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

INTEGRAL
Mission Report

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

No. 275
Week 52

31.12.07

Routine Phase

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1 General

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

It addresses the activities from 22.12.07 until 28.12.07 (both dates inclusive) and covers the revolutions 634, 635 and 636.

2 Summary of Activities

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

The targets of these revolutions consisted of two hexagonal dithers of NGC 4151 (RA 12:10:32.60, DEC +39:24:20.6), a raster dither of 3C 273 (RA 12:29:06.70, DEC +02:03:08.6), and a raster dither of the Galactic Plane Region 3 (RA 13:09:32.98, DEC -62:47:56.4).

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.

1 slew was missed from TL, during the observation period, due to a lack of suitable stars at the selected observation attitude (sparse stellar field).

The fuel consumption over the period between 21/12/2007 and 27/12/2007 was 0.0905 Kg. The remaining propellant is in the order of 143.1369 Kg.

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

3.1.2 Power

The EPS is working nominally; available power from the arrays is of the order of 2100W.

3.1.3 Thermal

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

3.1.4 OBDH

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

3.1.5 RFS

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

3.2 Payload

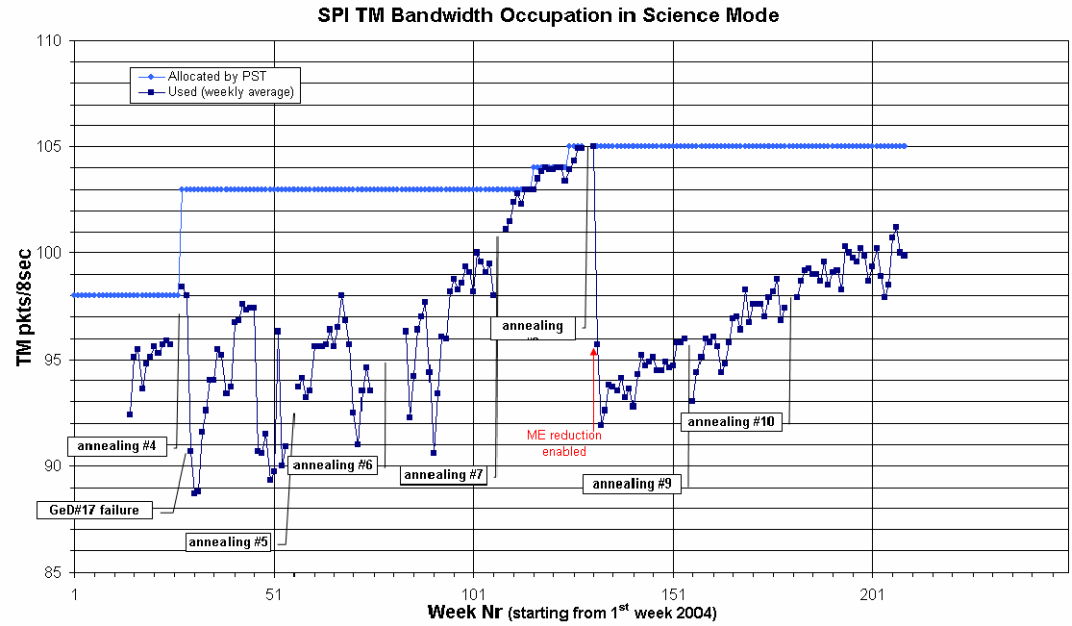
3.2.1 SPI

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

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

During science operations, the instrument was kept in photon-by-photon mode with spectra TM enabled. The assigned TM bandwidth in the science observation windows was 105 packets/cycle, except for the end of revolution 633, when the over-allocated PST with 108 packets/cycle for SPI was in effect. The average telemetry occupation in the science observation windows was 99.9 packets/cycle.

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



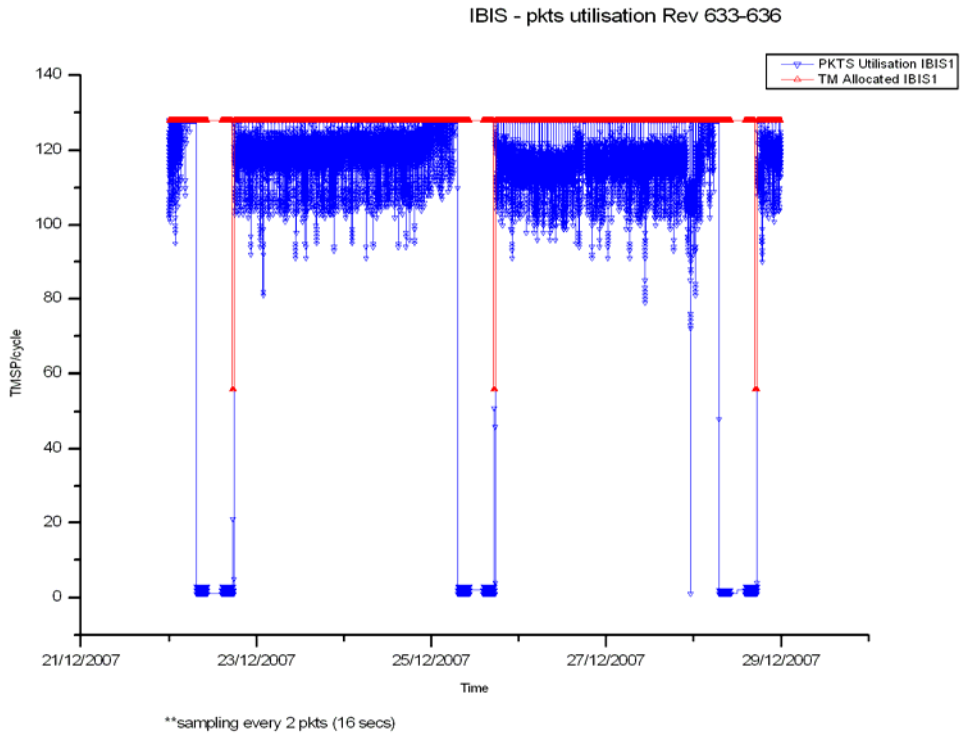
Note: Some more information concerning the SPI operations is provided in the Appendix.

3.2.2 IBIS

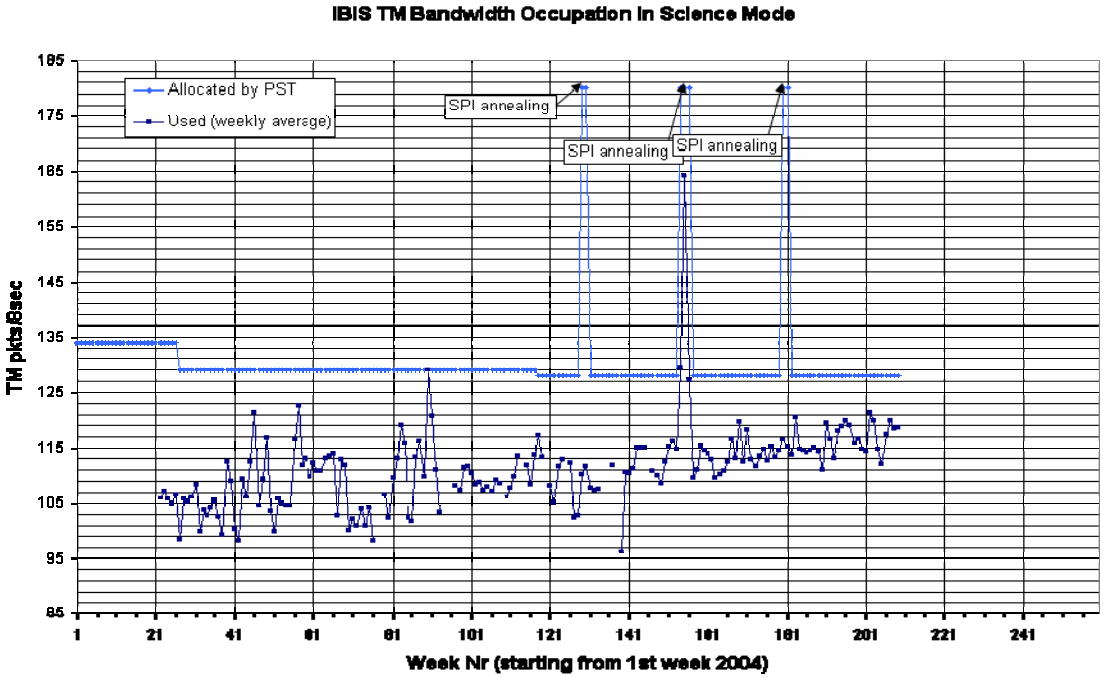
The overall status of the unit is nominal.

During the reporting period, the PST allocation to IBIS was 128 packets/cycle. The IBIS mean bandwidth utilisation during the observation period (when IBIS was in Science mode) was 118.63 packets/cycle, down 0.14 on last week.

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



A plot of the IBIS weekly bandwidth utilisation since 2004 is shown below:



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

3.2.3 JEM-X

The status of both JEM-X units is nominal.

JEM-X operations were performed by the automatic Timeline.

JEM-X1 was operated in Data Taking mode with a TM allocation of 8 packets/cycle. JEM-X2 was dormant (DPE OFF) with no TM slots allocated.

Note: Some more information concerning the JEM-X operations is provided in the Appendix.

3.2.4 OMC

The status of OMC is nominal.

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

During this reporting period, all of the 149 planned science pointings for OMC were executed 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, with very low risk of solar flares.

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 excellent this week. One slew had to be manually executed, (without affecting science return), due to ground problems. The overall performance was well over the 95% requirement.

4.1 Mission Operations Centre

The performance of the MOC was excellent this week. However, there was a 7 second drop in the connection to the TM RT Cache, without impact. Also, there were 4 occasions when the FD slew updates failed to arrive. These were caused by insufficient stars in the field of view. A slew had to be manually performed, but there was no impact to science return. The overall performance was well over the 95% requirement.

