

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 271
Week 48
03.12.07
Routine Phase

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1 General

The Flight Control Team at MOC has compiled this report with some input provided by the Flight Dynamics Team, ISOC and ISDC.

It addresses the activities from 24.11.07 until 30.11.07 (both dates inclusive) and covers the revolutions 625 and 626..

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 two raster dithers of the North Ecliptic Pole (RA 18:00:00.00, DEC +66:33:39.0).

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.

One slew was missed from TL, during the observation period, due to a problem on VIL-2 station.

The fuel consumption over the period between 24/11/2007 and 30/11/2007 was 0.0969 Kg. The remaining propellant is in the order of 143.5315 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 has been 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

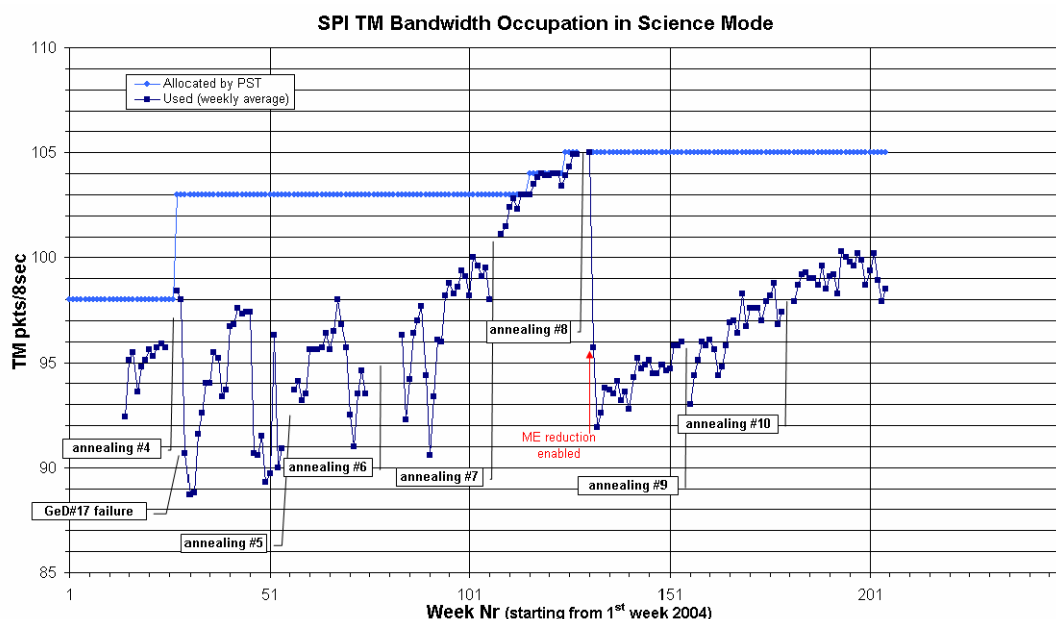
3.2.1 SPI

Following the 10th annealing, which ended on 17th June, the overall status of the gamma-ray spectrometer is nominal, except for the Ge detector #12 which is showing a slightly degraded energy resolution and is therefore operating at a lower HV setting of 3.5kV (instead of 4kV). Detector #2 is failed since 06.12.2003 and detector #17 since 17.07.2004.

The Stirling compressors are working nominally, maintaining the Germanium detectors at 80 +/-1K.

During science operations, the instrument was kept in photon-by-photon mode with spectra TM enabled. The assigned TM bandwidth in the science observation windows was 105 packets/cycle. The average telemetry occupation when the TM allocation was 105 packets/cycle was 98.5 packets/cycle.

The following plot shows the assigned and the average occupation of the SPI TM bandwidth.



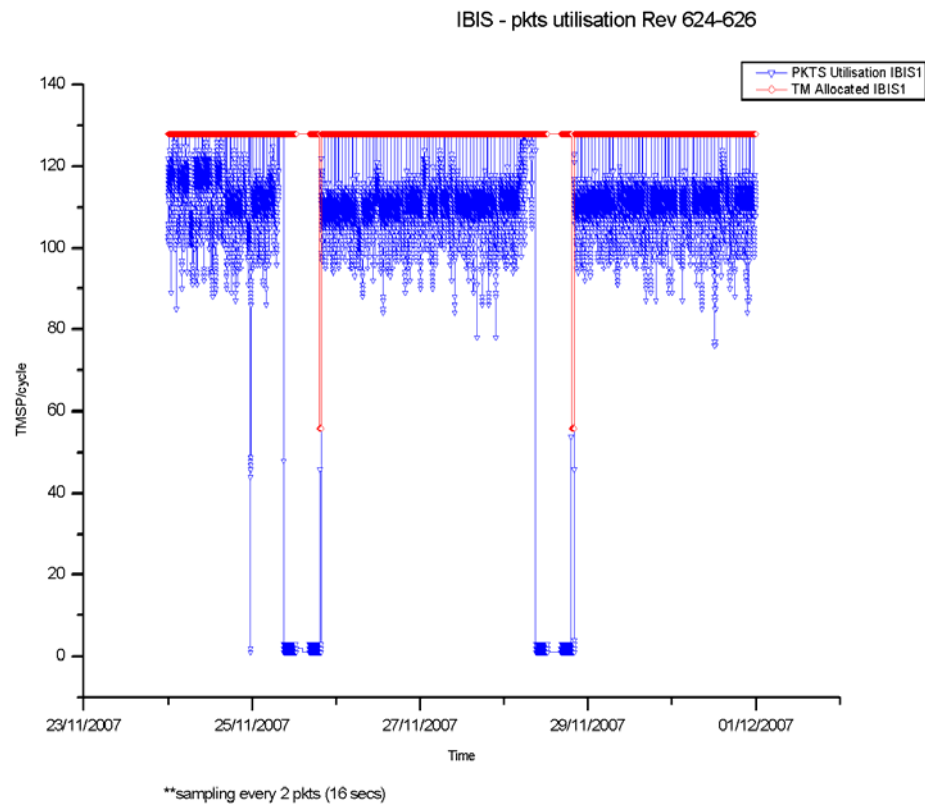
Note: Some more information concerning the SPI operations is provided in the Appendix.

3.2.2 IBIS

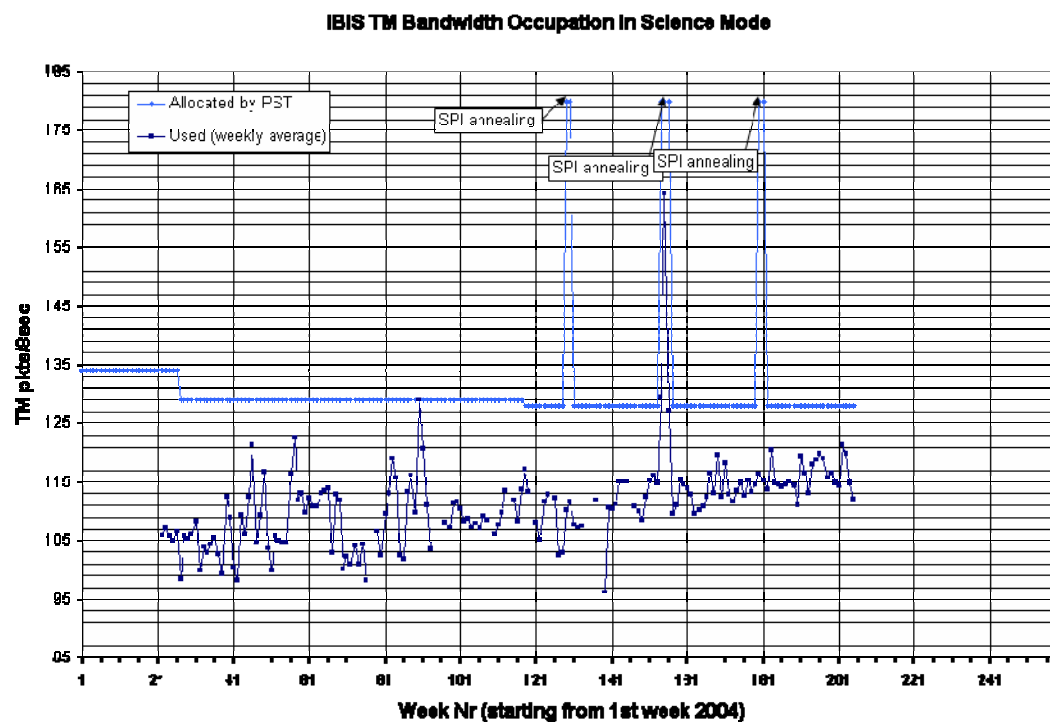
The overall status of the unit is nominal.

During the reporting period, the PST allocation to IBIS was 128 TMPS/cycle. The IBIS mean bandwidth utilisation during the observation period (when IBIS was in Science mode) was 112.04 TMPS/cycle, down 2.70 on last week.

A plot of the IBIS TM utilisation during the observation period is shown below:



A plot of the IBIS weekly bandwidth utilisation since 2004 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 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.

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.

During this reporting period, 134 of the 135 planned science pointings for OMC were executed nominally, 1 was lost.

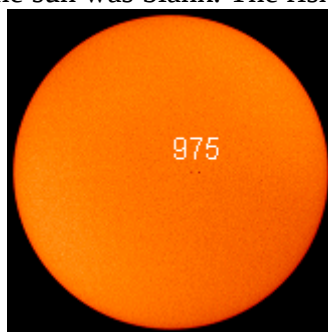
Note: Some more information concerning the OMC operations is provided in the Appendix.

3.2.5 IREM

The overall status of the unit is nominal.

Solar Activity

The observation period was characterised by low solar activity. For the first 3 days of the week, (24th, 25th, and 26th of November), there was a small sun-spot present (#975), the rest of the week, the sun was blank. The risk of solar flares was very low.



Reference: www.spaceweather.com

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

4 Ground Facilities

The Operational ground facilities performance was very good this week. One pointing was lost due to ground problems. The overall performance was well over the 95% requirement.

4.1 Mission Operations Centre

The performance of the MOC was good this week. There were two occasions of a lost link to the TM Cache, without impact. The overall performance was well over the 95% requirement.

4.2 Ground Stations & Network

The performance of the ground stations and Network was good this week. There were, however, 1 occasion of a TM drop from Redu, 2 from Vil2, 1 of which caused the loss of a pointing, 1 from DSS24 and 2 from DSS27. The overall performance was well over the 95% requirement.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

A new PSF has been received for revolution 633.

Revolutions 628-632 have been planned after the previously reported problem in setting up the Cygnus region Key Programme was resolved.

The TSFs for revolutions 628-630 have been received.

2. Observation status

ECS for Revolutions 614 & 615 have been received and processed.

3. ISOC Science Data Archive

A status meeting with the Computer Support Group has taken place in which the future Archive Scientist, Marion Cadolle Bel took part for the first time.

4. ISOC system

V 16.1 was formally released on 29 Nov. Work is ongoing for version 16.2 to be released still in December.

5. Problems

None.

4.3.2 ISDC

Status of ISDC observation processing on 03/12/2007:

- Latest Standard Analysis completed: observation 05200710006 (Galactic disk, Revolution 611) on 03/12/2007.

