

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 371
Week 44
02.11.09
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 24.10.09 until 30.10.09 (both dates inclusive) and covers the revolutions 858 and 859.

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 Mkn 509 (RA 20:44:09.76, -10:43:24.7), a raster dither of M82 X-1 (RA 09:55:50.10, +69:40:46.0), a staring observation for OMC FF #9 (RA 09:52:00.00, +17:06:00.0) and a hexagonal dither of GRS 1915+105 (RA 19:15:11.60, +10:56:44.0).

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.

Slews 086000006, 086000007, 086000008 and 086000009 were missed from the Timeline.

The fuel consumption over the period between 24/10/2009 and 30/10/2009 was 0.1819 Kg. The remaining propellant is in the order of 131.7227 Kg.

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

3.1.2 Power

All the other units of EPS are 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.

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

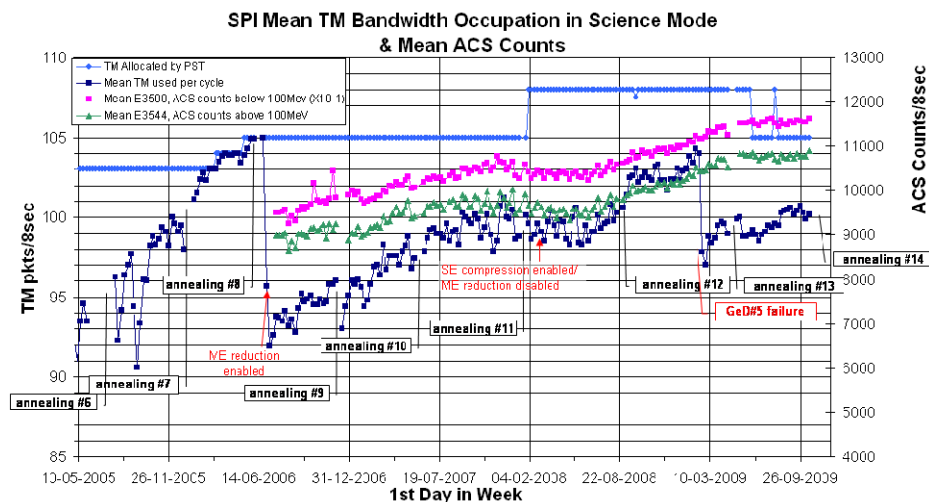
3.2.1 SPI

The 14th SPI annealing operations started on 19/10/2009 at 10:44Z. Operations for this annealing are progressing nominally. The main activities were as follows:

Date/Time	Activity
2009-10-19 10:44:00Z	Configure SPI for start of Annealing and stop SPI active cooling
2009-10-19 11:40:00Z	Annealing Heater Main ON
2009-10-19 13:40:00Z	Annealing Heater Redundant ON
2009-10-20 23:04:29Z	Cold plate temperature reached 373K (100degC)
2009-10-29 07:05:00Z	Stop SPI Annealing: Annealing Heater Main and Redundant OFF
2009-10-29 09:26:11Z	ACS switch-on and start of ACS calibration (also FEE#57 and FEE#81 ON)

Throughout the reporting period SPI was in CONF mode with a TM allocation of 30 packets/cycle due to the ongoing annealing.

The following plot shows the evolution of the assigned and the average occupation of the SPI TM bandwidth since May 2005 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 IBIS operations is provided in the Appendix.

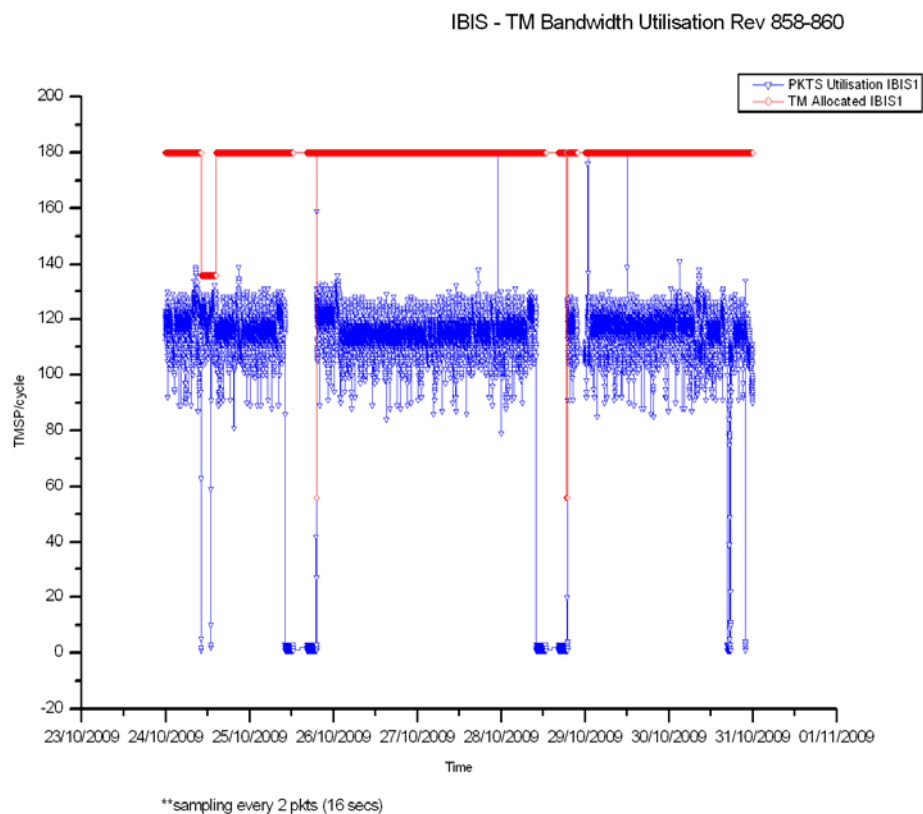
3.2.2 IBIS

The overall status of IBIS is nominal.

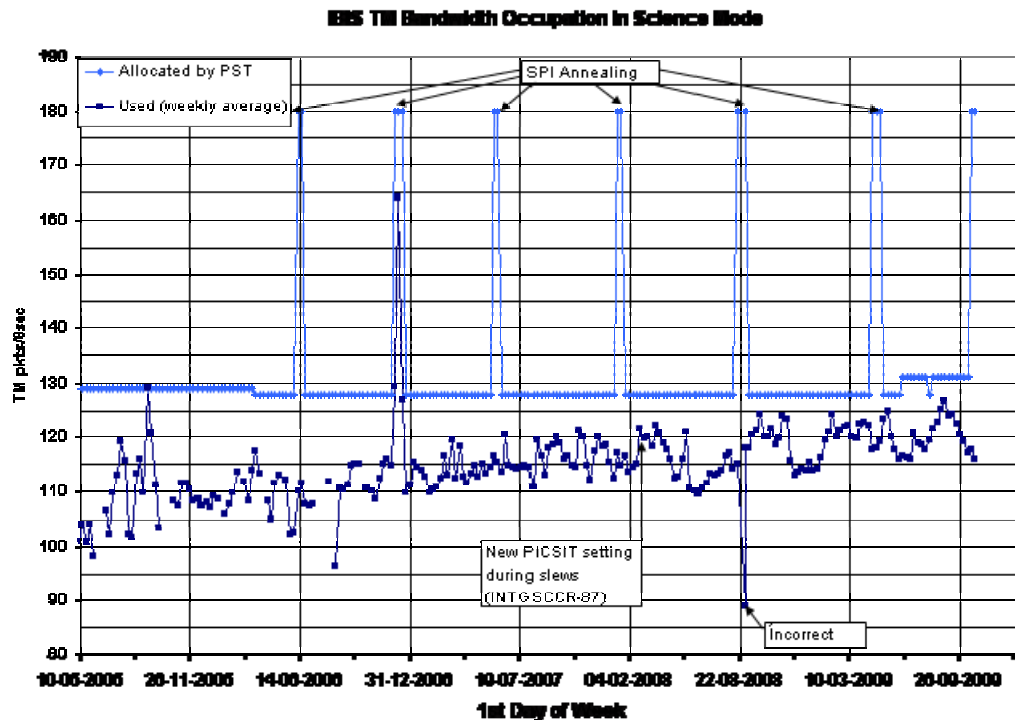
During the reporting period, IBIS was operated in Science Standard mode during science observations. The TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 180 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 115.85 packets/cycle (down 1.9 on previous week)
- Percentage of TM cycles for which full bandwidth was used: 0.009%

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



A plot of the IBIS weekly bandwidth utilisation since May 2005 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 & 2 were operated in Data Taking mode with a TM allocation of 15 packets/cycle each.

