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

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 327
Week 52
29.12.08
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 20.12.08 until 26.12.08 (both dates inclusive) and covers the revolutions 755, 756 and 757.

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 hexagonal dither of the Galaxy Cluster 47 Tuc and Small Cloud of Magellan SMC (RA 00:53:55.20, DEC -72:26:42.0), a hexagonal dither of the Quasar PKS 0208-512 (RA 02:10:46.20, DEC -51:01:01.9), a raster dither of the Cygnus Region (RA 20:35:53.00, DEC +40:39:49.0) and a hexagonal dither 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.

Two slews were missed from TL, during the observation period, due to problems on FDS.

The fuel consumption over the period between 20/12/2008 and 26/12/2008 was 0.1681 Kg. The remaining propellant is in the order of 136.8260 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

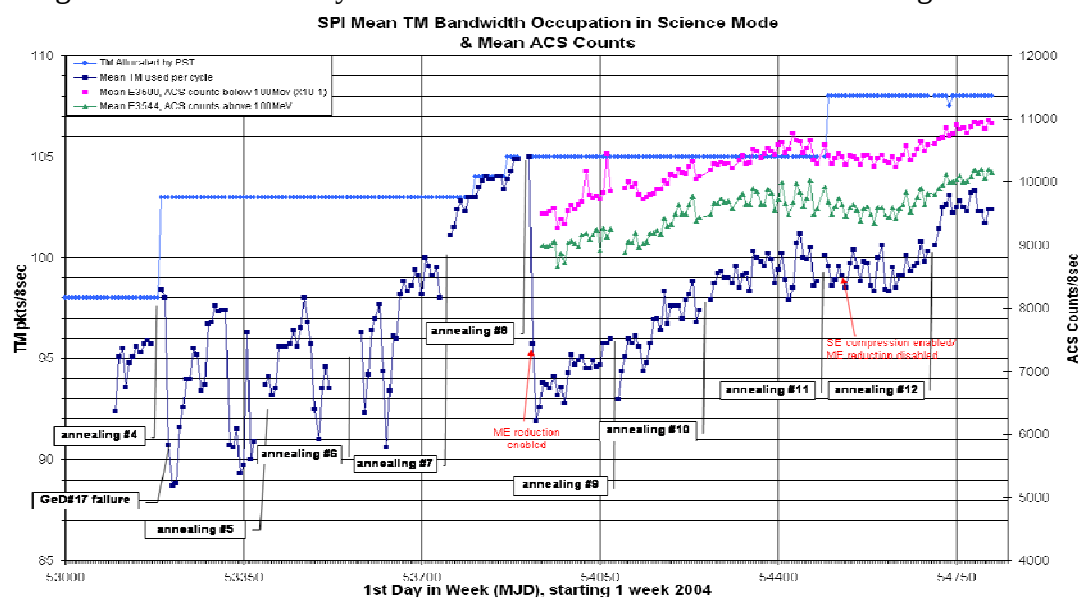
3.2.1 SPI

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 102.4 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.

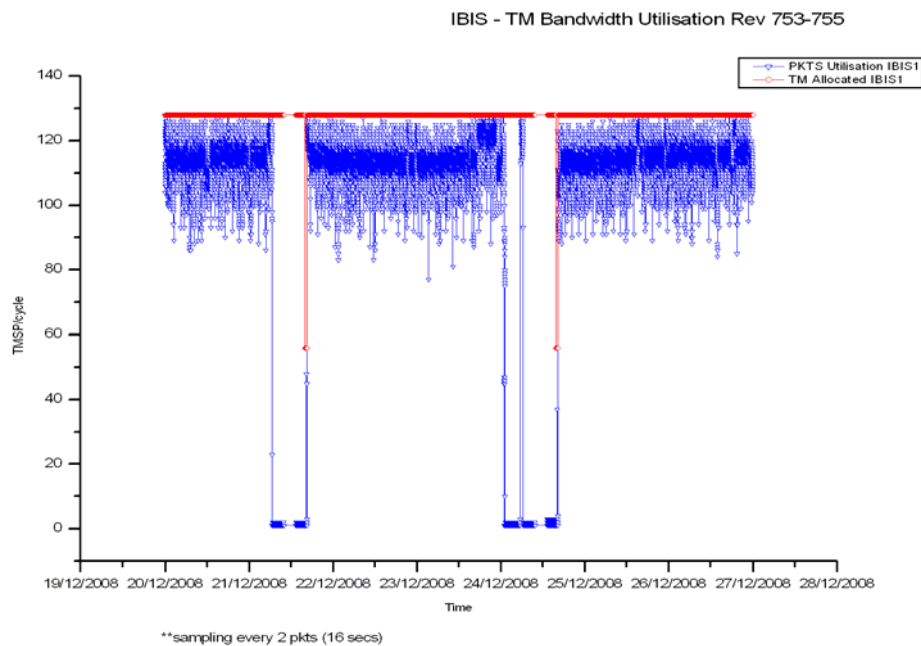
3.2.2 IBIS

The overall status of the unit is nominal.

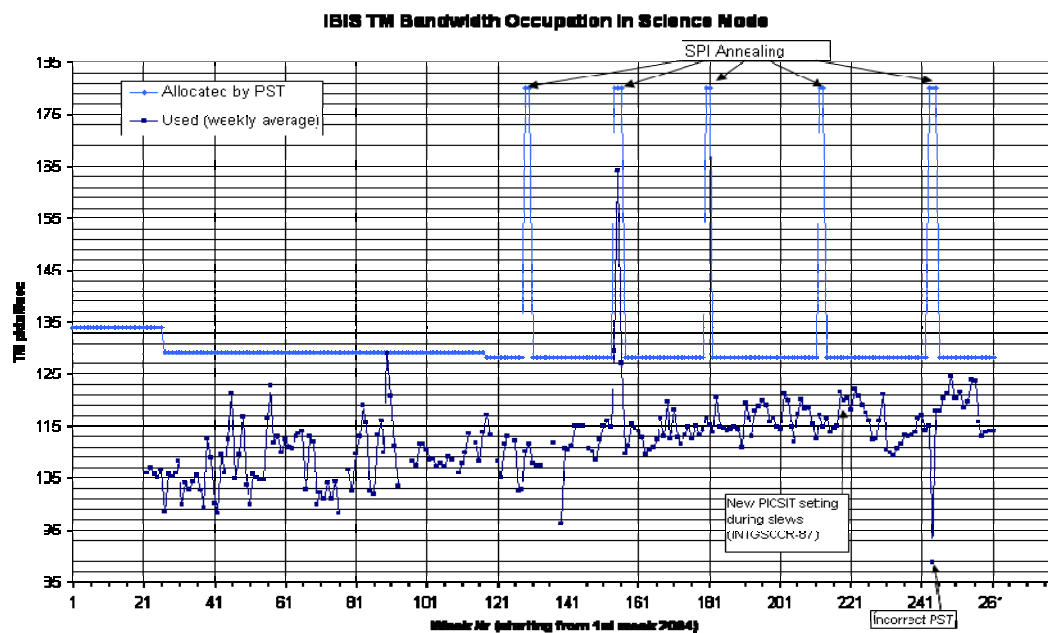
During the reporting period, the TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 128 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 113.97 packets/cycle (down 0.08 on previous week)
- Percentage of TM cycles in which full bandwidth was used: 0.81%

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, 145 of the 147 planned science pointings were executed nominally, 1 was shortened and another 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. The sun remained blank all week. 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. No 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. Two pointings were lost to MOC related issues. Due to problems with the FDS, the pointing 07550034 and 07560009 were not executed. The OTF was not reached during PID 07560051 and PID 07570025, due to loss of guide star.

4.2 Ground Stations & Network

The performance of the ground stations and Network was good this week. On DoY 358 at 10:21Z there was one link drop for a few seconds reported from Redu.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

No new PSFs have been received and no new observations have been planned, as previously agreed.

For the same reason, no new TSFs have been received.

2. Observation status

New ECS files have been received for revolutions 748 to 753 and have been processed up to 750.

3. ISOC Science Data Archive

No news.

4. ISOC system

Work is continuing on ISOC system V20.1.

5. Problems

No new problems.

4.3.2 ISDC

Status of ISDC observation processing on 19/12/2008:

- Latest Standard Analysis completed: observation 06200210009 (GRS 1915+105, Revolution 743) on 12/12/2008.
- Latest products archived: observation 06200210009 (GRS 1915+105, Revolution 743) on 12/12/2008.
- Latest observation products sent to the observer: observation 05297000004 (Perseus OB2 Cloud, Revolutions 706-710) on 13/09/2008.

5 Special Events

6 Anomalies

No anomaly reports were entered into the ARTS system this week.

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 755

The observations in revolution 755 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 ~28.0 hours. They continued with a hexagonal dither of the Quasar PKS 0208-512 (RA 02:10:46.20, DEC -51:01:01.9), lasting ~29.5 hours until the end of the revolution.

Revolution 756

The observations in revolution 756 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 ~28.0 hours. They continued with a hexagonal dither of the Quasar PKS 0208-512 (RA 02:10:46.20, DEC -51:01:01.9), lasting ~19.0 hours. This was followed by a raster dither of the Cygnus Region (RA 20:35:53.00, DEC +40:39:49.0), lasting ~8.8 hours until the end of the revolution.

Revolution 757

The observations in revolution 757 began with a hexagonal dither of the Quasar PKS 0208-512 (RA 02:10:46.20, DEC -51:01:01.9), lasting ~46.7 hours. They continued with a hexagonal dither of the North Ecliptic Pole (RA 18:00:00.00, DEC +66:33:39.0), lasting ~9.7 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

2008-12-11T00:24:39.000Z	137.1097	F	Automatic TM processing.
2008-12-13T22:25:34.000Z	137.0620	F	Automatic TM processing.
2008-12-15T14:31:07.000Z	137.0540	F	Automatic TM processing.
2008-12-17T00:30:30.000Z	137.0135	F	Automatic TM processing.
2008-12-18T14:19:15.000Z	136.9941	F	Automatic TM processing.
2008-12-20T00:12:23.000Z	136.9694	F	Automatic TM processing.
2008-12-21T14:08:03.000Z	136.9525	F	Automatic TM processing.
2008-12-23T00:05:27.000Z	136.9450	F	Automatic TM processing.
2008-12-23T18:52:25.000Z	136.9021	F	Automatic TM processing.
2008-12-24T09:19:30.000Z	136.8843	F	Automatic TM processing.
2008-12-24T13:53:15.000Z	136.8675	F	Automatic TM processing.
2008-12-25T23:24:15.000Z	136.8260	F	Automatic TM processing.

This report was generated Fri Dec 26 08:00:23 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, 20/12/2008 – 26/12/2008

The AOCS operations were executed from the Automatic Timeline.

During this period, 87 Open Loop Slews, 72 Closed Loop Slews and 7 Momentum Biases were executed (as reported by ACC OEM).

2 slews (CSL) were missed from TL, during the observation period, due to problem on FDS during slew update and S/T.

This is equivalent to $\sim 1.2\%$ of the total number of slews planned (159).