4.2 Ground Stations & Network

The performance of the ground stations and Network was very good this week. There were, however, 2 occasions of TM drops from Redu, and 1 occasion from DSS 27, all without impact. There were 6 incidences where the link with ISDC dropped, also without impact. The overall performance was well over the 95% requirement.

4.3 Science Ground Segment

4.3.1 ISOC

Input will be provided next week.

4.3.2 ISDC

Status of ISDC observation processing on 31/12/2007:

- Latest Standard Analysis completed: observation 05200180004 (Gamma Ray Source 1915+105, Revolution 619) on 21/12/2007.

- Latest products archived: observation 05200180004 (Gamma Ray Source 1915+105, Revolution 619) on 21/12/2007.

- Latest observation products sent to the observer: observation 05200260001 (mid-latitude 1 region, Revolution 616-617) on 10/12/2007.

5 Special Events

6 Anomalies

There were no problems reported that impacted operations this week.

The following anomaly report was entered into the ARTS system this week.

AR id	Date Created	Subject	Segment	Status
INT-2973	2007-12-26	Inefficient use of PST during revolution 641	ISOC	Pending

7 Future Milestones

The following activities are foreseen in the next few weeks.

- A SPI annealing activity is foreseen to be performed starting with revolution 641.
- The next On-Board Clock wrap-around is expected during revolution 650.

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 634

The observations in revolution 634 consisted entirely of a hexagonal dither of NGC 4151 (RA 12:10:32.60, DEC +39:24:20.6), lasting ~58.5 hours.

Revolution 635

The observations in revolution 635 consisted entirely of a raster dither of 3C 273 (RA 12:29:06.70, DEC +02:03:08.6), lasting ~55.6 hours.

Revolution 636

The observations in revolution 636 began with of a hexagonal dither of NGC 4151 (RA 12:10:32.60, DEC +39:24:20.6), lasting ~52.6 hours. They continued with a raster dither of the Galactic Plane Region 3 (RA 13:09:32.98, DEC -62:47:56.4) lasting ~2.9 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 105; JEM-X1 8; JEM-X2 0; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

```
2007-12-05T13:33:07.000Z     143.4298    F   Automatic TM processing.
2007-12-07T16:09:13.000Z     143.4135    F   Automatic TM processing.
2007-12-09T01:42:28.000Z     143.3920    F   Automatic TM processing.
2007-12-10T15:57:53.000Z     143.3795    F   Automatic TM processing.
2007-12-11T04:05:14.000Z     143.3505    F   Automatic TM processing.
2007-12-13T15:47:29.000Z     143.3304    F   Automatic TM processing.
2007-12-15T01:20:13.000Z     143.3054    F   Automatic TM processing.
2007-12-16T15:35:53.000Z     143.3004    F   Automatic TM processing.
2007-12-18T01:12:12.000Z     143.2567    F   Automatic TM processing.
2007-12-19T15:22:57.000Z     143.2454    F   Automatic TM processing.
2007-12-21T01:11:56.000Z     143.2274    F   Automatic TM processing.
2007-12-22T15:08:40.000Z     143.2027    F   Automatic TM processing.
2007-12-24T00:43:32.000Z     143.1854    F   Automatic TM processing.
2007-12-25T14:56:56.000Z     143.1557    F   Automatic TM processing.
2007-12-27T00:43:48.000Z     143.1369    F   Automatic TM processing.

This report was generated  Fri Dec 28 08:00:24 GMT 2007
```

8.3 Detailed Satellite Information

This section contains some detailed information concerning the various subsystems of the satellite and instruments.

8.3.1 AOCS SUMMARY OPERATIONS REPORT, 22/12/2007 – 28/12/2007

The AOCS operations were executed from the Automatic Timeline.

During this period, 73 Open Loop Slews, 87 Closed Loop Slews and 5 Momentum Biases were executed.

1 slew (CSL) was missed from TL, during the observation period, due to a lack of suitable stars at the selected observation attitude ~ (12:07:00, +37:29:00), between the constellations of Ursa Maior (UMa) and Canis Venatici (CVn).

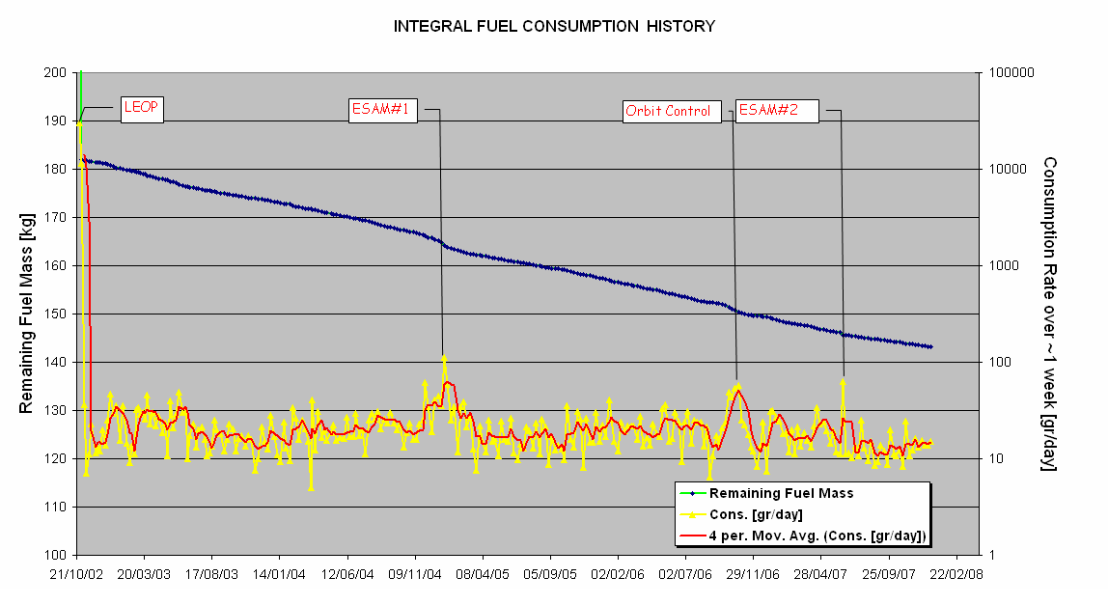
This is equivalent to ~ 0.6 % of the total number of slews planned (160).

Orbit Control

No update.

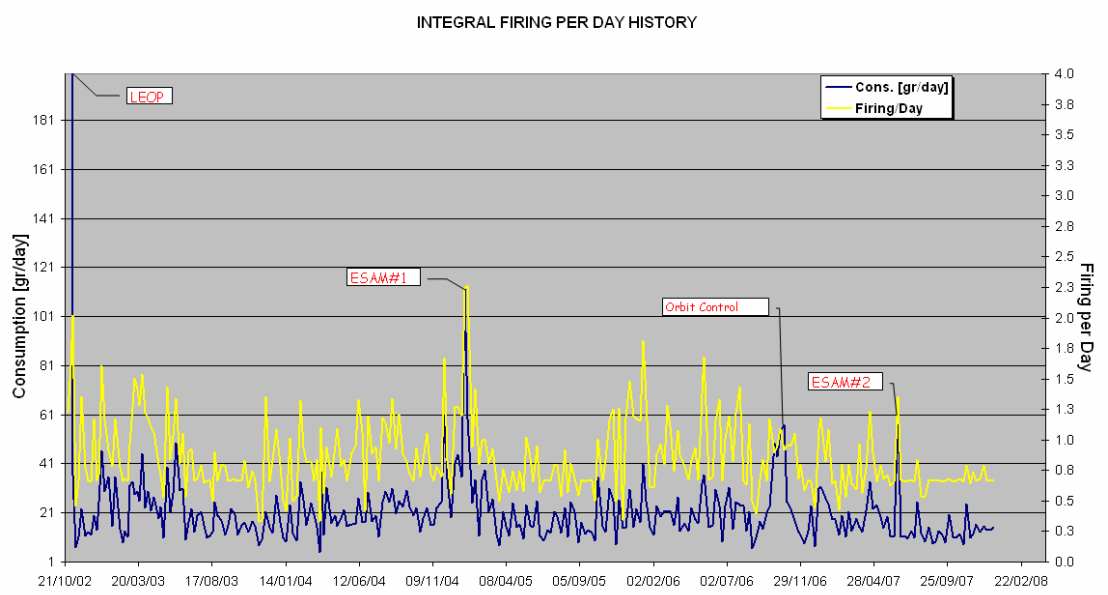
Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 27/12/2007 is reported in the plot below.



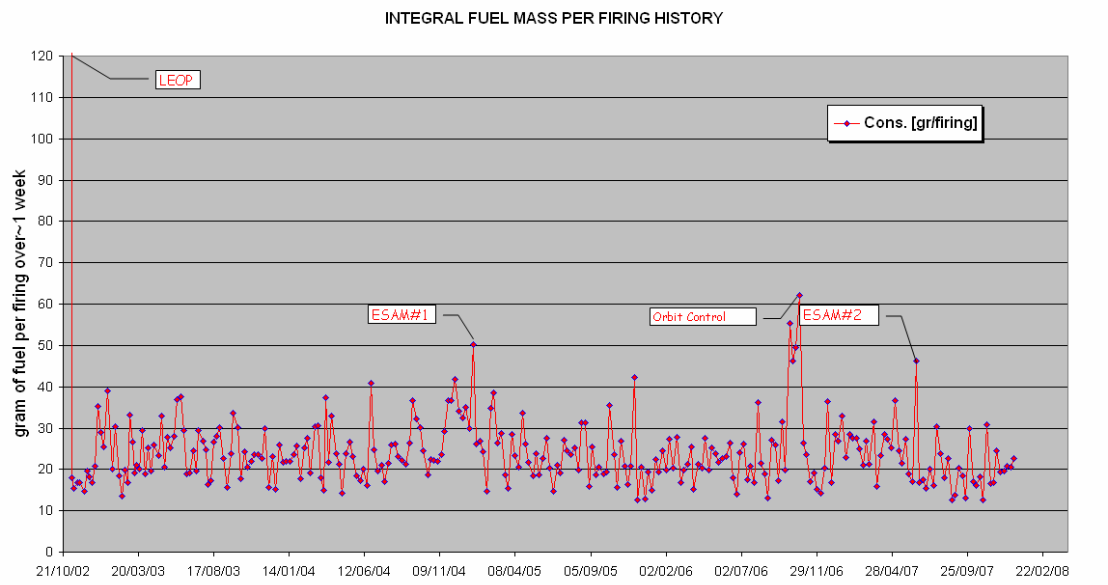
The above plot considers the ESAM fuel consumption spread over period of ~1 week.

