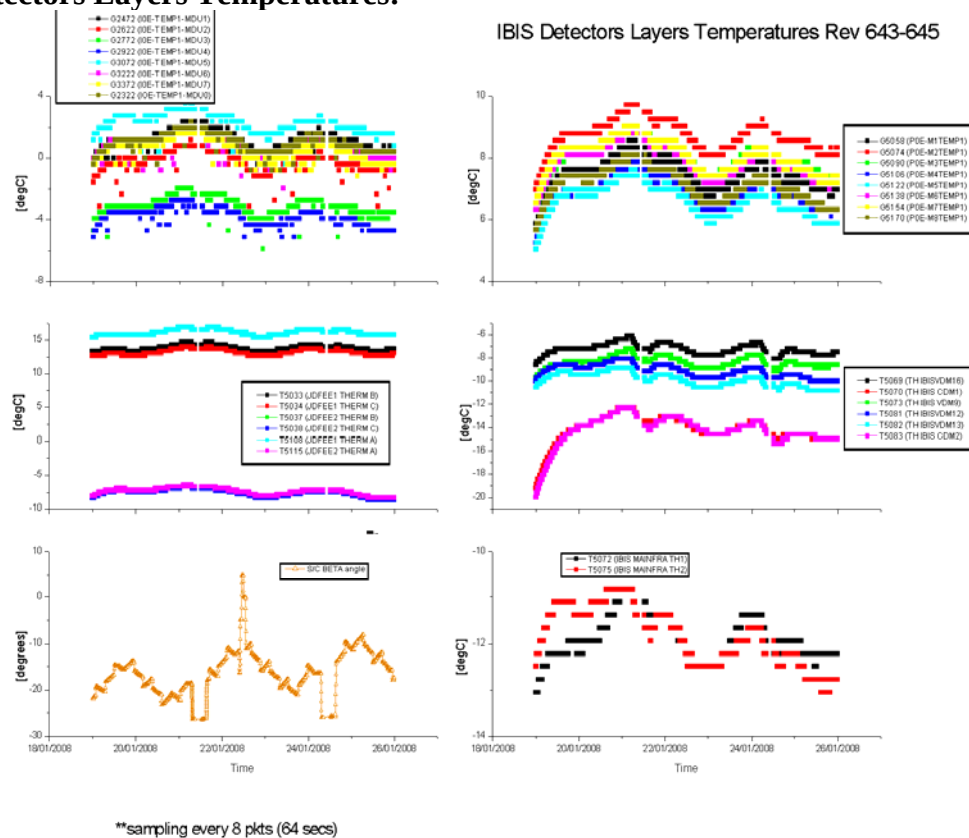
VETO Current:



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 (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.

2008-01-19 (DOY 019, Rev 643) to 2008-01-23 (DOY 023, Rev 644)

IBIS operations executed nominally.

2008-01-24 (DOY 024, Rev 644-645)

At 03:22:22Z the TM parameter families G5068 and G5072 failed status consistency check (value = TRUE). These are the PDM semimodule FIFO error flags. At 03:24:01Z the TM parameters families G5002 and G5003 for the PDM semimodule counters went OOL (value = 0). As these were followed at 03:27:21Z by OEM APID 1280 ID 132 EVENT IBIS1 IASW HEPI RESYNCHRONIZED, indicating that HEPI resynchronised autonomously, by which time all the above parameters had returned within limits, no action was taken.

At 13:40:30Z, before radiation belt exit of revolution 645, TM parameter G5079 went OOL High (Value = 2.60509804V). This is the PDM2 +2.5V voltage. As it returned within limits at 13:41:02Z no action was taken.