- Latest products archived: observation 05200290002 (SS433, Revolution 612-613) on 27/11/2007.

- Latest observation products sent to the observer: observation 05200010017 (Galactic Bulge region, Revolution 611) on 26/11/2007.

5 Special Events

6 Anomalies

The following problem was reported that impacted operations:

- On DoY 330, at 10:29, a TM data drop from VIL2 caused the loss of pointing 06250016.

There were no new anomaly reports were entered into the ARTS system this week.

7 Future Milestones

The following activities are foreseen in the next few weeks.

- A thruster calibration is foreseen to be performed on the 5th December, during revolution 628..

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 625

The observations in revolution 625 consisted entirely of a raster dither of the North Ecliptic Pole (RA 18:00:00.00, DEC +66:33:39.0), lasting ~55.1 hours.

Revolution 626

The observations in revolution 626 consisted entirely of a raster dither of the North Ecliptic Pole (RA 18:00:00.00, DEC +66:33:39.0), lasting ~55.1 hours.

Throughout these observations, all instruments were in their nominal science modes, except JEM-X2, which is switched off. The TM allocation was IBIS 128; SPI 105; JEM-X1 8; JEM-X2 0; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

2007-11-09T22:45:52.000Z	143.8097	F	Automatic TM processing.
2007-11-10T18:17:54.000Z	143.7986	F	Automatic TM processing.
2007-11-12T03:30:06.000Z	143.7714	F	Automatic TM processing.
2007-11-13T17:52:50.000Z	143.7629	F	Automatic TM processing.
2007-11-15T03:41:58.000Z	143.7418	F	Automatic TM processing.
2007-11-16T17:41:14.000Z	143.7260	F	Automatic TM processing.
2007-11-18T03:20:37.000Z	143.7039	F	Automatic TM processing.
2007-11-19T17:38:49.000Z	143.6869	F	Automatic TM processing.
2007-11-20T02:44:42.000Z	143.6575	F	Automatic TM processing.
2007-11-22T17:28:02.000Z	143.6284	F	Automatic TM processing.
2007-11-24T02:35:18.000Z	143.6118	F	Automatic TM processing.
2007-11-25T17:02:42.000Z	143.5963	F	Automatic TM processing.
2007-11-27T02:20:37.000Z	143.5719	F	Automatic TM processing.
2007-11-28T17:01:14.000Z	143.5549	F	Automatic TM processing.
2007-11-30T02:19:09.000Z	143.5315	F	Automatic TM processing.

This report was generated Fri Nov 30 08:00:22 GMT 2007

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, 24/11/2007 – 30/11/2007

The AOCS operations were executed from the Automatic Timeline.

During this period, 72 Open Loop Slews, 70 Closed Loop Slews and 5 Momentum Biases were executed.

1 slew (CSL) was missed from TL, during the observation period, due to a problem with TM links on VIL-2 station

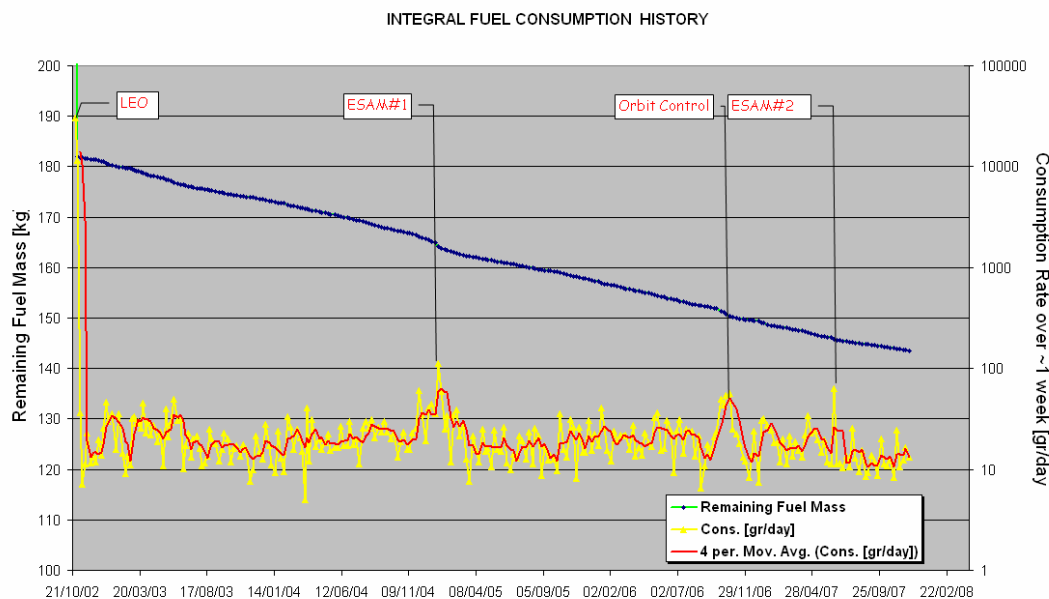
This is equivalent to $\sim 0.7\%$ of the total number of slews planned (142).

Orbit Control

No update.

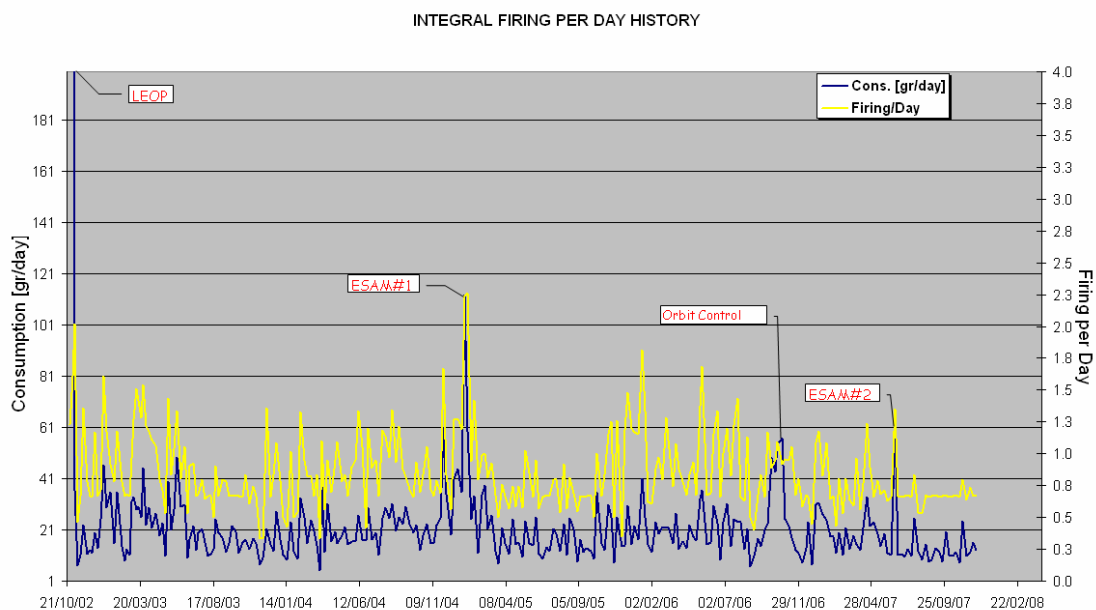
Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 30/11/2007 is reported in the plot below.



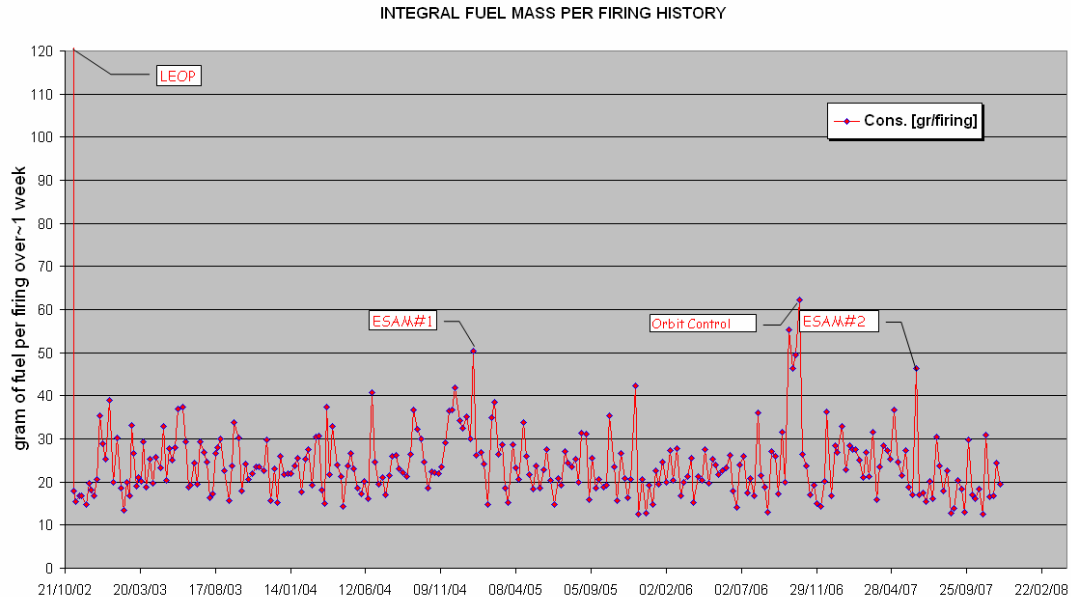
The plot above consider the ESAM fuel consumption spread over period of ~ 1 week.

The firing per day over the period between 01/11/2002 and 30/11/2007 is reported in the plot below.



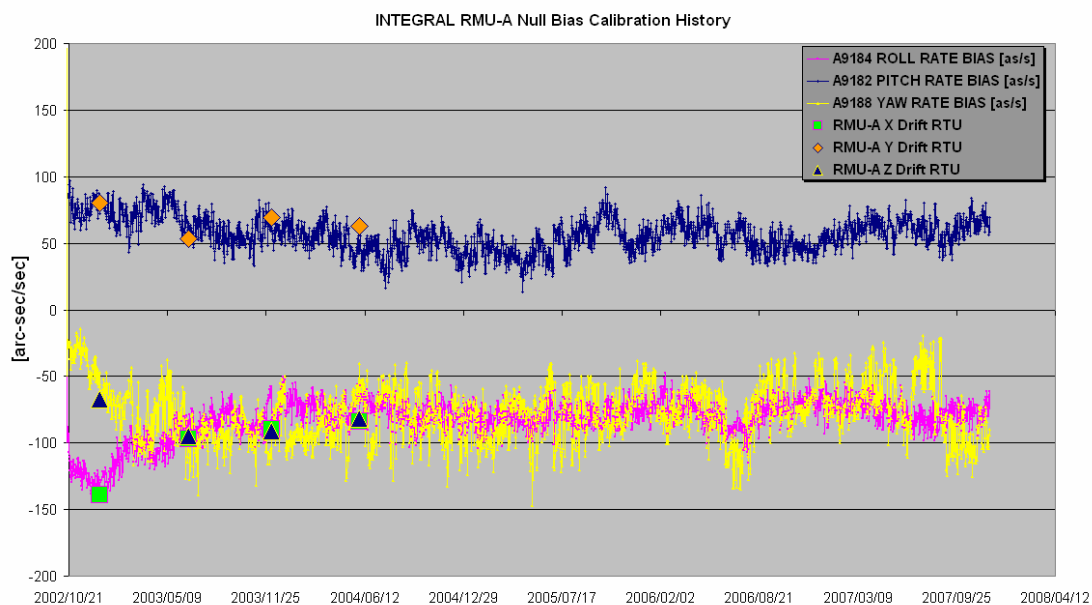
The plot above consider the ESAM fuel consumption spread over period of ~1 week.