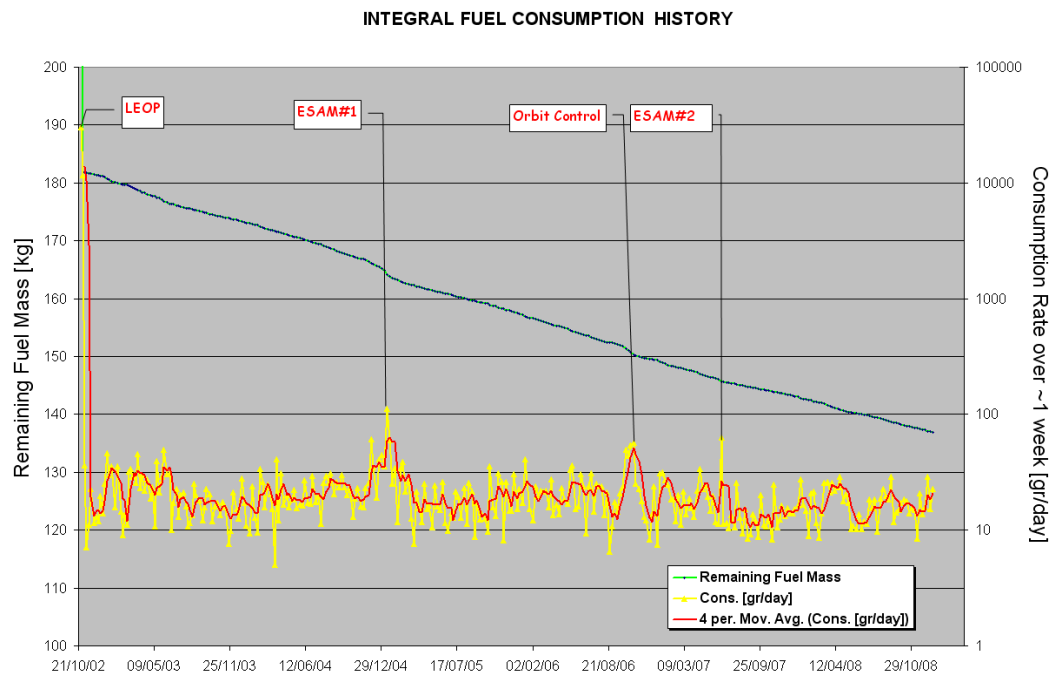
The OTF was not reached during PID 07560051 and PID 07570025, due to loss of guide star.

Orbit Control

No update

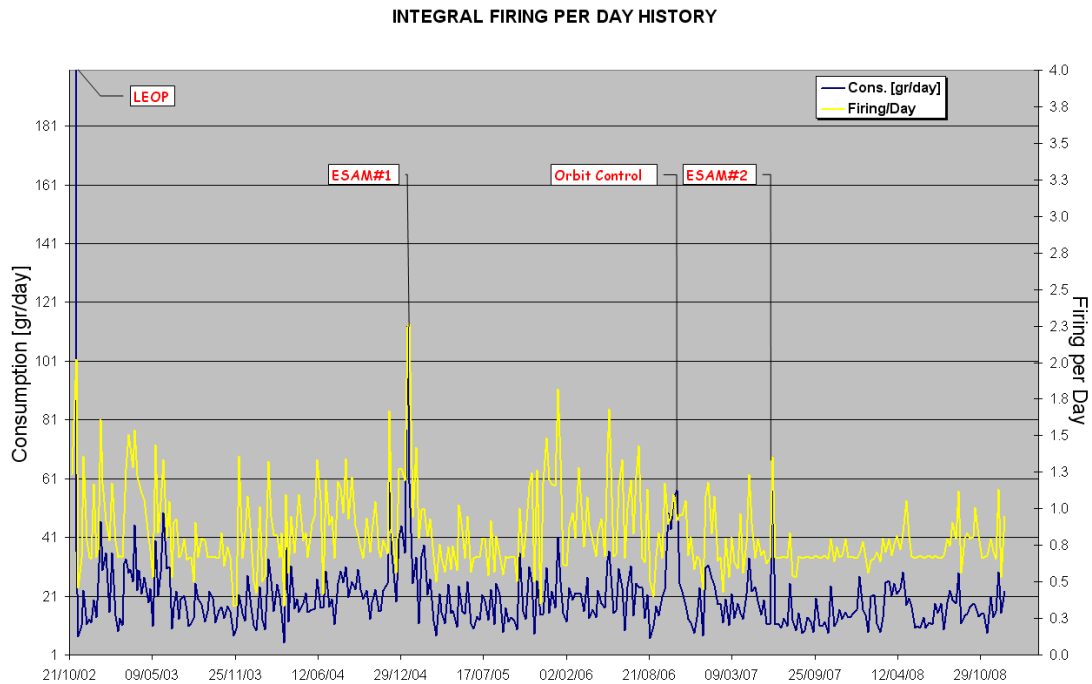
Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 26/12/2008 is reported in the plot below.



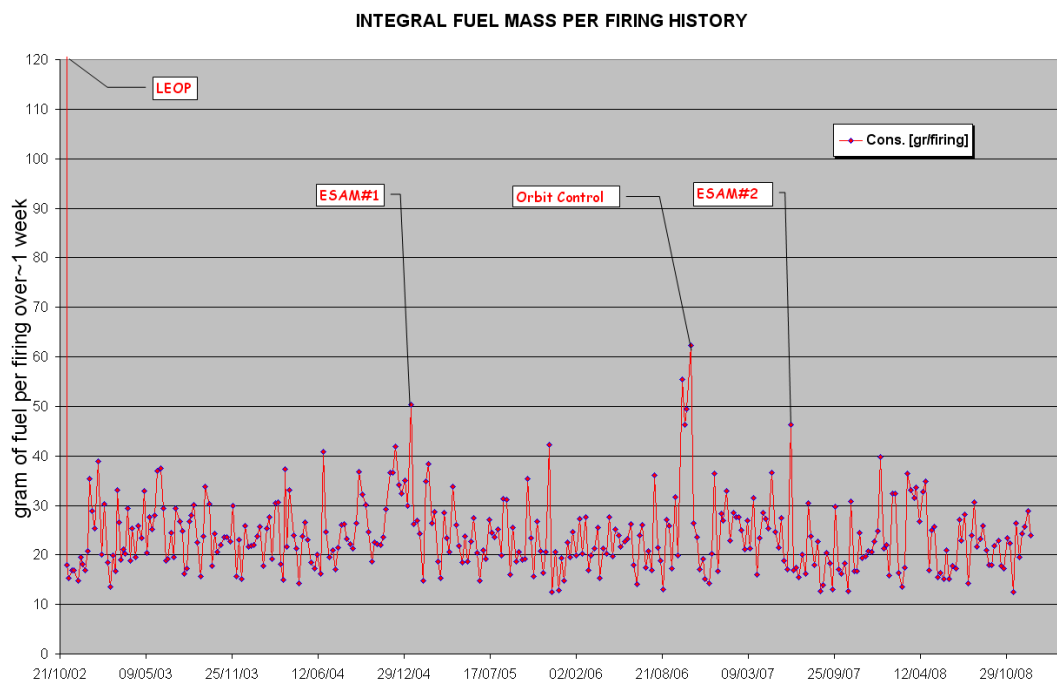
The above plot considers the ESAM fuel consumption spread over period of ~ 1 week.

The firing per day over the period between 01/11/2002 and 26/12/2008 is reported in the plot below.



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

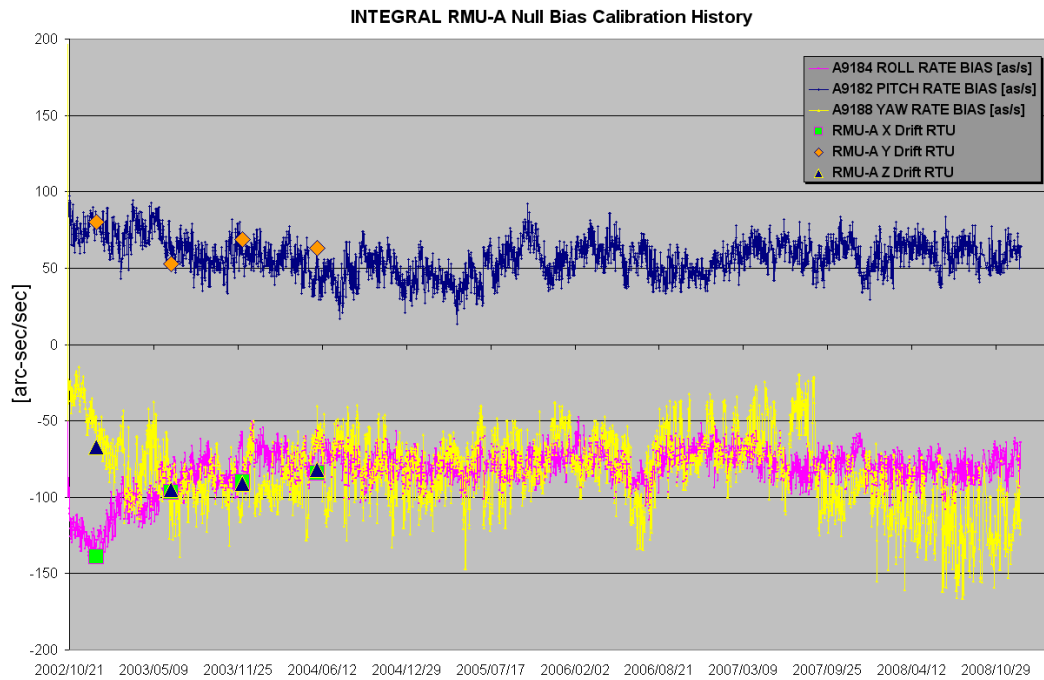
The fuel per firing over the period between 01/11/2002 and 26/12/2008 is shown in the plot below.



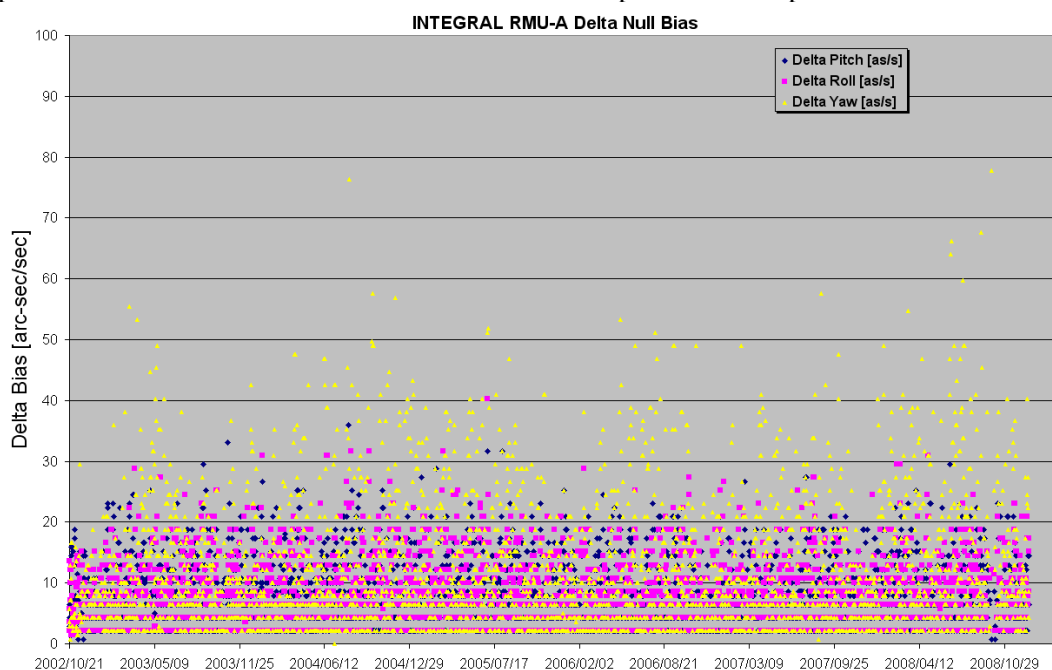
The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 26/12/2008 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 26/12/2008 is reported in the plot below.



20/12/2008 (Day of Year 355, Revolution 755)

FDS problem during slew update: at 00:26z a problem on FDS caused the slew update to fail for slew ID 07550034.

A manual recovery was then performed from the attitude of PID 07550033 to the attitude of PID 07550034 and the next slew ID 07550035 updated in TL.

The following slew was not executed in TL: PID 07550034(CSL)

21/12/2008 (Day of Year 356, Revolution 755-756)

STR problem during S/T: at 23:36z a problem on the planned star (slot#2) for slew ID 07560009 caused the slew to fail release.

