

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No.321
Week 46
17.11.08
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 08.11.08 until 14.11.08 (both dates inclusive) and covers the revolutions 741, 742 and 743.

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 1 raster dither of mid-latitude 2 (RA 19:42:44.23, DEC -15:04:03.4), a hexagonal dither of the Gamma Ray Source 1915+105 (RA 19:15:11.50, DEC +10:56:44.0) and a raster dither of the Cygnus Region (RA 20:35:53.00, DEC +40:39:49.0).

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.

Three slews were missed from TL, during the observation period, due to problem on IMCS

The fuel consumption over the period between 08/11/2008 and 14/11/2008 was 0.0622 Kg. The remaining propellant is in the order of 137.6425 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

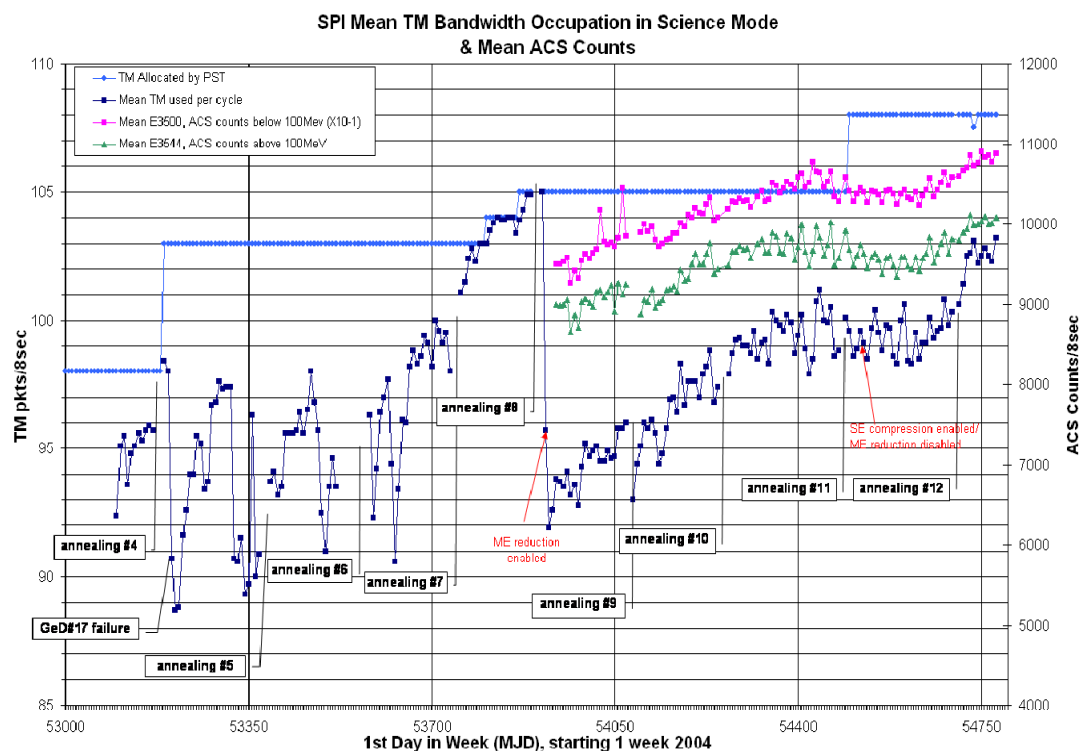
3.2.1 SPI

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 $\pm$ 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 103.2 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.

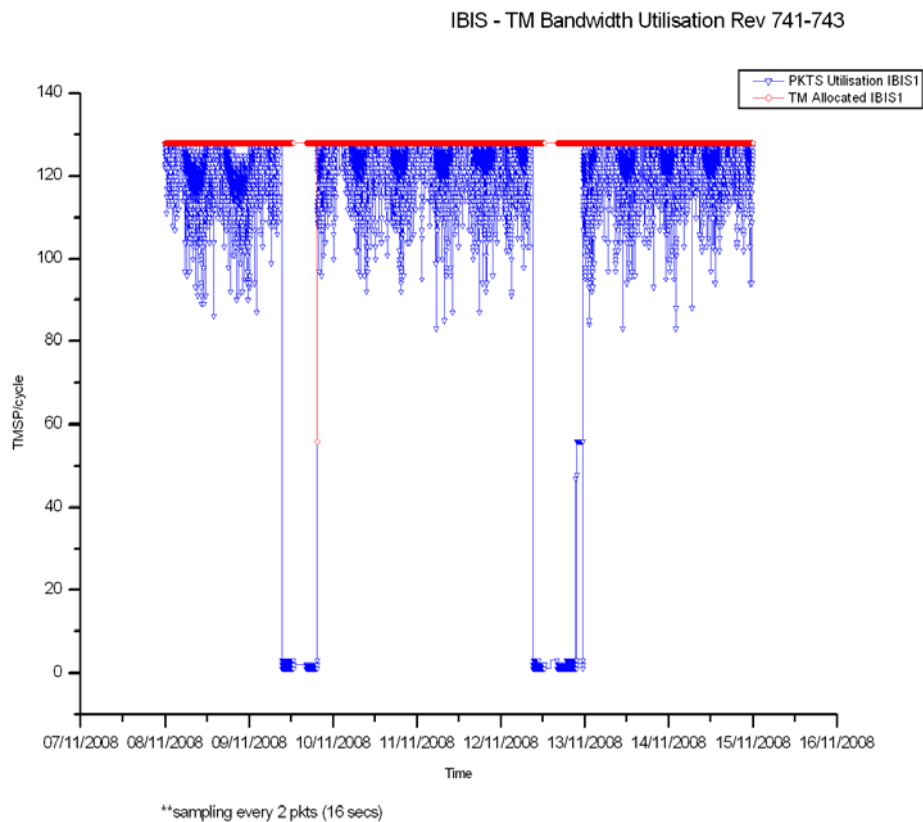
3.2.2 IBIS

The overall status of the unit is nominal.

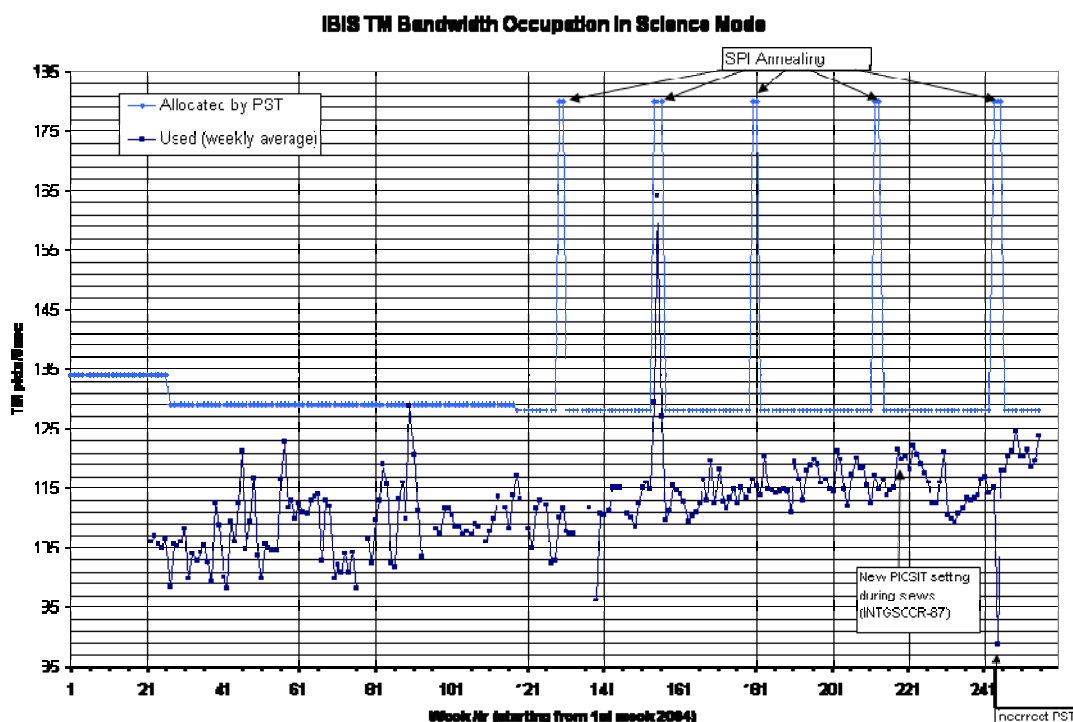
During the reporting period, the TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 128 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 123.86 packets/cycle (up 4.12 on previous week)
- Percentage of TM cycles in which full bandwidth was used: 55.93%

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, 235 of the 240 planned science pointings were executed nominally, 5 were lost.

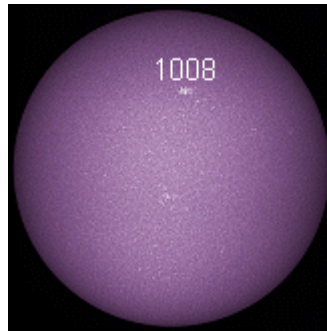
Note: Some more information concerning the OMC operations is provided in the Appendix.

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, #1008 appeared on the 10th, and remained visible for the rest of the week. The risk of solar flares was very low. The image below was taken through a violet Calcium-K filter.



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. Three pointings were 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. Three pointings were lost to MOC related issues. More information is given in section 6.

4.2 Ground Stations & Network

The performance of the ground stations and Network was good this week. On DoY 315 there was a TM drop from Redu at 15:54Z and Bad Frames were received at 20:41Z with no impact on operations. On DoY 316 at 17:55Z the Spacon reported no onboard bit lock. The cause was an early carrier uplink from DSS27 interfering with Redu's uplink. A telecon with JPL will be performed to discuss the DSN stations performance degradation. On DOY 317 at 01:07Z there were some short TM drops from DSS-27. At 18:46Z there was no TC link available from Redu for about 10 minutes. Eutelsat performed an emergency support proficiency test at short notice. Integral was moved to Vilspa Groundstation.

The SICFs validity dates have been updated on all stations' TMTCSs. NCTRSs' updates are pending, as well as the end-to-end validation.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 749 and 750.

Observations have been re-planned for revolution 746 for the same targets due to a database issue at ISOC.

A TSF has been received for revolution 745.

2. Observation status

New ECS files have been received for revolutions 729 to 734.

3. ISOC Science Data Archive

A date in early December has been set for the installation of the updated Ingest software.

4. ISOC system

Work is ongoing on the updates to PGT and ISOC system V20. The final release is foreseen for 24 November.

5. Problems

No new problems.

4.3.2 ISDC

Status of ISDC observation processing on 17/11/2008:

- Latest Standard Analysis completed: observation 06200210002 (GRS 1915+105, Revolution 726) on 29/10/2008.

- Latest products archived: observation 05200320004 (X Per, Revolutions 724) on 30/10/2008.

- 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:

- DOY 317 12-11-2008

At 18:38Z the Autostack stopped. Attempted restarted but stopped again. The Spacon tried moving to the B-chain but the TC link dropped out. At 18:51Z the Spacon decided to move back to the A-chain with TMTCS2 configured at the station and the Autostack was restarted and worked stable afterwards. The AOCS S/S was recovered with 2 manual slews and a recovery of the missed instrument activation sequences and OBDH commanding performed. The recovery was completed at 23:00Z.

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

AR id	Date Created	Subject	Segment	Status
INT-3039	2008-11-11	REDU - NO BITLOCK (DOY 316)	NASA Station	Pending
INT-3040	2008-11-12	TMTCS - known bug caused autostack to crash 2x (DOY 317)	IMCS	Pending
INT_SC-242	2008-11-11	VETO VDM04 High Voltage Breakdown	Payload	Pending
INT_SC-243	2008-11-13	IREM Anomaly: Reset of IREM_CSCI S/W #69, 01/11/2008	Payload	Pending

7 Future Milestones

IODB_3.1_058 is to undergo testing and validation on the C-Chain.