The fuel per firing over the period between 01/11/2002 and 30/11/2007 is reported in the plot below.



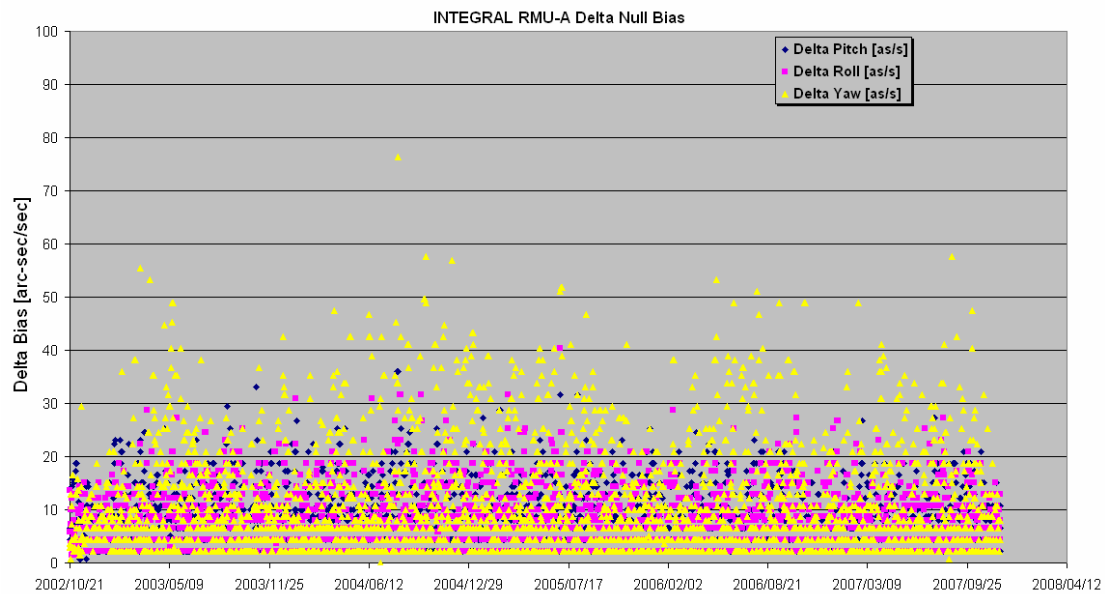
The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 30/11/2007 is reported in the plot below.



The evolution of the drift on yaw channel is under constant monitoring.

The RMU-A delta null bias calibration history, on pitch, roll and yaw channel over period between 01/11/2002 and 30/11/2007 is reported in the plot below.



24/11/2007 (Day of Year 328, Revolution 624)

Nothing to report.

25/11/2007 (Day of Year 329, Revolution 624)

Nothing to report.

26/11/2007 (Day of Year 330, Revolution 624-625)

Loss of TM links at VIL-2 station: at 10:29z the slew 06250016 failed release due to a problem on VC0 and VC7 TM link at VILSPA-2 station. After station handover from VIL-2 to REDU at 10:49z, the TM link was established again and a manual recovery performed from the attitude of PID 06250015 to the attitude of PID 06250016.

The next slew 06250017 was manually updated in TL at 11:26z.

The following slew was missed in TL: 06250016(CSL).

27/11/2007 (Day of Year 331, Revolution 625)

Nothing to report.

28/11/2007 (Day of Year 332, Revolution 625)

Nothing to report.

29/11/2007 (Day of Year 333, Revolution 625-626)

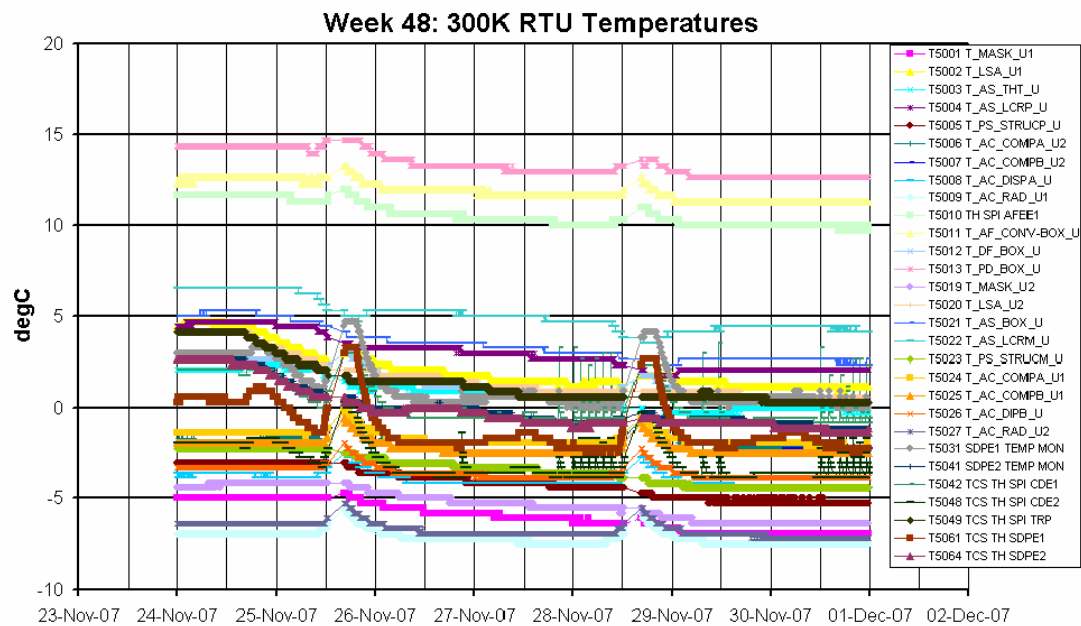
Nothing to report.

30/11/2007 (Day of Year 334, Revolution 626)

Nothing to report.

8.3.2 SPI Operations

Unit Temperatures: All the equipment temperatures are inside the operational limits. The following plot shows their evolution during the reporting period.

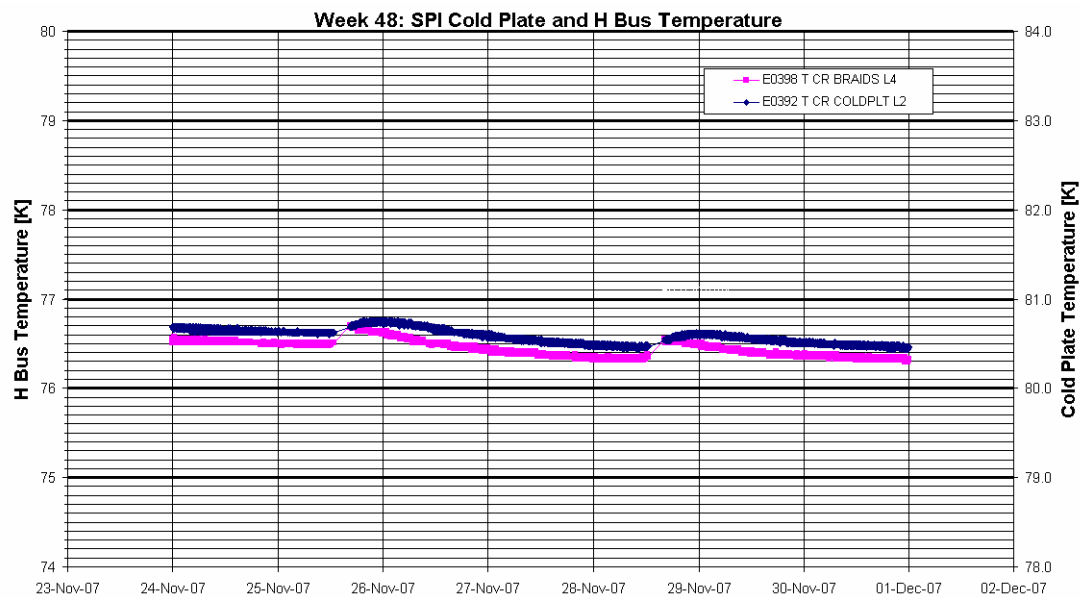


Stirling Compressors and Cryostat: The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K.

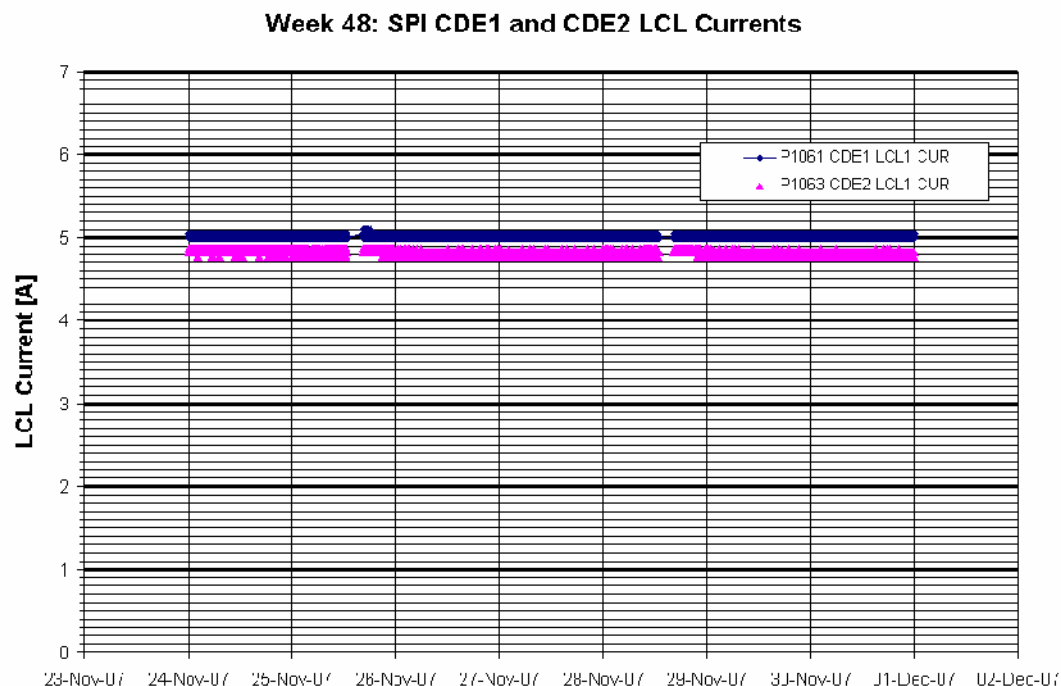
The stroke of all four compressors was set to 41 throughout the week. The average CDE LCL currents over the week were as follows:

