

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 360
Week 33
17.08.09
Routine Phase

Prepared by: F. Schmidt (OPS-OAI) and INTEGRAL FCT

LIST OF CONTENTS

1	General.....	3
2	Summary of Activities.....	3
3	Satellite Status.....	3
3.1	Platform.....	3
3.1.1	AOCS.....	3
3.1.2	Power.....	3
3.1.3	Thermal.....	3
3.1.4	OBDH.....	3
3.1.5	RFS.....	4
3.2	Payload.....	4
3.2.1	SPI.....	4
3.2.2	IBIS.....	6
3.2.3	JEM-X.....	7
3.2.4	OMC.....	7
3.2.5	IREM.....	8
3.2.6	Radiation Background.....	9
4	Ground Facilities.....	11
4.1	Mission Operations Centre.....	11
4.2	Ground Stations & Network.....	11
4.3	Science Ground Segment.....	12
4.3.1	ISOC.....	12
5	Special Events.....	12
6	Anomalies.....	12
7	Future Milestones.....	12
8	Appendix.....	13
8.1	Consumables.....	13
8.2	Detailed Satellite Information.....	13
8.2.1	AOCS SUMMARY OPERATIONS REPORT, 08/08/2009 – 14/08/2009.....	13
8.2.2	SPI Operations.....	16
8.2.3	IBIS Operations.....	19
8.2.4	JEM-X Operations.....	22
8.2.5	OMC Operations.....	23
8.2.6	IREM Operations.....	24

DISTRIBUTION LIST

Addressees	Copy	Addressees	Copy
D/OPS		ESAC	
G. Winters D/OPS	1	P. Kretschmar	1
J. F. Kaufeler OPS-G	1	M. Kessler SCI-O	1
N. Bobrinsky OPS-ON	1	E. Kuulkers	1
A. Rudolf OPS-OA	1	K. Engan	1
		A. Parmar SRE-OA	1
M. Kirsch	1	ESTEC/SCI-A	
R. Southworth	1	Nicola Rando	1
F. Di Marco	1		
F. Cordero	1	ESA HQ	
M. Walker	1	D. Southwood D/SRE	1
S. DePadova	1		
S. Fahmy	1	ESTEC	
F. Schmidt	1	J. Ellwood SRE-P	1
C. Lozano	1		
D. Webert	1	ESTEC / PG	
M. Pantaleoni	1	G. Sarri	1
J. Martin	1		
U. Weissmann	1	ESTEC/RSSD	
N. von Krusenstiern	1	C. Winkler	1
A. Mantineo	1		
K. Scott	1	ISDC	
		R. Walter	1
		ISDC Shift Team	1
SPACONs	1		
I. Bayliss	1	ALENIA	
G. Di Girolamo	1	M. Montagna	1
F. Dreger	1	F. Ravera	1
G. Gienger	1		
S. Pallaschke	1	PI / Instrument Teams	
W. Hell	1	J. P. Roques – SPI	1
K.J. Schulz	1	G. La Rosa – IBIS	1
M.A. Larsen	1	P. Ubertini – IBIS	1
		A. Bazzano - IBIS	1
M. Butkovic	1	F. Lebrun - IBIS	1
D. Heinzer	1	S. Brandt – JEM X	1
U. Feucht	1	E. De Miguel - OMC	1
Shift – Coord	1	W. Hajdas – IREM	1
Scheduling Office	1		
T. Beck	1	JPL / Goldstone	
M. Rossmann	1	D. Holmes	1
M. Unal	1	J. Valencia	1
P. Maldari	1	Jesse Velasco	1
		Julia Bell	1
		DSN - MPSETD	1
Redu			
B. Demellenne	1		

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 08.08.09 until 14.08.09 (both dates inclusive) and covers the revolutions 832, 833 and 834.

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 the Perseus Arm region (RA 04:46:58.46, +45:14:46.4), a target of opportunity a hexagonal dither of the Be/X-ray binary system 1A 0535+262 (RA 05:38:54.57, +26:18:56.8) and an OMC Flat Field Calibration OMC FF # 31 (RA 02:28:24.00, +15:30:00.0).

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.

Slews 08330078, 08340029, 08340030, 08340031 and 08340032 were missed from the TL.

The fuel consumption over the period between 08/08/2009 and 14/08/2009 was 0.1059 Kg. The remaining propellant is in the order of 132.9042 Kg.

Note: Some more information concerning the AOCS operations 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

Following the 13th SPI annealing, which ended on 11/05/2009, the overall status of the gamma-ray spectrometer is nominal, except for detector #2 (failed since 06/12/2003); detector #17 (failed since 17/07/2004) and detector #5 (failed since 19/02/2009).

The Stirling compressors are working nominally. The Germanium detectors' temperature was kept in the range 80K+/-1K.

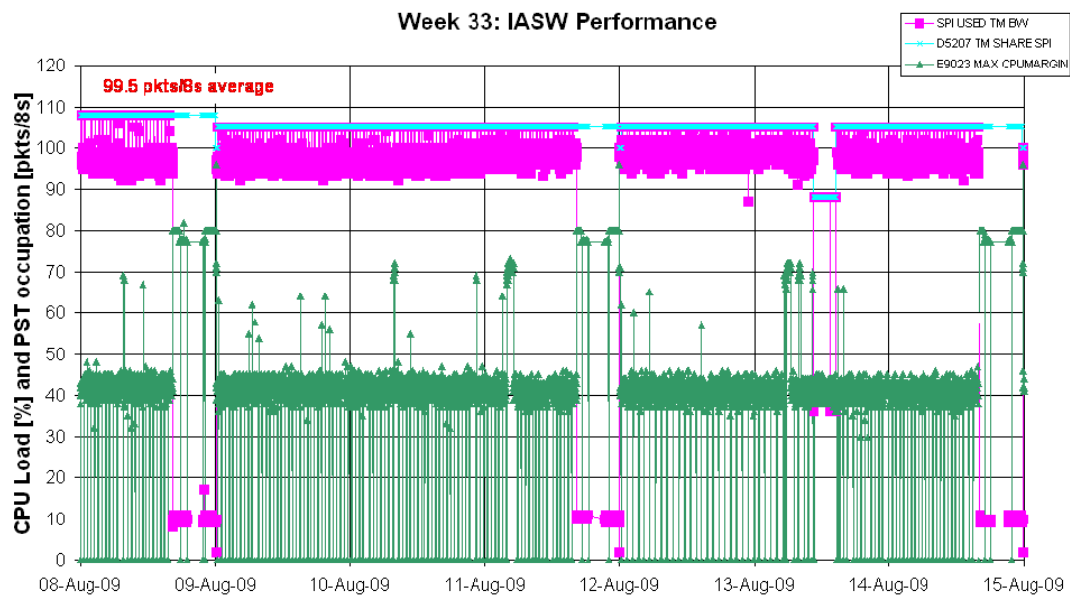
SPI was operated in photon-by-photon mode with spectra TM enabled during science observations. The assigned TM bandwidth in the science observation windows was as follows:

- 108 packets/cycle in revolution 832
- 105 packets/cycle in revolutions 833-834, except from 2009-08-13T10:38:19Z to 2009-08-13T14:28:59Z, when it was 88 packets/cycle due to an OMC FFC.

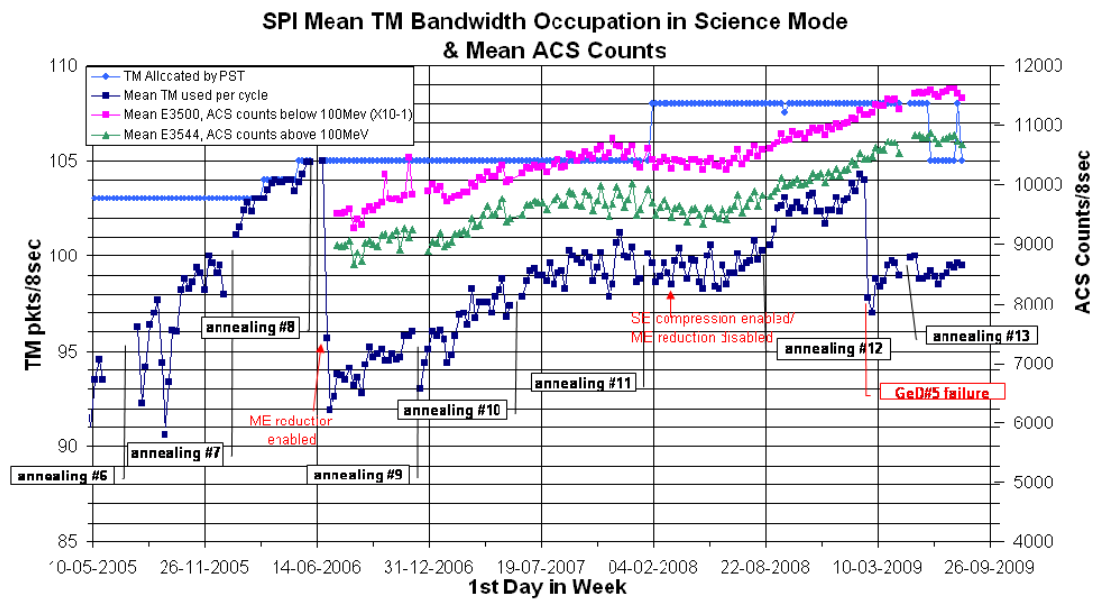
The average telemetry occupation, when the allocation was above 100 packets/cycle, was 99.5 packets/cycle.

