

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OF
No. 108
Week 42
18.10.04
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 09.10.04 until 15.10.04 (both dates inclusive) and covers the revolutions 243, 244 & 245.

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 were the Galactic Center and the Galactic Plane. The activities consisted of raster dithering, GCDE and GPS observations.

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.

Two slews (1 OSL and 1 CSL) were missed from the Timeline due to problem with the selection of guide stars for close loop slew. One reaction wheel bias was executed not at the planned time due to problem to restart some of the Integral Mission Control system tasks after the perigee passage.

The fuel consumption over the period between 09/10/2004 and 15/10/2004 was 0.112 kg. The remaining propellant is in the order of 167.331 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.

The evolution of the six Solar Array sections output currents from launch to 16th October 2004 is shown in the plots below.

Figure 1 shows the output currents, normalised to a pitch angle of 0 degrees, the seasonal effects can be clearly seen. From this plot it can also be seen that the minimum available current per section on 4th July (greatest distance from sun) was about 12.3A.

Figure 2 shows the output currents, normalised to a pitch angle of 0 degrees, with the seasonal variation also removed. Here it can be seen that the rate of degradation has (as expected) slowed.

In both plots the downward step in October 2003 was caused by the Solar storms at that time.

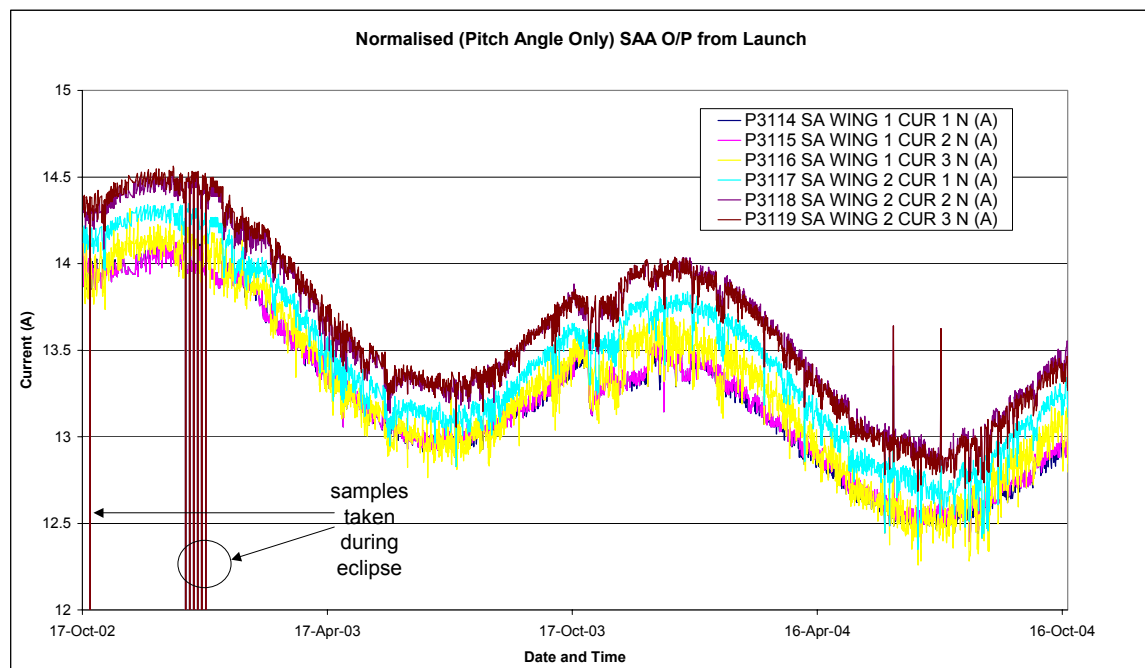


Figure 1

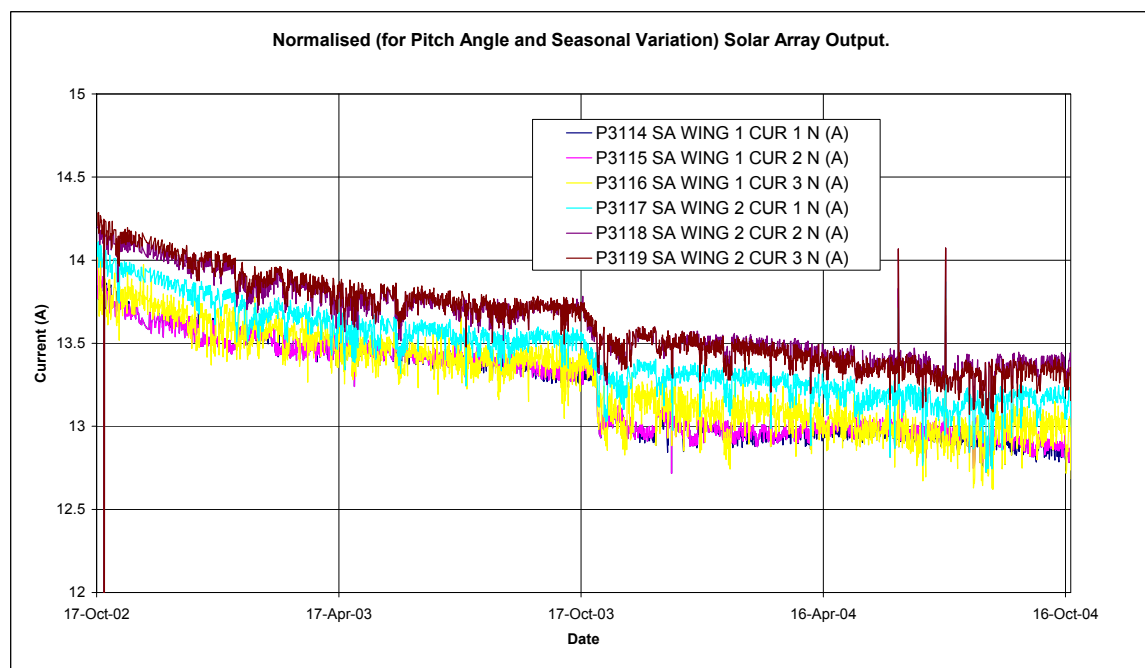


Figure 2

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 was identified.

3.1.5 RFS

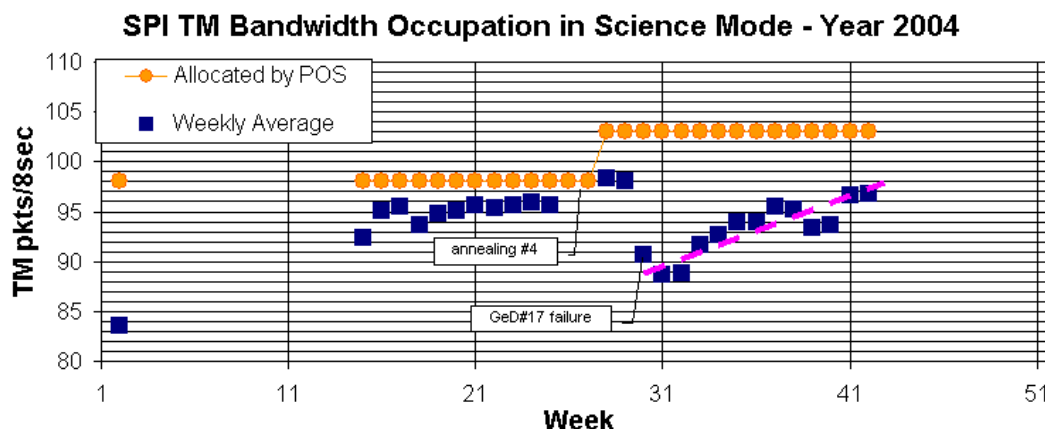
The RF subsystem is working properly. The link margin is sufficient to ensure proper TM reception and execution of commands with the ranging channel enabled.

3.2 Payload

3.2.1 SPI

The overall status of the instrument in this week is nominal, though the PSD (Pulse Shape Discriminator) still continues to randomly reproduce the malfunction of channel rates transitory blanking.

The instrument was kept in photon-by-photon mode with spectra TM enabled, an assigned TM bandwidth in the science observation windows of 103 pkts/cycle and an actual average occupation of 96.8 pkts/cycle. The following plot shows the occupied bandwidth, since beginning of 2004.



The cryo-cooler is working well, maintaining the temperature within 85+/-1K.