- CDE1 LCL Current = 5.02A
- CDE2 LCL Current = 4.81A

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

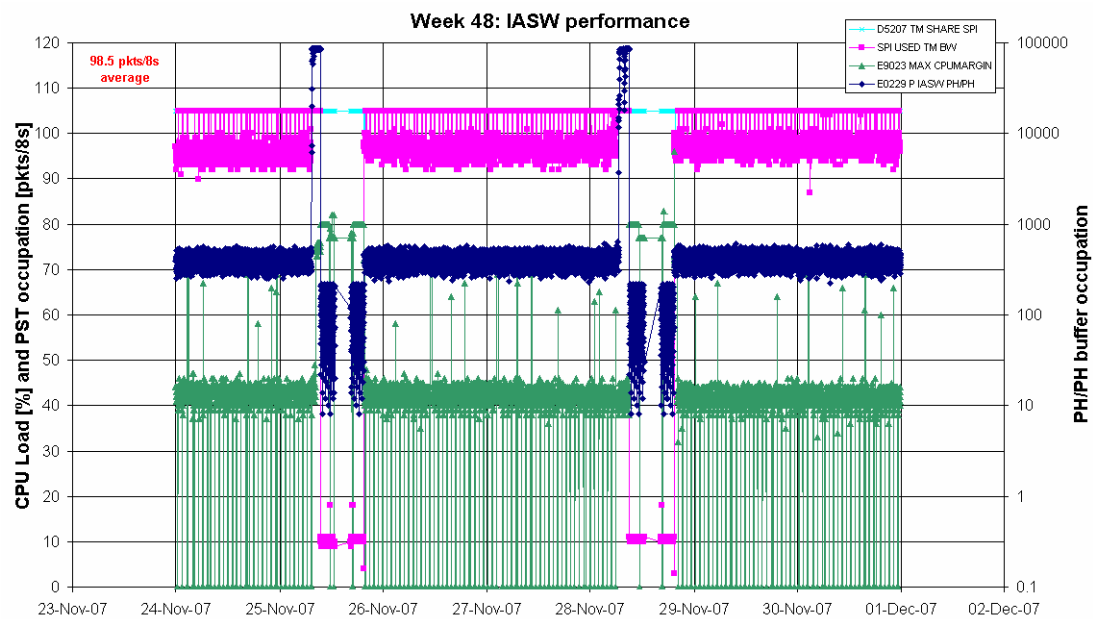


The following plot shows the evolution of the CDE currents during the reporting period.



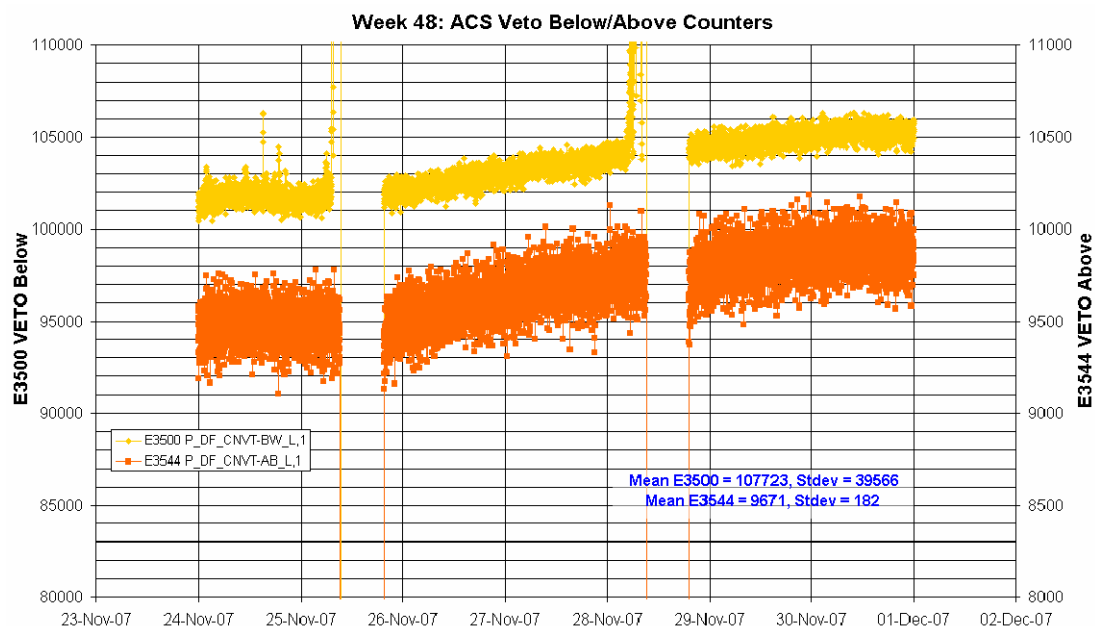
DPE & IASW: The DPE health and IASW performance is nominal. The IASW version installed is v433 patch #1 with the spectra scaling factor set to 8/19 SE. The average TM bandwidth occupation of SPI was 98.5 packets/cycle over the science window, when the TM allocation was 105 packets/cycle.

The following plot 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, except for FEE #81 which remains switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is still OFF due to the anomaly on 5/8/2003 (INT_SC-61).

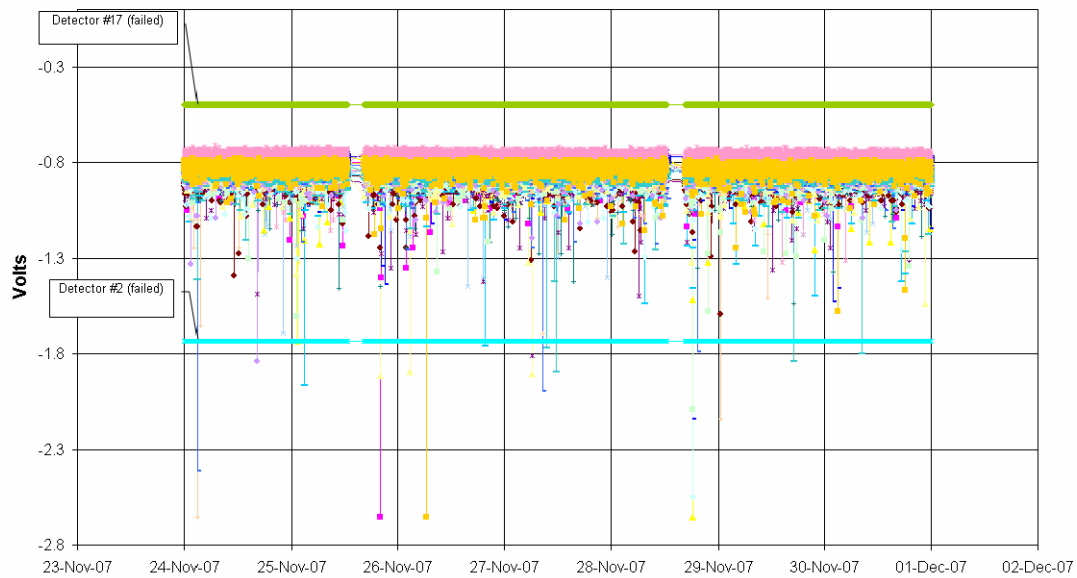
The following plot shows the ACS overall count rate evolution during the reporting period:



AFEE: The health of the AFEE is nominal. The performance of the AFEE and the detectors is nominal, except for the Ge detector #12 which is showing a slightly degraded energy resolution and is therefore operated at a lower HV setting of 3.5kV (instead of 4kV).

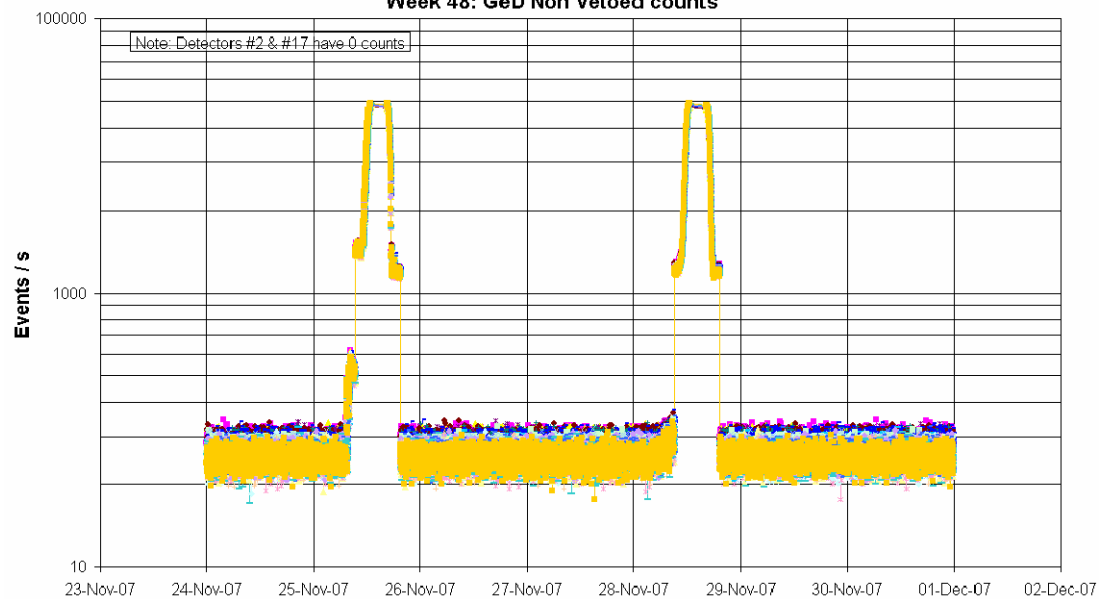
The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06.12.2003 and detector #17 is failed since 17.07.2004.