Note: Further information on JEM-X operations can be found in the Appendix Section 8.3.4.

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 9 packets/cycle.

During this reporting period, 144 of the 150 planned science pointings were executed nominally, 5 were lost and 1 cut short

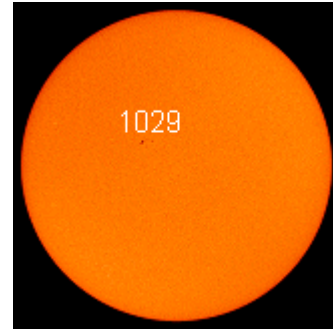
Note: Some more information concerning the OMC operations is provided in the Appendix.

3.2.5 IREM

The overall status of the unit is nominal.

Solar Activity

The observation period was characterised by low solar activity. The week began with sun spot #1029 visible, this remained for the rest of the week gradually rotating across the sun's face. The risk of solar flares was very low.

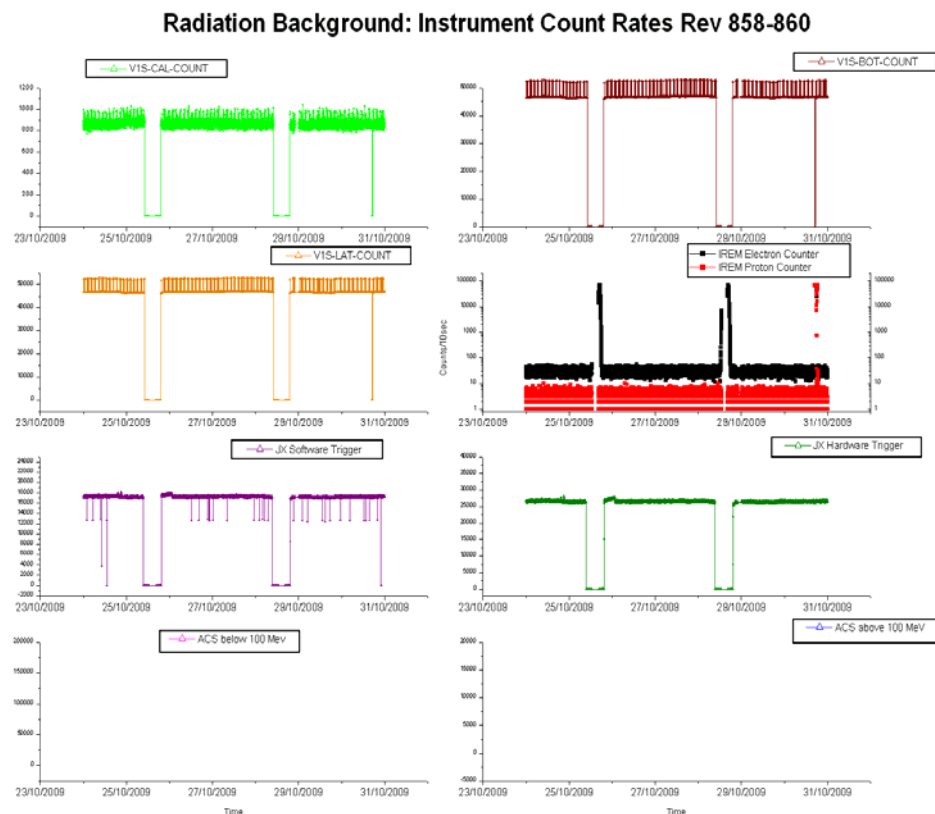


Reference: www.spaceweather.com

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

3.2.6 Radiation Background

The background radiation level as measured by the instrument counters was low during the reporting period. The following plots show the SPI ACS, IBIS VETO, JEM-X Triggers and IREM count rates over the week¹:

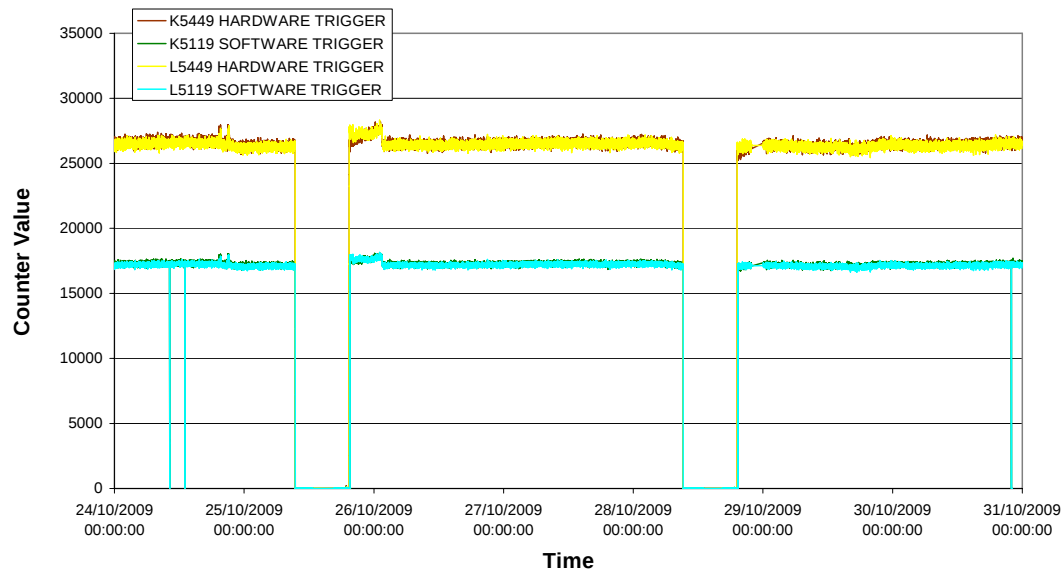


JEM-X Count Rates

JEM-X count rates over the reporting period are displayed in the following graph².

