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

INTEGRAL
Mission Report

INT-MOC-SYS-RP-1001-OPS-OAI

No.323
Week 48

01.12.08

Routine Phase

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

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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 22.11.08 until 28.11.08 (both dates inclusive) and covers the revolutions 746 and 748.

2 Summary of Activities

The operations were performed according to the planning inputs from ISOC combined with some manual commanding by MOC.

The targets of these revolutions consisted of a raster dither of the Cygnus Region (RA 20:35:53.00, DEC +40:39:49.0) and three hexagonal dithers of the Galaxy Cluster 47 Tuc and Small Cloud of Magellan SMC (RA 00:53:55.20, DEC -72:26:42.0) and two hexagonal dithers of the Virgo Cluster (RA 12:26:32.10, DEC +12:43:24.0).

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 problem on DSS27 station.

The fuel consumption over the period between 22/11/2008 and 28/11/2008 was 0.0973 Kg. The remaining propellant is in the order of 137.3866 Kg.

Note: Some more information concerning the AOCS operations and the fuel budget is provided in the Appendix.

3.1.2 Power

All the other units of EPS are working nominally; available power from the arrays is of the order of 2100W.

3.1.3 Thermal

The thermal control of the satellite is working well. The temperatures are currently all within the specified operational limits.

3.1.4 OBDH

The OBDH subsystem is working flawlessly. No on-board communications problem has been identified.

The PST was over-subscribed by 3 packets, which were allocated to SPI during the Instrument window for the entire reporting period.

3.1.5 RFS

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

3.2 Payload

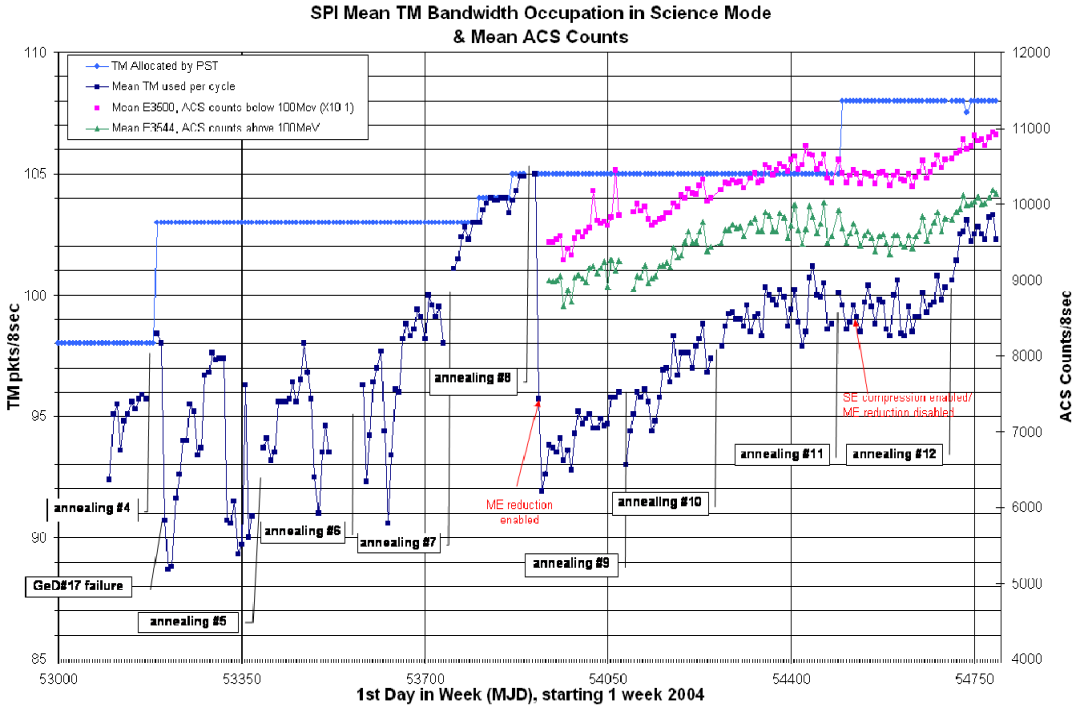
3.2.1 SPI

Following the 12th annealing, ended on 04/09/2008 at 23:50Z, the overall status of the gamma-ray spectrometer is nominal, except for detector #2 (failed since 06/12/2003) and detector #17 (failed since 17/07/2004). The energy resolution of the previously degraded GeD#12 has improved following this annealing and the bias of this detector is now set to 4kV as for the other detectors.

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

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 108 packets/cycle and the average telemetry occupation was 102.3 packets/cycle.

The following plot shows the evolution of the assigned and the average occupation of the SPI TM bandwidth along with the mean ACS count rate evolution (since July 2006). As can be seen, there is a strong correlation between the evolution of the background as measured by the ACS and the overall TM bandwidth usage.



Note: Some more information concerning the SPI operations is provided in the Appendix 8.3.2.

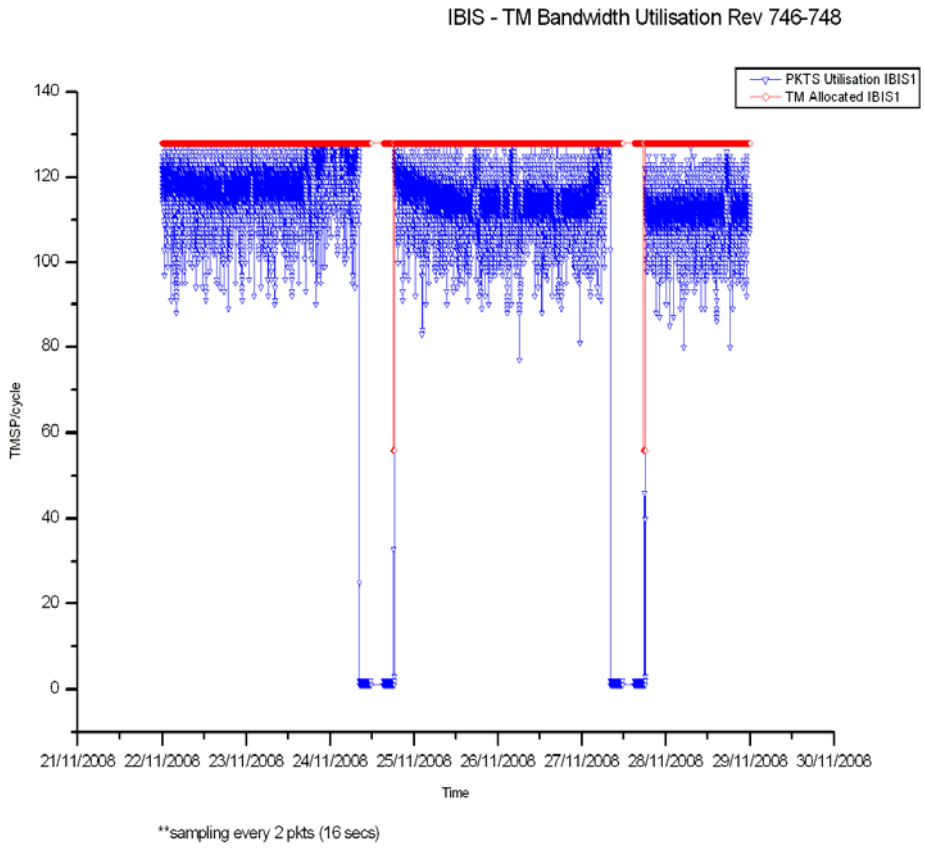
3.2.2 IBIS

The overall status of the unit is nominal.

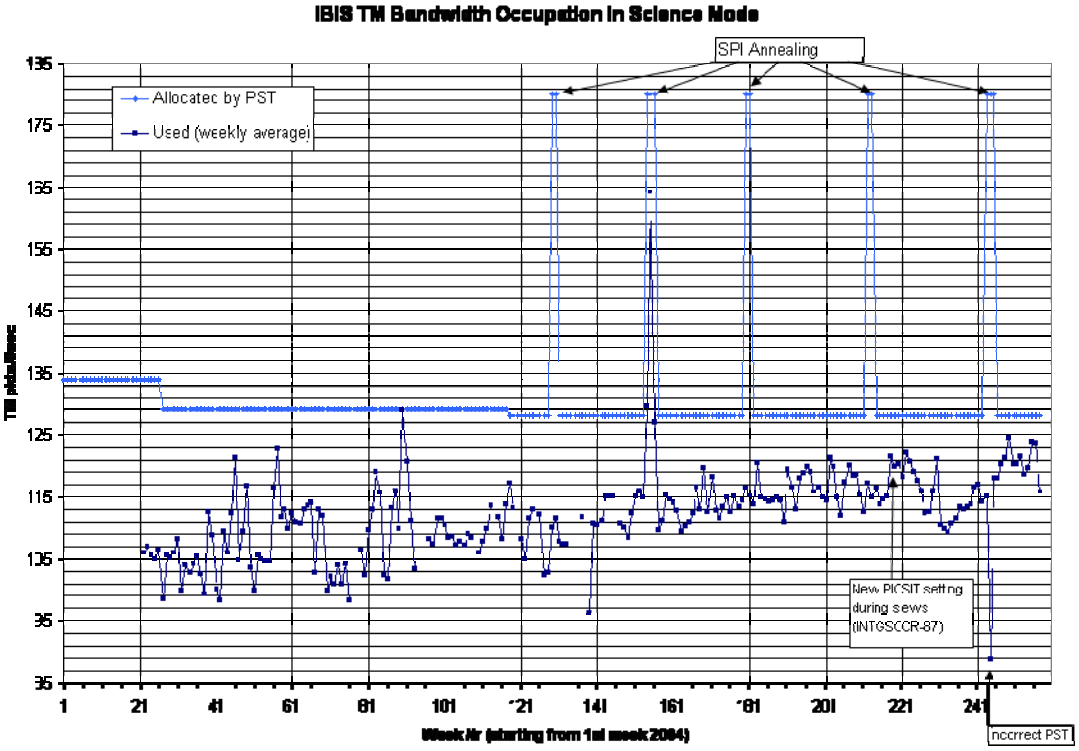
During the reporting period, the TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 128 packets/cycle
- IBIS mean bandwidth utilisation in science mode:115.75 packets/cycle (down 7.77 on previous week)
- Percentage of TM cycles in which full bandwidth was used: 6.95%

The plot below shows the IBIS TM utilisation during the observation period.



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 Section 8.3.4.

3.2.4 OMC

The status of OMC is nominal.

OMC operations were performed by the automatic Timeline. OMC was operated in Science Normal mode during science observations, with a TM allocation of 5 packets per cycle.

During this reporting period, 144 of the 146 planned science pointings were executed nominally, 2 were lost.

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

3.2.5 IREM

The overall status of the unit is nominal.

Solar Activity

The observation period was characterised by low solar activity. A small sun spot, appeared on the 27th, but had disappeared by the following day. 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 good this week. One pointing was lost due to ground problems. The overall performance though was above the 95% requirement.

4.1 Mission Operations Centre

The performance of the MOC was good this week. One pointing was lost to MOC related issues. More information is given in section 6.

4.2 Ground Stations & Network

On DoY 331 between 06:49z and 11:30z there were several drops in TM from DSS27. The links disconnected frequently. COMMS reported that there was a problem with the firewalls.