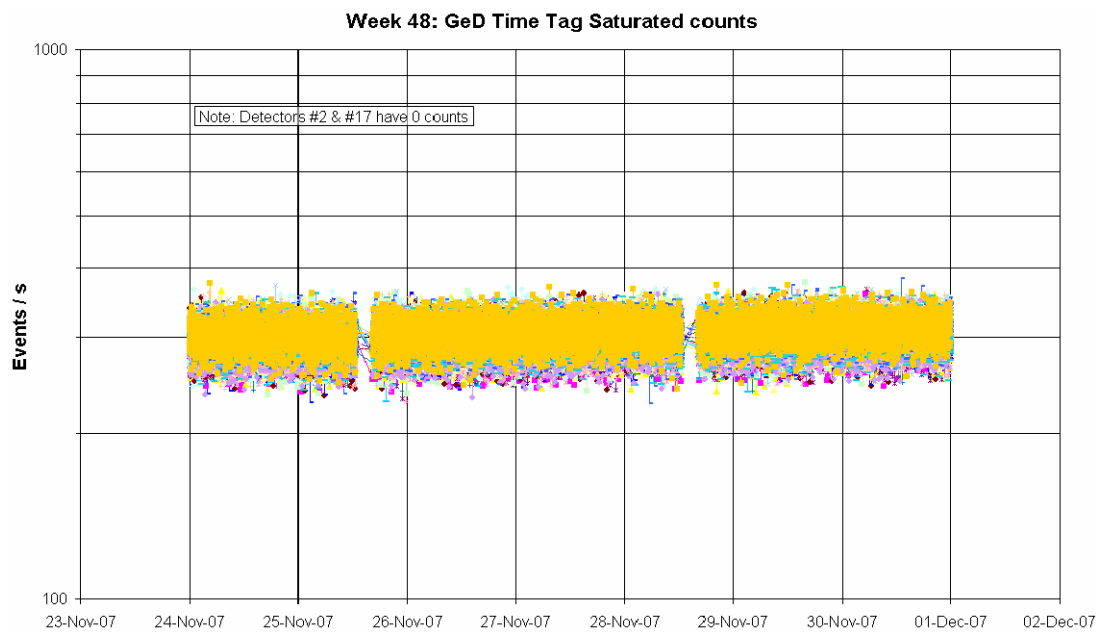
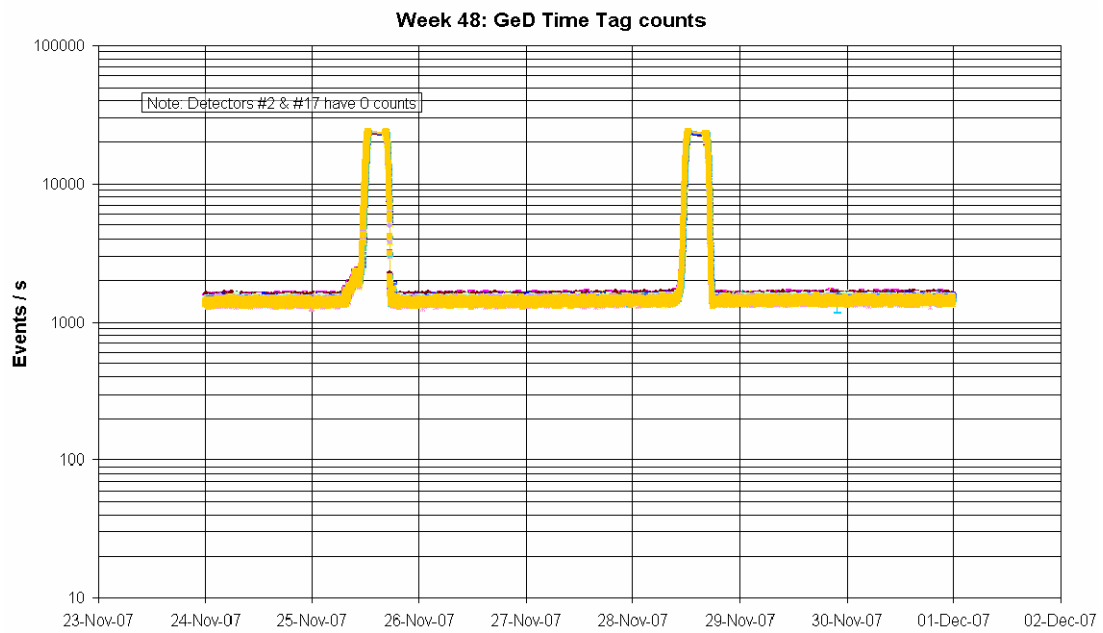
Week 48: AFEE DC output Voltages



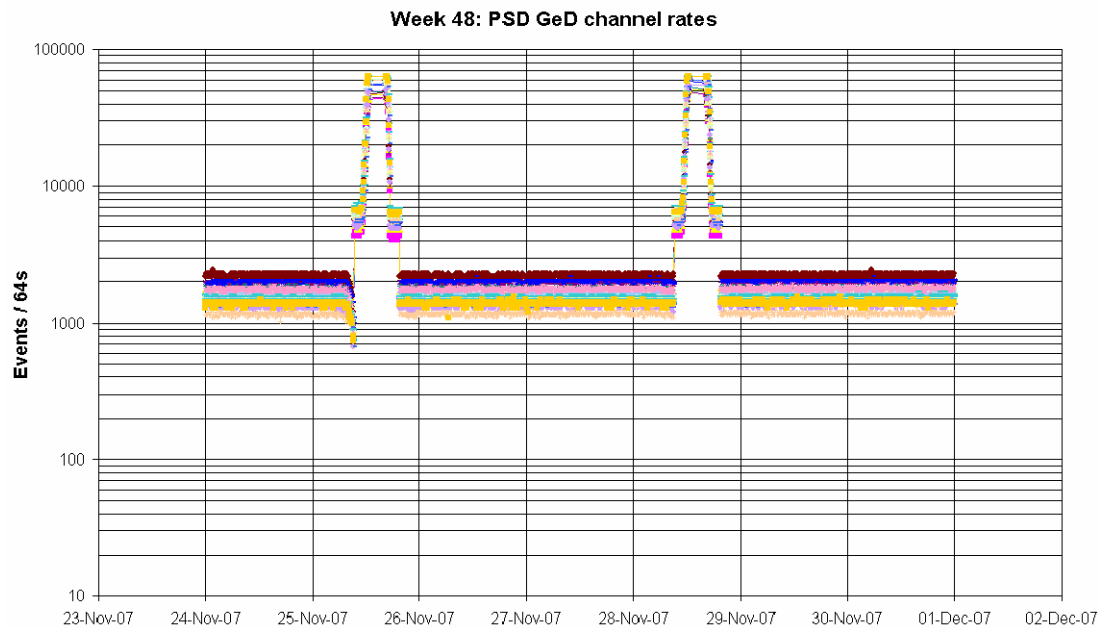
DFEE: The performance of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event Count Rates during the reporting period.

Week 48: GeD Non Vetoed counts





PSD: The health of the unit is nominal. The following plot shows the PSD channel rates during the reporting period.



Event Log:

The following non-nominal events occurred on SPI during the reporting period:

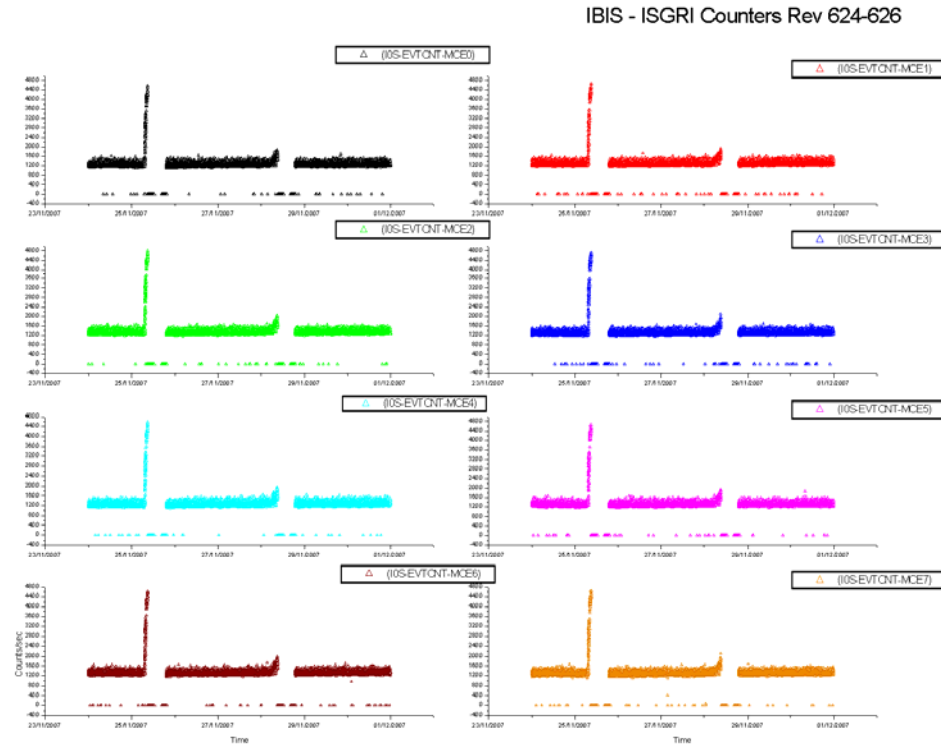
- 6 occurrences of OEM APID 1024 ID 243 EXCEPTION SPI1 SPECTRA BUILDING NOT COMPLETED were received during the week. As they were all single occurrences, no action was taken.
- Due to high background radiation conditions before the expected radiation belt entry of revolution 624, on 2007-11-25 at 07:23:23Z TM parameter E3500 went OOL High, fluctuating OOL until radiation belt entry, at 09:23:20Z.
- On 2007-11-25 between 08:52:34Z and 09:22:49Z (radiation belt entry of revolution 624) several occurrences of OEM APID 1024 ID 229 EXCEPTION SPI1 PARTIAL FLAG OVERFLOW were received, one every few minutes. These OEMs indicate that the DFEE was not able to transfer all its data within the 125ms cycle. This was due to the high background radiation conditions at the time, causing an increase in the count rates. As these OEMs stopped of their own accord at radiation belt entry, no action was taken.
- On 2007-11-25 at 09:26:04Z TM parameters E3981-E3984; E3986; E3988; E3991-E3992 and E3995-E3996 all went OOL with value = 0. These are the Coldbox temperatures; DFEE and PSD box temperatures; VCU temperature; Heat pipe temperatures and the AFEE power supply board temperature and are all in SPID 60602. This was shortly after radiation belt entry of revolution 624. The parameters returned within limits when the next packet was received at 09:28:56Z. This is covered by Anomaly Report INT_SC-205.
- On 2007-11-25 at 16:48:25Z OEM APID 1024 ID 1 EXCEPTION SPI1 FIXED POINT OVERFLOW was received. This was during the AOS_CHK window of revolution 625, when the time verification TC was sent. This OEM is sometimes received when this TC is sent and no action was taken.
- On 2007-11-27 between 16:44:10Z and 16:52:39Z a dump of the DPE/DFEE interface buffer was performed as requested by the SPI PI. This had no impact on ongoing operations.

- Due to high background radiation conditions before the expected radiation belt entry of revolution 625, on 2007-11-28 at 06:38:03Z TM parameter E3500 went OOL High, fluctuating OOL until radiation belt entry, at 09:10:01Z.