The following plot shows the TM bandwidth allocation, occupation and DPE CPU load during the reporting period¹:

¹ Data sampled every 8th packet (64sec)



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 SPI operations is provided in the Appendix 8.3.2.

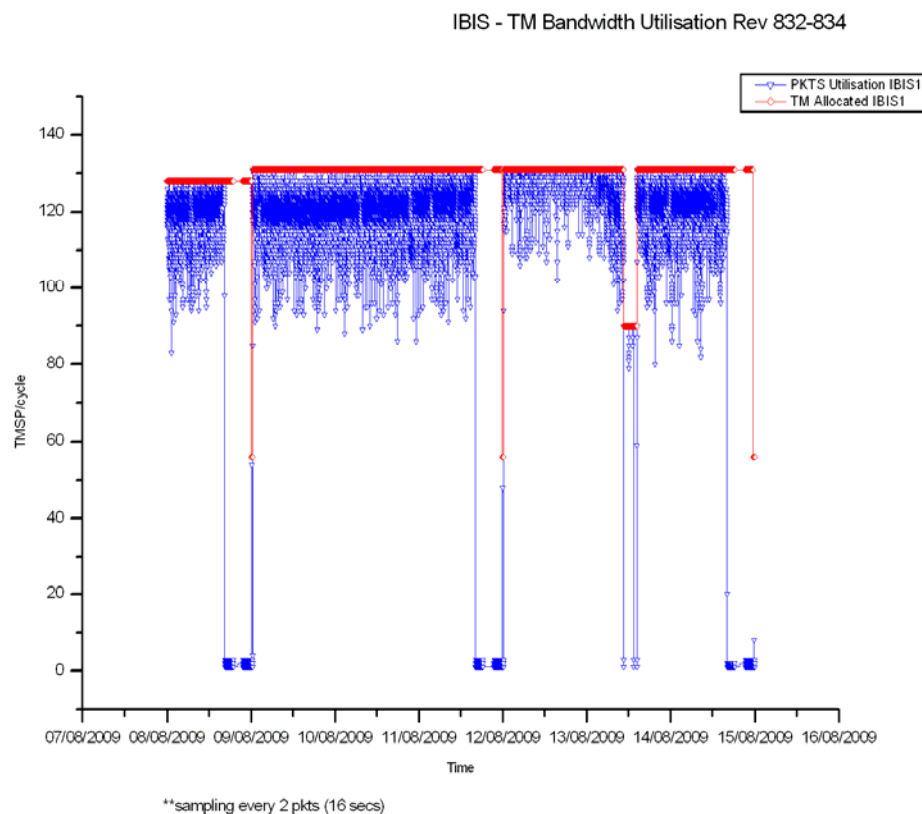
3.2.2 IBIS

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:

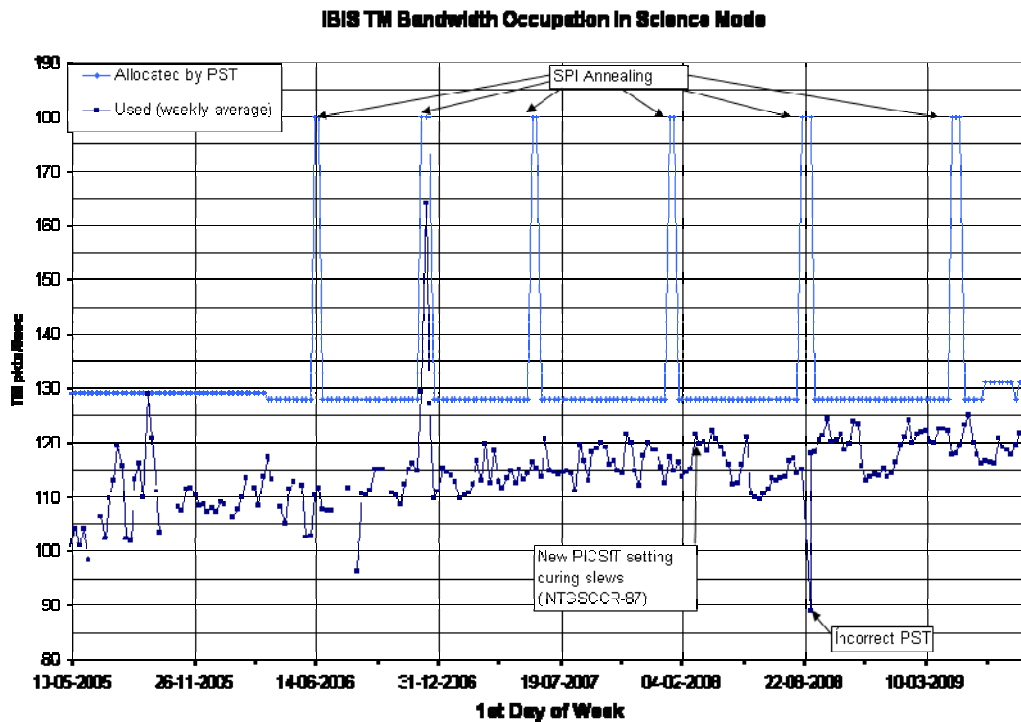
- PST allocation to IBIS above radiation belts:
 - 128 packets/cycle in revolution 832
 - 131 packets/cycle in revolutions 833-834, except from 2009-08-13T10:38:19Z to 2009-08-13T14:28:59Z, when it was 90 packets/cycle due to an OMC FFC.
- IBIS mean bandwidth utilisation in science mode: 121.61 packets/cycle (up 2.1 on previous week)
- Percentage of TM cycles, when allocation >100 packets/cycle, for which full bandwidth was used: 19.4%

The plot below shows the IBIS TM utilisation during the reporting period² :



A plot of the IBIS weekly bandwidth utilisation since May 2005 is shown below:

² Data sampled every 2nd packet (16sec)



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 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 5 packets/cycle, except from 2009-08-13T10:39:02Z to 2009-08-13T14:29:42Z during the Flat-field calibration, when it was 63 packets/cycle.

During this reporting period, 183 of the 187 planned science pointings were executed nominally, 1 was cut short, and 3 were 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.