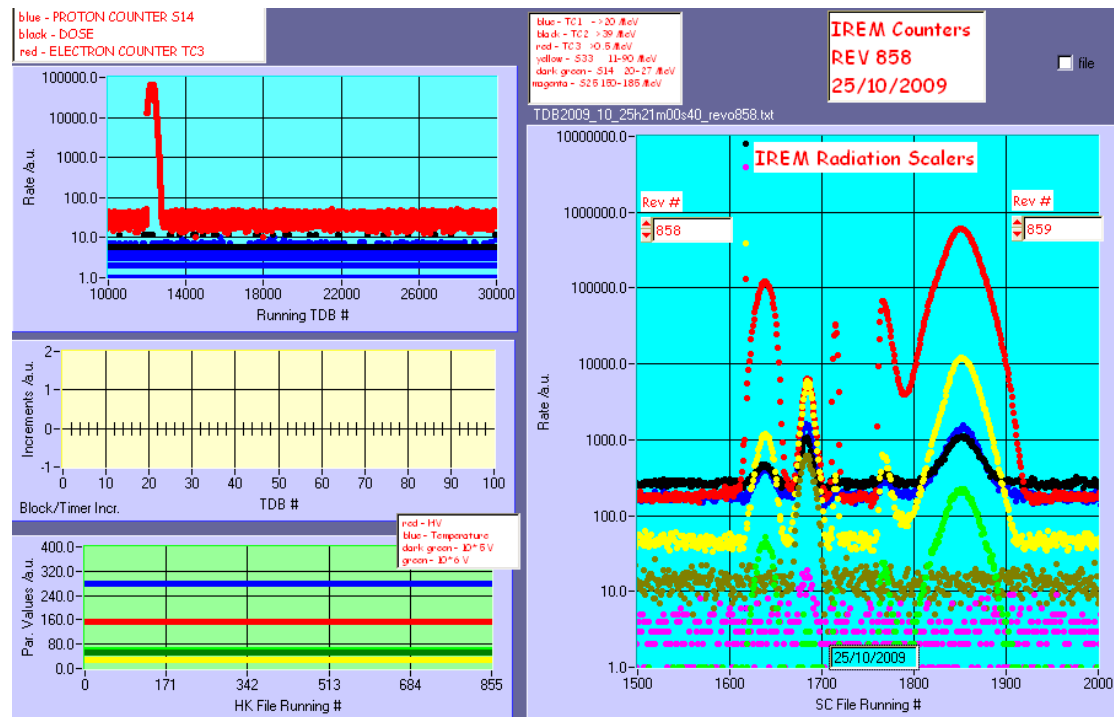
¹ Data sampled every 6th packet (48sec)

JEMX Count Rates



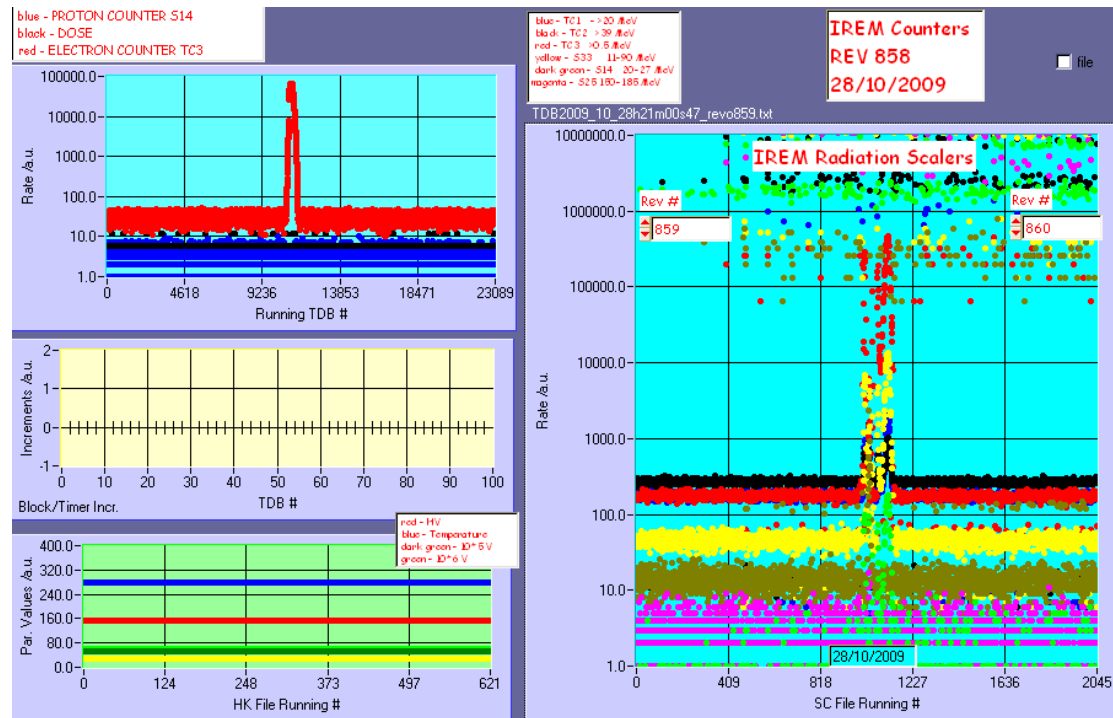
IREM radiation counters:

Revolution 858



² Data sampled (1 frame in 4) and smoothed to remove spikes in S/W Trigger due to flushing of buffer after slews.

Revolution 859



4 Ground Facilities

The Operational ground facilities performance was good this week. The overall performance was over the 95% requirement.

4.1 Mission Operations Centre

The performance of the MOC was good this week. There were three occasions when the links to ISDC dropped, necessitating a restart of the isds & ifrd. There was no impact. On 24.10.2009 the SCOS 2000 command verifier on imca had to be restarted and restarts of the HFA, AUX, OLF and PSRV tasks on iddb were necessary on 25.10.2009.

4.2 Ground Stations & Network

The performance of the ground stations and Network was good this week. At AOS on 29.10.2009 it was not possible to command to Vilspa from the A-chain. A swap to the B-chain was necessary to resume commanding. There was one occasion of a TM drop VC0 and VC7 from Redu, followed by Bad frames and one occasion where there was a data gap on VC7 from Vilspa.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs received for revolutions 865-867.

Doc. Title : INTEGRAL Mission Report #371
Doc. Ref. : INT-MOC-SYS-RP-1001-OPS-OAI
Date : 02/11/09

Issue : 1
Rev. : 0
Page : 10

Observations have been planned for revolutions 863-866.
Revolution 863 was last revolution of SPI annealing (with SPI turned on).

New TSF has been received for revolutions 847.

2. Observation status

New ECS files have been received for revolution 847.

3. ISOC Science Data Archive

No new news.

4. ISOC system

No new news.

5. Problems

No new problems.

5 Special Events

04.11.2009: Thruster calibration
06.11.2009: End of SPI annealing

6 Anomalies

AR id	Date Created	Subject	Segment	Status
INT-3080	2009-10-28	Loss of DSS-27 Support Due to high winds at DSN	NASA station	Pending
INT-3079	2009-10-29	MCS - Store of packet (65535:80:.....) messages & no TC capability	IMCS	Pending
INT_SC-274	2009-10-30	IREM Anomaly: Reset of IREM_CSCI S/W #83, 30/10/2009	Payload	Pending

7 Future Milestones

No future milestones

8 Appendix

The appendix includes various detailed information.

8.1 Detailed Satellite Information

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

8.1.1 AOCS SUMMARY OPERATIONS REPORT, 24/10/2009 –30/10/2009

The AOCS operations were executed from the Automatic Timeline.

During this period, 107 Open Loop Slews, 69 Closed Loop Slews and 6 Momentum Biases were executed (as reported by ACC OEM).

