

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OF
No. 109
Week 43
25.10.04
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 16.10.04 until 22.10.04 (both dates inclusive) and covers the revolutions 246 & 247.

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 GRS 1915+105 (RA 19:15:11.50; DEC +10:56:44.0); the Galactic Center field (RA 17:45:40.00; DEC -29:00:28.0) and IC443 (RA 06:42:4.00; DEC +22:27:28.0). The activities consisted of hexagonal and raster dithering observations and a staring observation.

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.

Six slews (4 OSL and 2 CSL) were missed from the Timeline due to problem with DSS16. In addition one change of guide star and one RMU calibration were executed not at the planned time still due to problems at DSS16.

The fuel consumption over the period between 16/10/2004 and 22/10/2004 was 0.112 kg. The remaining propellant is in the order of 167.219 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 was identified.

3.1.5 RFS

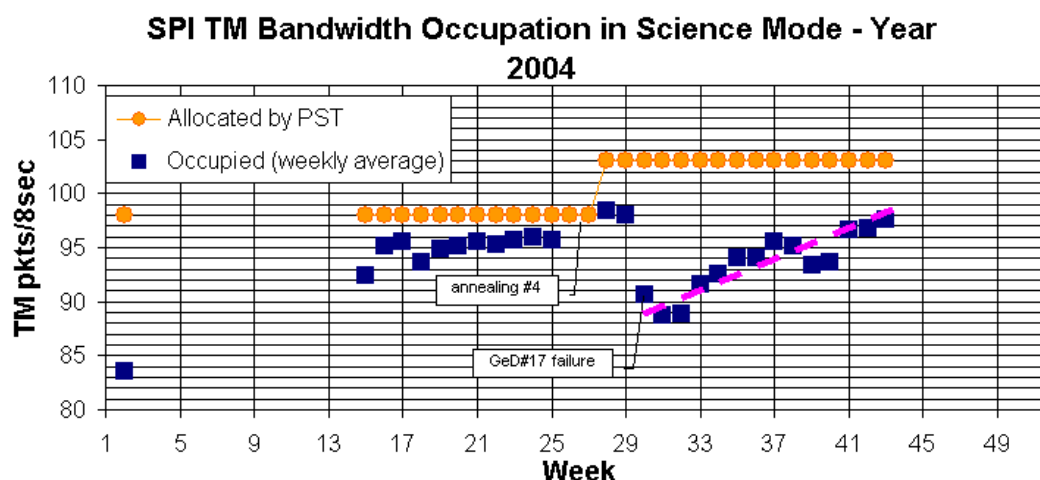
The RF subsystem is working properly. The link margin is sufficient to ensure proper TM reception and execution of commands with the ranging channel enabled.

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 97.6 pkts/cycle. The following plot shows the occupied bandwidth, since beginning of 2004.



The cryo-cooler is working well, maintaining the temperature within 85 $\pm$ 1K.

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

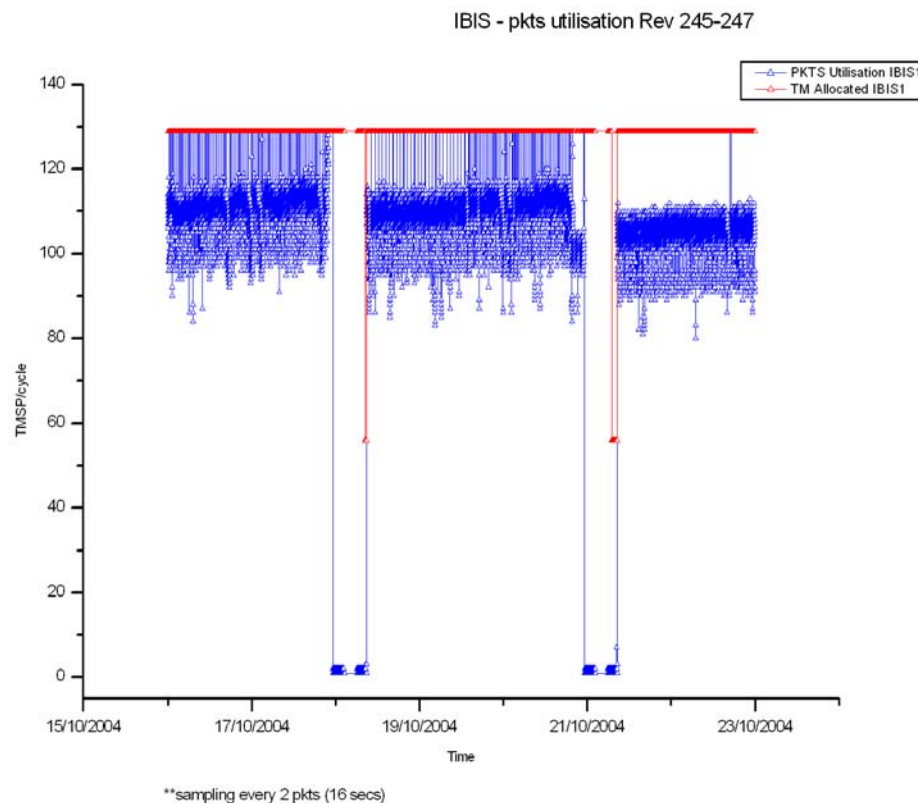
3.2.2 IBIS

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).

During the reporting period the PST Allocation to IBIS was 129 TMSP / Cycle. The mean IBIS Bandwidth usage was 109.4 TMSP / Cycle, up 11.1 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 by 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.

Due to high background radiation levels as reported by IREM, JEM-X1 made an autonomous transition to Safe mode in revolution 245 at 2004-10-17T21:52Z. This was about 17 minutes before it was due to be commanded to Safe mode before radiation belt entry.

Due to problems at the start of the Goldstone pass on 2004-10-20, the ED KESAFE01 scheduled at 21:56:52Z to put JEM-X1 in Safe mode before radiation belt entry of revolution 246 was missed. JEM-X1 was commanded to Safe mode manually at 22:47Z.

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 167 OMC pointings executed nominally, 6 were lost.

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. The Earth-facing side of the sun was almost blank during the week (just some small sunspots) and none of these small sunspots posed a threat for strong solar flares. 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, 6 pointing were lost due to a cancelled pass.

4.1 Mission Operations Centre

The performance of the MOC was in general good in the reporting period, although there were problems with the multiplexer, probably triggered by brief TM gaps caused by high winds in California affecting the DSS-16 pointing.

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 drops from both ground stations, however 6 pointings were lost when a DSS-16 pass was cancelled at short notice, later DSS-24 was able to step in allowing the satellite to enter perigee in a nominal condition. The overall performance though was well above the 95% requirement.

4.3 Science Ground Segment

4.3.1 ISOC

1. AO-3

New proposals have started to be entered.

2. Mission planning

PSF's up to rev 255 received. Revolutions up to 253 have been planned. TSF's received up to rev 249. No re-planning performed this week and no ToO request received.

3. Observation status

No ECS/OCS activity since last week.

4. ISOC science data archive

No new data available. Agreement to ship archive hardware to Spain in November agreed. Investigations into how to copy proprietary status information from ISDC to ISOC has been started.

5. ISOC system

Version 10.6.0 is still operational. Version 10.6.1 is planned to be installed next week. This version will contain a modification to the sequence of moves of the centre of the 5 x 5 dither pattern as requested by ISWT.

6. Problems

Nothing new to report.

7. Move to ESAC / Vilspa

The ISOC operational hardware is now available in Spain together with the network. Last week the ISOC system has been successfully installed on the computers. The system is now in principle working but some tuning is still necessary. The test of the IFTS to be used when Spain is active was supposed to be tested this week. However, it had to be postponed a second time due to a delay in the upgrade of Network at MOC. The test will be repeated on the 2nd November 2004.

