

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No.324
Week 49
08.12.08
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 29.11.08 until 05.12.08 (both dates inclusive) and covers the revolutions 748, 749 and 750.

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 Virgo Cluster (RA 12:26:32.10, DEC +12:43:24.0) and a OMC Flat Field Calibration (RA 09:52:00.00, DEC +17:06:00.0)

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.

No slew was missed from TL, during the observation period.

The fuel consumption over the period between 29/11/2008 and 05/12/2008 was 0.0968 Kg. The remaining propellant is in the order of 137.2898 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

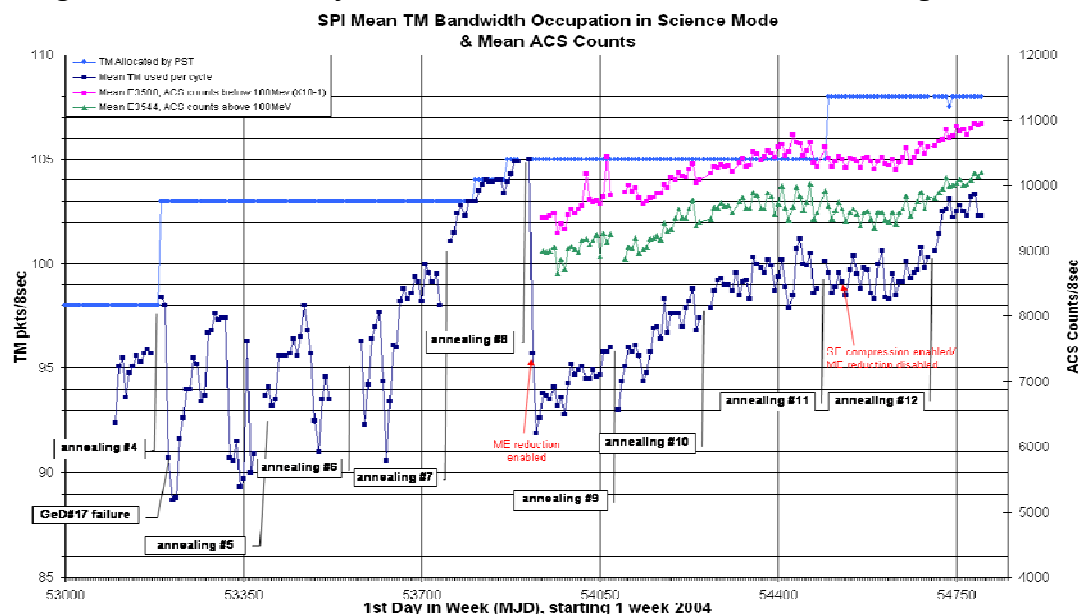
3.2.1 SPI

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 except from 2008-12-04T21:49:13Z to 2008-12-05T02:09:42Z, when it was 88 packets/cycle due to an OMC Flat Field Calibration. The average telemetry occupation when the allocation was 108 packets/cycle 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.

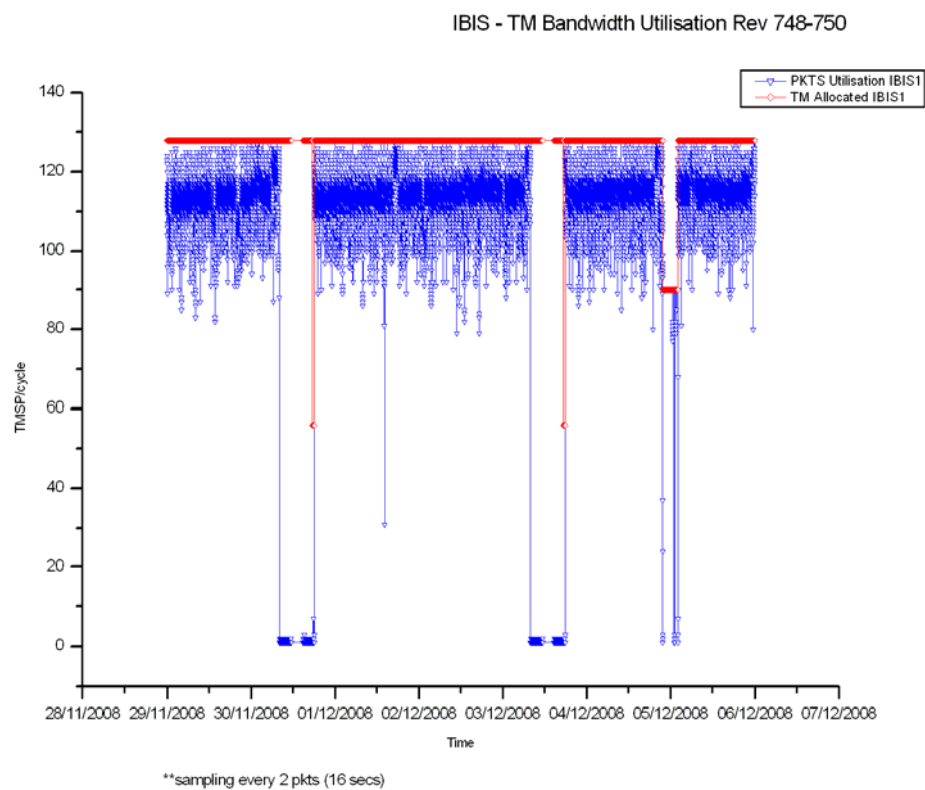
3.2.2 IBIS

The overall status of the unit is nominal.

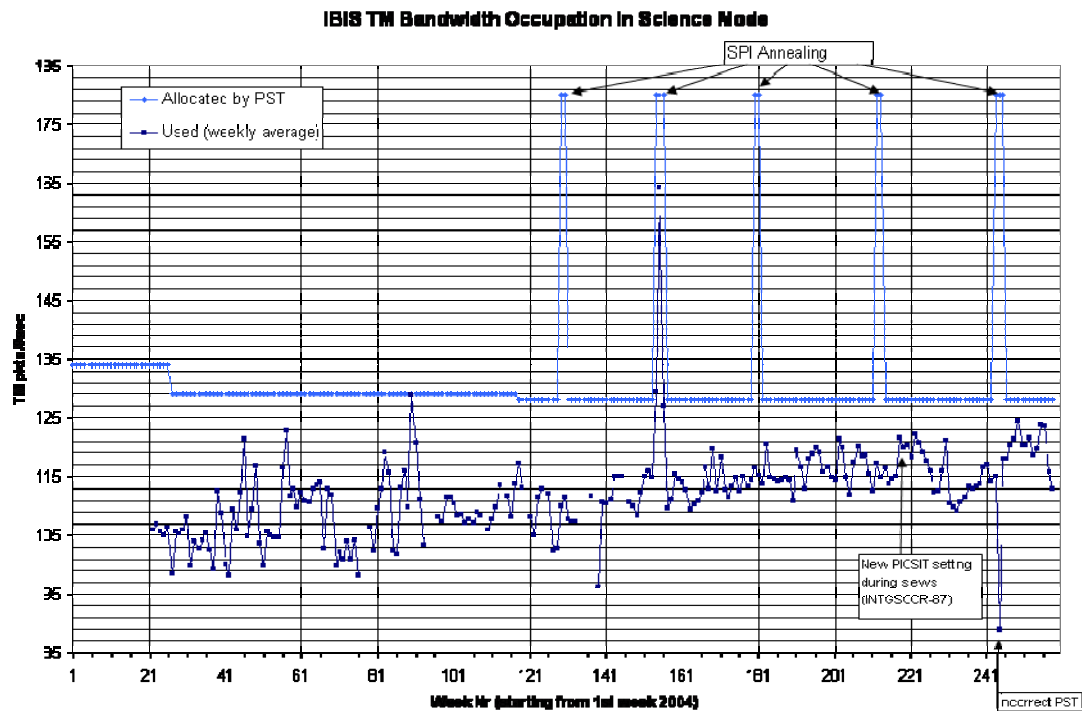
During the reporting period, the TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 128 packets/cycle except from 2008-12-04T21:49:13Z to 2008-12-05T02:09:42Z, when it was 90 packets/cycle due to an OMC Flat Field Calibration.
- IBIS mean bandwidth utilisation in science mode: 112.94 packets/cycle (down 2.8 on previous week)
- Percentage of TM cycles in which full bandwidth was used: 0.37%

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, except from 2008-12-04T21:49:56Z to 2008-12-05T02:10:25Z during the Flat-Field calibration when it was 63 packets per cycle.

During this reporting period, all of the 136 planned science pointings were executed nominally. In addition, Flat-Field and Dark Current calibrations were performed nominally.

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 was 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. No pointing was lost to MOC related issues. More information is given in section 6.

4.2 Ground Stations & Network

The end date for the period of possible Eutelsat emergency support from Redu-1 has been extended from 8th December until 14th December. A test with Eutelsat is planned on DOY 343 after the end of the Integral support.

No progress yet on the issue of the offline retrieval of VC 7 from Redu-1, due to workload. This week there should be time to continue the investigation.

The implementation of QoS on the T1 line to JPL is still outstanding.

2008-12-05 20:12:00 (340)

Data gaps on VC7 received from Goldstone for about 2 minutes.

2008-12-05 20:18:00 (340)

More data gaps received from Goldstone. VC7 link recycled.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 757 to 760. A second PSF was received for 759, where a satellite engineering window centred on midnight from Dec 31 - Jan 1 was inserted, to cover the leap second.

New observations have been approved and planning files sent for revolutions 757 to 759.

New TSFs have been received for revolutions 750 and 752.

A TOO was received on Dec 4, following a flux increase seen by the Fermi-GST LAT from 3C279. The TOO was approved under the condition that the trigger would be reached before Monday noon, so that re-planning could be done for revolution 752.

2. Observation status

New ECS files have been received for revolutions 737, 739-741.

3. ISOC Science Data Archive

No news.

4. ISOC system

Still on ISOC system V20.

5. Problems

The duty scientist phone still does not receive TOO alerts.

4.3.2 ISDC

Status of ISDC observation processing on 05/12/2008:

- Latest Standard Analysis completed: observation 05200260007 (mid-latitude 1, Revolution 740) on 04/12/2008.

- Latest products archived: observation 05200260007 (mid-latitude 1, Revolution 740) on 04/12/2008.

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

5 Special Events

On DoY 337 the installation of E3.2 on B-chain was done during the perigee outage.

6 Anomalies

Neither platform nor instrument anomalies

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

7 Future Milestones

- Possible TOO, replanning for revolution 752
- E3.2 to be installed on MCS A-chain 9/12/2008 during perigee
- MRB 8/12/2008, Firewall connectivity problems to JPL, Geneva.
- Database installation 15/12/2008
- Thruster Calibration 10/12/2008

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

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.