A manual recovery was then performed from the attitude of PID 07560008 to the attitude of PID 07560009 and the next slew ID 07560010 updated in TL.

The following slew was not executed in TL: PID 07560009(CSL)

22/12/2008 (Day of Year 357, Revolution 756)

Nothing to report.

23/12/2008 (Day of Year 358, Revolution 756)

Loss of guide star: at 17:50z a loss of the selected guide star occurred during PID 07570025. The origin of the event is not clear, likely due to SEU affecting the STR.

As foreseen by the IPS logic, the ACC did not switch ON the IMU 1, being the event occurred in the first minute after slew end. A new automatic mapping was commanded and a new guide star picked. The next CGS was automatically updated in TL.

No impact on TL.

The OTF was not reached during the part of PID 07560051.

24/12/2008 (Day of Year 359, Revolution 756-757)

Nothing to report.

25/12/2008 (Day of Year 360, Revolution 757)

Loss of guide star: at 15:19:40z a loss of the selected guide star occurred during PID 07570025. The origin of the event is not clear, likely due to SEU affecting the STR.

As foreseen by the IPS logic, the ACC switched ON the IMU 1, a new automatic mapping was commanded and a new guide star picked. The next slew 07570026 was manually updated in TL.

No impact on TL.

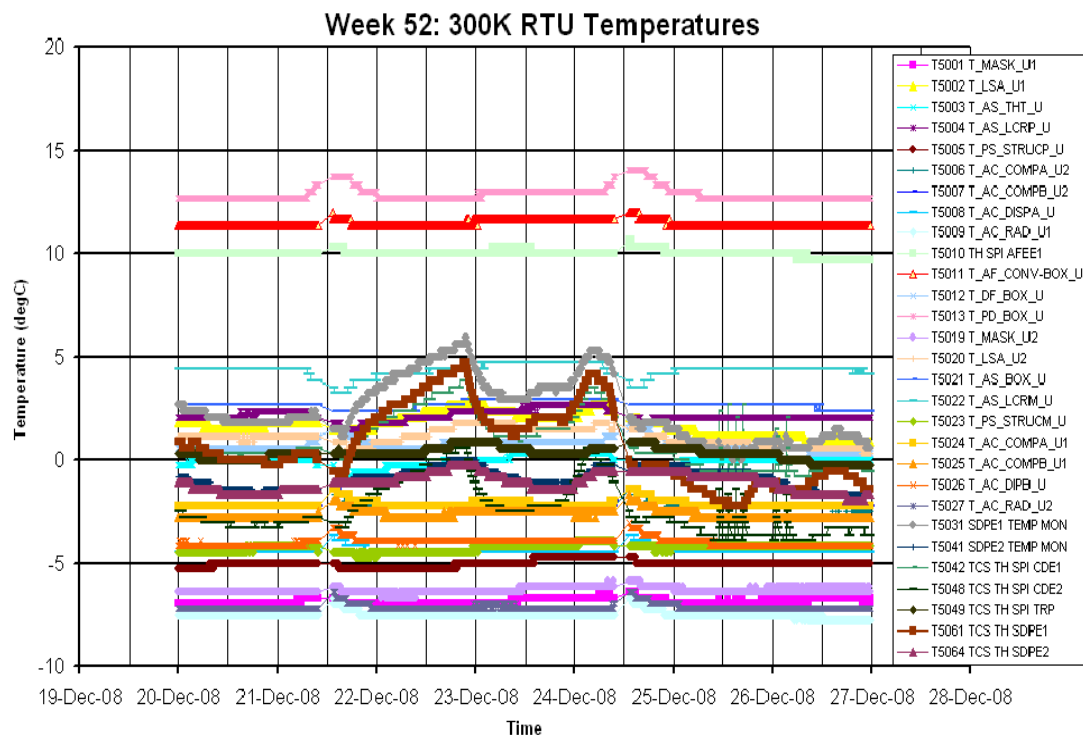
The OTF was not reached during the last part of PID 07570025.

26/12/2008 (Day of Year 361, Revolution 757)

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.



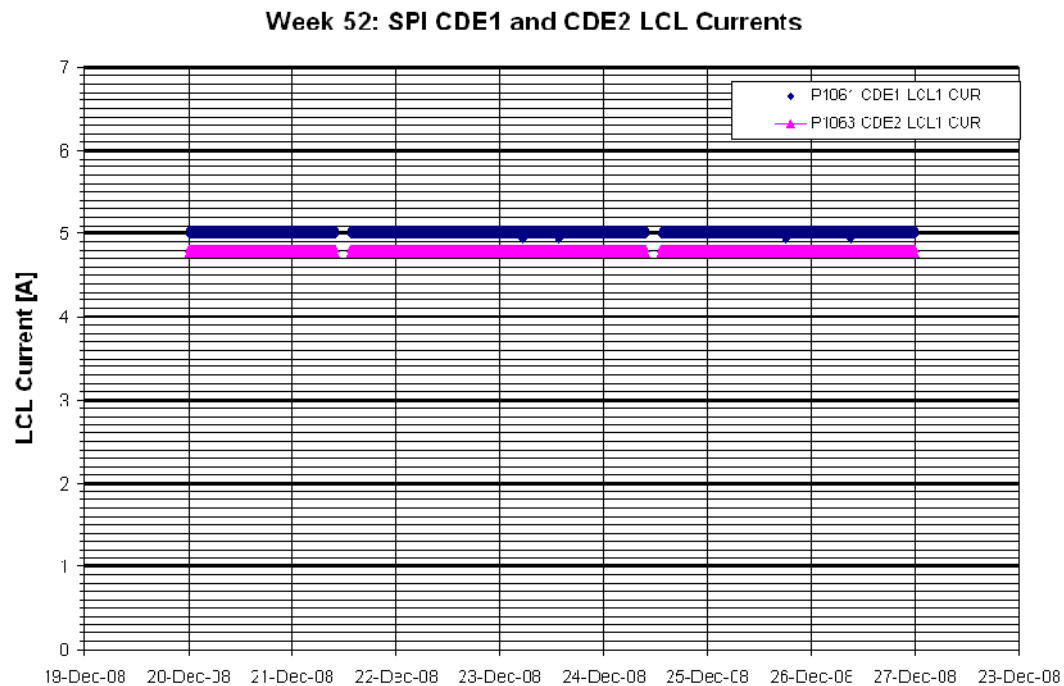
Stirling Compressors and Cryostat: The performance of the compressors is nominal.

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

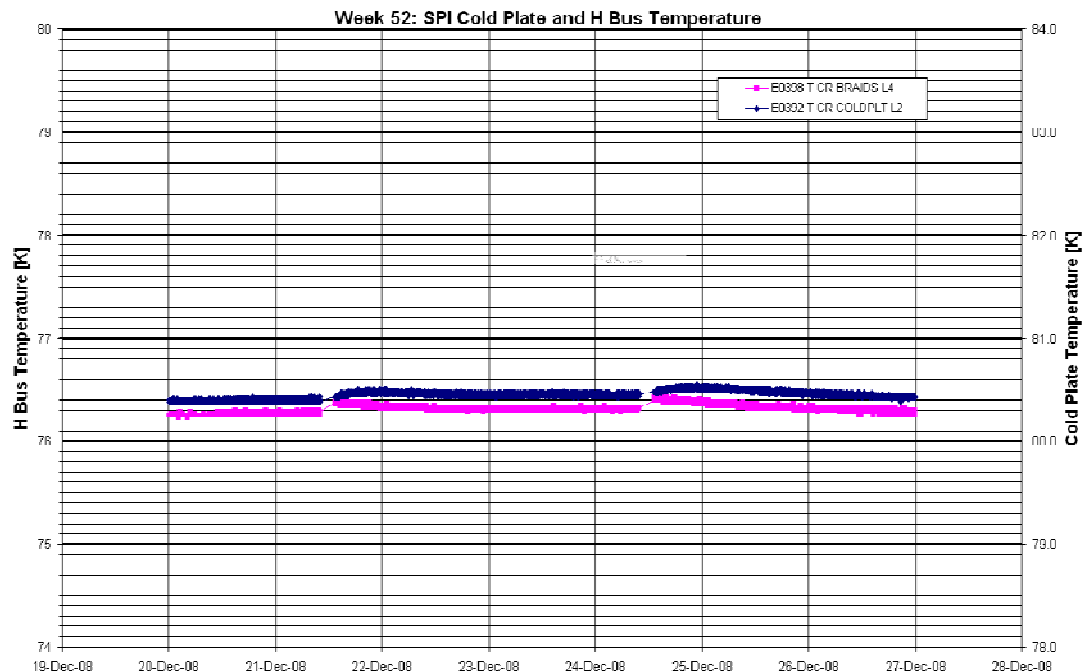
The stroke of all four compressors was set to 41 throughout the week and the average CDE LCL currents were as follows:

- CDE1 LCL Current = 5.01A
- CDE2 LCL Current = 4.79A

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



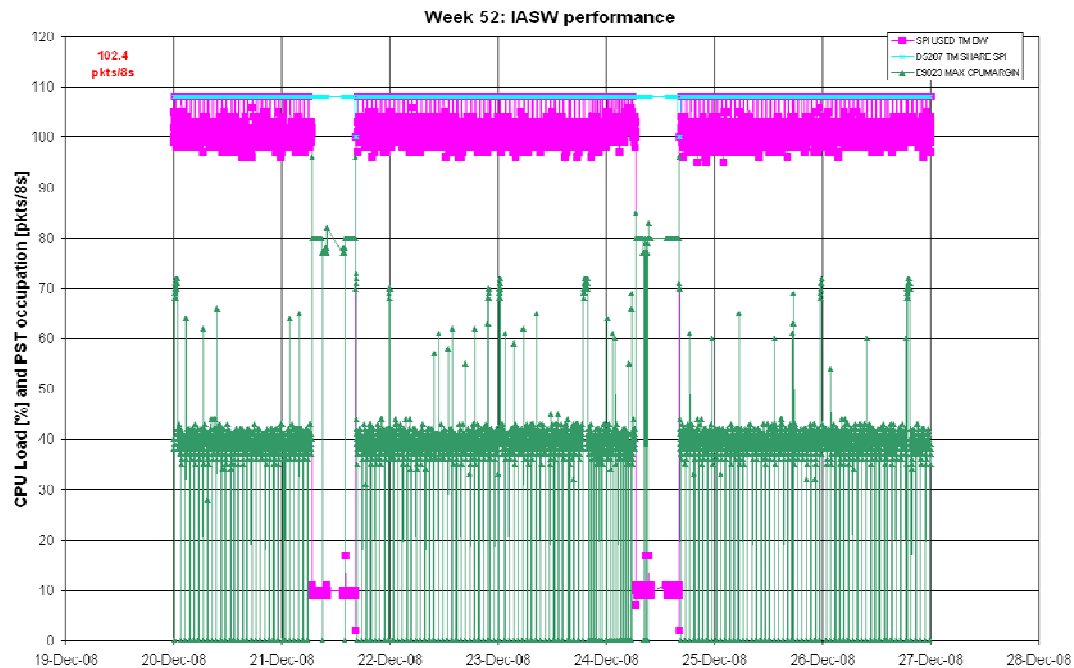
The following plot shows the evolution of the cold plate and H bus temperatures during the reporting period.