4.3.2 ISDC

Status of ISDC observation processing on 25/10/2004:

- Latest Standard Analysis completed: observation 02201450003 (Mkn 590, Revolution 208) on 28/08/2004
- 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 290, at 18:45, on the IMCS-B chain, the global tabs on the NCTRS status field show all links disconnected, except the VC0 Real-time pkt link, which shows connected, there was no impact.
- Later, at 20:56, there were data gaps on VC0 from Redu, a minute later, bad frames from Redu were reported.
- On DoY 291, at 00:41, bad TM frames from DSS-16 were received. At 01:06, the VC0 and VC7 TM links from DSS-16 dropped, the impact was command A2562 'RC Mapping' failed to verify, at 01:15, all links with DSS-16 dropped, again without impact. The corresponding DR# is G104887.
- On DoY 292 at 01:50, DSS-16 report high winds at the station, the rate of bad frame reception starts to increase. At 01:52 there is a TM drop for about 3 cycles. The corresponding DR# is G104890.
- From 02:09 onwards, there was a series of problems, firstly TM packets were coming in out-of-sequence, GFCC tried to re-bind to DSS-16, the VR was reset without effect. At 02:19 GFCC requested DSS-16 to re-sweep. At 02:21, sun122 loses the connection to the multiplexer. The event logger showed that both the multiplexer and releaser have a Misdynammic server connection problem. At 02:22 the multiplexer and releaser tasks were restarted, and the links re-established. There was no impact.
- On DoY 294, at 19:27, DSS-16 reported they might not be able to support the upcoming pass. At 19:46, the AOCS was disabled, at 20:02 the instruments were also disabled in the auto-stack, and at 20:20, a few seconds before Redu LOS, an antenna swap was performed in the assumption that no further tracking would be possible prior to the perigee passage. At 21:00, DSS16 unexpectedly returned, and at 21:07, the antenna was swapped back. At 21:11, further problems interrupted the pass, leaving the satellite on the wrong antenna for perigee. At 22:43 DSS24 was made available, Jem-X was immediately put into SAFE mode. The attitude was recovered at 23:19, and the commanding re-enabled in the Timeline. Finally the missing RMU was performed at 23:45, recovering the timeline. The impact was pointings 02460085 through to 02460090 were lost.
- On DoY 295, at 22:31, there were several drops in the TM link from Redu, no impact.

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

AR id	Date Occurrence	Subject	Segment	Status
INT-2660	21/10/2004	AD-Service terminated	ESA Stations	Pending
INT-2661	21/10/2004	FDS failed to generate autom. TPF	FDS	Pending
INT-2662	21/10/2004	Error sending data to ISDC	IMCS	Pending
INT-2663	21/10/2004	Loss of CLCW and Multiplexer, Releaser	NASA Station	Pending
INT-2664	21/10/2004	No DSS-16 pass due to U/L fluctuations	NASA Station	Pending

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 246

The observations in revolution 246 consisted of a hexagonal dithering observation of GRS 1915+105 (RA 19:15:11.50; DEC +10:56:44.0) lasting ~28.5 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 ~32.5 hours of observation time.

Revolution 247

In revolution 247 a staring observation of IC443 (RA 06:42:4.00; DEC +22:27:28.0) was performed throughout the available observation time (~62 hours).

Throughout this observation 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

2004-10-03T16:49:38.000Z	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.
2004-10-15T15:57:19.000Z	167.2968	F	Automatic TM processing.
2004-10-18T00:38:54.000Z	167.2747	F	Automatic TM processing.
2004-10-18T06:46:15.000Z	167.2646	F	Automatic TM processing.
2004-10-19T17:16:10.000Z	167.2332	F	Automatic TM processing.
2004-10-21T06:33:34.000Z	167.2191	F	Automatic TM processing.

This report was generated Fri Oct 22 08:00:24 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 16/10/2004-22/10/2004

AOCS operations were executed from the Automatic Timeline.

During this period, 71 Open Loop Slews, 112 Closed Loop Slews and 5 Momentum Bias were executed. 6 slews were missed. This is equivalent to a 3.3%.

16/10/04 (Day of Year 290, Revolution 245)

Nothing to report.

17/10/04 (Day of Year 291, Revolution 245)

Nothing to report.

18/10/04 (Day of Year 292, Revolution 245-246)

Sequence for change of guide star missed from the Timeline: the sequence for the change of the guide star before perigee entry was not executed at the expected time (02:19:17Z) due to problems on DSS16 station: high winds at station site affected the S/C lock causing intermittent bit lock and interruption of the scheduled activities.

Additional problems with the command multiplexer task at mission control system level further delayed the full recovery of the timeline. The current guide star being valid and the attitude safe until the 21/10/2004, the planned sequence was moved until after AOS of revolution 246 and before the execution of the sequence for the momentum dump. The change of guide star was executed at 06:23Z.

19/10/04 (Day of Year 293, Revolution 246)

Flickering of the pointing-bit due to yaw error: At 21:42:14Z an undetected false event on the star tracker caused a jump (~ 56 arcsec) in the position of the CCD image of the guide star. The error in yaw was more than the OTF threshold for this axis and resulted in the flickering of the pointing-bit. This was not seen at BCP level. The magnitude 8.4 guide star was picked by the ACC after an open loop slew at CCD location [822, -4441].

20/10/04 (Day of Year 294, Revolution 246)

Flickering of the pointing-bit due to pitch error: At 02:44:19Z an undetected false event on the star tracker caused a jump (~ 69arcsec) in the position of the CCD image of the guide star. The error in pitch was more than the OTF threshold for this axis and resulted in the flickering of the pointing-bit. This was not seen at BCP level. The magnitude 8.3 guide star was picked by the ACC after an open loop slew at CCD location [20717, -913].

Slews missed from the Timeline due to lost of the Goldstone pass: Due to maintenance problems (on antenna and transmitter) on station DSS16, the pass planned from DoY 294.19:35Z to 295.02:24Z was partially covered by DSS24 and slews 02460085 to and including 02460090 were missed from the Timeline. During the period from 18:07Z to 23:07Z INTEGRAL was staring in the attitude of PID 02200084. The planned RMU calibration (expected at 20:33Z) was executed later at 23:45Z.

21/10/04 (Day of Year 295, Revolution 246-247)

Nothing to report.

22/10/04 (Day of Year 296, Revolution 247)

Nothing to report.

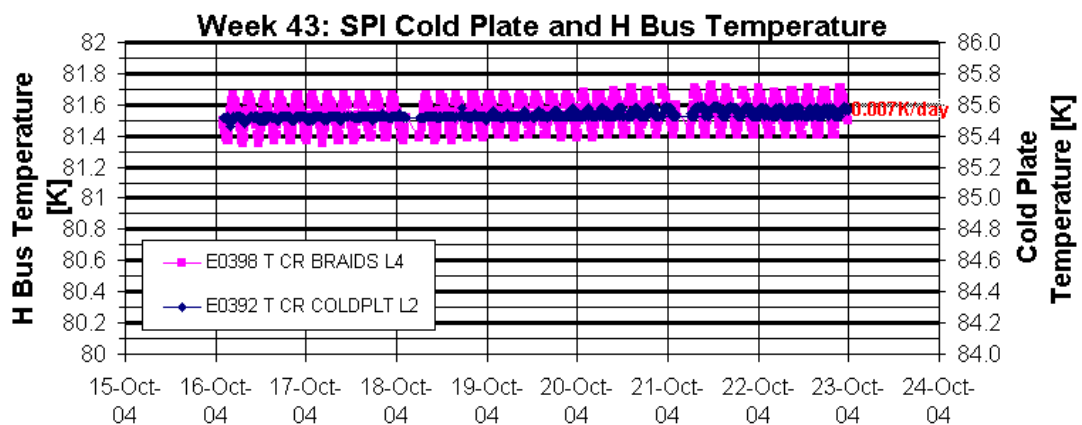
8.3.2 SPI Operations

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.