Revolution 749

The observations in revolution 749 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 750

The observations in revolution 750 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 ~25.1 hours. They continued with a Flat Field Calibration of OMC (RA 09:52:00.00, DEC +17:06:00.0) lasting ~3.4 hours. This was followed by a hexagonal dither of the Virgo Cluster (RA 12:26:32.10, DEC +12:43:24.0) lasting ~27.0 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, except during the OMC Flat-Field calibration from 2008-12-04T21:49:56Z to 2008-12-05T02:10:25Z when it was IBIS 90; SPI 88; JEM-X1 8; JEM-X2 0; OMC 63.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

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.
2008-11-30T15:34:12.000Z	137.3746	F	Automatic TM processing.
2008-12-01T17:14:55.000Z	137.3396	F	Automatic TM processing.
2008-12-03T15:24:36.000Z	137.3196	F	Automatic TM processing.
2008-12-04T20:03:59.000Z	137.2898	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, 29/11/2008 – 05/12/2008

The AOCS operations were executed from the Automatic Timeline.

During this period, 91 Open Loop Slews, 58 Closed Loop Slews and 4 Momentum Biases were executed (as reported by ACC OEM).

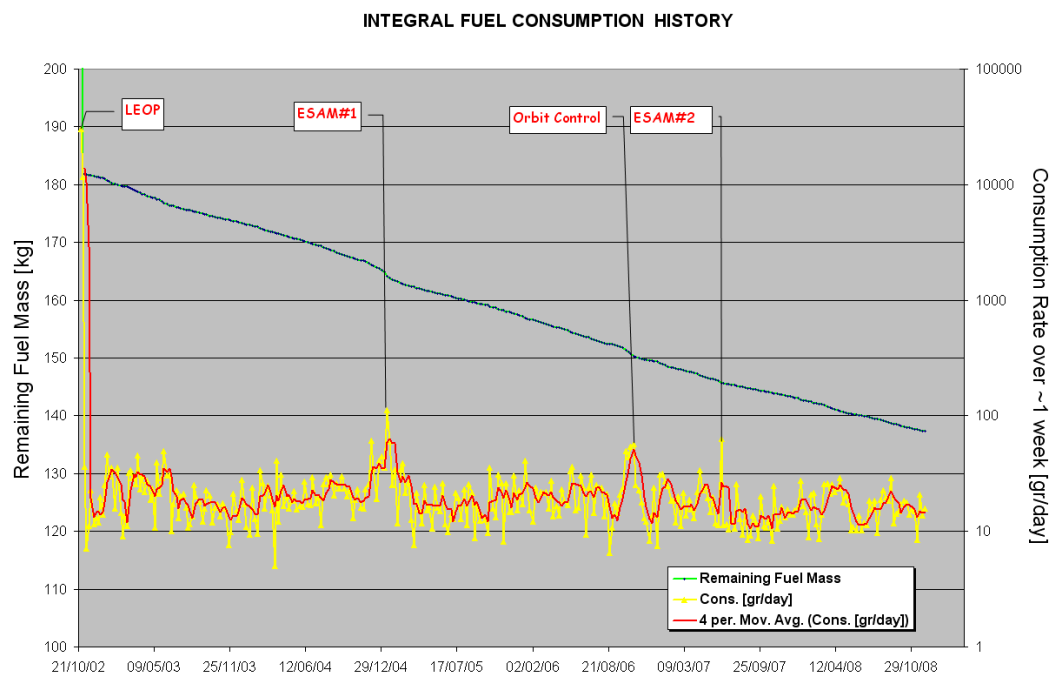
No slew was missed from TL, during the observation period.

Orbit Control

No update

Fuel consumption

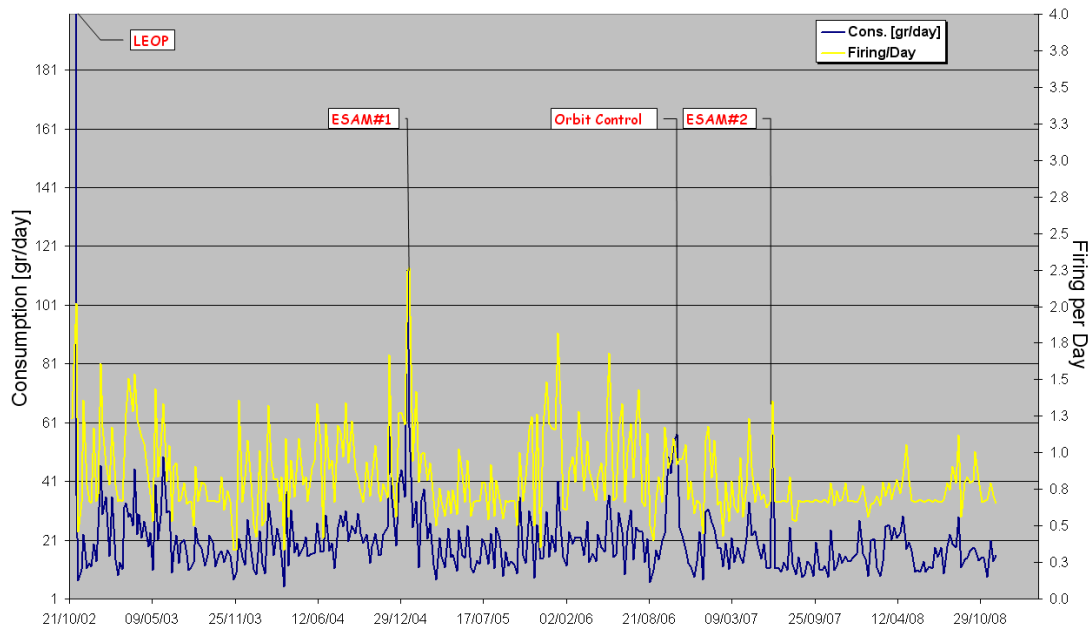
The fuel consumption (total, grams per day) over the period between 01/11/2002 and 05/12/2008 is reported in the plot below.



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 05/12/2008 is reported in the plot below.

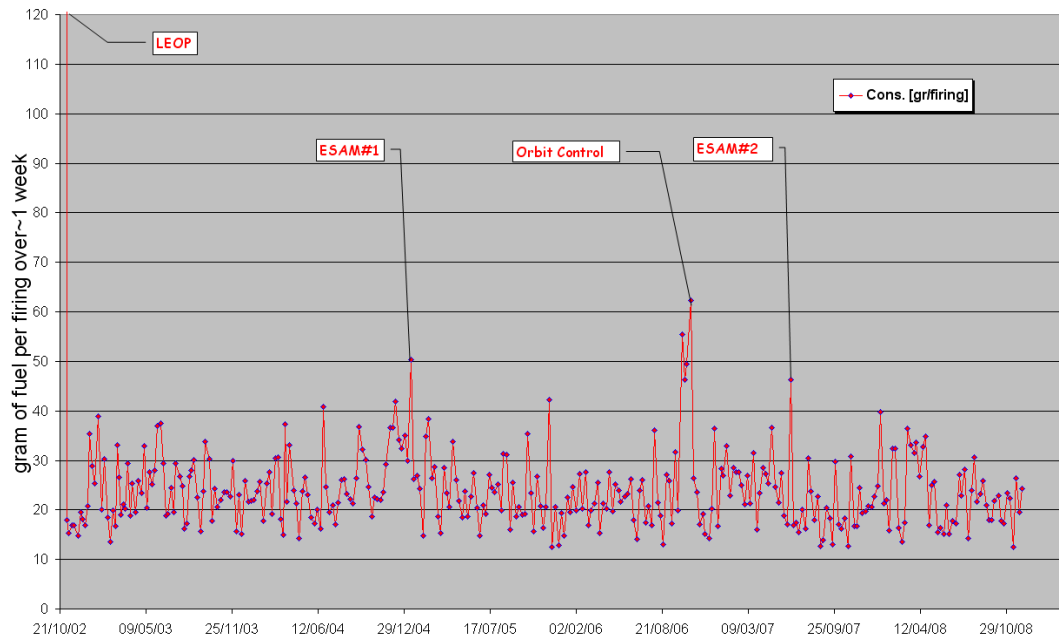
INTEGRAL FIRING PER DAY HISTORY



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 05/12/2008 is shown in the plot below.