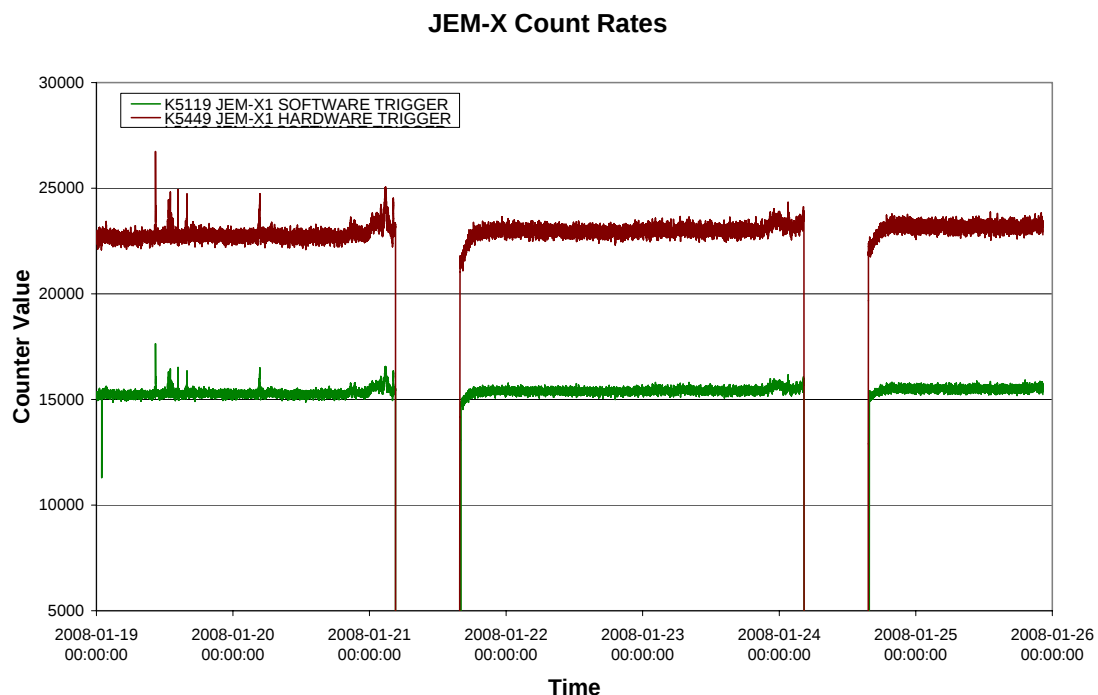
2008-01-25 (DOY 025, Rev 645)

At 11:57:02Z the TM parameter families G5068 and G5072 failed status consistency check (value = TRUE). These are the PDM semimodule FIFO error flags. At 11:58:33Z the TM parameters families G5002 and G5003 for the PDM semimodule counters went OOL (value = 0). As these were followed at 12:01:50Z by OEM APID 1280 ID 132 EVENT IBIS1 IASW HEPI RESYNCHRONIZED, indicating that HEPI resynchronised autonomously, by which time all the above parameters had returned within limits, no action was taken.