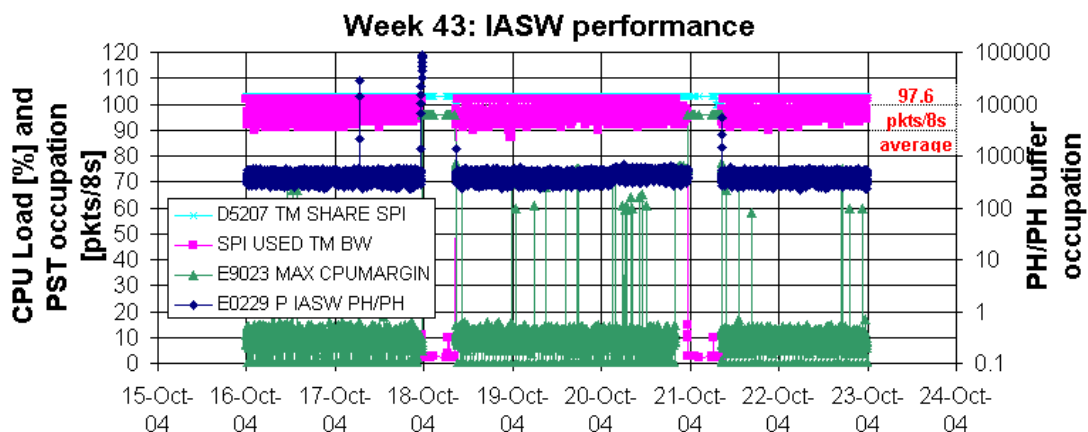
The following plot shows the evolution of the cold-plate and H bus temperatures during the reporting period.



IASW/DPE:

The performance of the IASW/DPE is nominal.

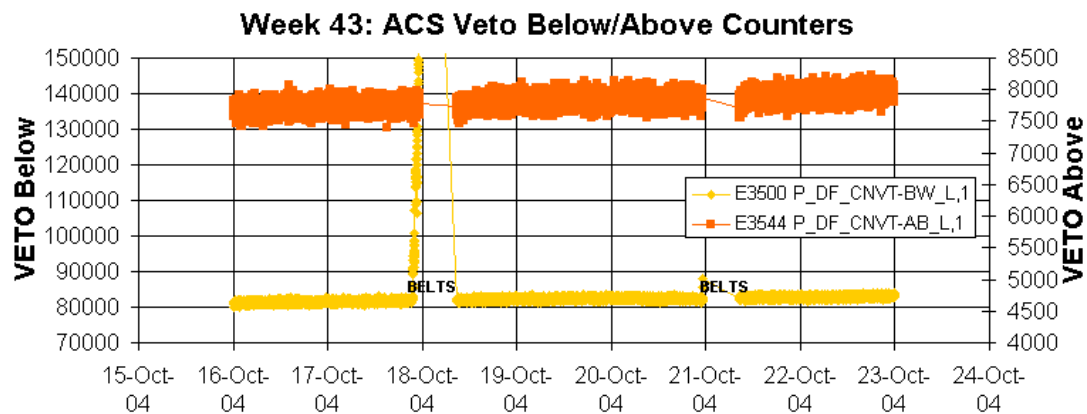
The following diagram shows the IASW performance in terms of TM bandwidth, event buffer occupation and DPE CPU load during the reporting period.



ACS:

The performance of the ACS is nominal.

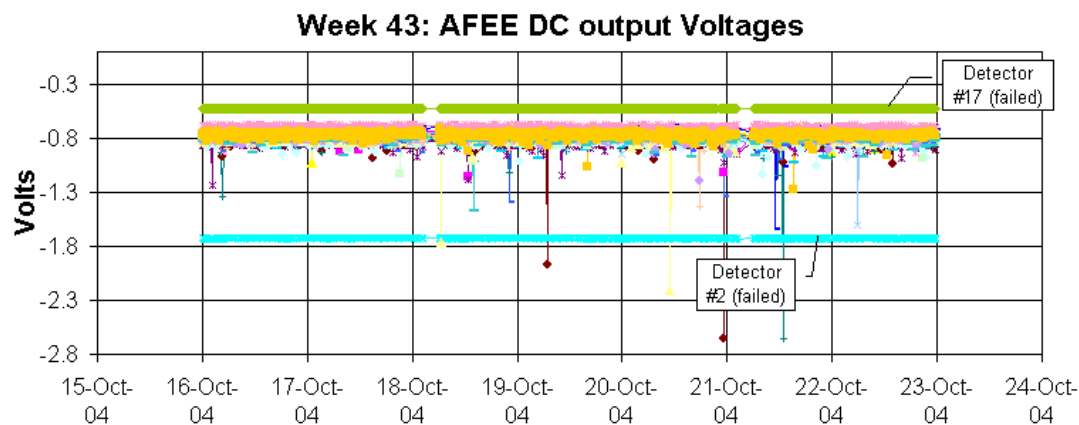
The following plot shows the ACS overall count rate evolution during the reporting period.



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.

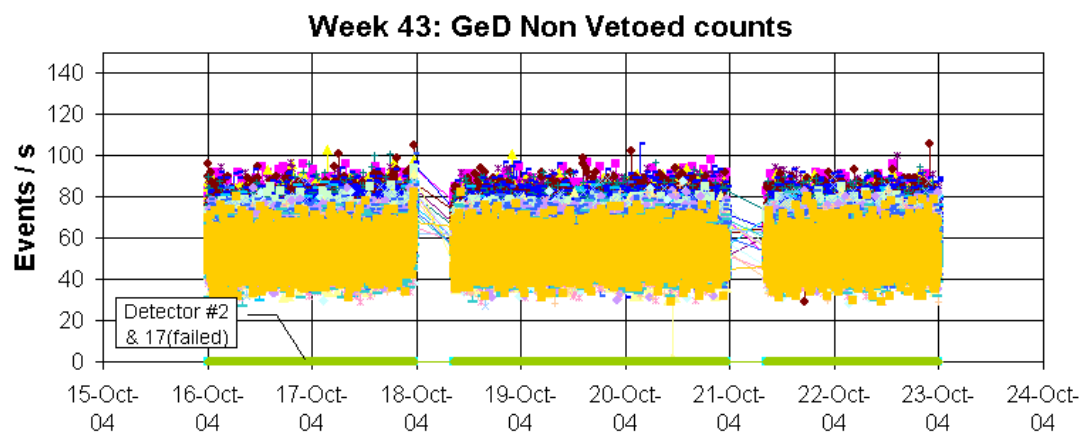
The following plot shows the AFEE dc output signals during the reporting period.



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 detector #2 and #17.

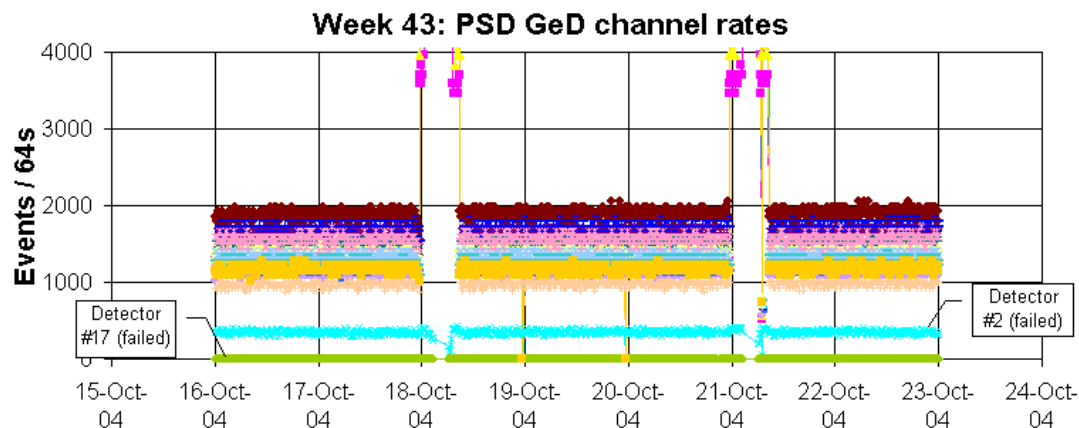


PSD:

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).