The SICFs validity dates have been updated on INCTRA, INCTRB and all stations' TMTCSs. The Redu-1 TMTCSs SIs are configured for the standard validity dates: 152/2008 to 334/2009.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 754 to 756. The PSF for revolution 7522 was updated to include the Thruster Calibration window, leading to a replan for revolutions 752 and 753.

New observations have been approved and planning files sent for revolutions 754 to 756.

New TSFs have been received for revolutions 748 and 749.

2. Observation status

New ECS files have been received for revolutions 736 and 738, lacking the one for 737.

3. ISOC Science Data Archive

No news.

4. ISOC system

ISOC system V20, supporting proposal submission for the first phase of AO-7 was installed on 24 November.

5. Problems

No new problems.

4.3.2 ISDC

Status of ISDC observation processing on 01/12/2008:

- Latest Standard Analysis completed: observation 06200590017 (Galactic disk scan, Revolution 735) on 24/11/2008.

- Latest products archived: observation 06200590017 (Galactic disk scan, Revolutions 735) on 24/11/2008.

- Latest observation products sent to the observer: observation 05297000004 (Perseus OB2 Cloud, Revolutions 706-710) on 13/09/2008.

5 Special Events

6 Anomalies

The following problem was reported this week that impacted operations:
On DoY 331 at 03:55z the two on-board event messages 'ACC STR THR EX' and 'ACC AIMU ON' were received. The IMU1 went on for 10 minutes. After that the OTF was not reached for PID #07470036.

On DoY 331 at 16:33z the TC A2541 'STR SRCH/TRK' failed release from the Autostack. The reason was a TM gap from DSS27. The CSL failed and the PID # 07470048 was lost. Flight Dynamics reported that this problem was caused due to an Attitude verification failure.

The following anomaly reports were entered into the ARTS system this week.

AR id	Date Created	Subject	Segment	Status
INT-3044	2008-11-26	RELAY LAN - TM flow problems with JPL & ISDC	COMMS	Pending

7 Future Milestones

- MCS version E3.2 is available on the B-chain, it will be installed on the B-chain on 3/12/2008 and on the A-chain on 9/12/2008.
- New database IODB_3.1_058 available on C-chain for checking.
- Playback from REDU TMTCS2 is working only intermittently.
- Thrusters calibration is planned for 11/12/2008.
- An MRB will be held as a result of the numerous problems on DoY 331 related to the Relay LAN firewall.
- GTPs checking should be configured for Integral as for XMM MCCM.

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 746

The observations in revolution 746 began with a hexagonal dither of the Galaxy Cluster 47 Tuc and Small Cloud of Magellan SMC (RA 00:53:55.20, DEC -72:26:42.0), lasting ~22.2 hours. They continued with a hexagonal dither of the region around the Quasar PKS 0208-512 (RA 02:10:46.20, DEC -51:01:01.9), lasting ~22.9 hours. This was followed by a raster dither of the Cygnus Region (RA 20:35:53.00, DEC +40:39:49.0) lasting ~11.1 hours until the end of the revolution.

Revolution 747

The observations in revolution 747 began with a hexagonal dither of the Galaxy Cluster 47 Tuc and Small Cloud of Magellan SMC (RA 00:53:55.20, DEC -72:26:42.0), lasting ~22.2 hours. They continued with a hexagonal dither of the Virgo Cluster (RA 12:26:32.10, DEC +12:43:24.0) lasting ~32.9 hours until the end of the revolution.

Revolution 748

The observations in revolution 748 began with a hexagonal dither of the Galaxy Cluster 47 Tuc and Small Cloud of Magellan SMC (RA 00:53:55.20, DEC -72:26:42.0), lasting ~22.2 hours. They continued with a hexagonal dither of the Virgo Cluster (RA 12:26:32.10, DEC +12:43:24.0) lasting ~32.9 hours until the end of the revolution.

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 108; JEM-X1 8; JEM-X2 0; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

```
2008-11-15T16:32:52.000Z     137.6314    F   Automatic TM processing.
2008-11-17T01:51:44.000Z     137.5623    F   Automatic TM processing.
2008-11-18T16:21:00.000Z     137.5540    F   Automatic TM processing.
2008-11-19T16:01:27.000Z     137.5064    F   Automatic TM processing.
2008-11-21T11:28:11.000Z     137.4892    F   Automatic TM processing.
2008-11-21T16:09:16.000Z     137.4839    F   Automatic TM processing.
2008-11-23T01:57:28.000Z     137.4630    F   Automatic TM processing.
2008-11-24T15:57:48.000Z     137.4506    F   Automatic TM processing.
2008-11-25T17:32:47.000Z     137.4372    F   Automatic TM processing.
2008-11-27T15:46:03.000Z     137.4151    F   Automatic TM processing.
2008-11-28T17:22:31.000Z     137.3866    F   Automatic TM processing.

This report was generated Fri Dec 5 08:00:29 GMT 2008
```

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, 22/11/2008 – 28/11/2008

The AOCS operations were executed from the Automatic Timeline.

During this period, 99 Open Loop Slews, 61 Closed Loop Slews and 5 Momentum Biases were executed (as reported by ACC OEM).

1 slews (CSL) was missed from TL, during the observation period, due to a TM link drop at DSS27 station.

This is equivalent to ~ 0.6 % of the total number of slews planned (160).

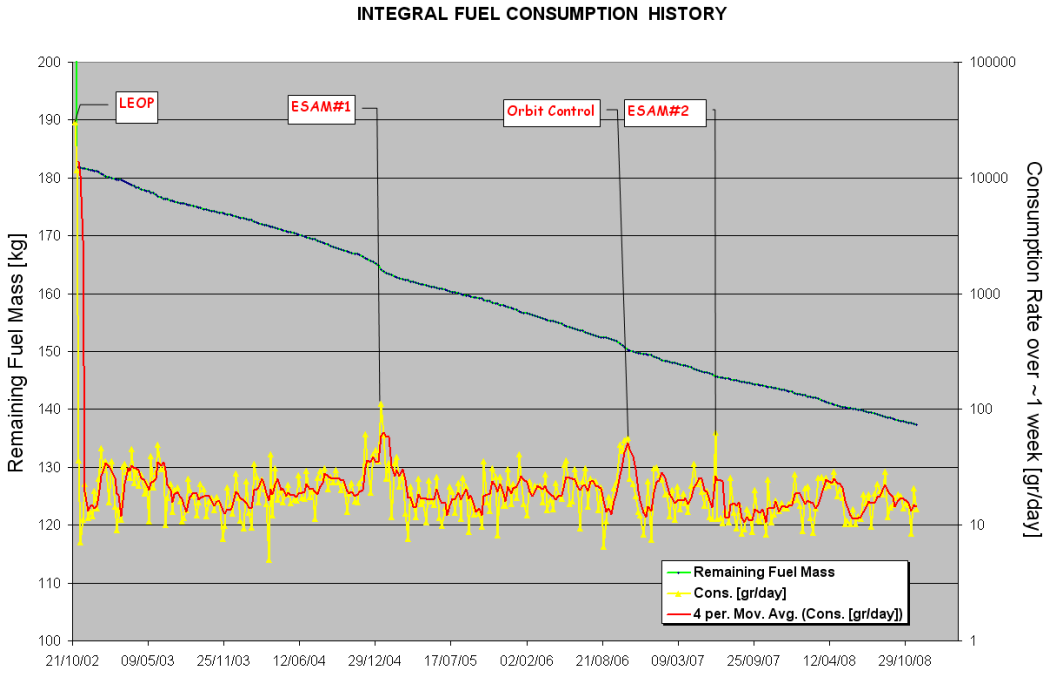
The OTF was not reached during PID 07470036.

Orbit Control

No update

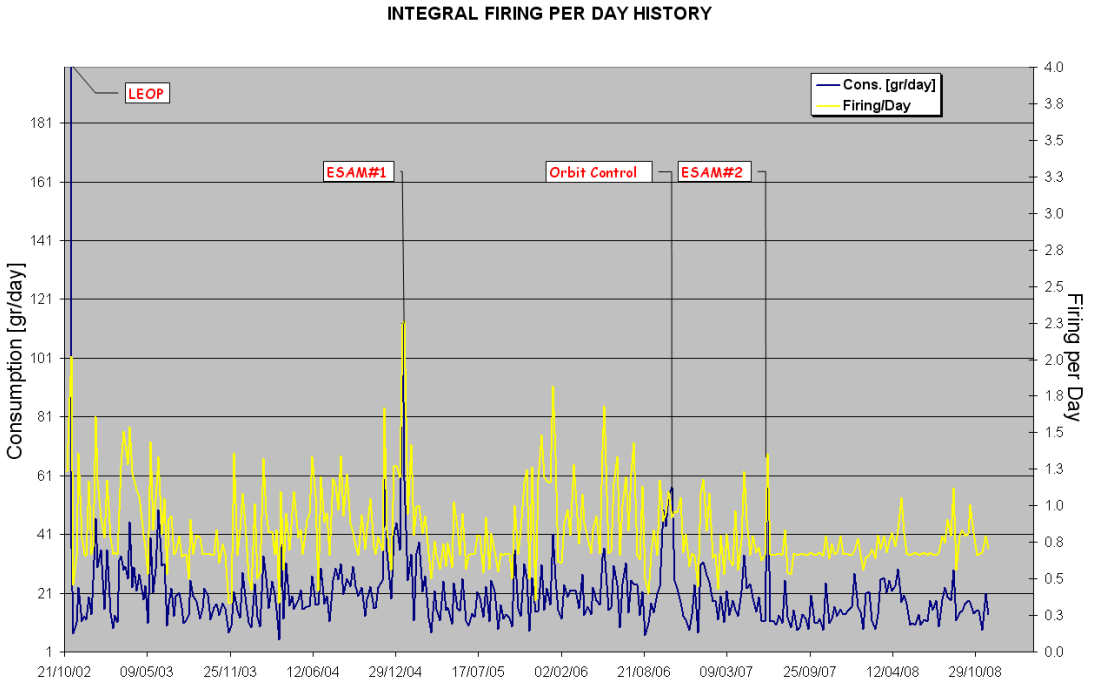
Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 28/11/2008 is reported in the plot below.