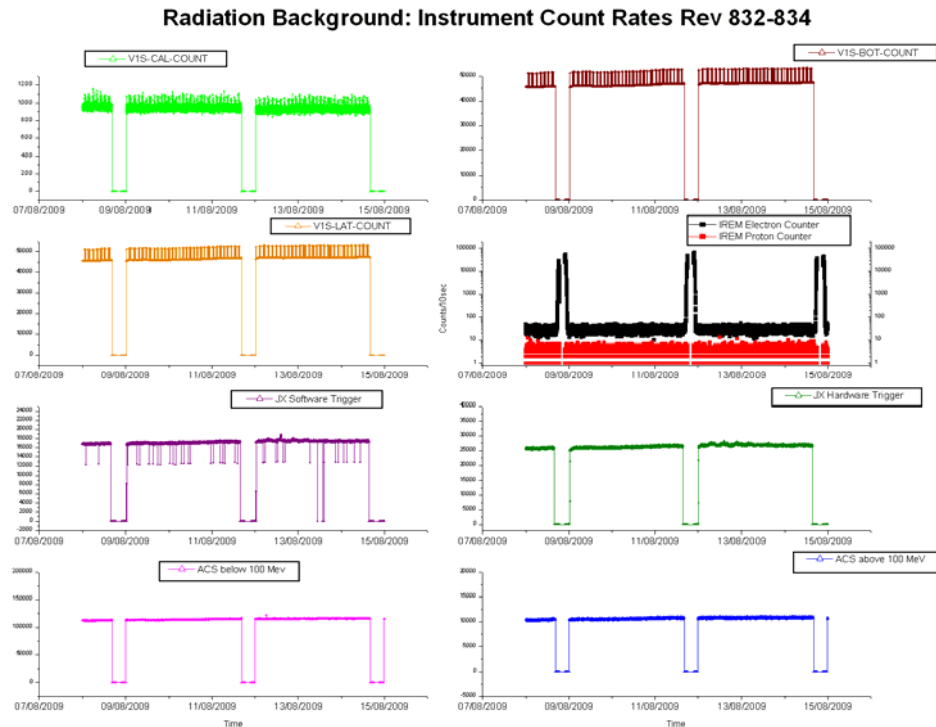
Solar Activity

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

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

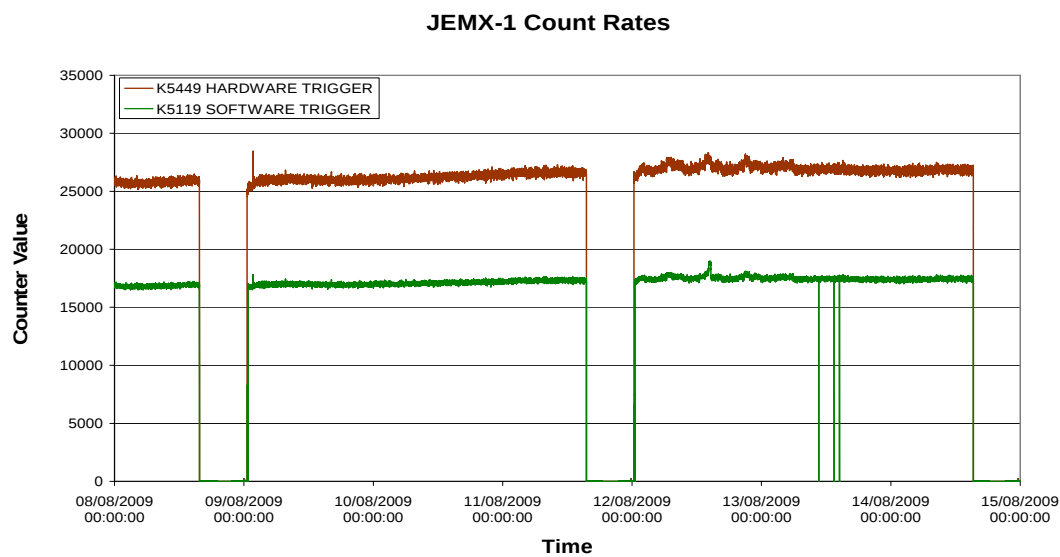
3.2.6 Radiation Background

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 week³ :



JEM-X Count Rates

JEM-X count rates over the reporting period are displayed in the following graph⁴.



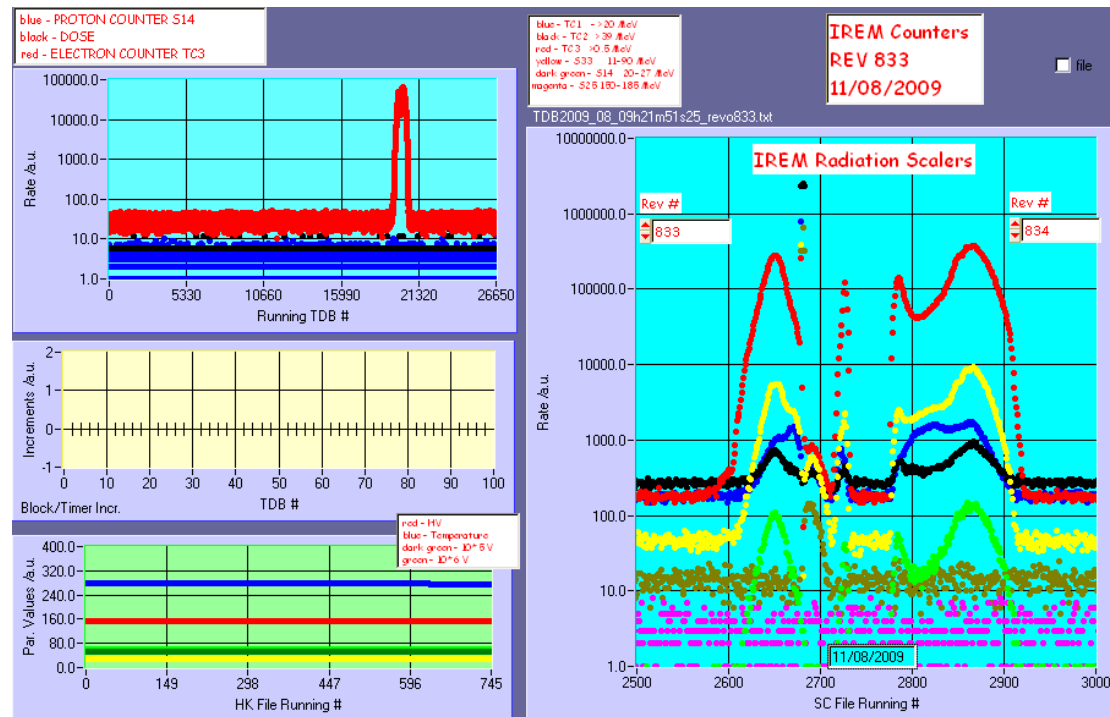
³ Data sampled every 6th packet (48sec)

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

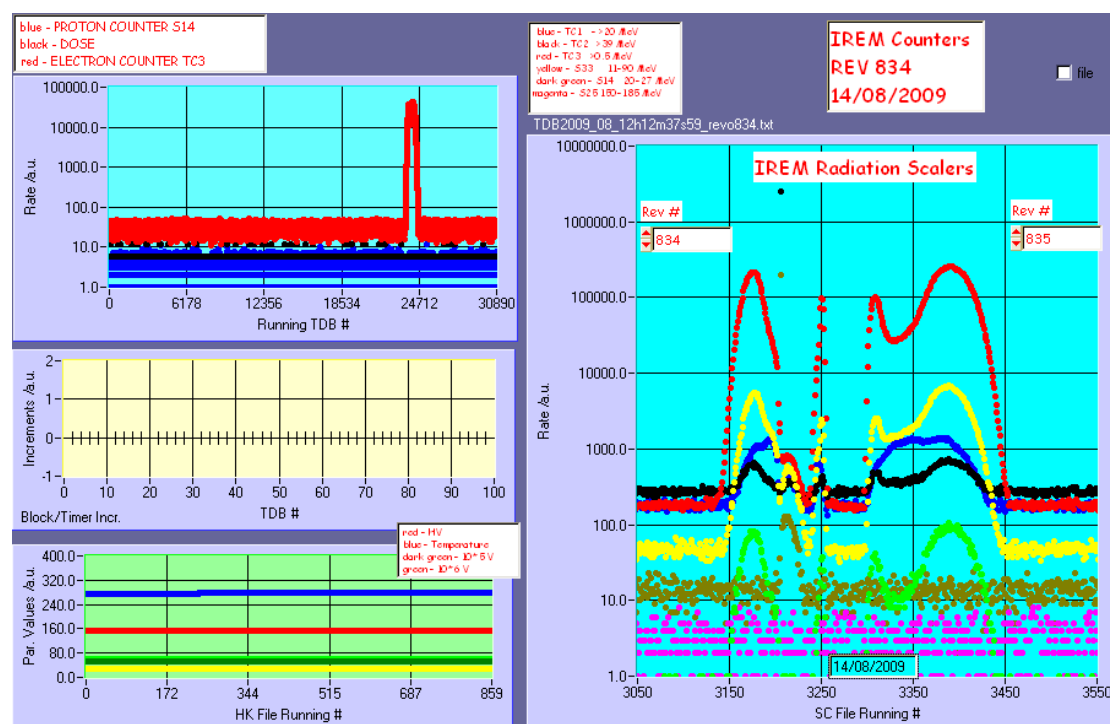
IREM radiation counters:

Revolution 832 not available

Revolution 833



Revolution 834



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 two occasions when the links with ISDC dropped, necessitating a restart of the isds & ifrd. On DOY 220 ISDC report they have not been receiving data since the previous night. The Connection status in TM spacon was green and CCC reported that isdsa is functioning correctly (including ftp connections to Geneva). ISDC switched the connection to isdsb at 09:40Z and it was decided to stay on isdsb until Monday. On DOY 221 at 06:28Z ISDC reported that they have not received data all night. At 06:30Z a restart of ISDS and IFRD on isdsa was performed and ISDC swapped the connection back to isdsa. ISDC was then receiving good data. Investigation is still on-going.

4.2 Ground Stations & Network

The performance of the ground stations and Network was good this week. There was one occasion of a TC drop from DSS-27 which caused the interruption of a slew and one occasion of a TM drop VC0 and VC7 from DSS-27. On DOY 225 a loss of bitlock from DSS-27 led to the suspension of the Timeline (DR G109614). 4 slews were not executed from the Timeline.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

A new PSF has been received for revolution 840.