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 741

The observations in revolution 741 began with a raster dither of mid-latitude 2 (RA 19:42:44.23, DEC -15:04:03.4), lasting ~7.7 hours. They continued with a hexagonal dither of the Gamma Ray Source 1915+105 (RA 19:15:11.50, DEC +10:56:44.0), lasting ~5.6 hours. Finally a raster dither of the Cygnus Region (RA 20:35:53.00, DEC +40:39:49.0) lasting ~42.8 hours until the end of the revolution.

Revolution 742

The observations in revolution 742 consisted entirely of a raster dither of the Cygnus Region (RA 20:35:53.00, DEC +40:39:49.0) lasting ~56.7 hours.

Revolution 743

The observations in revolution 743 began with a hexagonal dither of the Gamma Ray Source 1915+105 (RA 19:15:11.50, DEC +10:56:44.0), lasting ~5.6 hours. They continued with a raster dither of the Cygnus Region (RA 20:35:53.00, DEC +40:39:49.0) lasting ~51.1 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

2008-10-24T03:31:13.000Z	137.9108	F	Automatic TM processing.
2008-10-25T17:57:17.000Z	137.8982	F	Automatic TM processing.
2008-10-27T03:15:21.000Z	137.8806	F	Automatic TM processing.
2008-10-28T17:45:49.000Z	137.8618	F	Automatic TM processing.
2008-10-30T03:38:56.000Z	137.8052	F	Automatic TM processing.
2008-10-31T17:35:24.000Z	137.7942	F	Automatic TM processing.
2008-11-02T02:58:40.000Z	137.7738	F	Automatic TM processing.
2008-11-03T17:23:08.000Z	137.7612	F	Automatic TM processing.
2008-11-05T02:44:56.000Z	137.7177	F	Automatic TM processing.
2008-11-06T17:13:16.000Z	137.7047	F	Automatic TM processing.
2008-11-08T02:26:15.000Z	137.6969	F	Automatic TM processing.
2008-11-09T17:03:00.000Z	137.6951	F	Automatic TM processing.
2008-11-11T02:15:36.000Z	137.6714	F	Automatic TM processing.
2008-11-12T16:48:36.000Z	137.6677	F	Automatic TM processing.
2008-11-14T02:18:40.000Z	137.6425	F	Automatic TM processing.

This report was generated Fri Nov 14 08:00:28 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, 08/11/2008 – 14/11/2008

The AOCS operations were executed from the Automatic Timeline.

During this period, 150 Open Loop Slews, 94 Closed Loop Slews and 5 Momentum Biases were executed (as reported by ACC OEM).

3 slews (2 OSL, 1 CSL) were missed from TL, during the observation period, due to a problem on the AutoStack task of IMCS.

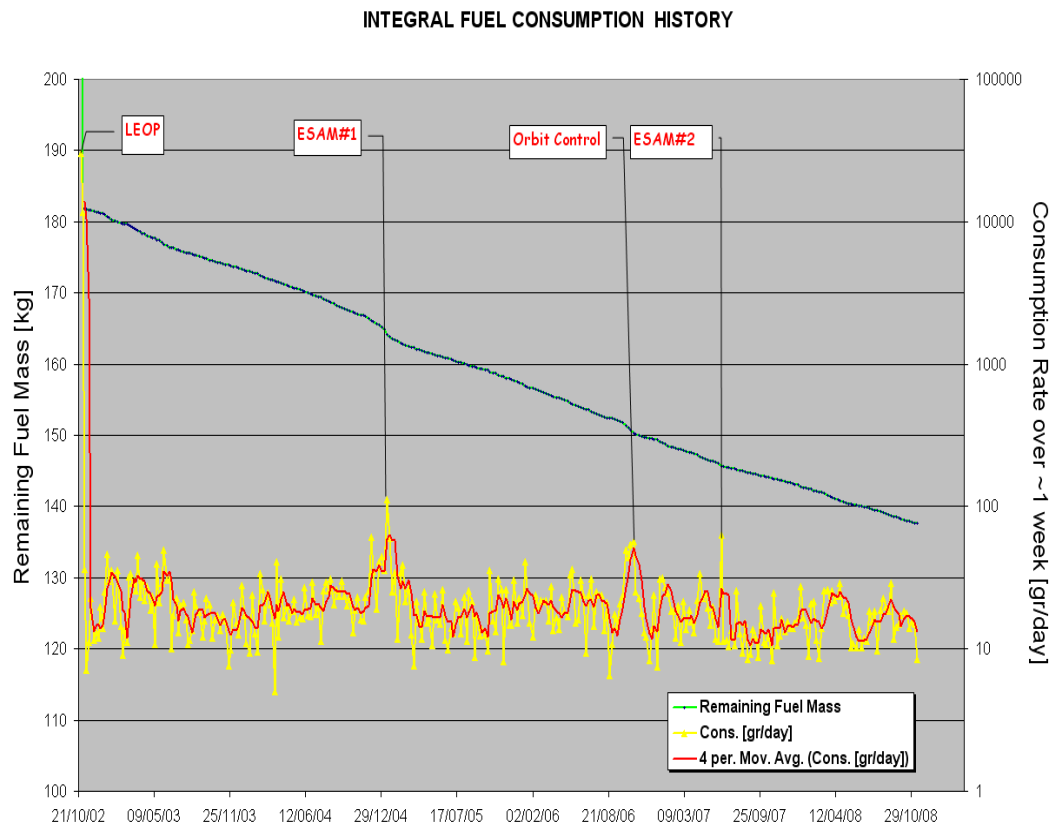
The OTF was partially not reached during PID 07420102.

Orbit Control

No update

Fuel consumption

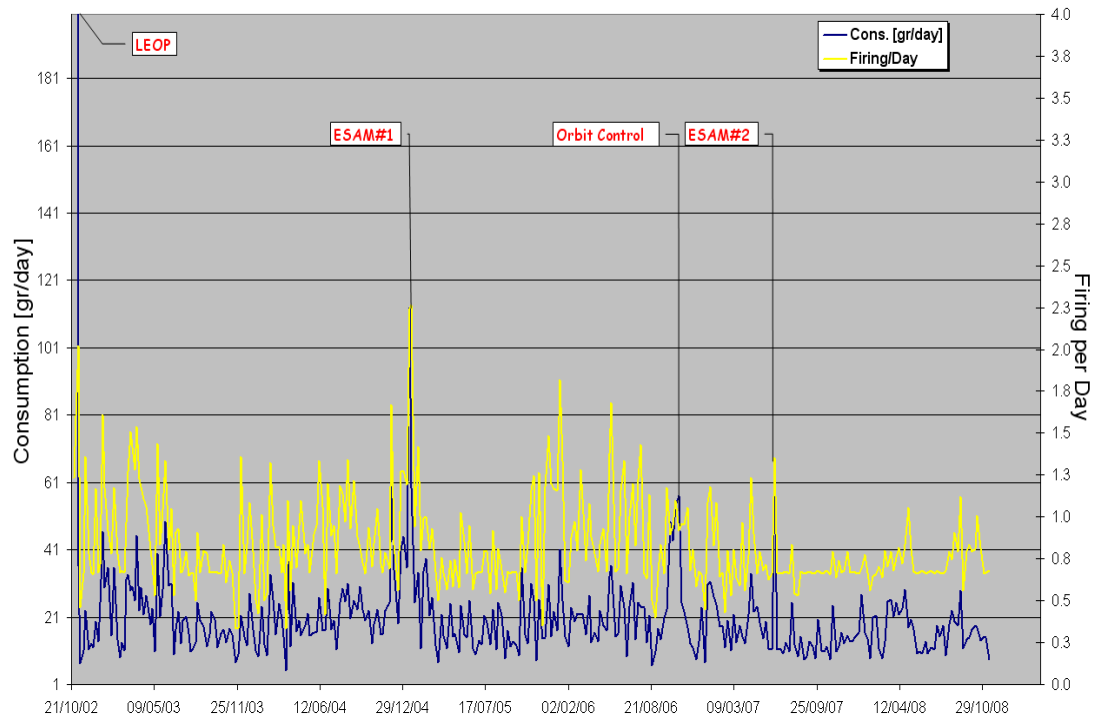
The fuel consumption (total, grams per day) over the period between 01/11/2002 and 14/11/2008 is reported in the plot below.



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 14/11/2008 is reported in the plot below.

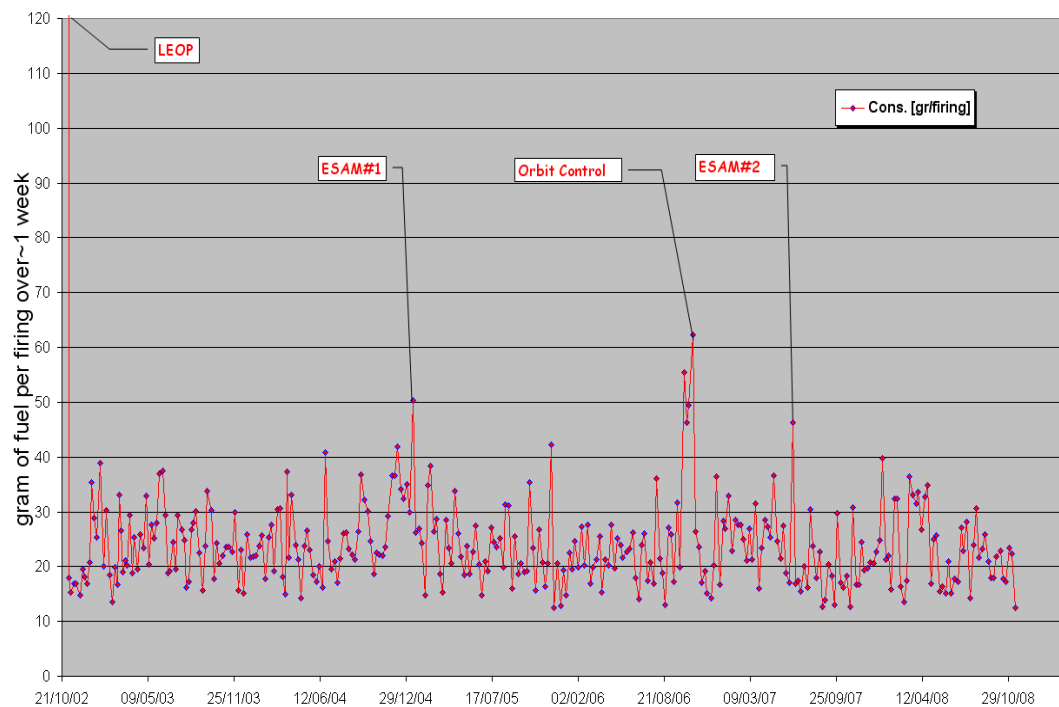
INTEGRAL FIRING PER DAY HISTORY



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 14/11/2008 is shown in the plot below.