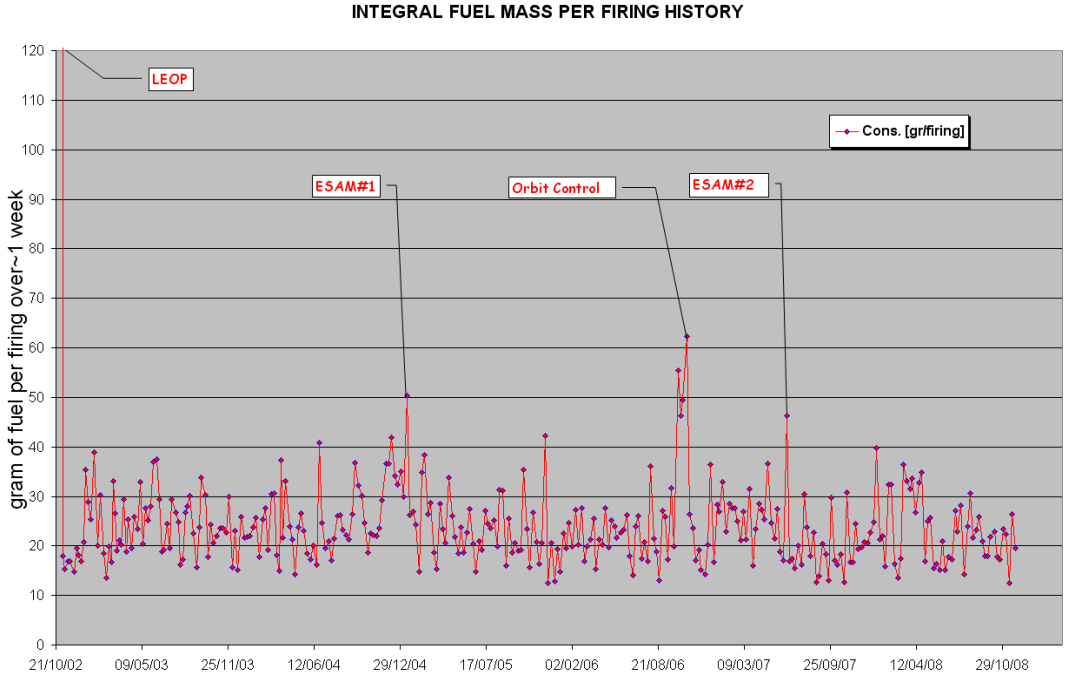
The above plot considers the ESAM fuel consumption spread over period of ~1 week.

The firing per day over the period between 01/11/2002 and 28/11/2008 is reported in the plot below.



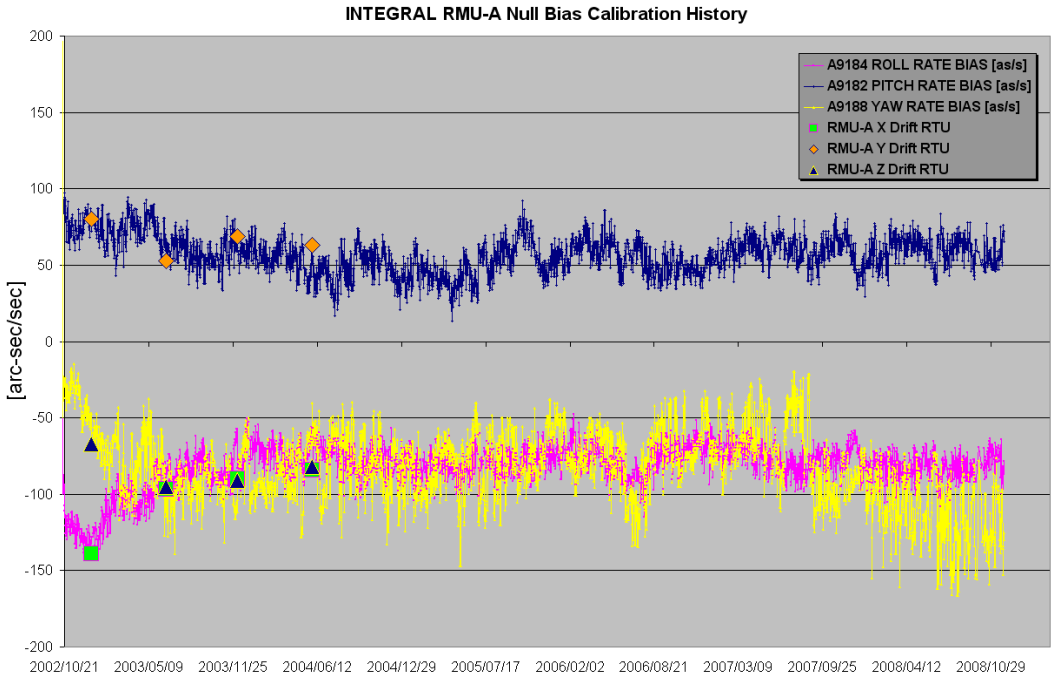
The above plot considers the ESAM fuel consumption spread over period of ~1 week.

The fuel per firing over the period between 01/11/2002 and 28/11/2008 is shown in the plot below.

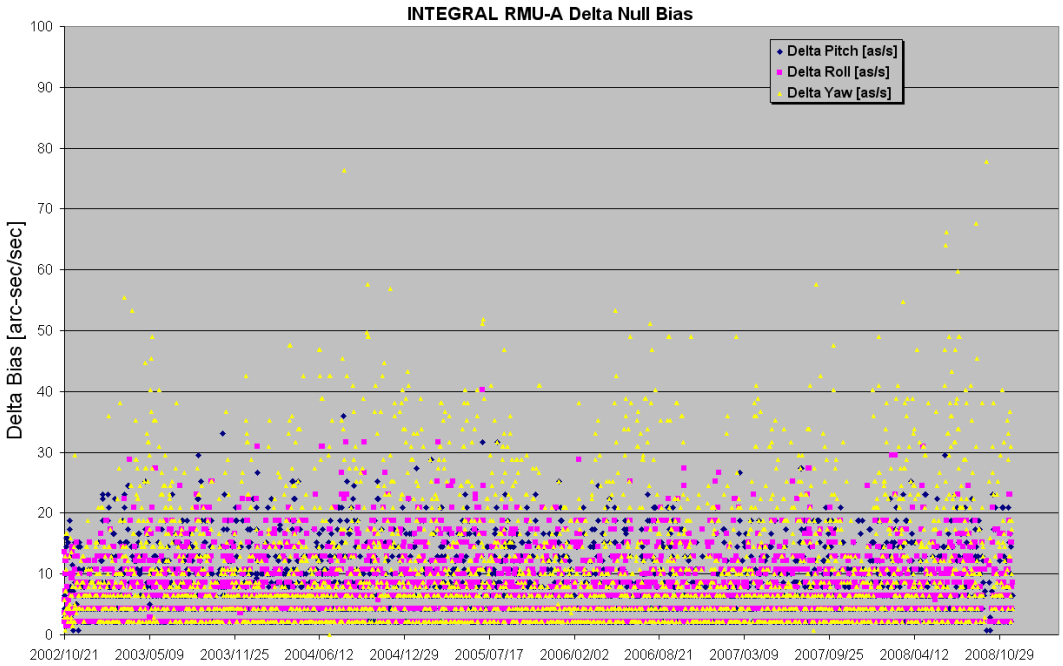


The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 28/11/2008 is reported in the plot below.
The evolution of the drift on yaw channel is under constant monitoring but the values are still well within the specs. At moment the current constraints (for drift update generation) on the FDS have been relaxed to cope with the current situation.



The RMU-A delta null bias calibration history, on pitch, roll and yaw channel over period between 01/11/2002 and 28/11/2008 is reported in the plot below.



22/11/2008 (Day of Year 327, Revolution 746)

Nothing to report.

23/11/2008 (Day of Year 328, Revolution 746)

Nothing to report.

24/11/2008 (Day of Year 329, Revolution 746-747)

Nothing to report.

25/11/2008 (Day of Year 330, Revolution 747)

Nothing to report.

26/11/2008 (Day of Year 331, Revolution 747)

Loss of guide star: at 03:55z a loss of the current guide star occurred due to false event. As foreseen by the IPS logic, the IMU1 went on until a new guide star picked.

The next slew ID 07470037 was manually updated in TL. The OTF was not reached during PID 07470036.

FDS problem during slew update: at 08:43z a problem on FDS caused the slew update to fail for slew ID 07470041. A manual recovery was attempted but a fatal error was reported from the Spacon Recovery Schedule Tool, therefore the FD engineer was called in.

A manual recovery was then performed and the next slew (ID 07470041) in TL updated.

No slew missed in TL.

Problem at DSS27 station: at 16:33z due to a TM link drop at DSS27 station the slew commanding fail for slew ID 07470048.

A manual recovery was then performed from the attitude of PID 07470047 to the attitude of PID 07470048 and the next slew ID 07470049 updated in TL.

The following slew was not executed in TL: PID 07470048(CSL)

27/11/2008 (Day of Year 332, Revolution 747-748)

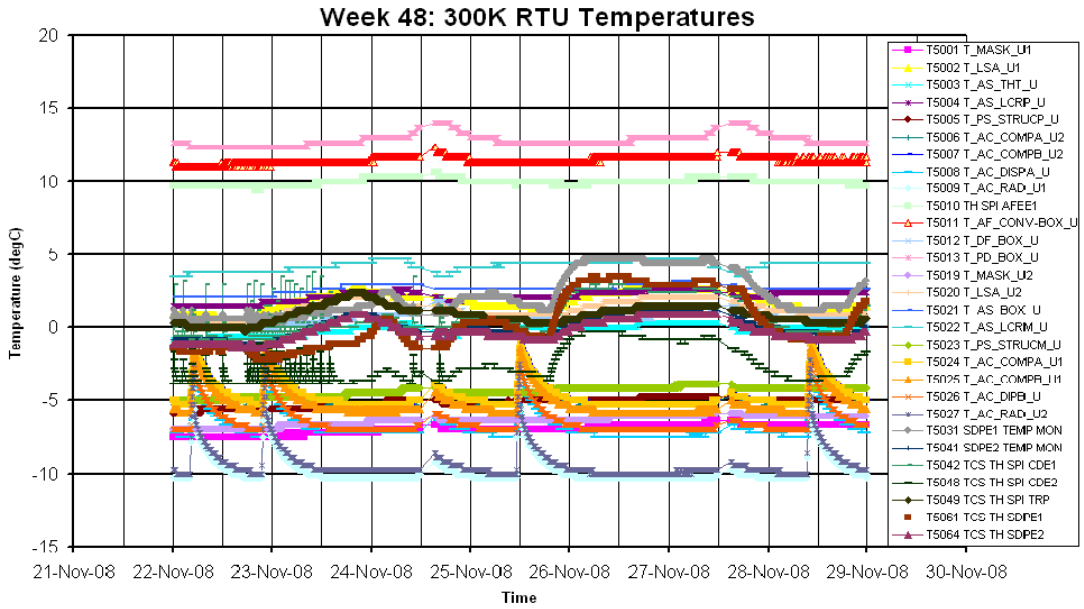
Nothing to report.

28/11/2008 (Day of Year 333, Revolution 748)

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.

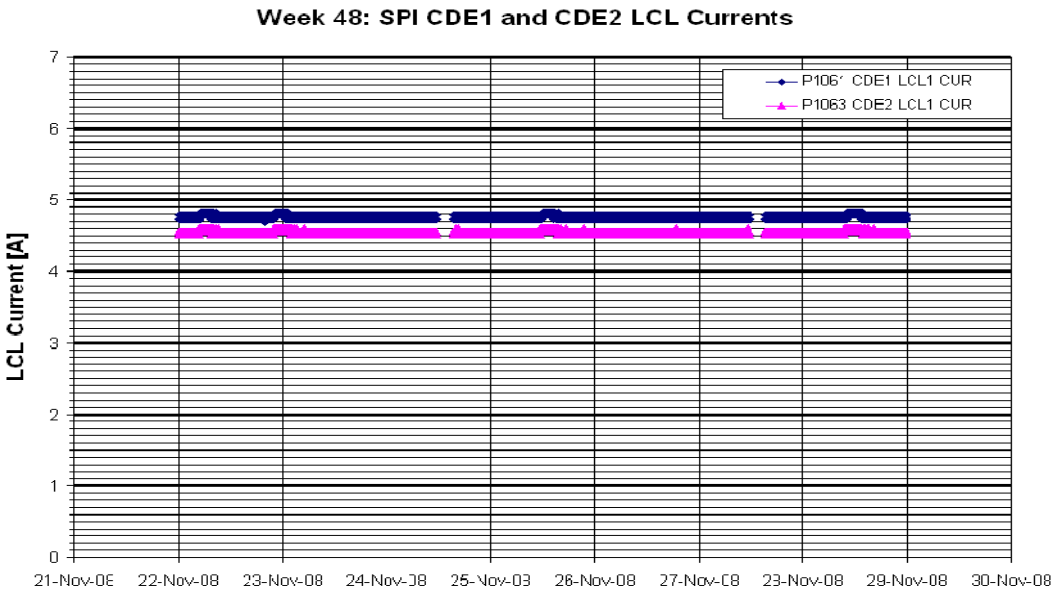


Stirling Compressors and Cryostat: The performance of the compressors is nominal.
The cold plate temperature was maintained in the range 80K +/-1K.