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

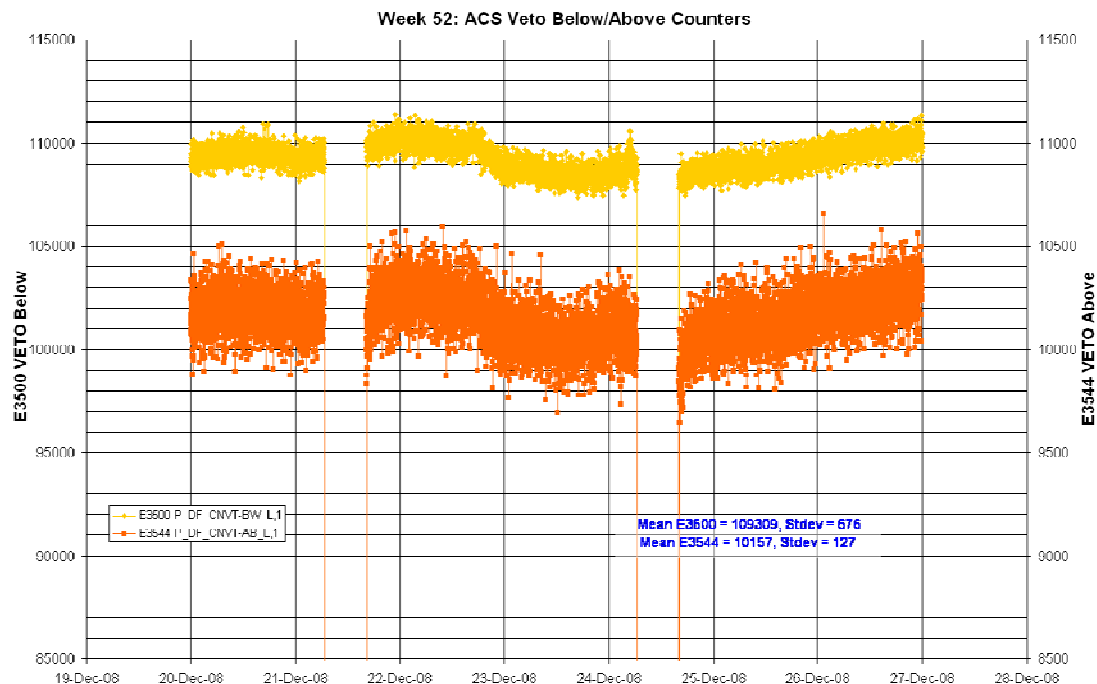
The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling factor set to 8/19 SE. The average TM bandwidth occupation of SPI was 102.4 packets/cycle over the science window when the TM allocation was 108 packets/cycle.

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

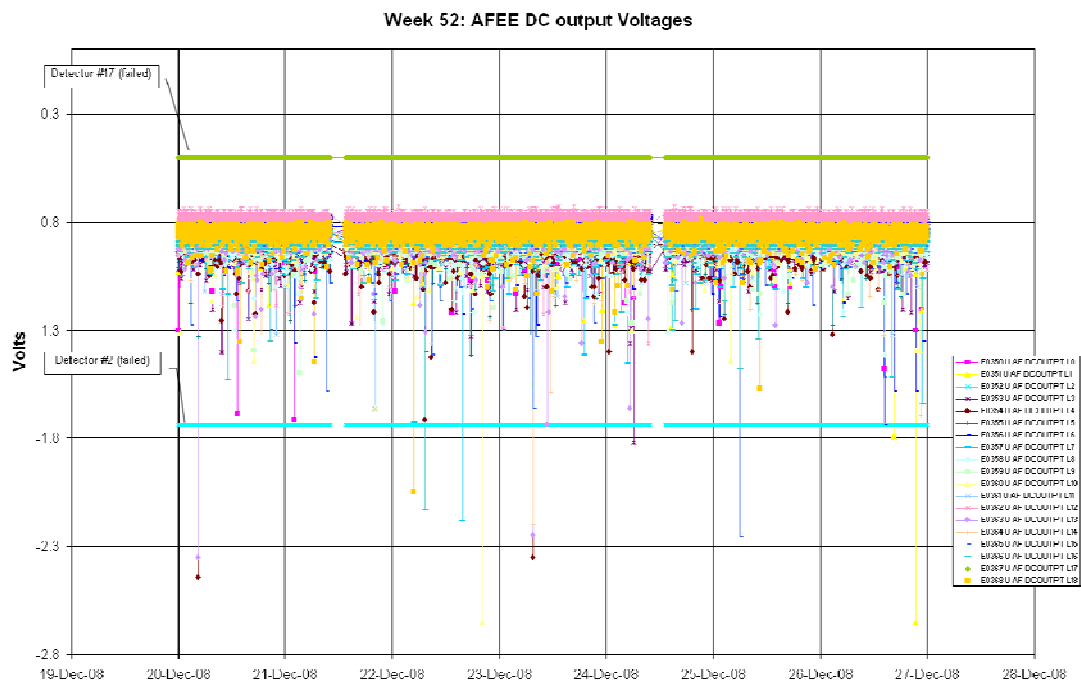


ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61).

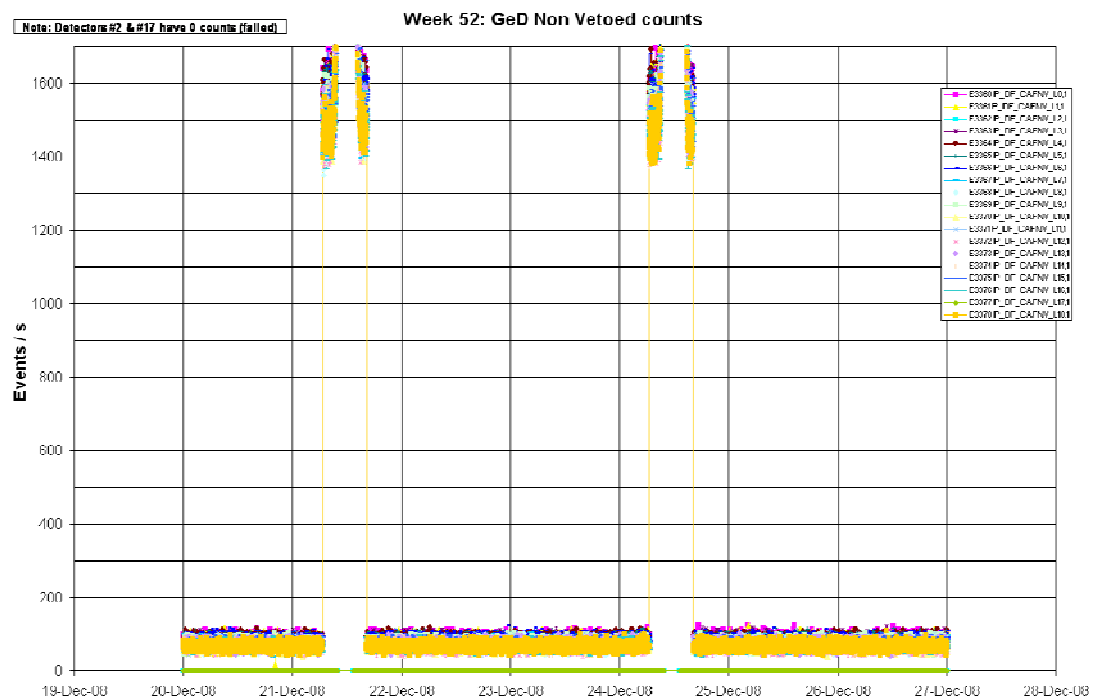
The following plot shows the ACS overall count rate evolution during the reporting period:

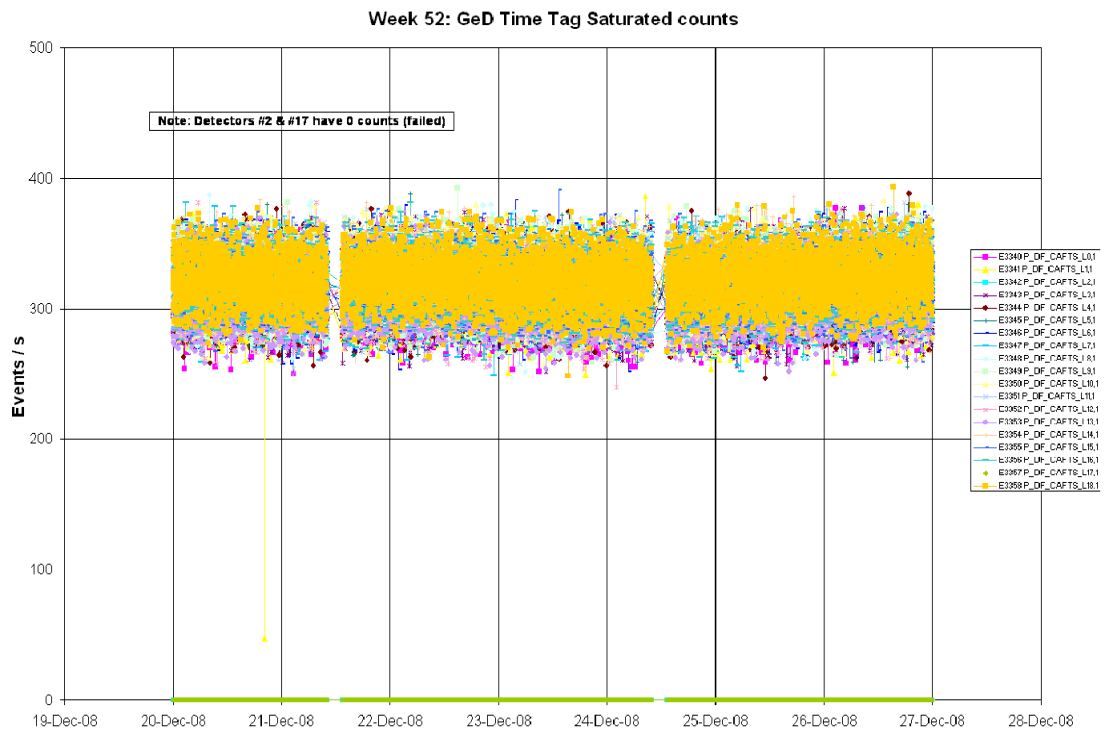
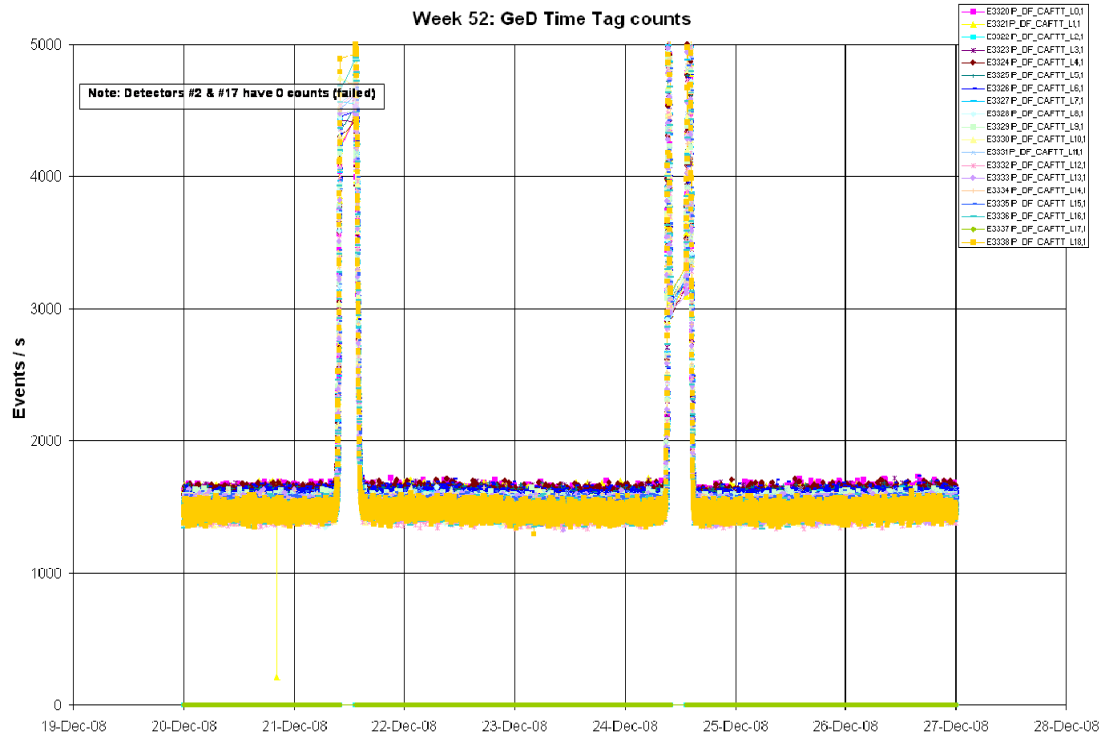


AFEE: The health of the AFEE is nominal. The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06/12/2003 and detector #17 is failed since 17/07/2004.