The firing per day over the period between 01/11/2002 and 27/12/2007 is reported in the plot below.



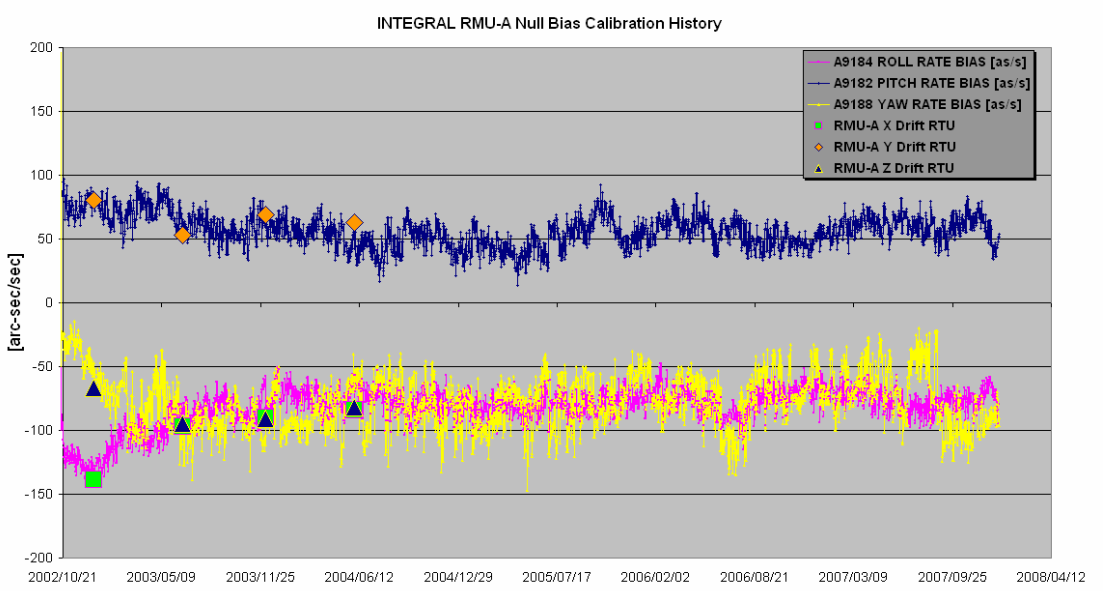
The plot above consider the ESAM fuel consumption spread over period of ~1 week.

The fuel per firing over the period between 01/11/2002 and 27/12/2007 is reported in the plot below.



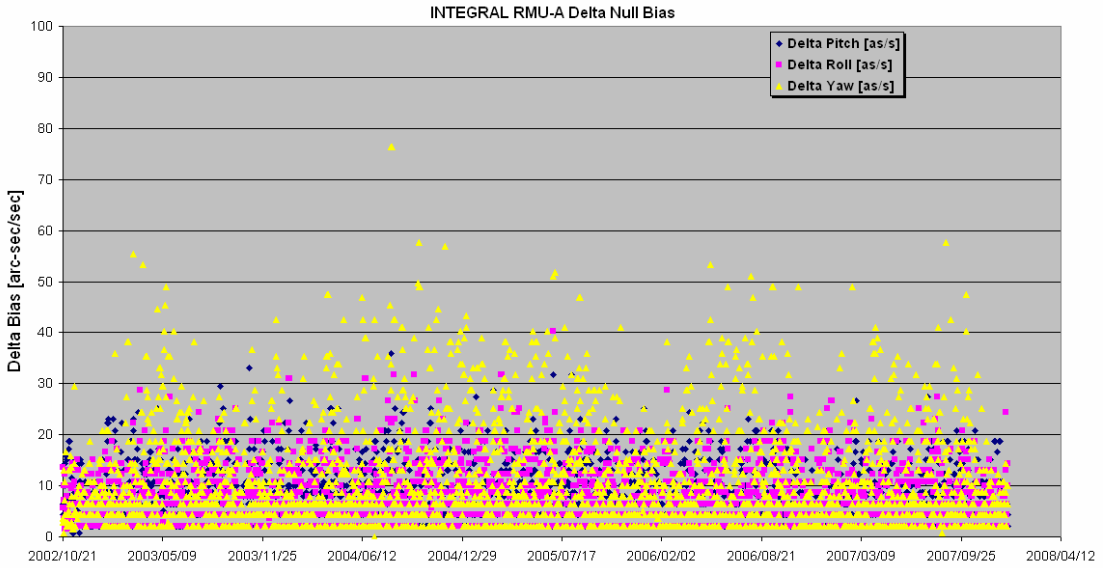
The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 28/12/2007 is reported in the plot below.



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

The RMU-A delta null bias calibration history, on pitch, roll and yaw channel over period between 01/11/2002 and 28/12/2007 is reported in the plot below.



22/12/2007 (Day of Year 356, Revolution 633-634)

Nothing to report.

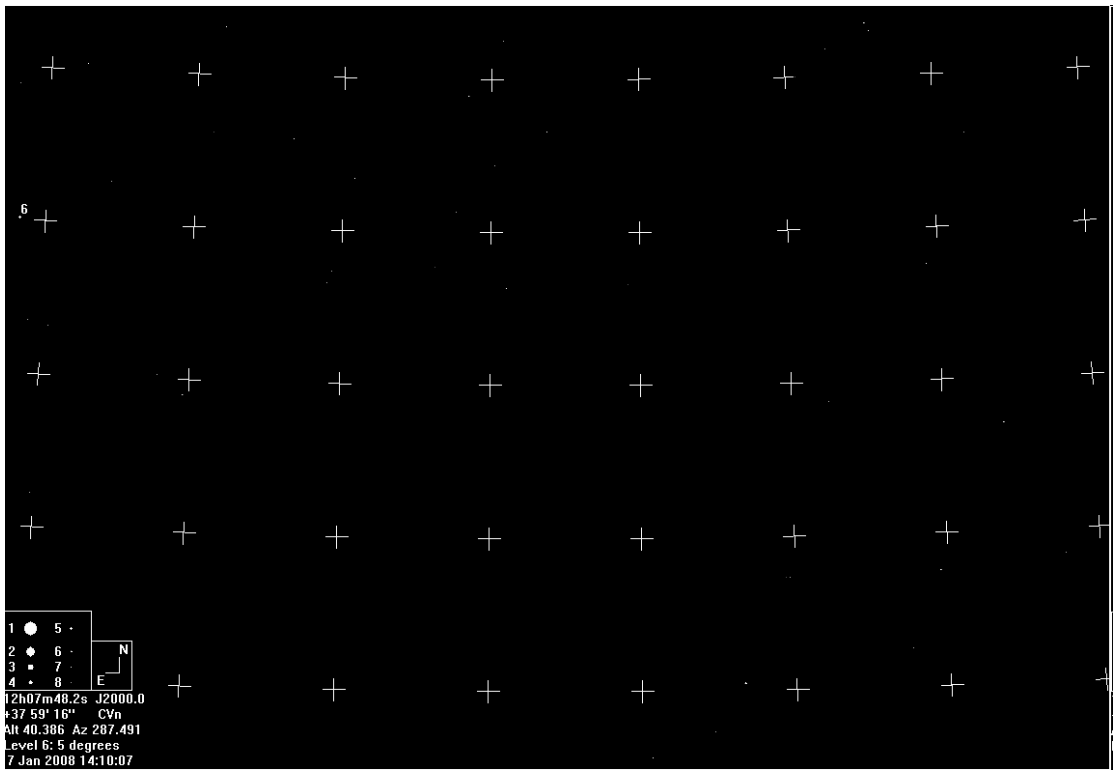
23/12/2007 (Day of Year 357, Revolution 634)

FDS failed update generation: at 00:06z the automatic update of the slew 0634009 failed: this was caused by a sparse stellar field at the selected attitude for PID 06340008 (RA 12:07:47, Dec +37:29:11) and no suitable stars were found for the update of the next slew.

A manual update of the slew ID 06340009 was attempted, several times, with no success, after indication from FD on-call the next slew ID 06340009 was left executing with default parameters from TL.

No impact on TL.

The above mentioned sparse stellar field, between the constellation of Ursa Maior and Canis Venatici, as extracted from the star catalogue is shown below.
The Mi threshold is set to 8.5 Mi, i.e. the nominal limit for STR operations and the paucity of bright stars is evident.



FDS failed update generation: at 14:26z the automatic update of the slew 0634023 failed: this was caused again by the sparse stellar field at the selected attitude for PID 06340022 (RA 12:05:36, Dec +37:59:35) and no suitable stars were found for the update of the next slew.

After indication from FD on-call, the next slew ID 06340023 was left executing with default parameters from TL.

No impact on TL.

24/12/2007 (Day of Year 358, Revolution 634)

FDS failed update generation: at 12:24z the automatic update of the slew 0634044 failed: this was caused again by the sparse stellar field at the selected attitude for PID 06340043 (RA 12:10:07, Dec +36:58:52) and no suitable stars were found for the update of the next slew.

After indication from FD on-call, the next slew ID 06340044 was left executing with default parameters from TL.

No impact on TL.

25/12/2007 (Day of Year 359, Revolution 634-635)

FDS failed update generation: at 02:45z the automatic update of the slew 0634058 failed: this was caused again by the sparse stellar field at the selected attitude for PID 06340057 (RA 12:07:56, Dec +37:28:54) and no suitable stars were found for the update of the next slew.