8.3.4 JEM-X Operations

JEM-X Count Rates

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



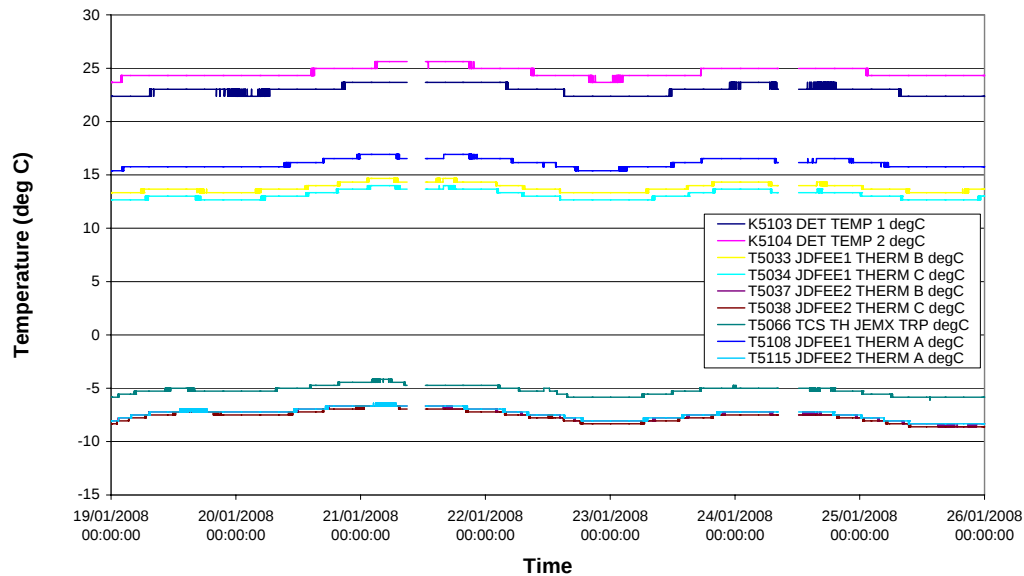
JEM-X Temperatures

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

2008-01-19 (DoY 019, Rev 643) to 2008-01-24 (DoY 024, Rev 644-645)

JEM-X1 operations executed nominally

2008-01-25 (DoY 025, Rev 645)

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

Time	Rev	RealTime	Exception
2008.025.02.20.48.830	2008.025.02.20.53.776	1536	5
JEM-X1 EXC IACS INTERF EXID		0	0
E			65535
FIX6		0	
K9079	MESS CLASS	1	
K9080	MESS ID	5	
K9065	CSSW OPERAT ID	START	
K9066	TASK ID 8	IASW	
K9067	LOGICAL ADDRESS	4989	
2008.025.02.20.48.830	2008.025.02.20.53.800	1536	6
JEM-X1 EXC IACS INTERF CULP		0	0
E			65535
FIX6		0	
K9079	MESS CLASS	1	
K9080	MESS ID	6	
K9065	CSSW OPERAT ID	START	
K9066	TASK ID 8	IASW	
K9067	LOGICAL ADDRESS	19726	

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

8.3.5 OMC Operations

2008-01-12 (DoY 012, Rev 640-641) to 2008-01-17 (DoY 017, Rev 642)

Nothing to Report.

2008-01-18 (DoY 018, Rev 642-643)

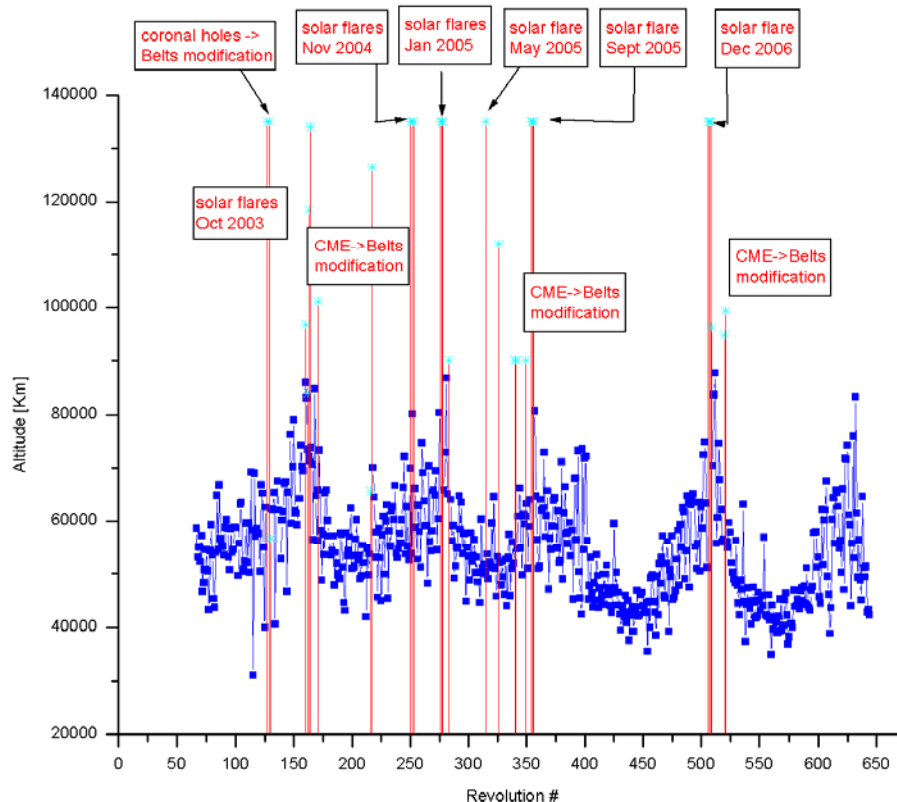
At 15:12, the Command verifier task crashed. During the recovery, there were continuous link drops, which delayed things. The Timeline was rejoined at 16:12. The impact was the loss of pointing 06430002.