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

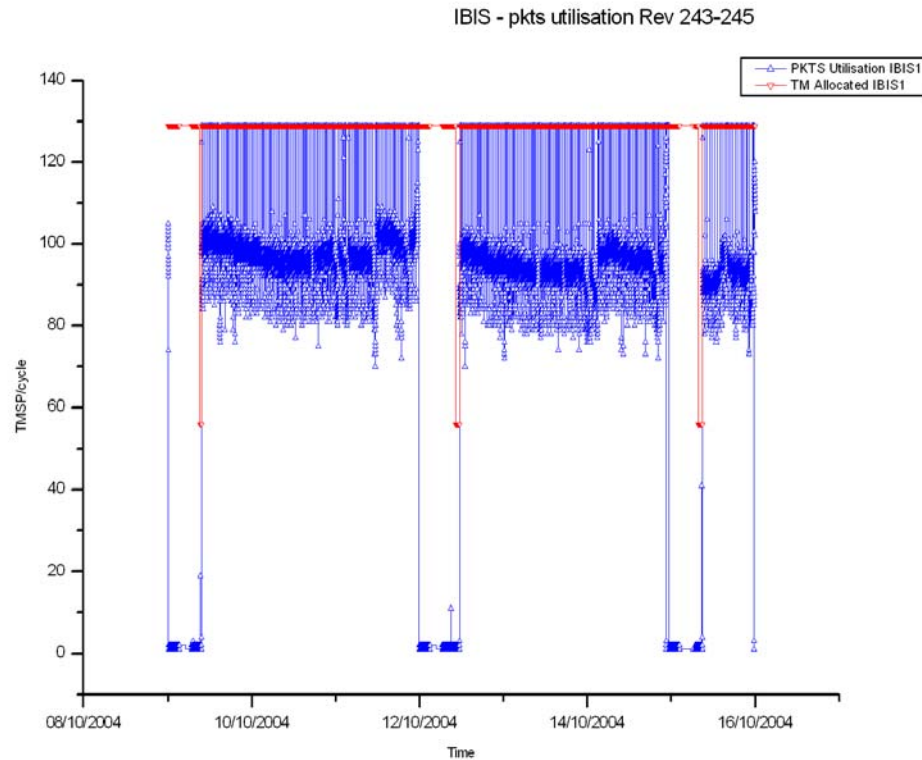
3.2.2 IBIS

The overall status of the unit is Nominal.

Recently there have been many occurrences of the Veto 28 V PMT set by IASW in out of limits (warning high >29.4 V) for few TM cycles inside the Radiation Belts (see details in the daily report). The limit for the IBIS/VETO calibration counter has been updated, to cope with the natural decay of the on-board calibration source.

During the reporting period the PST Allocation to IBIS was 129 TMSP / Cycle. The mean IBIS Bandwidth usage was 98.3 TMSP / Cycle, down 1.9 on last week.

A plot of the IBIS TM utilisation during the observation period 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 from the automatic Timeline.

JEM-X1 was operated in Data Taking mode during science observations, with a TM allocation of 8 packets/cycle. JEM-X2 remained dormant (DFEE OFF) with a TM allocation of 1 packet/cycle.

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

3.2.4 OMC

The status of OMC is nominal.

During the reporting period OMC operations were performed by the automatic timeline, with the TM allocation to OMC of 5 packets/cycle.

There were 234 OMC pointings executed nominally, 2 were lost due to AOCS problems, and a further 5 were dropped during the manual Flat Field Calibration, which was performed on DoY 285.

Note: Some more information concerning the OMC operations is provided in the Appendix Section 8.3.5.

3.2.5 IREM

The overall status of the unit is Nominal.

Solar Activity

The observation period was characterized by low solar activity. No major events were reported.

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

4 Ground Facilities

The performance of the Operational ground facilities was very good this week, well above the system performance requirements, 2 pointing were lost due to guide star problems.

4.1 Mission Operations Centre

The performance of the MOC was in general good in the reporting period, another quiet week.

4.2 Ground Stations & Network

The performance of the ground stations and Network was in general good this week. There were some problems with TM flow to ISDC, and some minor workstation problems. The overall performance though was well above the 95% requirement.

4.3 Science Ground Segment

4.3.1 ISOC

1. AO-3

Still no proposals have been received yet. Preparation for the shipment of CD's to TAC members has been done.

2. Mission planning

No new PSF's or TSF's received. Hence up to rev 250 and 244. No planning activities in ISOC this week.

3. Observation status

No ECS/OCS activity since last week.

4. ISOC science data archive

No new data available. Planning for the move of the archive equipment to Spain discussed and will be concluded next week.

5. ISOC system

Version 10.6.0 is still operational.

6. Problems

Nothing new to report.

7. Move to ESAC / Vilspa

System activities this week have concentrated on preparation for the hardware and software installation activities in Spain next week.

4.3.2 ISDC

Status of ISDC observation processing on 18/10/2004:

- Latest Standard Analysis completed: observation 02297000014 (Cygnus X, Revolution 215-218) on 17/10/2004
- Latest products archived: observation 02201450003 (Mkn 590, Revolution 208) on 31/08/2004
- Latest observation products sent to the observer: observation 02297000010 (Abell 2256, Revolution 205-206) on 11/09/2004

5 Special Events

6 Anomalies

There were a number of problems related to the ground segment that impacted the operations:

- On DoY 283, at 11:33, there was a VC0 TM gap from Redu, 1 frame was lost. No further impact.
- On DoY 284, at 19:30, the MMI for sun121 was in a yellow state due to high cpu consumption. The TM displays were closed and re-opened curing the problem.
- On DoY 285 at 01:40, an AOCS guide star command failed release, the AOCS subsystem was disabled in the timeline, and not re-enabled until after the subsequent recovery at 02:33. The impact was pointings 02430076 and 02430077 were lost.
- On DoY 286 at 04:47, GFCC restarted for a second time the NCTRSs due to connectivity problems with TCE-1 at Redu, there was no impact.
- At 13:11 the link to ISDC dropped for about 30 seconds, without impact.
- At 15:03, the NCTRS-A had to be restarted due to the presence of a ghost link, again without impact.
- At 16:27, there were errors sending data to the isds. The Firewall, and PI workstations were checked, without finding the cause. At 17:23, the isds & ifrd were restarted. At 17:25, the TM was flowing once more, there was no impact.

- On DoY 287, at 12:30, there were errors sending data to isds. After a few minutes, the errors disappeared, and at 12:38, the data was flowing once more, there was no impact.
- On DoY 288, at 16:28, the MMIAppl.launcher for imca had to be restarted owing to high cpu usage, and low swap space.
- On DoY 289, at 06:40, the timeline had to be stopped due to a problem starting some of the imcs tasks after perigee, the impact was that the Reaction Wheel Bias had to be manually performed, and a guide star change was instigated as a precaution.

The following new anomaly reports were entered into the ARTS system.

AR id	Date Occurrence	Subject	Segment	Status
INT-2657	10/10/2004	OMC Flat Field Calibration incorrectly Performed	ISOC	Pending
INT-2659	15/10/2004	Several attempts required to restart server imca	IMCS	Pending

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 243

In revolution 243 a GCDE observation was performed throughout the available observation time (~62 hours).

Revolution 244

The observations in revolution 244 consisted of a GCDE lasting ~59 hours, followed by 1 pointing of a raster dithering observation of the Galactic Centre field (RA 17:45:40.00; DEC -29:00:28.0) performed the remaining ~30 minutes of observation time.

Revolution 245

The observations in revolution 245 consisted of a GPS lasting ~14 hours, followed by a raster dithering observation of the Galactic Center field (RA 17:45:40.00; DEC -29:00:28.0), performed for the remaining ~47 hours of observation time.

Throughout these observations all instruments were in their nominal science modes, except JEM-X2 for which the DFEE remained off, and the TM allocation was IBIS 129; SPI 103; JEM-X1 8; JEM-X2 1; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

2004-09-27T08:13:54.000Z	167.6629	F	Automatic TM processing.
2004-09-28T18:34:21.000Z	167.6535	F	Automatic TM processing.
2004-09-30T08:07:45.000Z	167.5911	F	Automatic TM processing.
2004-10-03T00:42:40.000Z	167.5495	F	Automatic TM processing.
2004-10-03T07:51:21.000Z	167.5376	F	Automatic TM processing.
2004-10-03T16:49:38.000Z	167.4956	F	Automatic TM processing.
2004-10-06T07:41:28.000Z	167.4932	F	Automatic TM processing.
2004-10-06T15:39:13.000Z	167.4682	F	Automatic TM processing.
2004-10-06T17:51:53.000Z	167.4434	F	Automatic TM processing.
2004-10-09T07:28:40.000Z	167.4304	F	Automatic TM processing.
2004-10-10T17:44:27.000Z	167.4060	F	Automatic TM processing.
2004-10-12T07:16:39.000Z	167.3971	F	Automatic TM processing.
2004-10-13T17:34:42.000Z	167.3817	F	Automatic TM processing.
2004-10-14T23:39:34.000Z	167.3397	F	Automatic TM processing.
2004-10-15T07:19:50.000Z	167.3314	F	Automatic TM processing.

This report was generated Fri Oct 15 08:00:36 GMT 2004

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 09/10/2004-15/10/2004

AOCs operations were executed from the Automatic Timeline.

During this period, 149 Open Loop Slews, 110 Closed Loop Slews and 7 Momentum Bias were executed. 2 slews were missed. This is equivalent to a 0.8%.

09/10/04 (Day of Year 283, Revolution 242-243)

Nothing to report.

10/10/04 (Day of Year 284, Revolution 243)

Nothing to report.