A IASW patch is under final acceptance testing at Cessr to enable 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.

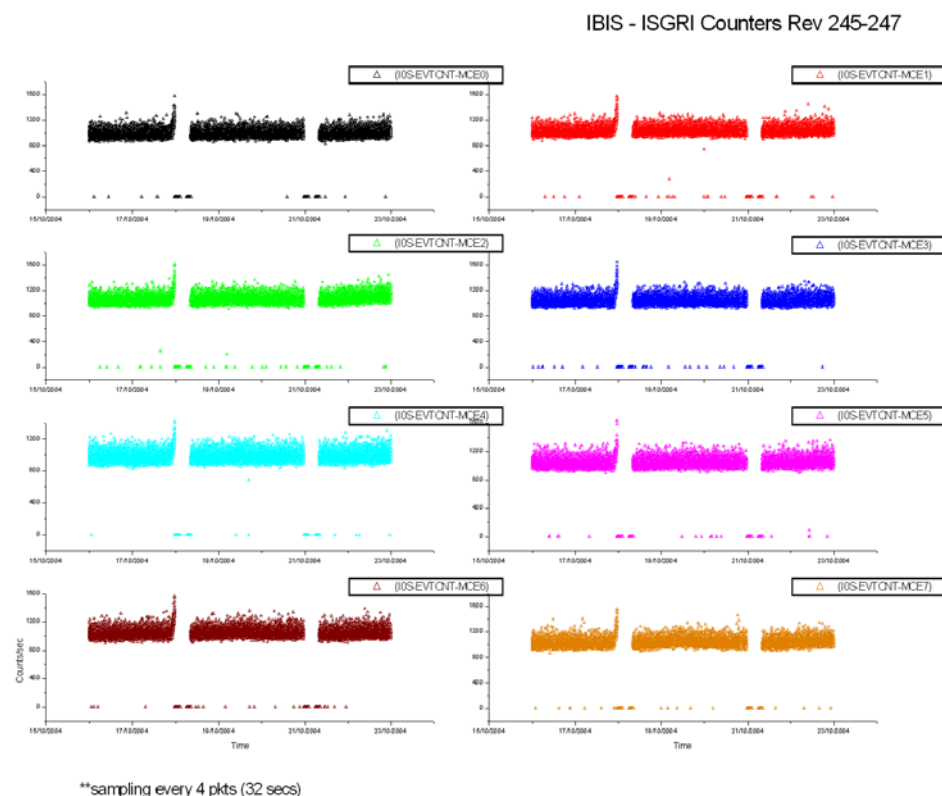
The following plot shows the PSD channel rates during the reporting period.



8.3.3 IBIS Operations

IBIS Event Counters Plots.

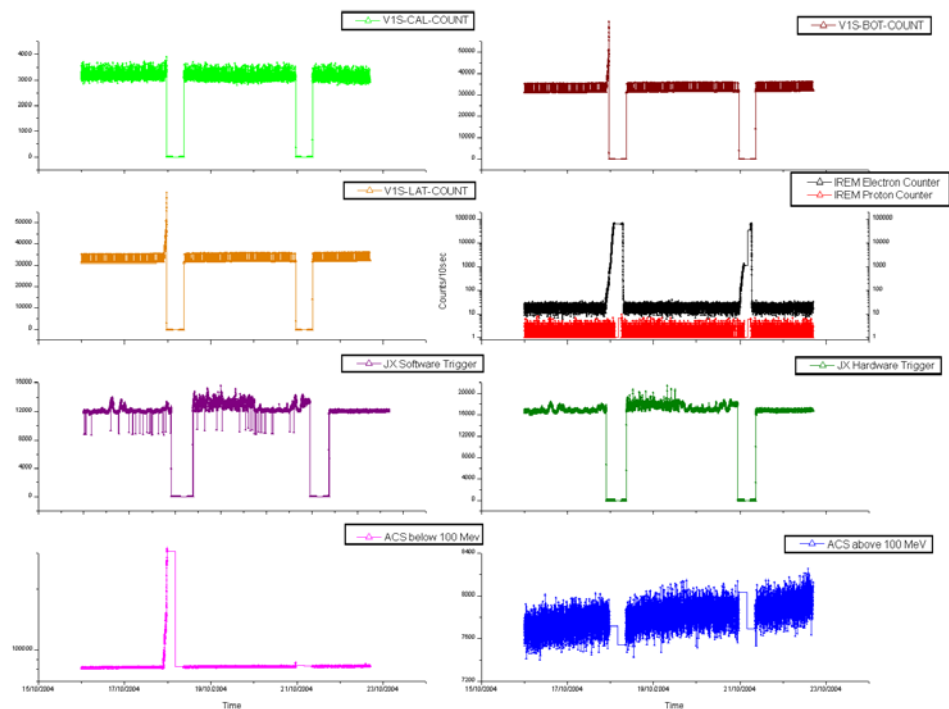
ISGRI Counters:



VETO vs Payloads Counters

The week was characterized by low solar activity.

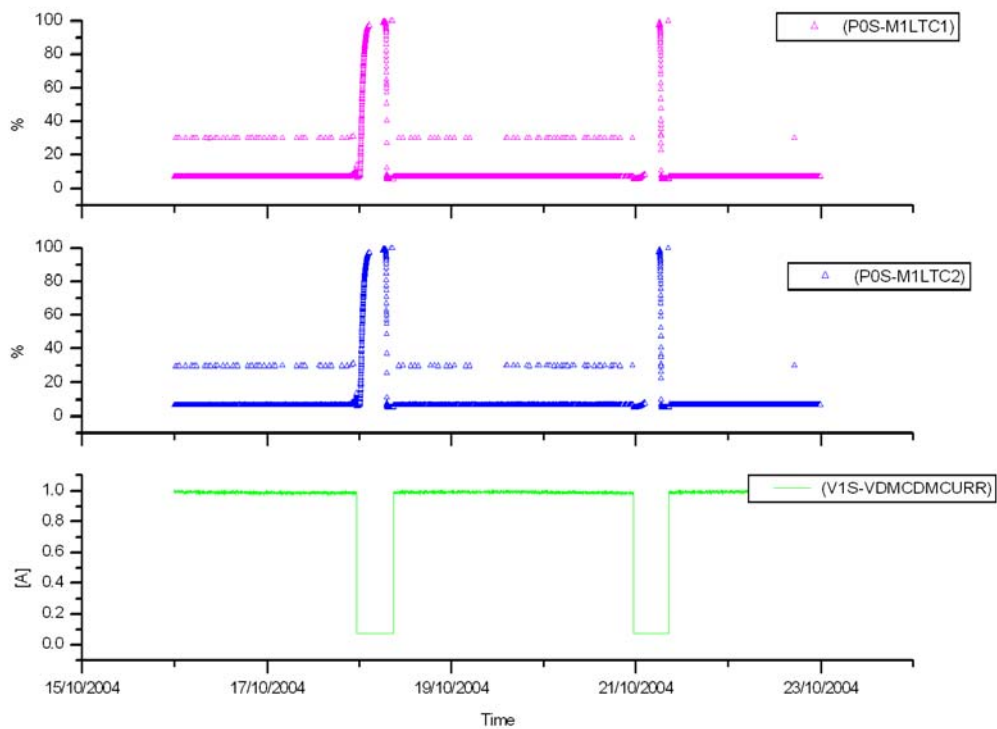
IBIS-VETO vs Payloads Counters Rev 245-247