8.3.3 IBIS Operations

IBIS Event Counters Plots

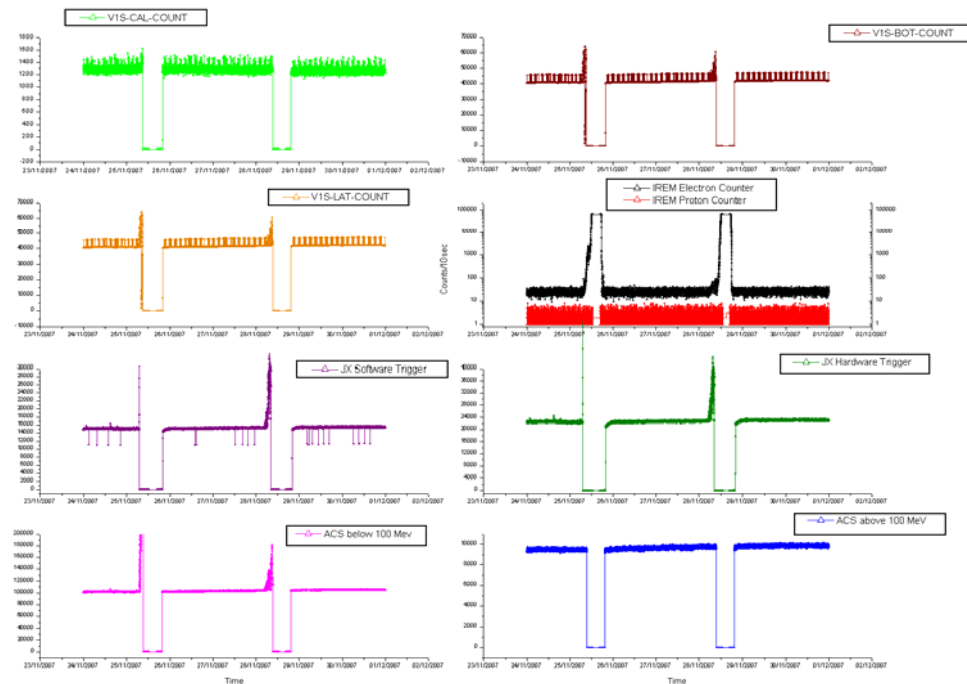
ISGRI Counters:



**sampling every 4 pkts (32 secs)

VETO vs Payloads Counters:

IBIS-VETO vs Payloads Counters Rev 624-626

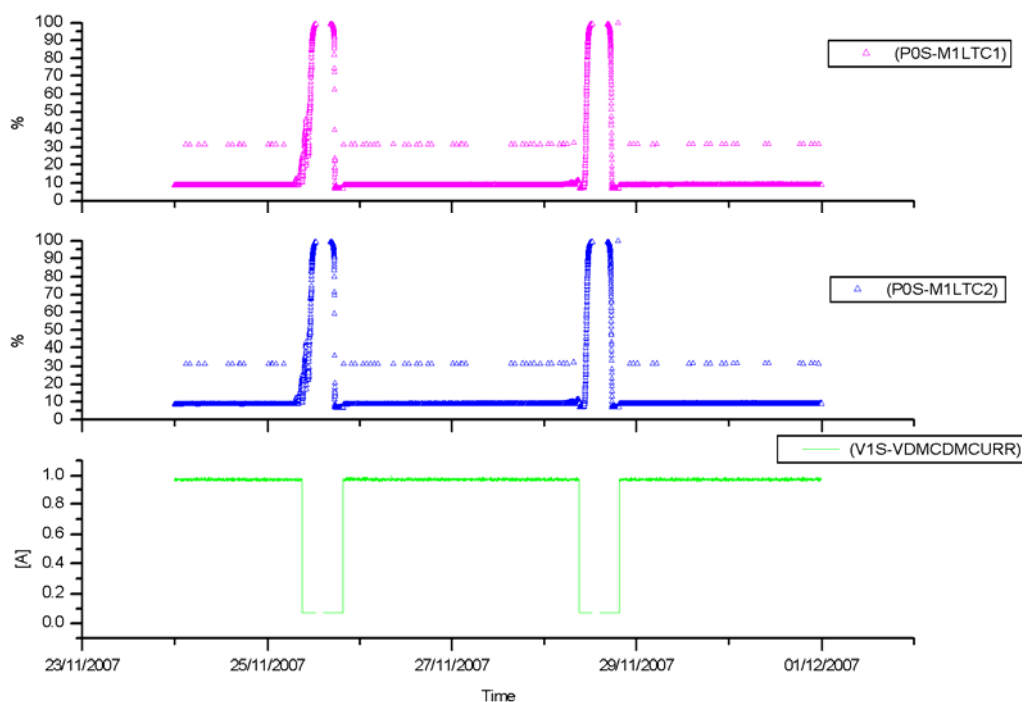


**with the exception of IREM counters (counts/10sec), all the plots are reporting counts/sec sampling every 5 pkts (40 sec)

The week was characterised by high radiation before the expected radiation belt entry of revolutions 624 and 625 as reported by the payload.

VETO Current:

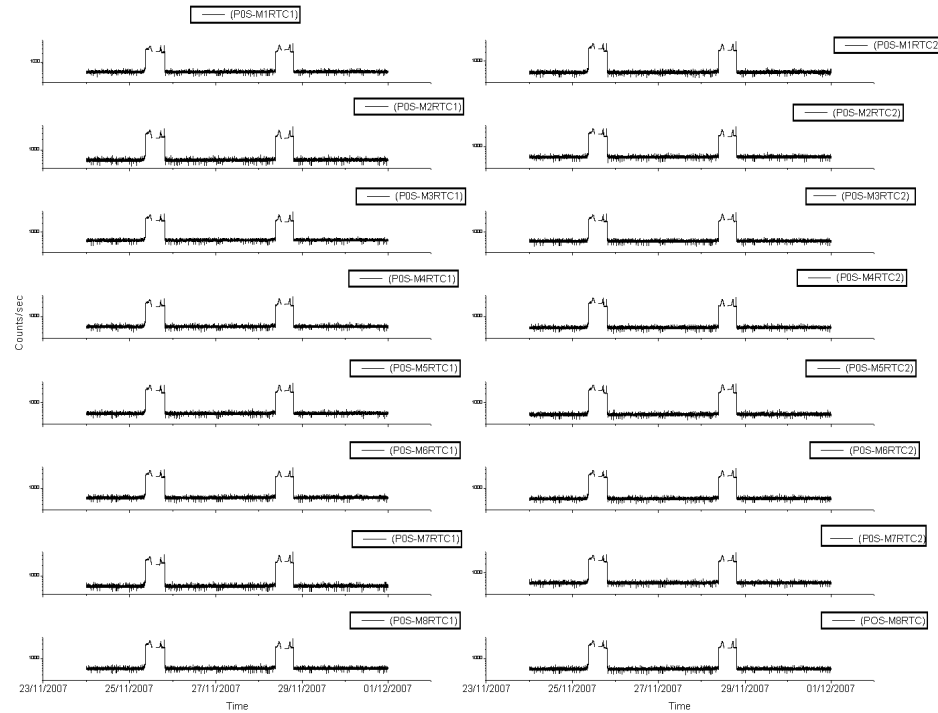
IBIS-VETO Current & PICsIT dead times Rev 624-626



**sampling every 4 pkts (32 secs)

PICsIT Counters:

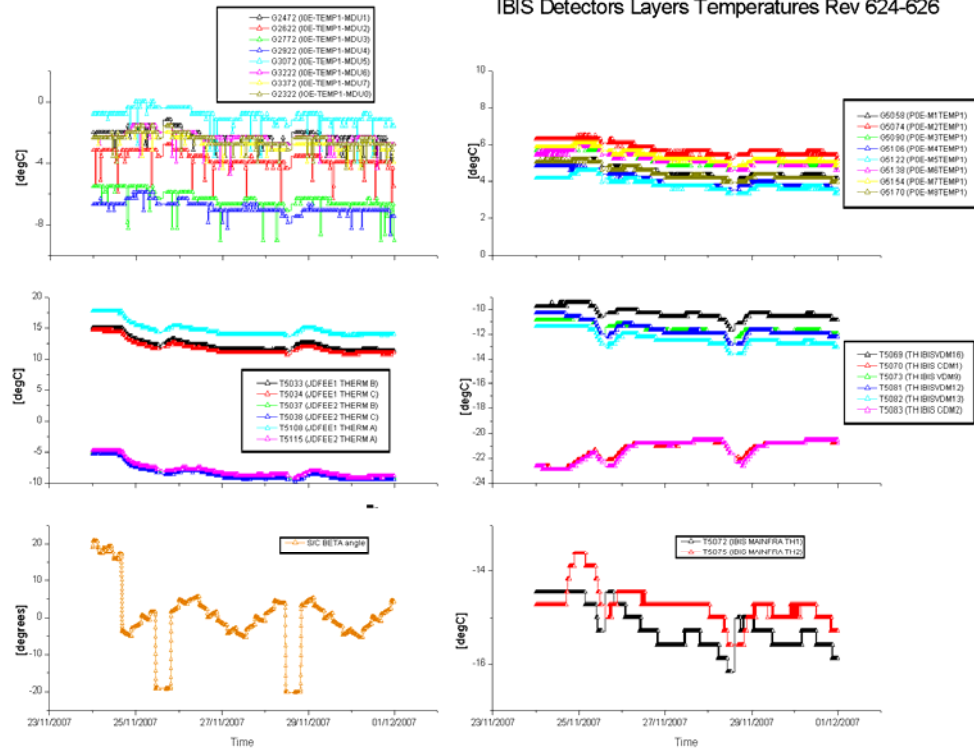
IBIS - PICsIT Counters Rev 624-626



**sampling every 4 pkts (32 secs)

IBIS Detectors Layers Temperatures:

IBIS Detectors Layers Temperatures Rev 624-626



**sampling every 8 pkts (64 secs)

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.

In addition, throughout the week, TM parameter G8080 went OOL Warning High several times. This is the Valid event rate on HBRA. As at each occurrence it remained OOL for only 1 TM cycle, no action was taken. This indicates an overflow in the counters and affects only the quality of the scientific data but not the safety of the instrument.

2007-11-24 (DOY 328, Rev 624)

At 23:18Z, following a ground station handover, TM parameter X7500 went OOL, indicating a problem with the histogram process. The following recovery procedure was then executed to force the histogram accumulation and download process to resume:

- 23:34:07Z FCP_IBIS1_0312
- 23:39:47Z TC G0129 uplinked to return IBIS to Science Standard mode.

IBIS operations continued nominally.

2007-11-25 (DOY 329, Rev 624-625)

Due to the high background radiation, at 07:22:38Z, ~2 hours before radiation belt entry of revolution 624, TM parameters G6062 and G6063 started toggling OOL High. These are the VETO bottom and lateral counters respectively. In addition, starting at 07:28:54Z the G2013 family (Number of events triggering the MCEi per second) also started toggling OOL High. IBIS then made an autonomous transition to Safe mode at 09:05:38Z, about 20 minutes earlier than planned in the Broadcast Packet.

During the radiation belt passage at the end of revolution 624, at 10:22:03Z and again at 10:46:35Z, TM parameter G5079 went OOL Soft High (value = 2.60509804V). This is the PDM2 +2.5V. As in each case it returned within limits at the next TM cycle, no action was taken.

2007-11-26 (DOY 330, Rev 625) to 2007-11-27 (DOY 331, Rev 625)

IBIS operations executed nominally.

2007-11-28 (DOY 332, Rev 625-626)

At 08:20:06Z, ~50 minutes before the expected radiation belt entry of revolution 625, TM parameters G6062 and G6063 started toggling OOL High. These are the VETO bottom and lateral counters respectively. This was due to high background radiation conditions and these parameters continued to toggle OOL until radiation belt entry.