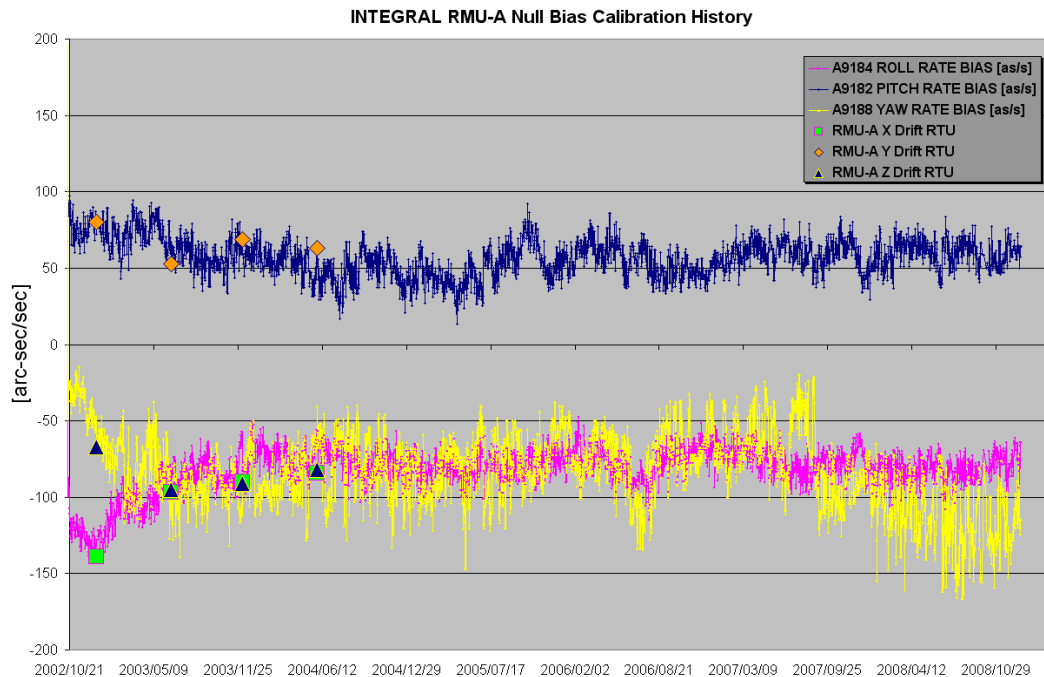
INTEGRAL FUEL MASS PER FIRING HISTORY



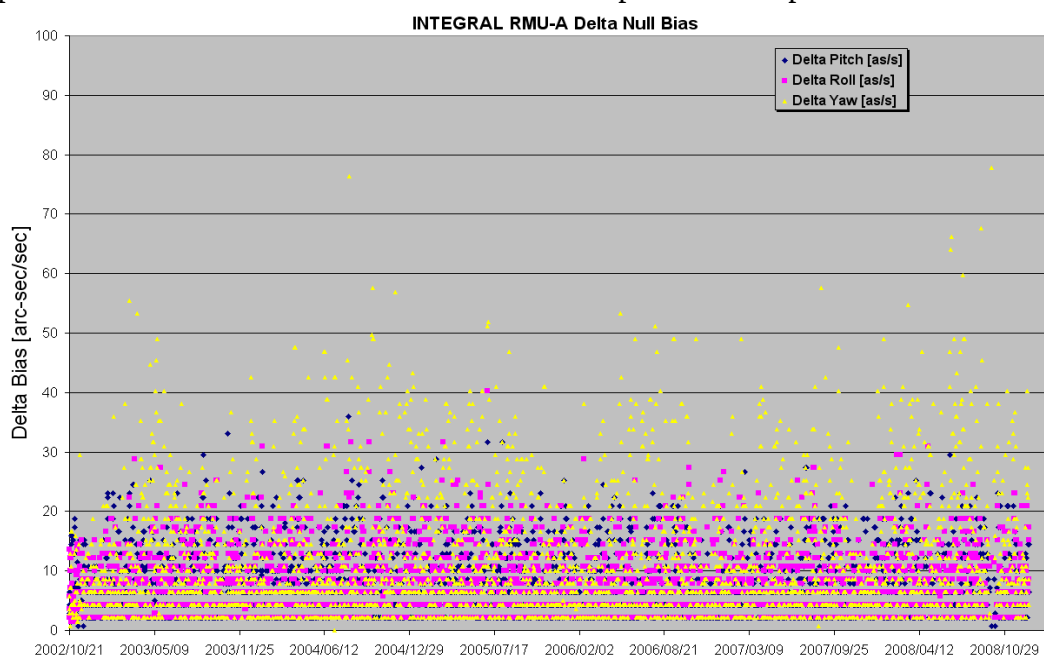
The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 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.



29/11/2008 (Day of Year 334, Revolution 748)

Nothing to report.

30/11/2008 (Day of Year 335, Revolution 748-749)

Nothing to report.

01/12/2008 (Day of Year 336, Revolution 749)

Nothing to report.

02/12/2008 (Day of Year 337, Revolution 749)

Nothing to report.

03/12/2008 (Day of Year 338, Revolution 749-750)

Nothing to report.

04/12/2008 (Day of Year 339, Revolution 750)

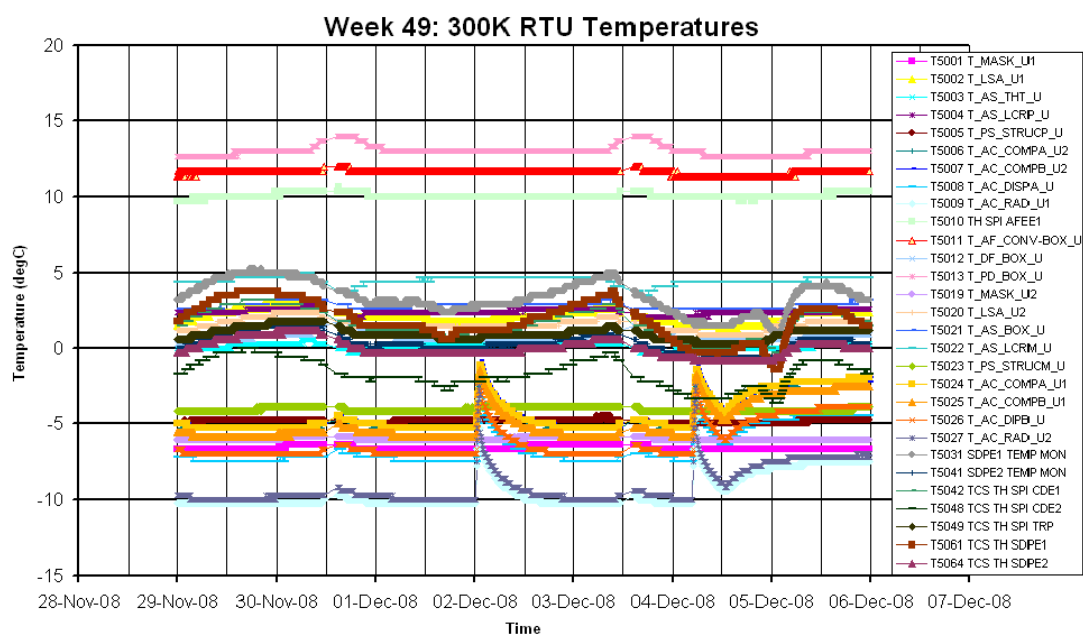
Nothing to report.

05/12/2008 (Day of Year 340, Revolution 750)

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.

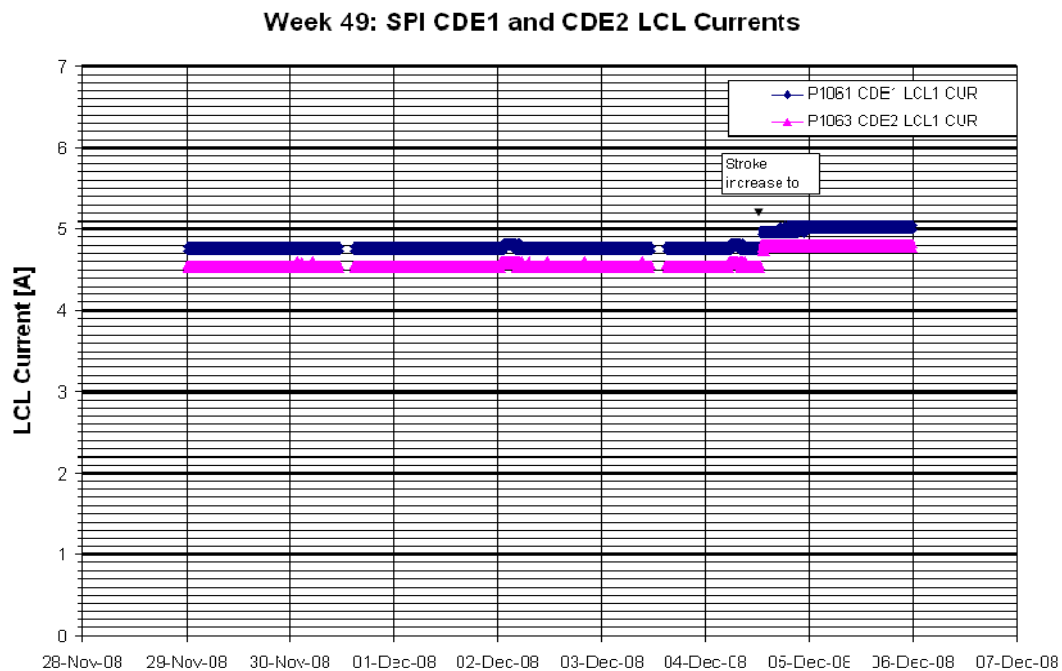


Stirling Compressors and Cryostat: The performance of the compressors is nominal.

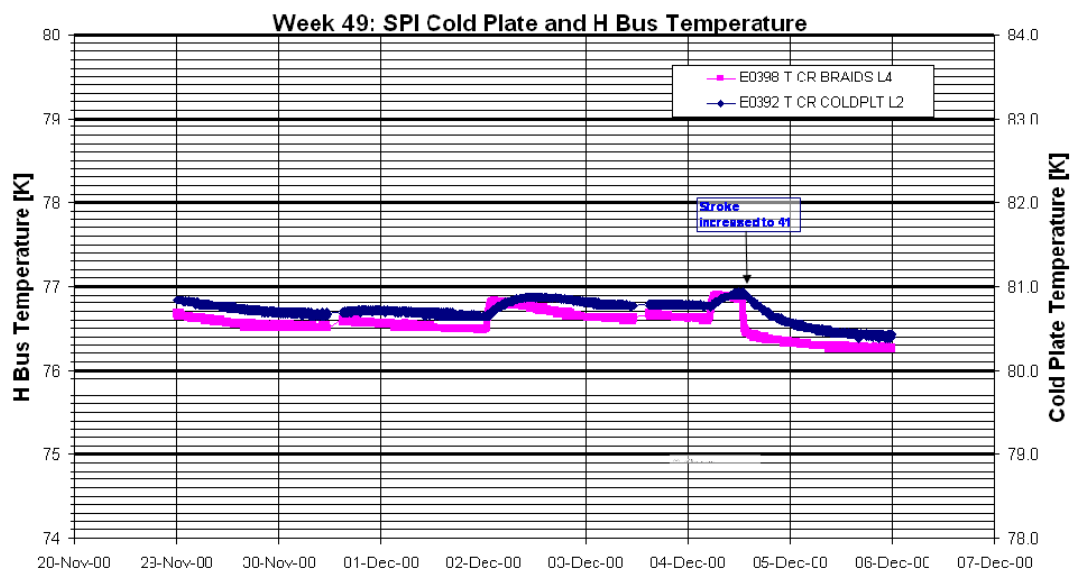
The cold plate temperature was maintained in the range 80K +/-1K.

The stroke of all four compressors was set to 40 until 2008-12-04 at 12:53Z when the stroke of all four compressors was increased to 41 as the Cold Plate temperature, TM parameter E0392 had reached 80.9K.

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



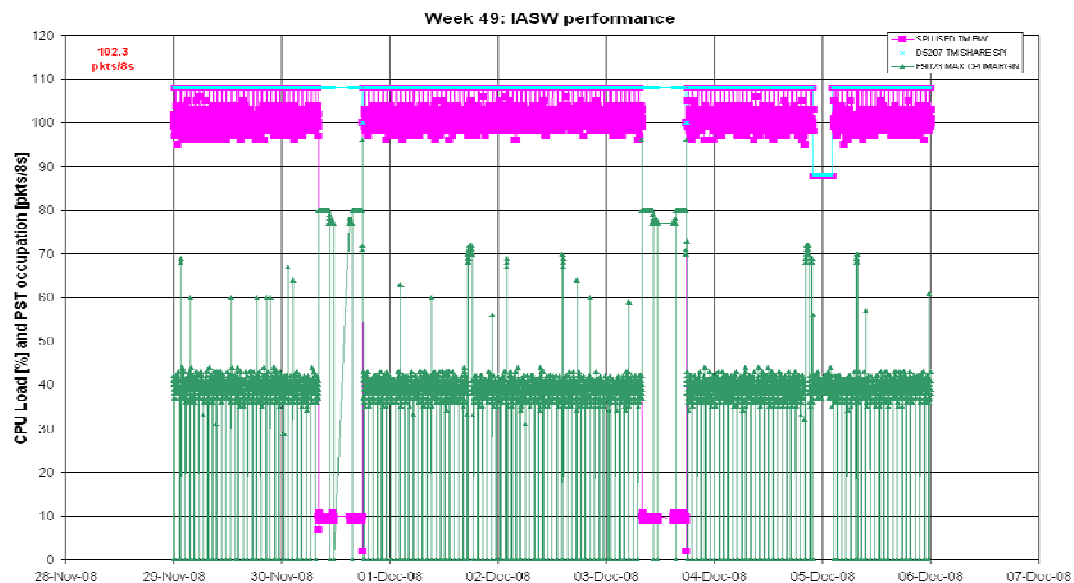
The following plot shows the evolution of the cold plate and H bus temperatures during the reporting period.