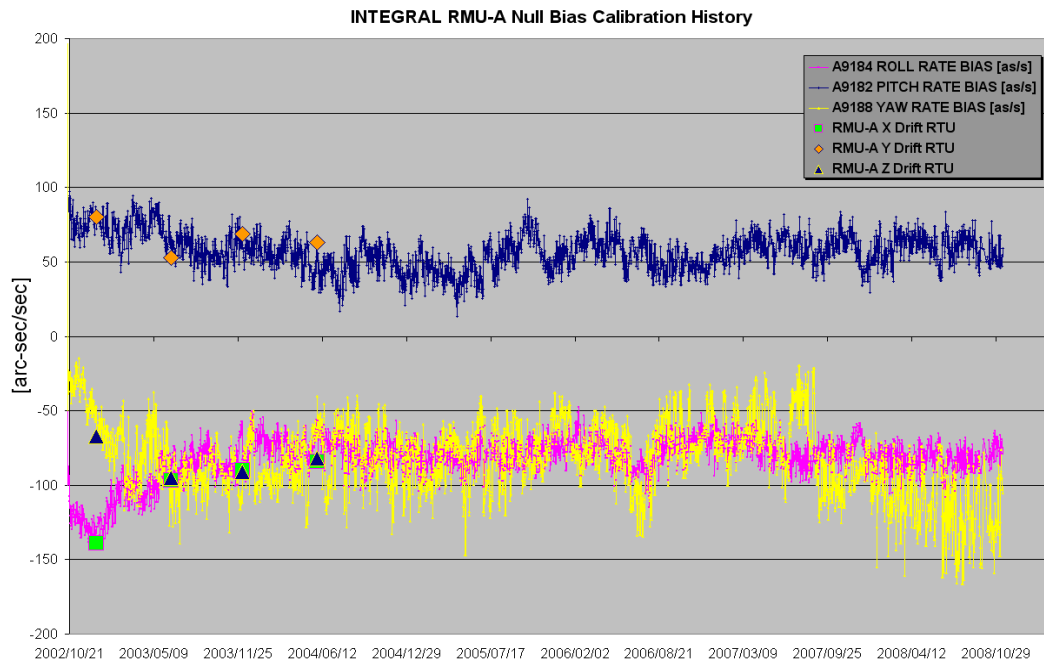
INTEGRAL FUEL MASS PER FIRING HISTORY



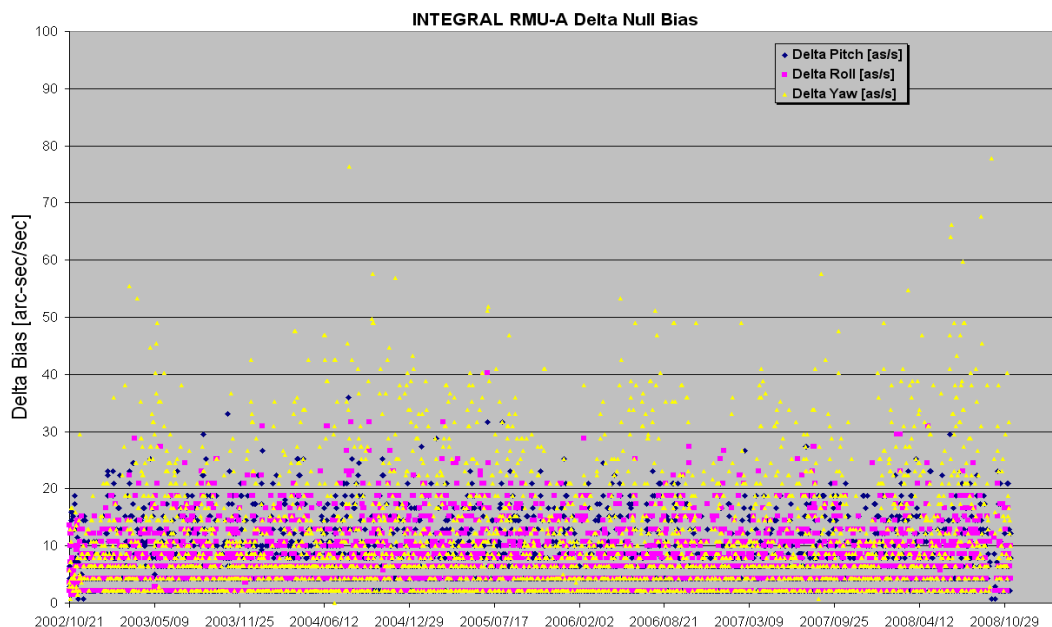
The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 14/11/2008 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 14/11/2008 is reported in the plot below.



08/11/2008 (Day of Year 313, Revolution 741)

Nothing to report.

09/11/2008 (Day of Year 314, Revolution 741-742)

Nothing to report.

10/11/2008 (Day of Year 315, Revolution 742)

Nothing to report.

11/11/2008 (Day of Year 316, Revolution 742)

Nothing to report.

12/11/2008 (Day of Year 317, Revolution 742-743)

Loss of guide star: at 10:39z a loss of the current guide star occurred. As foreseen by the IPS logic, the IMU1 went on until a new guide star picked.

The operator performed a manual mapping and the next slew was manually updated in TL.

The OTF was not reached partially during PID 07420102.

No impact on TL.

IMCS problem on AutoStack: at 18:38z a problem on the IMCS AutoStack task occurred. This cause several s/s to fail TC release. The operations were moved to the B-Chain but this action was not successful: the B-chain reported problem to connect to the ground stations. The operator then performed a switch back to A-chain but by using the TMTCS2. This time the connections worked and a recovery of the TL was initiated.

A manual recovery was performed from attitude of PID 07420104 to the attitude of PID 07430003 (by executing an OSL, followed by a CSL) and the next slew ID 07430004 was manually updated in TL.

The AOCS s/s was enabled in TL at 20:19z.

The following slews were not executed in TL: 07430001(OSL)-02(CSL)-03(OSL)

13/11/2008 (Day of Year 318, Revolution 743)

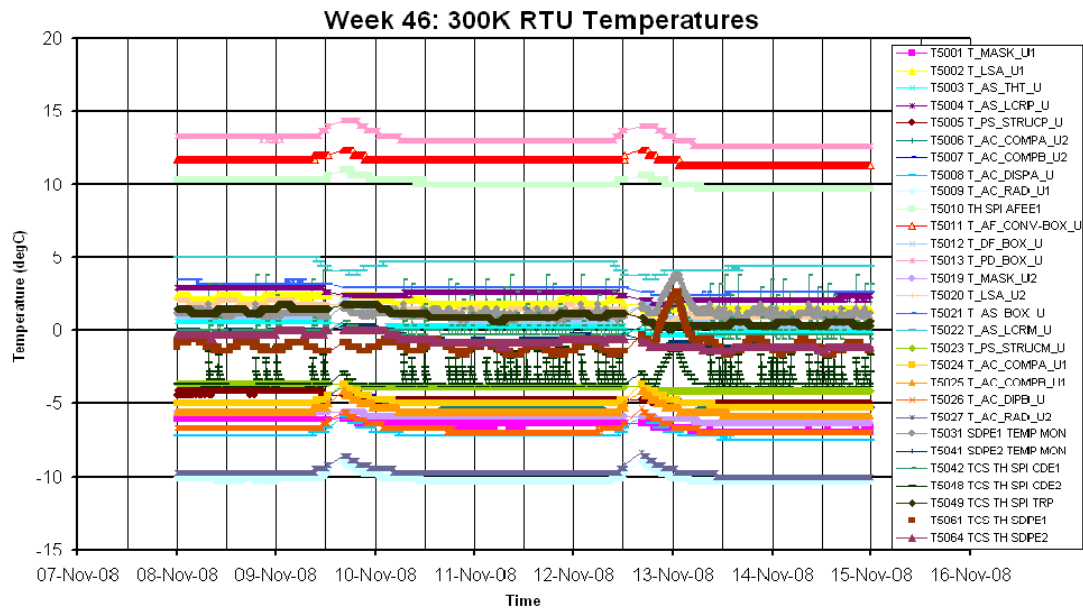
Nothing to report.

14/11/2008 (Day of Year 319, Revolution 743)

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.



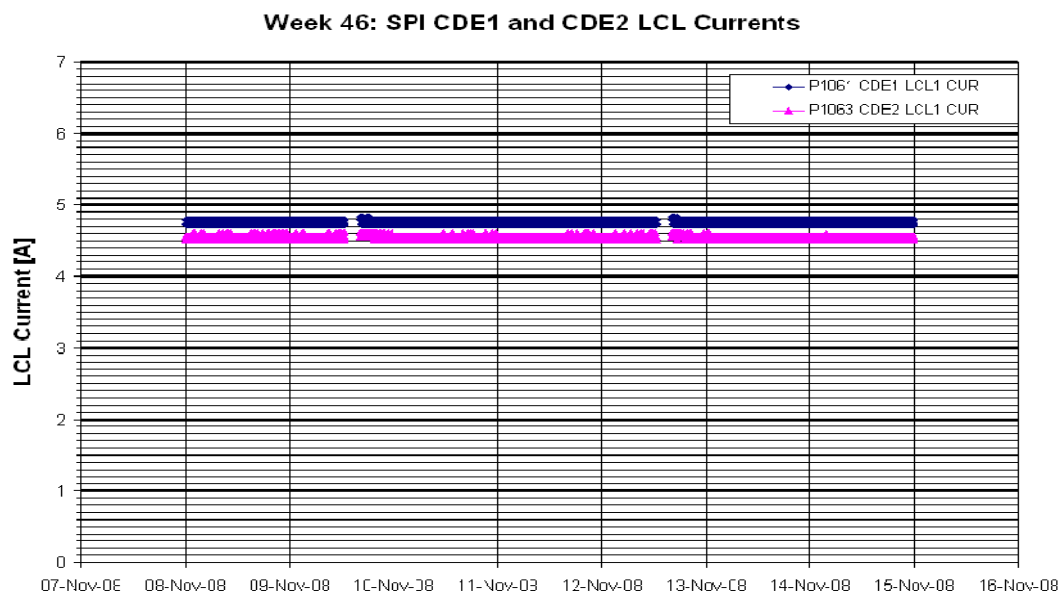
Stirling Compressors and Cryostat: The performance of the compressors is nominal.

The cold plate temperature was maintained in the range 80K +/-1K.

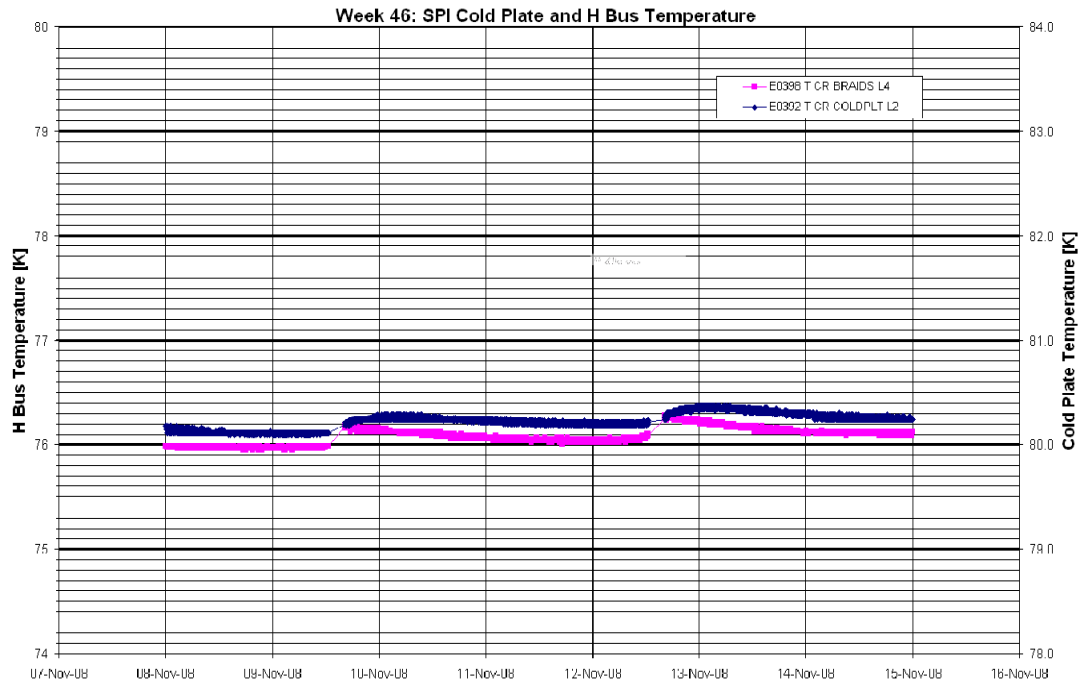
The stroke of all four compressors was set to 40 throughout the week and the average CDE LCL currents were as follows:

- 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.