New observations have been planned for revolution 835 to 837, including further TOO observations of A0535+26. The planning for revolution 834 was updated to change the perigee exit.

New TSFs have been received for revolutions 834-836.

2. Observation status

New ECS files have been received and processed for revolutions 822-824.

3. ISOC Science Data Archive

A new test data base has been set up for SAT to prepare ingestion of OSA 7 and higher results.

4. ISOC system

No news.

5. Problems

None.

5 Special Events

6 Anomalies

The following anomalies occurred this week:

AR id	Date Created	Subject	Segment	Status
INT-3070	2009-08-08	ISDS - Problem sending data to ISDC	I/F to SGS	Pending

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Consumables

8.2 Detailed Satellite Information

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

8.2.1 AOCS SUMMARY OPERATIONS REPORT, 08/08/2009 – 14/08/2009

The AOCS operations were executed from the Automatic Timeline.

During this period, 125 Open Loop Slews, 73 Closed Loop Slews and 5 Momentum Biases were executed (as reported by ACC OEM).

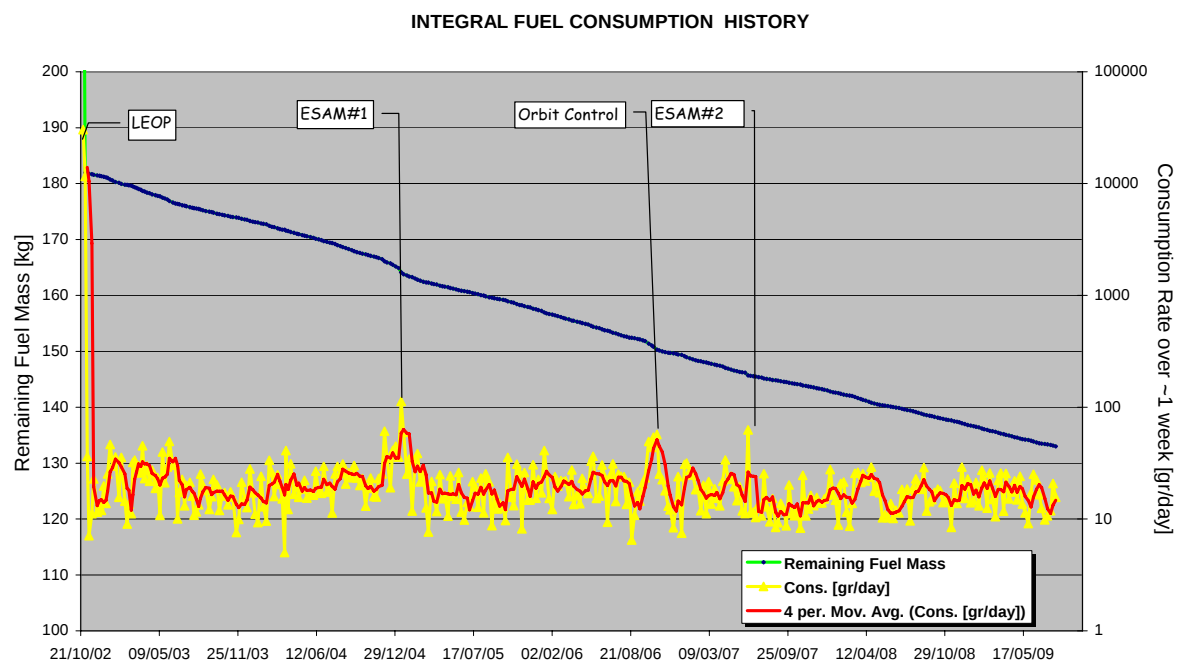
Slews 08330078, 08340029, 08340030, 08340031 and 08340032 were missed from the TL.

Orbit Control

No update.

Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 14/08/2009 is reported in the plot below.

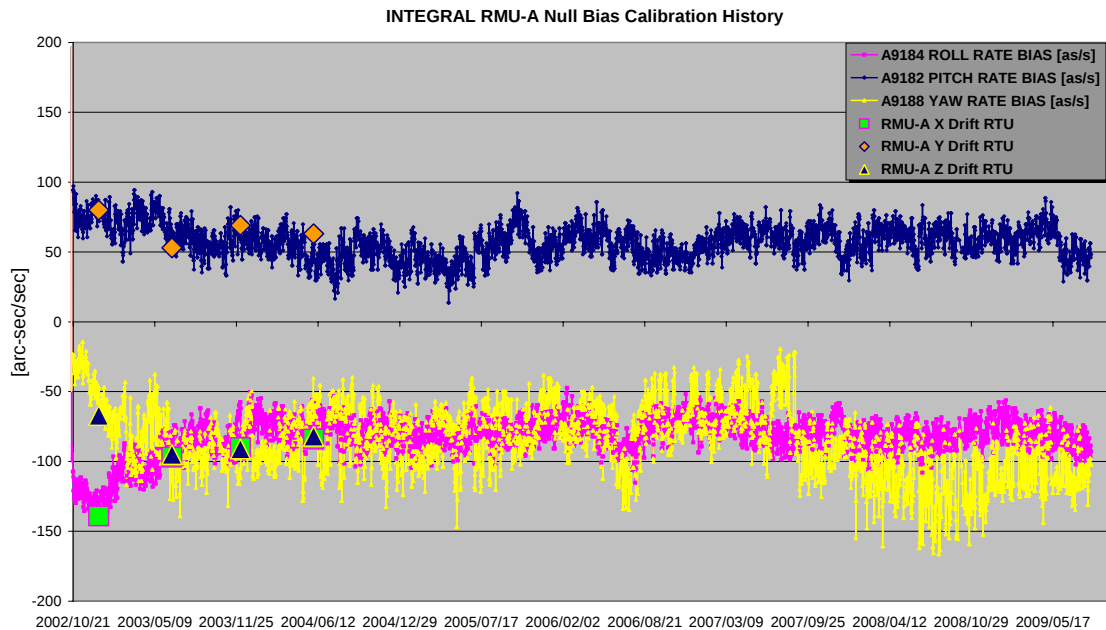


The above plot considers the ESAM fuel consumption spread over period of ~1 week.

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 14/08/2009 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.



08/08/2009 (Day of Year 220, Revolution 832)

Nothing to report

09/08/2009 (Day of Year 221, Revolution 832 to 833)

- Flight Dynamics updateslew task failed to update the parameters for slew 08330006. A mapping was commanded and the slew parameters were updated manually (spacontool).

No impact on the Timeline

10/08/2009 (Day of Year 222, Revolution 833)

Nothing to report

11/08/2009 (Day of Year 223, Revolution 833)

- Slew 08330078 failed release because of a loss of TC link from DSS27 (03:38:00Z).

Doc. Title : INTEGRAL Mission Report #360
Doc. Ref. : INT-MOC-SYS-RP-1001-OPS-OAI
Date : 17/08/09

Issue : 1
Rev. : 0
Page : 15

After the TC link was back, a mapping was commanded and a manual slew generated from PID 08330077 to PID 08330079 via spacontool. Once this slew was completed, the parameters for slew 08330080 were as well manually updated (spacontool)

Slew 08330078 was missed from the Timeline.

12/08/2009 (Day of Year 224, Revolution 833 to 834)

Nothing to report

13/08/2009 (Day of Year 225, Revolution 834)

- CSL 08340029 failed completion of execution because of a Ground Station problem (04:17:00Z).

After the GS problem was solved and the TC link was restored, the SPACON tried to recover by generating a slew (spacontool) from PID 08340028 to PID 08340030 (0834_0500_M.OSL).

Unfortunately, because of a bug in the MCS, this slew failed to be executed and a new one was generated (0834_0500_M.OSL), this time from PID 08340028 to PID 08340031. It worked.

A mapping was commanded in order to update the parameters for slew 08340032, but this didn't work since slew 08340032 was expected to be a CSL and an OSL was generated instead.

An OSL was then generated and executed manually to go from PID 08340031 to PID 08340032. After this slew was completed, the parameters for 08340033 were successfully updated via spacontool and the subsystem 1 got re-enabled.

Slews 08340029, 08340030, 08340031 and 08340032 were not executed from the Timeline.