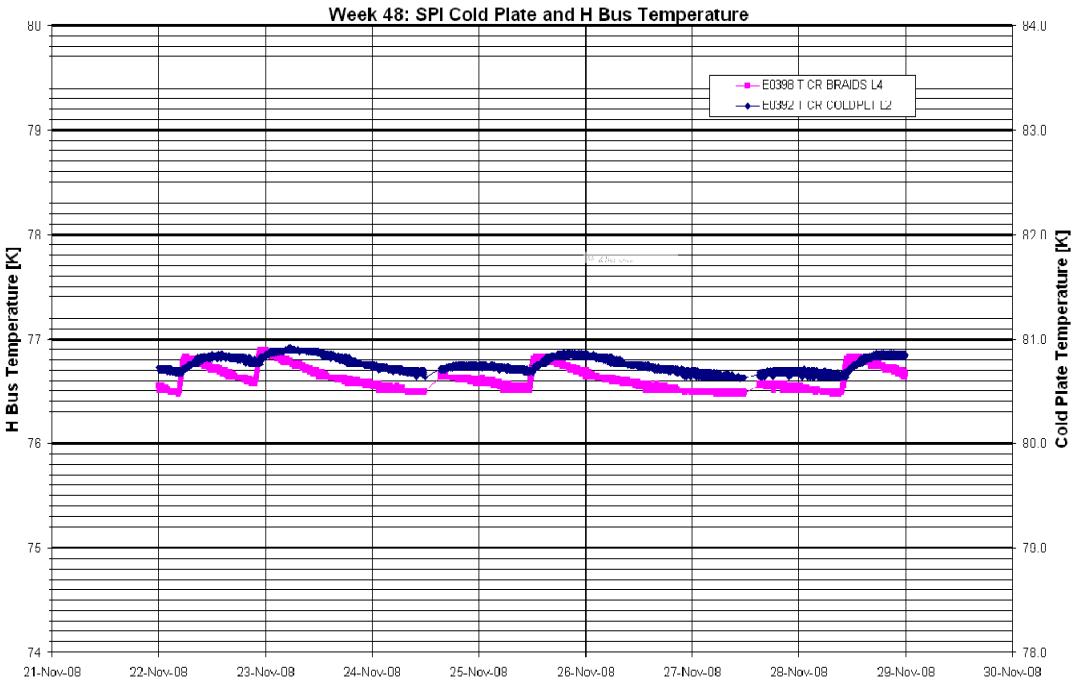
The stroke of all four compressors was set to 40 throughout the week and the average CDE LCL currents were as follows:

- CDE1 LCL Current = 4.76A
- CDE2 LCL Current = 4.55A

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



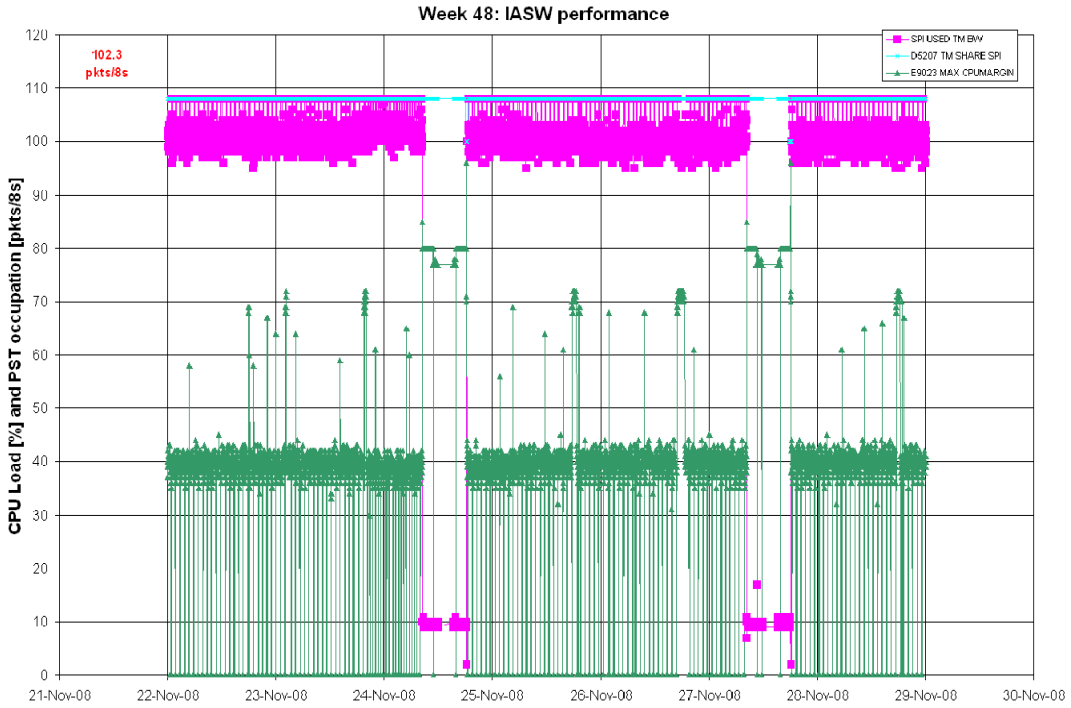
The following plot shows the evolution of the cold plate and H bus temperatures during the reporting period.



DPE & IASW: The DPE health and IASW performance are nominal.

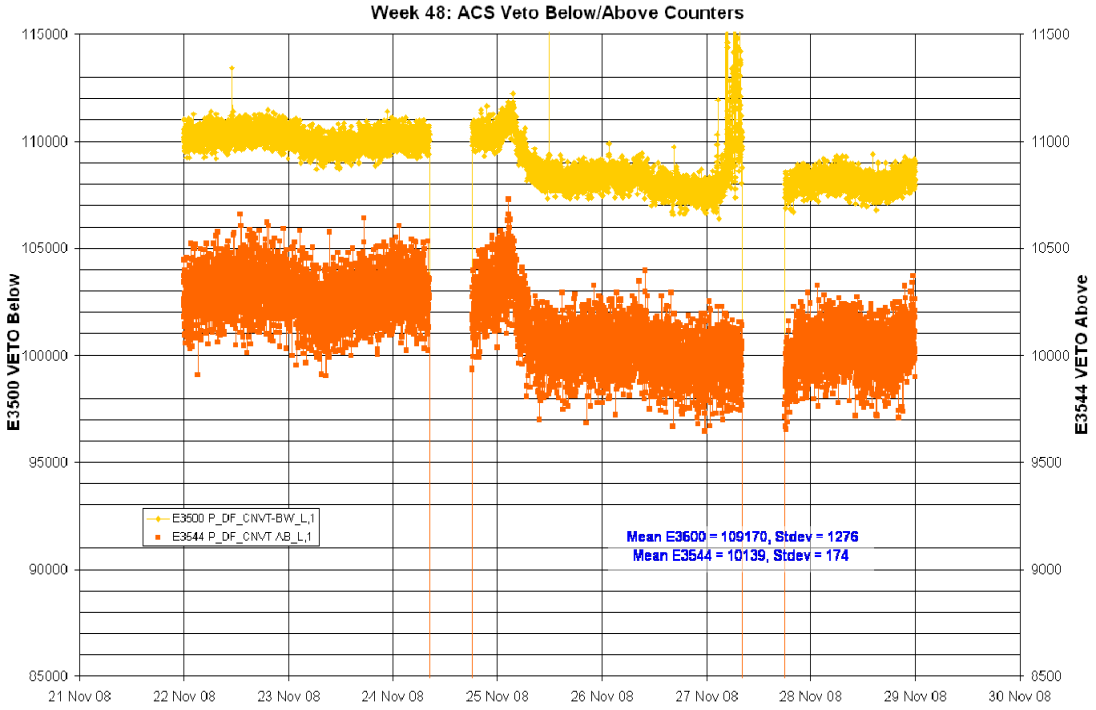
The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling factor set to 8/19 SE. The average TM bandwidth occupation of SPI was 102.3 packets/cycle over the science window when the TM allocation was 108 packets/cycle.

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

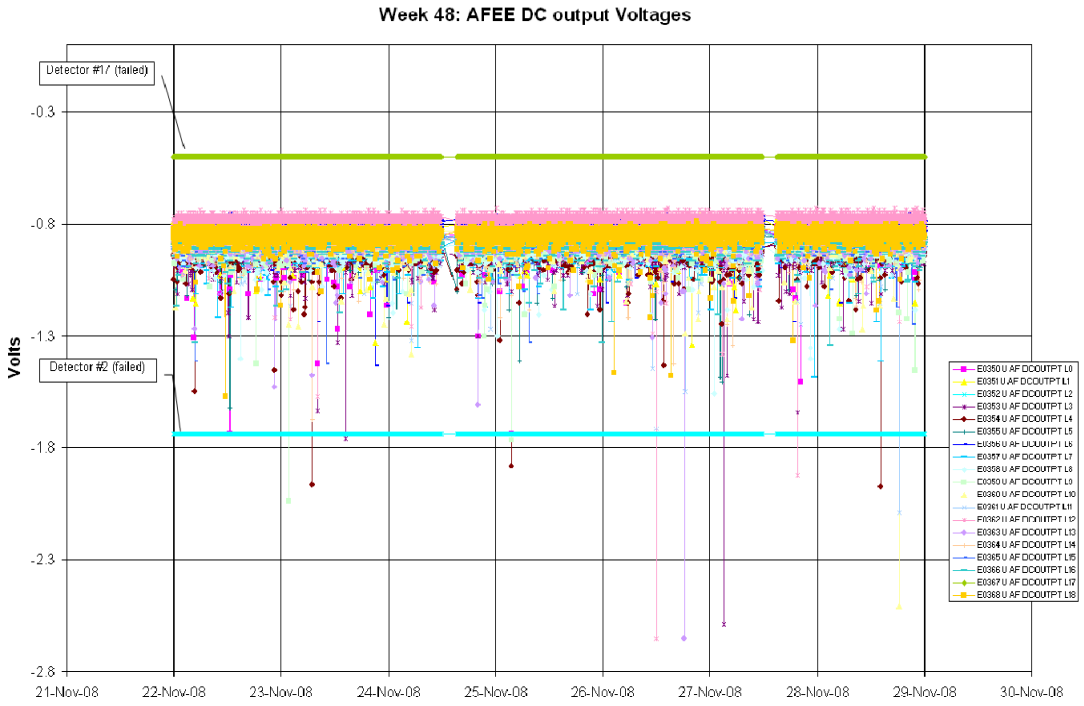


ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61).