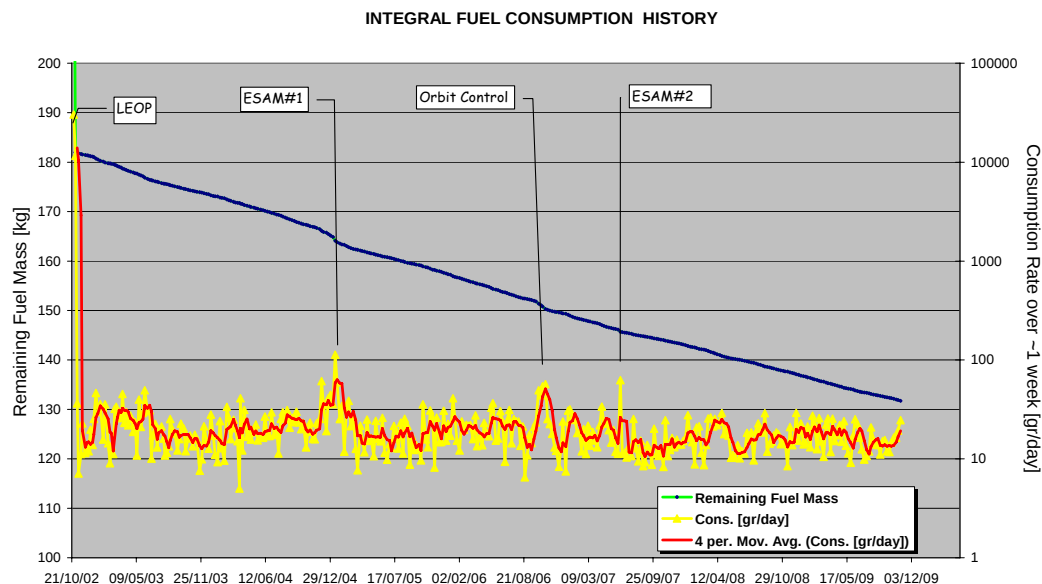
Slews 08600006, 08600007, 08600008 and 08600009 were missed from the Timeline, neither the OTF was reached for their PIDs.

Orbit Control

No update.

Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 30/10/2009 is reported in the plot below.

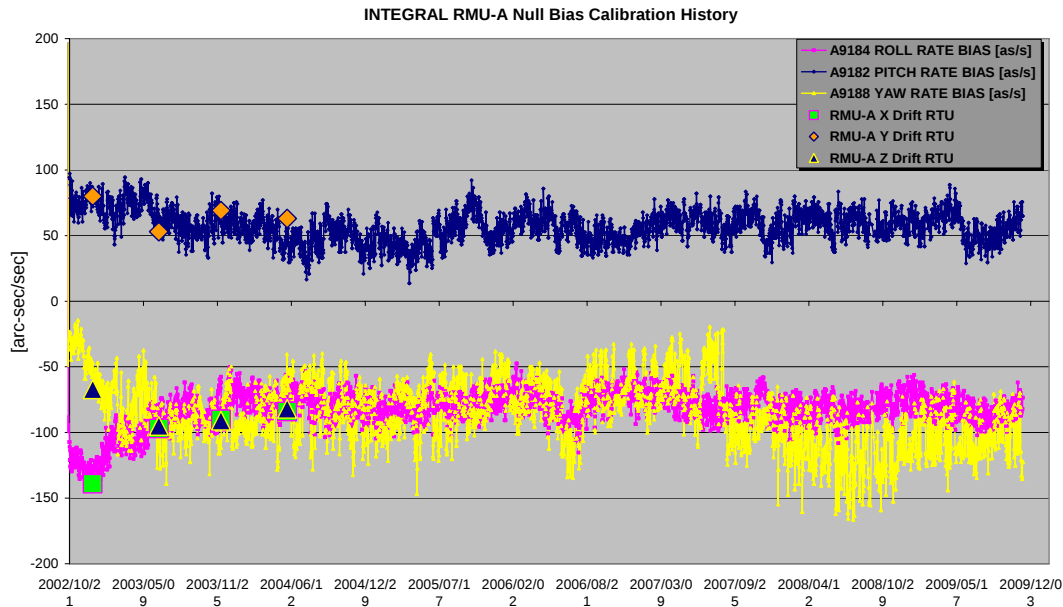


The above plot considers the ESAM fuel consumption spread over period of ~1 week.

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 30/10/2009 is reported in the plot below.

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.



Daily events Log:

24/10/2009 (Day of Year 297, Revolution 858)

Nothing to report

25/10/2009 (Day of Year 298, Revolution 858 to 859)

Nothing to report

26/10/2009 (Day of Year 299, Revolution 859)

Nothing to report

27/10/2009 (Day of Year 300, Revolution 859)

Nothing to report

28/10/2009 (Day of Year 301, Revolution 859 to 860)

- Loss of GS TM/TC link (21:54:00Z). Slews 08600006, 08600007, 08600008 and 08600009 failed release from the timeline.

After TM/TC was recovered, a manual slew (spacontool) was performed from attitude 08600005 to 08600009. The parameters for PREQ 08600010 were updated afterwards.

29/10/2009 (Day of Year 302, Revolution 860)

- FDS failed to update slew 08600024 (11:17:00Z). A mapping was commanded and the parameters were manually updated (spacontool)

No impact on the Timeline.

- FDS failed to update slew 08600039 (21:49:00Z). A mapping was commanded and the parameters were manually updated (spacontool)

No impact on the Timeline.

30/10/2009 (Day of Year 303, Revolution 860)

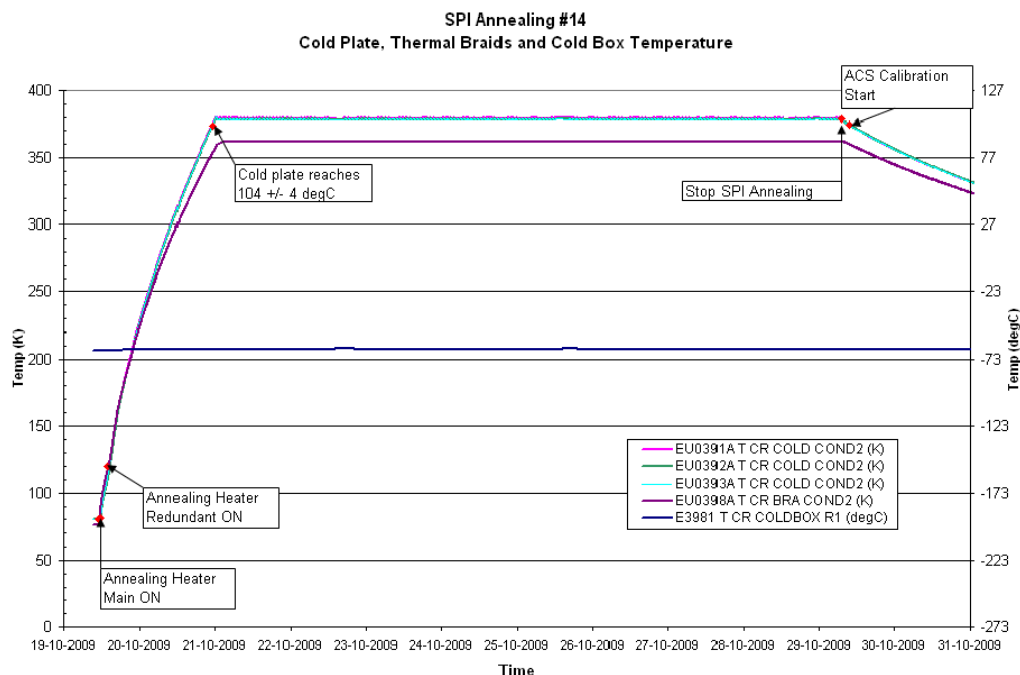
- IMU switched ON prior to a RWB (02:35:00Z). No impact on the Timeline.