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

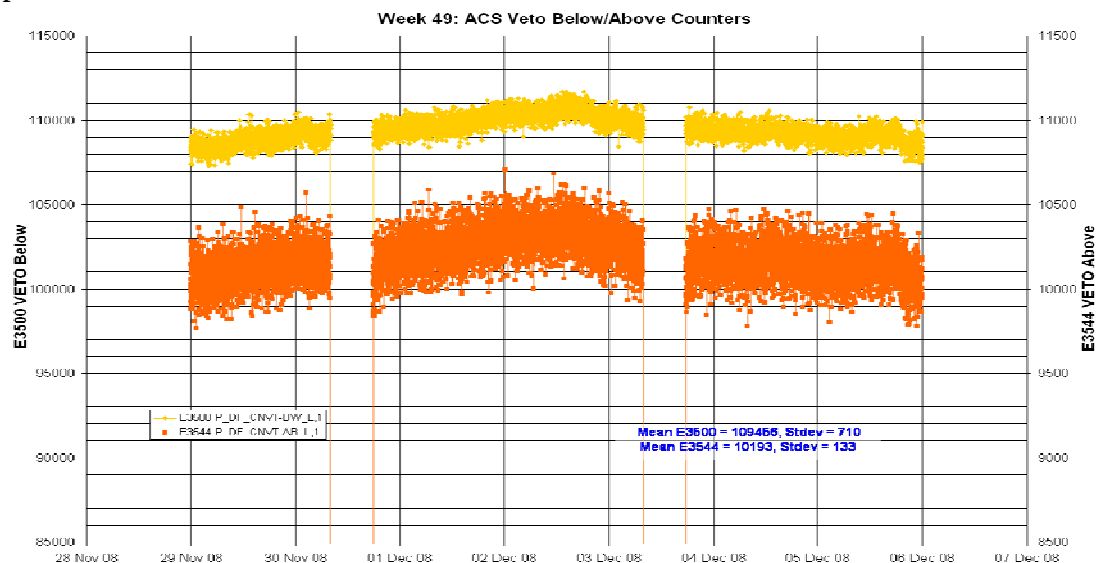
The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling factor set to 8/19 SE. The average TM bandwidth occupation of SPI was 102.3 packets/cycle over the science window when the TM allocation was 108 packets/cycle.

The following plot shows the IASW performance in terms of TM bandwidth occupation and DPE CPU load during the reporting period. Note that from 2008-12-04T21:49:13Z to 2008-12-05T02:09:42Z the TM allocation was 88 packets/cycle due to an OMC Flat Field Calibration.

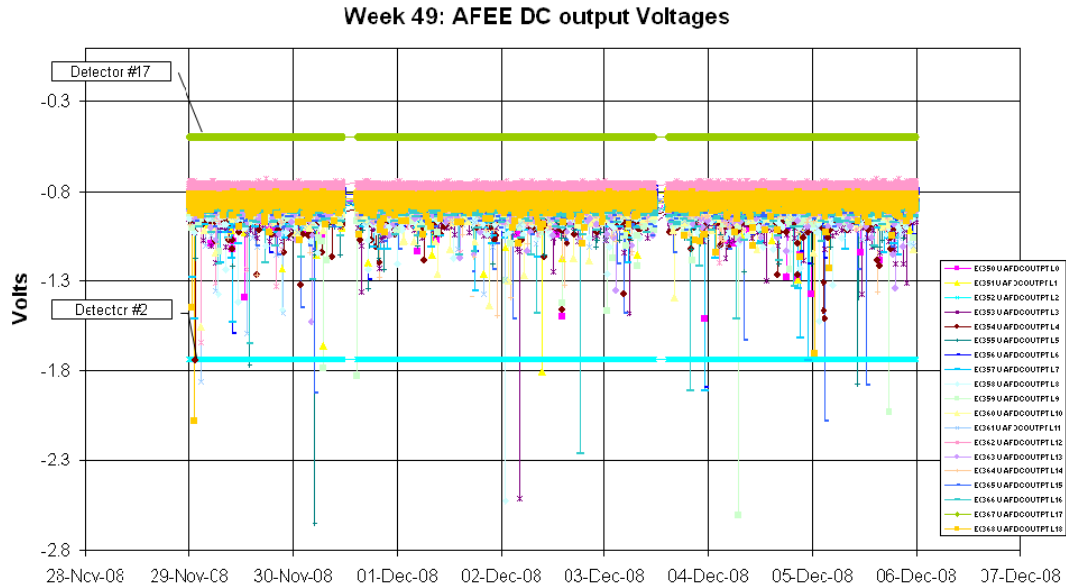


ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61).

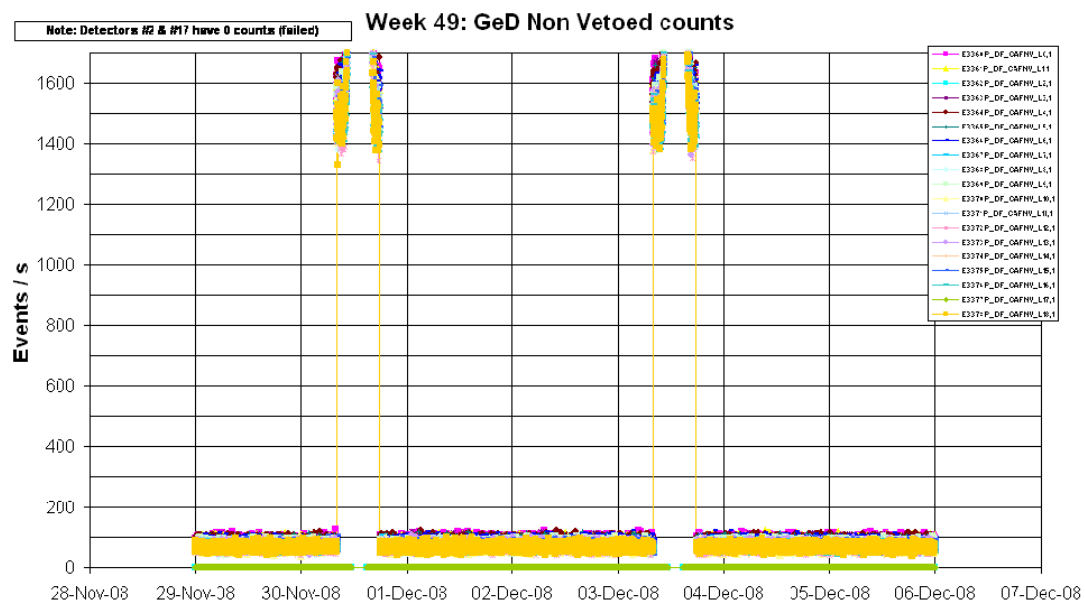
The following plot shows the ACS overall count rate evolution during the reporting period:

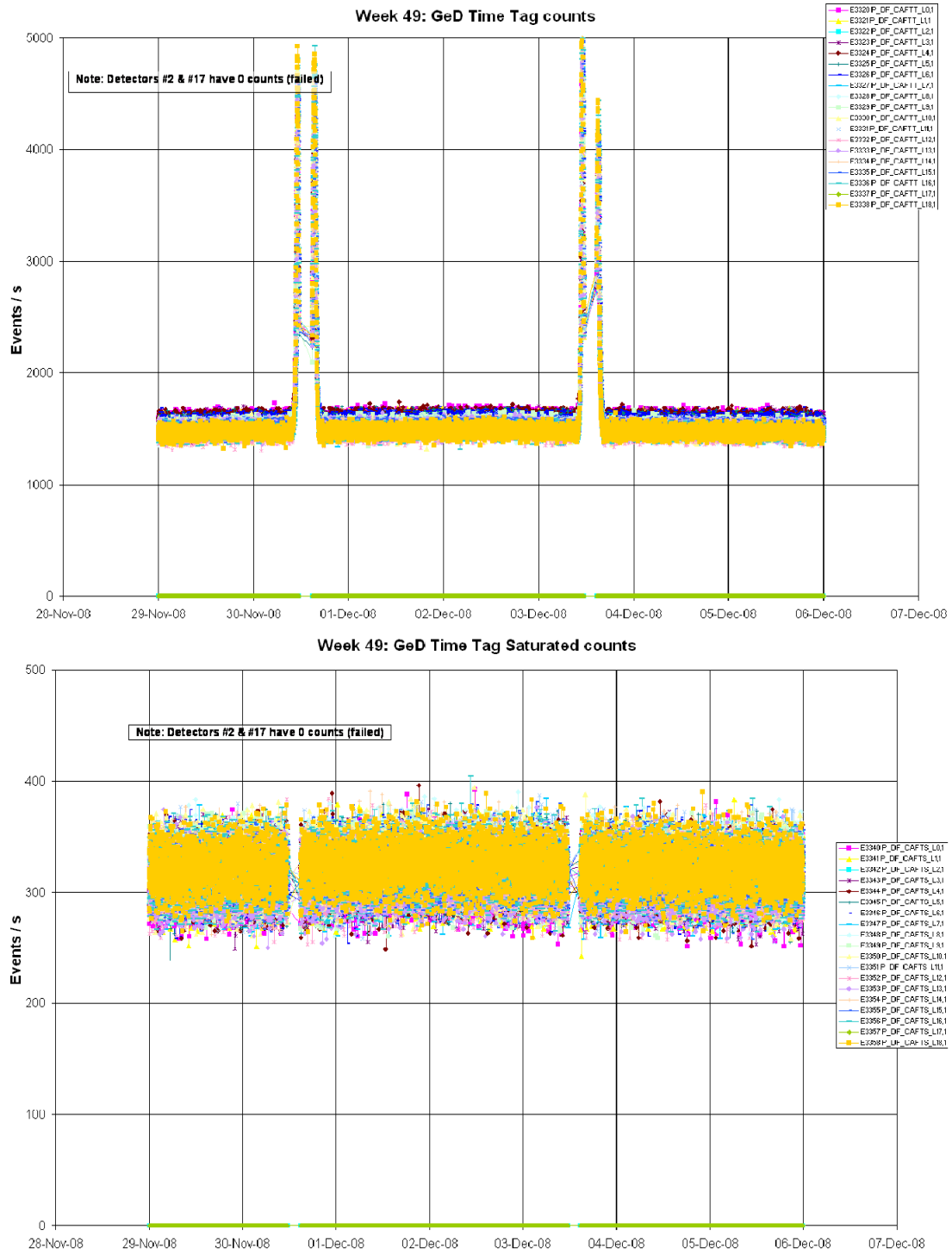


AFEE: The health of the AFEE is nominal. The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06/12/2003 and detector #17 is failed since 17/07/2004.