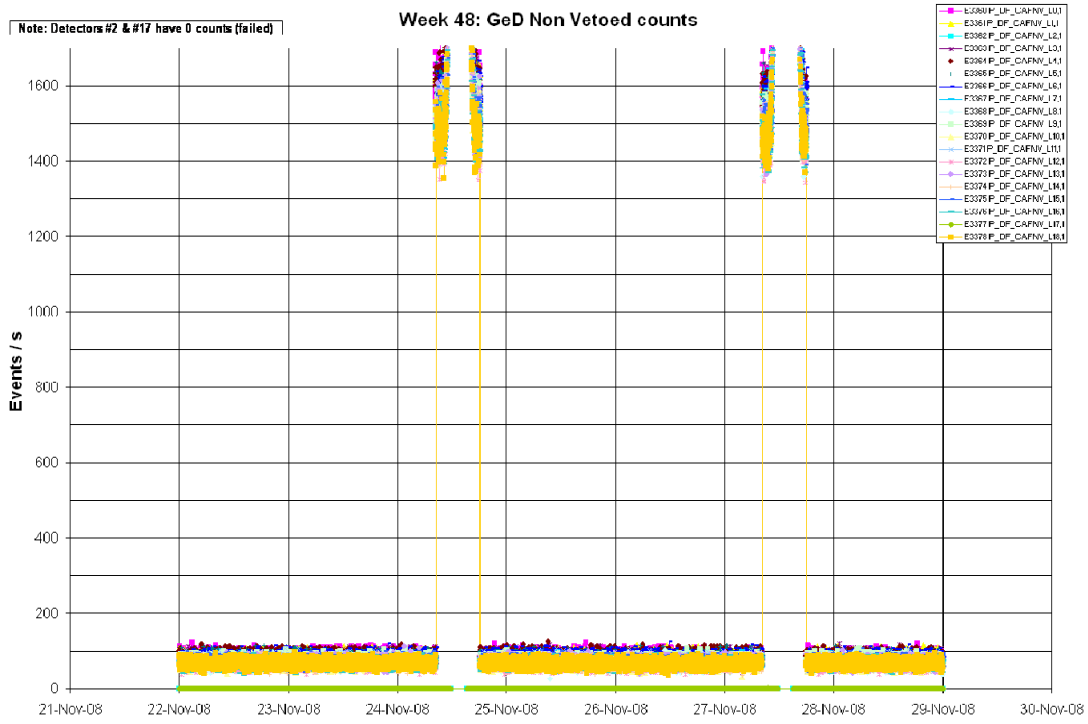
The following plot shows the ACS overall count rate evolution during the reporting period:

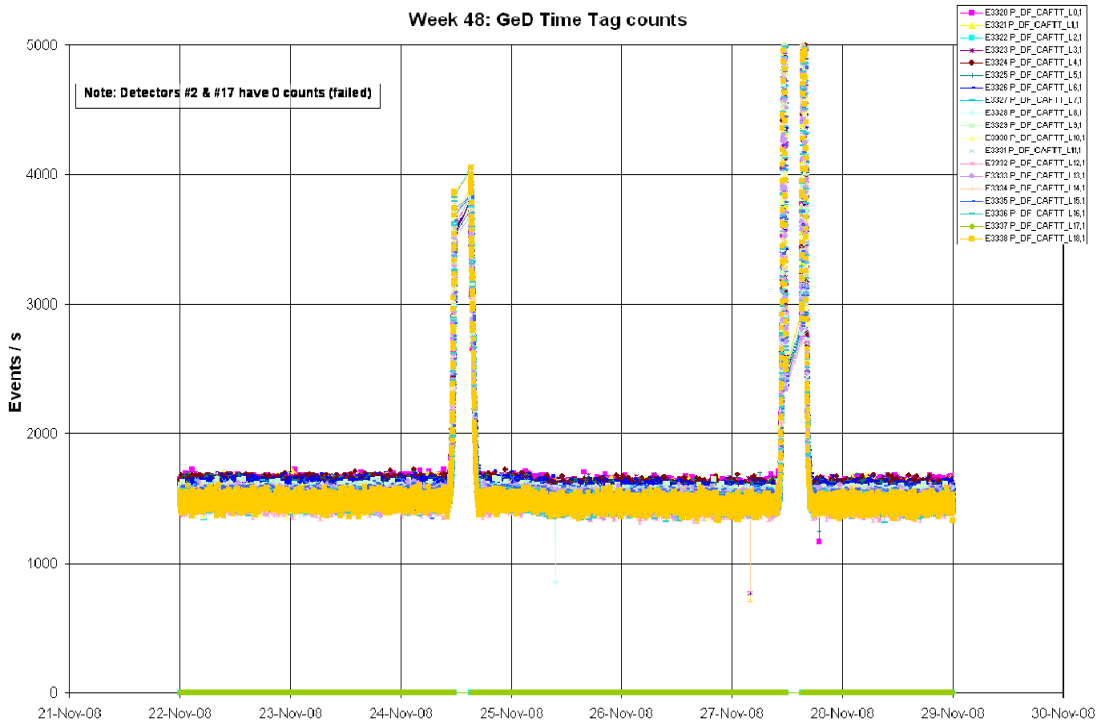


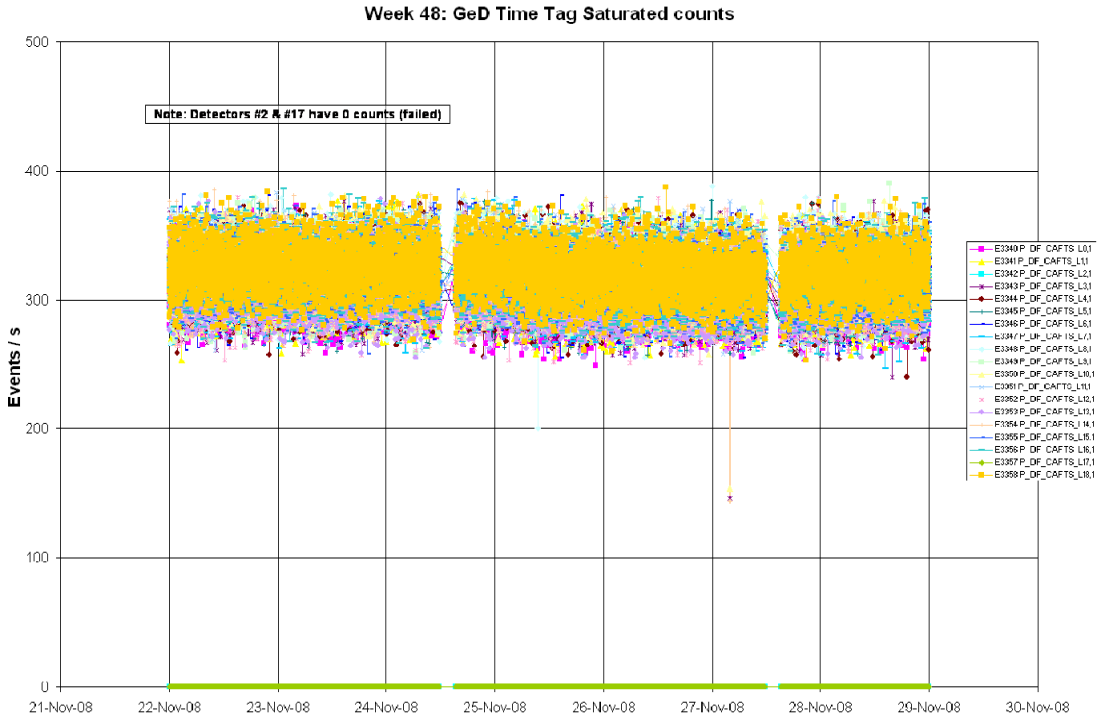
AFEE: The health of the AFEE is nominal. The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06/12/2003 and detector #17 is failed since 17/07/2004.



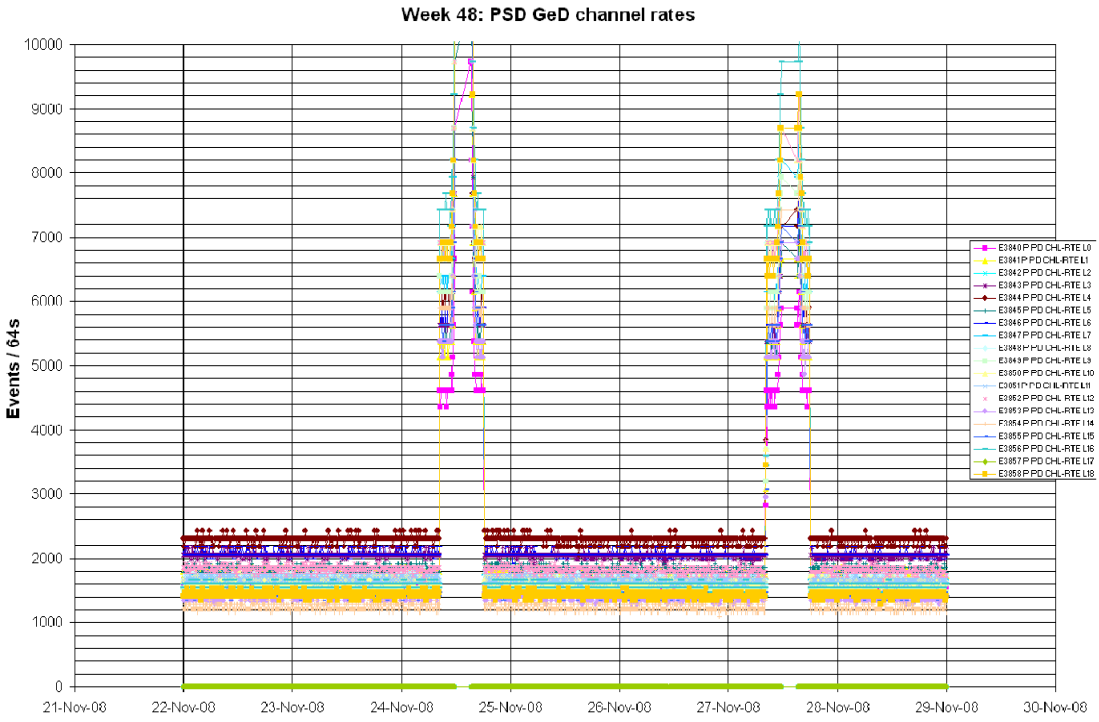
DFEE: The performance of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event count rates during the reporting period.