11/10/04 (Day of Year 285, Revolution 243)

Slews missed from the Timeline: At 01:42Z the sequence for the closed loop slew 02430076 was interrupted when the STR failed to track the commanded guide star in the search and track process. The commanded star was 1047-2085 with instrumental magnitude 7.7. The Timeline recovery tool was then used to perform a manual open loop slew to the attitude of PID 02430077. Slew 02430078 was executed from the Timeline.

Star 1047-2085 has a dim neighbour at ~2.4 arc-minutes: 1047-258 with magnitude 9.5, which has likely caused the release of the selected guide star for slew 02430076.

12/10/04 (Day of Year 286, Revolution 243-244)

Flickering of the Pointing-Bit at the end of open loop slew due to Roll Error: At the end of open loop slew 02430116 the error in roll with respect to the Sun-Steering-Law assumed roll angle was -131 arc-seconds. This is more than the OTF threshold for roll and resulted in the flickering of the Pointing-Bit, which was not seen at BCP level. This error already existed at the start of the slew and was introduced by the attitude reconstruction after open loop slew 02430115. The attitude determination was based on the first mapping after this slew, during which the SSL was enabled. The jitter caused by enabling of the SSL after the slew introduced the error in roll, which was propagated to the next slew by the slew update.

13/10/04 (Day of Year 287, Revolution 244)

Nothing to report.

14/10/04 (Day of Year 288, Revolution 244)

Nothing to report.

15/10/04 (Day of Year 289, Revolution 244-245)

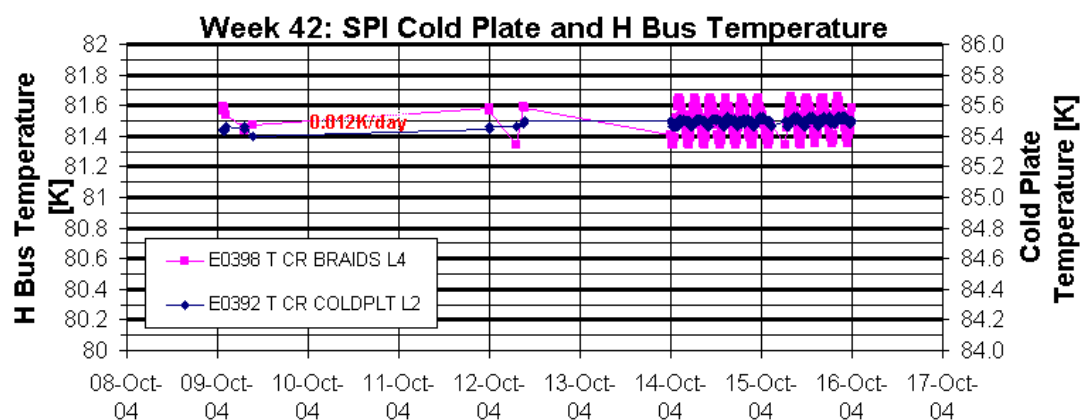
RWB not executed at the expected time due to problem to restart IMCS tasks after the perigee passage: The uplink of the timeline was stopped at 06:40Z due to problem restarting some of the IMCS tasks after perigee passage. The sequence AERWB_00 was not executed at the nominal time and the AOCS sub-system disabled in the Timeline. Before the recovery of the Timeline the guide star was changed as a precaution, then the mandatory reaction wheel bias executed. At 07:35Z the first slew of the revolution (02450001) was automatically updated following the attitude reconstruction after the reaction wheel bias and the AOCS re-enabled in the Timeline.

8.3.2 SPI Operations

Cryo-cooler / Detector Cold-Plate:

The performance of the cryo-cooler is nominal. The cold plate temperature was maintained at 85K $\pm$ 1K showing the expected small positive drift.

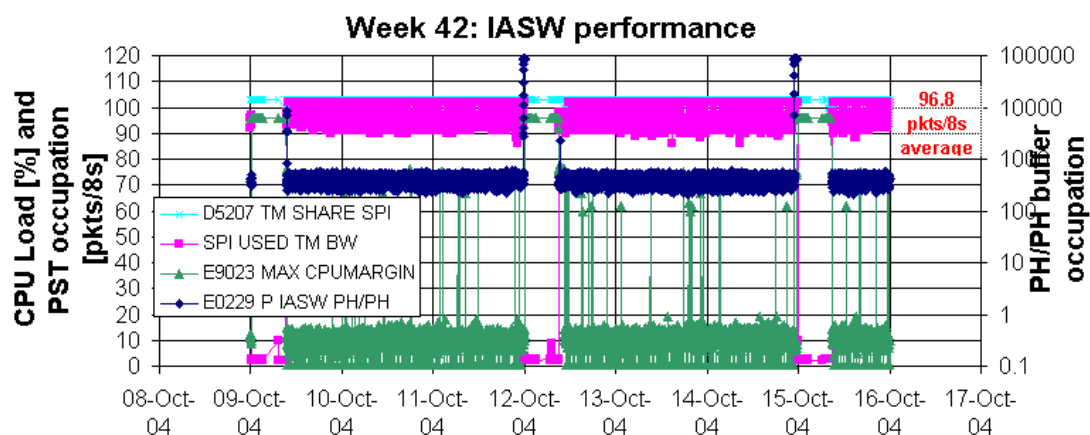
The following plot shows the evolution of the cold-plate and H bus temperatures during the reporting period.



IASW/DPE:

The performance of the IASW/DPE is nominal.

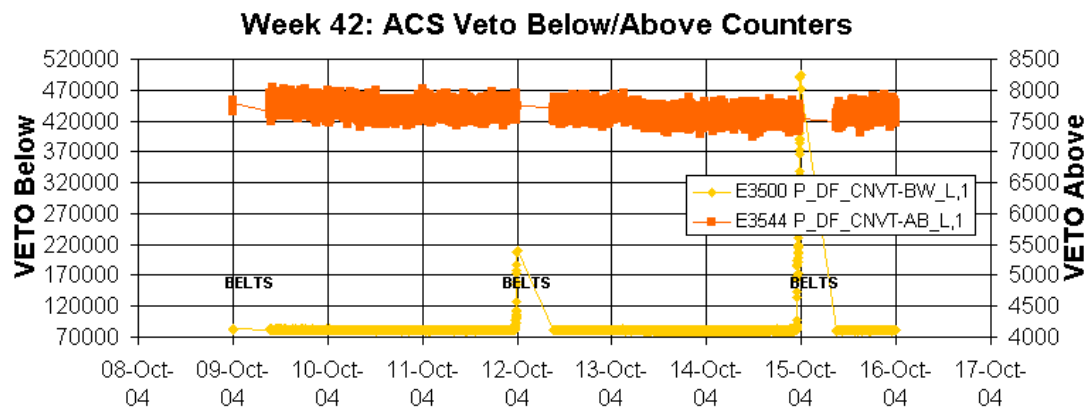
The following diagram shows the IASW performance in terms of TM bandwidth, event buffer occupation and DPE CPU load during the reporting period.



ACS:

The performance of the ACS is nominal.

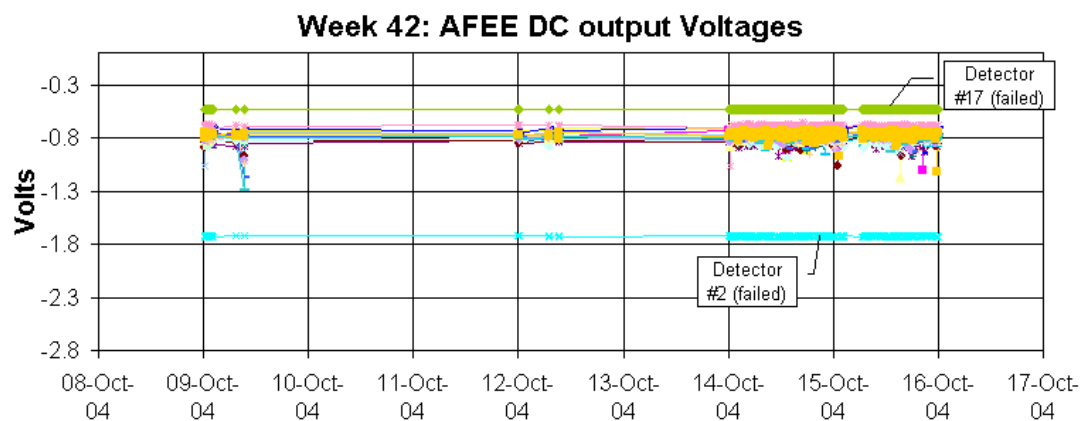
The following plot shows the ACS overall count rate evolution during the reporting period.



AFEE:

The performance of the detectors is nominal except for the detector #2, failed since 06.12.2003, and detector #17, failed since 17.07.2004.