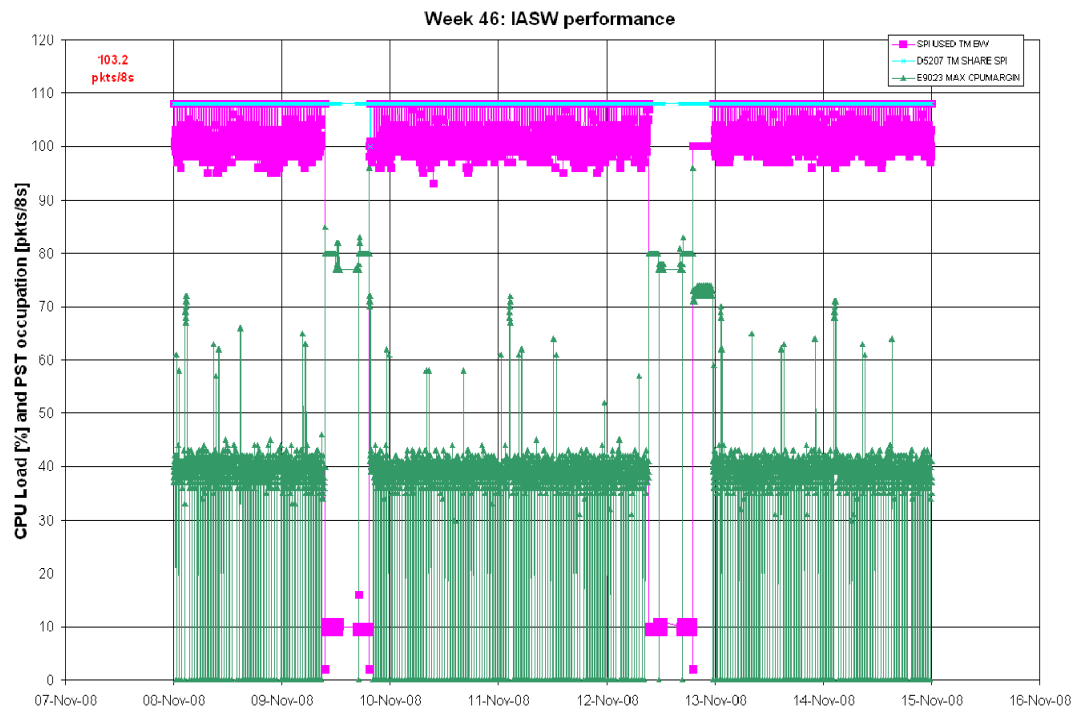


DPE & IASW: The DPE health and IASW performance are nominal.

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 103.2 packets/cycle over the science window when the TM allocation was 108 packets/cycle.

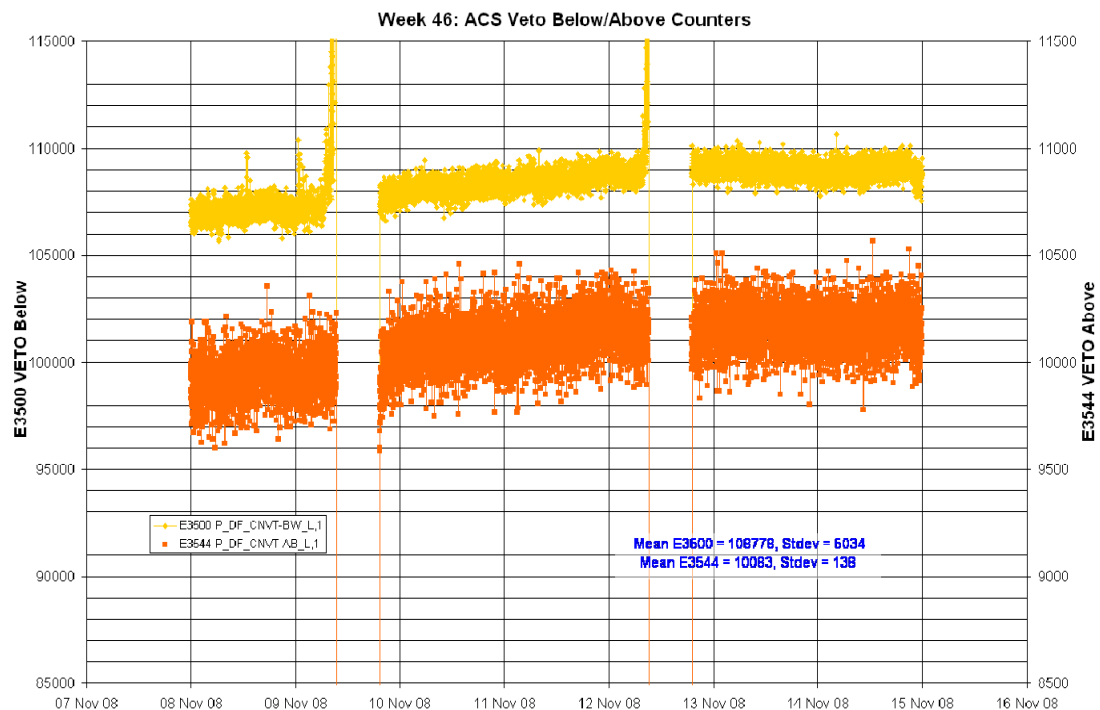
The following plot shows the IASW performance in terms of TM bandwidth occupation and DPE CPU load during the reporting period.

Due to a crash and subsequent inoperability of the Autostack at the start of revolution 743 (see Anomaly Report INT-3040), the PST ED scheduled at 2008-11-12T19:17:55Z was not executed and the planned TM allocation to the instruments was restored with the execution of the PST ED in the CCCF at 2008-11-12T23:32:34Z. Therefore between these times SPI had a TM allocation in the PST of 100 packets/cycle.

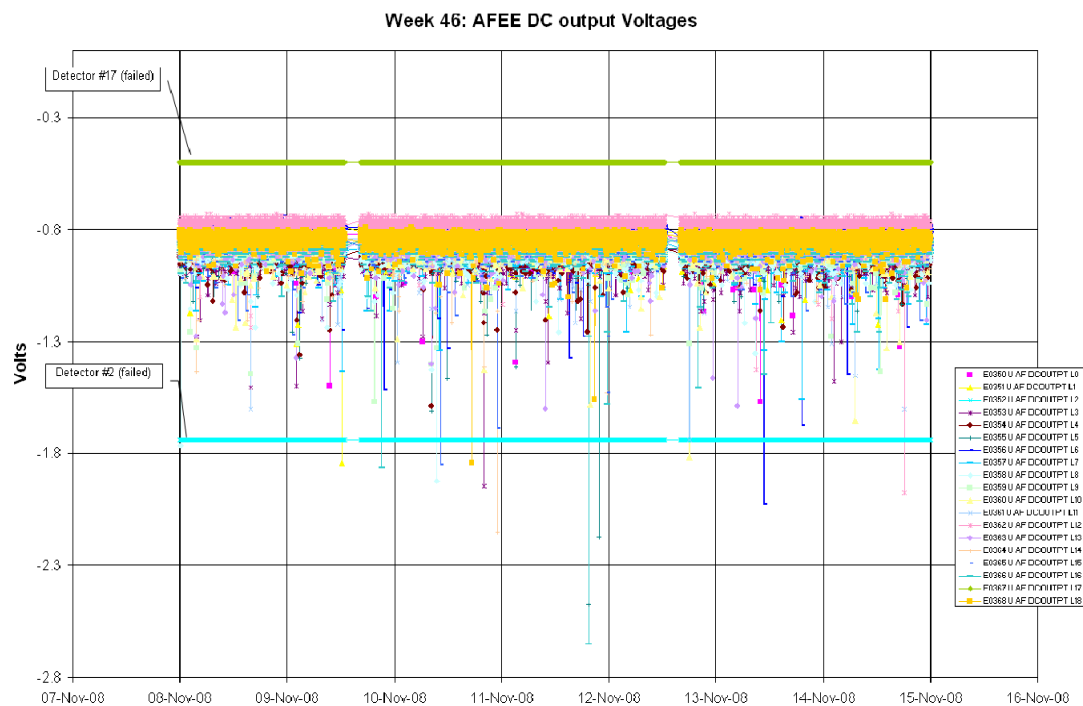


ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61).

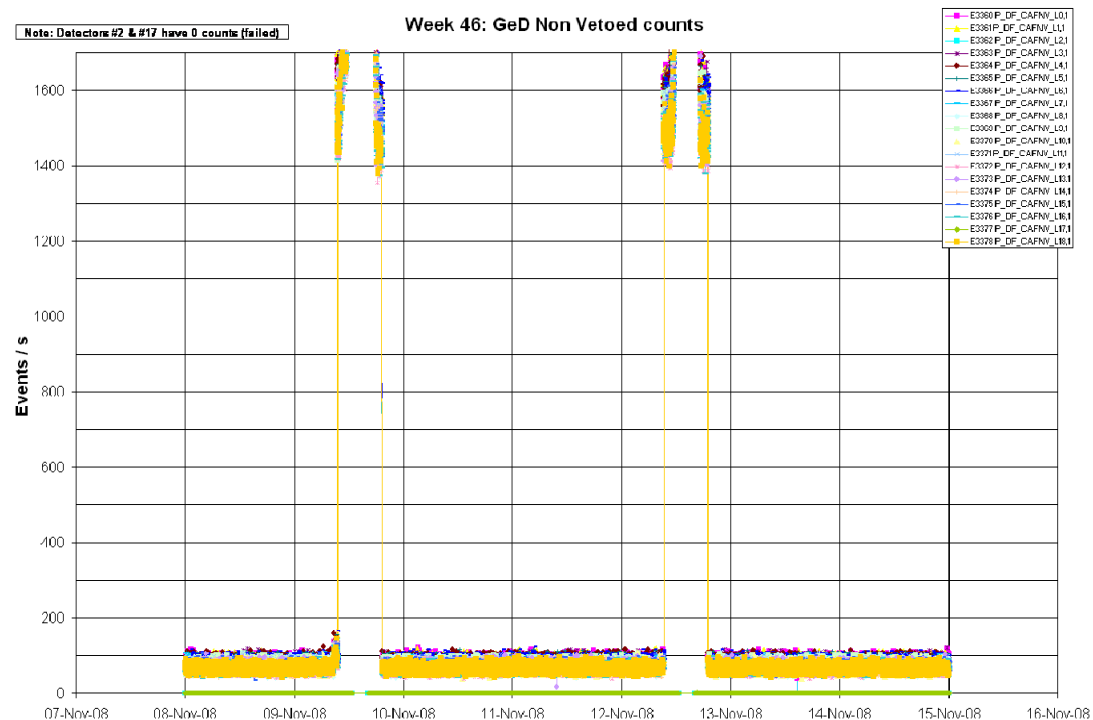
The following plot shows the ACS overall count rate evolution during the reporting period:

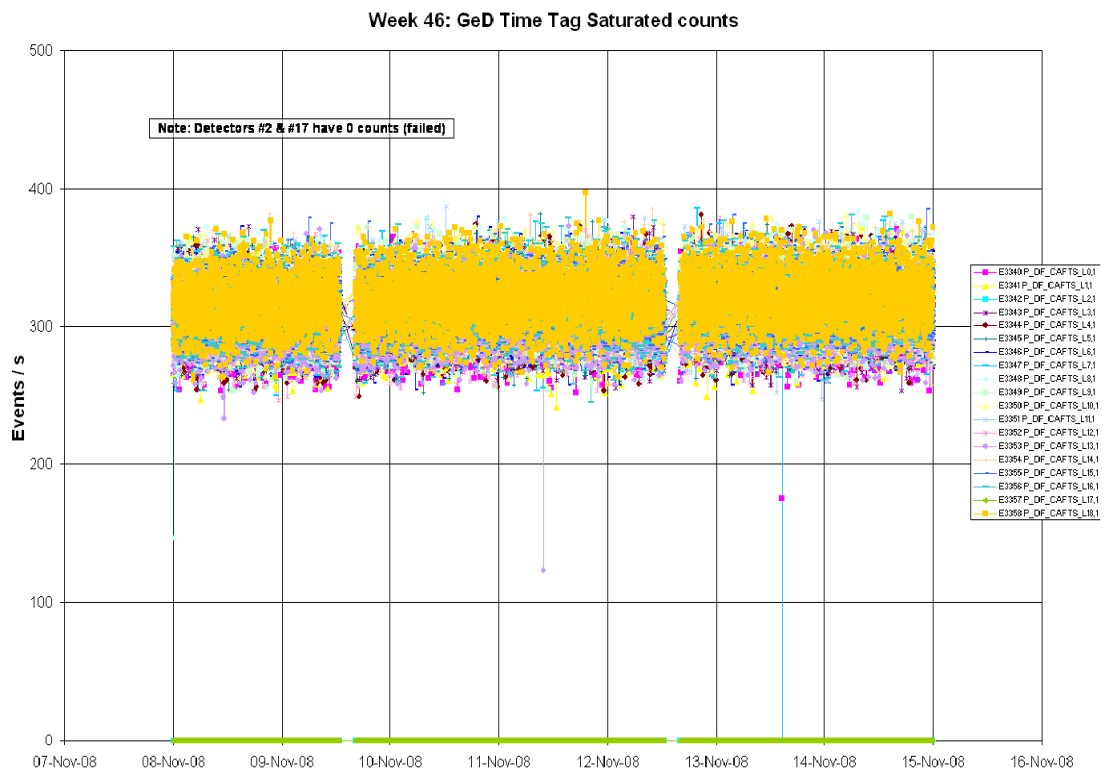
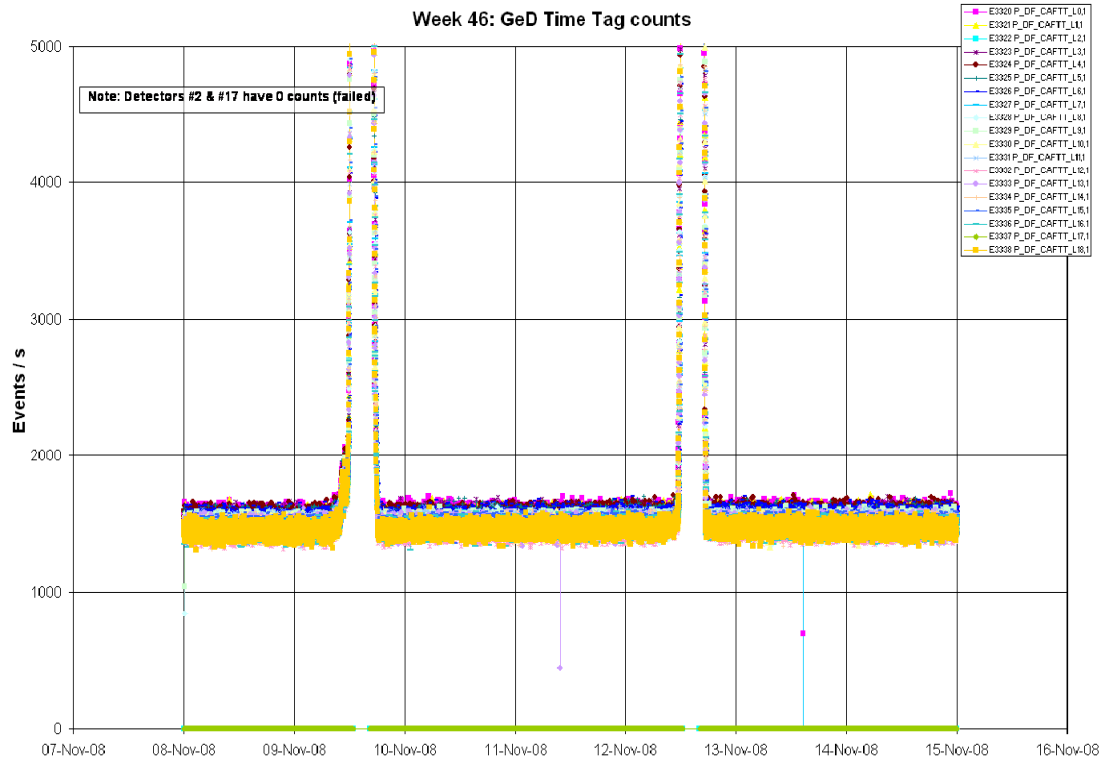


AFEE: The health of the AFEE is nominal. The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06/12/2003 and detector #17 is failed since 17/07/2004.

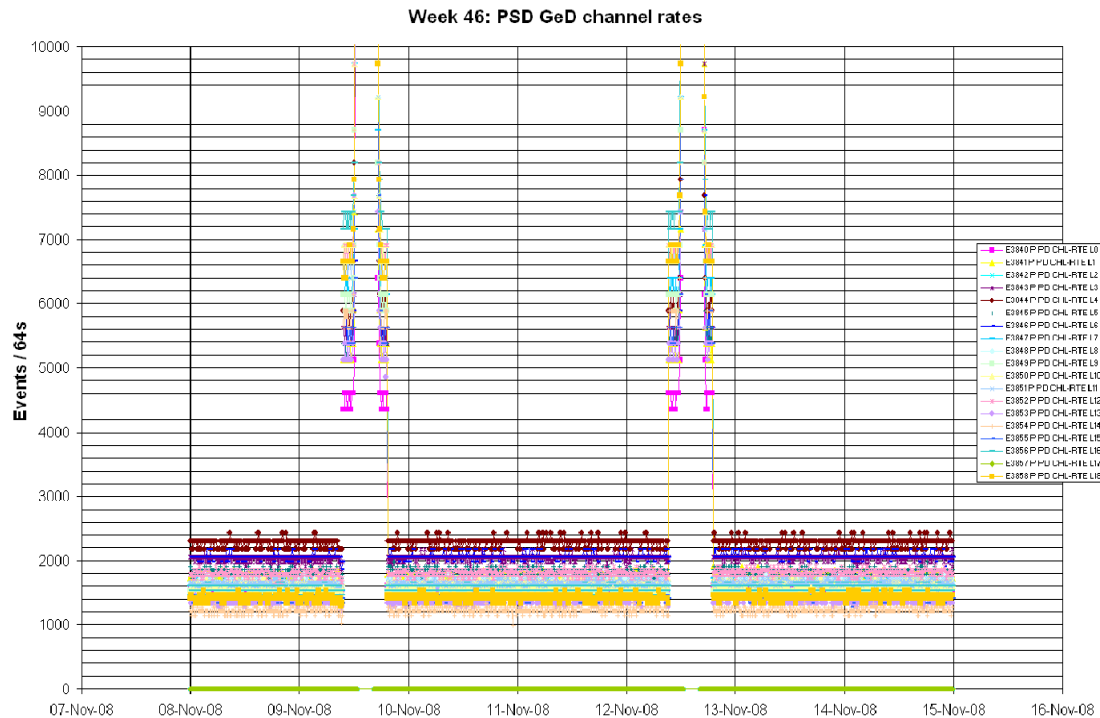


DFEE: The performance of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event count rates during the reporting period.





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



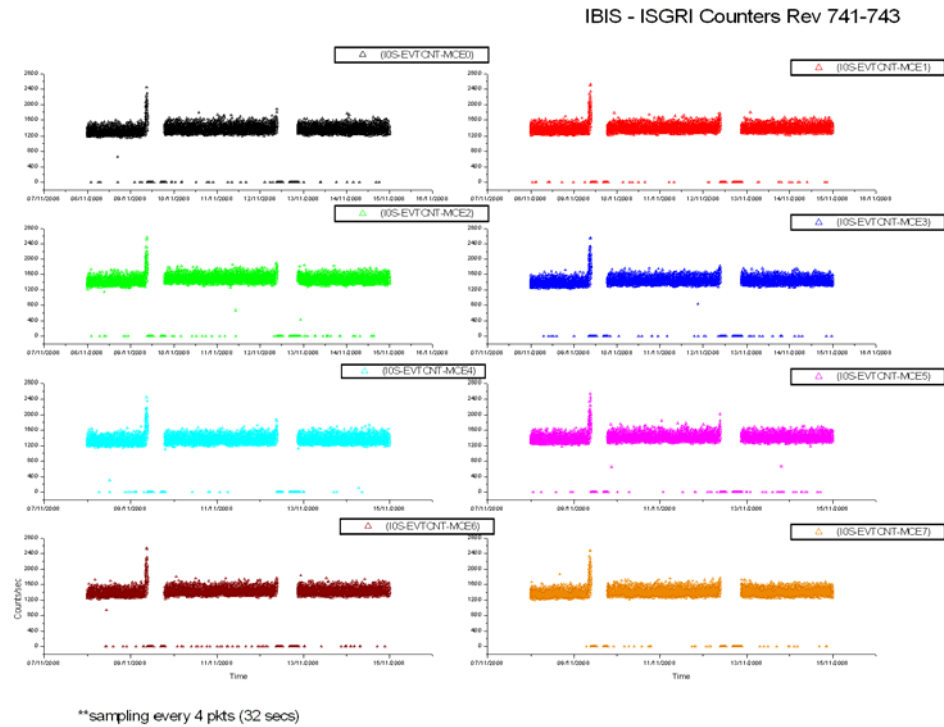
Event Log:

- On 2008-11-08 at 00:49:19Z TM parameter E2092 went OOL (value = PARAM > SPEC). This is the ACS FEE HV status #51. As it returned within limits when the next packet was received at 00:59:59Z, no action was taken.
- Due to high radiation before the expected radiation belt entry of revolution 741, on 2008-11-09 at 08:25:42Z TM parameter E3500 (ACS CntVetoBelow) went OOL, toggling OOL until radiation belt entry at 09:28:11Z.
- Due to high radiation before the expected radiation belt entry of revolution 742, on 2008-11-12 at 09:01:58Z TM parameter E3500 (ACS CntVetoBelow) went OOL, remaining OOL until radiation belt entry at 09:14:59Z.
- On 2008-11-12 at 16:53:53Z TM parameter E4009 went OOL, indicating errors on the HSL. As it returned within limits of its own accord at 16:54:01Z, no action was taken.