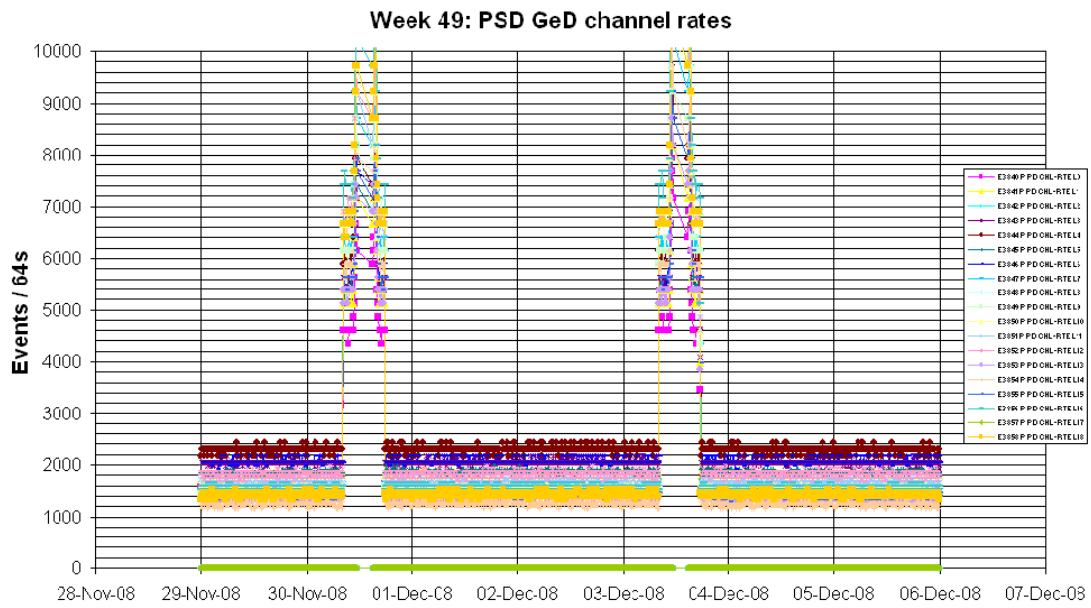


DFEE: The performance of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event count rates during the reporting period.





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



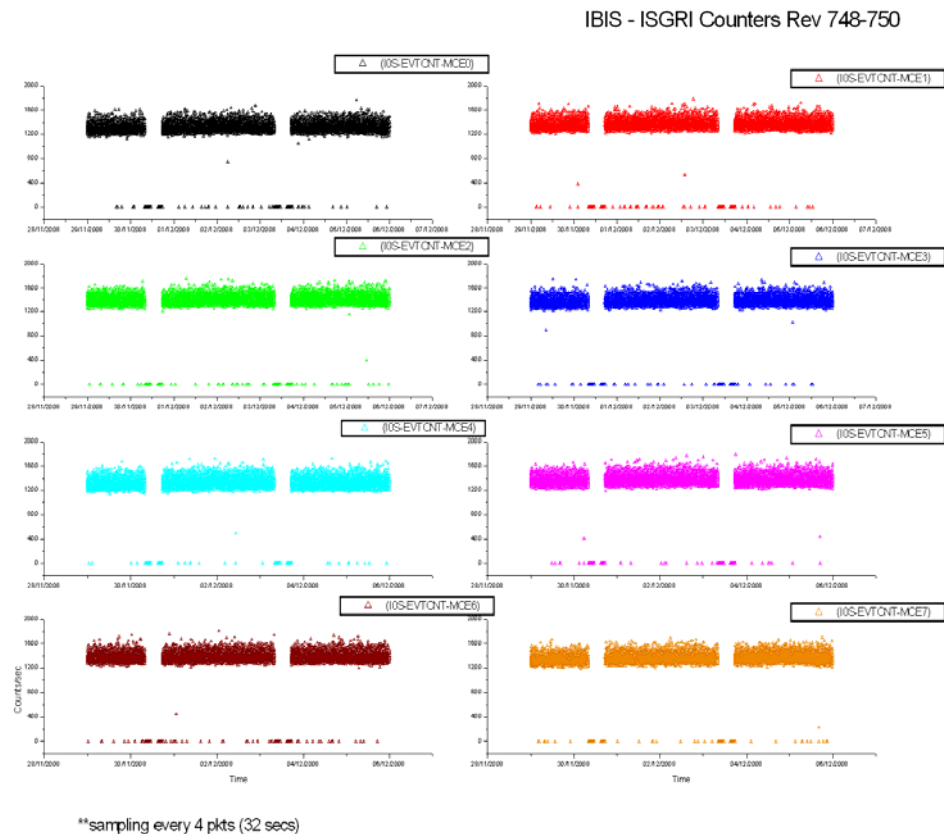
Event Log:

No non-nominal events occurred on SPI during the reporting period.

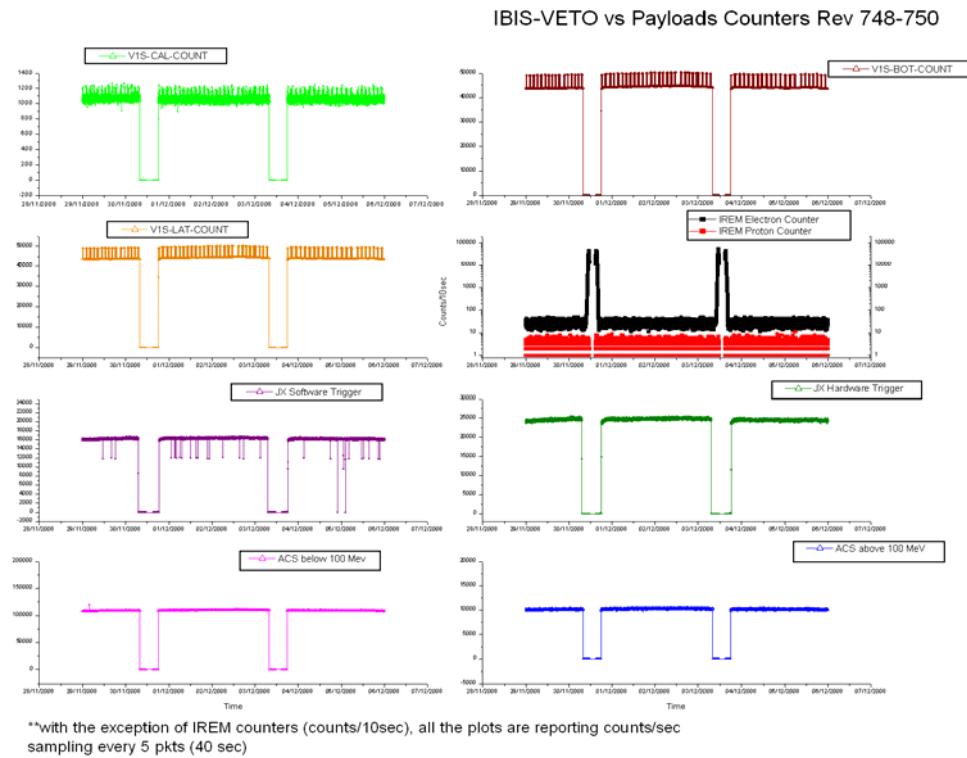
8.3.3 IBIS Operations

IBIS Event Counters Plots

ISGRI Counters:

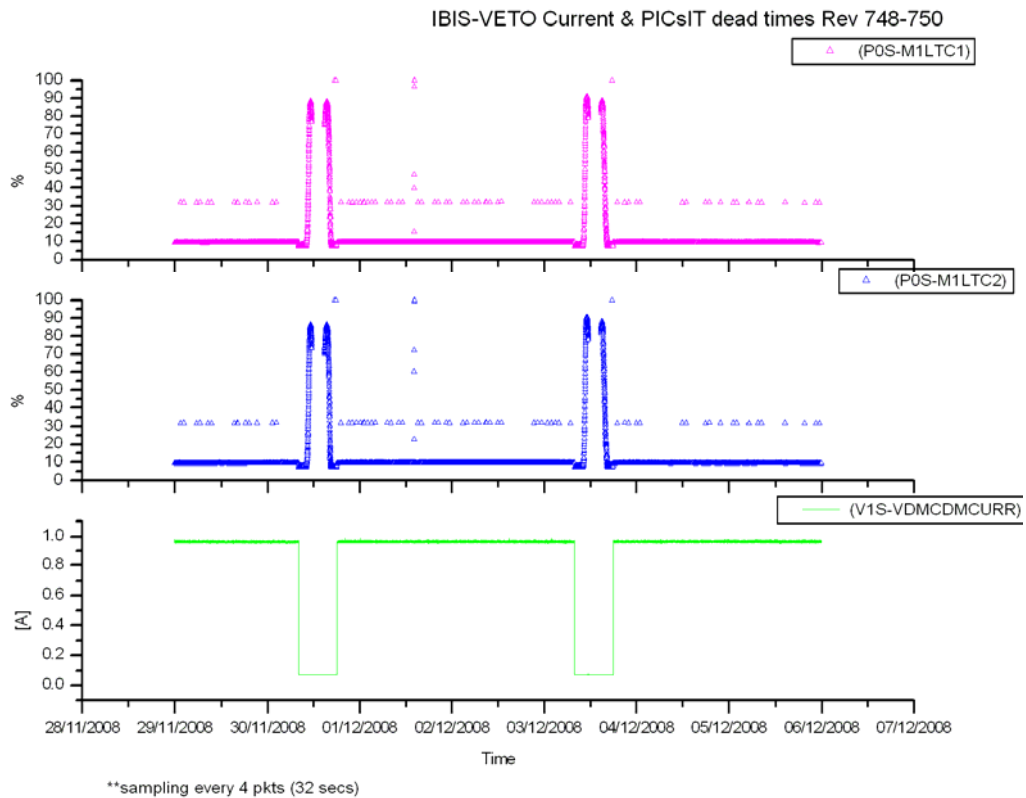


VETO vs Payload Counters:

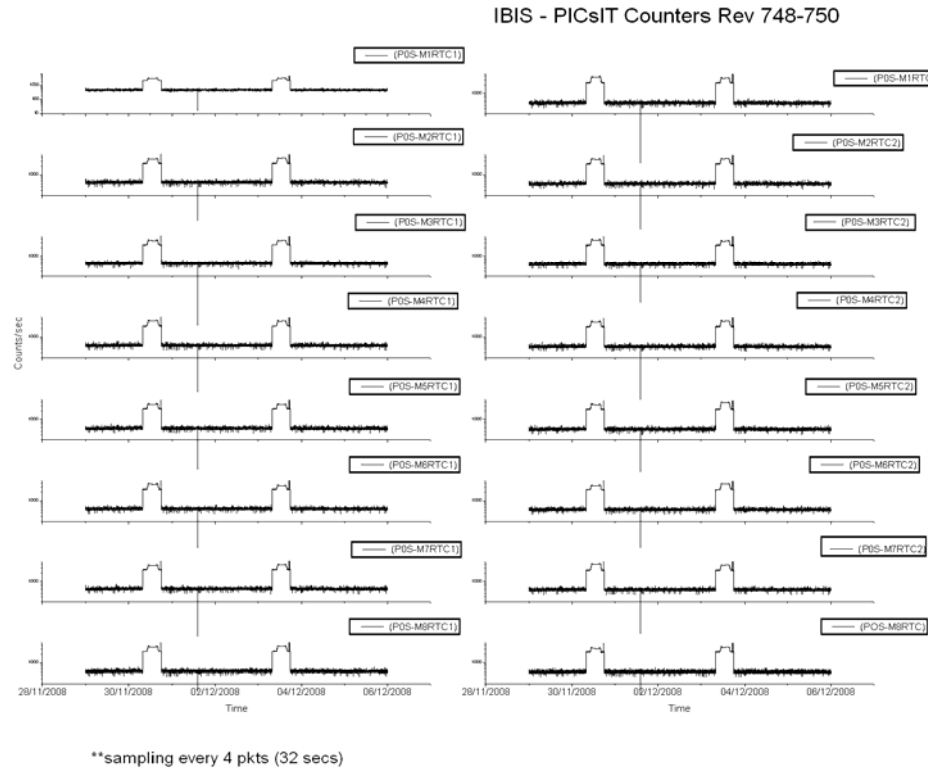


The week was characterised by low radiation as reported by the payload.