On DoY 021 at 05:28:36 and DoY 024 at 05:15:40 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]
643	RAD_ENTR R 2008-01- 21T05:28:32Z	21/01/2008 06:59:22	43180.4	21-Jan-2008 07:00:12	42682.78
644	RAD_EXIT R 2008-01- 21T15:30:47Z	21/01/2008 14:48:19	>>33272.2	21-Jan-2008 14:30:12	44483.99
644	RAD_ENTR R 2008-01- 24T05:15:39Z	24/01/2008 06:54:35	42312.0	24-Jan-2008 06:42:20	43564.94
645	RAD_EXIT R 2008-01- 24T15:18:14Z	24/01/2008 14:08:35	>>31603.4	24-Jan-2008 14:22:20	45023.2

Reference

High radiation

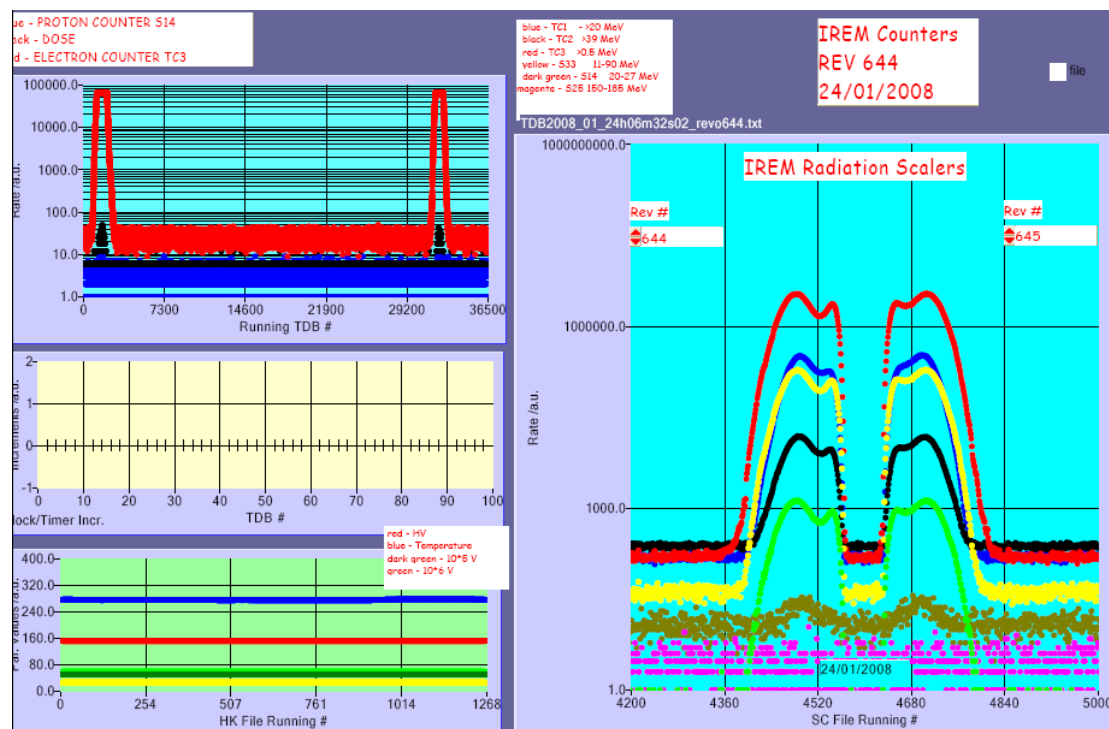
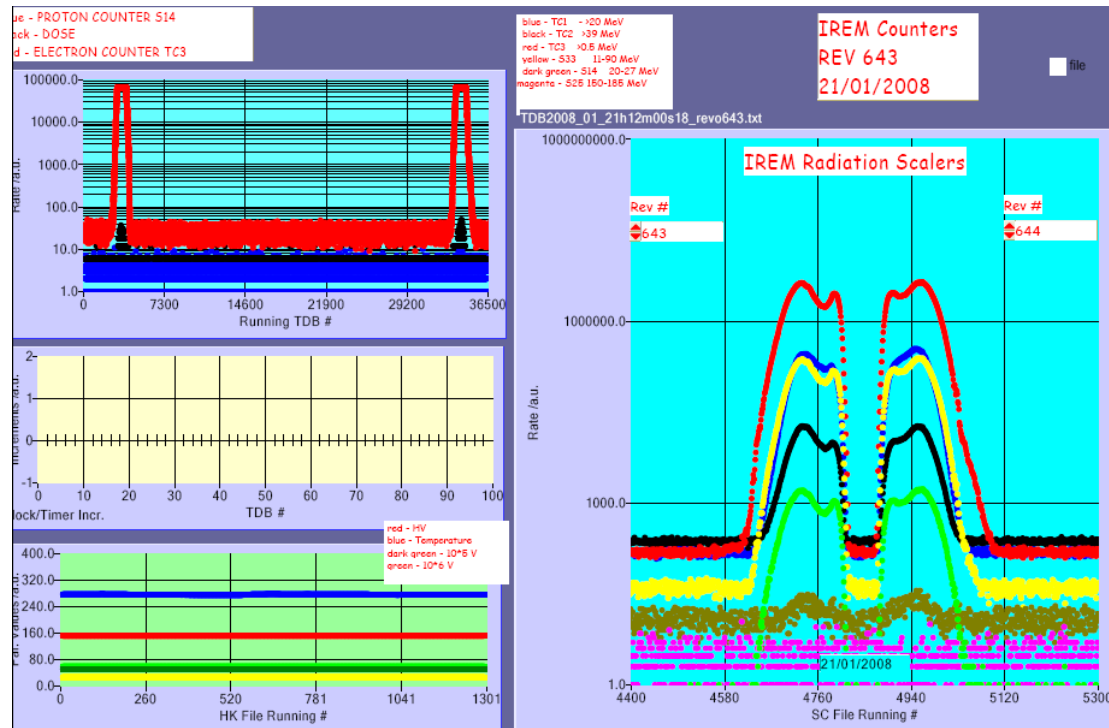
Very small error vs reference (less than 10 minutes)

Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

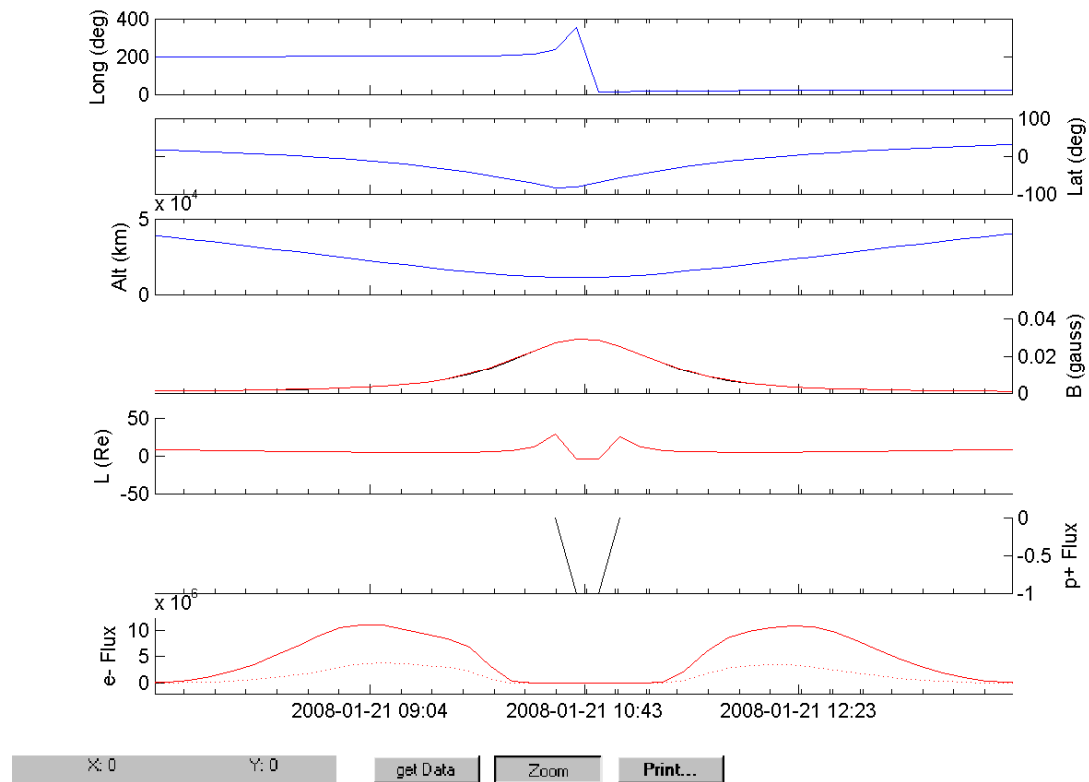
* Rad belt entry time ignoring previous threshold crossings where a gap of more than 30 minutes is present.