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



Event Log:

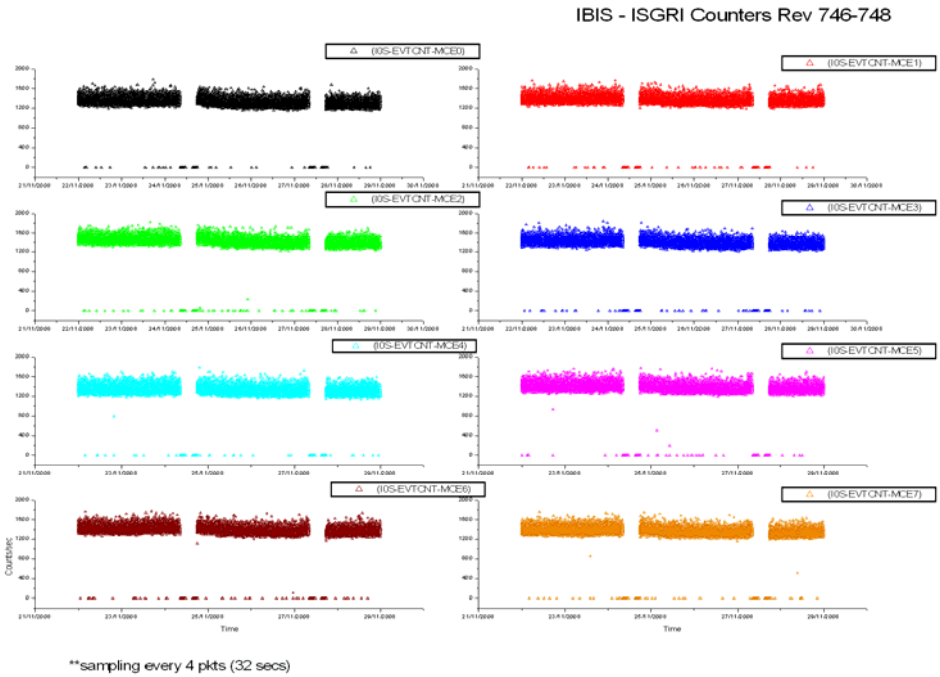
The following non-nominal events occurred on SPI over the reporting period:

- On 2008-11-28 at 20:07:56Z TM parameter E2134 (Rate meter of 1st FEE in group MSB+LSB) went OOL Low (value = 28). As it returned within limits of its own accord at 20:08:04Z, no action was taken.

8.3.3 IBIS Operations

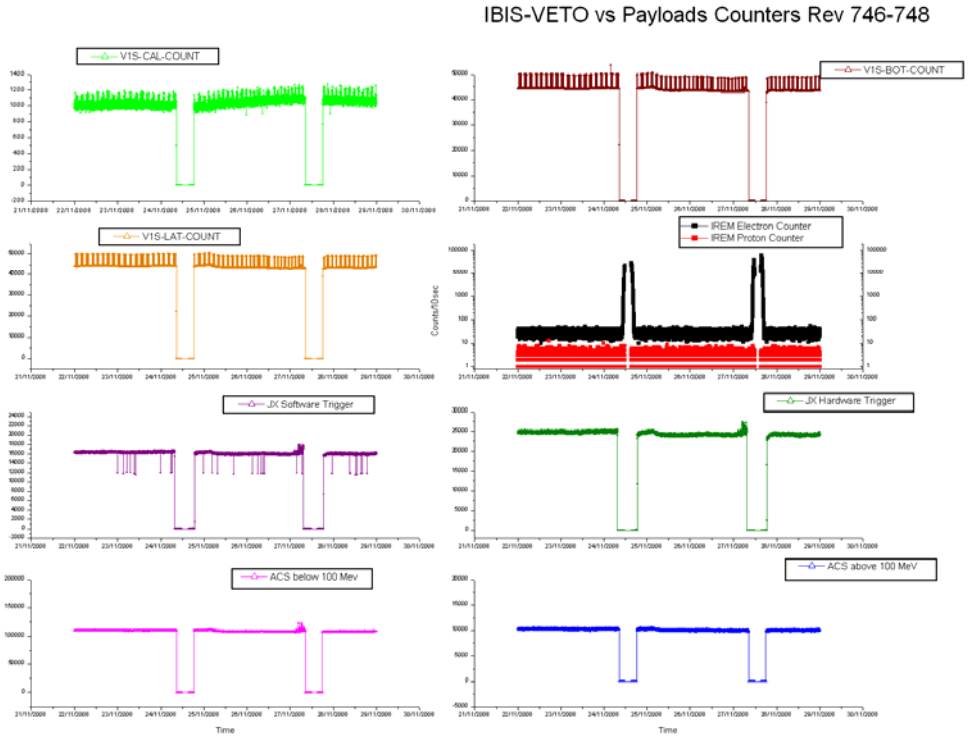
IBIS Event Counters Plots

ISGRI Counters:



**sampling every 4 pkts (32 secs)

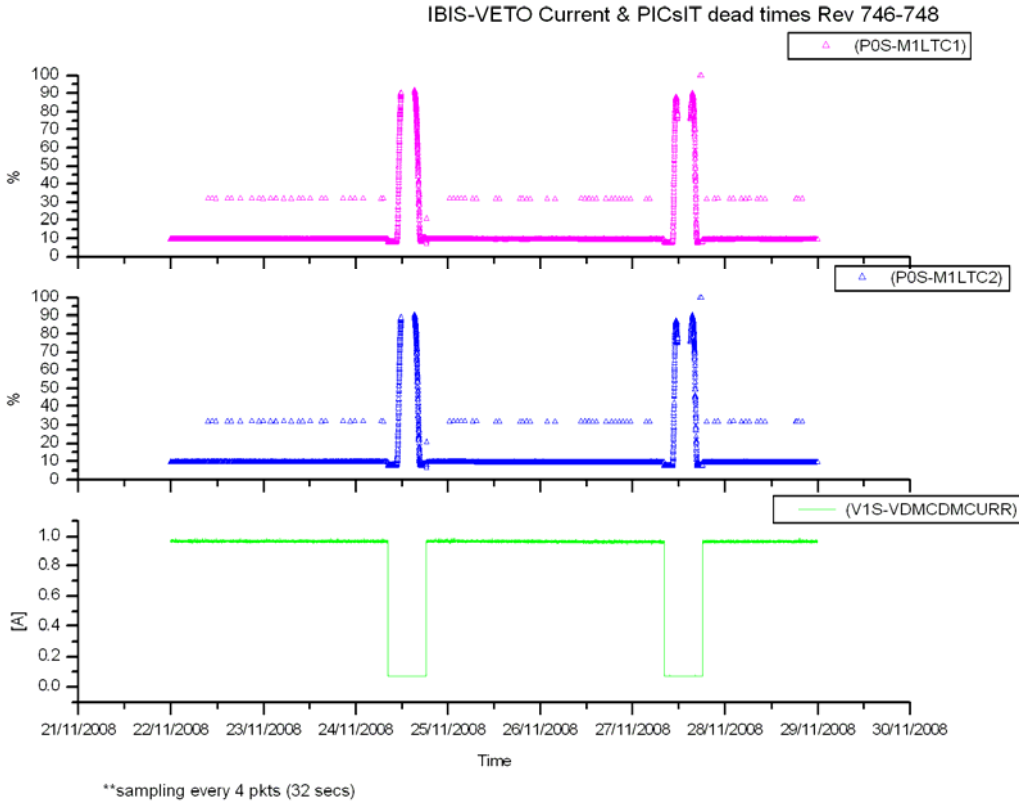
VETO vs Payload Counters:



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

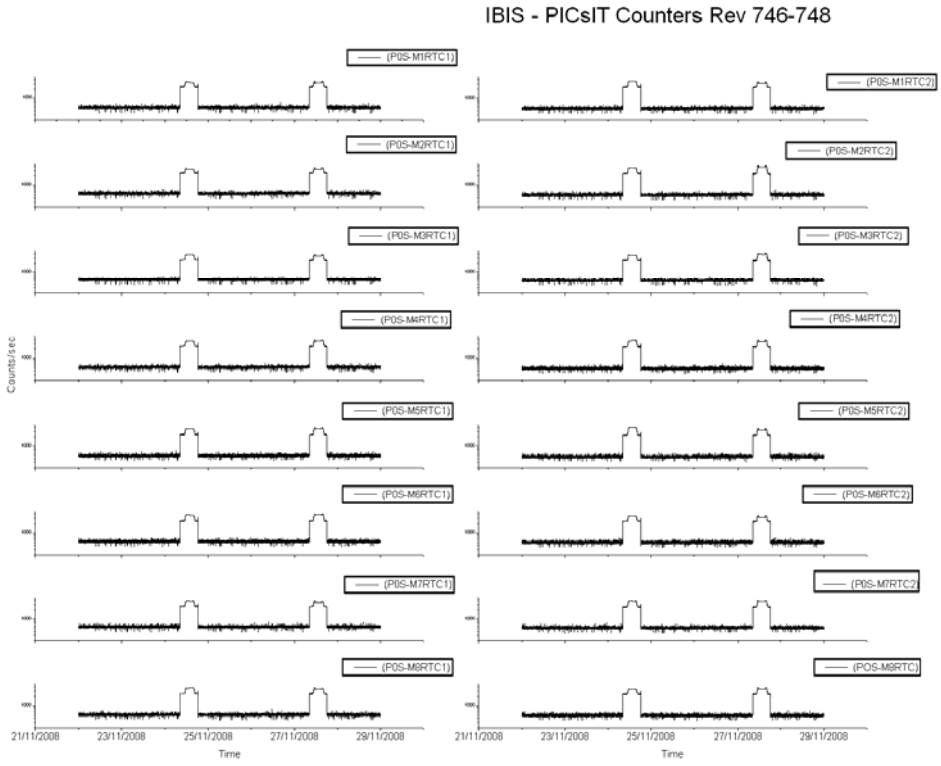
The week was characterised by low radiation as reported by the payload.

VETO Current:



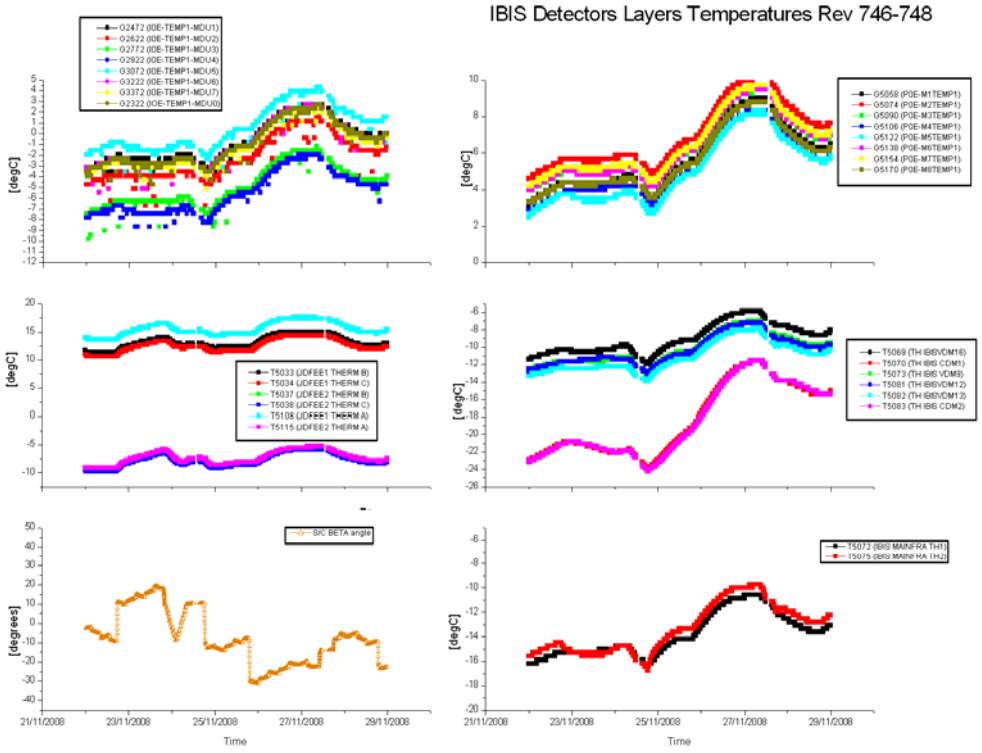
**sampling every 4 pkts (32 secs)

PICsIT Counters:



**sampling every 4 pkts (32 secs)

IBIS Detectors Layers Temperatures:



**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.

2008-11-22 (DOY 327, Rev 746) to 2008-11-25 (DOY 330, Rev 747)

TM parameter G6061 (VETO Calibration Source counter) briefly went OOL Low several times during this period. As in each case it returned within limits of its own accord, no action was taken. However these frequent OOLs indicate that an adjustment of the limit is required to take into account the radioactive decay of the calibration source. This will be implemented in the next IODB release.