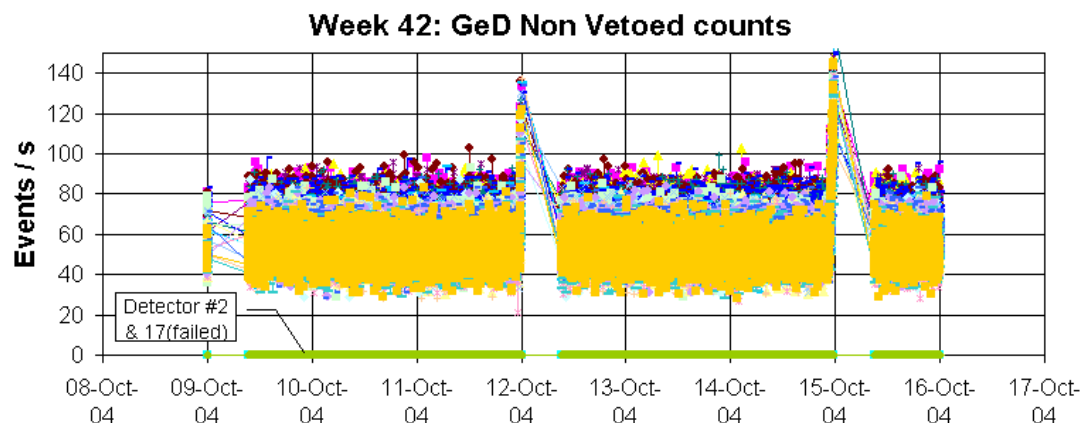
The following plot shows the AFEE dc output signals during the reporting period.



DFEE:

The performance of the unit is nominal.

The following plot shows the Non Vetoed event rates processed by the DFEE during the reporting period. The count rate of each detector is within the expected range, except for the failed detectors #2 and #17.

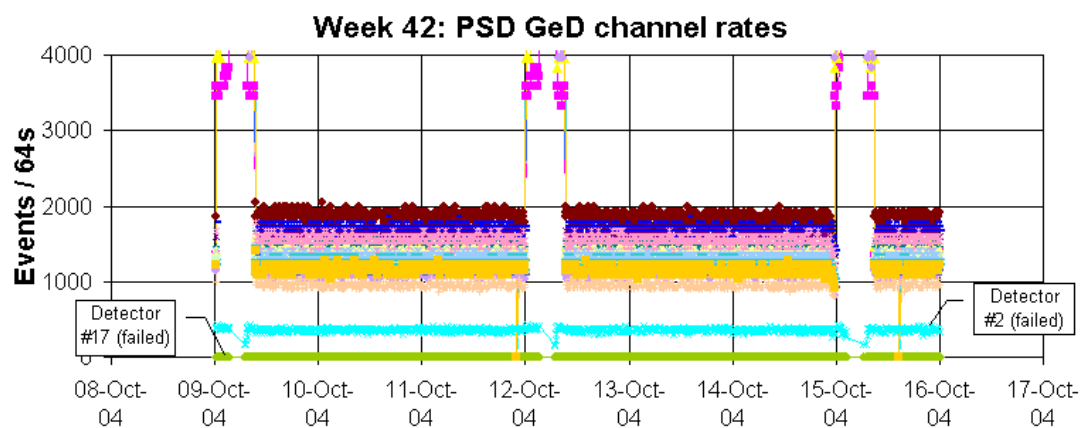


PSD:

The performance of the unit is nominal, though the malfunction of the channel rates transitory blanking reproduced itself this week (see AR INT_SC-90 for a detailed description of the anomaly).

An IASW patch is under development at Cesr to allow the Sci HK TM downlink inside the radiation belts. This would allow the deletion of the Out-Of-Limit currently defined on the PSD channel rates, thus removing the false alarms associated to the malfunction.

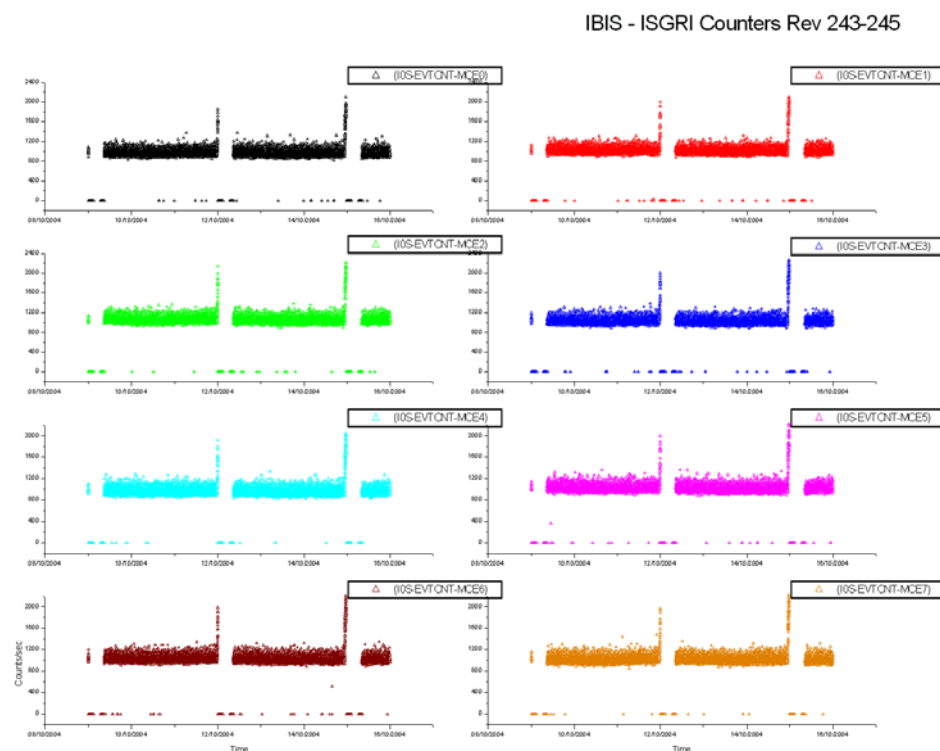
The following plot shows the PSD channel rates during the reporting period.



8.3.3 IBIS Operations

IBIS Event Counters Plots.

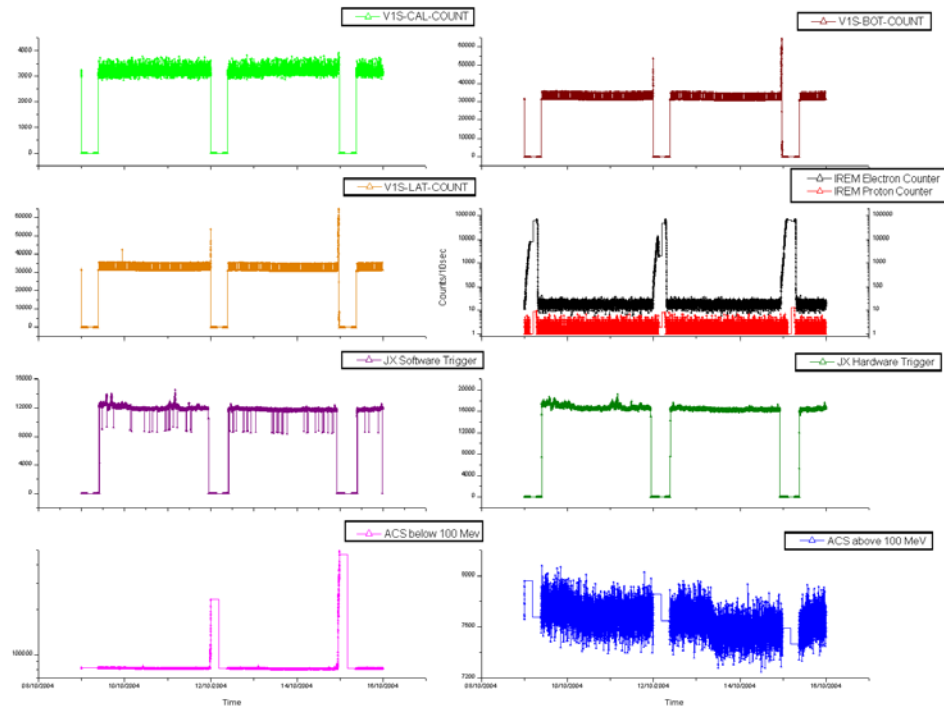
ISGRI Counters:



VETO vs Payloads Counters

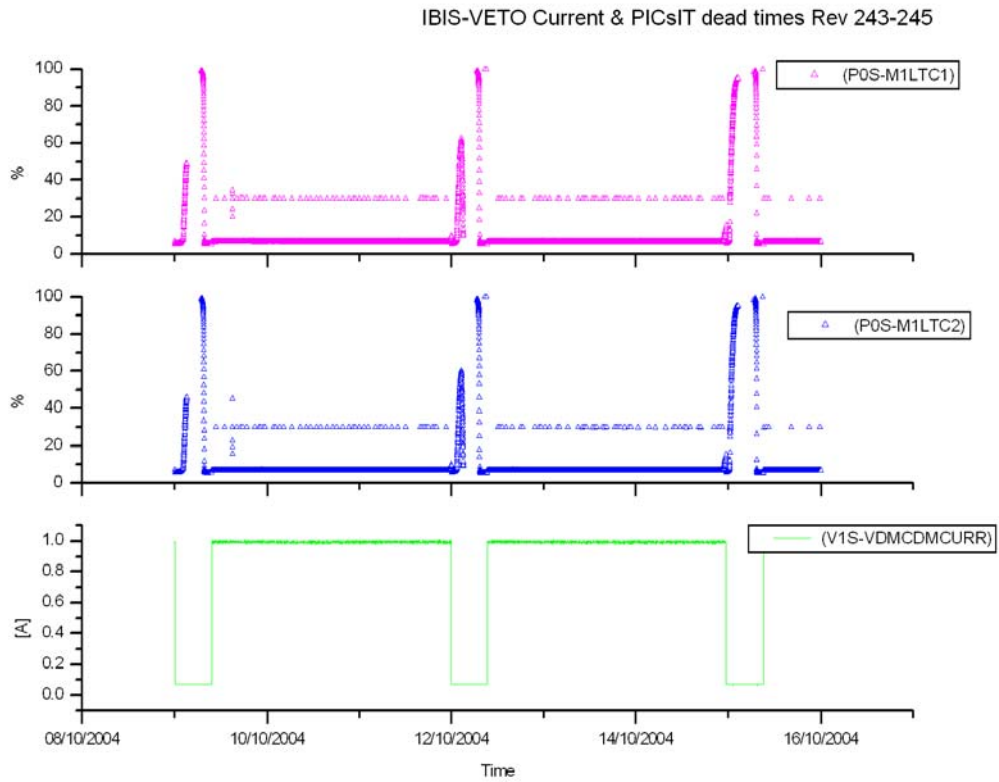
The week was characterised by low solar activity. The high count-rates reported by IBIS/VETO on DoY 288 during the revolution 244 are due to an early Radiation Belt entry.

IBIS-VETO vs Payloads Counters Rev 243-245

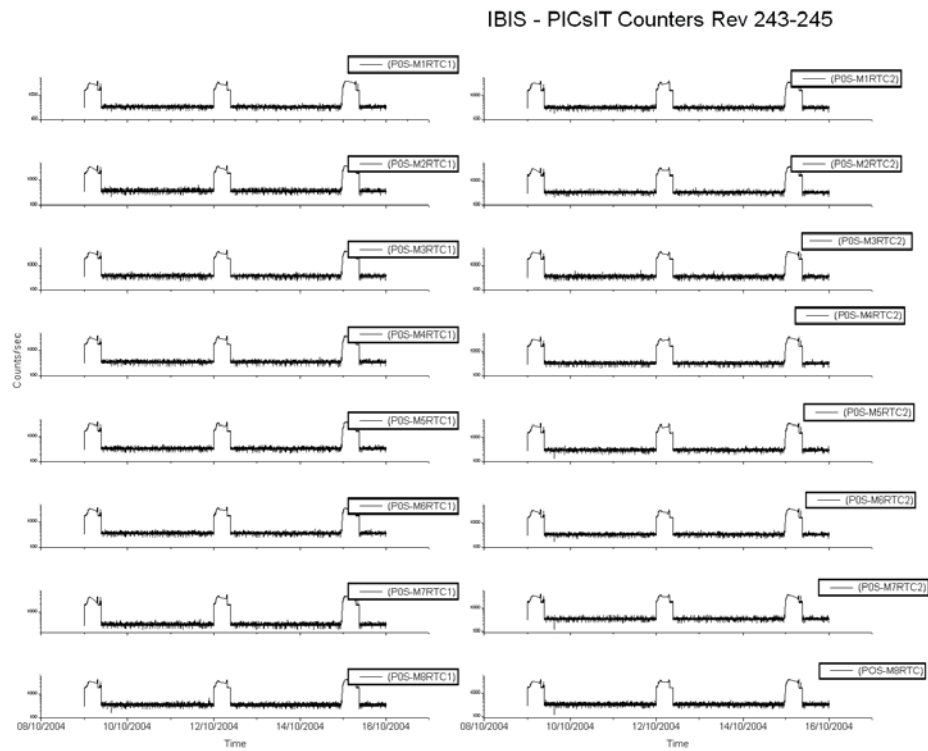


*with the exception of IREM counters (counts/10sec), all the plots are reporting counts/sec

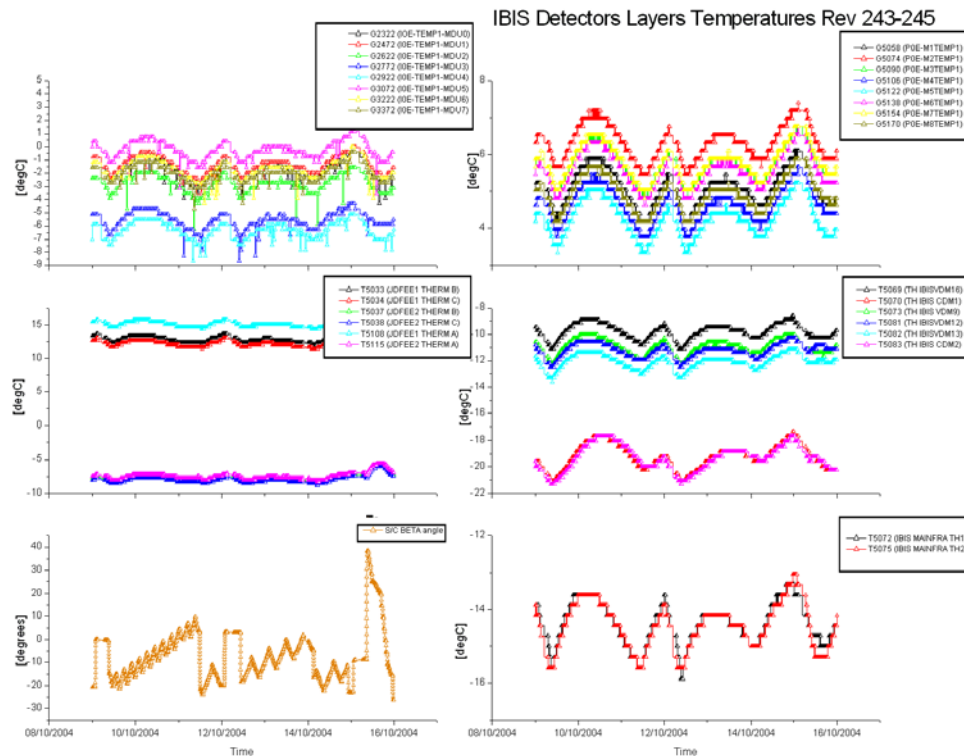
Veto Current:



Picsit Counters:



IBIS Detectors Layers Temperatures



IBIS daily report

Recently, many occurrences of the Veto 28 V PMT set by IASW (parameter G8015) in warning high (>29.4 V) for few TM cycles. This value is acquired/set by the IASW and not by through the payloads PPDU or VETO power interface. The parameter toggled out/in limits reaching the limit value 29.4 V triggering the warning condition. During the event the VETO PMTs were OFF, which is nominal inside the Radiation Belts and no further action was taken. Clarification is on-going with the IBIS PIs.

During the first part of the week many occurrences of the Veto calibration Counter (parameter G6061) in low limit (warning) for few TM cycles were reported. The fluctuation of this parameter is due to the natural decay of the Na22 radioactive source and follows a Poisson distribution. An update of the low limit, according to the decay law, was performed on DoY 286.

DoY 2004.283 (09/10/04)

At 20:04Z the parameter family G5072 (PICsIT Semimod XX FIFO Error Flag) reported OOL (SCC Fail) for few TM cycles. According to the Payloads FDIR document no action was taken.

DoY 2004.284 (10/10/04)

Nothing to report.

DoY 2004.285 (11/10/04)

Nothing to report.

DoY 2004.286 (12/10/04)

At 03:49Z, during the Belt passage, many occurrences of the OEM APID 1280 ID 167 Class 2 <<IBIS1 PICsIT NOISY SEMIMODULE SIGNALLING>> were reported due to the PICsIT detectors being ON without the VETO anticoincidence system, as required by the PIs.

DoY 2004.287 (13/10/04)

Nothing to report

DoY 2004.288 (14/10/04)

At 23:03Z the VETO bottom (G6062) and lateral (G6063) counters reported OOL (warning high) for few TM cycles due to an early Radiation Belt entry.

At 23:33Z the unit autonomously switched to Stand-By (Safe configuration) due to an earlier than expected Radiation Belt entry (the time in the broadcast packet was 23:45Z).

DoY 2004.289 (15/10/04)

At 03:49Z, during the Belt passage, many occurrences of the OEM APID 1280 ID 167 Class 2 <<IBIS1 PICsIT NOISY SEMIMODULE SIGNALLING>> were reported due the PICsIT detectors being ON without the VETO anticoincidence system, as required by the PIs.

