
EUROPEAN SPACE AGENCY
DIRECTORATE OF TECHNICAL & OPERATIONAL SUPPORT
MISSION OPERATIONS DEPARTMENT

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OF
No. 100
Week 34
23.08.04
Routine Phase

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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.....	4
3.1.4	OBDH.....	4
3.1.5	RFS.....	4
3.2	Payload.....	4
3.2.1	SPI.....	4
3.2.2	IBIS.....	4
3.2.3	JEM-X.....	4
3.2.4	OMC.....	5
3.2.5	IREM.....	5
4	Ground Facilities.....	6
4.1	Mission Operations Centre.....	6
4.2	Ground Stations & Network.....	6
4.3	Science Ground Segment.....	6
4.3.1	ISOC.....	6
4.3.2	ISDC.....	7
5	Special Events.....	7
6	Anomalies.....	7
7	Future Milestones.....	8
8	Appendix.....	9
8.1	Overview of Revolutions.....	9
8.2	Consumables.....	9
8.2.1	Detailed Fuel Book-keeping.....	9
8.3	Detailed Satellite Information.....	10
8.3.1	AOCS Summary Operations Report 14/08/2004-20/08/2004.....	10
8.3.2	SPI Operations.....	11
8.3.3	IBIS Operations.....	15
8.3.4	JEM-X Operations.....	20
8.3.5	OMC Operations.....	21
8.3.6	IREM Operations.....	22

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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 14.08.04 until 20.08.04 (both dates inclusive) and covers the revolutions 225 & 226.

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 plane; an OMC Flat Field target (RA 13:12:24.00, DEC -27:53:60.0); the Target of Opportunity SGR1806-20 (RA 18:08:39.32; DEC -20:24:39.5); IGR J16320-4751 (RA 16:32:1.90; DEC -47:52:29.0) and the Galactic Center field (RA 17:45:40.00; DEC -29:00:28.0). The activities consisted of GPS; staring; hexagonal dithering and raster dithering observations. In addition, OMC Flat Field and Dark Current Calibrations were performed.

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.

Due to a high radiation background during the perigee pass on DoY 232, the STR condition was very unstable for a period of about 25 minutes. The guide star was released/lost 16 times during this period.

One slew was lost because of a problem with the AD service.

The fuel consumption over the period between 13/08/2004 and 20/08/2004 was 0.185 kg. The remaining propellant is in the order of 168.618 Kg on the 20th of August.

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

After the failure of Germanium Detector#17, on 17th July, the overall status of the instrument in this week is nominal, except for:
the PSD (Pulse Shape Discriminator), which reproduced once the anomaly of zero counts on all the channel rates, for a few minutes;
a spike to zero on both the DC output voltage and the PSD counts on Ged#0 only, at two different times. These two events have been reported to the PI for additional assessment / feedback.

The instrument was maintained in photon-by-photon mode with spectra TM enabled, an assigned TM bandwidth in the science windows of 103 pkts/cycle (except during the OMC FFC (2004-08-16 23:54:39Z - 2004-08-17 04:20:07Z) where the PST allocation was 84 TMSP/Cycle), and an actual average occupation of 92.6 pkts/cycle. 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.

During the reporting period the PST Allocation to IBIS was 129 TMSP / Cycle except during the OMC FFC (2004-08-16 23:54:39Z - 2004-08-17 04:20:07Z) where the PST allocation was 90 TMSP/Cycle. The mean IBIS Bandwidth usage was 102.8 TMSP / Cycle, down 1.1 TMSP on last week.

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 was dormant 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, except during the Flat-Field and Dark-Current calibrations when the TM allocation was 63 packets/cycle.

There were 157 OMC pointings executed nominally, 1 was 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 still characterised by the influence of the past and recent solar activity on the structure of the Radiation Belts. The inner part of the Belts passage did not show the typical footprint due to the Integral orbit, but still appeared compressed around the perigee area.

The proton counter presented a high peak during each Belts passages for rev 224-225, some orders of magnitude over the typical values.

On 18/08 at 17:40Z, after two weeks threatening to explode, the sunspot 649 unleashed an X1.8-class solar flare. The explosion hurled a coronal mass ejection into space but not toward Earth.

The following major event was reported during the observation period:

X-ray Event exceeded X1 class

Begin Time: 2004 Aug 18 17:29Z
Maximum Time: 2004 Aug 18 17:40Z
End Time: 2004 Aug 18 17:54Z
X-ray Class: X1.8
Location: S16W90

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, one pointing was lost.

4.1 Mission Operations Centre

The performance of the MOC was in general good in the reporting period, there was an instance where problems were experienced sending data to the isds, but apart from that, another quiet week.

4.2 Ground Stations & Network

The performance of the ground stations and Network was in general good this week. There was a problem with the auto-track at Redu, which caused a TM drop of two minutes, and another problem with the TCE that led to the loss of a pointing, but that was all. The overall performance though was well above the 95% requirement.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

PSFs: up to 232 received

POS and POD: POS / POD sent up to rev 231.

TSFs: complete up to revolution 228.

One ToO, SGR 1806-20, was accepted and included in the scheduling. Rev 227 was replanned. This revolution also had a rejection in MOC because the constraint files used by MOC were different from the ones used at the time of scheduling in ISOC.

2. Observation status

All ECS's received up to rev 216 except rev 213. Corresponding OCS's sent. No extra time credited.

3. ISOC science data archive

A new tape has just been received from ISDC. Will be ingested next week.

4. ISOC system

The new version, version 10.5.0 has been installed this week. This version has enhanced dither pattern implementation and enhancements to the copy function. It is now possible to copy a proposal with more than one observation. This system version is used in the planning from revolution 229.

5. AO 3 preparation

The preparation status has been reviewed this week in ISOC. Documentation is still being updated in some areas. The aim is to have everything ready by 3 September. The software required to support the AO 3 proposal submission is available. Remaining work is to test and tune the PGT installation scripts to make them as user friendly as possible. For the OTE it is required to verify the consistency between the output from this software with the documentation provided. It is expected the software will be timely available.

6. ISOC move to VILSPA / ESAC

The draft software test plan has been reviewed this week. The plan is to issue a first release by mid September. The Interface test between MOC and ISOC has been in principle agreed by the relevant parties.

4.3.2 ISDC

Status of ISDC observation processing on 23/08/2004:

- Latest Standard Analysis completed: observation 02201450004 (Mkn 590, Revolution 210) on 20/08/2004
- Latest products archived: amalgamated observations 02200210001, 02201030001, 02297000004 (Carina, Revolution 197-200) on 30/07/2004
- Latest observation products sent to the observer: amalgamated observations 02200210001, 02201030001, 02297000004 (Carina, Revolution 197-200) on 07/08/2004

5 Special Events

6 Anomalies

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

- On DoY 227, at 23:09, there were errors sending data from isds to the ISDC. At 23:12, the errors seemed to clear autonomously, there was no apparent cause.
- On DoY 229 at 22:00, the link isds – ISDC briefly disconnected and reconnected.
- On DoY 230 at 22:36 the antenna at REDU station stopped tracking. It was switched to program track, which cured the problem. The impact was a two-minute TM gap.
- On DoY 231, at 03:54, the scheduled DSS-16 pass was cancelled due to maintenance. The backup antenna DSS-24 was made available, there was no data loss, and no impact.
- On DoY 232, at 22:31, there were two instances of a single cycle telemetry drop from Redu. These were later found to be coincident with queue overflow alarms on the TMP. At 22:40, manual and auto-stack showed no AD service. At 22:45, it was decided to switch to TCE-2, however TCE-1 could not be disconnected. It was therefore decided to stop the timeline to reboot TCE-1. The impact was the loss of pointing 02260012.

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

AR id	Date Occurrence	Subject	Segment	Status
INT-2633	19/08/2004	Auto track at REDU stopped	ESA Stations	Pending

Doc. Title : INTEGRAL Mission Report #100
Doc. Ref. : INT-MOC-SYS-RP-1001-OPS-OF
Date : 23/08/04

Issue : 1
Rev. : 0
Page : 8

INT-2634	19/08/2004	Unavailability of DSS-16 on DOY 231	NASA Stations	Pending
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7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 225

The observations in revolution 225 consisted of:

- 12 pointings of a GPS lasting ~8 hours;
- Staring observation at an OMC Flat Field target OMC FF #18 (RA 13:12:24.00, DEC -27:53:60.0) lasting ~3.5 hours, during which OMC Flat Field and Dark Current Calibrations were performed;
- Hexagonal dithering observation of the Target of Opportunity SGR1806-20 (RA 18:08:39.32; DEC -20:24:39.5) performed for the remaining ~47 hours of observation time.