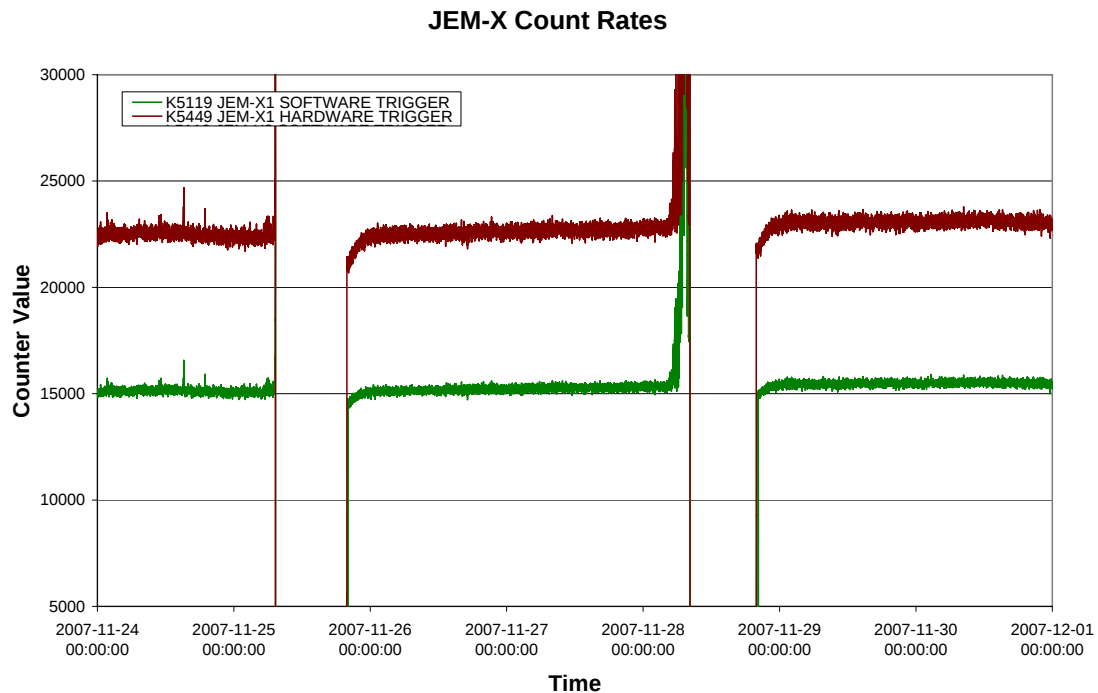
2007-11-29 (DOY 333, Rev 626) to 2007-11-30 (DOY 334, Rev 626)

IBIS operations executed nominally.

8.3.4 JEM-X Operations

JEM-X Count Rates

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

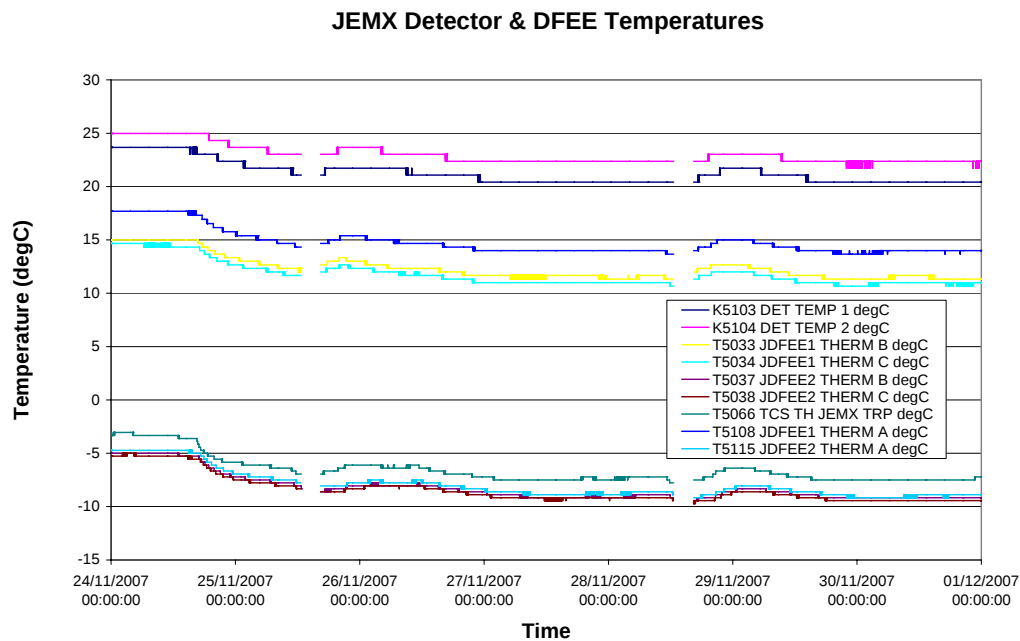


JEM-X Temperatures

JEM-X Detector and DFEE temperatures, along with the temperature on the detector bench between the two units, over the reporting period are displayed in the following graph².

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)



JEM-X Daily Report

2007-11-24 (DoY 328, Rev 624)

JEM-X1 operations executed nominally

2007-11-25 (DoY 329, Rev 624-625)

At 07:17:14, 07:17:46, 07:18:18 and again at 07:19:30, K5449 exceeded its soft limits, and at 07:17:46, K5136, and at 07:19:36 K9104 exceeded their soft limits, no action was taken, and there was no impact. At 07:17:55 K5449 exceeded its hard limit, then at 07:19:38, K5119 exceeded its hard limit, which caused JEMX-1 to switch to SAFE mode.

At 08:28:38, when the KESAFE ED was scheduled, the commands were then rejected, as the unit was already in SAFE.

2007-11-26 (DoY 330, Rev 625) to 2007-11-27 (DoY 331, Rev 625)

JEM-X1 operations executed nominally

2007-11-28 (DoY 332, Rev 625-626)

From 05:47:14 to 08:04:34, in the run-up to the belt entry, there were repeated warnings about parameter K5449 being out of soft limit. No action was taken and there was no impact.

2007-11-29 (DoY 333, Rev 626)

On this day, the following group of anomalous OEMs were received, at the indicated times:

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```

2007.333.11.12.45.883 2007.333.11.12.49.057 1536 RealTime 5 EXCEPTION
JEM-X1 EXC IACS INTERF EXID 0 0 65535 PR N
E E
  FIX6 0
  K9079 MESS CLASS 1
  K9080 MESS ID 5
  K9065 CSSW OPERAT ID START
  K9066 TASK ID 8 IASW
  K9067 LOGICAL ADDRESS 4989
2007.333.11.12.45.883 2007.333.11.12.49.092 1536 RealTime 5 EXCEPTION
JEM-X1 EXC IACS INTERF CULP 0 0 65535 PR N
E E
  FIX6 0
  K9079 MESS CLASS 1
  K9080 MESS ID 6
  K9065 CSSW OPERAT ID START
  K9066 TASK ID 8 IASW
  K9067 LOGICAL ADDRESS 19726

```

No action was taken and the messages did not reappear. There was no impact.

2007-11-30 (DoY 334, Rev 626)

JEM-X1 operations executed nominally

8.3.5 OMC Operations

2007-11-24 (DoY 328, Rev 624) to 2007-11-25 (DoY 329, Rev 624-625)

Nothing to Report.

2007-11-26 (DoY 330, Rev 625)

At 10:29, a drop in TM caused the slew commands to fail. A recovery was subsequently performed, and the Timeline rejoined at 11:28. The impact was the loss of pointing 06250016. It was at this time the following OEMs were received:

```

2007.330.10.43.30.970 2007.330.10.43.39.745 1792 RealTime 131 TC REJECT
REJECTED TC1 0 0 65535 PR N
E E
2007.330.10.43.36.970 2007.330.10.43.50.002 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 that pointing.

2007-11-27 (DoY 331, Rev 625) to 2007-11-30 (DoY 334, Rev 626)

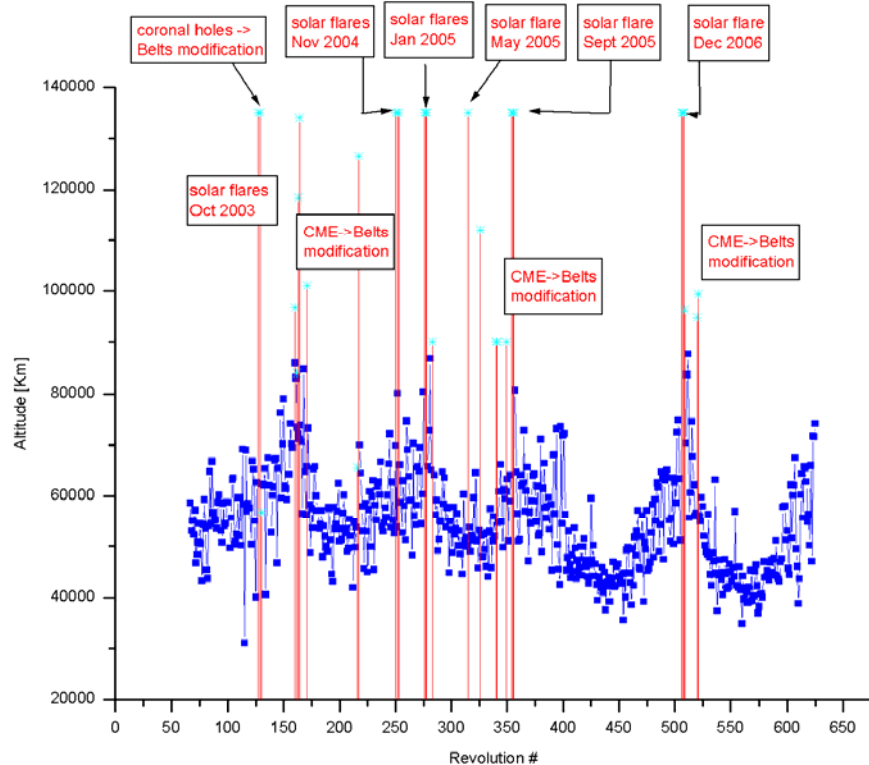
Nothing to Report.

On DoY 329 at 09:23:21 and DoY 332 at 09:10:09 OMC went to SAFE mode nominally, at the radiation belt entry time as set in the Broadcast Packet.