8.3.4 JEM-X Operations

8.3.4.1 JEM-X Count Rates

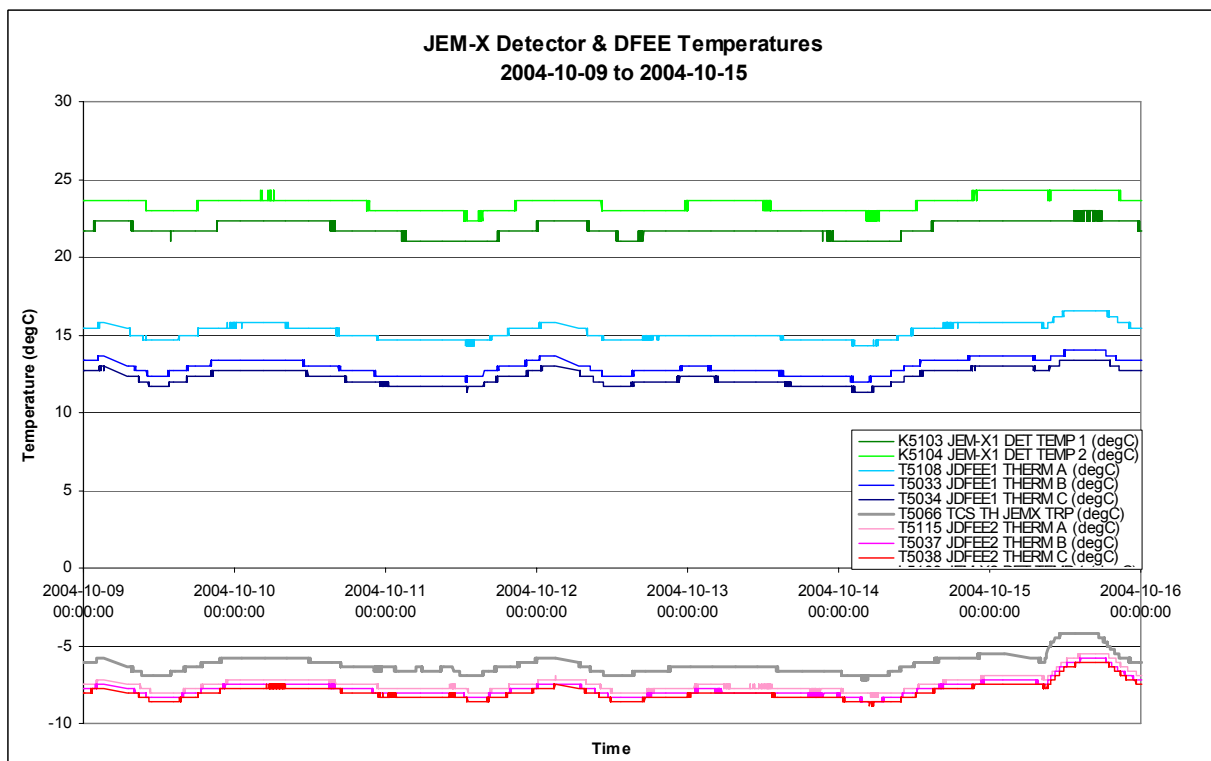
JEM-X count rates over the reporting period are displayed in the following graph¹.

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



8.3.4.2 JEM-X Temperatures

JEM-X Detector and DFEE temperatures over the reporting period are displayed in the following graph, along with the temperature on the detector bench between the two units².



² Data sampled (1 frame in 8)

8.3.4.3 JEM-X Daily Report

2004-10-09 (DOY 283, Rev 242-243) to 2004-10-15 (DOY 289, Rev 244-245)

Nothing to report

8.3.5 OMC Operations

On DoY 285, at 01:44, due to an AOCS problem pointings 02430076 and 02430077 were lost, it was at these time the following OMC commands were rejected:

```
2004.285.01.47.47.863 2004.285.01.47.34.404 1792 Real Time Rejection 131
REJECTED TC1
FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=130,RESET IM M9068=1 FIX2=0
M9069=2228
2004.285.01.47.47.923 2004.285.01.47.40.404 1792 Real Time Rejection 131
REJECTED TC1
FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=60,IM A M9068=1 FIX2=0
M9069=2229

2004.285.02.19.47.342 2004.285.02.19.38.405 1792 Real Time Rejection 131
REJECTED TC1
FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=130,RESET IM M9068=1 FIX2=0
M9069=2230
2004.285.02.19.54.182 2004.285.02.19.44.655 1792 Real Time Rejection 131
REJECTED TC1
FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=60,IM A M9068=1 FIX2=0
M9069=2231
```

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

Later at 11:56, the OMC commanding was disabled so that the manual Flat Field calibration could begin. The exposure began at 12:04:10, terminating at 12:12:34. Transmitting the data to ground took rather longer, finishing at 14:23:54. The OMC was set back into Stand-by at 14:37, and the commanding re-enabled at 14:38. The pointings originally scheduled for this period, namely 02430094 through to 02430098 were lost. The attitude at the time of the calibration was 17:42:20.21 Right Ascension, -32:37:59.3 Declination, which is in the general direction of the galactic centre. The resulting image is shown below:



On DoY 288, at 06:44, the following OEMs were received:

2004.288.06.45.08.321 2004.288.06.44.58.305 1792 Real Time Anomaly 5 OMC
CSSW INT ER

FIX6=0 M9079=2 M9080=5 M9074=4 M9067=5531

2004.288.06.45.08.273 2004.288.06.44.58.305 1792 Real Time Exception 7 OMC
CONSTRAINT D

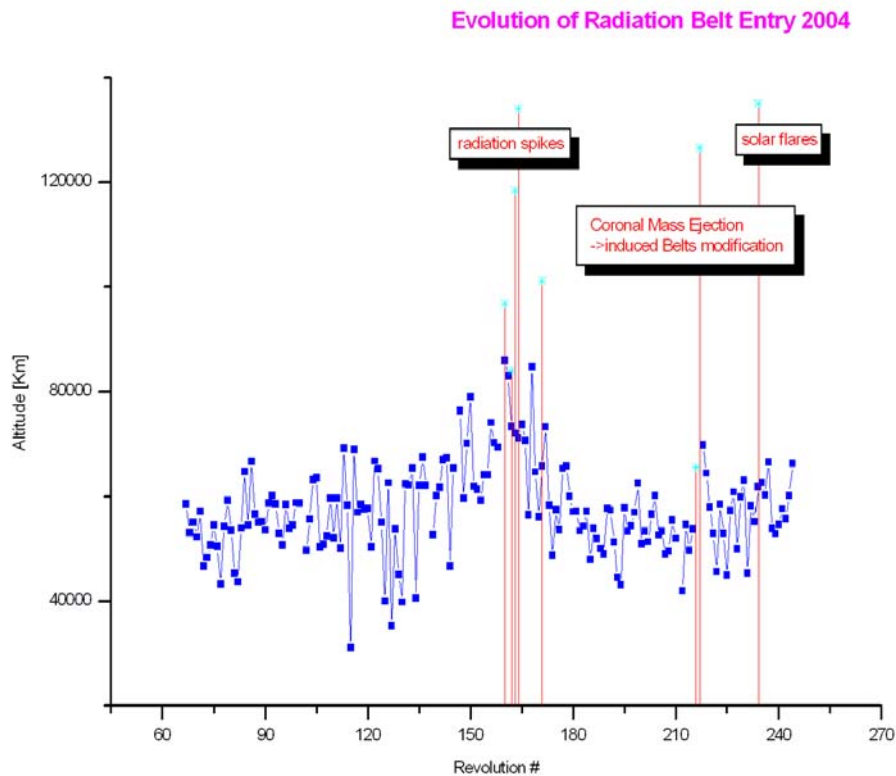
M9073=4, IASW TASK 4 M9079=1 M9080=7 M9076=66 M9067=20216

These are frequently seen when viewing a crowded region of the sky, and are not a problem.

On DoY 283, at 00:12:56, DoY 286, at 00:00:02 and DoY 288, at 23:46:34, OMC was switched by the Timeline to SAFE mode, at the nominal time.

8.3.6 IREM Operations

Radiation Belts Entry



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]
242	RAD_ENTR R 2004-10-09T00:12:31Z	2004-10-09 00:47:57	55787.4	2004-10-09 01:00:18	53551
243	RAD_EXIT R 2004-10-09T09:19:04Z	2004-10-09 07:43:49	>23164.2	2004-10-09 08:00:18	27310
243	RAD_ENTR R 2004-10-11T23:59:42Z	2004-10-11 23:53:41	>60188.8	2004-10-12 00:43:03	54071
244	RAD_EXIT R 2004-10-12T09:06:11Z	2004-10-12 07:26:29	>23162.3	2004-10-12 07:53:03	28362
244	RAD_ENTR R 2004-10-14T23:46:17Z	2004-10-14 22:53:17	66309.4	2004-10-15 00:33:03	53446
245	RAD_EXIT R 2004-10-15T08:53:26Z	2004-10-15 07:25:25	>23172.9	2004-10-15 07:33:03	27382

Reference

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)