Throughout these observations SPI, IBIS and JEM-X1 were in their nominal science modes and JEM-X2 was in Safe mode. OMC was in Normal mode for the GPS observation; FFCalibration followed by DCCalibration mode for the Flat Field observation and Fast Monitoring mode for the SGR1806-20 observation. The TM allocation was IBIS 90; SPI 84; JEM-X1 8; JEM-X2 1; OMC 63 for the OMC Flat Field observation and IBIS 129; SPI 103; JEM-X1 8; JEM-X2 1; OMC 5 for the other observations.

Revolution 226

The observations in revolution 226 consisted of:

- Amalgamated hexagonal dithering observation of IGR J16320-4751 (RA 16:32:1.90; DEC -47:52:29.0) lasting ~33 hours;
- 26 pointings of a GPS lasting ~18.5 hours;
- Raster dithering observation of the Galactic Center field (RA 17:45:40.00; DEC -29:00:28.0), performed for the remaining ~6.5 hours of observation time.

Throughout these observations all instruments were in their nominal science modes, except for JEM-X2, which was in Safe mode, 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

2004-08-07T07:01:44.000Z	168.9750	F	Automatic TM processing.
2004-08-07T12:14:01.000Z	168.9236	F	Automatic TM processing.
2004-08-08T15:06:35.000Z	168.8940	F	Automatic TM processing.
2004-08-08T16:47:24.000Z	168.8735	F	Automatic TM processing.
2004-08-08T22:54:52.000Z	168.8575	F	Automatic TM processing.
2004-08-10T11:51:12.000Z	168.8414	F	Automatic TM processing.
2004-08-11T23:02:12.000Z	168.8037	F	Automatic TM processing.
2004-08-13T11:38:56.000Z	168.7812	F	Automatic TM processing.
2004-08-14T18:38:19.000Z	168.7471	F	Automatic TM processing.

Doc. Title : INTEGRAL Mission Report #100
Doc. Ref. : INT-MOC-SYS-RP-1001-OPS-OF
Date : 23/08/04

Issue : 1
Rev. : 0
Page : 10

2004-08-14T20:19:47.000Z	168.7351	F	Automatic TM processing.
2004-08-14T21:58:03.000Z	168.6773	F	Automatic TM processing.
2004-08-16T11:24:31.000Z	168.6673	F	Automatic TM processing.
2004-08-16T20:16:24.000Z	168.6504	F	Automatic TM processing.
2004-08-17T03:26:01.000Z	168.6350	F	Automatic TM processing.
2004-08-17T22:11:23.000Z	168.6185	F	Automatic TM processing.

This report was generated Fri Aug 20 08:00:21 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 14/08/2004-20/08/2004

AOCS operations were executed from the Automatic Timeline.

During this period, 62 Open Loop Slews, 114 Closed Loop Slews and 9 Momentum Bias were executed. One slew was executed manually. This is equivalent to a 0.6%.

14/08/04 (Day of Year 227, Revolution 224)

Nothing to report.

15/08/04 (Day of Year 228, Revolution 224)

Nothing to report.

16/08/04 (Day of Year 229, Revolution 224-225)

Nothing to report.

17/08/04 (Day of Year 230, Revolution 225)

Nothing to report.

18/08/04 (Day of Year 231, Revolution 225)

Nothing to report.

19/08/04 (Day of Year 232, Revolution 225-226)

Guide star released by the STR SEU Filter during perigee passage: At 10:06:52, the SUE Filter threshold of the ACC exceeded and the guide star was released. At LOS the magnitude 6.2 guide star was located at [-6182, -13681]. From this time until 10:30:59, the guide star was released/lost 16 times because of the high radiation background. At AOS the new guide star was located at [1188, 34] with magnitude 7.05.

Slew lost due to interruption in the AD service: At 22:40 the AD service terminated and could not be restored before 23:06. The reason was reported to be a problem in the CLCW protocol, which required a reboot of the TCE. The Timeline was stopped because of this problem and slew 02260012 was missed. After resuming the AD service, the Timeline was rejoined by performing a manual close loop slew to the attitude of PID 02260012. PID 02260012 was affected.

20/08/04 (Day of Year 233, Revolution 226)

Nothing to report.

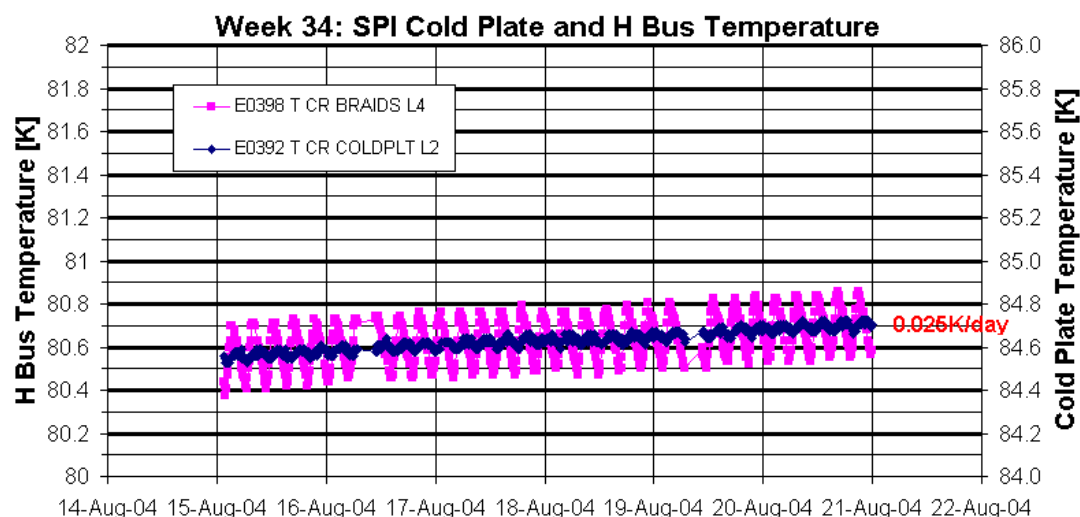
8.3.2 SPI Operations

Cryo-cooler / Detector Cold-Plate:

The performance of the cryo-cooler is nominal.

The cold plate temperature was maintained at 85K $\pm$ 1K with the expected small positive drift.

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

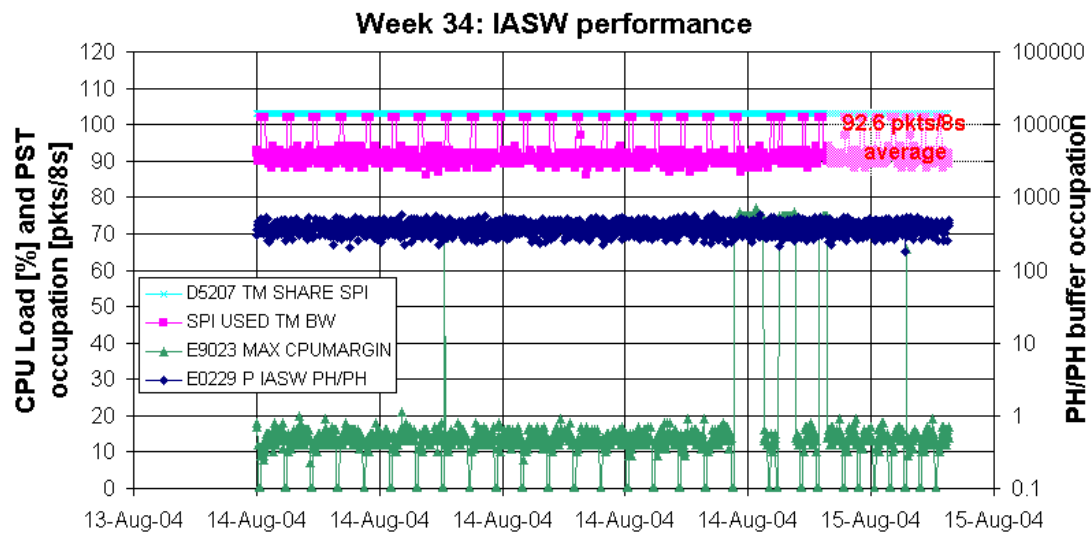


IASW/DPE:

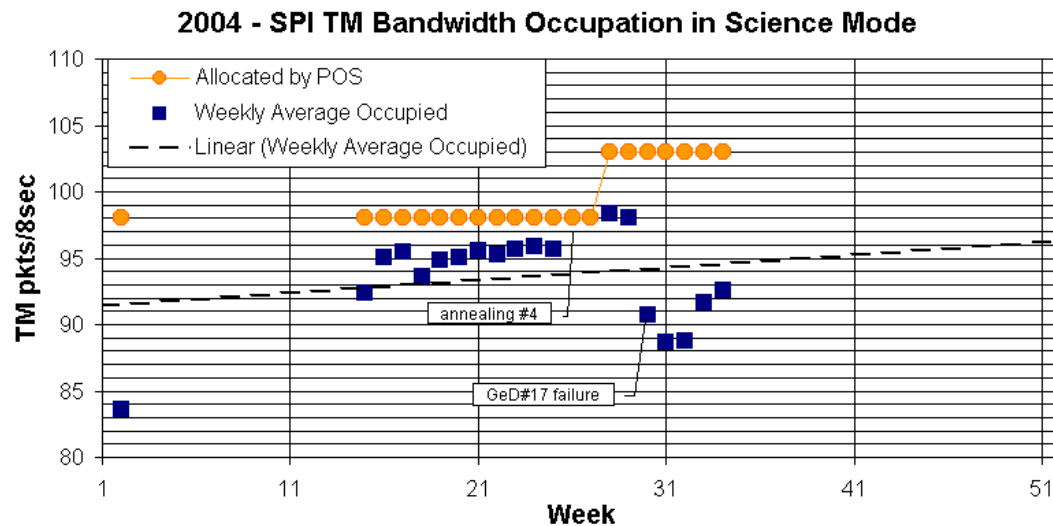
The performance of the IASW/DPE is nominal.

The average TM bandwidth occupation was 92.6 pkts/cycle in the science windows.

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



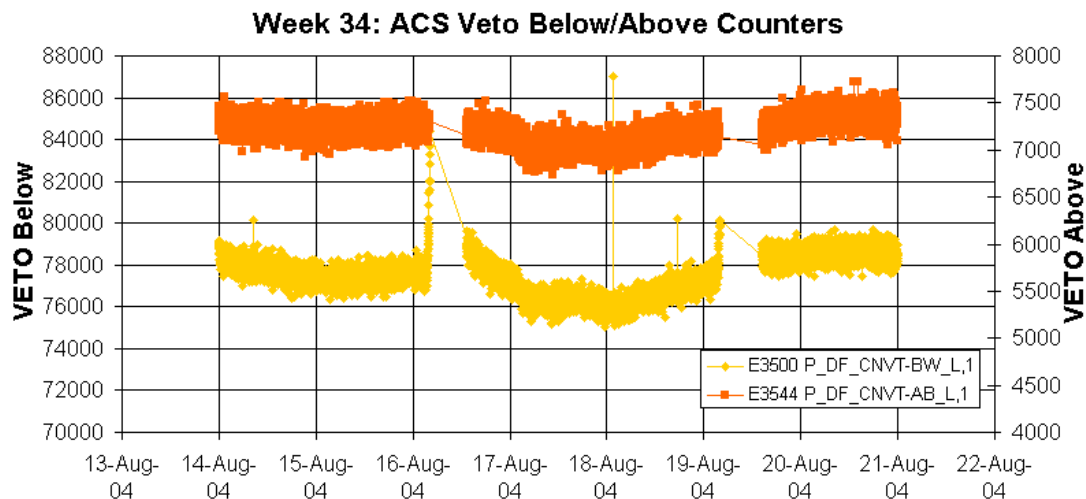
The following plot shows the trend of the occupied bandwidth, since beginning of 2004.



ACS:

The performance of the ACS is nominal.

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

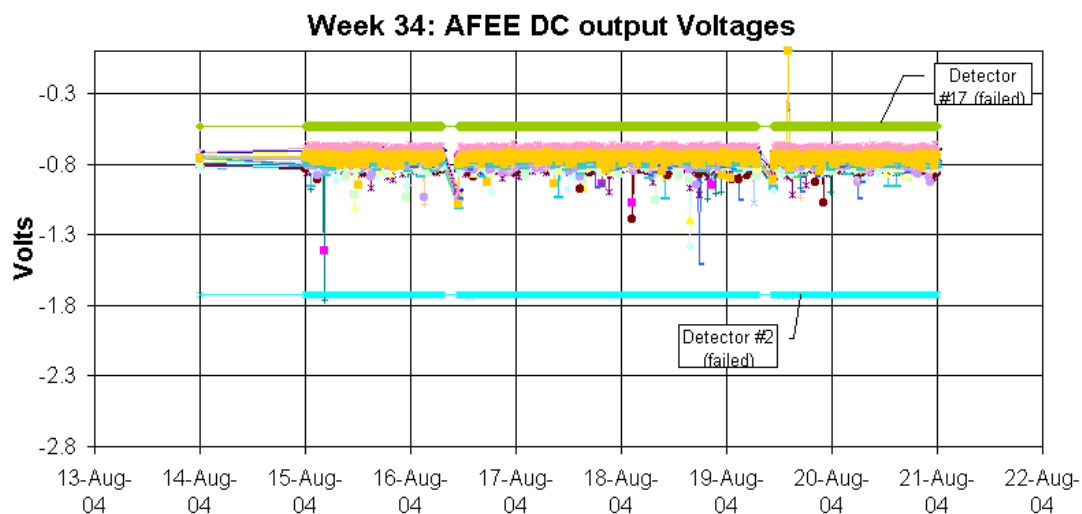


AFEE

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.

At 14:00:47z on 19th August a spike to zero of the GeD#0 signal was detected. This event and the one detected by the PSD, always on GeD#0, a few days earlier (see PSD section hereafter) have been reported to the PI for further evaluations/feedback.

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

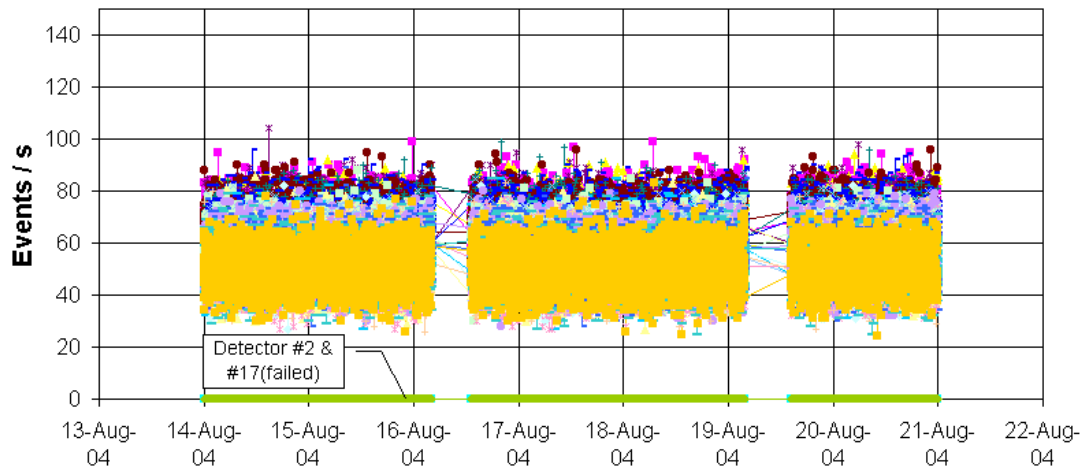


DFEE

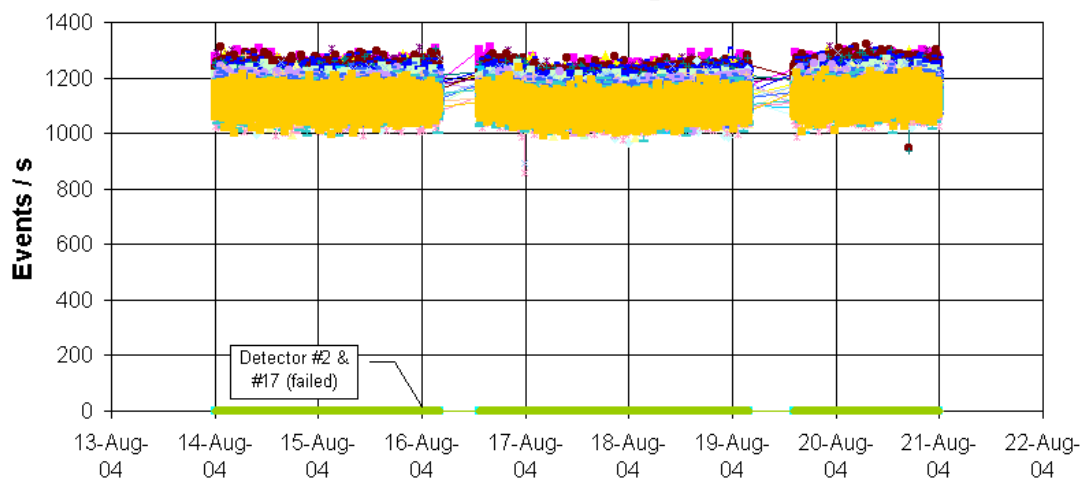
The performance of the unit is nominal.