14/08/2009 (Day of Year 226, Revolution 834)

Nothing to report

8.2.2 SPI Operations

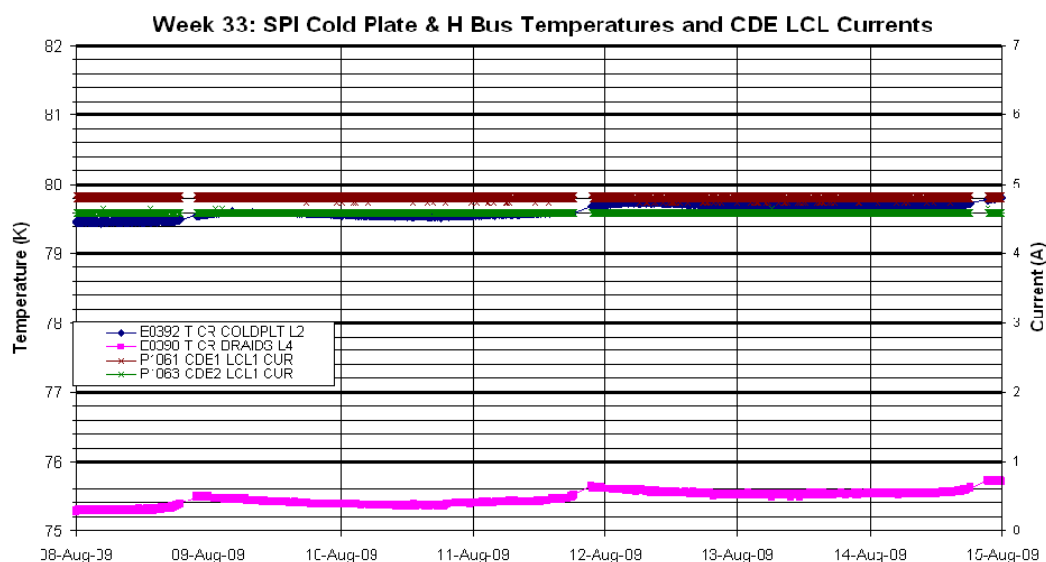
Unit Temperatures: All the equipment temperatures are inside the operational limits.

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

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

- CDE1 LCL Current = 4.80A
- CDE2 LCL Current = 4.60A

The following plot shows the evolution of the cold plate and H bus temperature as well as the CDE LCL currents during the reporting period⁵:



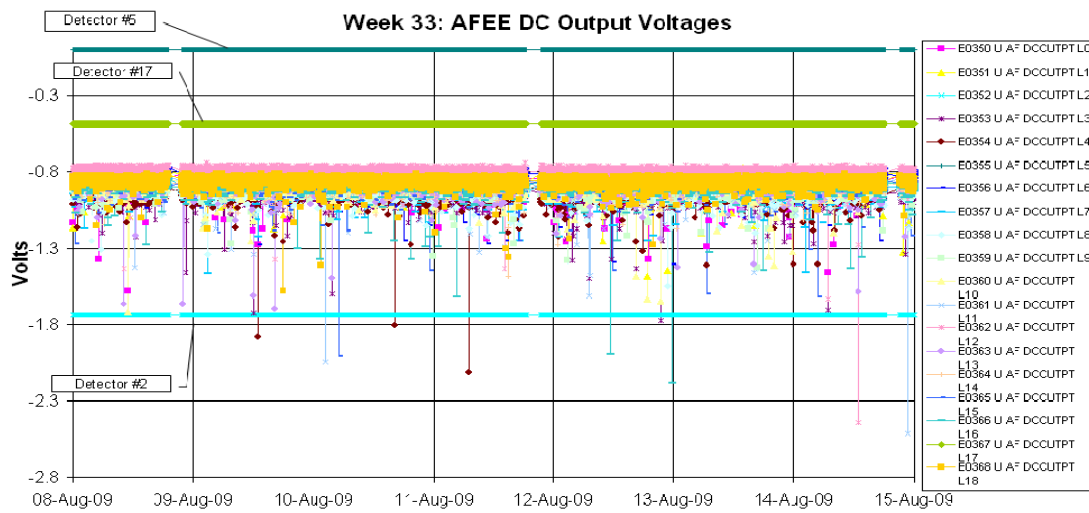
DPE & IASW: The DPE health and IASW performance are nominal. The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling factor set to 8/19 SE. The DPE CPU usage was nominal during the reporting period (see plot in Section 3.2.1).

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). A plot of the ACS counts is given in Section 3.2.6.

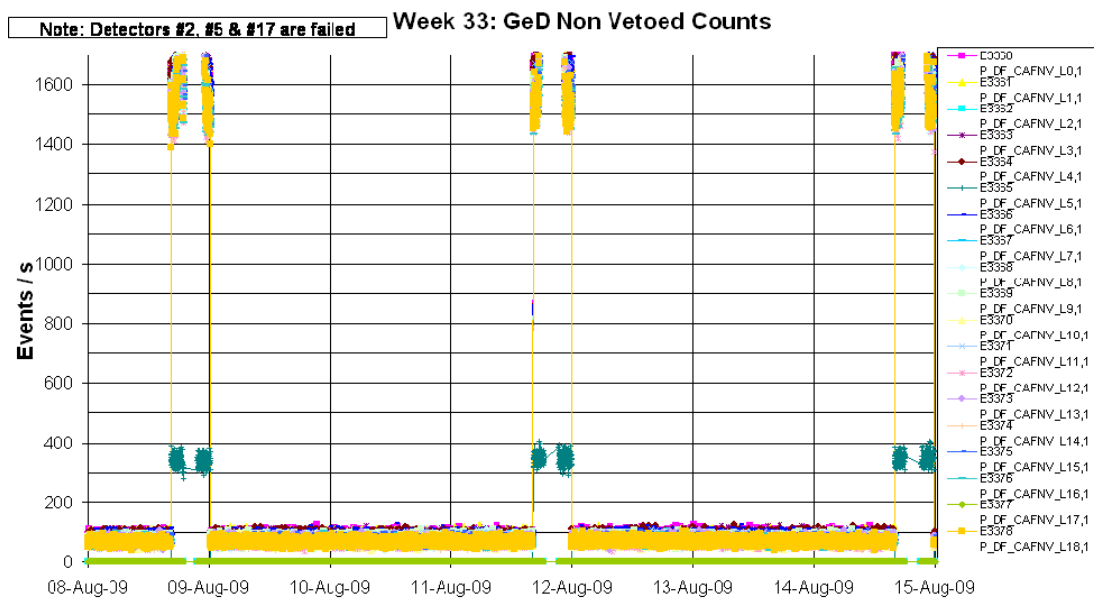
AFEE: The health of the AFEE is nominal. The following plot shows the dc output voltage of the detector channels during the reporting period⁶. The values are nominal. Detector #2 is failed since 06/12/2003; detector #17 is failed since 17/07/2004 and detector #5 is failed since 19/02/2009. The HV of the failed detectors are nominally set to 0.5kV.

⁵ Data sampled every 8th packet (64sec)