A manual recovery of the slew ID 06340058 was attempted and the expected CSL in TL was replaced by executing an OSL. The next slew ID 06340059 was manually updated in TL.

The following slew was missed in the TL: 06340058 (CSL).

26/12/2007 (Day of Year 360, Revolution 635)

Nothing to report.

27/12/2007 (Day of Year 361, Revolution 635)

Nothing to report.

28/12/2007 (Day of Year 362, Revolution 635-636)

Loss of guide star: at 10:01:47z a loss of the selected guide star occurred during the execution of the last pointing of the rev 635, PID 06350079.

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.

A new CGS was manually generated in order to set the correct guide star for the RWB to be executed at the beginning of the rev 636.

The OTF was not reached during PID 06350079 but it is not belonging to observation pointing.

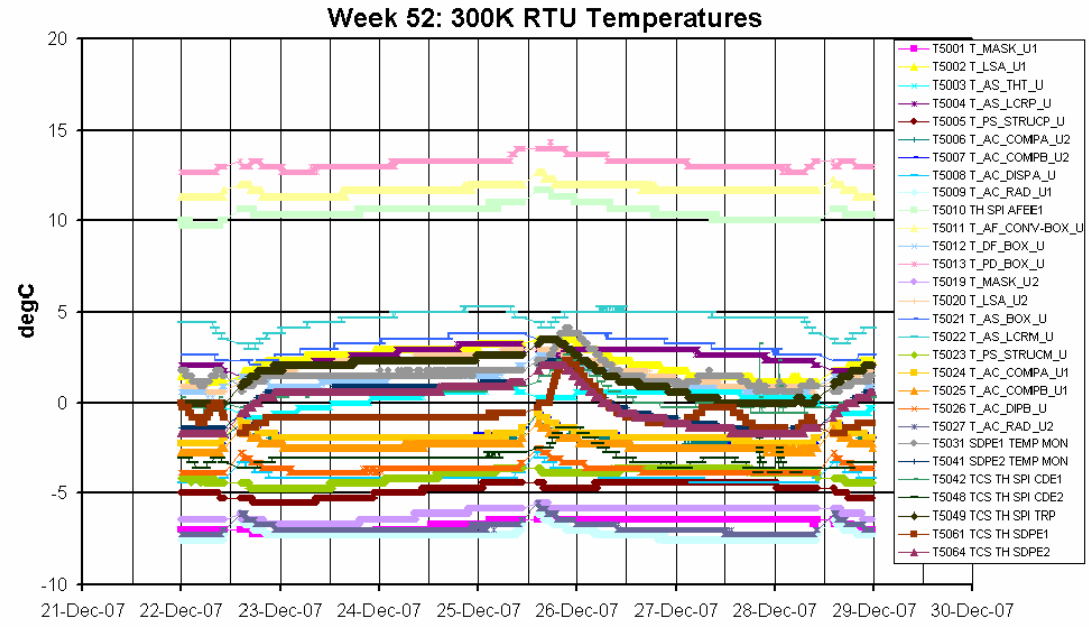
FDS failed update generation: at 19:33z the automatic update of the slew 06360005 failed: this was caused again by the sparse stellar field at the selected attitude for PID 06360004 (RA 12:13:50, Dec +37:05:58) and no suitable stars were found for the update of the next slew.

After indication from FD on-call, the next slew ID 06360005 was left executing with default parameters from TL.

No impact on TL.

8.3.2 SPI Operations

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

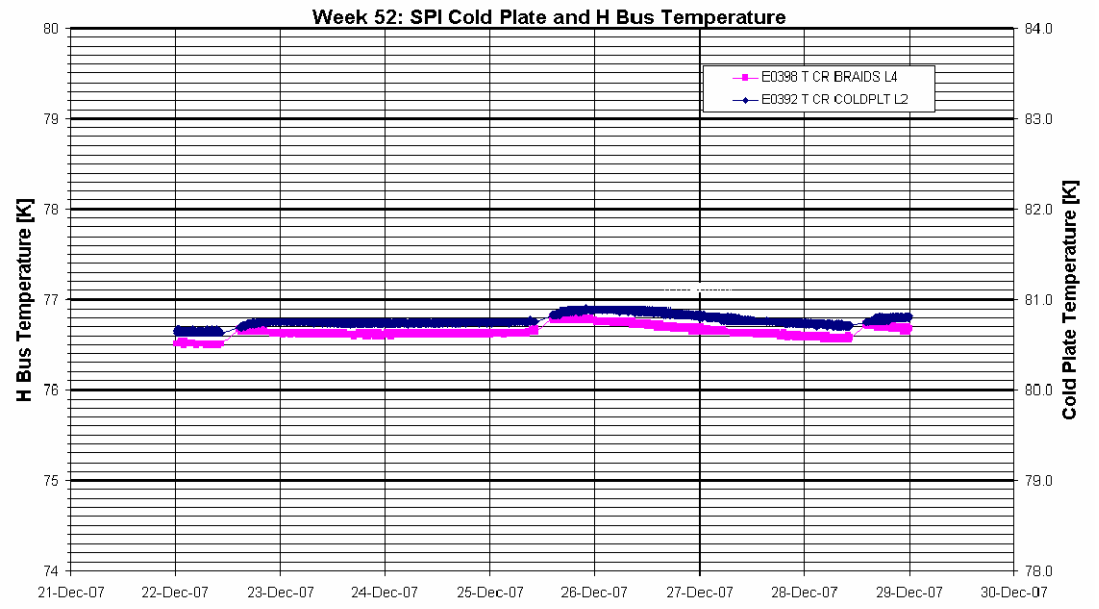


Stirling Compressors and Cryostat: The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K.

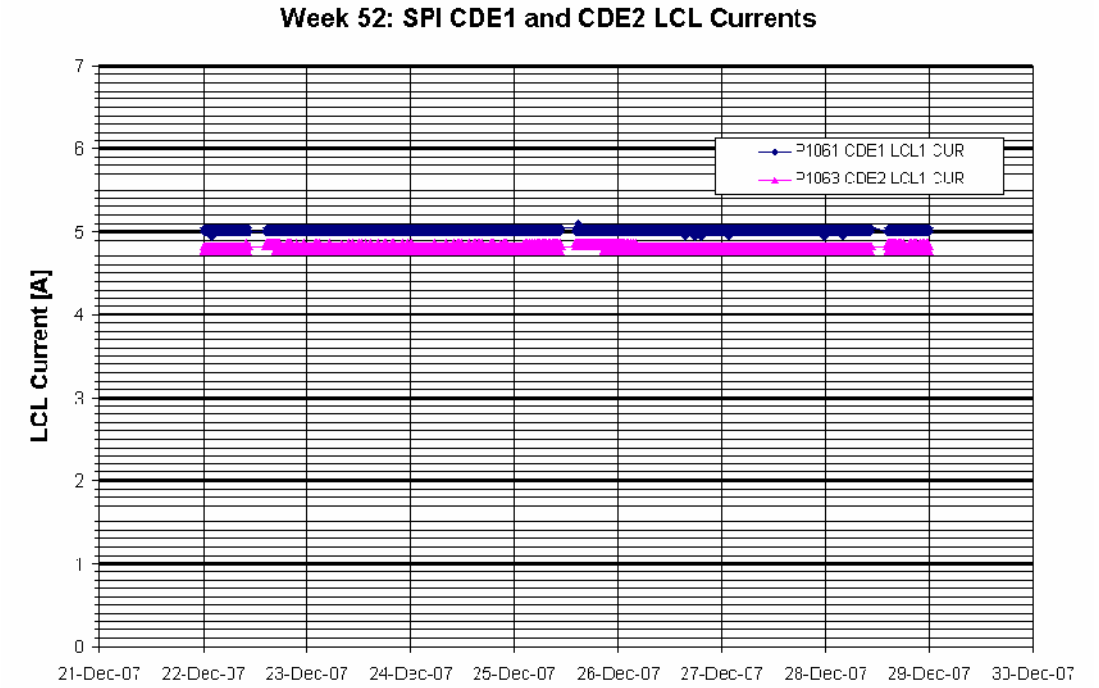
The stroke of all four compressors was set to 41 throughout the week. The average CDE LCL currents over the week were as follows:

- CDE1 LCL Current = 5.01A
- CDE2 LCL Current = 4.81A

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

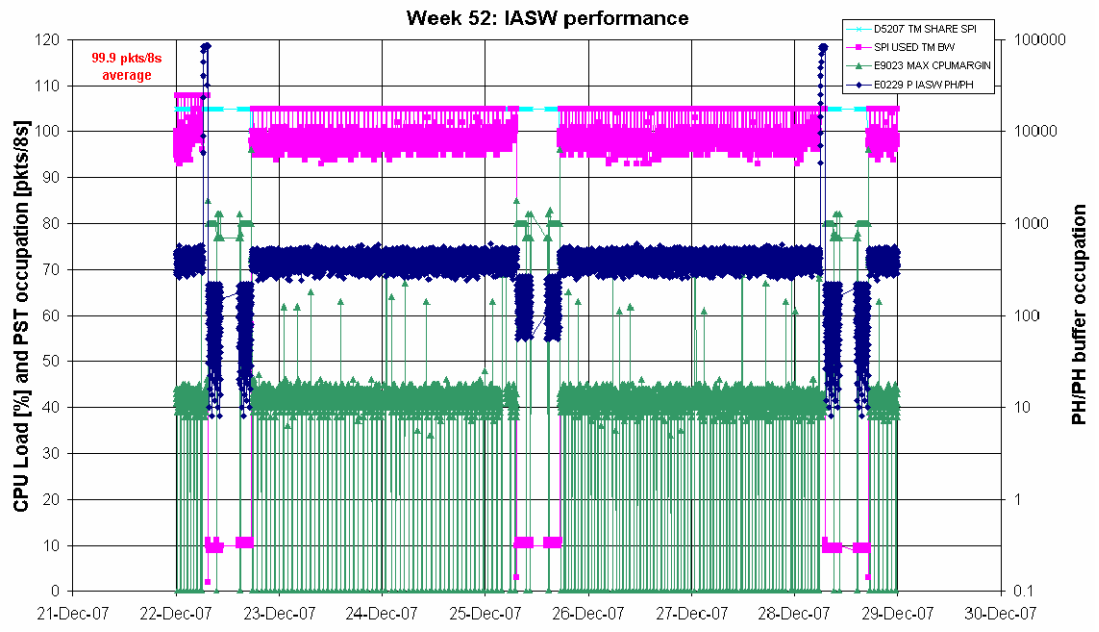


The following plot shows the evolution of the CDE currents during the reporting period.