The following plot shows the GeD Time Tagged, Time Tagged Saturating and 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.

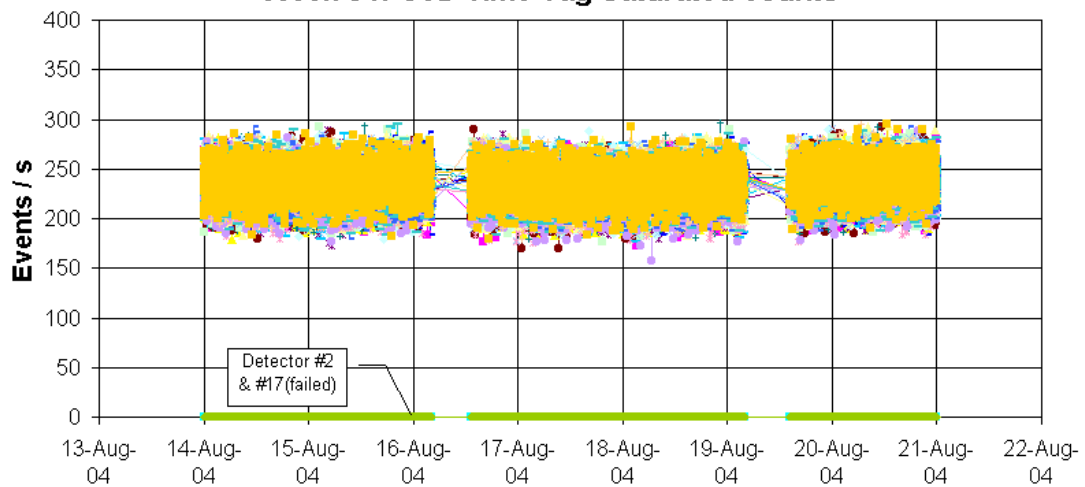
Week 34: GeD Non Vetoed counts



Week 34: GeD Time Tag counts



Week 34: GeD Time Tag Saturated counts



PSD:

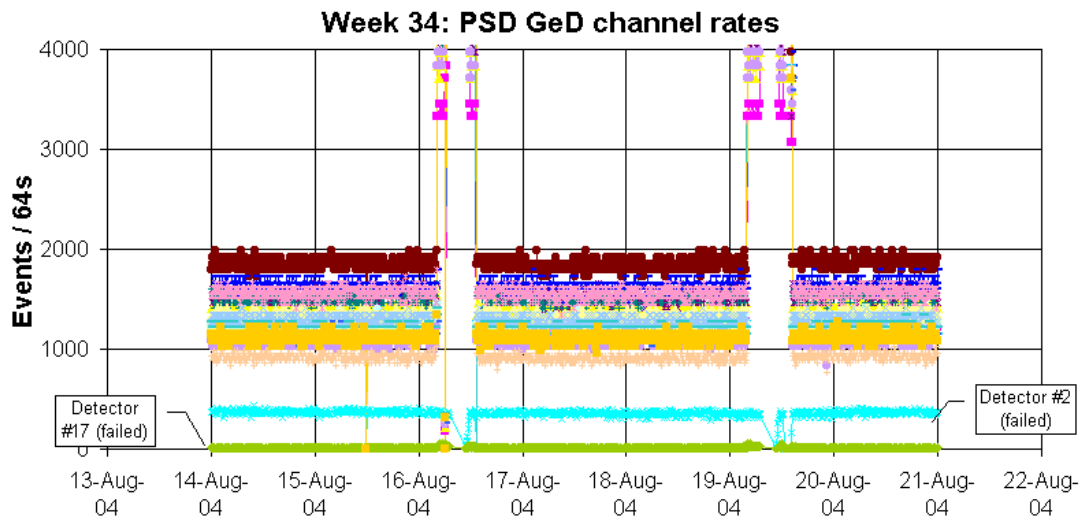
The performance of the unit is nominal, though the malfunction of all PSD channel rates dropping to zero counts for a few minutes repeated itself once on at 06:07:06z on 16th August (this malfunction is described by AR INT_SC-90).

The anomaly affected only the PSD locally as the GeD count rates measured by the DFEE (see above) were still nominal; also the dc output voltage showed a nominal pattern during the malfunction.

This anomaly was first recorded the day after the GeD#17 failure and present explanations correlate it to this failure. A possible recovery procedure is under discussion with the PI.

A spike to zero counts was also recorded on Ged#0 at 11:53:46z on 15th August, also in this case affecting only the PSD as it was not recorded by the DFEE rate-meter. This event and the one recorded by the AFEE dc output voltage a few days later, always on the GeD#0, have been reported to the PI for additional assessment/feedback.

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

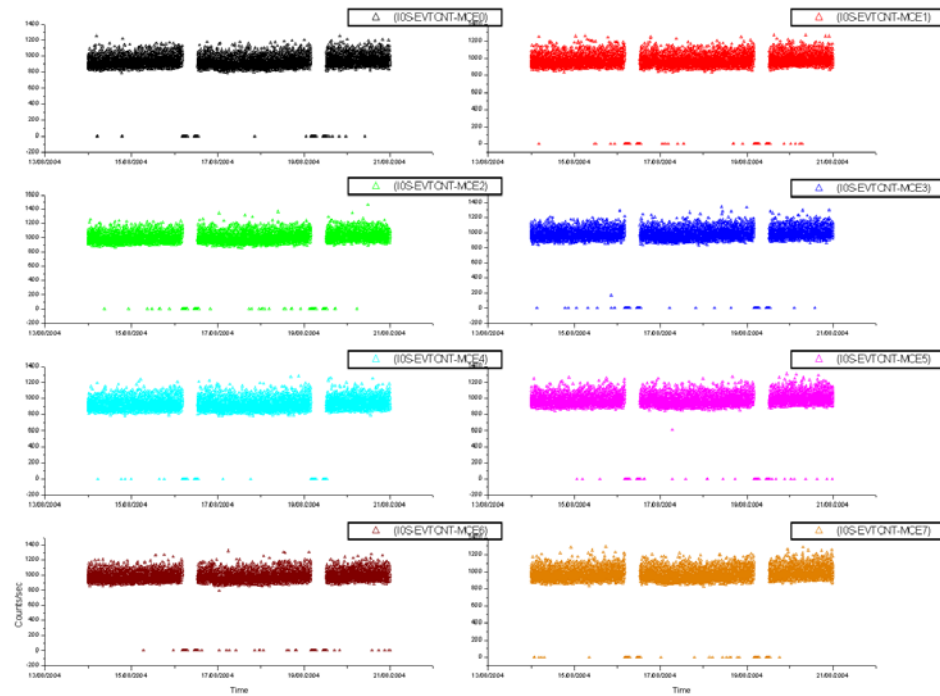


8.3.3 IBIS Operations

IBIS Event Counters Plots.