8.3.6 IREM Operations

Radiation Belts Entry

Evolution of Radiation Belt Entry 2003-2007



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]
624	RAD_ENTR R 2007-11-25T09:23:20Z	25/11/2007 07:17:36	71633.3	25-Nov-2007 10:54:42	43610.00
625	RAD_EXIT R 2007-11-25T19:31:22Z	25/11/2007 18:21:52	>>33115.0	25-Nov-2007 18:34:42	44438.60
625	RAD_ENTR R 2007-11-28T09:10:01Z	28/11/2007 06:39:44	74190.6	28-Nov-2007 10:44:27	43221.16
626	RAD_EXIT R 2007-11-28T19:17:20Z	28/11/2007 17:40:56	>>34751.0	28-Nov-2007 18:24:27	44909.47

Reference

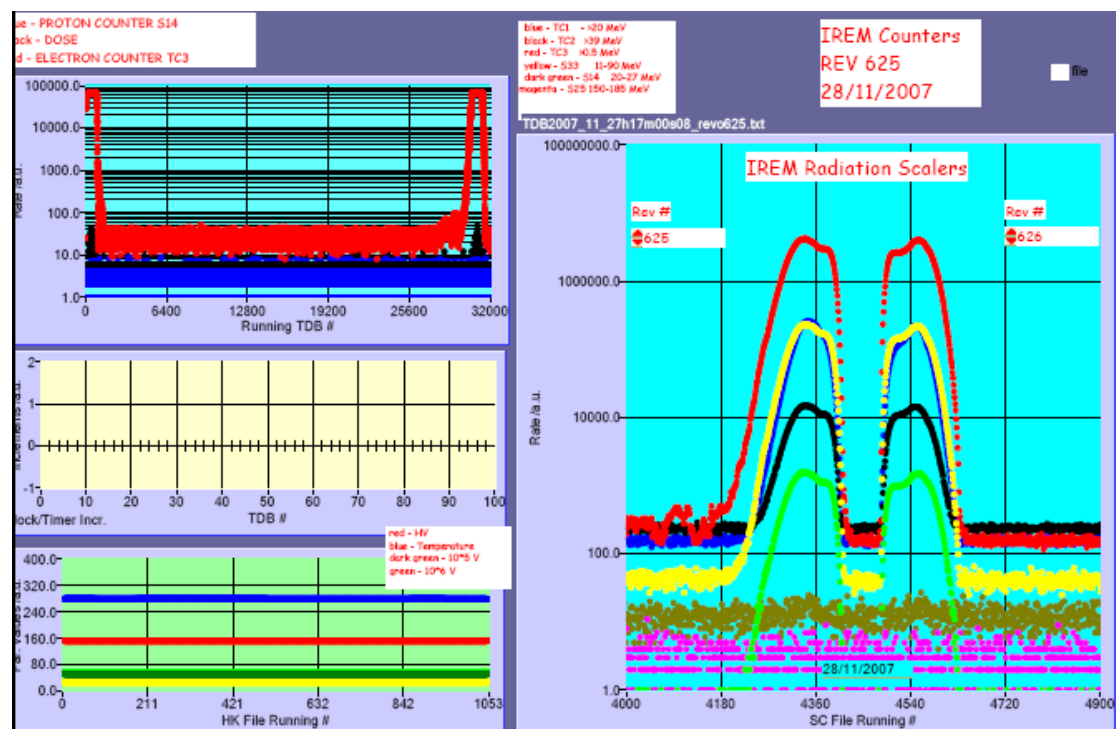
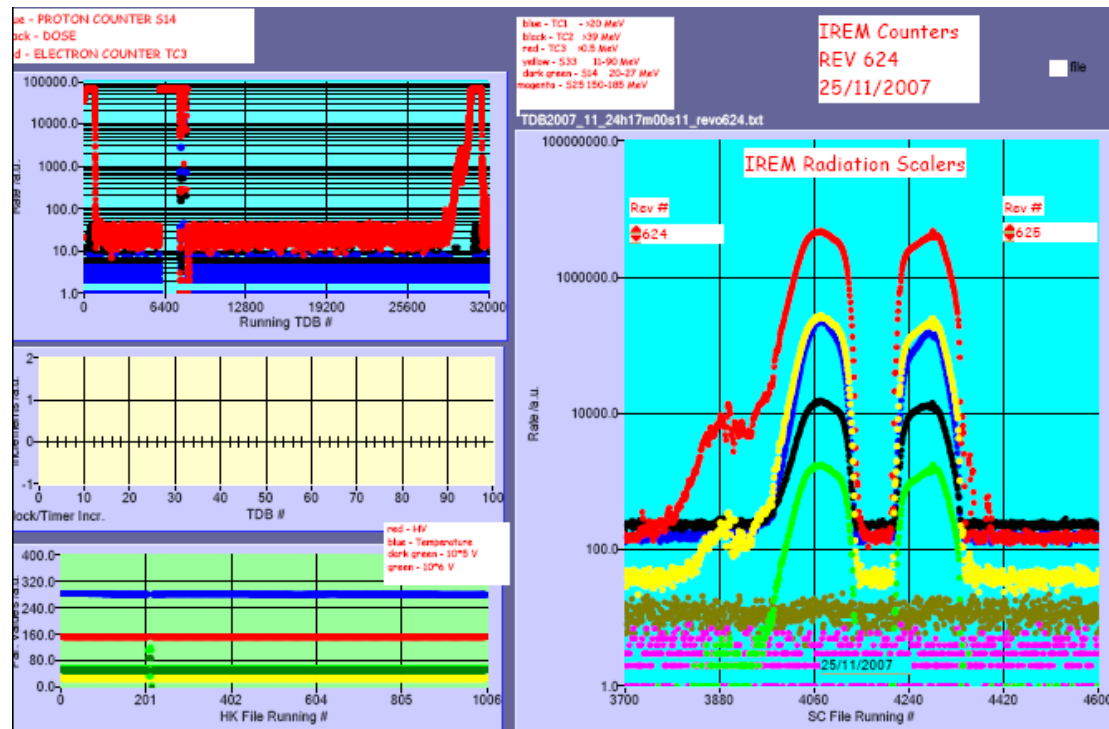
High radiation

Very small error vs reference (less than 10 minutes)

Small error vs reference (between 10 and 30 minutes)

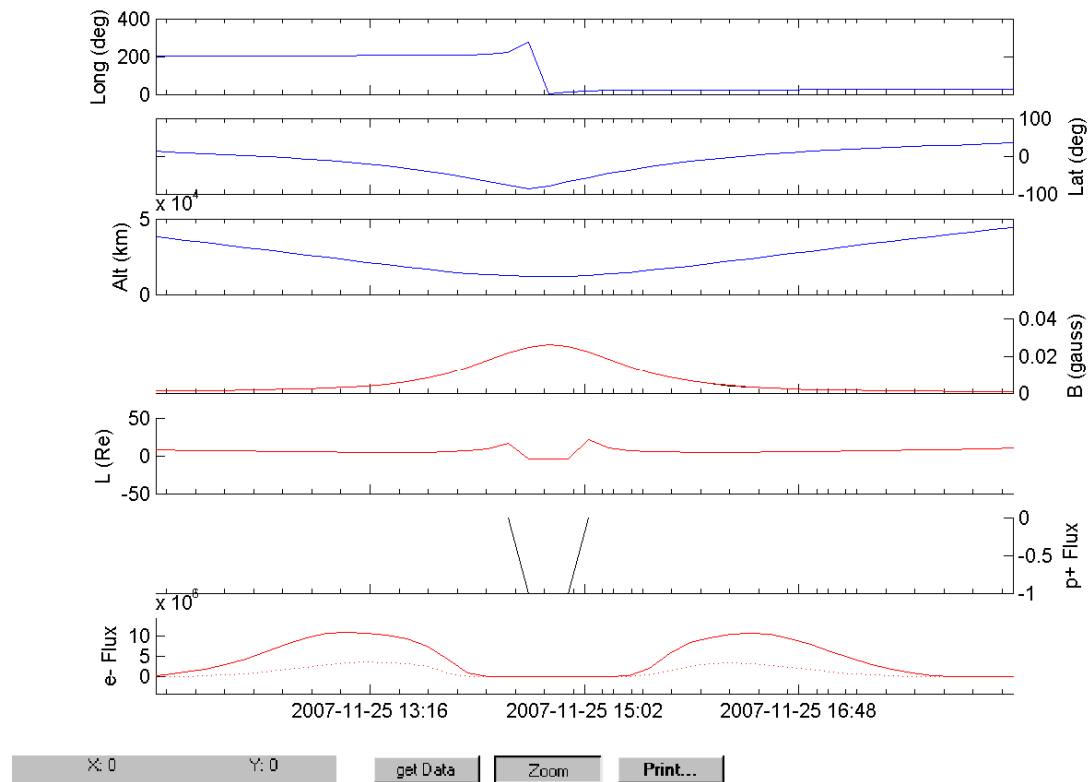
Large error vs reference (more than 30 minutes)

IREM radiation counters:

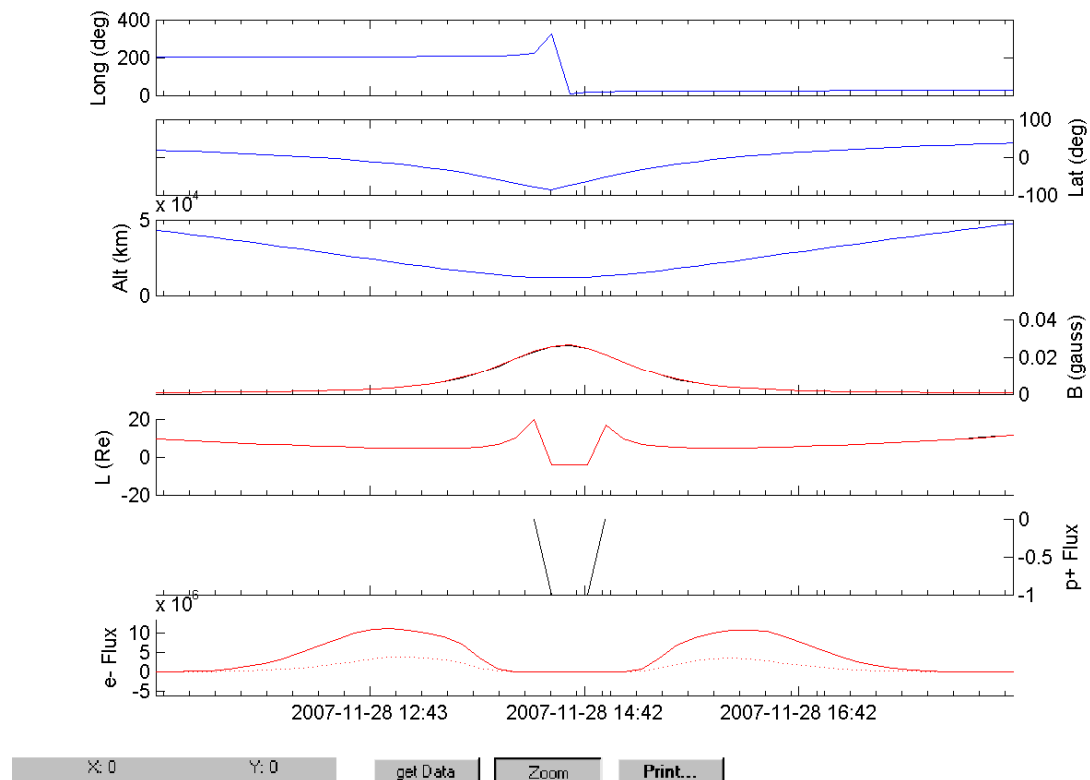


IREM Predicted Radiation Belt Passages

Rev 624



Rev 625



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SEC-GOES Observed Particles Fluxes (using SEIS/RAT tool):

Due to a problem on the SEISOP server, no data are available this week. However, the week was very quiet and no radiation was reported.