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

Veto Current:

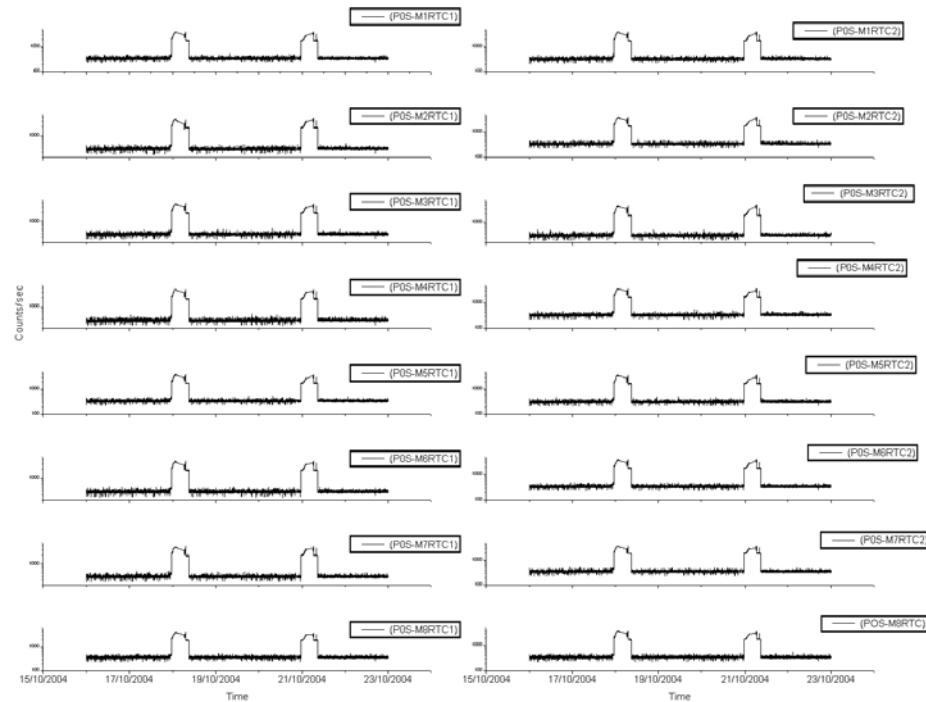
IBIS-VETO Current & PICsIT dead times Rev 245-247



**sampling every 4 pkts (32 secs)

Picsit Counters:

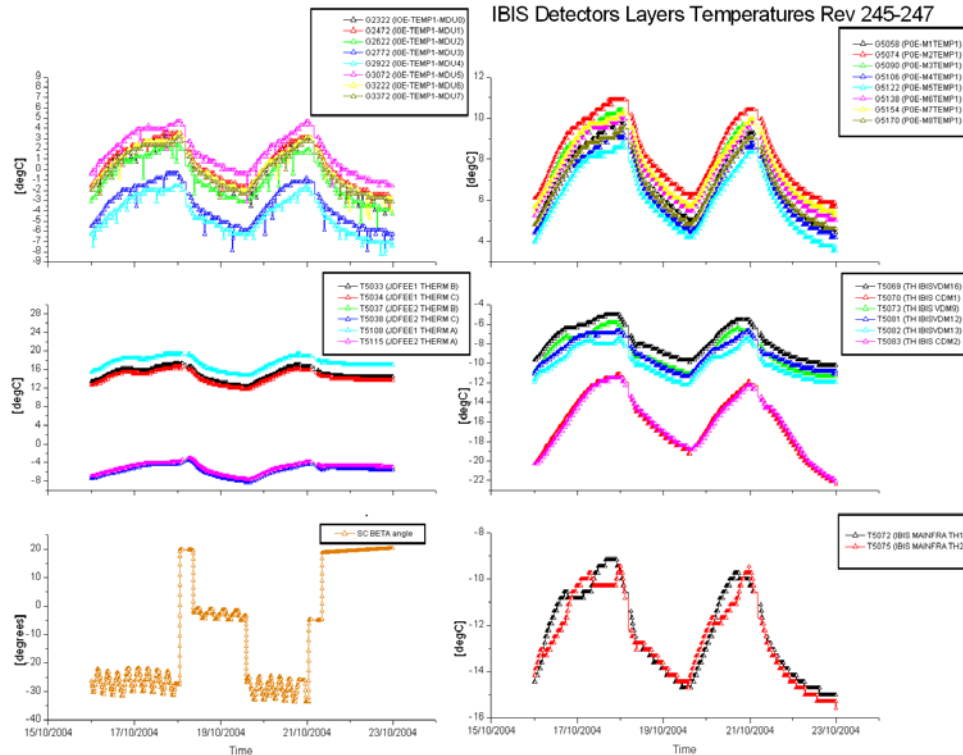
IBIS - PICsIT Counters Rev 245-247



**sampling every 4 pkts (32 secs)

IBIS Detectors Layers Temperatures

IBIS Detectors Layers Temperatures Rev 245-247



**sampling every 8 pkts (64 secs)

IBIS daily report

Recently there have been many occurrences of the Veto 28 V PMT set by IASW (parameter G8015) in out of limits (warning high >29.4 V) for few TM cycles. This value is set by the IASW and not 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 as it is nominally inside Radiation Belts and no further action was taken. Clarification is ongoing with the IBIS PIs.

DoY 2004.290 (16/10/04)

At 20:24Z the parameter G2056 (ISGRI Overflow of the noisy pixel address buffer in MCE4) reported OOL (SCC Fail) for few TM cycles. According to the Payloads FDIR document no action was taken.

DoY 2004.291 (17/10/04)

At 03:50Z the parameter G2098 (ISGRI Overflow of the noisy pixel address buffer in MCE7) reported OOL (SCC Fail) for few TM cycles. According to the Payloads FDIR document no action was taken.

At 23:12Z the VETO bottom (G6062) and lateral (G6063) counters reported OOL (warning high) for few TM cycles due an earlier than expected Radiation Belt entry (the time set in the BCPKT was 23:31Z).

At 23:21Z an autonomous transition to Stand-By (Safe configuration) of the unit was reported due to the early expected Radiation Belt entry.

DoY 2004.292 (18/10/04) - 2004.293 (19/10/04)

Nothing to report.

DoY 2004.294 (20/10/04)

At 20:02Z the IBIS s/s was disabled from the automatic scheduling system (timeline) due to problem on the DSS16 station. The PIDs from 02460085-90 were missed and the unit continued in a long staring at the attitude of the PID 02460084. At 23:19Z the s/s was re-enabled in the timeline.