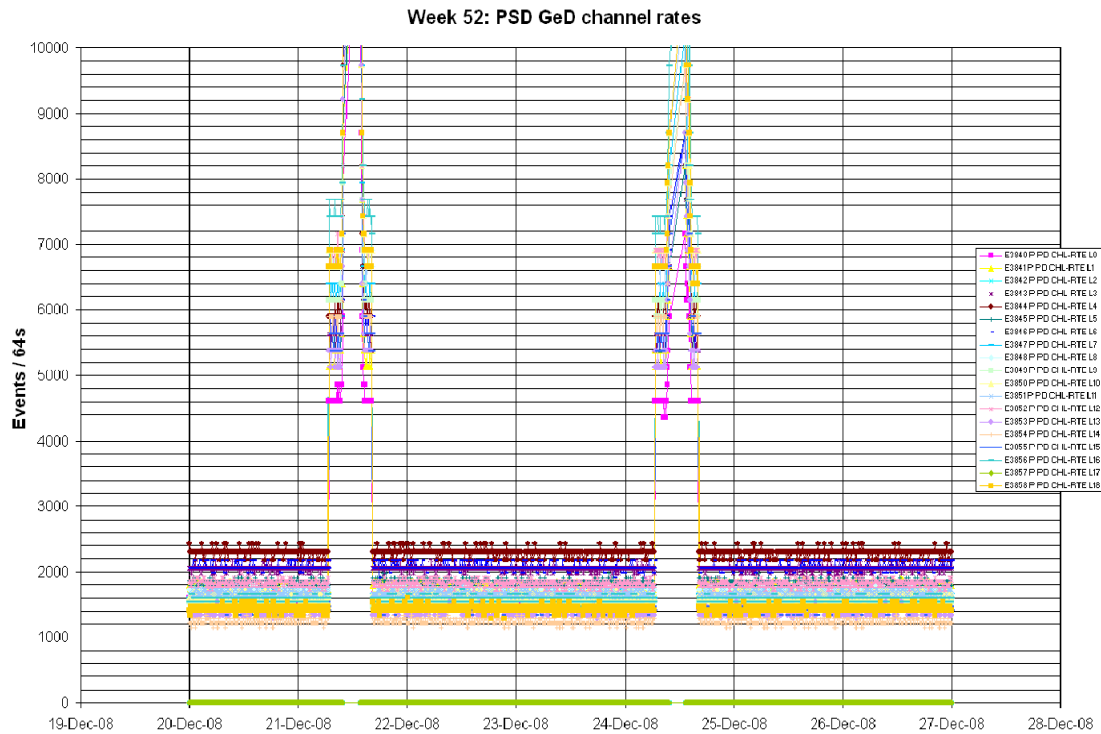


DFEE: The performance of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event count rates during the reporting period.





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



Event Log:

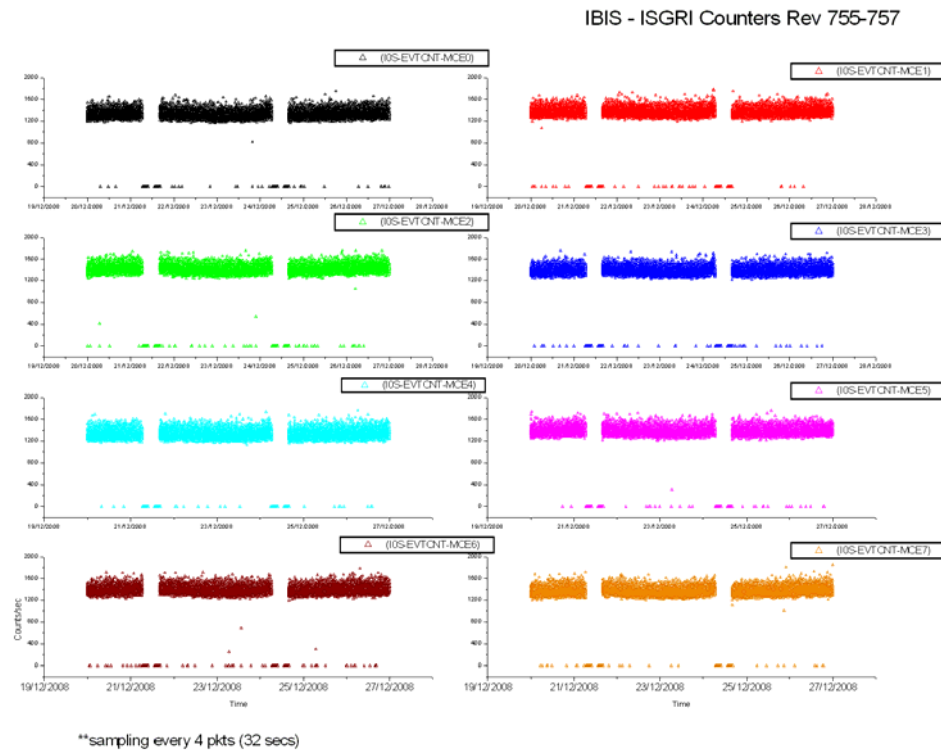
The following non-nominal events occurred on SPI during the reporting period:

- On 2008-12-25 at 18:14:41Z TM parameter E2222 went OOL (value = PARAM > SPEC). This is the ACS FEE digital status 5V #72. As it returned within limits of its own accord when the next packet was received at 18:25:21Z, no action was taken.

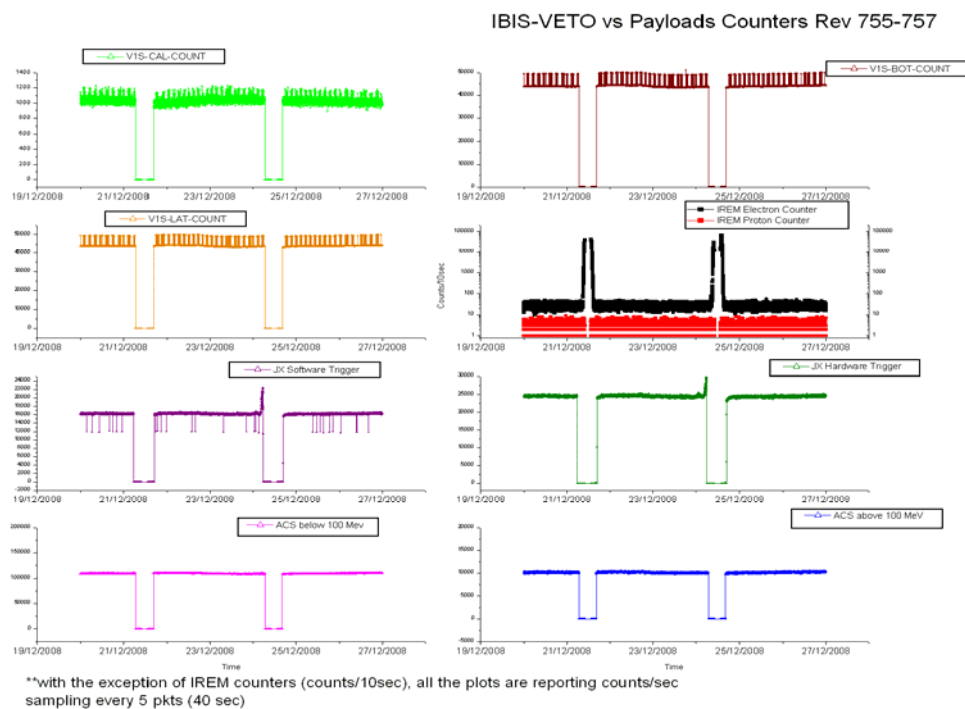
8.3.3 IBIS Operations

IBIS Event Counters Plots

ISGRI Counters:

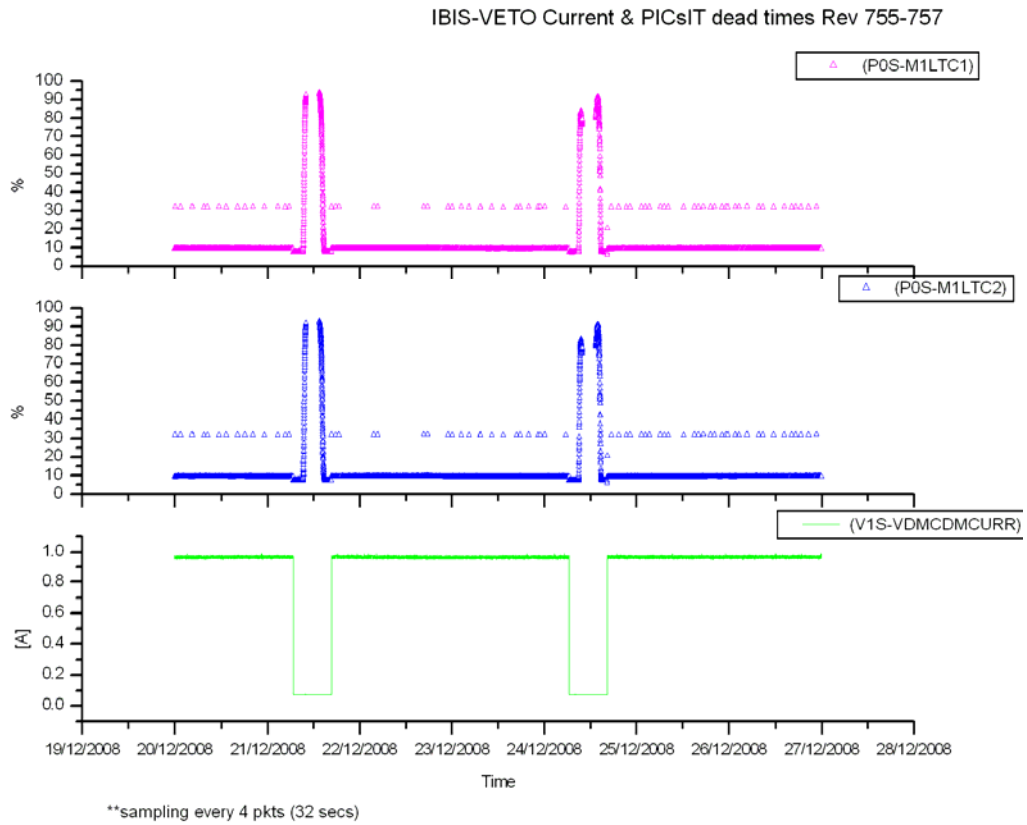


VETO vs Payload Counters:

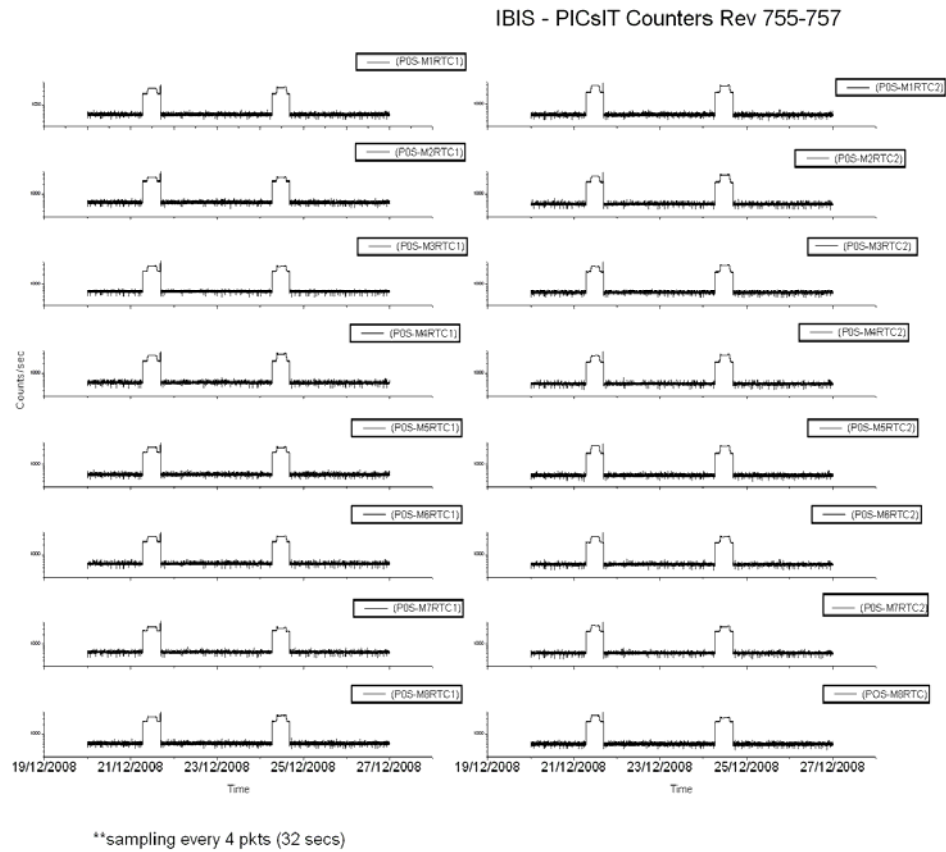


The week was characterised by low radiation as reported by the payload.

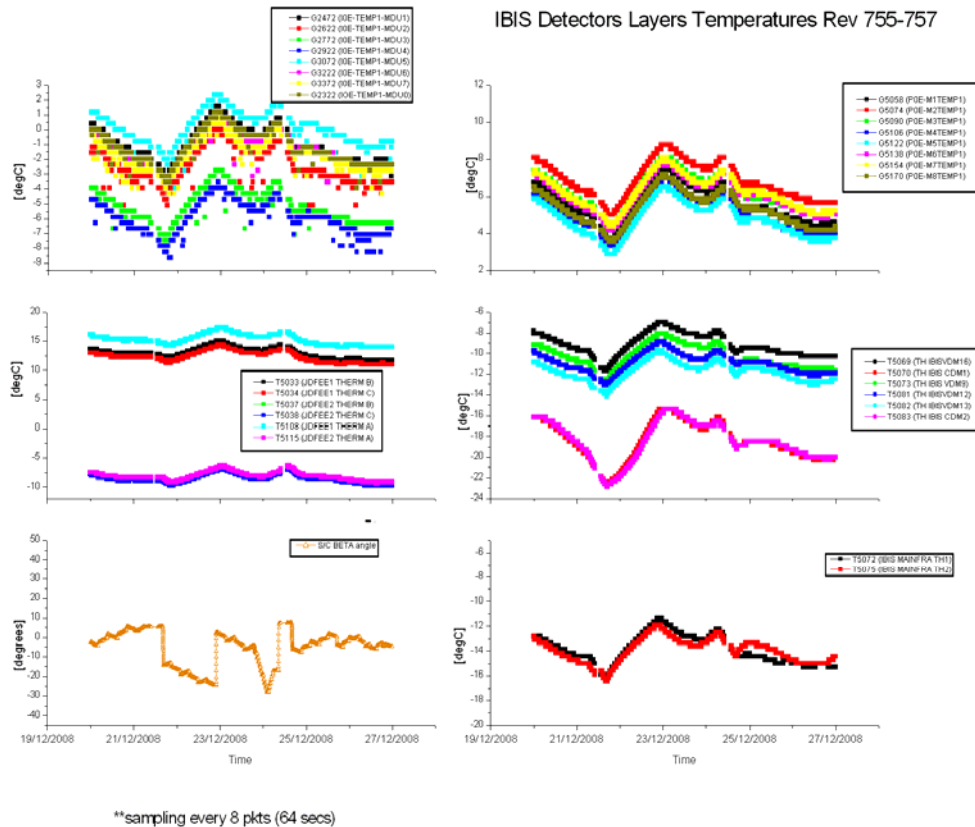
VETO Current:



PICsIT Counters:



IBIS Detectors Layers Temperatures:



IBIS daily report:

The usual Out Of Limits on TM parameter G8015 (S1E-A2_PMT_V), G5002 (POS-Mi_RTC1) and G5003 (POS-Mi_RTC2) families and G2000 family (IOE-OVFWPXADD-Mi) were received during the radiation belt passages.

2008-12-20 (DOY 355, Rev 755) to 2008-12-21 (DOY 356, Rev 755-756)

IBIS operations executed nominally.

2008-12-22 (DOY 357, Rev 756)

At 17:00:59Z TM parameter G2070 went OOL, indicating an overflow of the noisy pixel address buffer in MCE5. As it returned within limits of its own accord at 17:01:07Z, no action was taken.

2008-12-23 (DOY 358, Rev 756)

IBIS operations executed nominally.

2008-12-24 (DOY 359, Rev 756-757)

At 00:47Z, following a ground station handover, TM parameter X7500 went OOL, indicating a problem with the histogram process. Procedure FCP_IBIS1_0312 was

then executed at 01:04:31Z to force the histogram accumulation and download process to resume, however the TC G0129 to return IBIS to Science Standard mode was overlooked and therefore the IASW remained in Standby mode until the CCCF_ED GESTAN02 was uplinked from the Timeline at 05:32:43Z.

IBIS operations continued nominally.

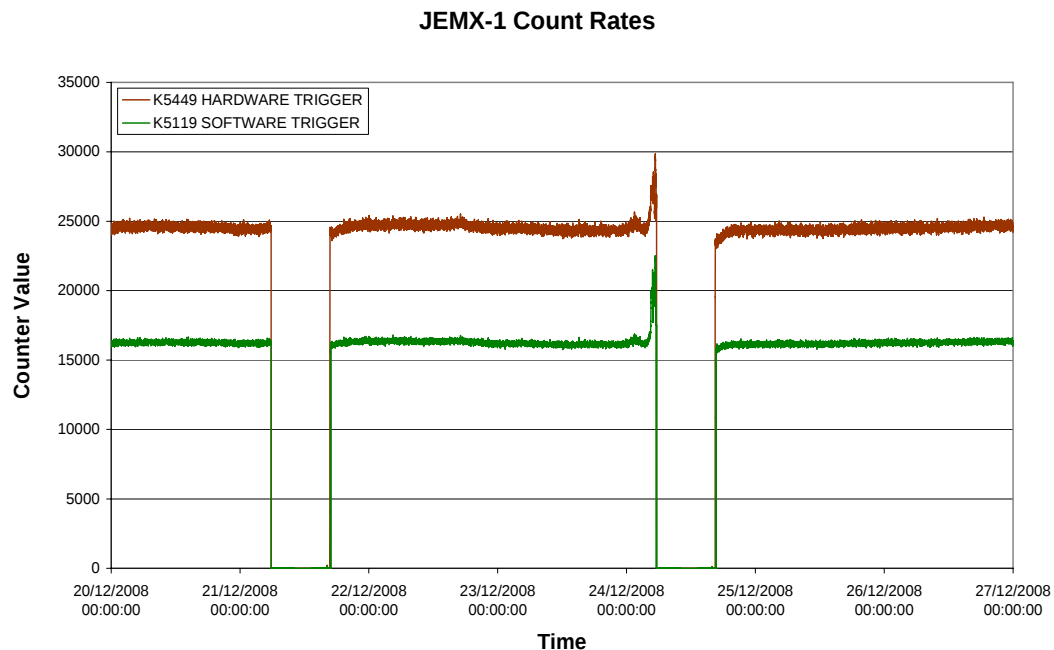
2008-12-25 (DOY 360, Rev 757) to 2008-12-26 (DOY 361, Rev 757)

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.

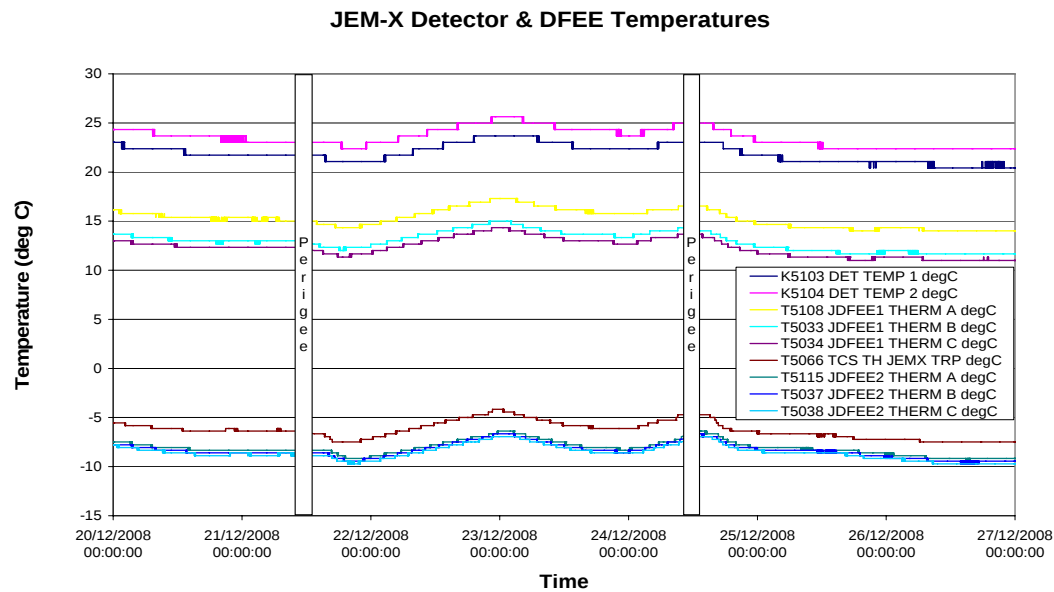


JEM-X Temperatures

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

2008-12-20 (DoY 355, Rev 755) to 2008-12-22 (DoY 357, Rev 756)

JEM-X 1 operations executed nominally.

2008-12-23 (DoY 358, Rev 756)

The following On-Event Messages were received, at the indicated times:

2008.358.14.10.10.774	2008.358.14.10.13.963	1536	RealTime	5	EXCEPTION
JEM-X1 EXC IACS INTERF EXID			0	0	65535 PR N
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			
2008.358.14.10.10.774	2008.358.14.10.14.054	1536	RealTime	6	EXCEPTION
JEM-X1 EXC IACS INTERF CULP			0	0	65535 PR N
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 there was no impact.

2008-12-24 (DoY 359, Rev 756) to 2008-12-26 (DoY 361, Rev 757)

JEM-X 1 operations executed nominally.

8.3.5 OMC Operations

2008-12-20 (DoY 355, Rev 755)

At 00:26, a FD problem forced the suspension of the timeline. A recovery was performed, and the timeline rejoined at 00:54. The impact was pointing 07550034 was shortened from a planned 3429 to 2672 seconds.

2008-12-21 (DoY 356, Rev 755-756)

At 23:36, an AOCS problem forced the suspension of the timeline. A recovery was performed, and the timeline rejoined at 00:05, the following day. The impact was the loss of pointing 07560009.