ISGRI Counters:

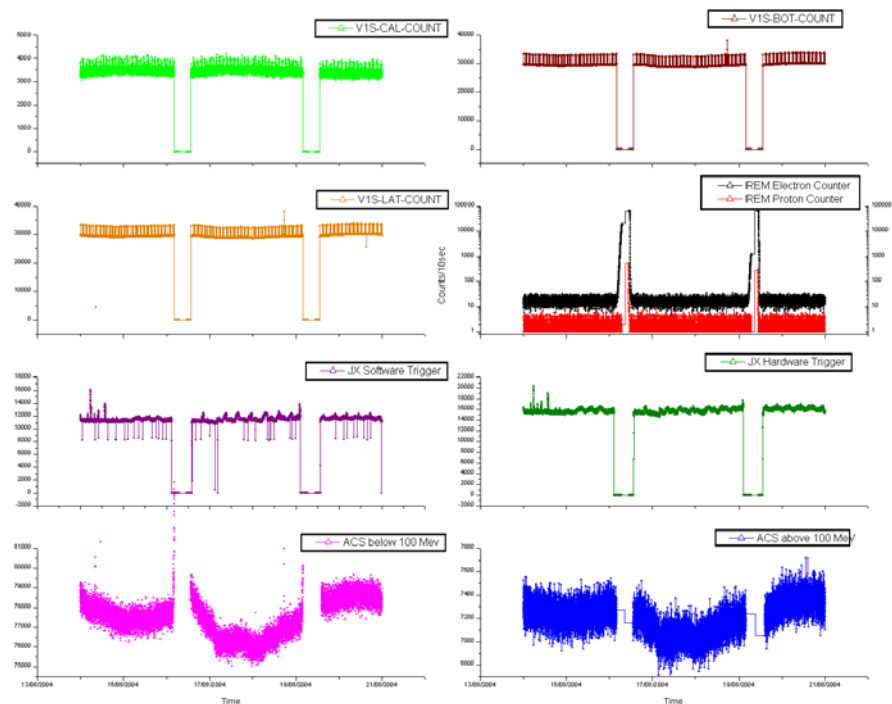
IBIS - ISGRI Counters Rev 224-226



VETO vs Payloads Counters:

The comparison between the count-rates reported by VETO, the SPI-ACS, the IREM counters and JEM-X hardware/software triggers, gives an indication of modification of the radiation background consequent the recent solar activity. Some irregularities were observed in the JEM-X count-rates due probably to the entry/exit of the selected sources in the FOV of the payloads.

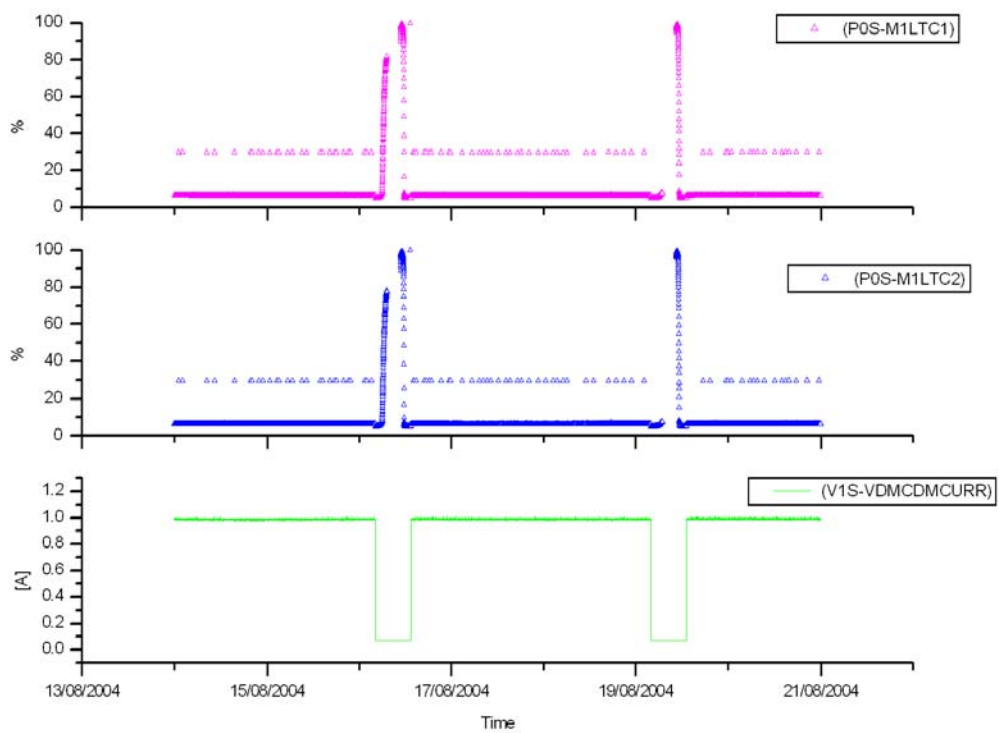
IBIS-VETO vs Payloads Counters Rev 224-226



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

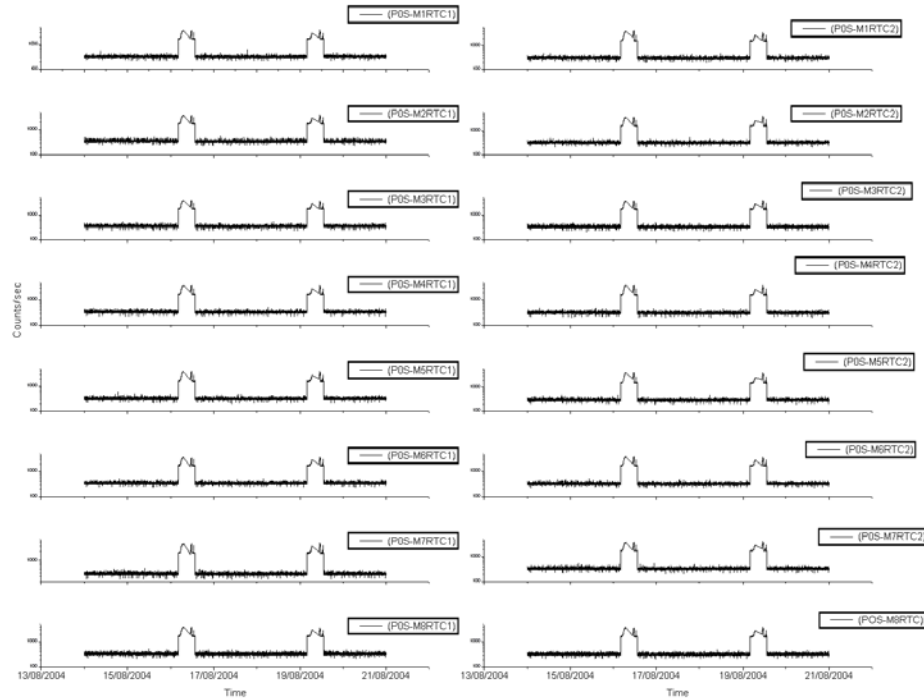
Veto Current:

IBIS-VETO Current & PICsIT dead times Rev 224-226



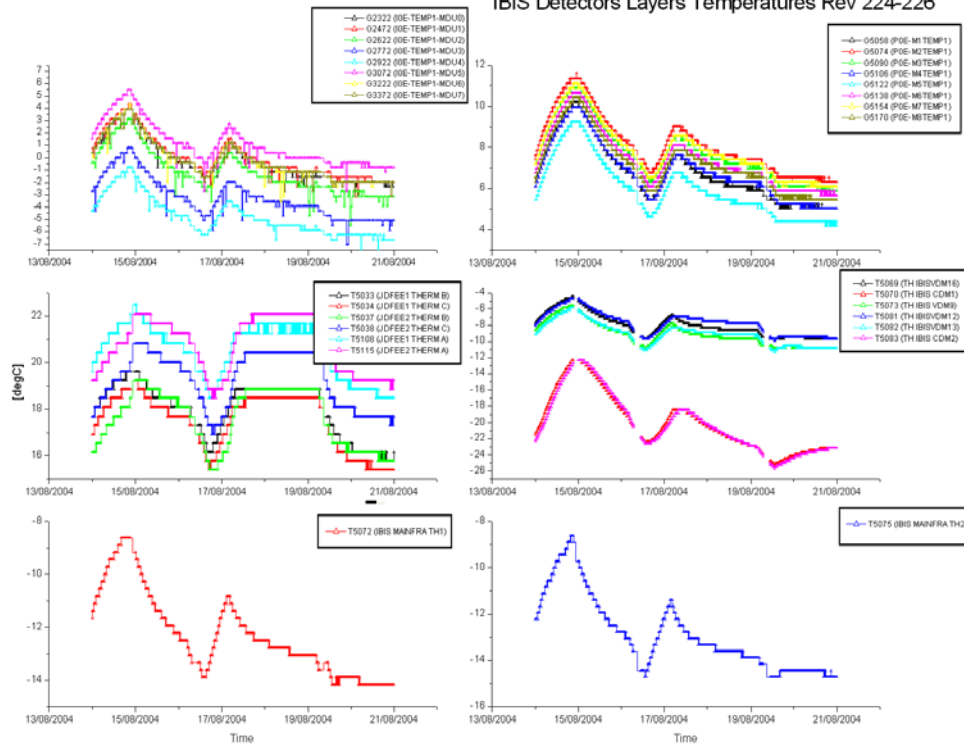
Picsit Counters

IBIS - PICsIT Counters Rev 224-226



IBIS Detectors Layers Temperatures

IBIS Detectors Layers Temperatures Rev 224-226



IBIS daily report

DoY 2004.227 (14/08/04)

At 21:05Z a problem with the PICsIT Histogram downloading was reported. The relevant parameters show a stop of the downloading activities 2 hours and 30 minutes earlier. The reason was that at 18:30Z the instruments window closed as per timeline and the S/C performed a large Open Loop Slew (~160 deg) with additional corrective slews and RWB activities. During this period the payloads were not in observation and no histograms were downloaded.