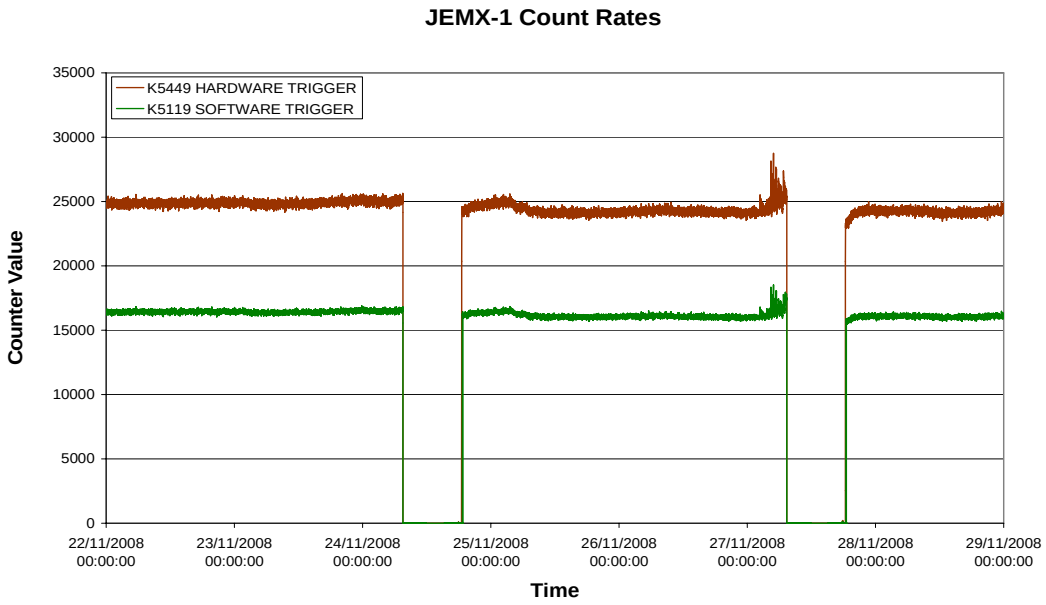
2008-11-26 (DOY 331, Rev 747) to 2008-11-28 (DOY 333, Rev 748)

IBIS operations executed nominally.

8.3.4 JEM-X Operations

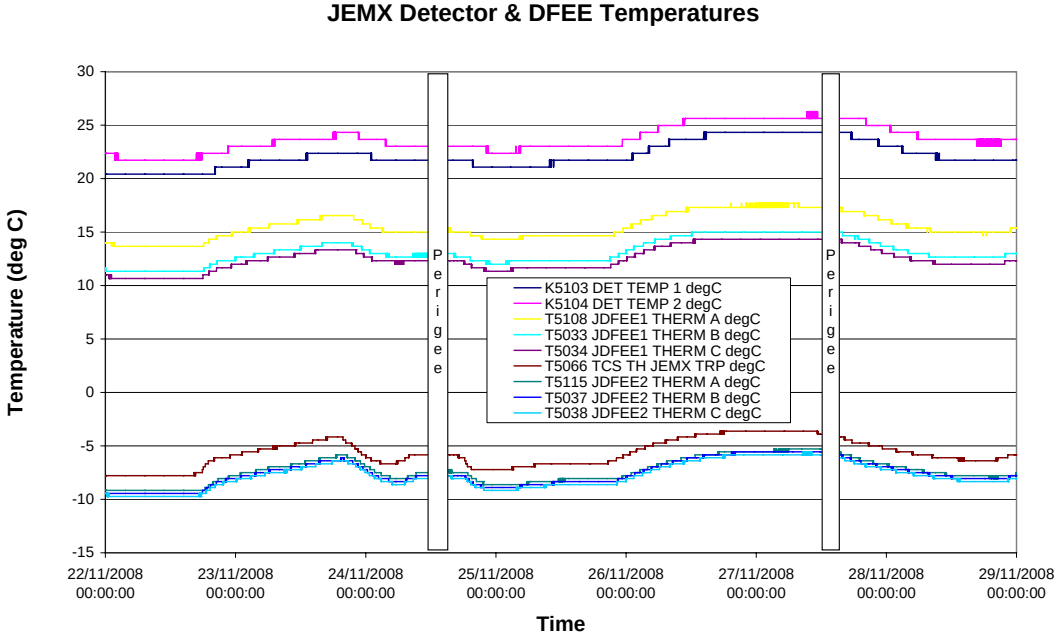
JEM-X Count Rates

JEM-X count rates over the reporting period are displayed in the following graph[1].



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 graph[2].



[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

2008-11-22 (DoY 327, Rev 746) to 2008-11-27 (DoY 332, Rev 747-748)

JEM-X 1 operations executed nominally.

2008-11-28 (DoY 333, Rev 748)

The following OEMs were received at the indicated times:

```
2008.333.20.24.03.503    2008.333.20.24.05.564    1536    RealTime    5          ANOMALY
JEM-X1 CSSW INT ER EXCEPTIO                                0        0    65535    PR     N
E   E
    FIX6                                                   0
    K9079          MESS CLASS                              2
    K9080          MESS ID                                 5
    K9074          TASK ID 16                              12
    K9067          LOGICAL ADDRESS                         4989
2008.333.20.24.03.503    2008.333.20.24.05.609    1536    RealTime    5          ANOMALY
JEM-X1 CSSW INT ER EXCEPTIO                                0        0    65535    PR     N
E   E
    FIX6                                                   0
    K9079          MESS CLASS                              2
    K9080          MESS ID                                 5
    K9074          TASK ID 16                              12
    K9067          LOGICAL ADDRESS                         4989
2008.333.20.24.03.503    2008.333.20.24.05.610    1536    RealTime    5          ANOMALY
JEM-X1 CSSW INT ER EXCEPTIO                                0        0    65535    PR     N
E   E
    FIX6                                                   0
    K9079          MESS CLASS                              2
    K9080          MESS ID                                 5
    K9074          TASK ID 16                              12
    K9067          LOGICAL ADDRESS                         4989
2008.333.20.24.03.503    2008.333.20.24.05.611    1536    RealTime    5          ANOMALY
JEM-X1 CSSW INT ER EXCEPTIO                                0        0    65535    PR     N
E   E
    FIX6                                                   0
    K9079          MESS CLASS                              2
    K9080          MESS ID                                 5
    K9074          TASK ID 16                              12
    K9067          LOGICAL ADDRESS                         4989
2008.333.20.24.03.503    2008.333.20.24.05.612    1536    RealTime    5          ANOMALY
JEM-X1 CSSW INT ER EXCEPTIO                                0        0    65535    PR     N
E   E
    FIX6                                                   0
    K9079          MESS CLASS                              2
    K9080          MESS ID                                 5
    K9074          TASK ID 16                              12
    K9067          LOGICAL ADDRESS                         4989
2008.333.20.24.03.503    2008.333.20.24.05.612    1536    RealTime    5          ANOMALY
JEM-X1 CSSW INT ER EXCEPTIO                                0        0    65535    PR     N
E   E
    FIX6                                                   0
    K9079          MESS CLASS                              2
    K9080          MESS ID                                 5
    K9074          TASK ID 16                              12
    K9067          LOGICAL ADDRESS                         4989
2008.333.20.24.03.503    2008.333.20.24.05.613    1536    RealTime    5          ANOMALY
JEM-X1 CSSW INT ER EXCEPTIO                                0        0    65535    PR     N
E   E
    FIX6                                                   0
    K9079          MESS CLASS                              2
    K9080          MESS ID                                 5
    K9074          TASK ID 16                              12
    K9067          LOGICAL ADDRESS                         5336
```

No action was taken and there was no impact.

8.3.5 OMC Operations

2008-11-22 (DoY 327, Rev 746) to 2008-11-25 (DoY 330, Rev 747)

Nothing to report.

2008-11-26 (DoY 331, Rev 747)

At 10:39:24, the OEM message for the start of pointing 07470042 arrived twice for some reason, there was no impact.

At 13:37, the MU1323 command in the OMC command sequence failed release due to a brief TM drop from DSS27. The impact was the loss of pointing 07470045.

At 16:33, another TM drop caused the AOCS Search/Track commands to fail release. The impact was the loss of pointing 07470048.

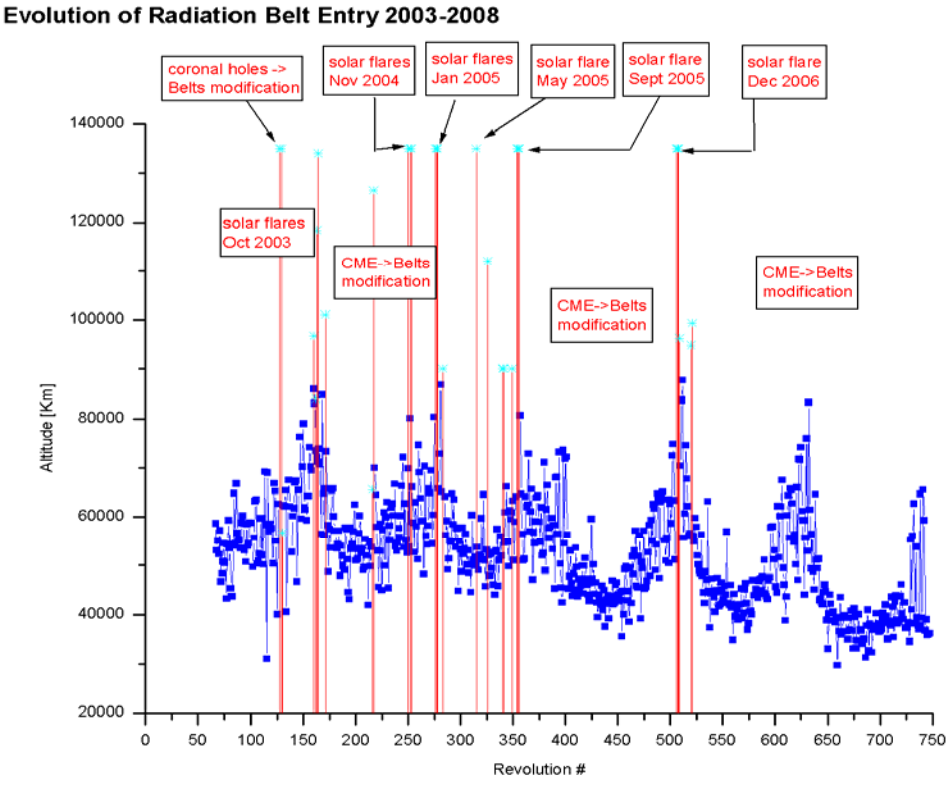
2008-11-27 (DoY 332, Rev 747) to 2008-11-28 (DoY 333, Rev 748)

Nothing to report.