IREM radiation counters:

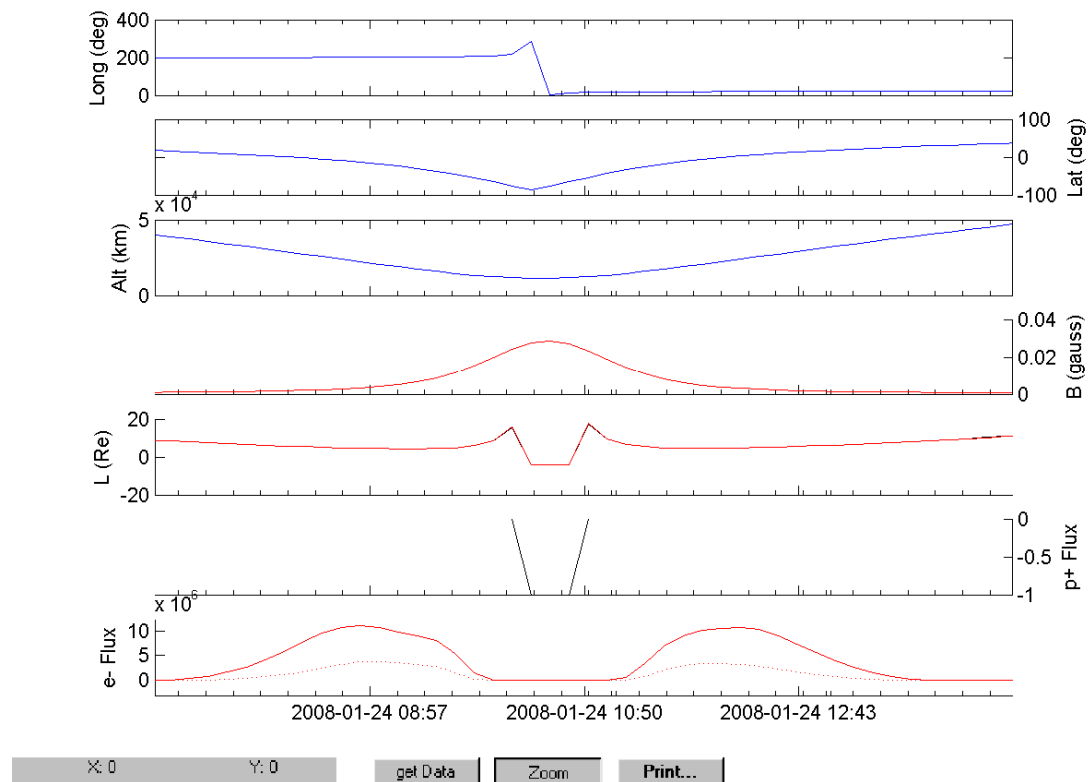


IREM Predicted Radiation Belt Passages

Rev 643



Rev 644



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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.