8.1.2 SPI Operations

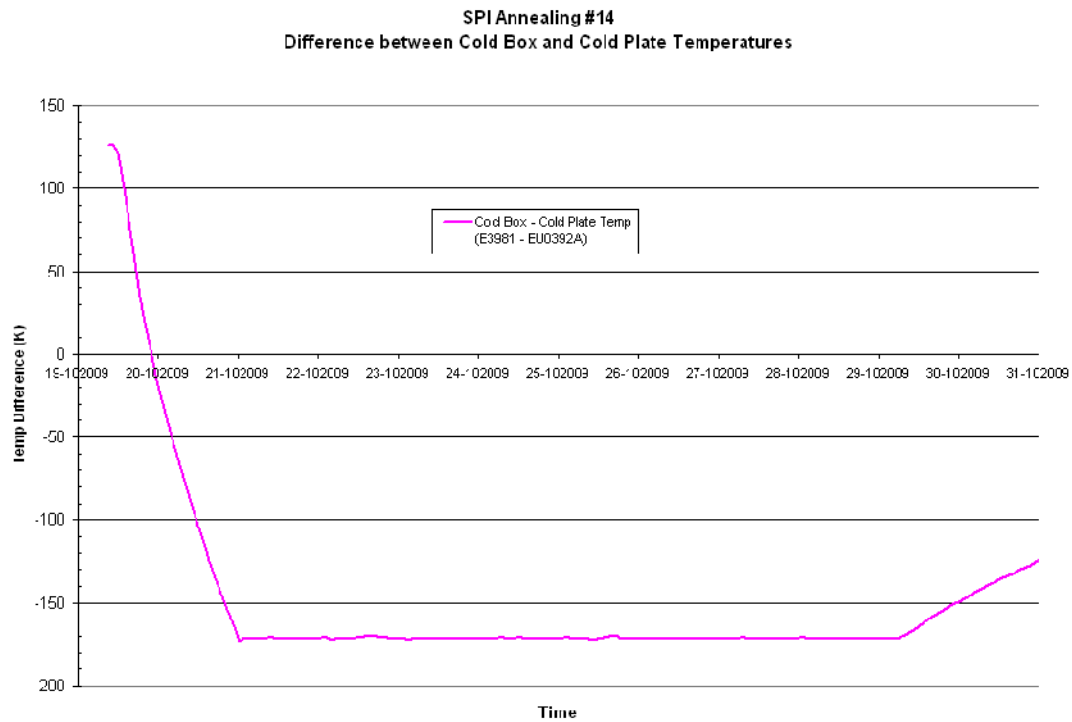
Unit Temperatures: All the equipment temperatures are inside the operational limits.

Stirling Compressors and Cryostat: The performance of the compressors is nominal. Due to the ongoing annealing operations, started on 19/10/2009, the cryocooler was in Standby mode throughout the reporting period.

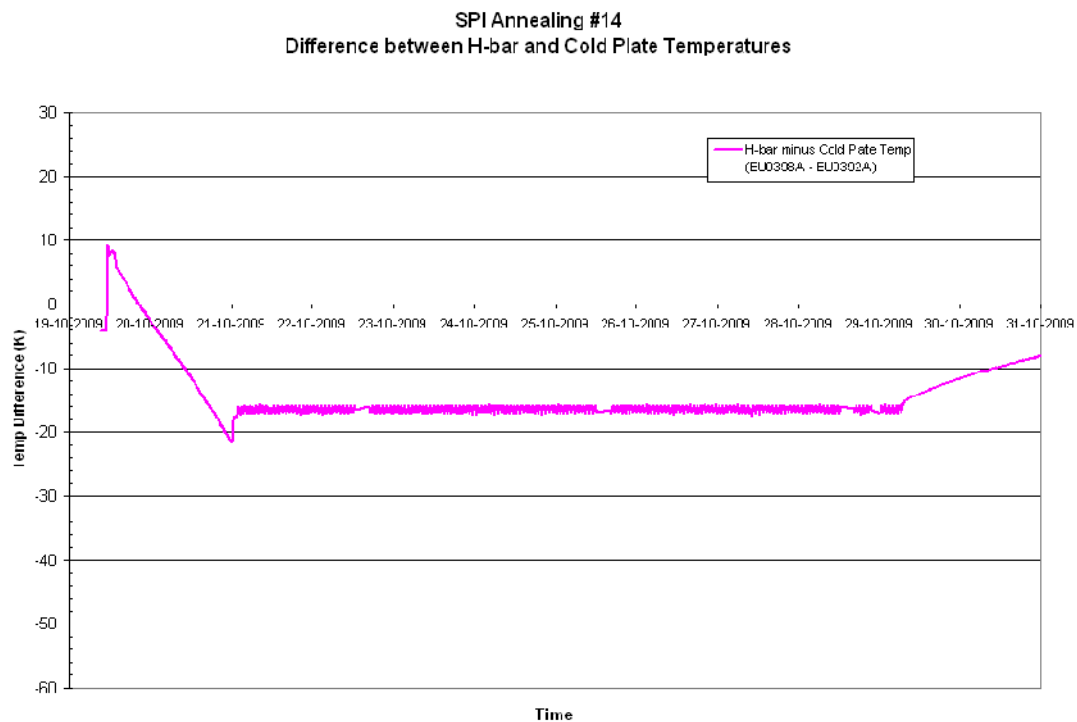
The following plot shows the evolution of the Cold Plate, thermal braids and Cold Box temperatures since the start of annealing:



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 are nominal. The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling

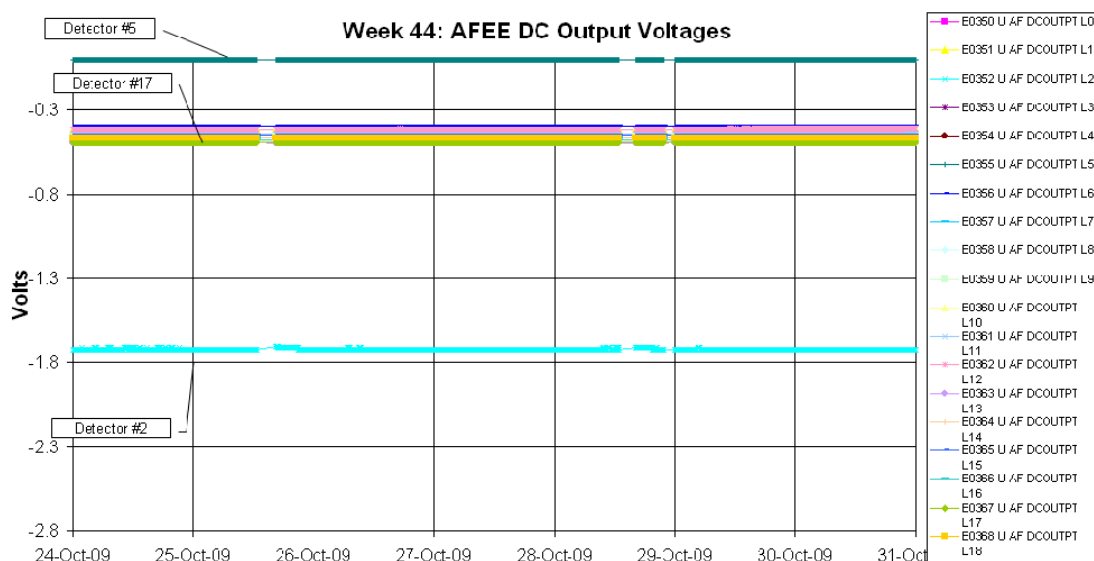
factor set to 8/19 SE. For the 14th annealing operations, started on 19/10/2009, SPI was in CONF mode with a TM allocation of 30 packets/cycle.

ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally 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).