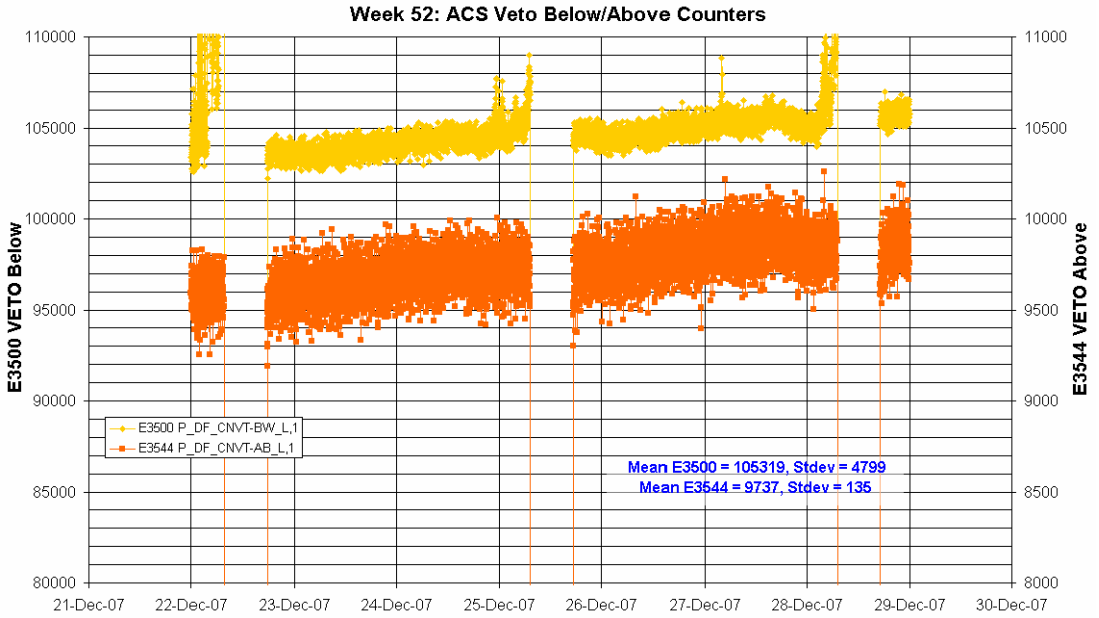
DPE & IASW: The DPE health and IASW performance is nominal. The IASW version installed is v433 patch #1 with the spectra scaling factor set to 8/19 SE. The average TM bandwidth occupation of SPI was 99.9 packets/cycle over the science window. The TM allocation during the science window was 105 packets/cycle, except for the end of revolution 633, when the over-allocated PST with 108 packets/cycle for SPI was still in effect.

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



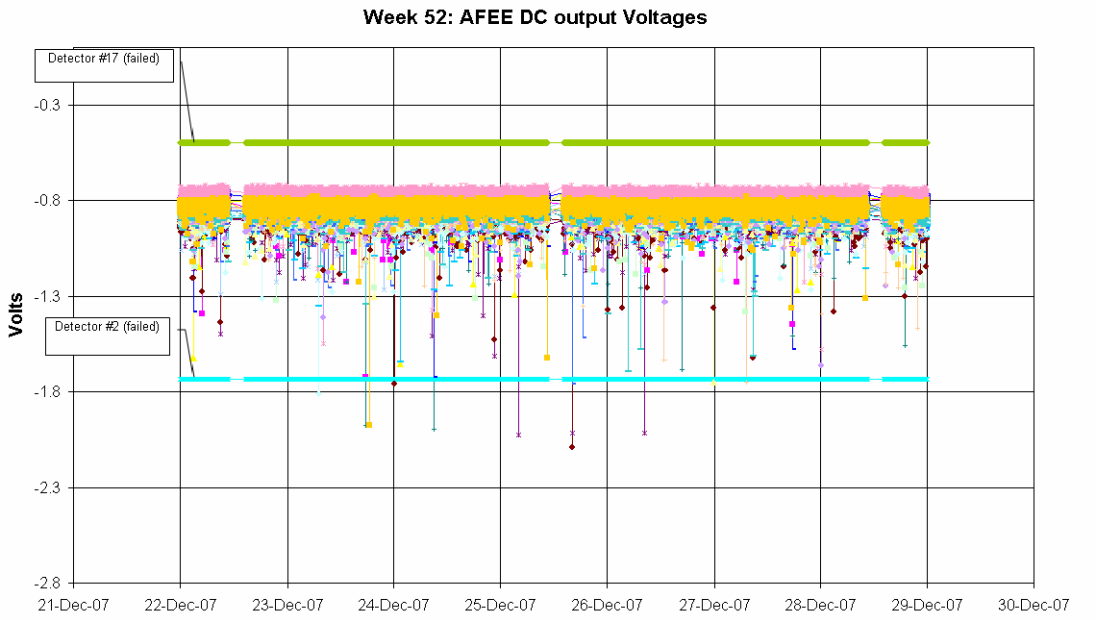
ACS: The performance of the ACS is nominal, except for FEE #81 which remains switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is still OFF due to the anomaly on 5/8/2003 (INT_SC-61).

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

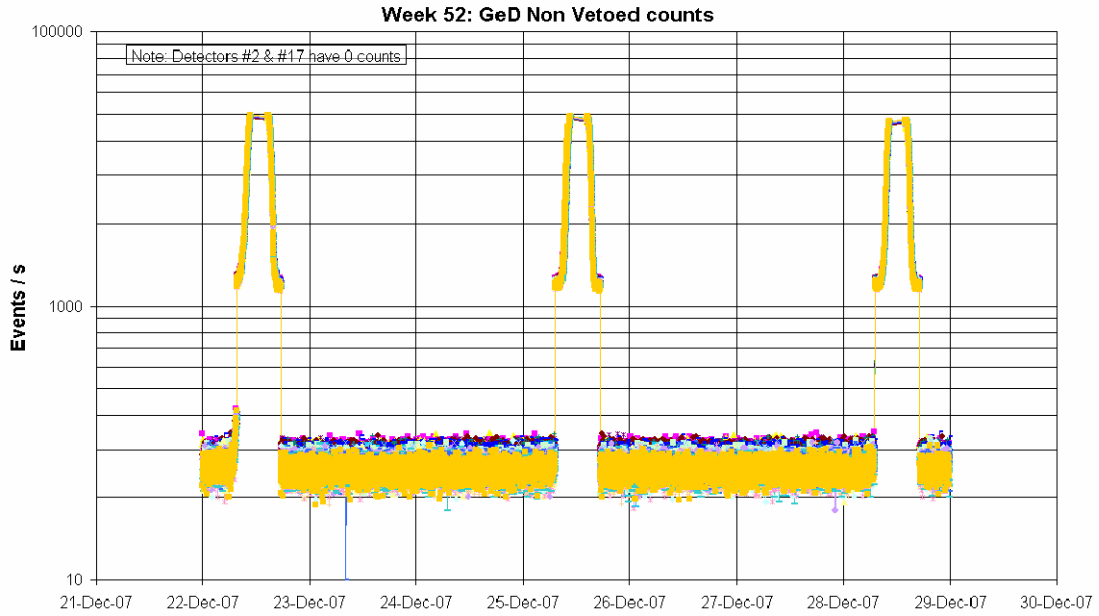


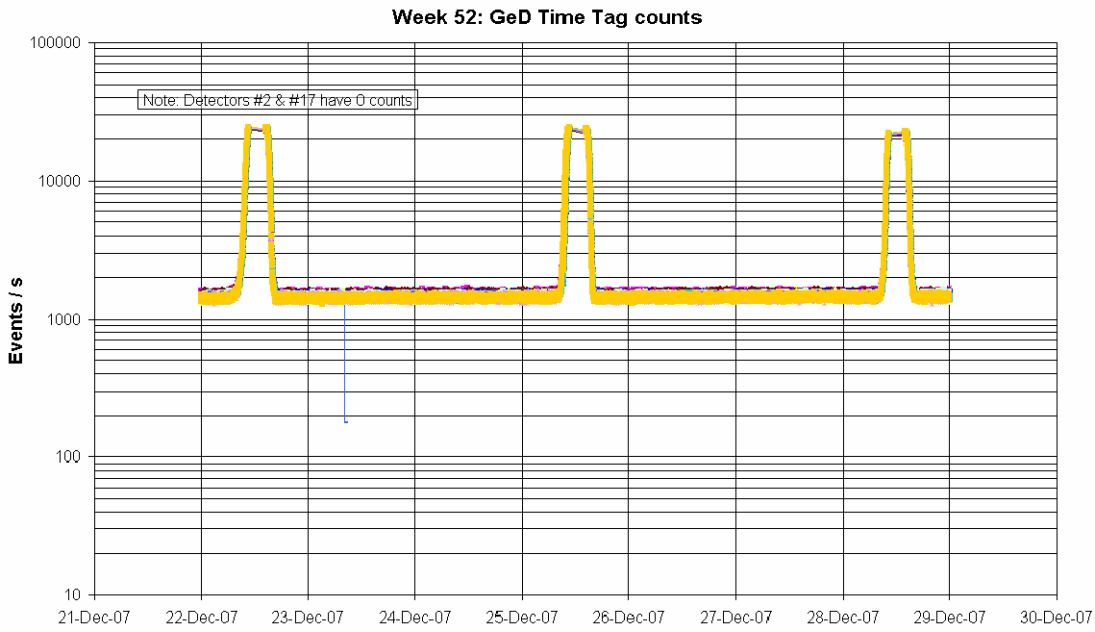
AFEE: The health of the AFEE is nominal. The performance of the AFEE and the detectors is nominal, except for the Ge detector #12 which is showing a slightly degraded energy resolution and is therefore operated at a lower HV setting of 3.5kV (instead of 4kV).