At 21:15Z a new pointing with duration 2041 sec started, the unit re-started downloading the histograms nominally at 21:35Z. This behaviour is considered nominal and no action was taken by the operator.

DoY 2004.228 (15/07/04)

Nothing to report.

DoY 2004.229 (16/08/04)

There were a few reports during the Belt passage of the OEM APID 1280 ID 167 Class 2 <<IBIS1 PICsIT NOISY SEMIMODULE SIGNALLING>> due to the PICsIT detectors being ON without the VETO anticoincidence system, as required by the PIs.

DoY 2004.230 (17/08/04)

Nothing to report.

DoY 2004.231 (18/08/04)

Nothing to report.

DoY 2004.232 (19/08/04)

There were a few reports during the Belt passage of the OEM APID 1280 ID 167 Class 2 <<IBIS1 PICsIT NOISY SEMIMODULE SIGNALLING>> due to the PICsIT detectors being ON without the VETO anticoincidence system, as required by the PIs.

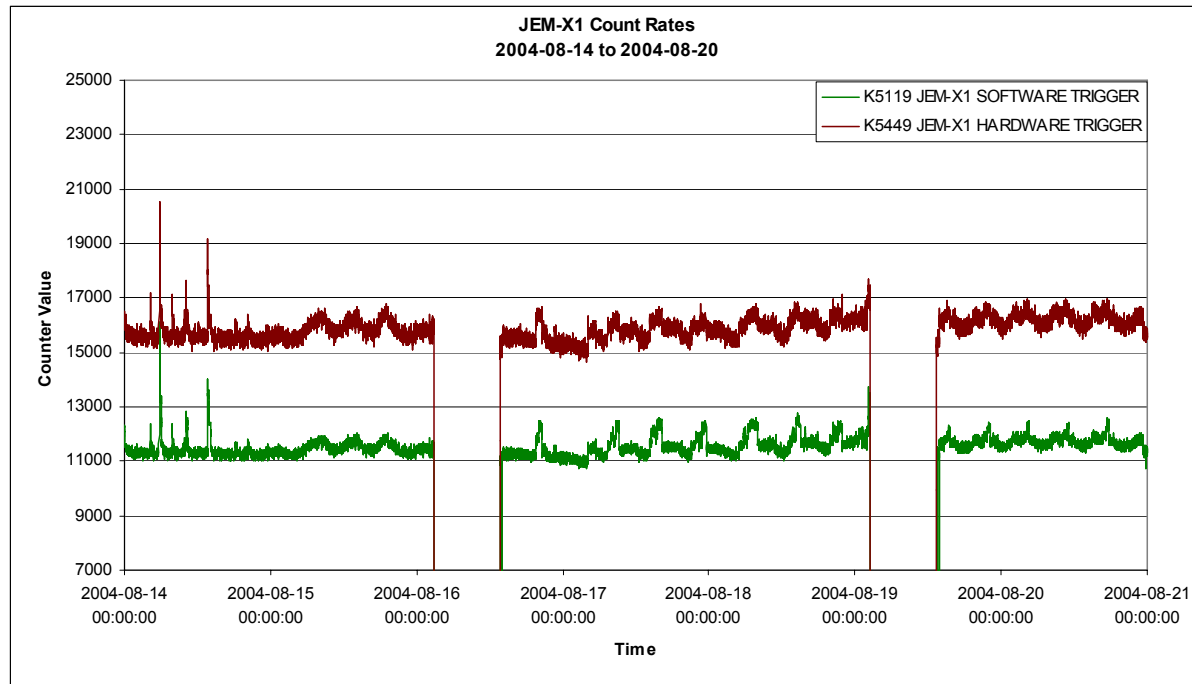
DoY 2004.233 (20/08/04)

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.

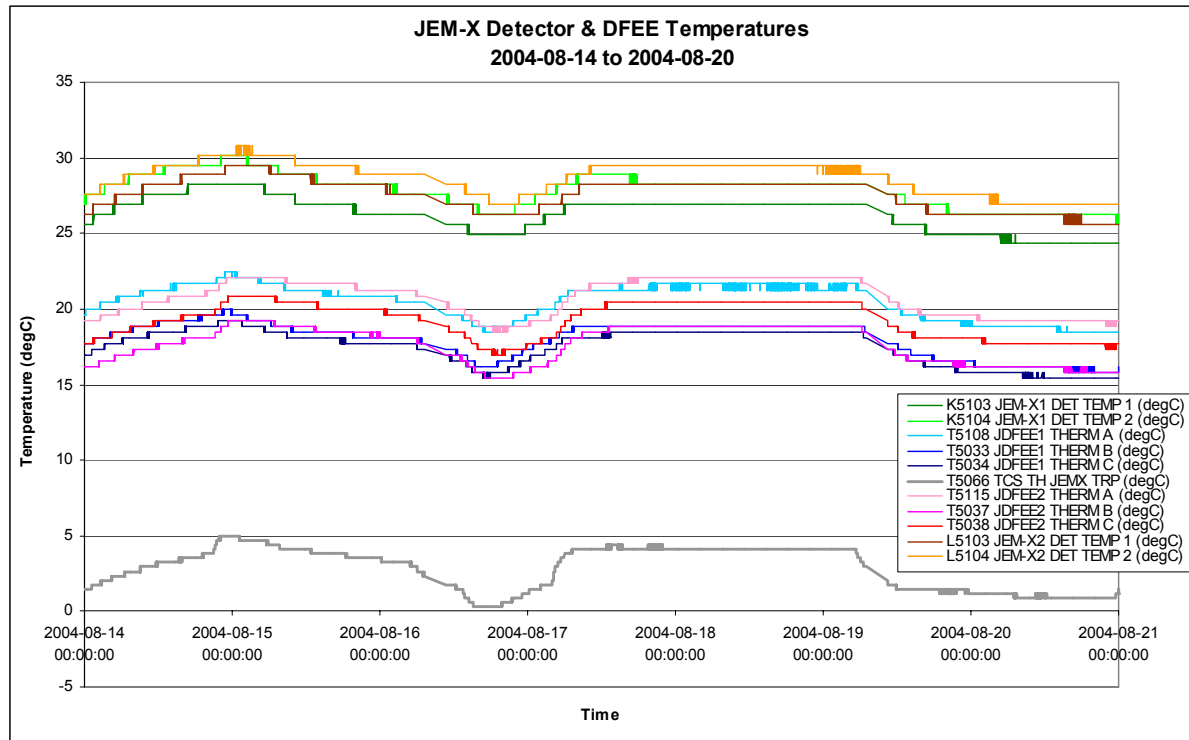


8.3.4.2 JEM-X Temperatures

The JEM-X1 and JEM-X2 detector temperatures over the reporting period are displayed in the following graph, along with the temperatures at a selection of DFEE locations and 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

2004-08-14 (DoY 227, Rev 224) to 2004-08-20 (DoY 233, Rev 226)

Nothing to report

8.3.5 OMC Operations

From DoY 229 at 23:55:35 to DoY 230 at 02:42:23, a Flat-Field calibration was performed. A Dark-Current calibration followed on starting at 02:46:30, and terminating at 03:19:02, during this time the PST for OMC was increased from 5 packets per cycle to 63 packets per cycle.

On DoY 231, at 10:45:27, then later at 17:11:10, and again on DoY 232, at 00:03:43, OMC was commanded directly by ISDC into TRIGGER mode.