On DoY 329 at 08:25:40 and DoY 332 at 08:15:57 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



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]
746	RAD_ENTR R 2008-11-24T08:25:37Z	24/11/2008 10:36:27	35996.4	24-Nov-2008 10:35:56	36172.09
747	RAD_EXIT R 2008-11-24T18:10:48Z	24/11/2008 16:46:59	>>33847.6	24-Nov-2008 17:25:56	46350.27
747	RAD_ENTR R 2008-11-27T08:15:51Z	27/11/2008 10:25:55	36157.6	27-Nov-2008 10:32:16	35247.9
748	RAD_EXIT R 2008-11-27T17:59:59Z	27/11/2008 16:51:47	>>33888.1	27-Nov-2008 17:12:16	45714.18

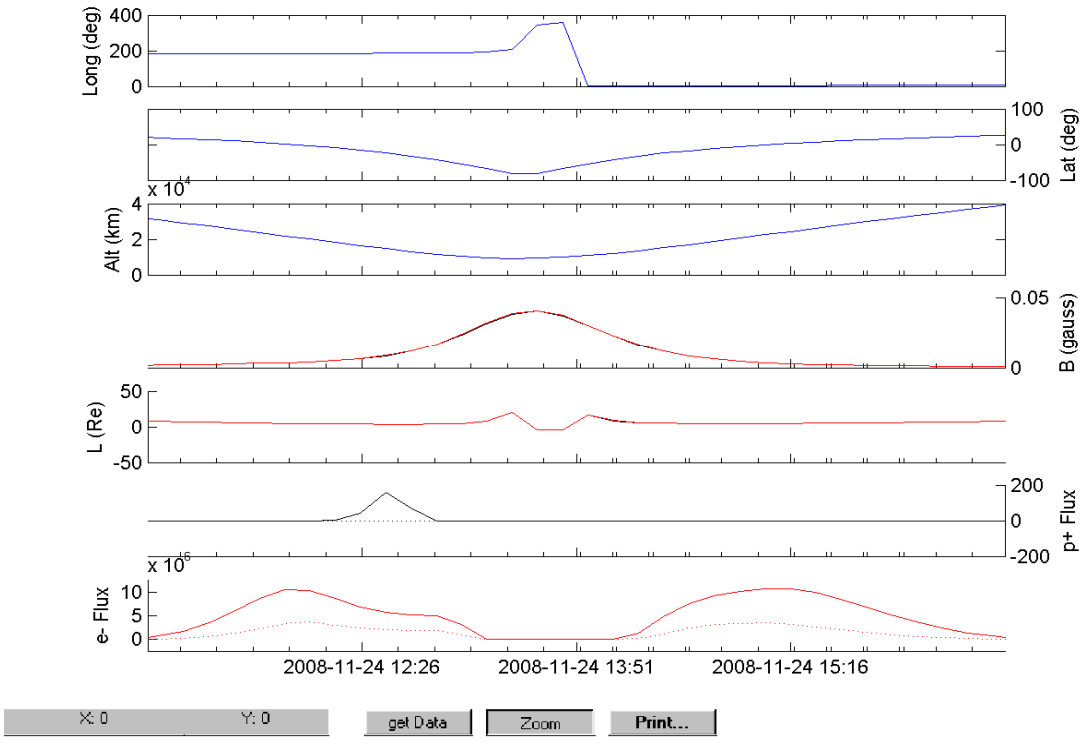
Reference
High radiation
Very small error vs reference (less than 10 minutes)
Small error vs reference (between 10 and 30 minutes)
Large error vs reference (more than 30 minutes)
* Rad belt entry time ignoring previous threshold crossings where a gap of more than 30 minutes is present.

IREM radiation counters:

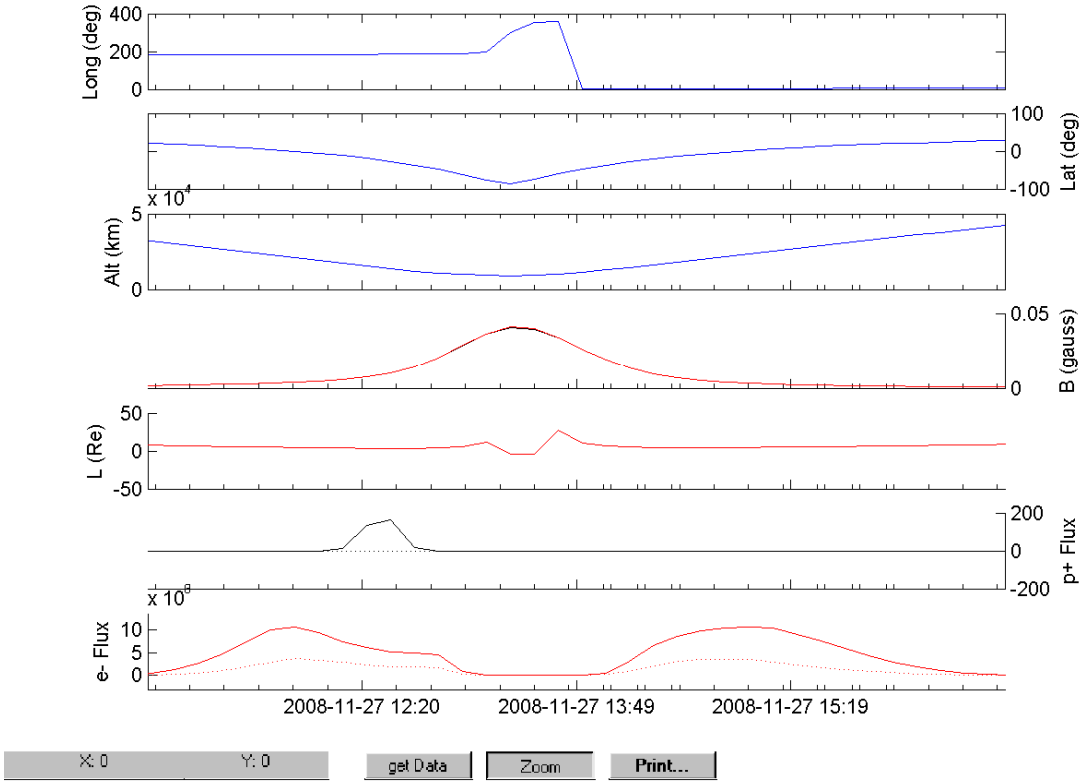
The IREM radiation counter plots are not available this week.

IREM Predicted Radiation Belt Passages

Rev 746

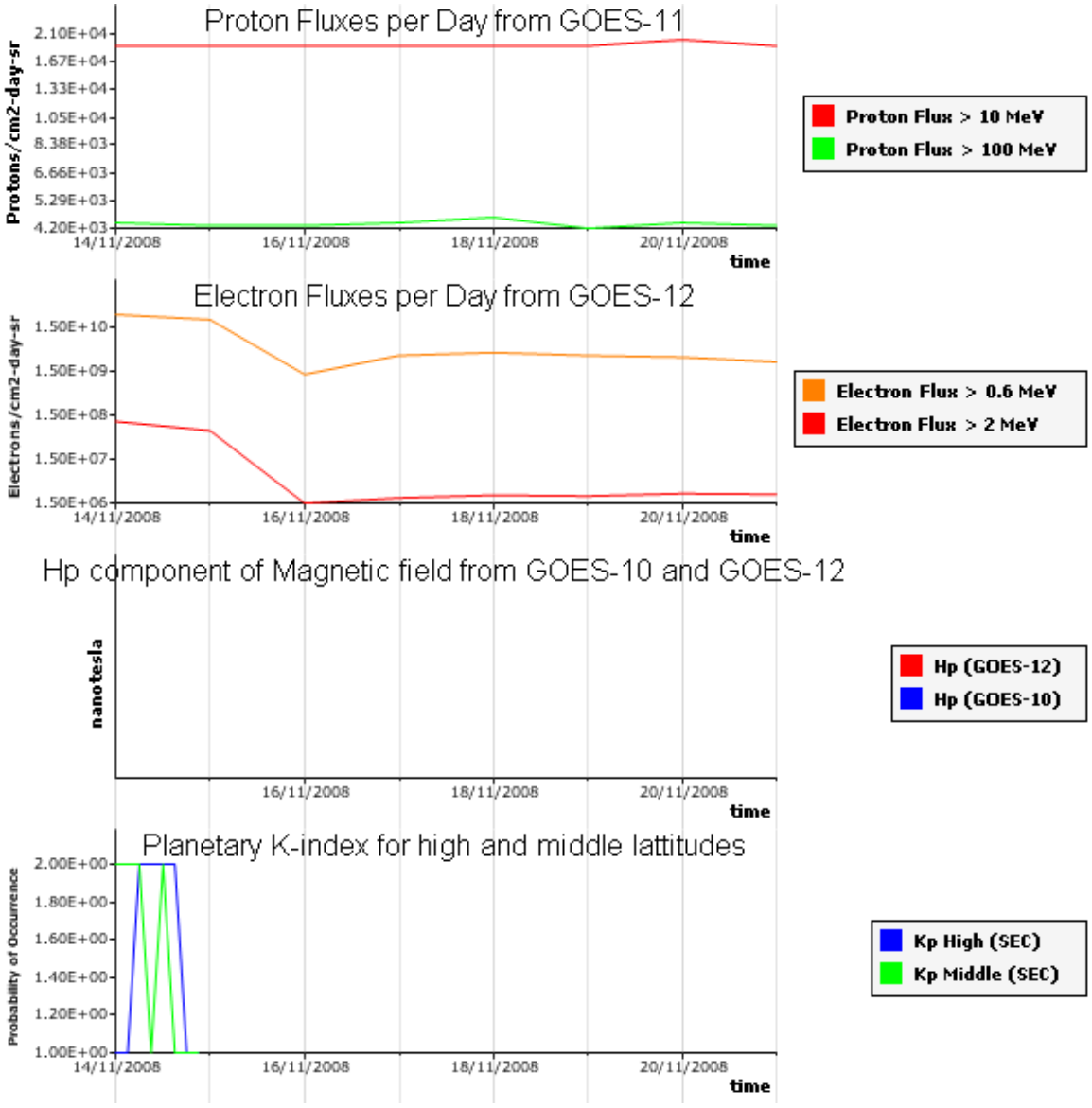


Rev 747


Long (deg)
400
200
0
100
0
-100
Lat (deg)
x 10^4
Alt (km)
5
0
0.05
0
B (gauss)
L (Re)
50
0
-50
200
0
-200
p+ Flux
x 10^3
e- Flux
10
5
0
2008-11-27 12:20
2008-11-27 13:49
2008-11-27 15:19
X: 0
Y: 0
get Data
Zoom
Print...

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

The system was down for most of the week, and only some data was available:



Proton and electron flux report low radiation background.
Hp component of the Geomagnetic Field is essentially parallel to the Earth's rotation axis. A drop near 0 nT is associated with a significant variation in the magnetic field.
Kp index is based on ground magnetometers. Kp >=5 features storm-level geomagnetic activity.