2008-12-22 (DoY 357, Rev 756) to 2008-12-26 (DoY 361, Rev 757)

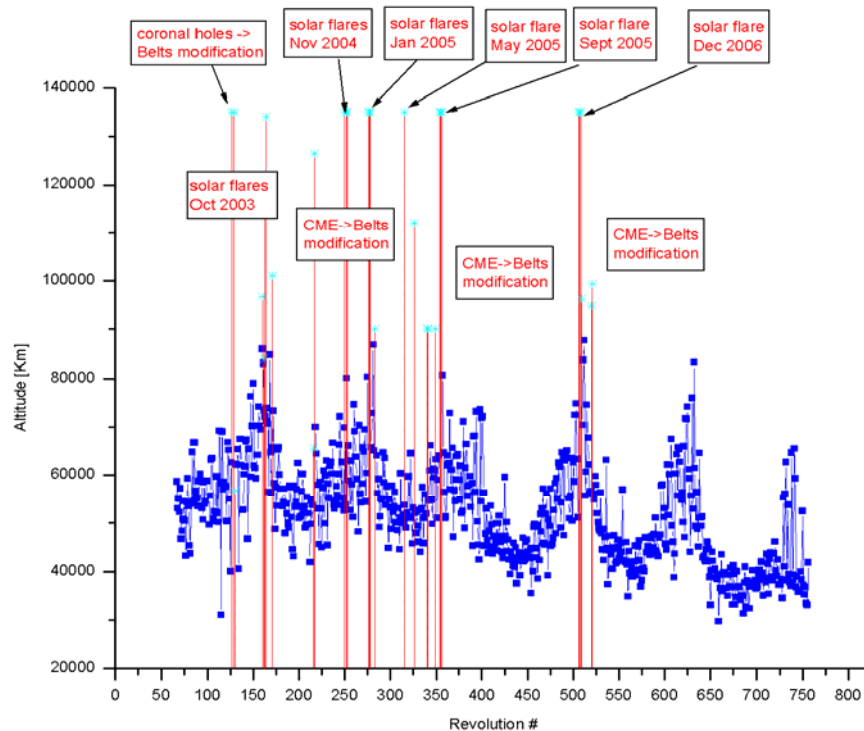
Nothing to report.

On DoY 356 at 06:39:34 and DoY 359 at 06:28:46 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]
755	RAD_ENTR R 2008-12- 21T06:39:31Z	21/12/2008 09:09:49	33093.3	21-Dec-2008 09:06:13	35345.7
756	RAD_EXIT R 2008-12- 21T16:21:23Z	21/12/2008 14:54:53	>>33977.2	21-Dec-2008 15:46:13	45831.27
756	RAD_ENTR R 2008-12- 24T06:28:40Z	24/12/2008 08:03:41	41908.1	24-Dec-2008 09:01:13	34522.96
757	RAD_EXIT R 2008-12- 24T16:09:44Z	24/12/2008 15:00:53	>>34010.0	24-Dec-2008 15:41:13	46662.67

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)

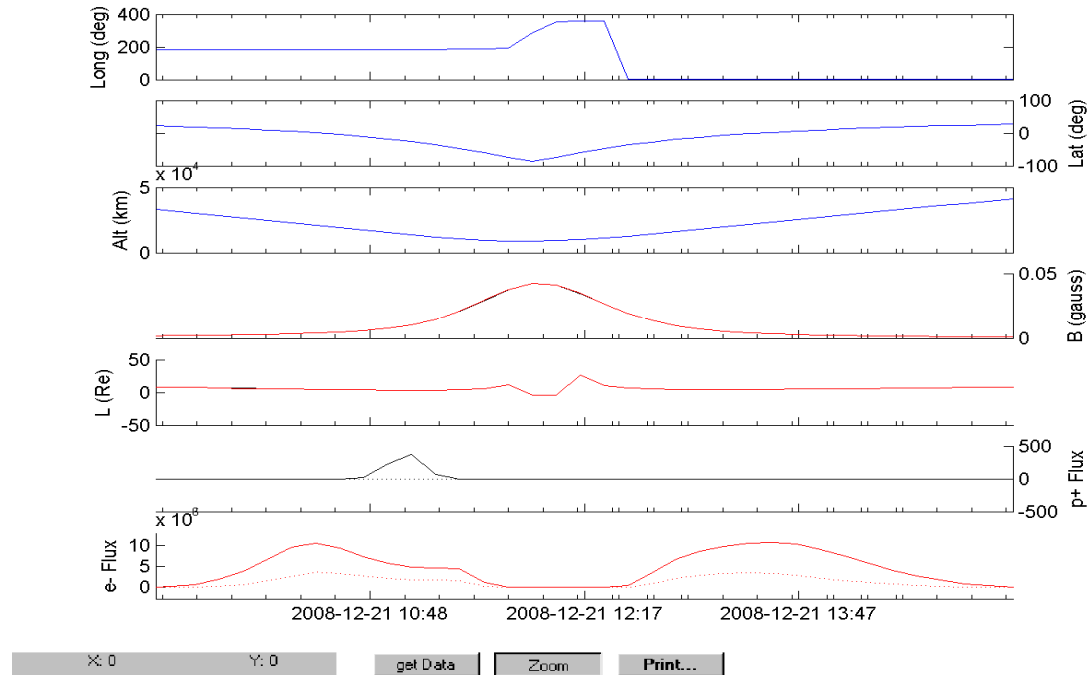
- Rad belt entry time ignoring previous threshold crossings where a gap of more than 30 minutes is present.

IREM radiation counters:

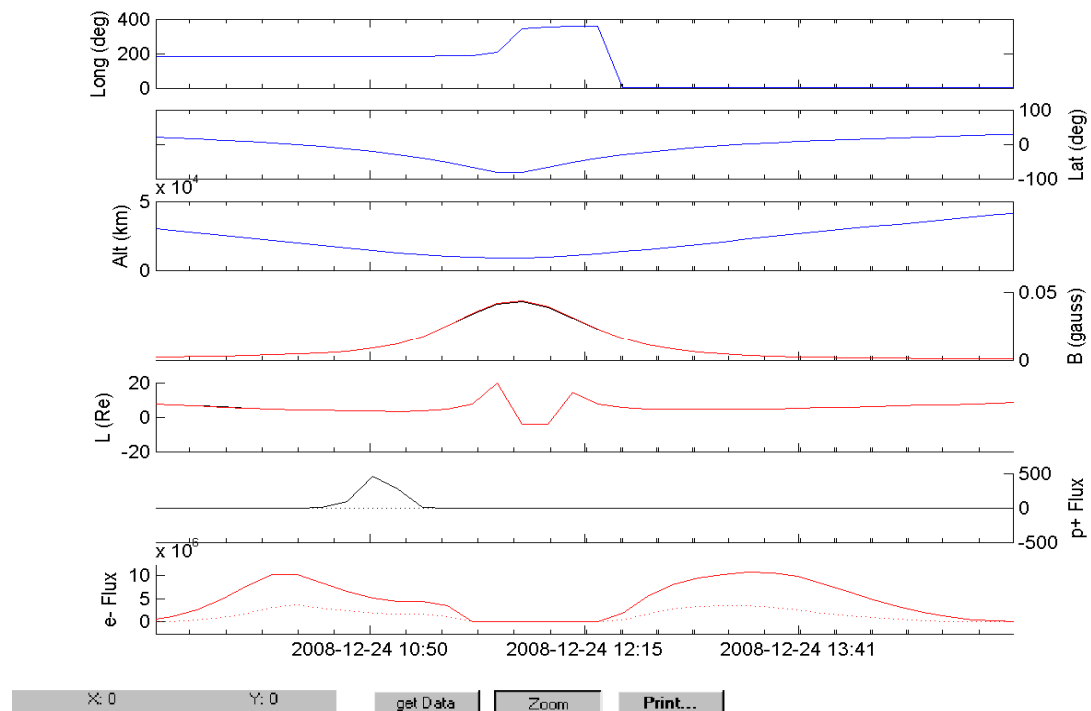
The IREM radiation counter plots are not available this week.

IREM Predicted Radiation Belt Passages

Rev 755



Rev 756



Radiation Assessment

Generated with SEIS Report and Analysis tool.

INTRODUCTION

This note summarises the space weather status over the observation period

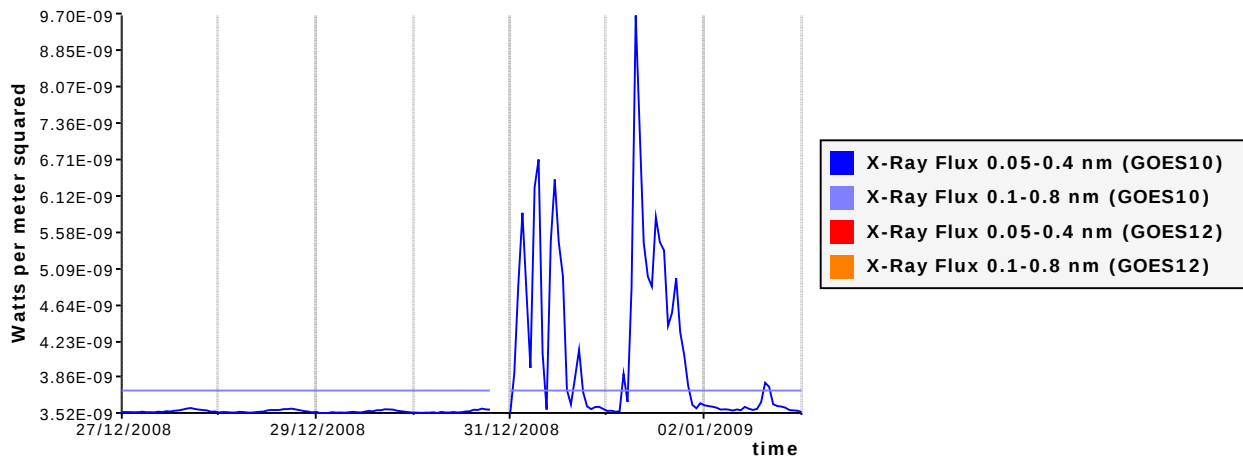
DAILY SUN

see in WR section 3.2.5

RADIATION FLUXES

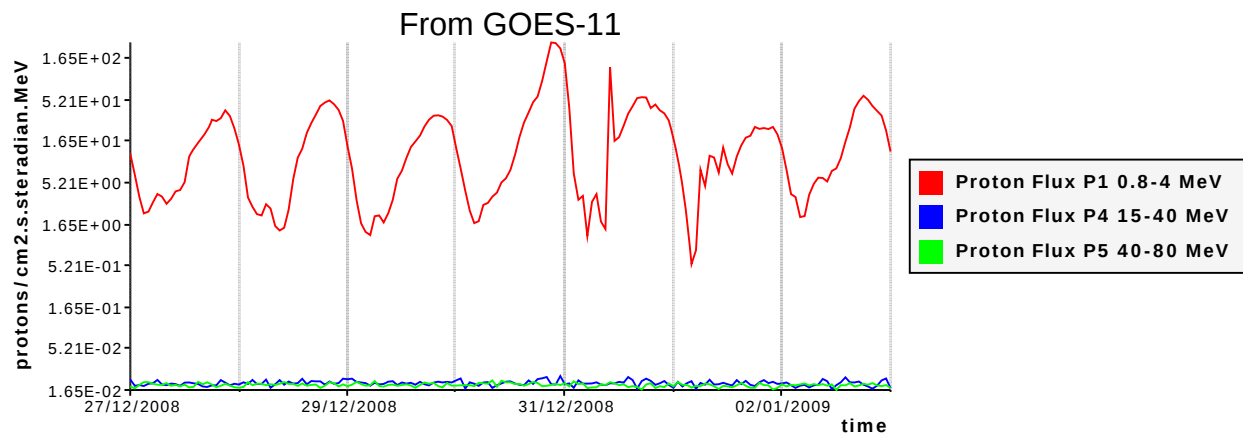
X-ray fluxes

X-ray fluxes for different energies are presented below as reported by GOES satellites. From $1\text{E-}5$ W/m², they start featuring significant radiation activity corresponding to M-class solar flares from $1\text{E-}5$ to $1\text{E-}4$ W/m², and to X-class solar flares from $1\text{E-}4$ and onwards.