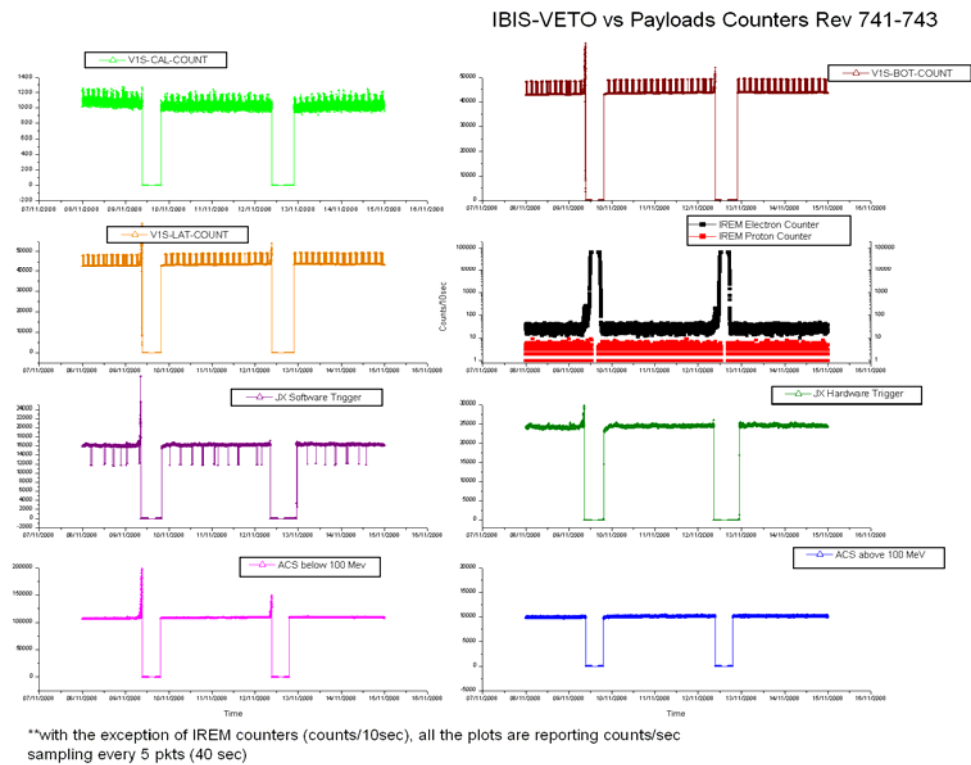
8.3.3 IBIS Operations

IBIS Event Counters Plots

ISGRI Counters:

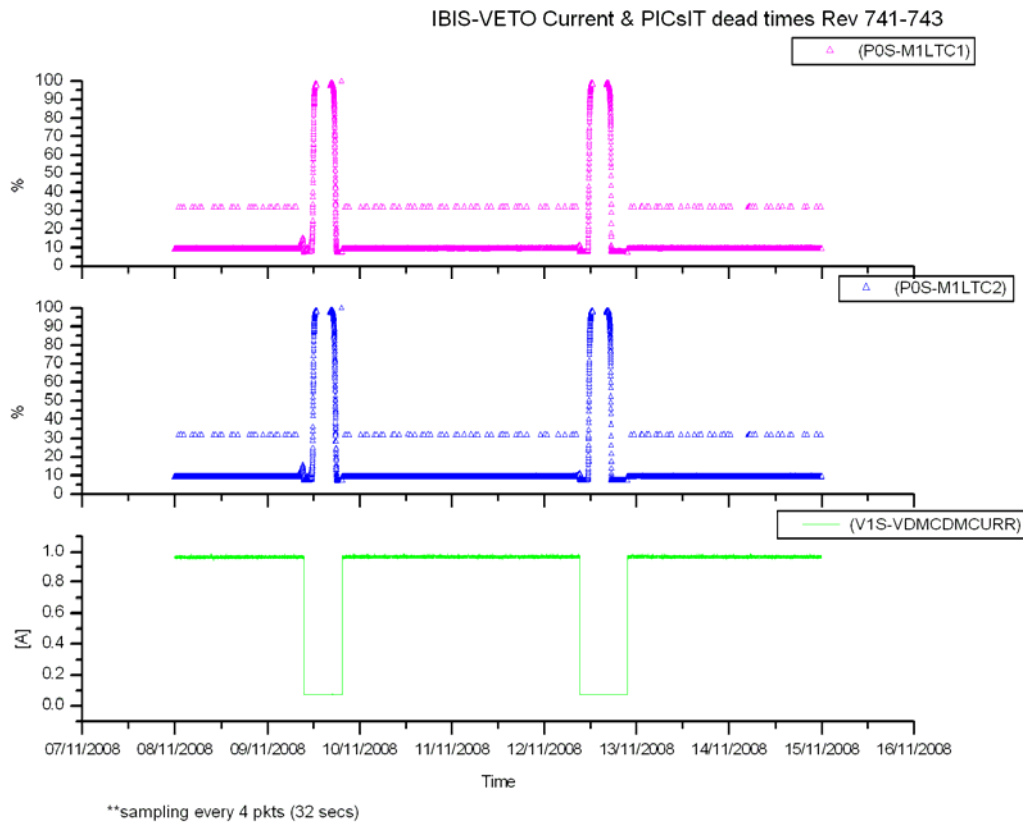


VETO vs Payload Counters:

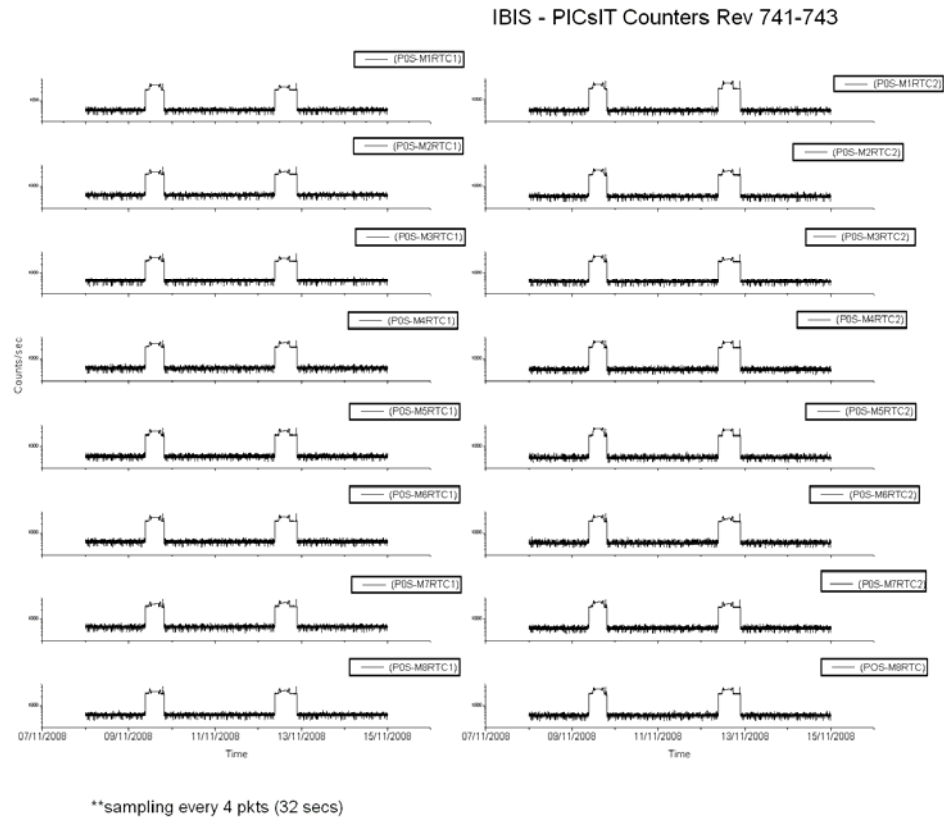


The week was characterised by slightly high radiation before the expected radiation belt entry of revolution 741 as reported by the payload.

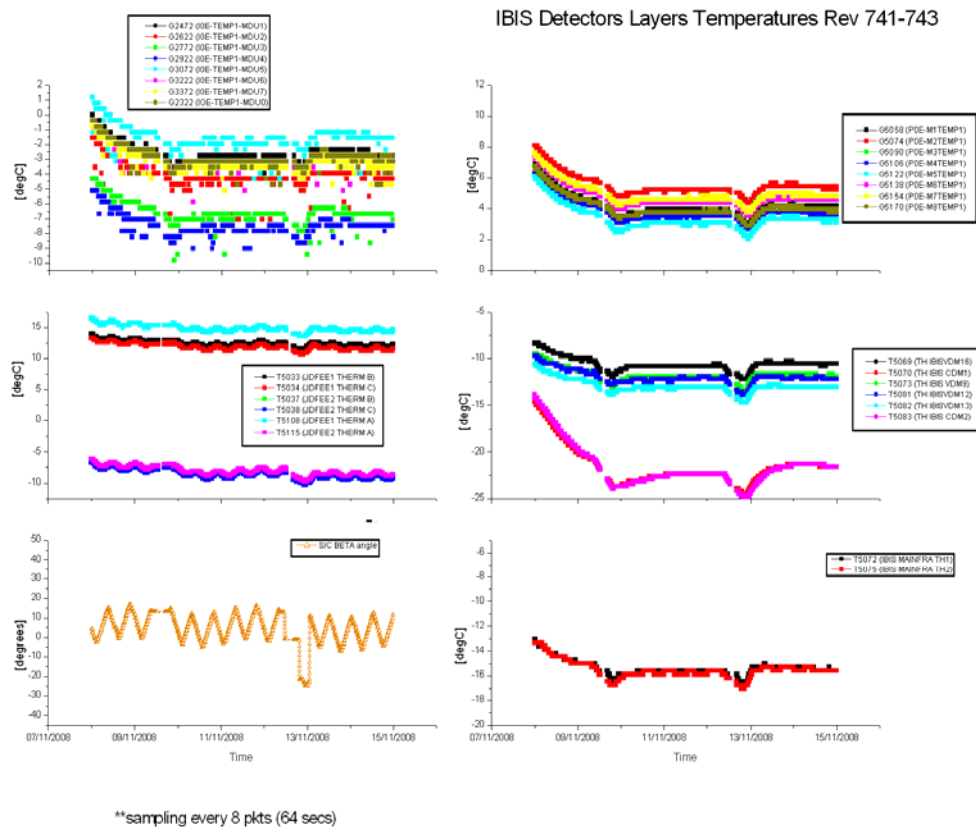
VETO Current:



PICsIT Counters:



IBIS Detectors Layers Temperatures:



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 (IOE-OVFWPXADD-Mi) were received during the radiation belt passages.

2008-11-08 (DOY 313, Rev 741)

IBIS operations executed nominally.

2008-11-09 (DOY 314, Rev 741-742)

Due to slightly high radiation before the expected radiation belt entry, TM parameters G6062, G6063 and GU6062 (VETO bottom and lateral counters) toggled OOL High from 08:39:37Z until radiation belt entry at 09:28:11Z.

2008-11-10 (DOY 315, Rev 742) to 2008-11-11 (DOY 316, Rev 742)

IBIS operations executed nominally.

2008-11-12 (DOY 317, Rev 742-743)

Due to slightly high radiation before the expected radiation belt entry, TM parameters G6062, G6063 and GU6062 (VETO bottom and lateral counters) toggled OOL High from 08:58:25Z until radiation belt entry at 09:15:09Z.