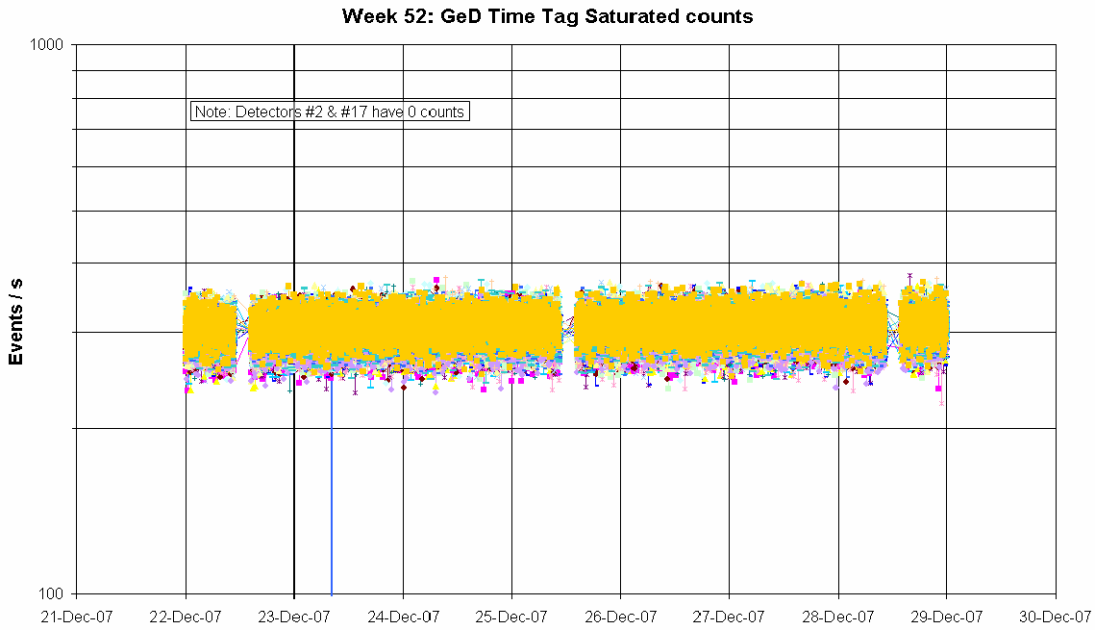
The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06/12/2003 and detector #17 is failed since 17/07/2004.



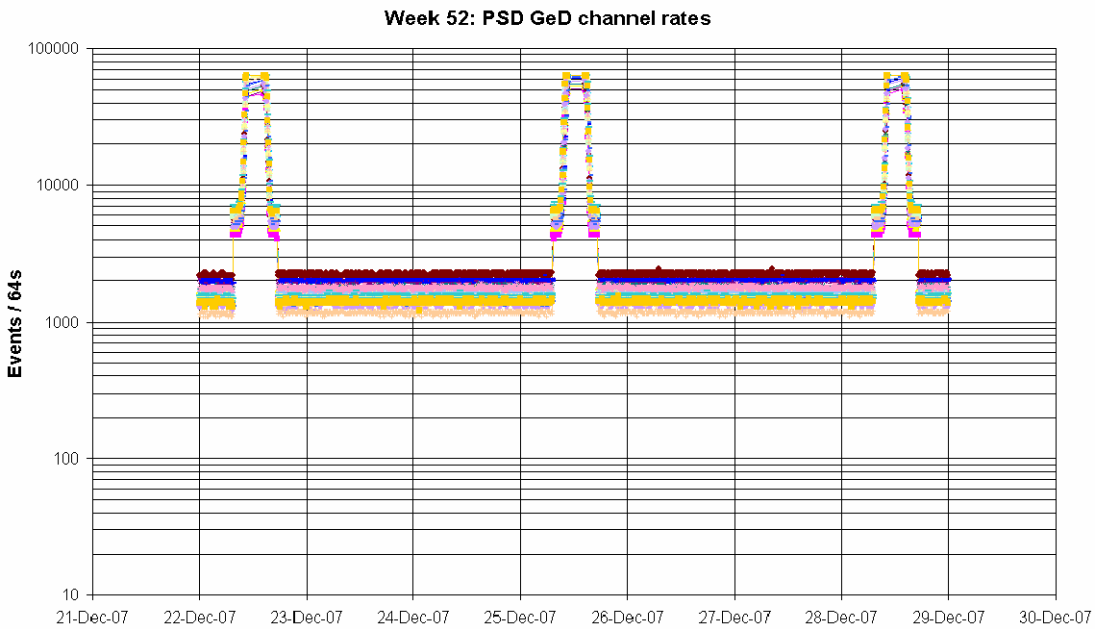
DFEE: The performance of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event Count Rates during the reporting period.







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



Event Log:

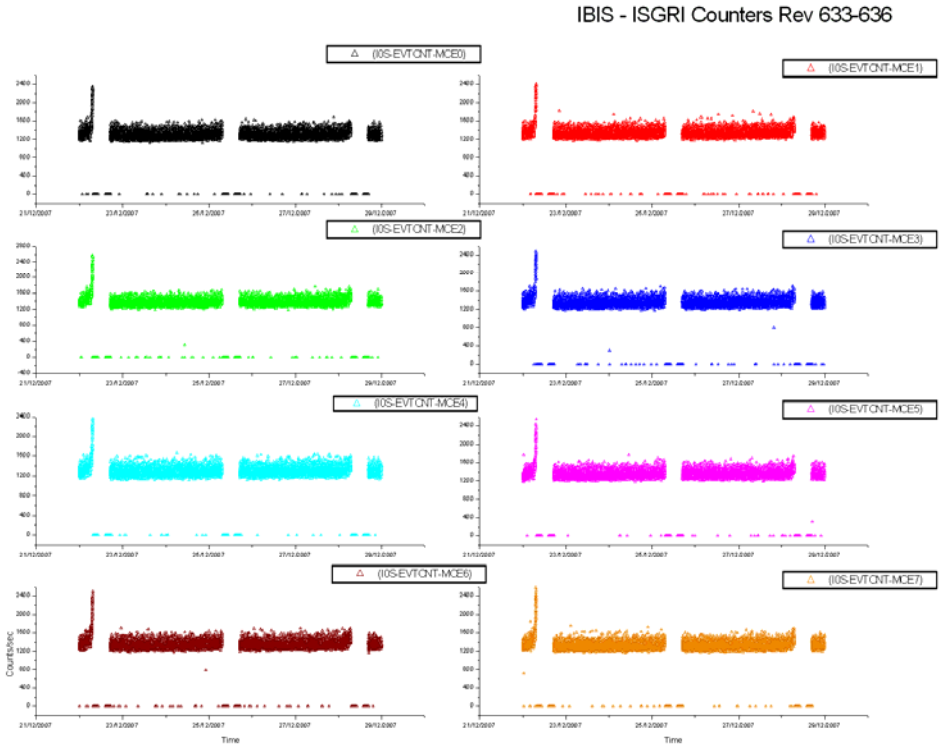
The following non-nominal events occurred on SPI during the reporting period:

- 7 occurrences of OEM APID 1024 ID 243 EXCEPTION SPI1 SPECTRA BUILDING NOT COMPLETED were received during the week. As they were all single occurrences, no action was taken.
- Due to high background radiation conditions before the expected radiation belt entry of revolution 633, on 2007-12-22 at 03:45:01Z TM parameter E3500 went OOL High, toggling OOL until radiation belt entry, at 07:30:58Z.
- On 2007-12-25 at 14:41:14Z OEM APID 1024 ID 1 EXCEPTION SPI1 FIXED POINT OVERFLOW was received. This was during the AOS_CHK window of revolution 635, when the time verification TC was sent. This OEM is sometimes received when this TC is sent and no action was taken.

8.3.3 IBIS Operations

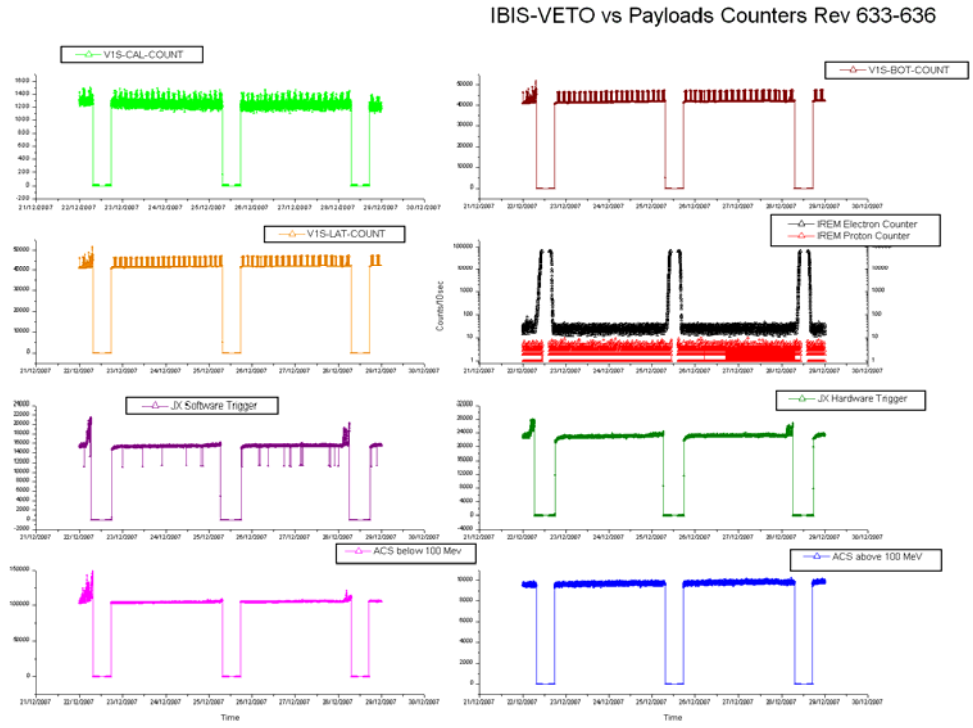
IBIS Event Counters Plots

ISGRI Counters:



**sampling every 4 pkts (32 secs)

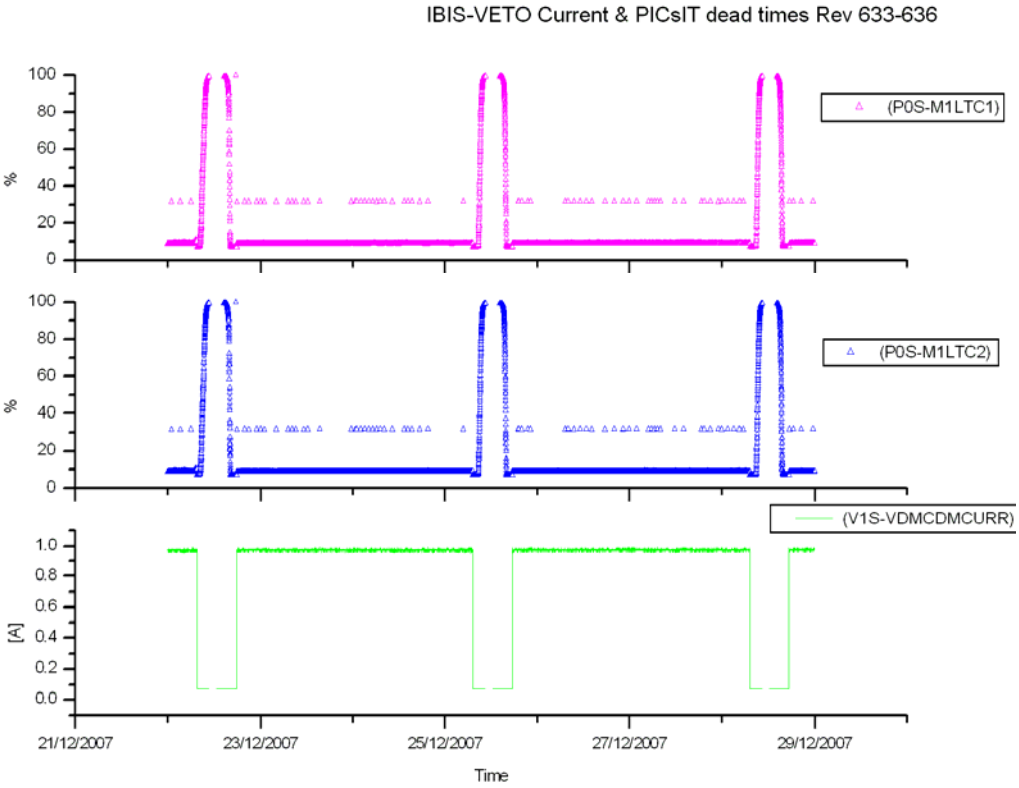
VETO vs Payloads Counters:



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

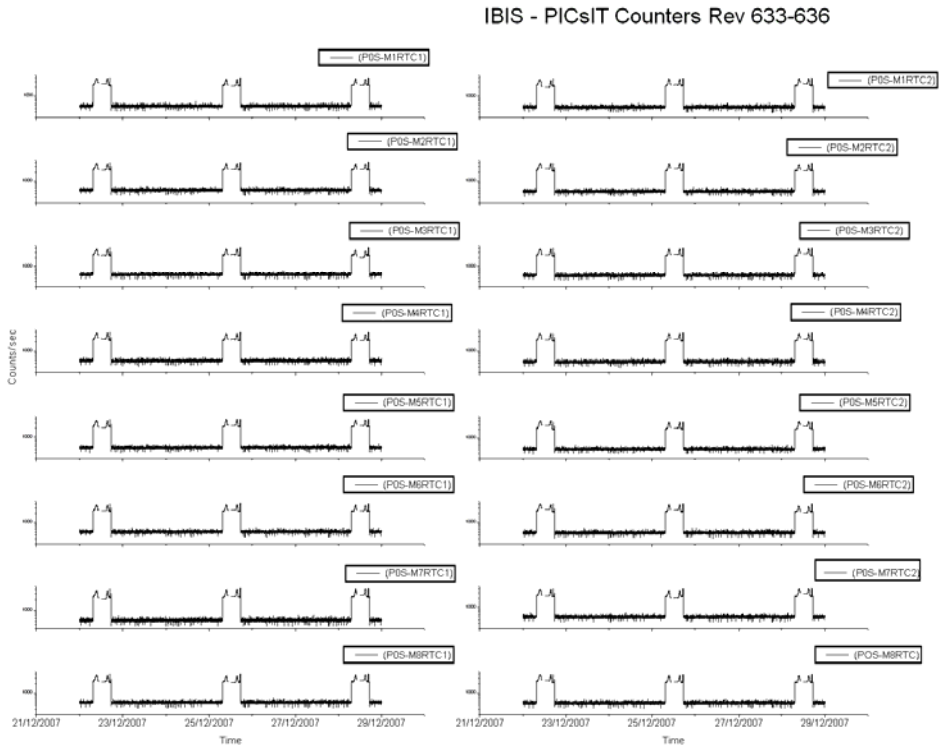
The week was characterised by slightly high radiation before the expected radiation belt entry of revolution 633 as reported by the payload.

VETO Current:



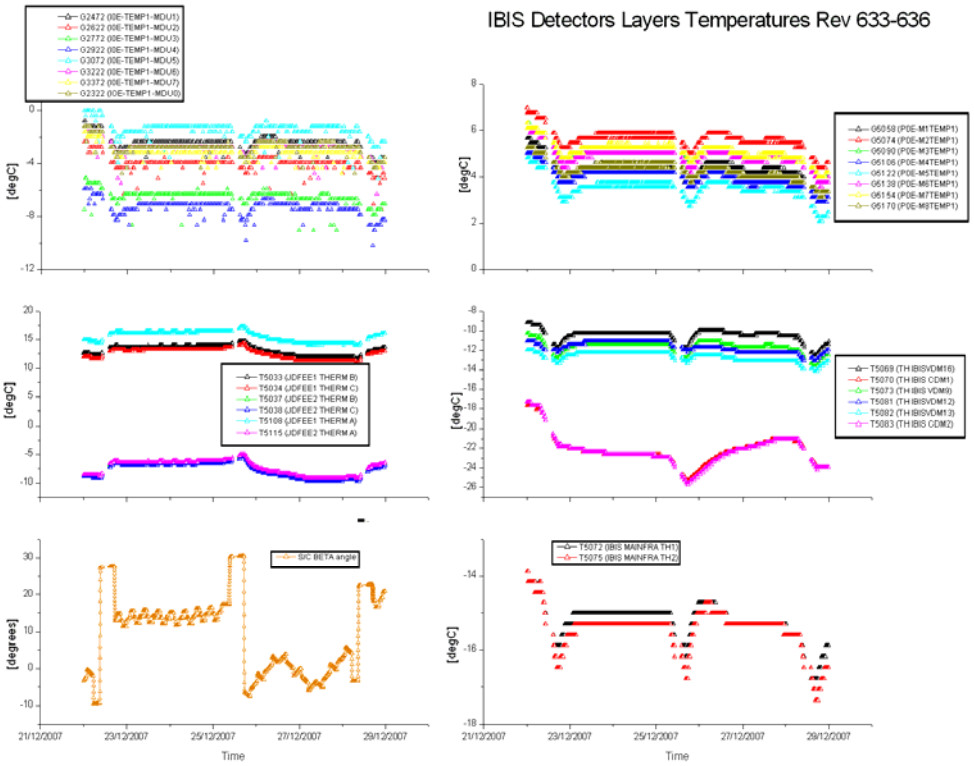
**sampling every 4 pkts (32 secs)

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.

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

2007-12-22 (DOY 356, Rev 633-634)

Due to high background radiation, at 07:06:32Z, ~25 minutes before the expected radiation belt entry of revolution 633, TM parameters G6062 and G6063 started toggling OOL High. These are the VETO bottom and lateral counters respectively. In addition, starting at 07:17:36Z the G2013 family (Number of events triggering the MCEi per second) also started going OOL High. These parameters continued to toggle OOL until radiation belt entry at 07:30:44Z.

2007-12-23 (DOY 357, Rev 634) to 2007-12-26 (DOY 360, Rev 635)

IBIS operations executed nominally.

2007-12-27 (DOY 361, Rev 635)

At 22:28Z, following a ground station handover, TM parameter X7500 went OOL, indicating a problem with the histogram process. The following recovery procedure was then executed to force the histogram accumulation and download process to resume:

- 23:19:20Z FCP_IBIS1_0312
- 23:25:04Z TC G0129 uplinked to return IBIS to Science Standard mode.

IBIS operations continued nominally.