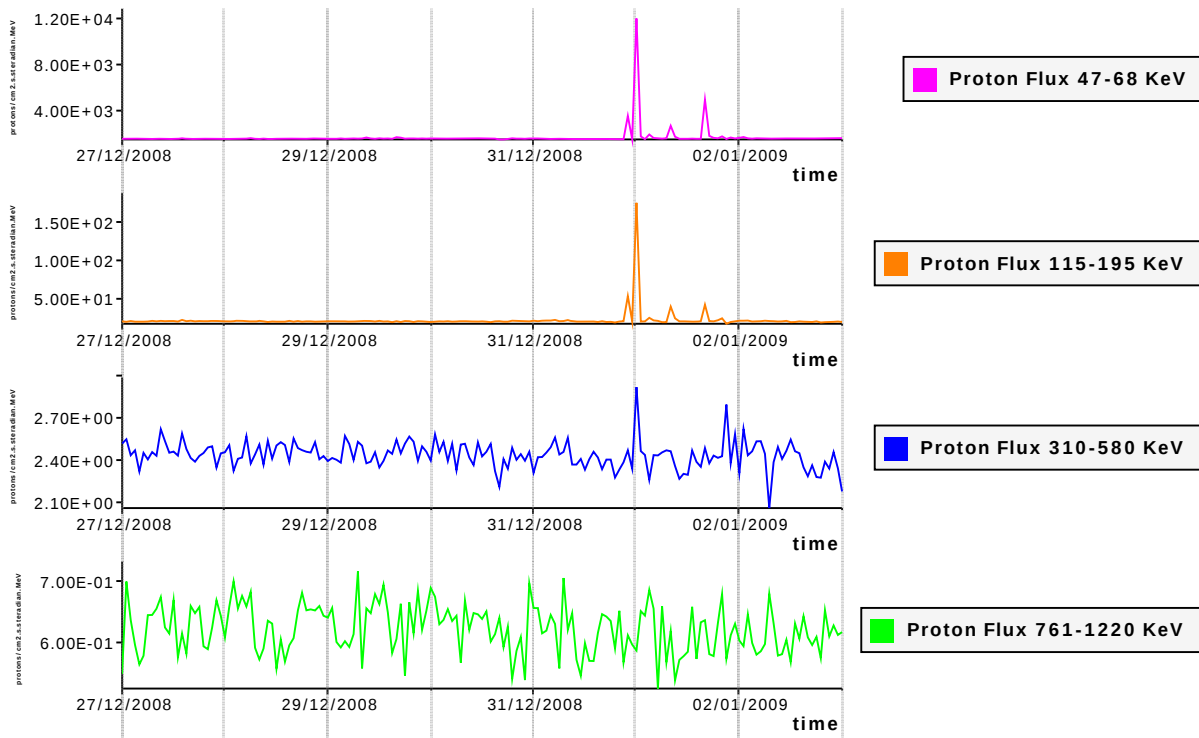
Proton fluxes (GOES-11)

Proton fluxes as measured by GOES satellites are presented in the following plot. Usually P1 oscillates between $1\text{E}+1$ and $1\text{E}+2$, while P2 and P3 evolve around $1\text{E-}2$.



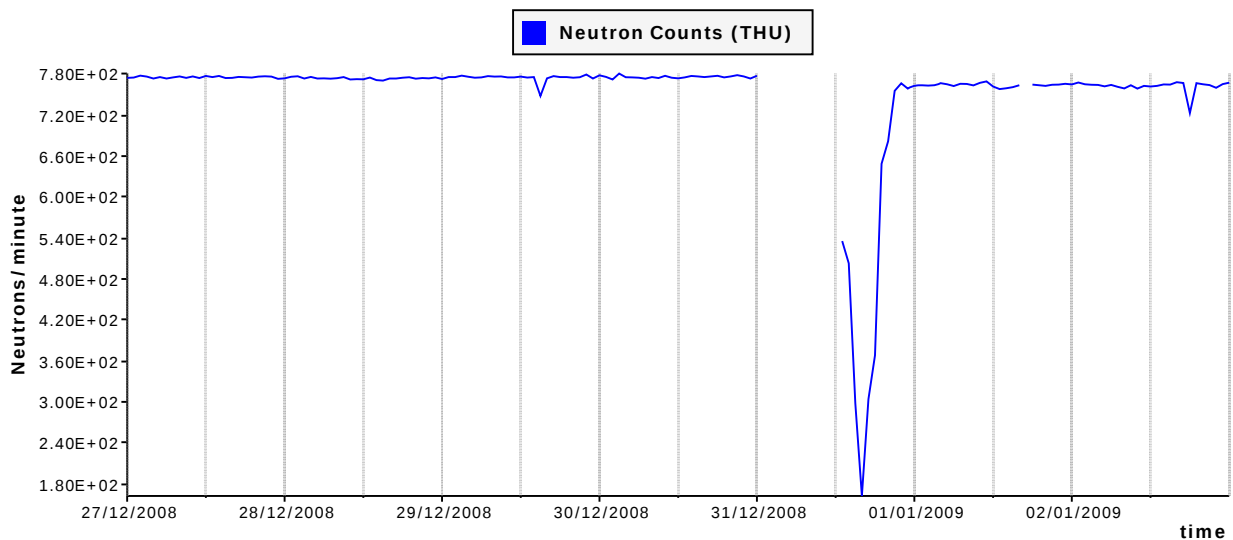
Proton fluxes (ACE)

Proton fluxes as measured by ACE satellite are presented in the following plot.



Neutron counts

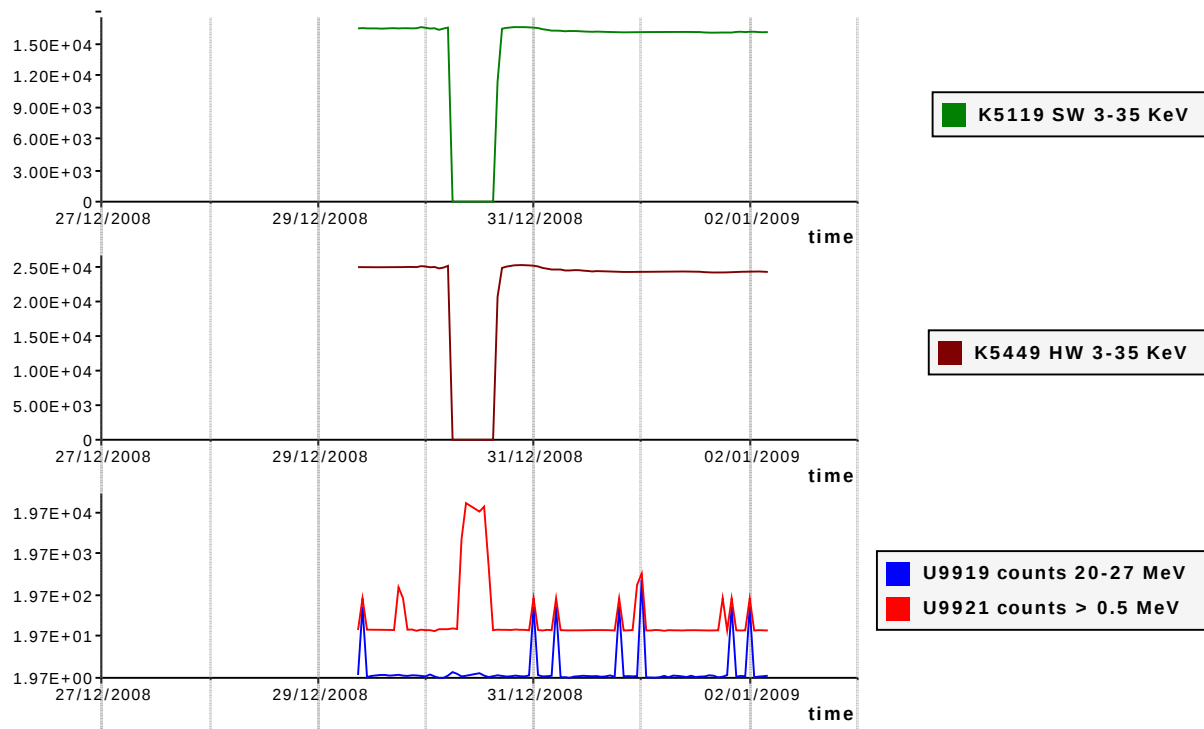
The neutron counts for the last 3 days are presented in the following plot. Nominally they remain stable around 7.2×10^2 .



IREM and JEM-X (INTEGRAL)

IREM proton and electron fluxes as well as JEM-X1 software and hardware triggers are presented in the following plots.

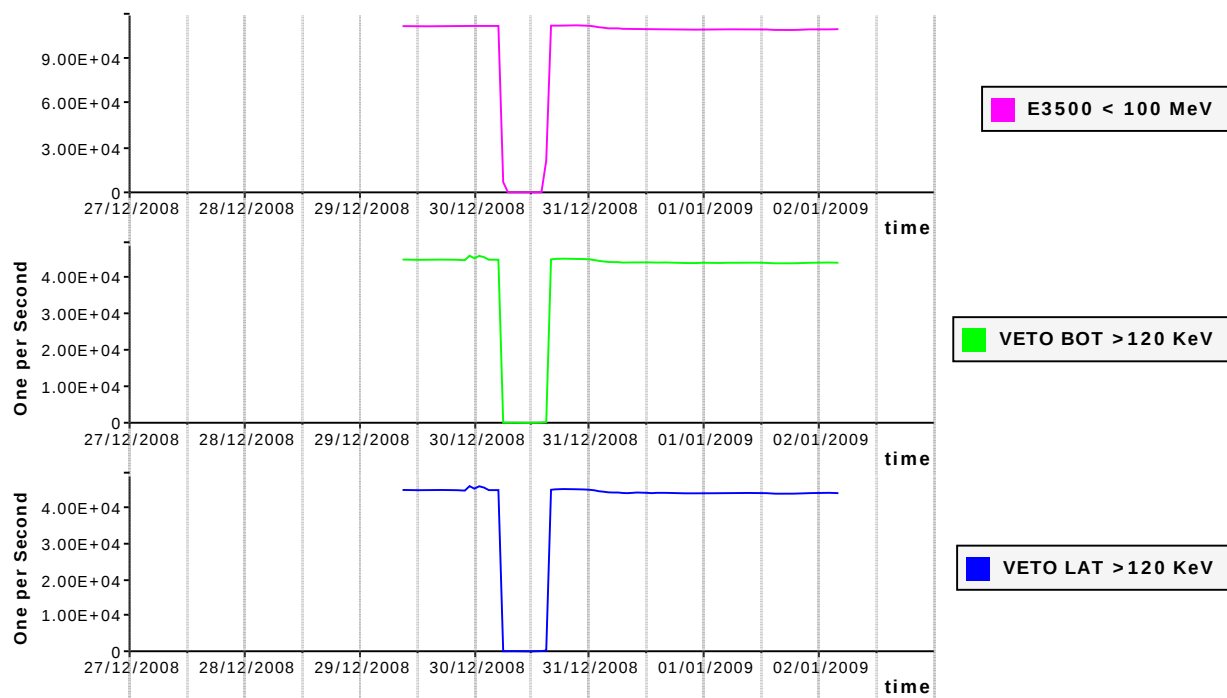
Nominal values are respectively about 1 and 18 for IREM counts, and, 13000 and 19000 for JEM-X ones.



SPI and IBIS (INTEGRAL)

SPI-ACS counters below 100MeV as well as IBIS-VETO bottom and lateral counters are presented in the following plots.

Nominal values are respectively about 90000 for SPI counts, and 36000 for IBIS ones.



SOLAR FLARES FORECAST

The probabilities of M and X-class solar flares during the last month are presented below. Chances of solar flare start to be meaningful from 15%.