Due to a crash and subsequent inoperability of the Autostack (see Anomaly Report INT-3040), the EDs for IBIS at the start of revolution 743 were missed from the Timeline, starting from TC G0220 of the ED GEISCL03 at 18:43:59Z. Once the problem was fixed, IBIS was activated manually as follows:

- 20:44:31Z CRP_IBIS1_0010 IBIS SAFE CONFIG (Fast) executed
- 20:49Z ISGRI context tables re-uplinked
- 21:04:36Z ED GEISCL03 re-uplinked
- 21:33:55Z ED GEBENT02 re-uplinked
- 21:38:00Z ED GEBEXT01 re-uplinked
- 21:48:20Z ED GESTAN02 uplinked to put IBIS in Science Standard mode with the planned observation parameters and commanding to IBIS from the Timeline was re-enabled.

The PST ED had also been missed at the start of the revolution and the planned TM allocation to the instruments was restored with the execution of the PST ED in the CCCF at 23:32:34Z.

TM parameter G6061 (VETO Calibration Source counter) went briefly OOL Low several times from 22:50:41Z until 2008-11-13 at 05:34:25Z. As in each case it returned within limits of its own accord, no action was taken. If these OOLs become more frequent, this may indicate that an adjustment of the limit is required to take into account the radioactive decay of the calibration source.

2008-11-13 (DOY 318, Rev 743)

At 14:21:13Z TM parameter G2055 (Number of events triggering the MCE3 per second) went OOL with value 0. As it returned within limits of its own accord at 14:22:33Z, no action was taken.

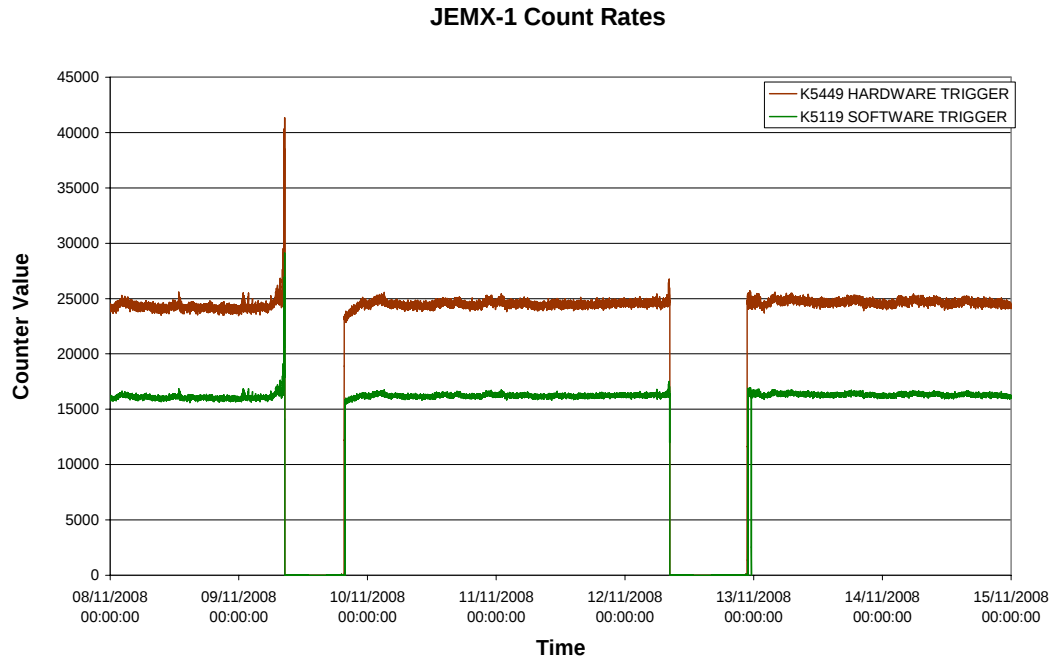
2008-11-14 (DOY 319, Rev 743)

IBIS operations executed nominally.

8.3.4 JEM-X Operations

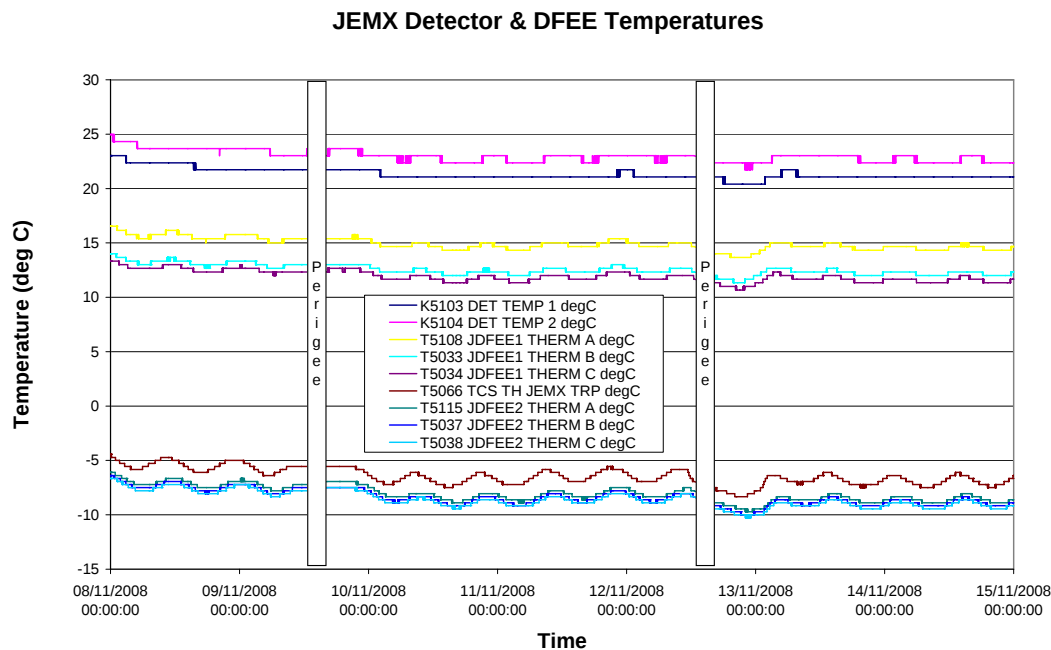
JEM-X Count Rates

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

2008-11-08 (DoY 313, Rev 741)

JEM-X 1 operations executed nominally.

2008-11-09 (DoY 314, Rev 741-742)

At 08:16:38, 08:17:41, 08:22:14, 08:26:12, 08:29:15, 08:32:28 and 08:34:04, parameter K5449 briefly went outside soft limits. At 08:24:12 and 08:24:35, parameter K5136 briefly went outside soft limits. No action was taken, and there was no impact.

2008-11-10 (DoY 315, Rev 742) to 2008-11-11 (DoY 316, Rev 742)

JEM-X 1 operations executed nominally.

2008-11-12 (DoY 317, Rev 742-743)

At 18:38:00, a problem with the TMTCS forced an interruption of the Timeline. At 18:51, GFCC switched to TMTCS2, and a recovery commenced. At 22:26, the KEACAL01 ED was sent, at 22:40, the KEHVAC01 was uplinked, and at 22:56, the KEDATA02 ED was sent putting the unit back in Science mode. The impact was the loss of 3 hours 22 minutes of science data.

2008-11-13 (DoY 318, Rev 743) to 2008-11-14 (DoY 319, Rev 743)

JEM-X 1 operations executed nominally.

8.3.5 OMC Operations

2008-11-08 (DoY 313, Rev 741) to 2008-11-11 (DoY 316, Rev 742)

Nothing to report.

2008-11-12 (DoY 317, Rev 742-743)

At 18:38:00, a problem with the TMTCS forced an interruption of the Timeline. At 18:51, GFCC switched to TMTCS2, and a recovery started. At 22:58, the MEBEXT01 ED was sent, and at 23:27, the unit was back in Science mode. The impact was the loss of pointings 07430002 through to 07430006.

2008-11-13 (DoY 318, Rev 743) to 2008-11-14 (DoY 319, Rev 743)

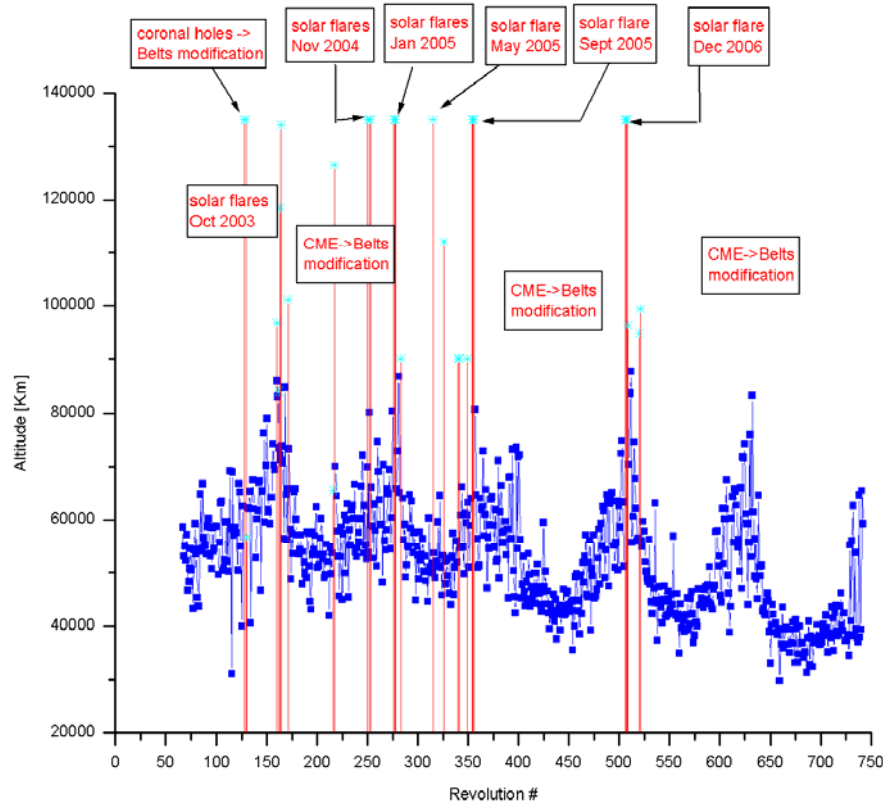
Nothing to report.

On DoY 314 at 09:28:12 and DoY 317 at 09:15:00 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 2003-2008



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]
741	RAD_ENTR R 2008-11-09T09:28:07Z	09/11/2008 08:16:50	65543.5	09-Nov-2008 11:30:47	37476.19
742	RAD_EXIT R 2008-11-09T19:16:19Z	09/11/2008 18:06:35	>>33734.5	09-Nov-2008 18:30:47	46268.37
742	RAD_ENTR R 2008-11-12T09:14:58Z	12/11/2008 08:49:47	59285.4	12-Nov-2008 11:29:19	35825.09
743	RAD_EXIT R 2008-11-12T19:02:40Z	12/11/2008 17:31:39	>>33752.2	12-Nov-2008 18:19:19	46336.42

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)

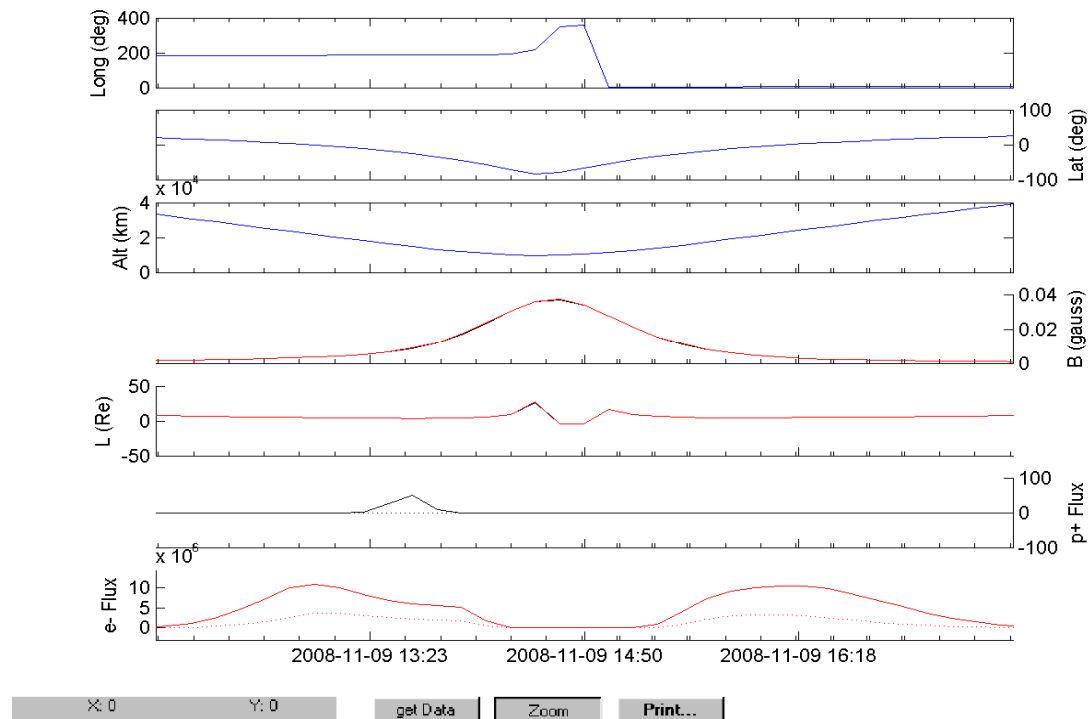
* Rad belt entry time ignoring previous threshold crossings where a gap of more than 30 minutes is present.