Due to the annealing operations, started on 19/10/2009, the ACS High Voltages were set to the minimum voltage (~980V) and the ACS was in CONF mode until 29/10/2009 at 09:26:11Z. At this time, during the passive cooling phase, the ACS HV was increased to the nominal value and the failed FEEs were switched on for the purpose of the ACS Calibration. The ACS Calibration was then started and continued throughout the remainder of the reporting period.

AFEE: The health of the AFEE is nominal. The following plot shows the dc output voltage of the detector channels during the reporting period³. The values are nominal. Detector #2 is failed since 06/12/2003; detector #17 is failed since 17/07/2004 and detector #5 is failed since 19/02/2009. The HV of the failed detectors are nominally set to 0.5kV.

Due to the ongoing annealing operations, all detector HVPSs were switched off and only the LVPSs were left on and the AFEE was in CONF mode throughout the reporting period.



DFEE: The health of the unit is nominal. The DFEE was in CONF mode throughout the reporting period due to the ongoing annealing operations.

PSD: The health of the PSD is nominal. The PSD was in CONF mode throughout the reporting period due to the ongoing annealing operations.

³ Data sampled every 8th packet (64sec)

Event Log:

No non-nominal event occurred with SPI over the reporting period.

FUTURE EVENTS:

The 14th annealing operations started on 19th October 2009 at radiation belt entry of revolution 856. Below is the summary timeline of the planned annealing activities:

14th SPI ANNEALING - revs 856-863																														
ID	Task Name	Duration	Start	Resource	19 Oct '0926 Oct '0902 Nov '0909 Nov '09																									
				Names	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa		
2	Start SPI Annealing - Warm-up Phase	36.5 hrs	19 Oct 10:35	P8 T[20 pkts]	19 Oct 10:35																									
15	Annealing at 104degC	200 hrs	20 Oct 23:05	P8 T[20 pkts]																										
28	Stop SPI Annealing - Passive Cooling Phase	64.02 hrs	29 Oct 07:05	P8 T[20 pkts]																										
32	ACS Calibration	40.4 hrs	29 Oct 07:05	P8 T[20 pkts]																										
44	Start Cryocoolers - Active Cooling Phase	140.5 hrs	31 Oct 23:06	P8 T[20 pkts]	WARNING: Active cooling SHALL not start later!																									
55	Camera Switch on & Performance Tests	29.9 hrs?	05 Nov 03:36	P8 T[106 pkts]																										
77	Active Cooling Fine Tuning	62 hrs	06 Nov 19:36	P8 T[106 pkts]																										
79	Resume SPI POS Observations	62 hrs	06 Nov 19:36	P8 T[106 pkts]																										

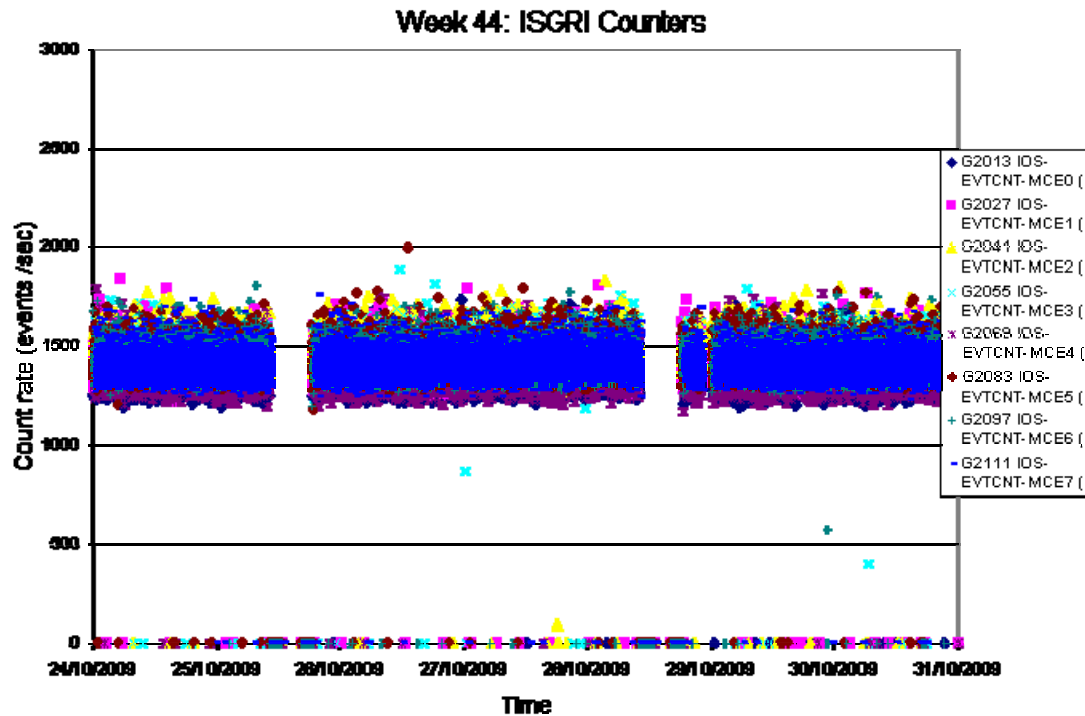
In addition, a patch of the SPI IASW to version 4.3.5 is planned for the week of 2nd November 2009, with the testing to be performed following the SPI camera switch-on on 5th November.

8.1.3 IBIS Operations

Unit Temperatures: All the equipment temperatures were inside the operational limits throughout the week.

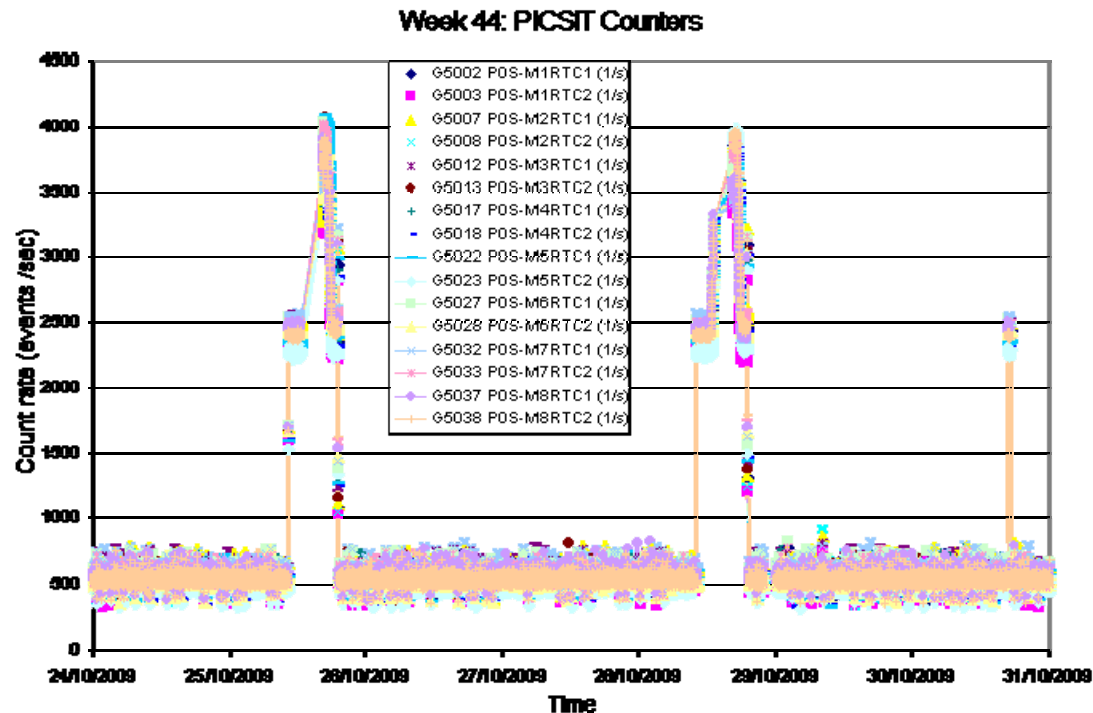
ISGRI

The health and performance of ISGRI was nominal during the reporting period. The following plot shows the ISGRI MCE counters during the week⁴:



PICsIT

The health and performance of PICsIT was nominal during the reporting period. The following plot shows the PICsIT semi-module counters during the week⁵:

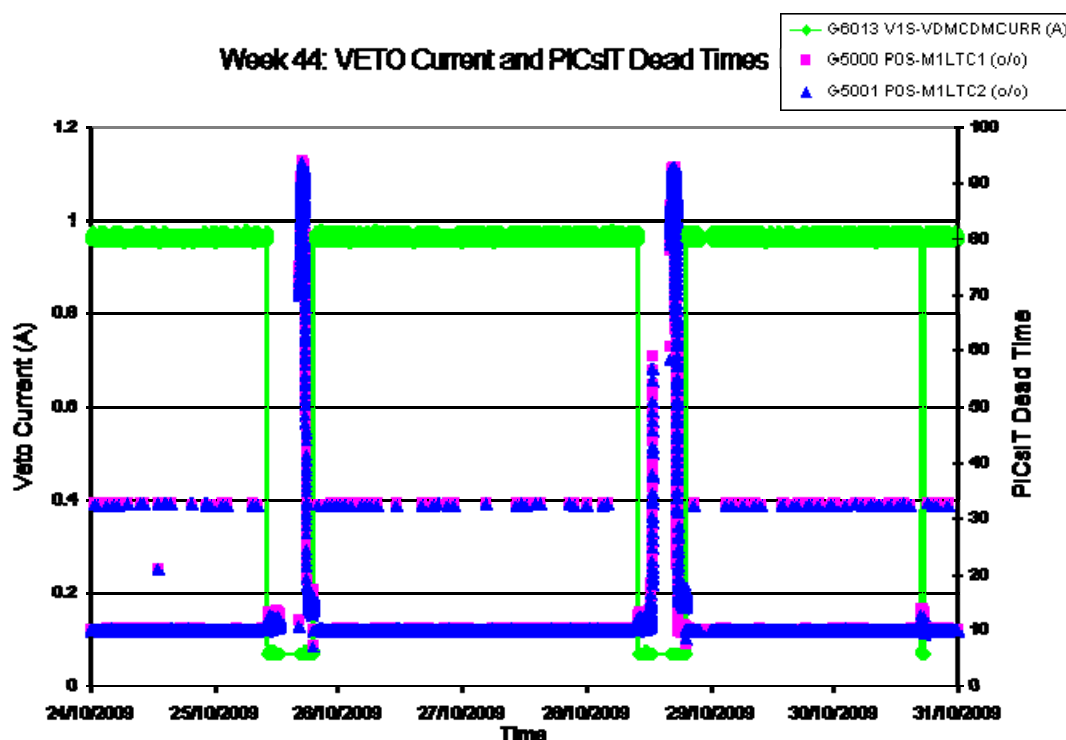


⁴ Data sampled every 4th packet (32sec)

⁵ Data sampled every 4th packet (32sec)

VETO

The health and performance of VETO was nominal during the reporting period. The following plot shows the VETO current and PICsIT dead-times during the week⁶:



IBIS Daily Report

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

2009-10-24 (DOY 297, Rev. 858) to 2009-10-29 (DOY 302, Rev. 860)

IBIS operations executed nominally.

2009-10-30 (DOY 303, Rev. 860)

Due to an IREM SEU, IBIS transitioned autonomously to Safe configuration at 16:50:42Z. It was recovered as follows:

- At 17:12:14Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 17:36:29Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled.

At 17:40Z 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:

- 17:47:24Z FCP_IBIS1_0312

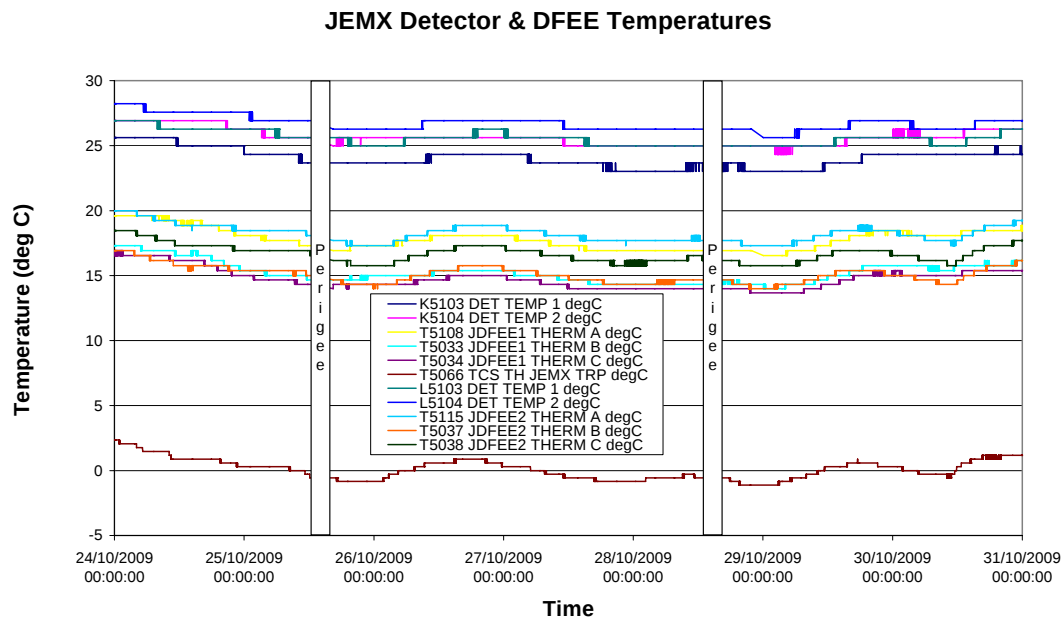
⁶ Data sampled every 4th packet (32sec)

- 17:48:54Z TC G0129 uplinked to return IBIS to Science Standard mode.
 IBIS operations continued nominally.

8.1.4 JEM-X Operations

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 graph⁷.



JEM-X Daily Report

2009-10-24 (DoY 297 Rev 858)

At 10:16:47 TCs K0011, K0021 & KU0014 together with L0011, L0021 & LU0014 terminated with status unknown, no action was taken, and there was no impact.

2009-10-25 (DoY 298 Rev 858-859) to 2009-10-29 (DoY 302 Rev 860)

JEM-X 1 & 2 operations executed nominally.

2009-10-30 (DoY 303 Rev 860)

At 16:51:16 JEMX parameters K5315, K5316, K5317 L5315, L5316 & L5317 went Out-of-Limits due to an IREM SEU (#83). There was no impact as the reaction has been disabled.

⁷ Data sampled (1 frame in 8)

8.1.5 OMC Operations

2009-10-24 (DoY 297, Rev 858) to 2009-10-27 (DoY 300, Rev 859)

Nothing to report.

2009-10-28 (DoY 301, Rev 859-860)

At 21:54, high winds at Goldstone forced the stowing of the antenna. The link was not recovered until 00:12:00 the following day, when the signal was acquired from Vil2. A recovery was subsequently performed, and the timeline restored at 01:05. The impact was the loss of pointings 08600006, 08600007, 08600008 & 08600009.