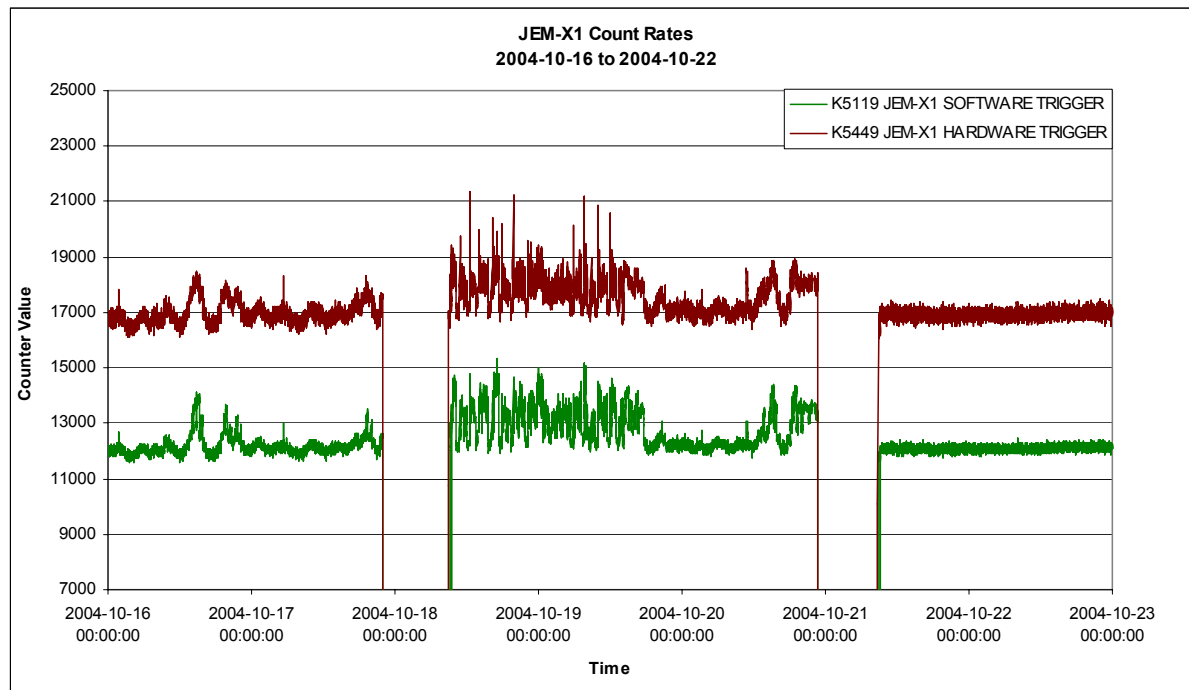
DoY 2004.295 (21/10/04) - 2004.296 (22/10/04)

Nothing to report.

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.

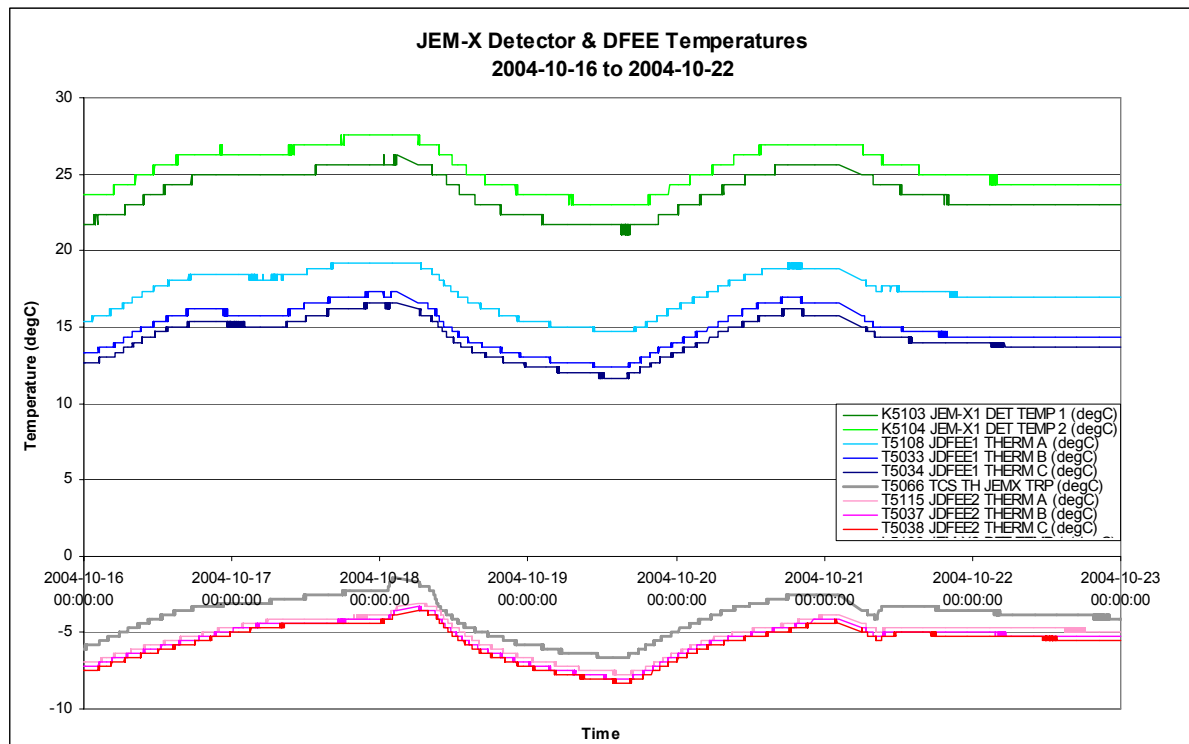


8.3.4.2 JEM-X Temperatures

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.

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)



8.3.4.3 JEM-X Daily Report

2004-10-16 (DOY 290, Rev 245)

Nothing to report

2004-10-17 (DOY 291, Rev 245)

At 21:50Z the IREM radiation monitoring parameter K5317 RAD MONITOR 3 (Electron Counter) went Out of Limits (value = 64), but then returned within limits at the next TM cycle.

At 21:52Z K5317 RAD MONITOR 3 went Out of Limits again (value = 64) and, after remaining out of limits for 2 TM cycles, caused JEM-X1 to transition to Safe mode autonomously (issuing OEM 231 JEM-X1 AUTO EVENT 1). This was only ~17 minutes before JEM-X1 was due to be commanded to Safe mode by the ED KESAFE01 in the Timeline (scheduled at 22:09:35Z) before radiation belt entry of revolution 245. The ED KESAFE01 was then also allowed to execute from the Timeline, at which time another OEM 231 JEM-X1 AUTO EVENT 1 was received.

2004-10-18 (DOY 292, Rev 245-246) to 2004-10-19 (DOY 293, Rev 246)

Nothing to report

2004-10-20 (DOY 294, Rev 246)

Due to a delay in the availability of the Goldstone ground station (DSS-16), commanding to JEM-X1 was disabled from the Timeline at 20:02Z and the automatic Timeline was then stopped at 20:25Z. Therefore, the ED KESAFE01 scheduled in the

Timeline at 21:56:52Z was missed. Once ground station coverage with TC capability was obtained, procedure FCP_JEM1_0040 was executed at 22:47Z to put JEM-X1 into Safe mode before radiation belt entry of revolution 246. As the radiation levels had not exceeded the JEM-X safe thresholds during this time, JEM-X1 had remained in Data Taking mode. (The autostack was restarted at 22:52Z.)

2004-10-21 (DOY 295, Rev 246-247) to 2004-10-22 (DOY 296, Rev 247)

Nothing to report

8.3.5 OMC Operations

On DoY 291, at 12:34:41, the following OEMs were received:

```
2004.291.12.34.41.503 2004.291.12.34.33.335 1792 Real Time Anomaly 5 OMC
CSSW INT ER
      FIX6=0 M9079=2 M9080=5 M9074=4 M9067=5531
2004.291.12.34.41.384 2004.291.12.34.33.335 1792 Real Time Exception 7 OMC
CONSTRAINT D
      M9073=4, IASW TASK 4 M9079=1 M9080=7 M9076=22 M9067=20216
```

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

On DoY 294, at 19:46, the AOCS was disabled prior to a DSS-16 pass that was cancelled at short notice. The impact was pointings 02460085 through to 02460090 were lost. The commands for pointing 02460085 were sent, but rejected:

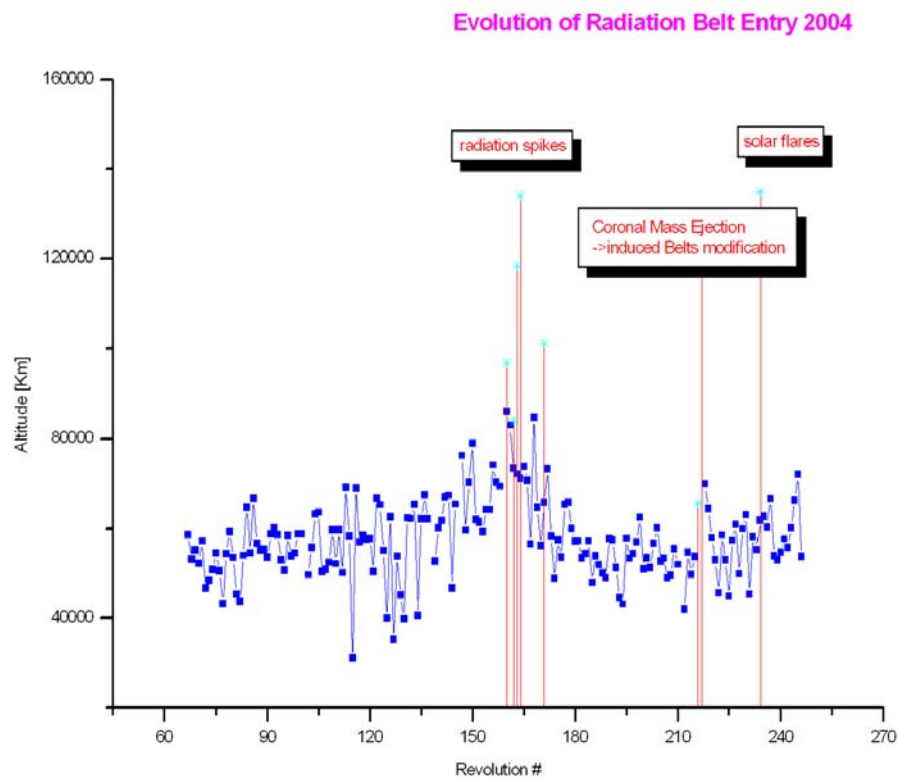
```
2004.294.19.55.38.092 2004.294.19.55.26.368 1792 Real Time Rejection 131
REJECTED TC1
      FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=60,IM A M9068=1 FIX2=0 M9069=667
2004.294.19.55.30.465 2004.294.19.55.20.368 1792 Real Time Rejection 131
REJECTED TC1
      FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=130,RESET IM M9068=1 FIX2=0
M9069=666
```

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

On DoY 291, at 23:32:22 and DoY 294, at 23:19:35, 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]
245	RAD ENTR R 2004-10-17T23:32:00Z	2004-10-17 21:50:05	72124.1	2004-10-18 00:16:23	53868
246	RAD EXIT R 2004-10-18T08:39:37Z	2004-10-18 07:17:57	>23179.9	2004-10-18 07:26:23	28434
246	RAD ENTR R 2004-10-20T23:19:13Z	2004-10-21 00:09:17	<53719.8	2004-10-21 00:12:26	52970
247	RAD EXIT R 2004-10-21T08:26:29Z	2004-10-21 06:39:57	<23174.6	2004-10-21 07:12:26	27956

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

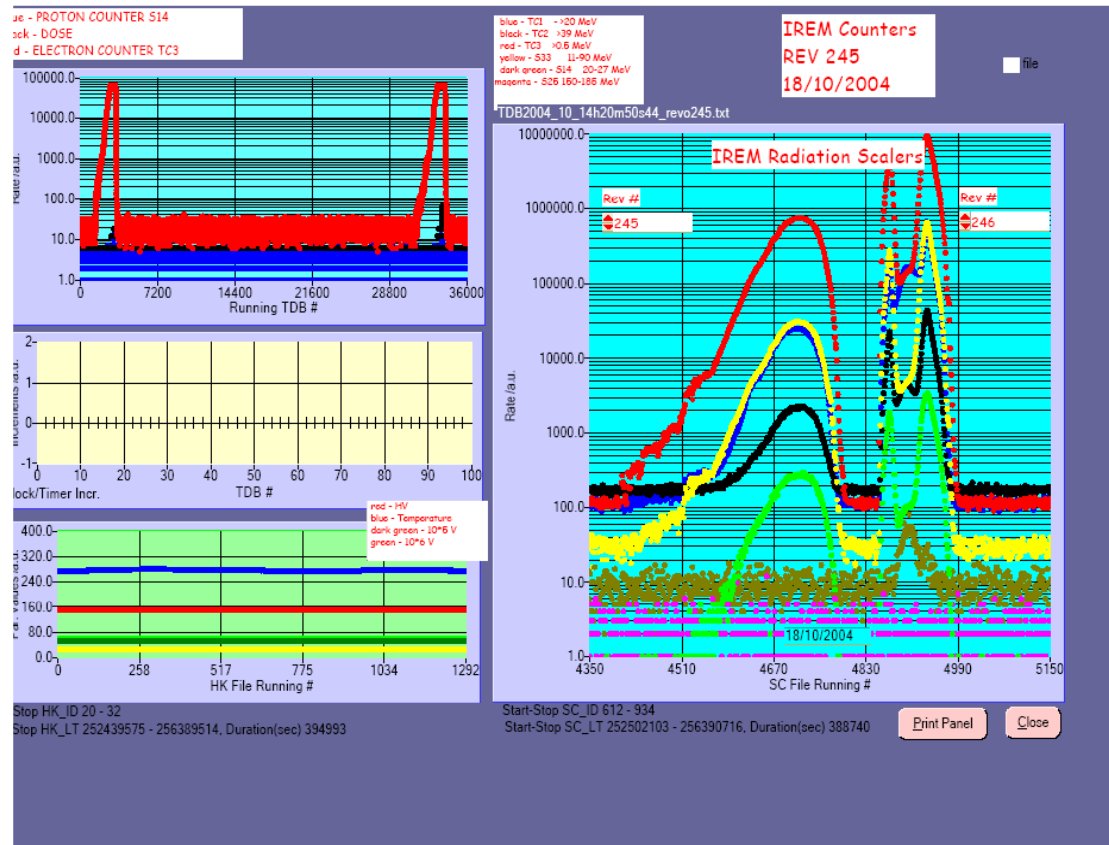
REV	Proton CUT-OFF Predicted Entry/Exit	ALT[Km] predicted
245	PROTON_RAD_ENTR 2004-10-18 05:46:23	13278
246	PROTON_RAD_EXT 2004-10-18 05:56:23	14360
246	PROTON_RAD_ENTR 2004-10-21 05:42:26	13933
247	PROTON_RAD_EXT 2004-10-21 05:52:26	15168