IREM radiation counters:

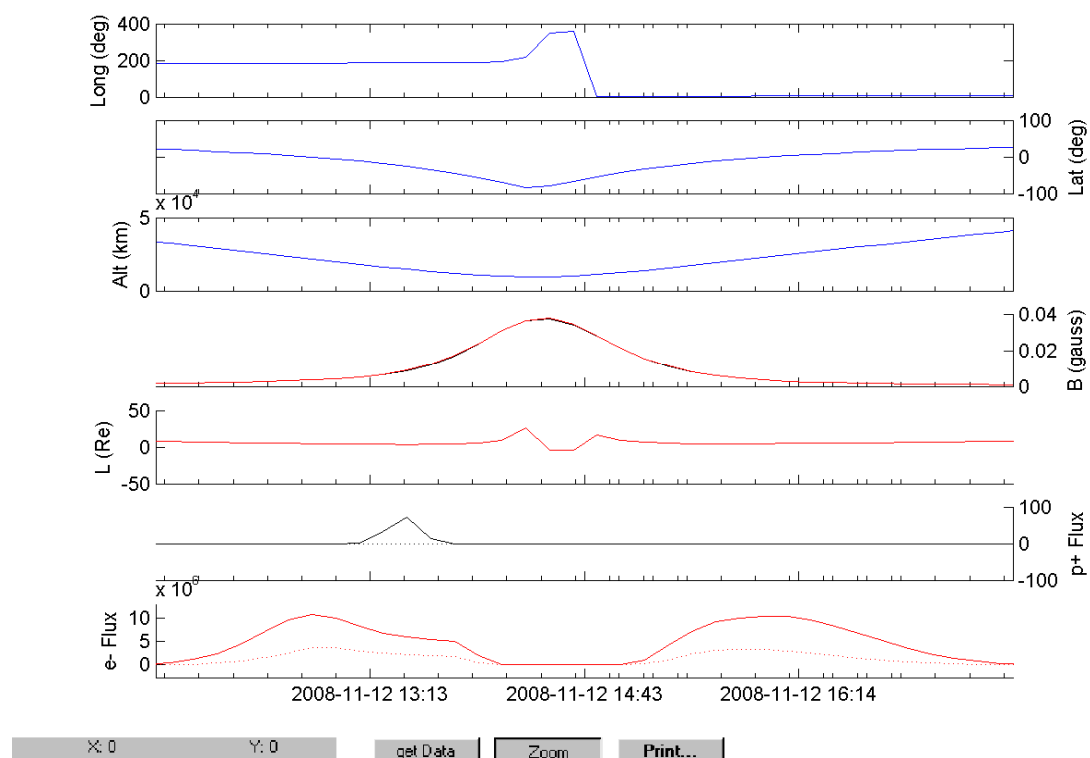
The IREM radiation counter plots are not available this week.

IREM Predicted Radiation Belt Passages

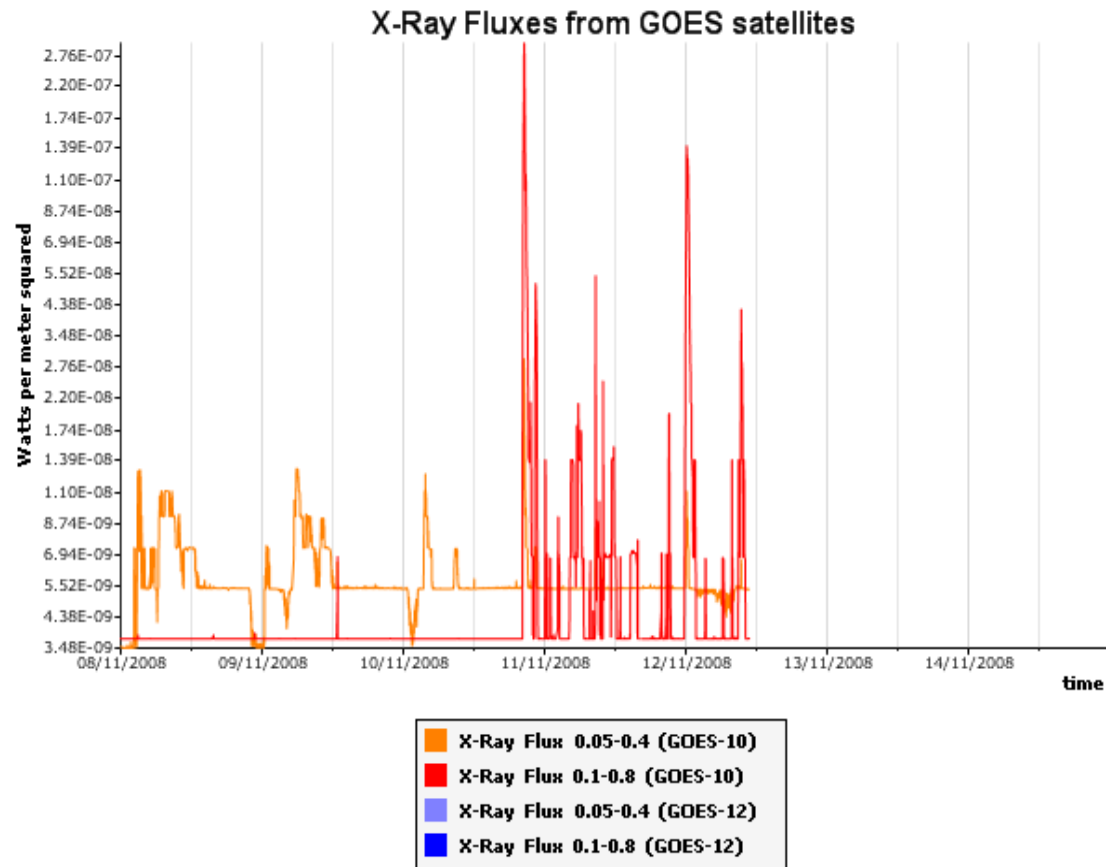
Rev 741



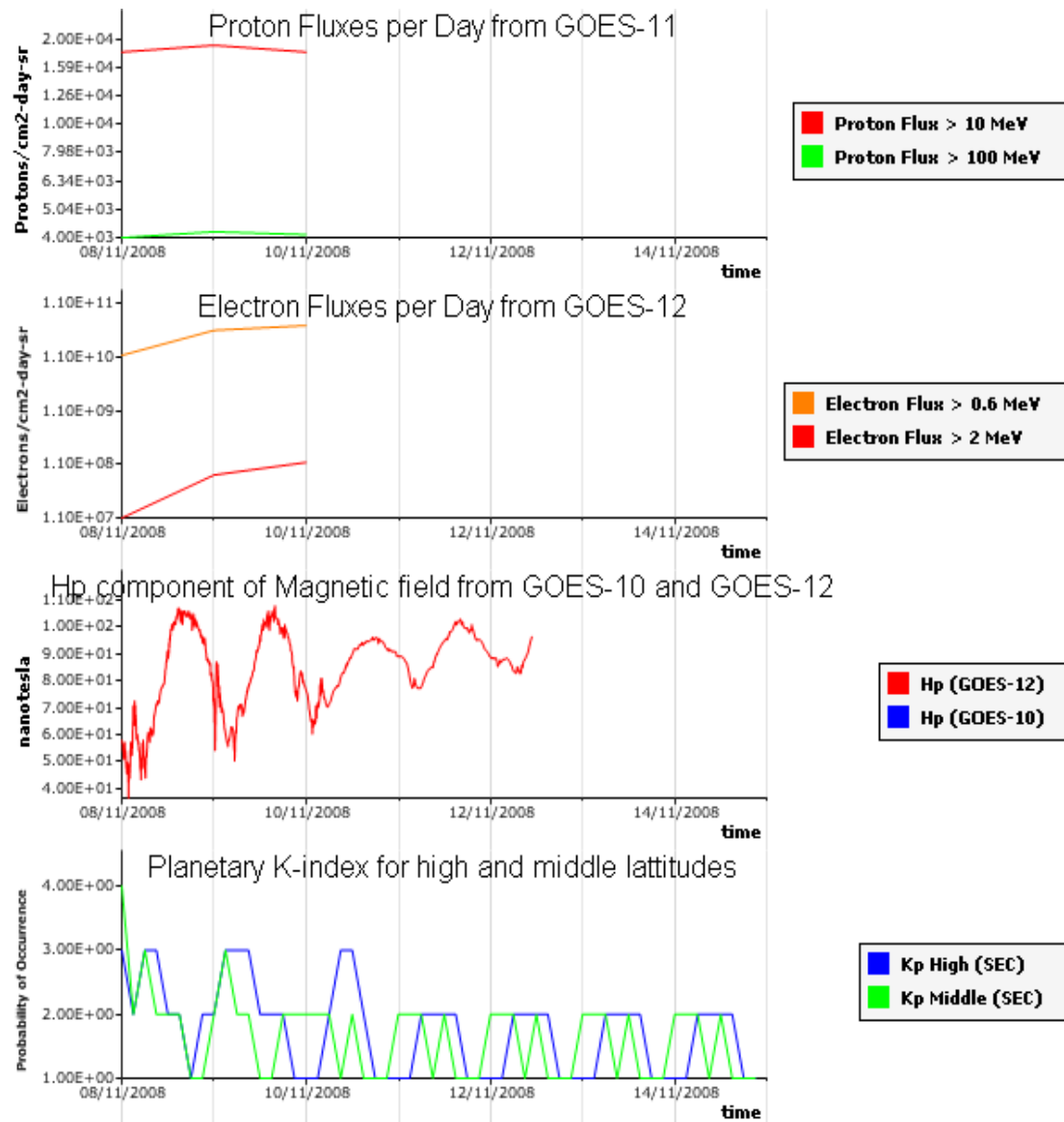
Rev 742



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



X-Ray fluxes start to be significant over 10^{-5} W/m^2 (corresponding to M-class flares). Above 10^{-4} W/m^2 , they correspond to strong X-class flares.



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.