Radiation Spike

Proton Belts

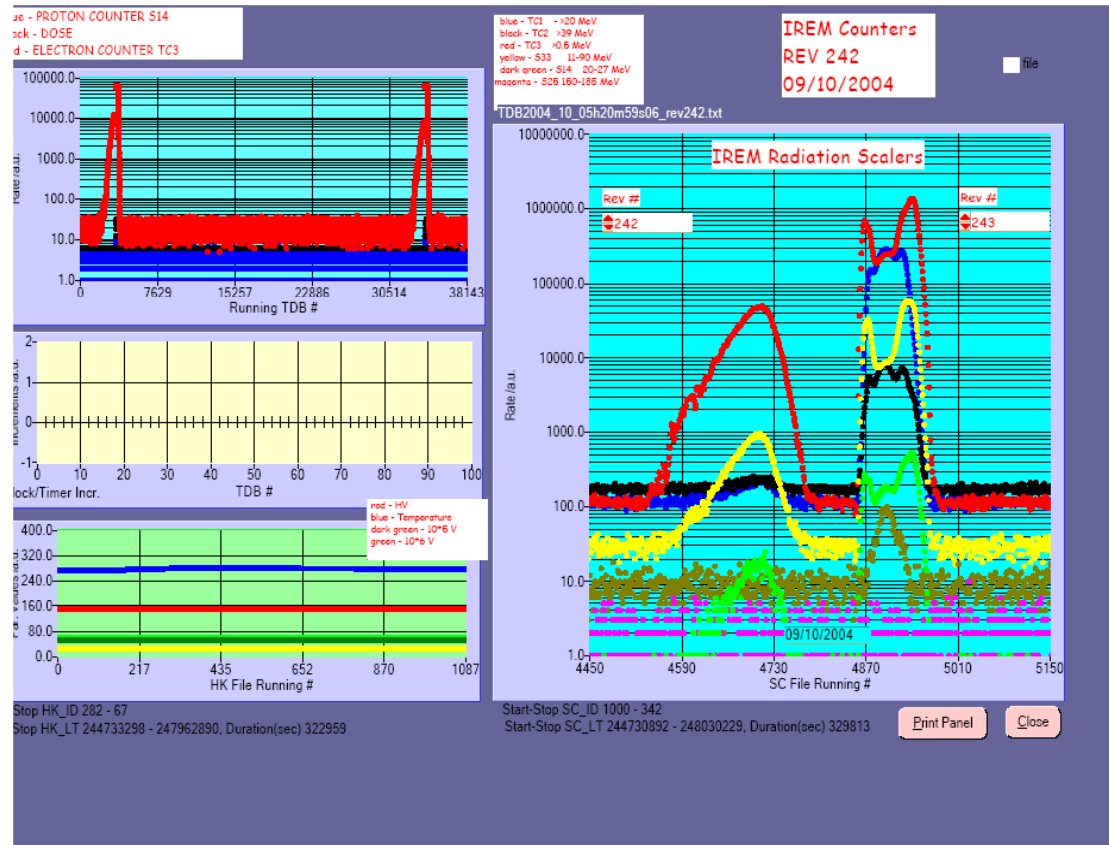
REV	Proton CUT-OFF Predicted Entry/Exit	ALT[Km] predicted
242	PROTON_RAD_ENTR 2004-10-09 06:30:18	13433
243	PROTON_RAD_EXT 2004-10-09 06:40:18	14605

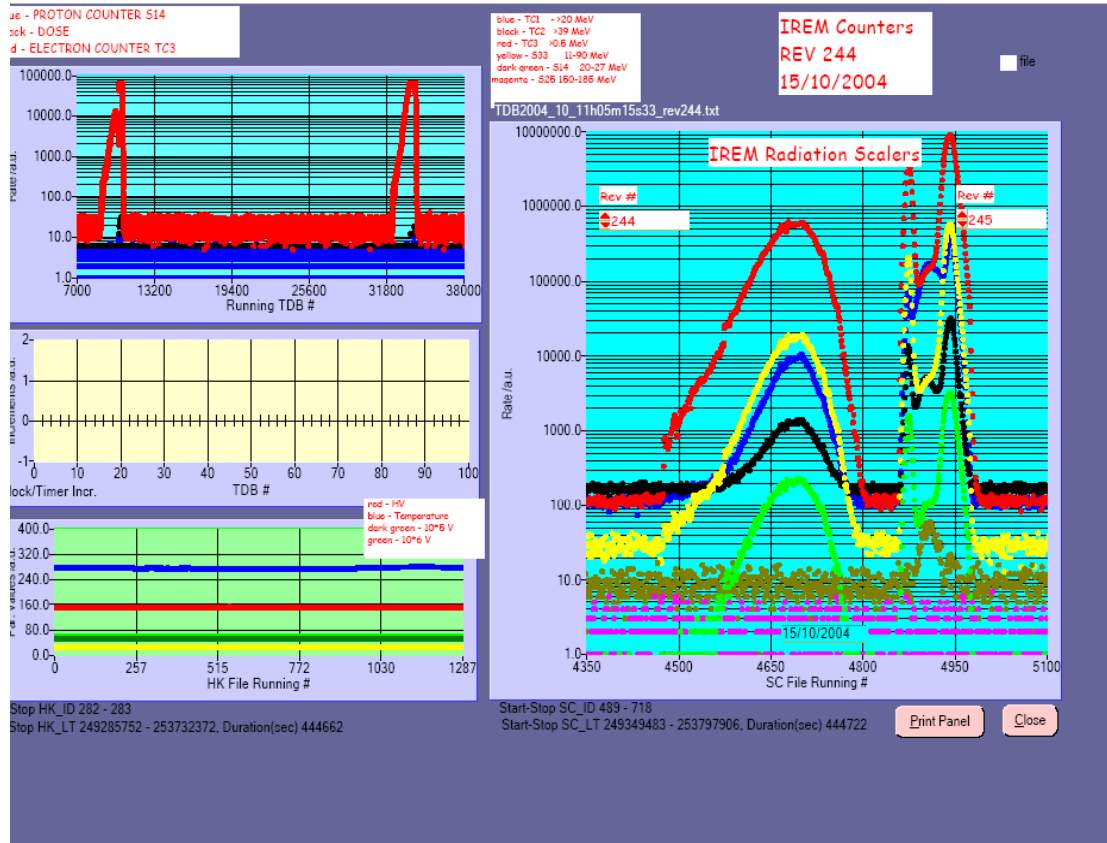
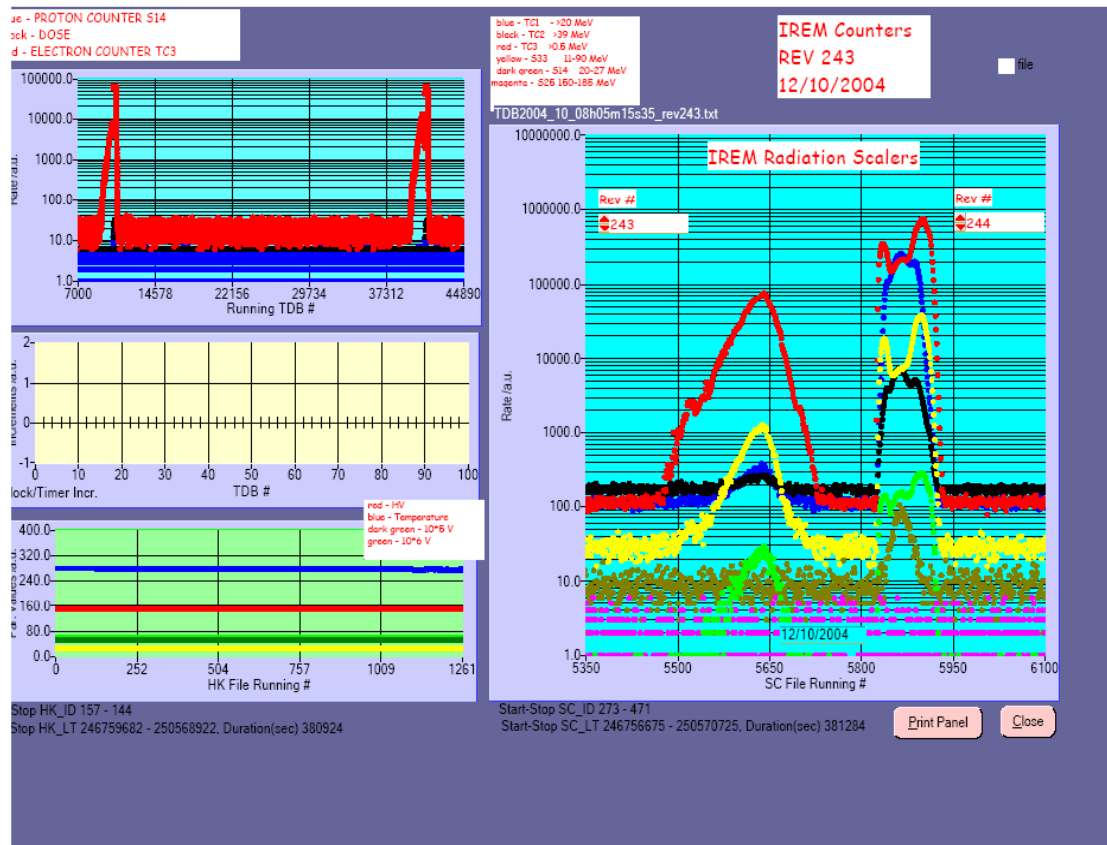
REV		Proton CUT-OFF Predicted Entry/Exit	ALT[Km] predicted
243	PROTON_RAD_ENTR	2004-10-12 06:13:03	13039
244	PROTON_RAD_EXT	2004-10-12 06:33:03	15421
244	PROTON_RAD_ENTR	2004-10-15 06:03:03	13540
245	PROTON_RAD_EXT	2004-10-15 06:13:03	14713