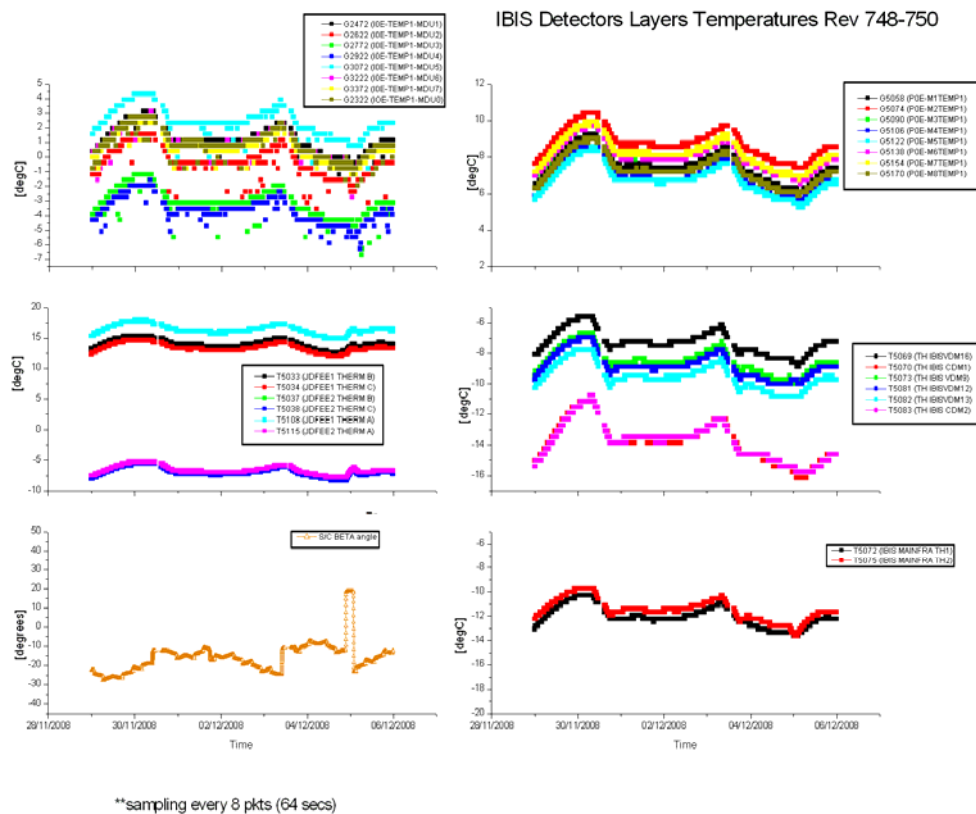
VETO Current:



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.

2008-11-29 (DOY 334, Rev 748) to 2008-11-30 (DOY 335, Rev 748-749)

IBIS operations executed nominally.

2008-12-01 (DOY 336, Rev 749)

At 14:10:39Z the TM parameters families G5068 and G5072 failed status consistency check (value = TRUE). These are the PDM semi-module FIFO error flags. At 14:10:50Z the TM parameter families G5002 and G5003 for the PDM semi-module counters started going OOL Low. As these were followed at 14:15:26Z by OEM APID 1280 ID 132 EVENT IBIS1 IASW HEPI RESYNCHRONIZED, indicating that HEPI resynchronised autonomously, by which time all the above parameters had returned within limits, no action was taken.

2008-12-02 (DOY 337, Rev 749) to 2008-12-04 (DOY 339, Rev 750)

IBIS operations executed nominally.

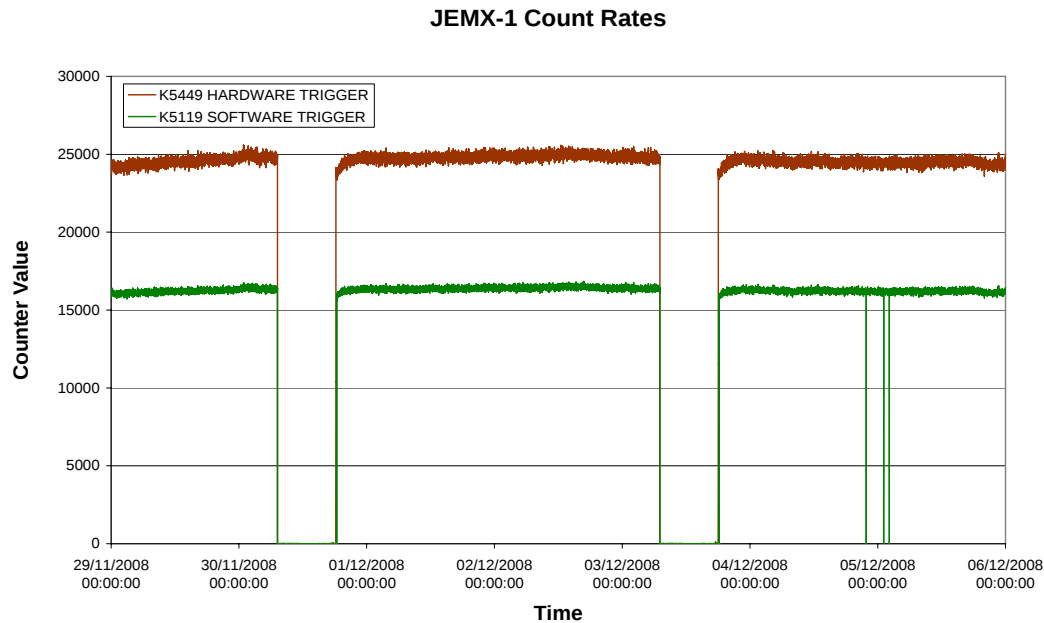
2008-12-05 (DOY 340, Rev 750)

At 21:46:50Z 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 21:46:58Z, no action was taken.

8.3.4 JEM-X Operations

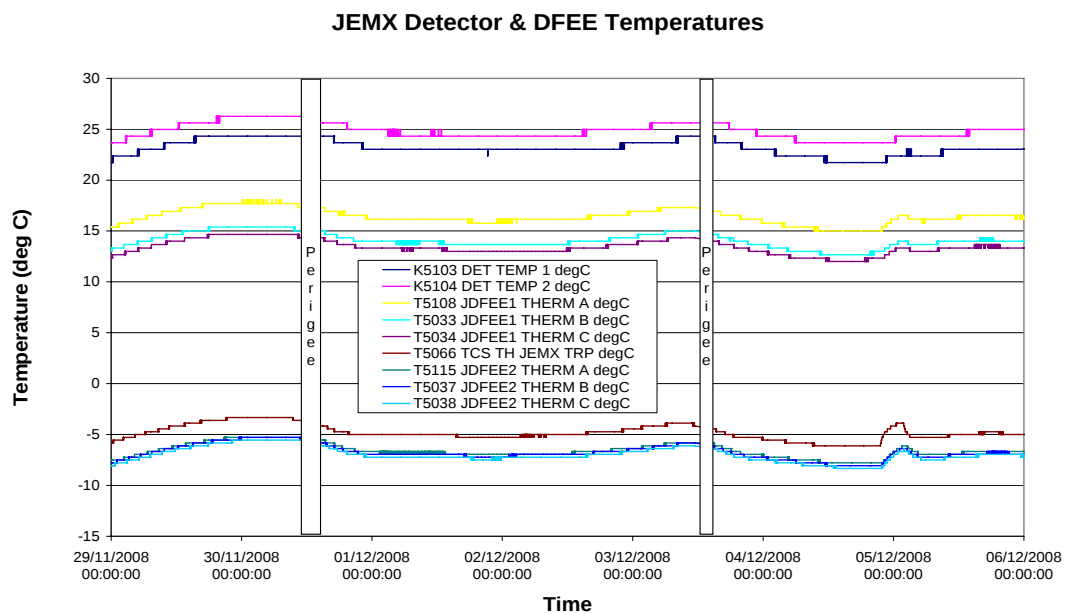
JEM-X Count Rates

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

2008-11-29 (DoY 334, Rev 748) to 2008-12-05 (DoY 340, Rev 750)

JEM-X 1 operations executed nominally.

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)

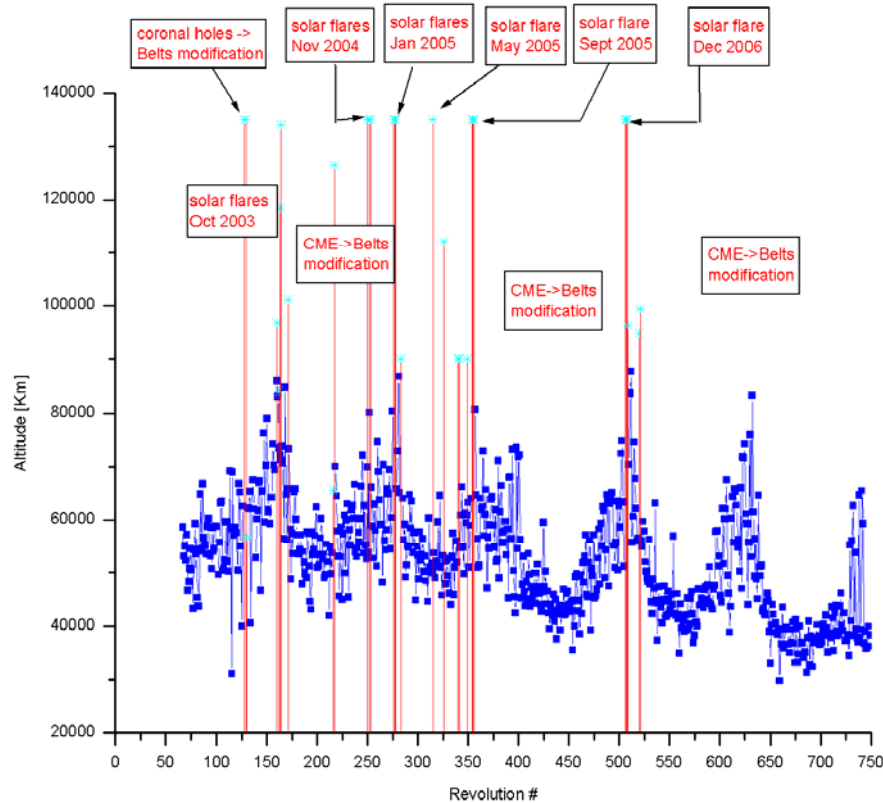
Nothing to report.