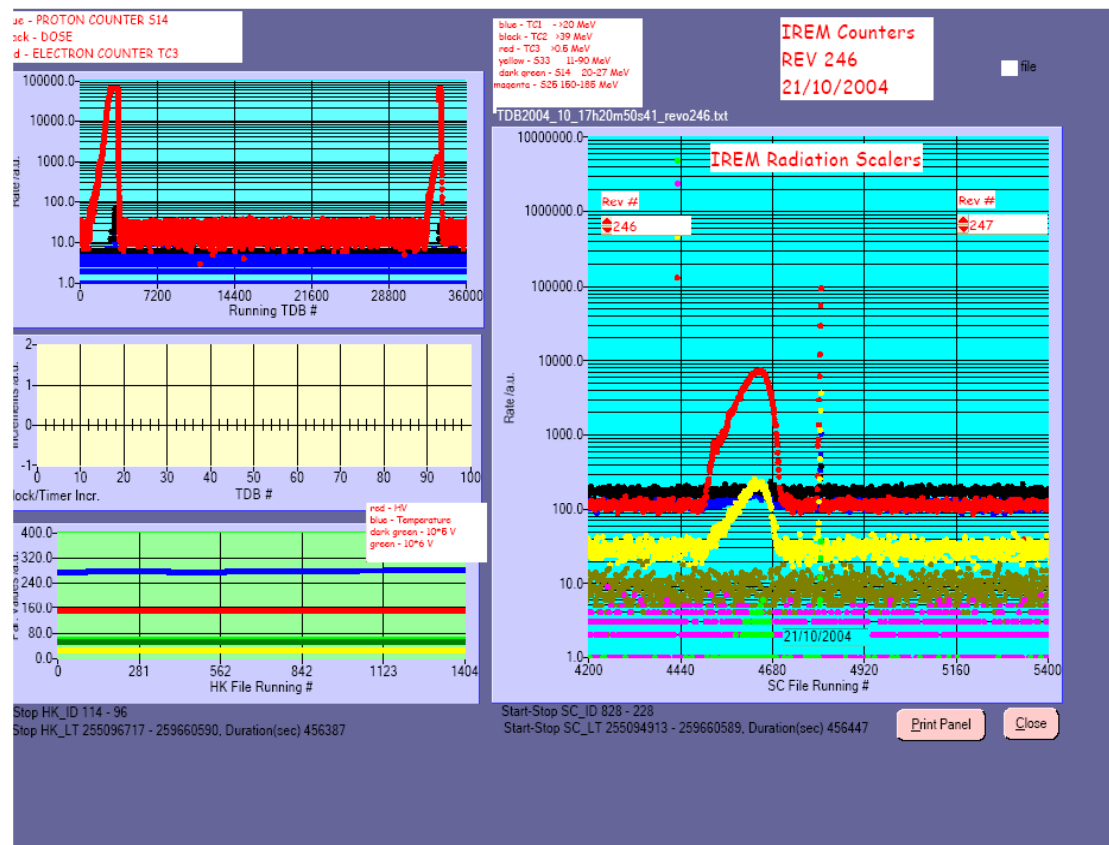
IREM daily report

DoY 2004.292 (18/10/04)

Due to Ground Station (DSS-16) and MCS (multiplexer) problems, TC U4921 (INT GND LINK OFF) was sent manually at 02:27Z.

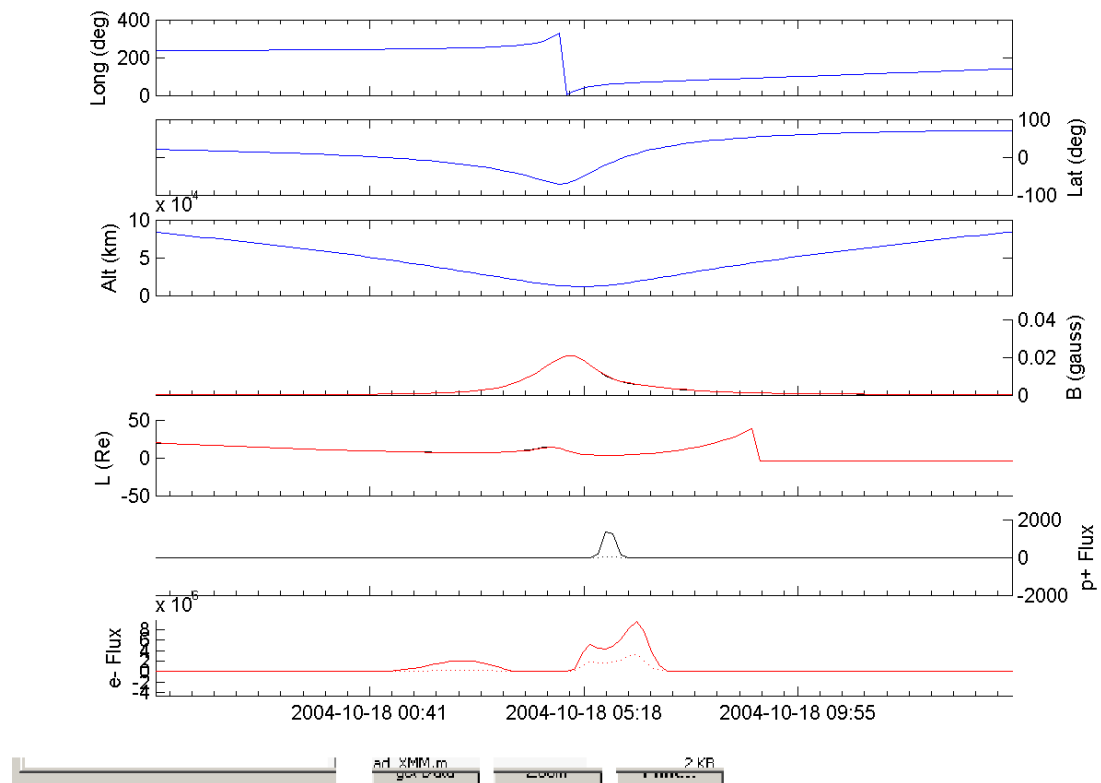
IREM radiation counters



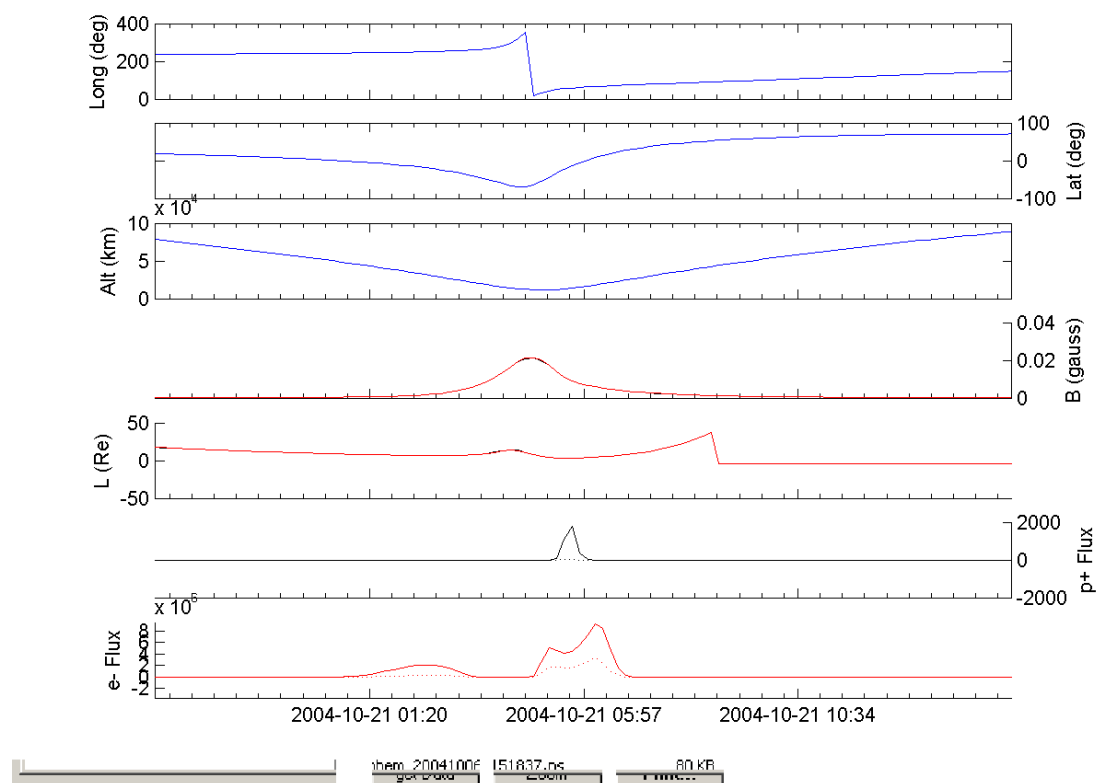


The Scientific data for radiation belt passage between revolutions 246 and 247 are partially missing because the IFRD was stopped for firewall investigation during the downloading period of IREM (on 2004.295 from 08:36Z to 08:51Z).

IREM Predicted Radiation Belt Passages. Rev 245



Rev 246



SEC-GOES Observed Particles Fluxes.