There were 5 commands rejected during the week, all of them were attempts by ISDC to command OMC to TRIGGER mode:

```
2004.232.01.06.16.443 2004.232.01.06.04.833 1792 Real Time Rejection 131
REJECTED TC1
FIX2=0 M5010=8,TRIGGER M9079=3 M9080=131 M5001=61,IM B M9068=1 FIX2=0
M9069=488

2004.232.00.14.17.109 2004.232.00.14.08.831 1792 Real Time Rejection 131
REJECTED TC1
FIX2=0 M5010=8,TRIGGER M9079=3 M9080=131 M5001=61,IM B M9068=1 FIX2=0
M9069=487

2004.232.00.12.09.041 2004.232.00.11.56.831 1792 Real Time Rejection 131
REJECTED TC1
```

FIX2=0 M5010=8,TRIGGER M9079=3 M9080=131 M5001=61,IM B M9068=1 FIX2=0
M9069=486

2004.232.00.12.01.155 2004.232.00.11.53.581 1792 Real Time Rejection 131
REJECTED TC1

FIX2=0 M5010=8,TRIGGER M9079=3 M9080=131 M5001=61,IM B M9068=1 FIX2=0
M9069=485

2004.232.00.10.00.547 2004.232.00.09.52.206 1792 Real Time Rejection 131
REJECTED TC1

FIX2=0 M5010=8,TRIGGER M9079=3 M9080=131 M5001=61,IM B M9068=1 FIX2=0
M9069=484

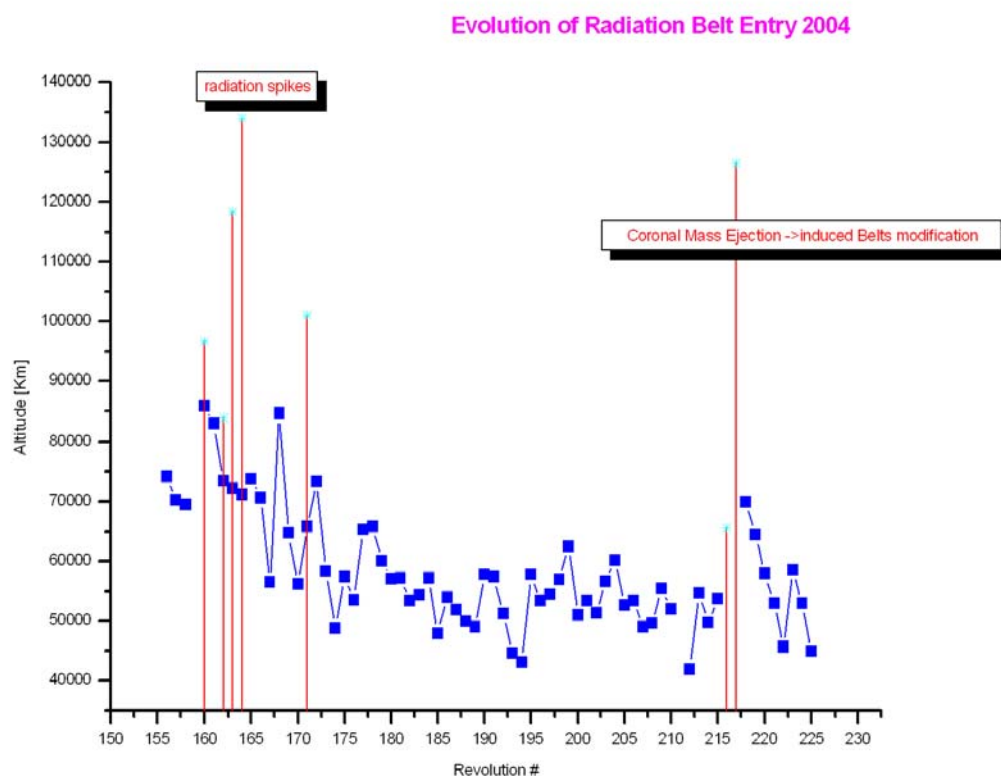
The reason for these rejections was in each case that OMC was already in TRIGGER mode at the time.

On DoY 232, at 22:45, due to a problem with the TCE at Redu, the Timeline had to be stopped. The impact was the loss of pointing 02260012

On DoY 229 at 04:07:57 and DoY 232 at 03:54:04, 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]
224	RAD ENTR R 2004-08-16T04:07:40Z	2004-08-16 05:00:34	52968.6	16-Aug-2004 04:55	53467
225	RAD EXIT R 2004-08-16T13:13:50Z	2004-08-16 11:50:02	26580.8	16-Aug-2004 11:55	27495
225	RAD ENTR R 2004-08-19T03:53:40Z	2004-08-19 05:40:35	44955.3	19-Aug-2004 04:37	54290
226	RAD EXIT R 2004-08-19T12:59:31Z	2004-08-19 11:27:47	24846.1	19-Aug-2004 11:47	28178

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

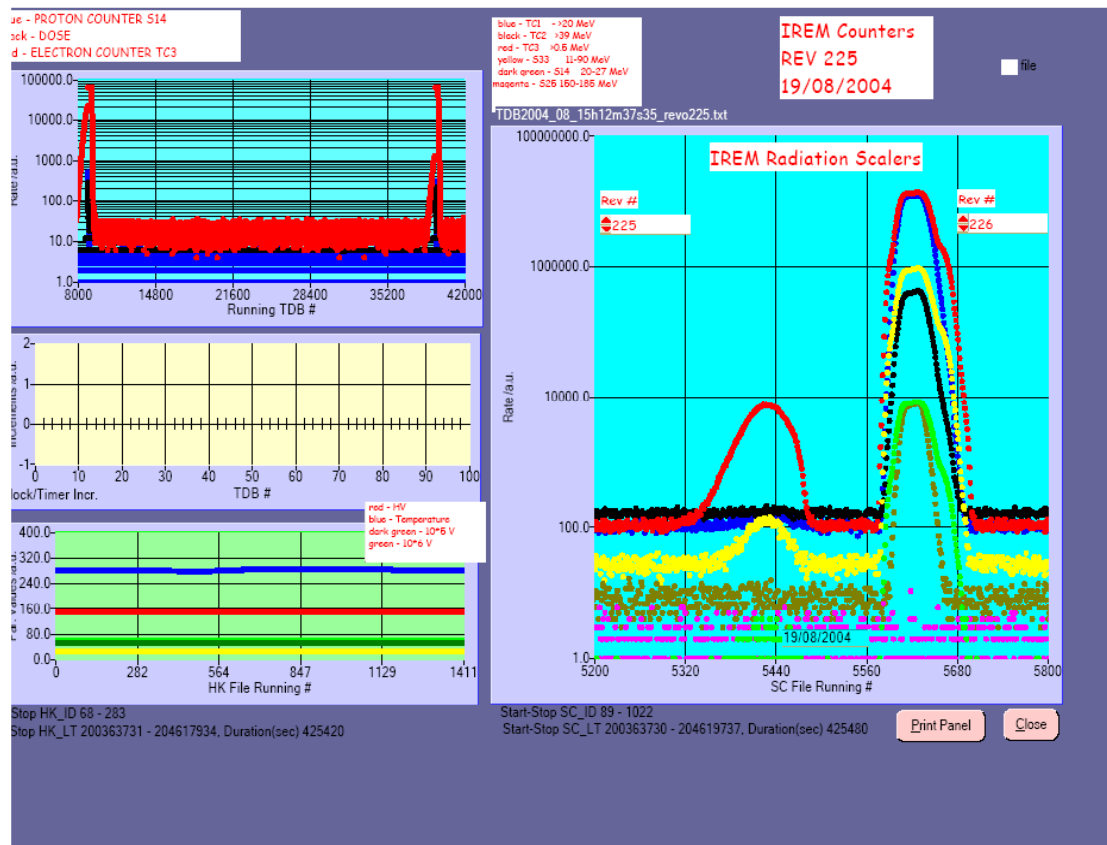
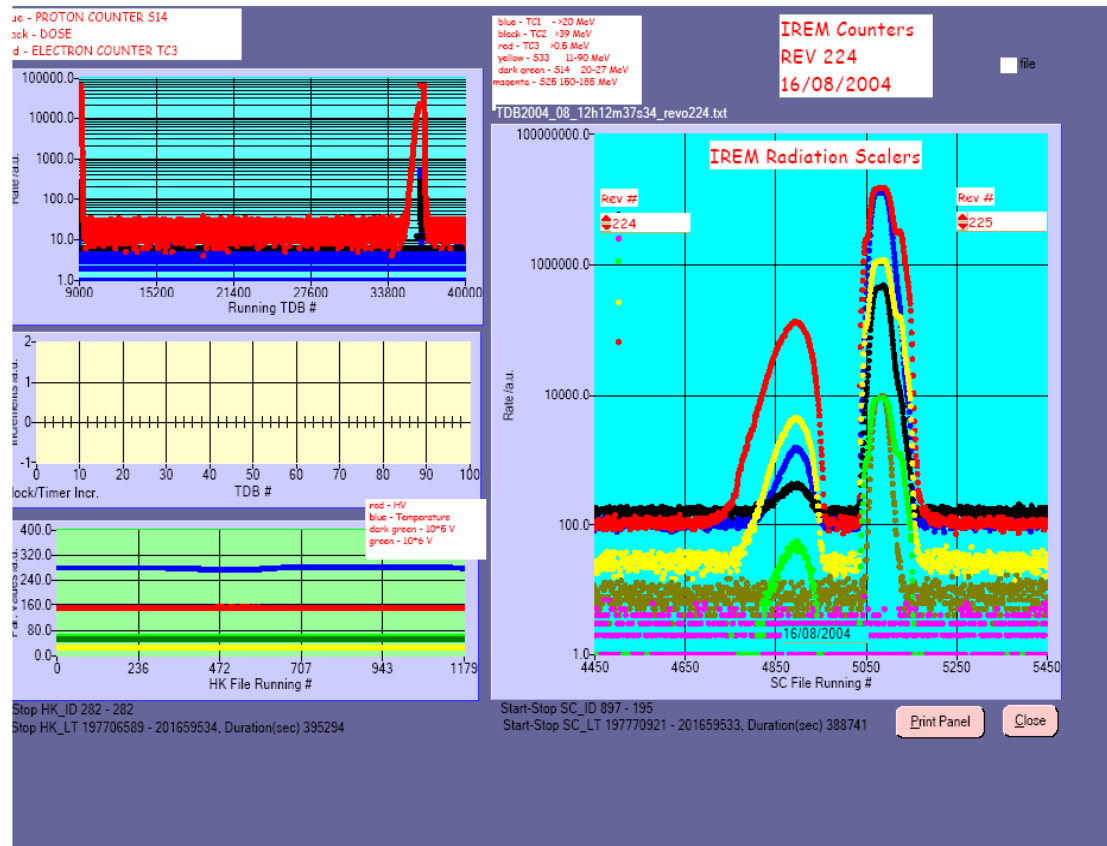
REV		Proton CUT-OFF Predicted Entry/Exit	ALT[Km] predicted
224	PROTON_RAD_ENTR	16-Aug-2004 10:15	12481
225	PROTON_RAD_EXIT	16-Aug-2004 10:35	14670
225	PROTON_RAD_ENTR	19-Aug-2004 10:07	12842
226	PROTON_RAD_EXIT	19-Aug-2004 10:27	15203