2009-10-29 (DoY 302, Rev 860)

At 11:17, the TPF update for slew 08600024 failed. Operations were stopped and a recovery performed. At 12:45, the timeline was rejoined. The impact was the loss of pointing 08600024.

2009-10-30 (DoY 303, Rev 860)

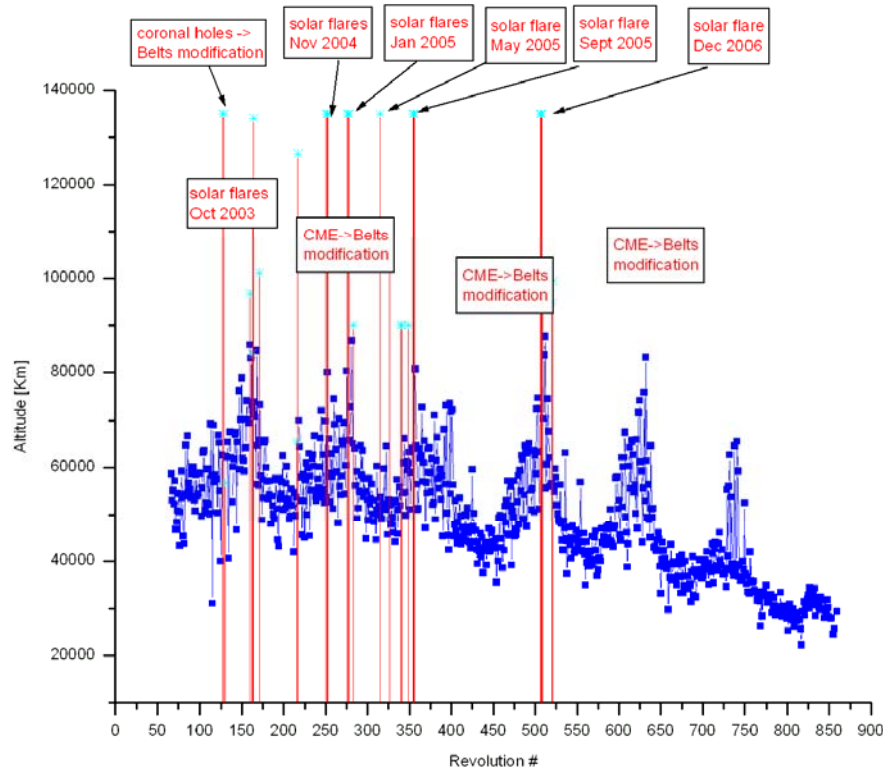
At 16:50:30 an IREM SEU (#83) forced OMC to SAFE mode, a recovery was performed, and the unit returned to standby at 17:06:28. At 17:07, the OMC commands for pointing 08600064 were manually sent. The impact was a shortening of that pointing to 2984 from a planned 3479 seconds. Pointing 08600063, which was ongoing at the time of the anomaly should have completed its download in-time, and ought to be unaffected.

On DoY 298 at 10:15:18 and DoY 301 at 10:03:58 OMC went to SAFE mode nominally, at the radiation belt entry time as set in the Broadcast Packet.

8.1.6 IREM Operations

Radiation Belts Entry

Evolution of Radiation Belt Entry 2003-2008



IREM daily report

DoY 2009.303 (30/10/2009):

At 16:50:29Z, a local reset of the IREM CSCI S/W (SEU #83) 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 at 2009.303.16:50:29Z (138550.6 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 immediately using procedure CRP_SYS_2570. The first dump of the status word after the anomaly reported a value of BCC0 HEX = 48320 DEC = 1011110011000000, i.e the Checksum Failure Flag ON. The unit was still reporting the status as if it was in Integral mode with counting ON and accumulation ON. This value of the status word is assumed to be an old one written by the S/W at the moment of the anomaly.

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 19:06:00Z.

The IREM automatic transition to Standard Mode affected the instruments by forcing them to automatically enter Safe configuration, except for SPI and JEM-X whose automatisms are disabled according to the PIs request. OMC was recovered at 17:06:28Z and IBIS at 17:38:00Z.

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]
858	RAD_ENTR R 2009-10-25T10:15:12Z	Not Available	Not Available	25-Oct-2009 12:55:04	27237.17
859	RAD_EXIT R 2009-10-25T19:02:11Z	25/10/2009 18:06:53	>>33118.0	25-Oct-2009 18:45:04	46972.28
859	RAD_ENTR R 2009-10-28T10:03:50Z	28/10/2009 12:36:53	29407.0	28-Oct-2009 12:45:02	27132.66
860	RAD_EXIT R 2009-10-28T18:50:58Z	28/10/2009 17:54:13	>>33111.4	28-Oct-2009 18:35:02	47026.24

Reference

High radiation

Very small error vs reference (less than 10 minutes)

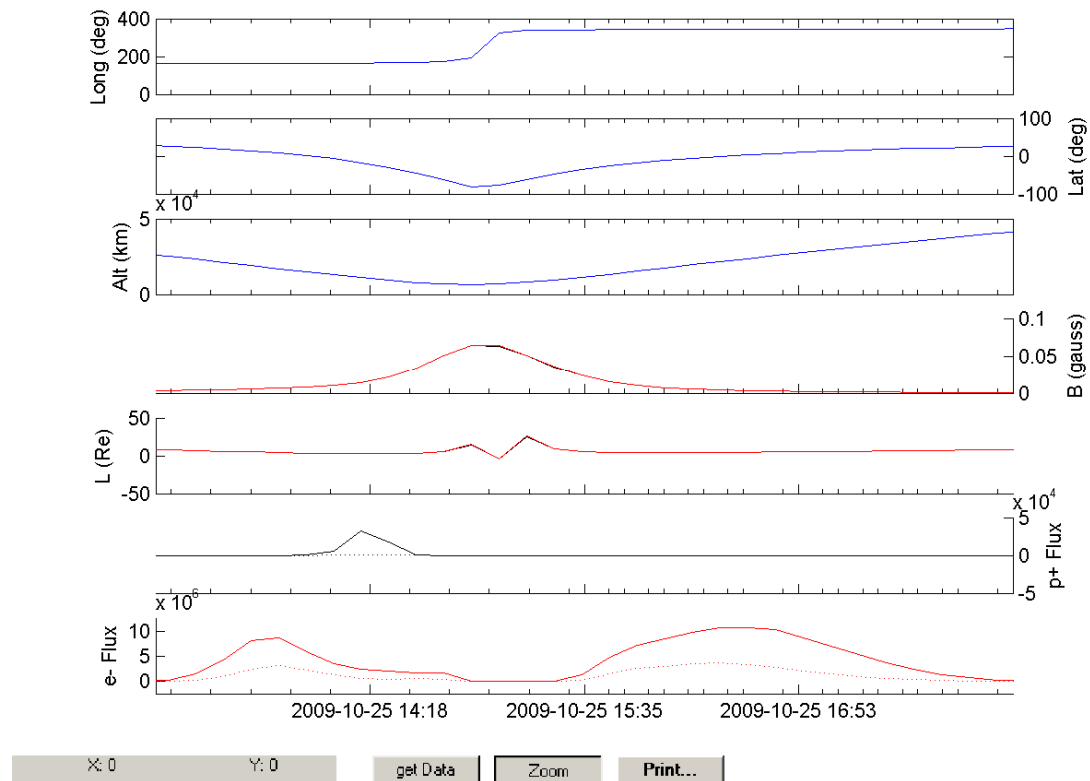
Small error vs reference (between 10 and 30 minutes)

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 Predicted Radiation Belt Passages

Rev 858



Rev 859