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

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]
748	RAD_ENTR R 2008-11-30T08:07:19Z	30/11/2008 09:53:48	39959.2	30-Nov-2008 10:25:38	34956.85
749	RAD_EXIT R 2008-11-30T17:50:53Z	30/11/2008 16:38:44	>>33912.0	30-Nov-2008 17:05:38	46015.61
749	RAD_ENTR R 2008-12-03T07:56:29Z	03/12/2008 09:53:48	38337.9	03-Dec-2008 10:17:57	34755.8
750	RAD_EXIT R 2008-12-03T17:40:06Z	03/12/2008 16:22:20	>>33910.3	03-Dec-2008 16:57:57	46154.01

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)

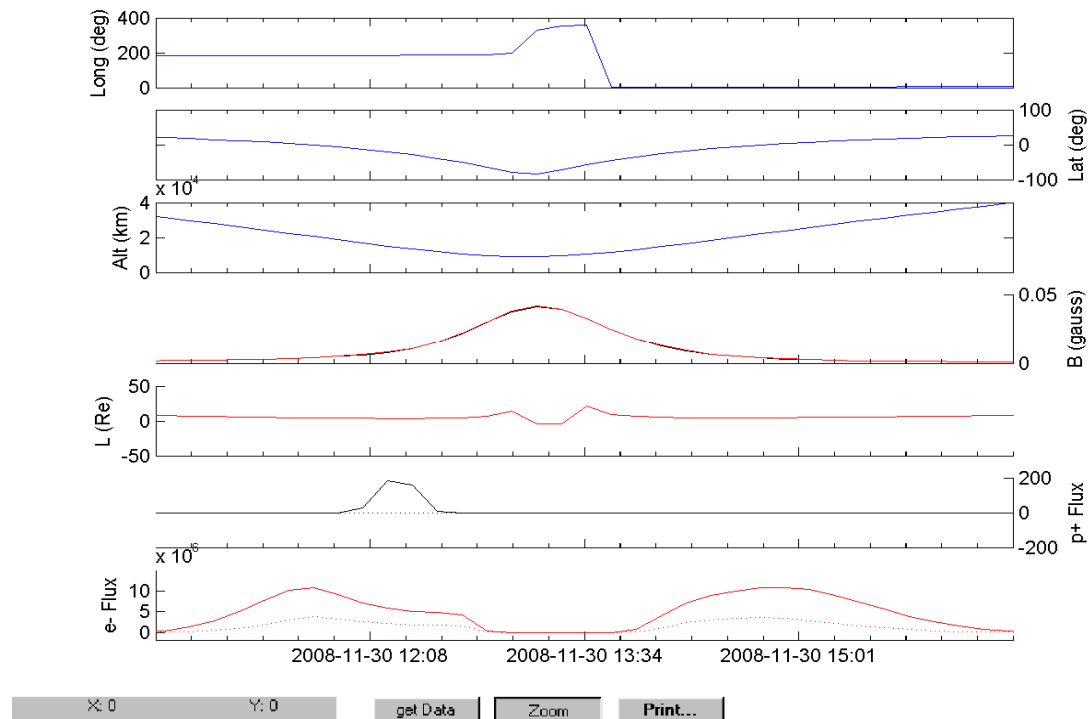
* Rad belt entry time ignoring previous threshold crossings where a gap of more than 30 minutes is present.

IREM radiation counters:

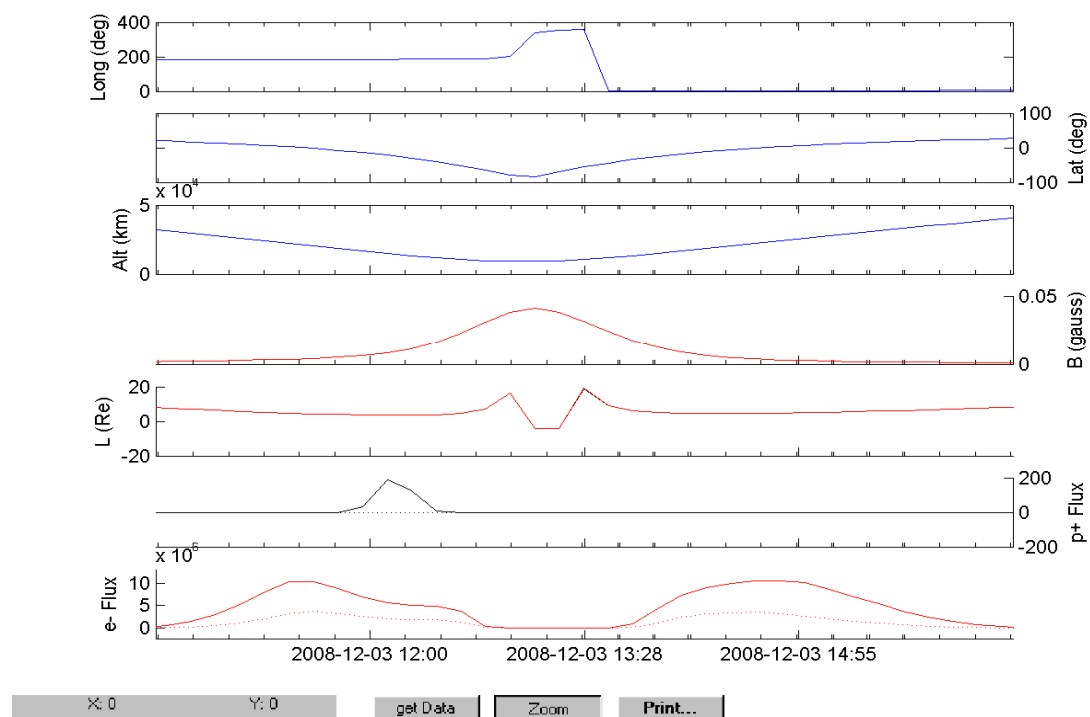
The IREM radiation counter plots are not available this week.

IREM Predicted Radiation Belt Passages

Rev 748



Rev 749



Radiation Assessment

Generated with SEIS Report and Analysis tool.

INTRODUCTION

This note summarises the space weather status during the observation period

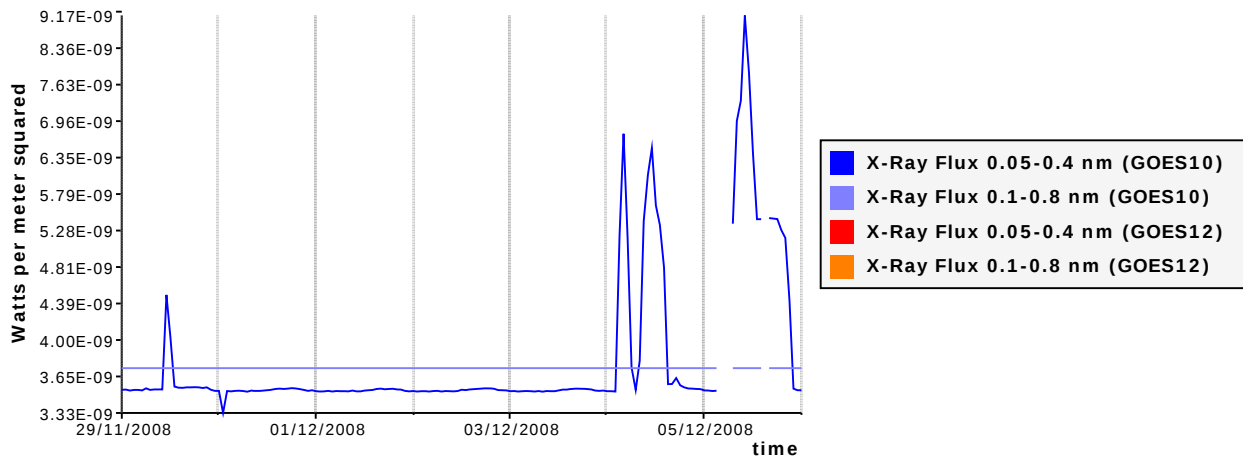
DAILY SUN

see in sections before

RADIATION FLUXES

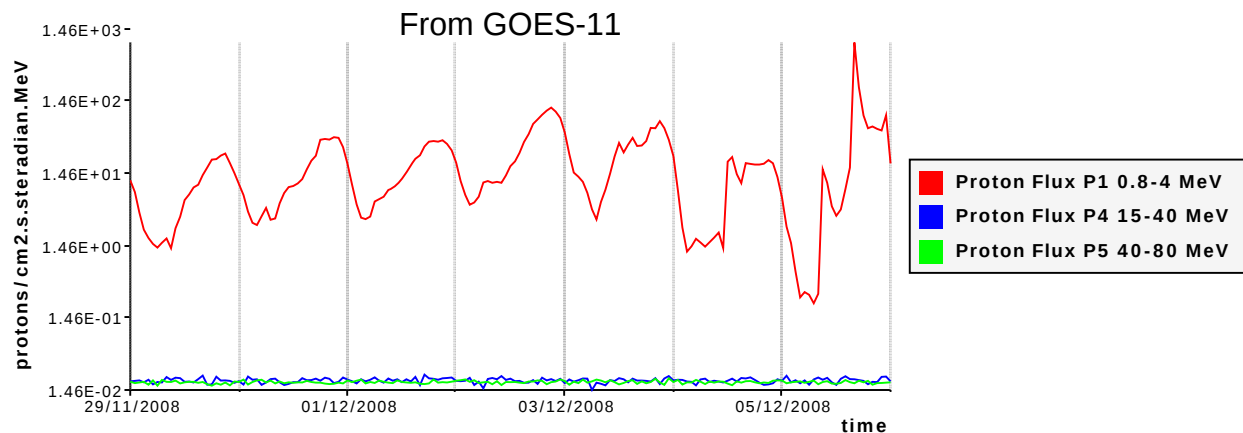
X-ray fluxes

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.