IREM daily report

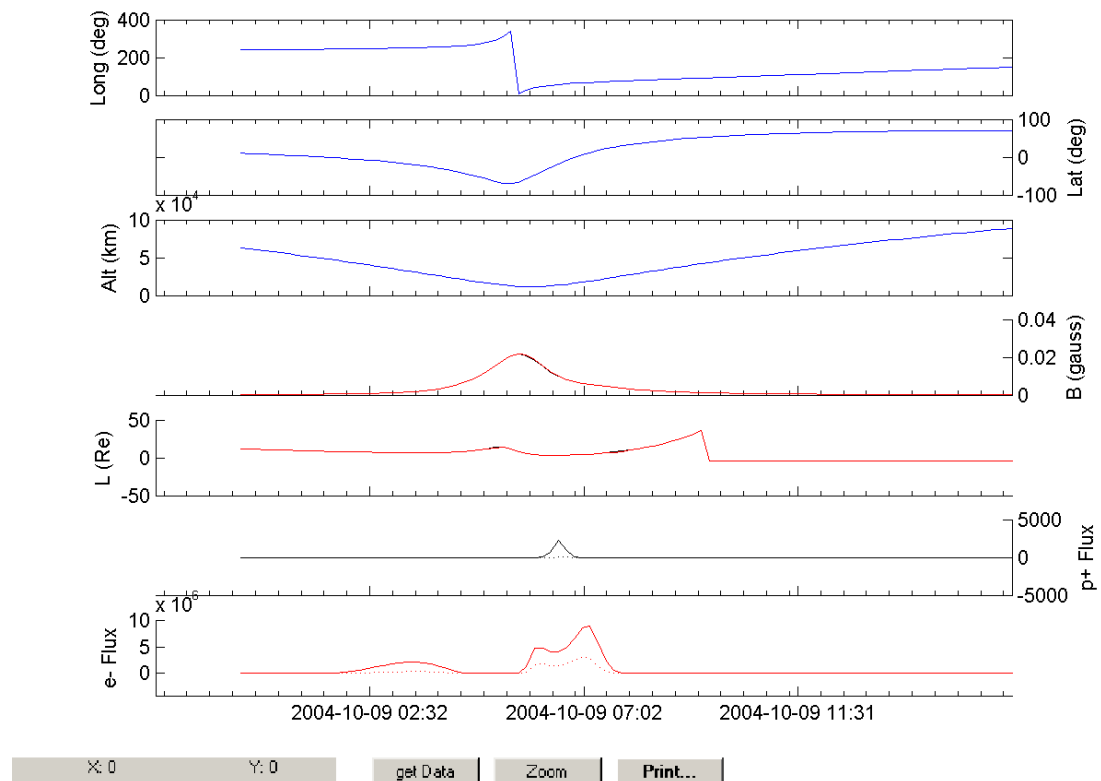
Nothing to report.

IREM radiation counters

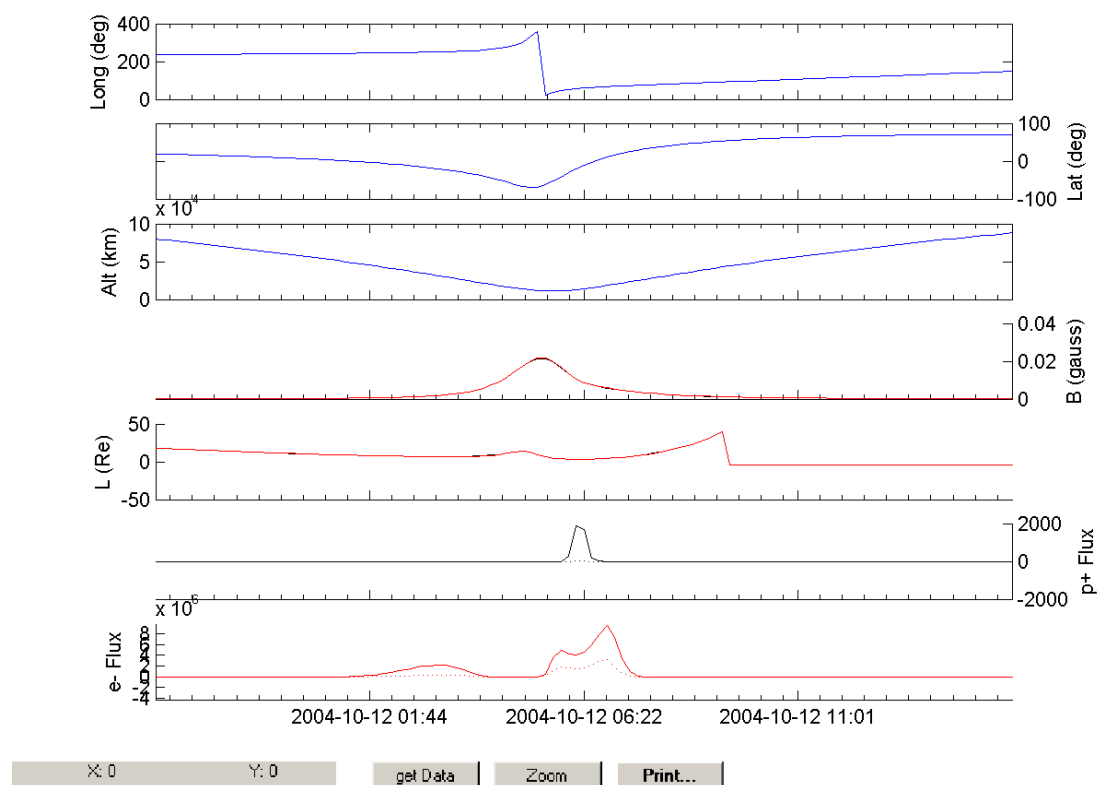




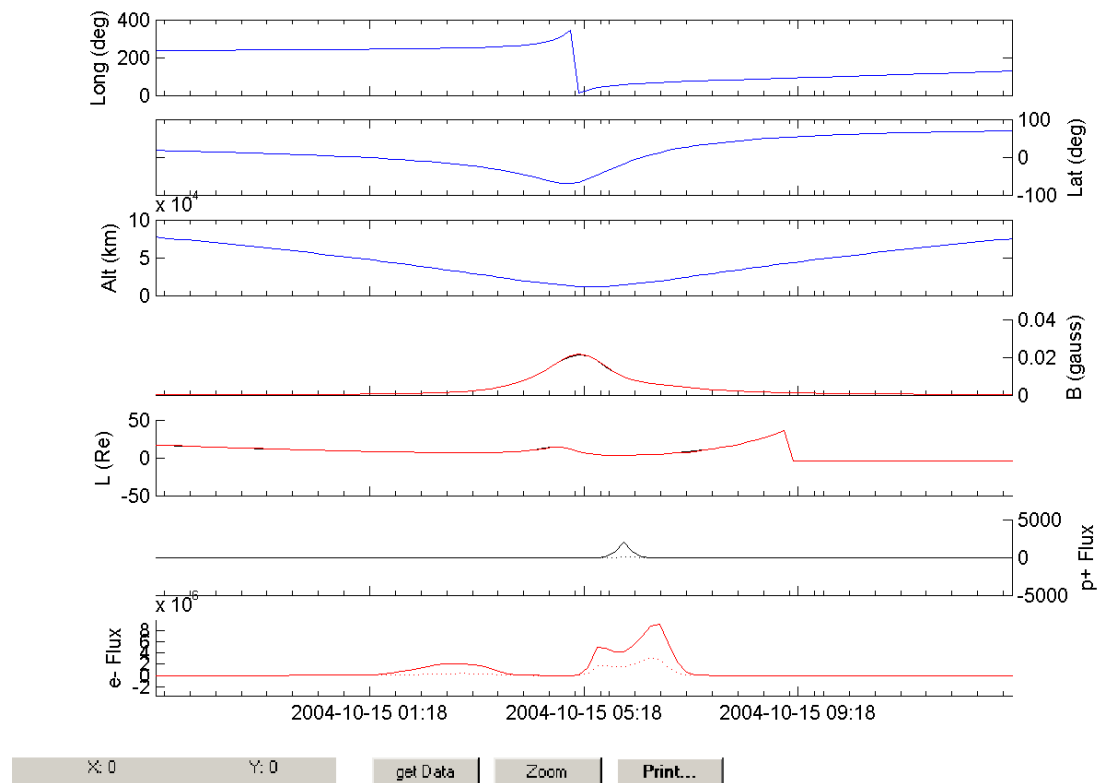
IREM Predicted Radiation Belt Passages. Rev 242



Rev 243



Rev 244



SEC-GOES Observed Particles Fluxes.