IREM daily report

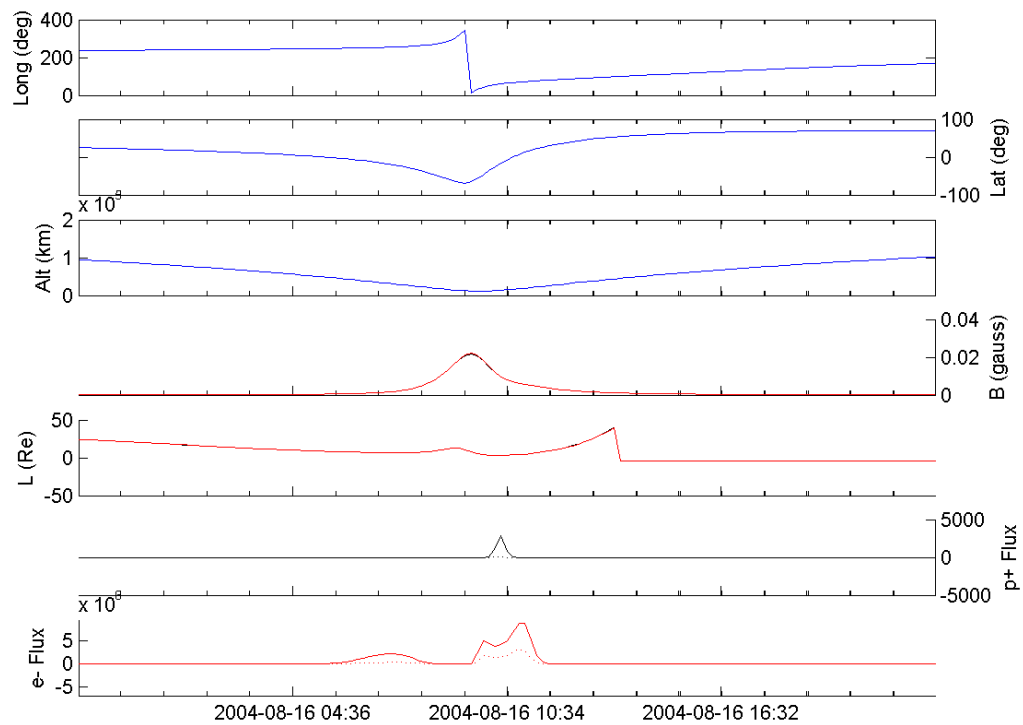
DoY 2004.232 (19/08/04)

At 06.28Z the IREM TC U4921 (Ground Link OFF) failed the CEV due to a late update of the relevant TM parameter in the CMD verifier task. No further action was taken after positive verification of the status OFF of the Ground Link (parameter U9903=OFF).

IREM radiation counters

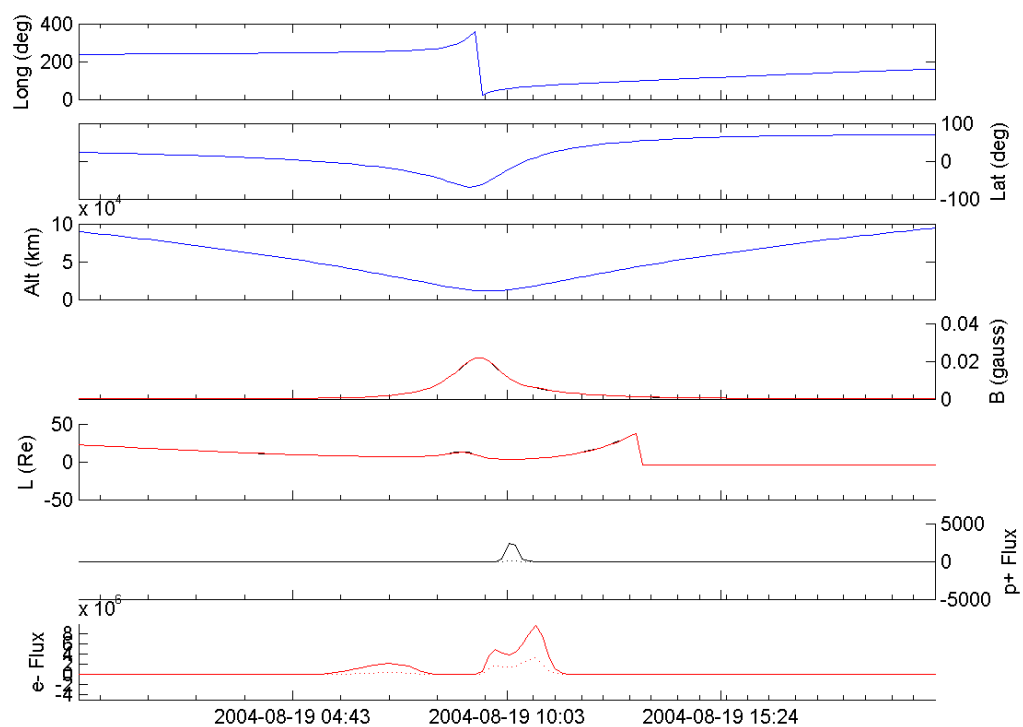


IREM Predicted Radiation Belt Passages. Rev 224



X: 0 Y: 0 [get Data](#) [Zoom](#) [Print...](#)

Rev 225



em_revo217.pn

15 KB F

SEC-GOES Observed Particles Fluxes.