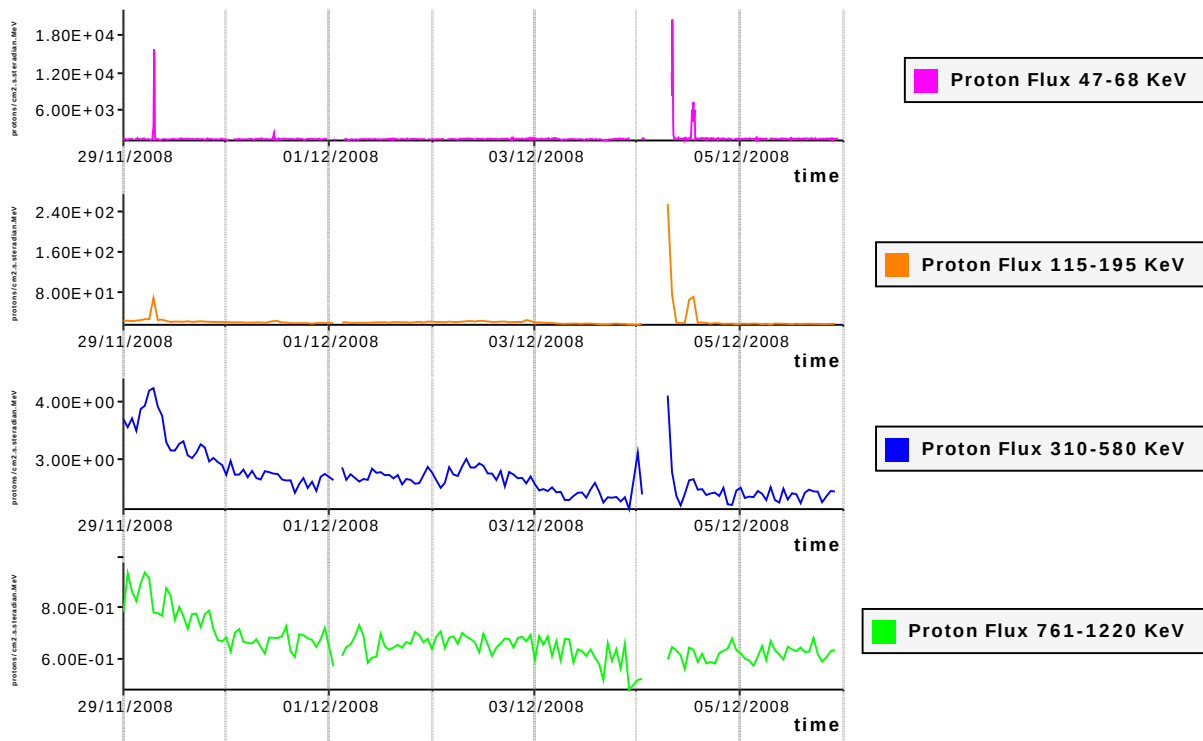
Proton fluxes (GOES-11)

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 $1\text{E-}2$.



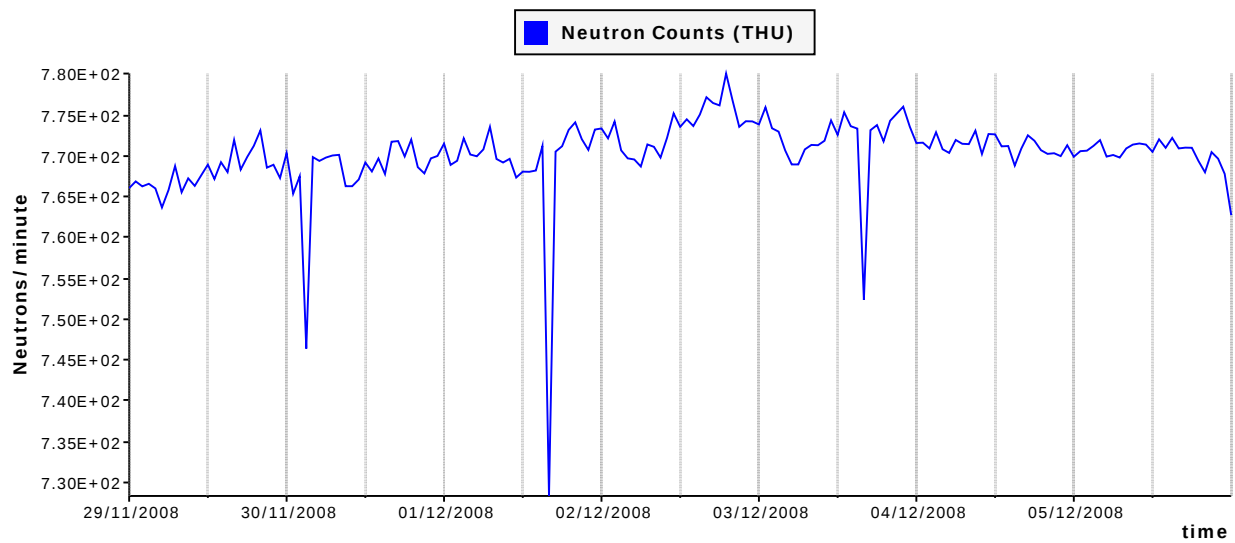
Proton fluxes (ACE)

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



Neutron counts

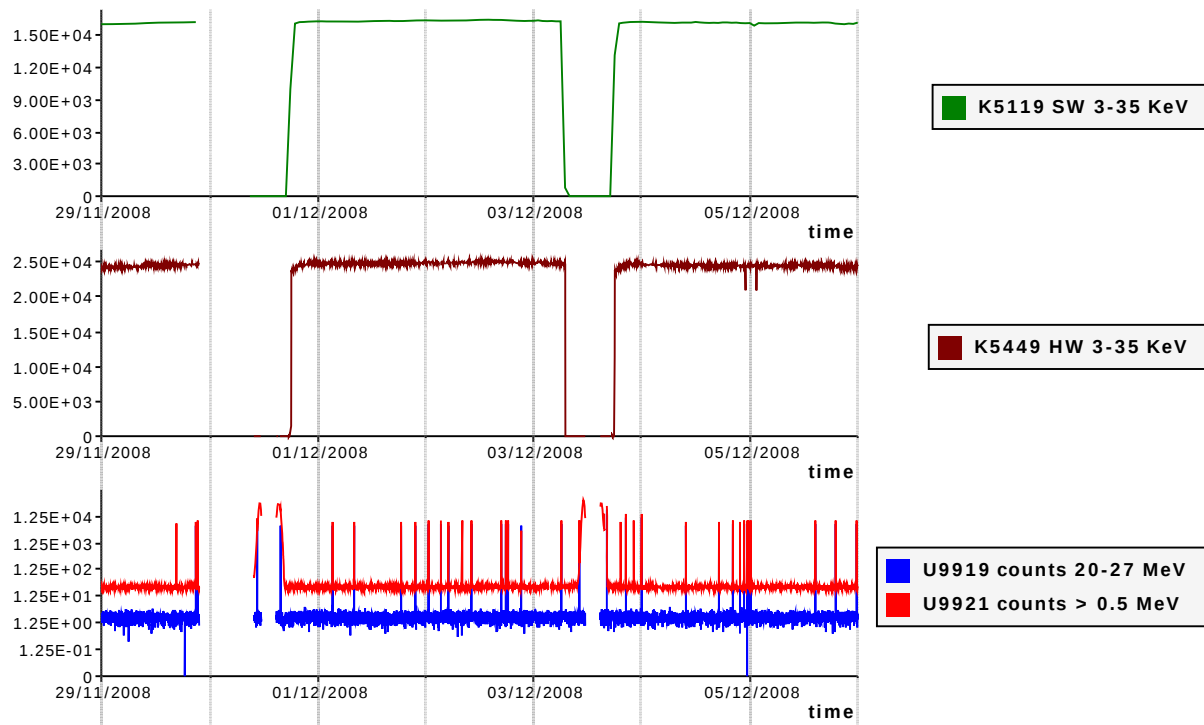
The neutron counts for the last 3 days are presented in the following plot. Nominally they remain stable around 7.2E+2.



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.

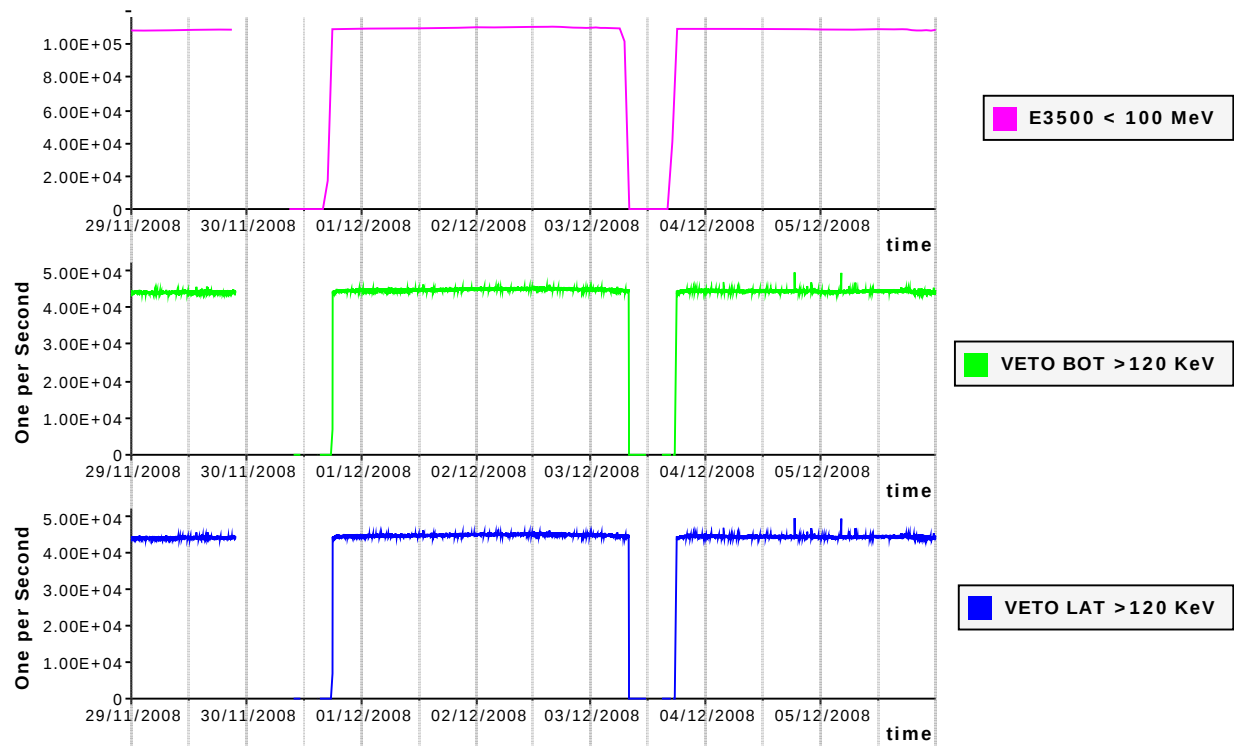
Nominal values are respectively about 1 and 18 for IREM counts, and, 13000 and 19000 for JEM-X ones.



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%.