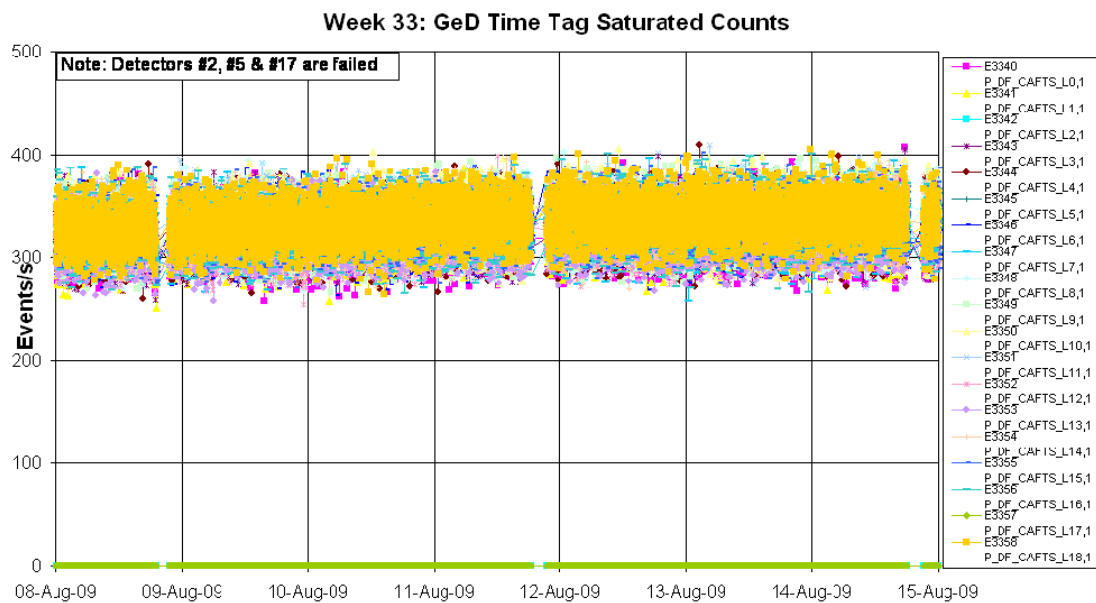
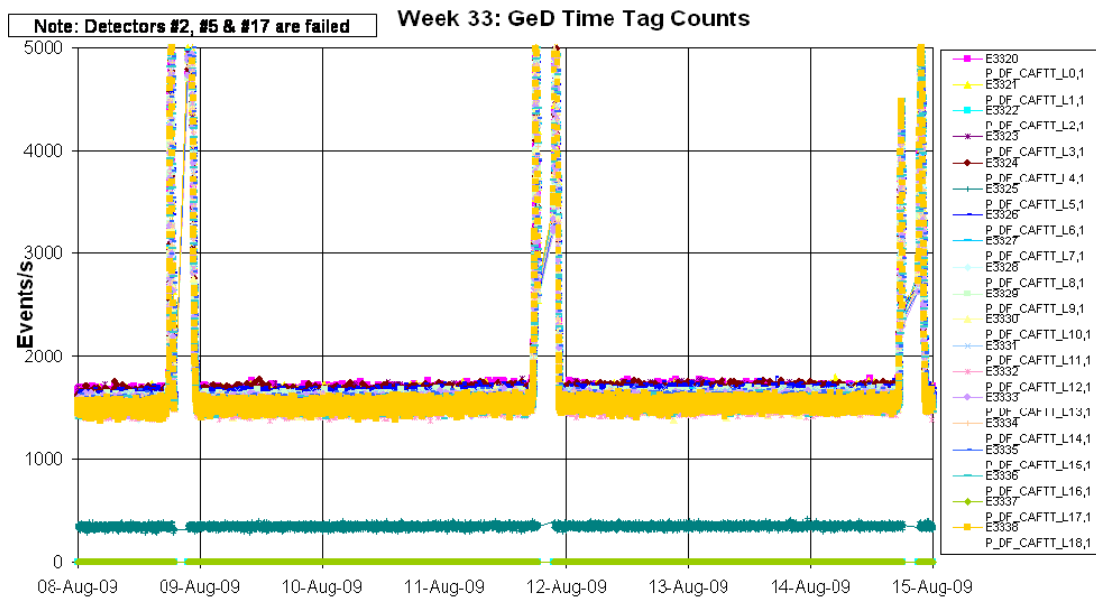
⁶ Data sampled every 8th packet (64sec)



DFEE: The health of the unit is nominal. The following plots show the Non Vetoes, Time Tag and Time Tag Saturated Event count rates during the reporting period⁷.

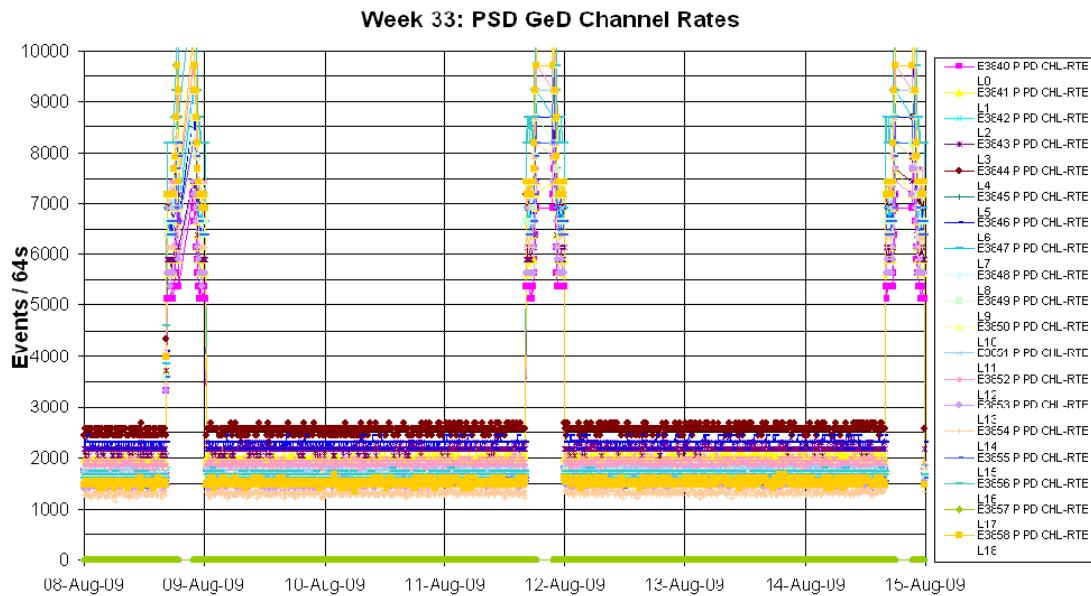


⁷ Data sampled every 8th packet (64sec)



PSD: The overall health of the unit is nominal. The following plot shows the PSD channel rates over the reporting period⁸:

⁸ Data sampled every 8th packet (64sec)



Event Log:

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

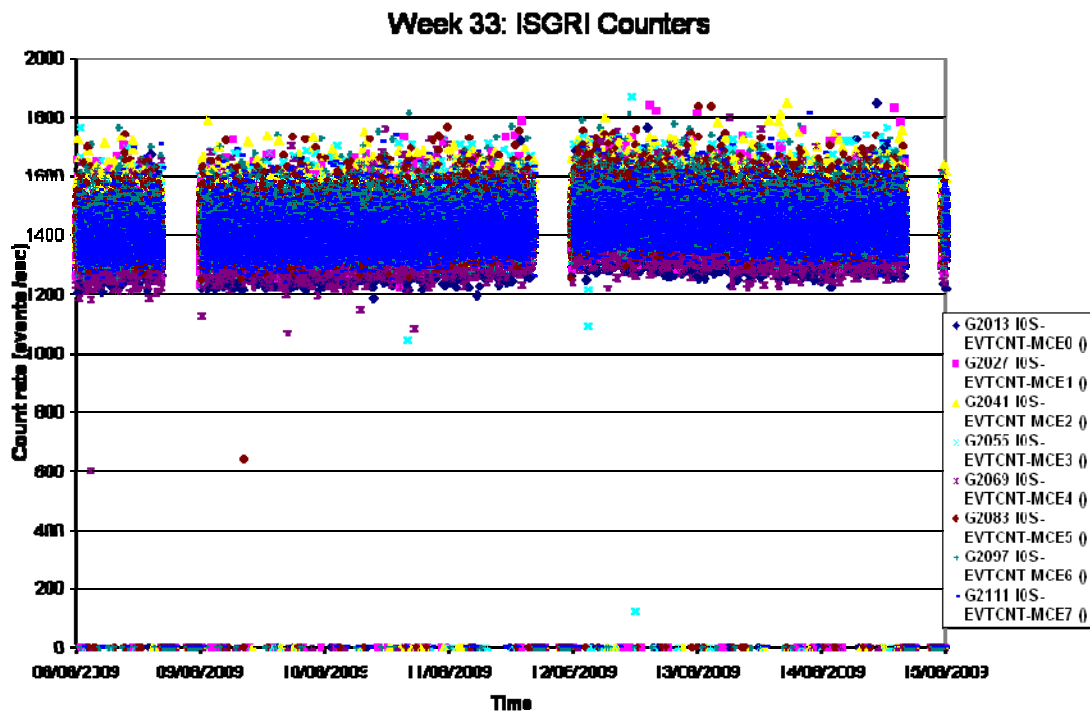
8.2.3 IBIS Operations

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

ISGRI

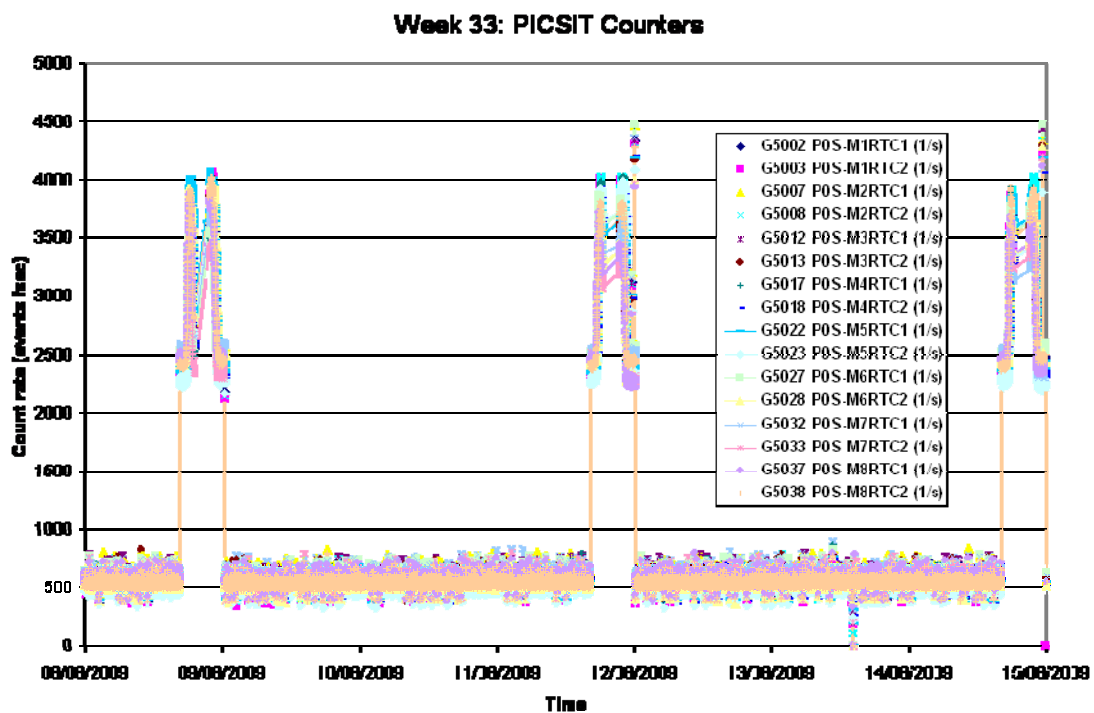
The health and performance of ISGRI was nominal during the reporting period. The following plot shows the ISGRI MCE counters during the week⁹:

⁹ Data sampled every 4th packet (32sec)



PICsIT

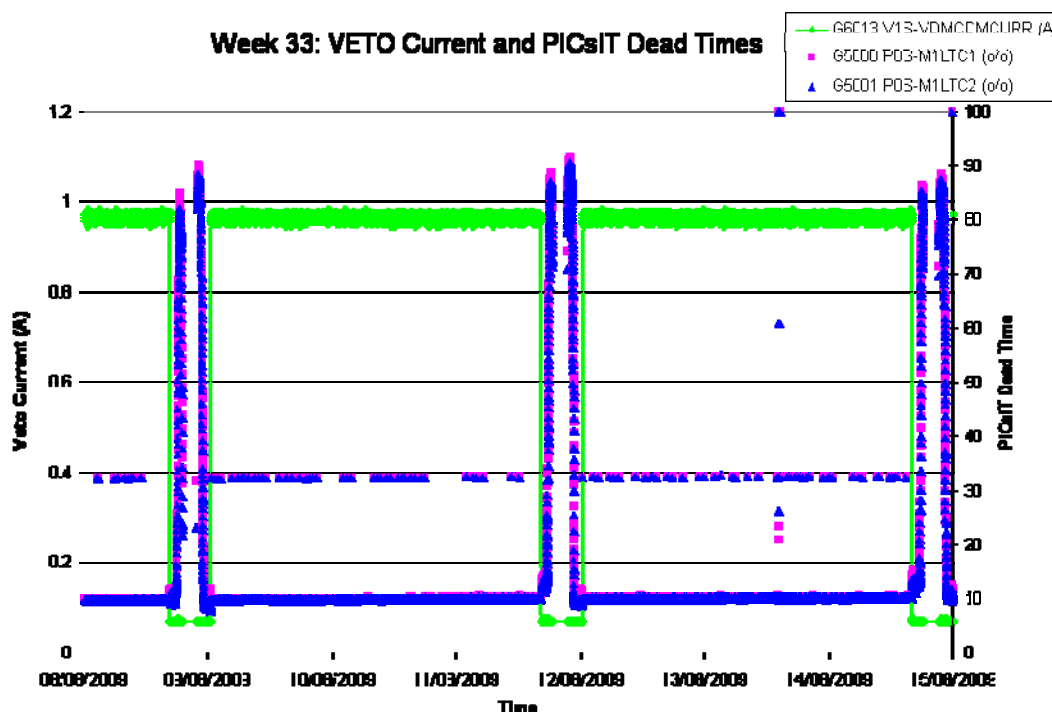
The health and performance of PICsIT was nominal during the reporting period. The following plot shows the PICsIT semi-module counters during the week¹⁰ :



¹⁰ 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 week¹¹ :



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.

2009-08-08 (DOY 220, Rev 832-833) to 2009-08-12 (DOY 224, Rev 834)

IBIS operations executed nominally.

2009-08-13 (DOY 225, Rev 834)

At 14:19:56Z the TM parameters families G5068 and G5072 failed status consistency check (value = TRUE). These are the PDM semi-module FIFO error flags. At 14:20:47Z the TM parameter families G5002 and G5003 for the PDM semi-module counters started going OOL Low. As these were followed at 14:23:47Z 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.

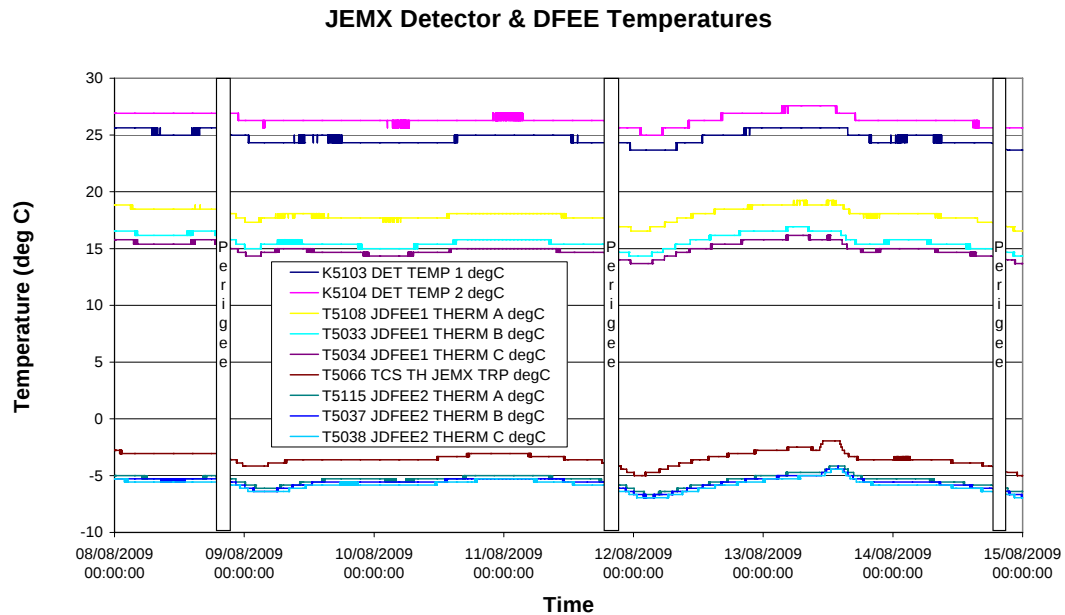
2009-08-14 (DOY 226, Rev 834-835)

IBIS operations executed nominally.

¹¹ Data sampled every 4th packet (32sec)

8.2.4 JEM-X Operations

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 graph¹².



JEM-X Daily Report

2009-08-08 (DoY 220 Rev 832) to 2009-08-14 (DoY 226 Rev 834)

JEM-X 1 operations executed nominally.

¹² Data sampled (1 frame in 8)

8.2.5 OMC Operations

2009-08-08 (DoY 220, Rev 832) to 2009-08-10 (DoY 222, Rev 833)

Nothing to report.

2009-08-11 (DoY 223, Rev 833)

Between 03:38 and 03:53, the TC link with Goldstone was lost. After recovery of the link, a manual recovery was performed and the Timeline recovered at 04:33. The impact was the loss of pointing 08330078.

2009-08-12 (DoY 224, Rev 834)

Nothing to report.

2009-08-13 (DoY 225, Rev 834)

At 04:16, problems with Goldstone led to the suspension of the Timeline. At 06:27, after an investigation, a manual slew was executed to the attitude of pointing 08340032, and the Timeline rejoined at 06:44. The impact was the loss of pointings 08340029, 08340031, with pointing 08340032 cut short from a planned 2250 to 1792 seconds. It was at this time the following OEMs were received:

2009.225.05.44.07.275	2009.225.05.44.10.729	1792	RealTime	131	TC REJECT
REJECTED TC1		0	0	65535	PR N
E E					
2009.225.05.44.13.525	2009.225.05.44.18.769	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 pointing 08340031.

From 2009-08-13T10:39:02Z to 2009-08-13T14:29:42Z, a Flat-field calibration was successfully performed.

2009-08-14 (DoY 226, Rev 834)

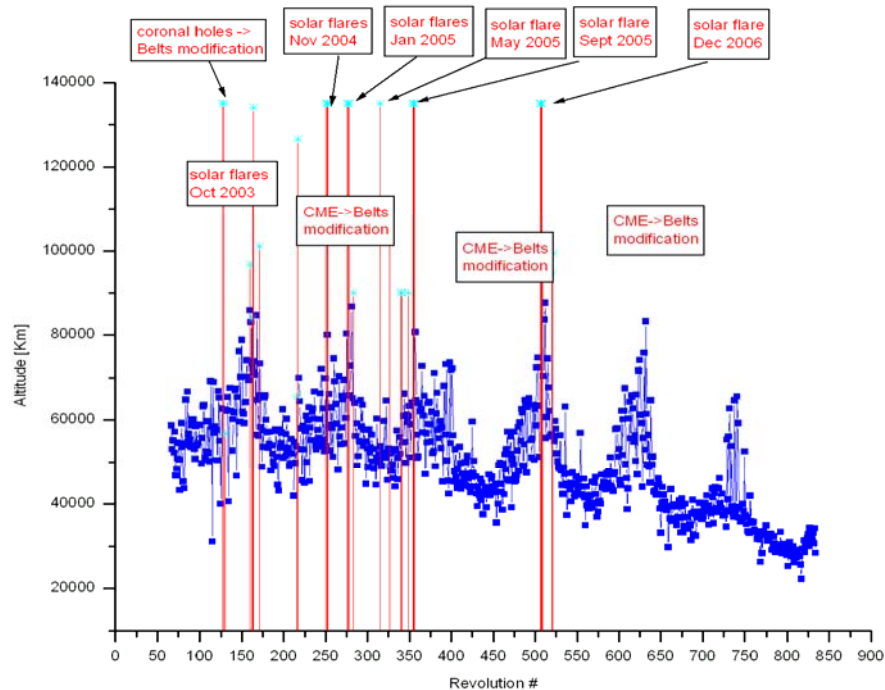
Nothing to report.

On DoY 220 at 16:29:37, DoY 223 at 16:16:18 and DoY 226 at 16:04:02 OMC went to SAFE mode nominally, at the radiation belt entry time as set in the Broadcast Packet.

8.2.6 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]
832	RAD_ENTR R 2009-08-08T16:29:29Z	08/08/2009 17:40:48	30702.2	08-Aug-2009 17:42:36	30986.57
833	RAD_EXIT R 2009-08-09T00:13:01Z	08/08/2009 23:17:36	>>32738.3	09-Aug-2009 00:02:36	47768.59
933	RAD_ENTR R 2009-08-11T16:16:12Z	11/08/2009 17:11:04	34164.3	11-Aug-2009 17:34:12	30353.18
834	RAD_EXIT R 2009-08-11T23:59:42Z	11/08/2009 22:47:20	>>32740.8	11-Aug-2009 23:44:12	46747.46
834	RAD_ENTR R 2009-08-14T16:04:01Z	14/08/2009 17:25:05	28365.2	14-Aug-2009 17:24:12	30552.85
835	RAD_EXIT R 2009-08-14T23:47:00Z	14/08/2009 22:41:53	>>32768.5	14-Aug-2009 23:34:12	46636.28

Reference

High radiation

Very small error vs reference (less than 10 minutes)

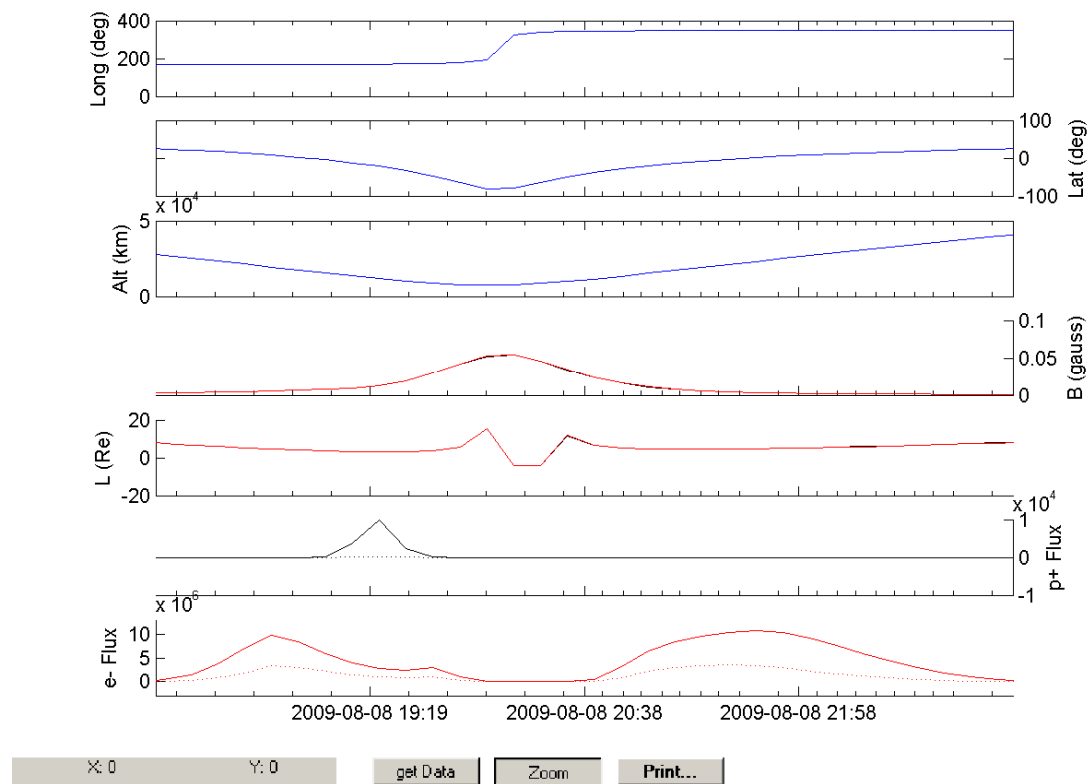
Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

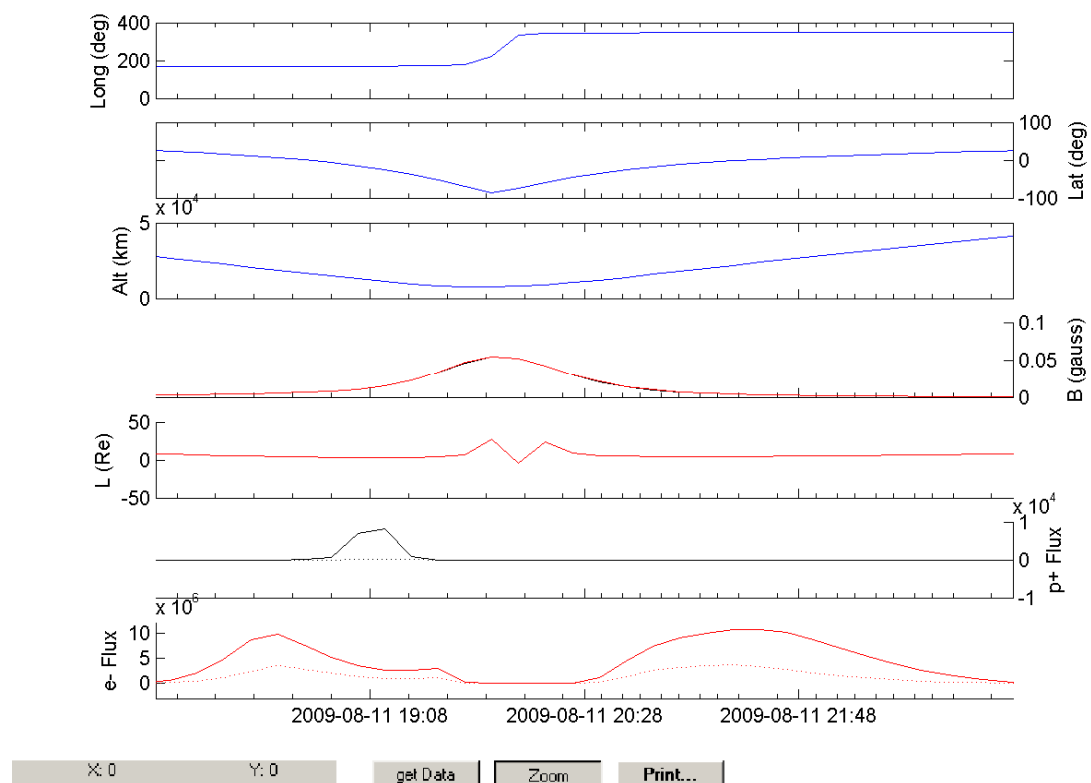
Rad belt entry time ignoring previous threshold crossings where a gap of more than 30 minutes is present.

IREM Predicted Radiation Belt Passages

Rev 832



Rev 833



Rev 834