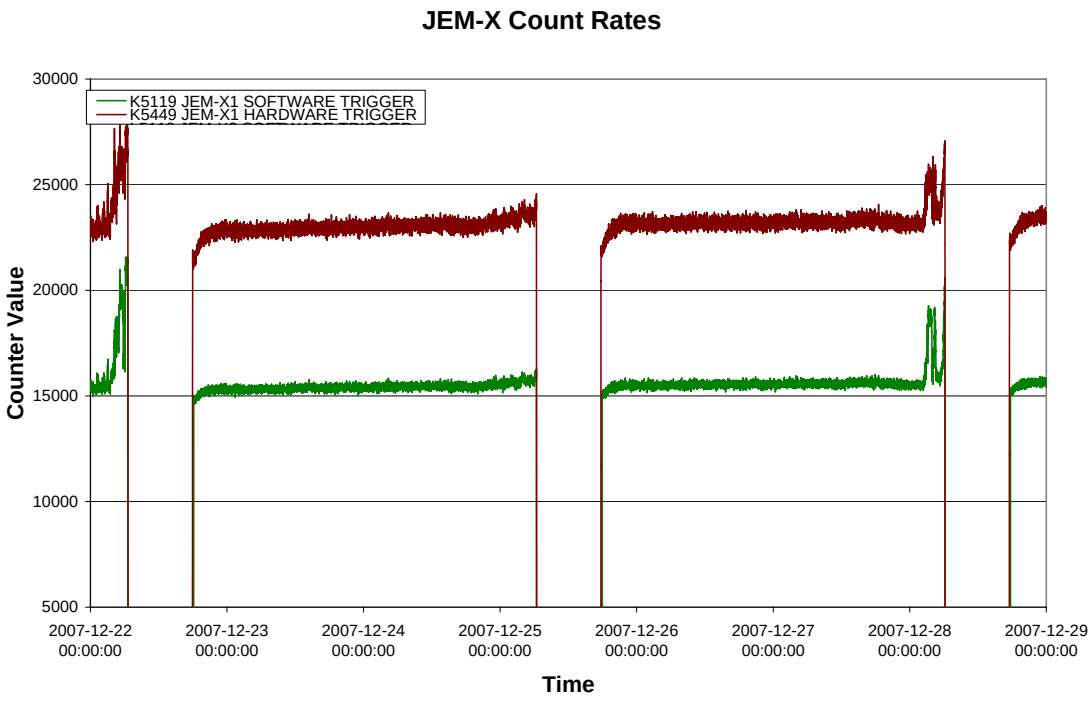
2007-12-28 (DOY 362, Rev 635-636)

At 17:13:52Z, just after radiation belt exit of revolution 636, TM parameter G2041 went OOL Low (value =0). This is the number of events triggering the MCE2 per second. As it returned within limits at 17:14:32Z, no action was taken.

8.3.4 JEM-X Operations

JEM-X Count Rates

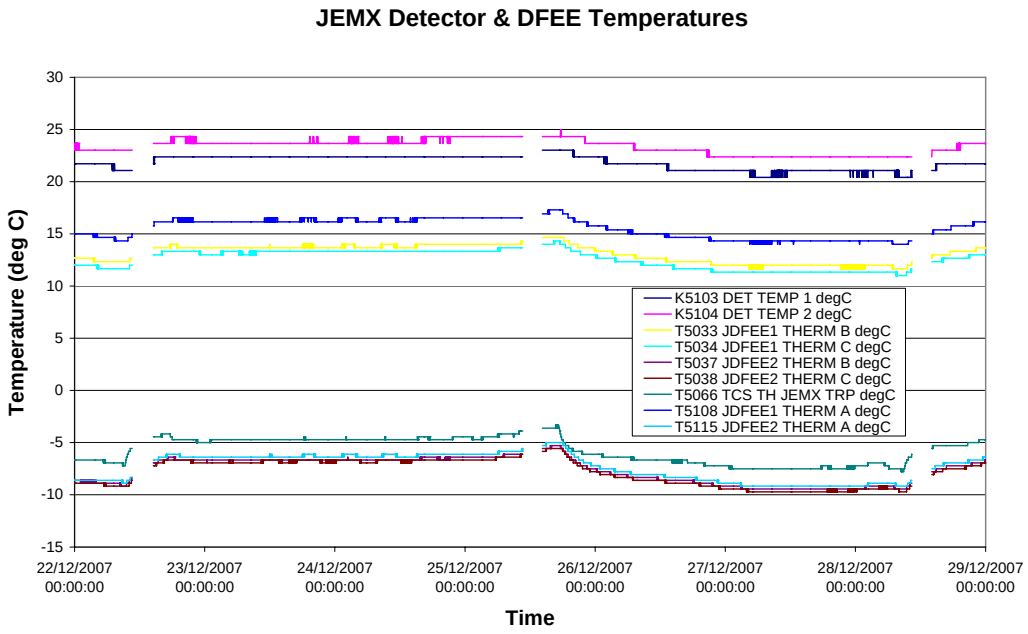
JEM-X count rates over the reporting period are displayed in the following graph[1].



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

2007-12-22 (DoY 356, Rev 631-632) to 2007-12-28 (DoY 362, Rev 633-634)

JEM-X1 operations executed nominally

8.3.5 OMC Operations

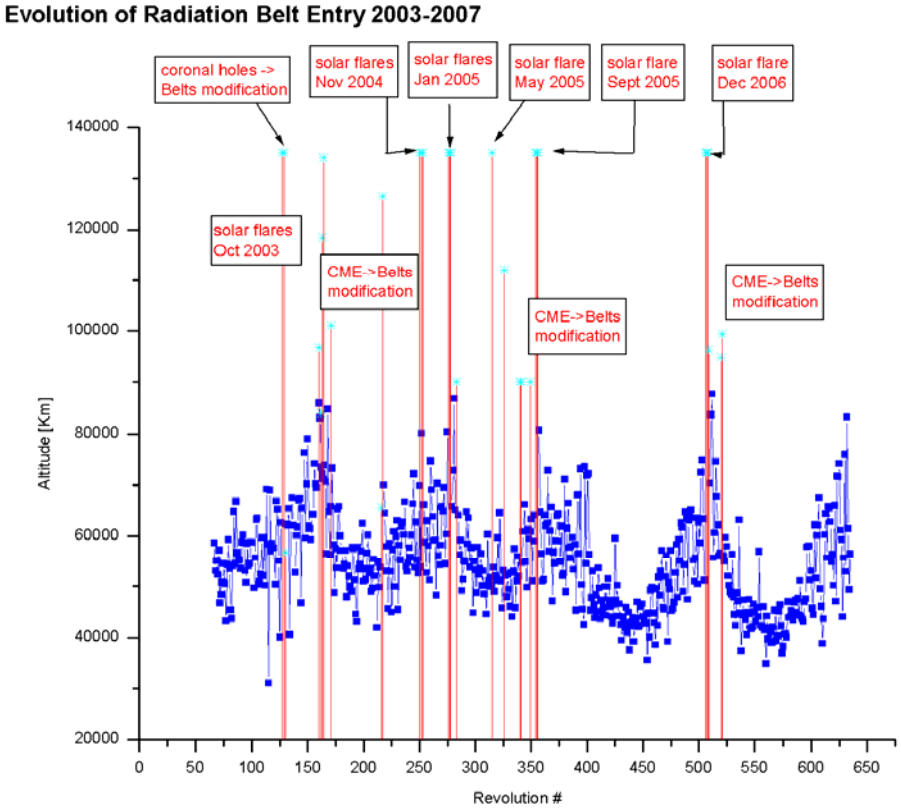
2007-12-22 (DoY 356, Rev 633-634) to 2007-12-28 (DoY 362, Rev 635-636)

Nothing to Report.

On DoY 356 at 07:30:50, DoY 359 at 07:18:42 and DoY 362 at 07:05:22 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

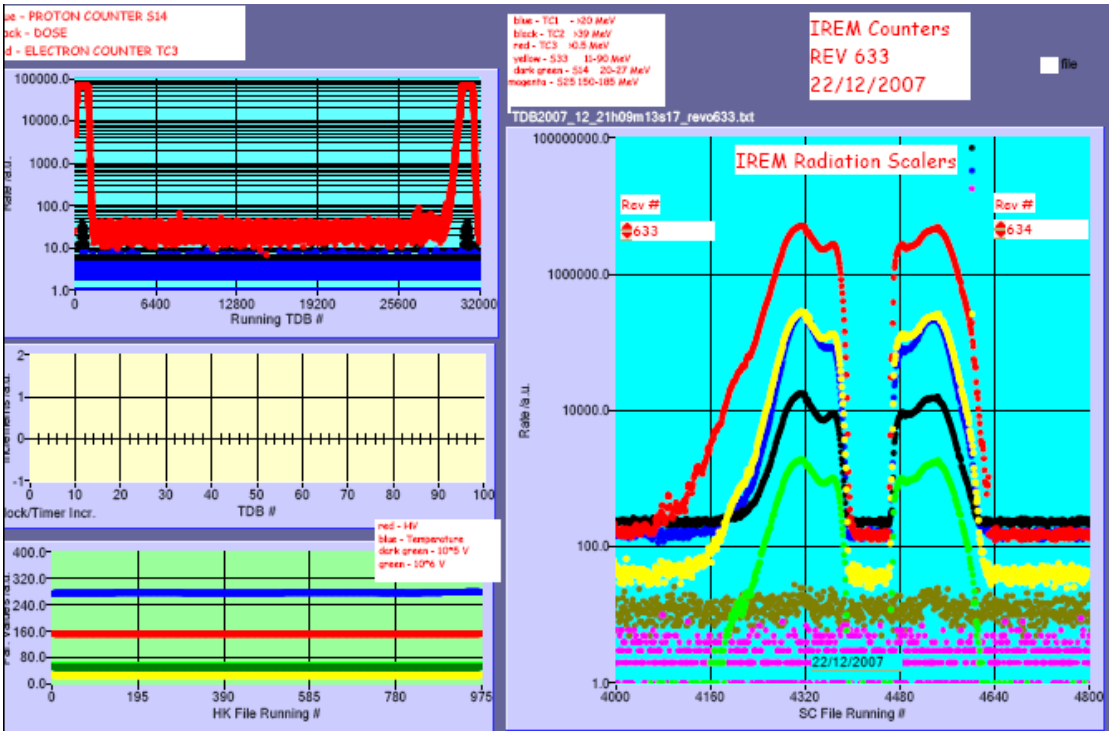
Nothing to report.

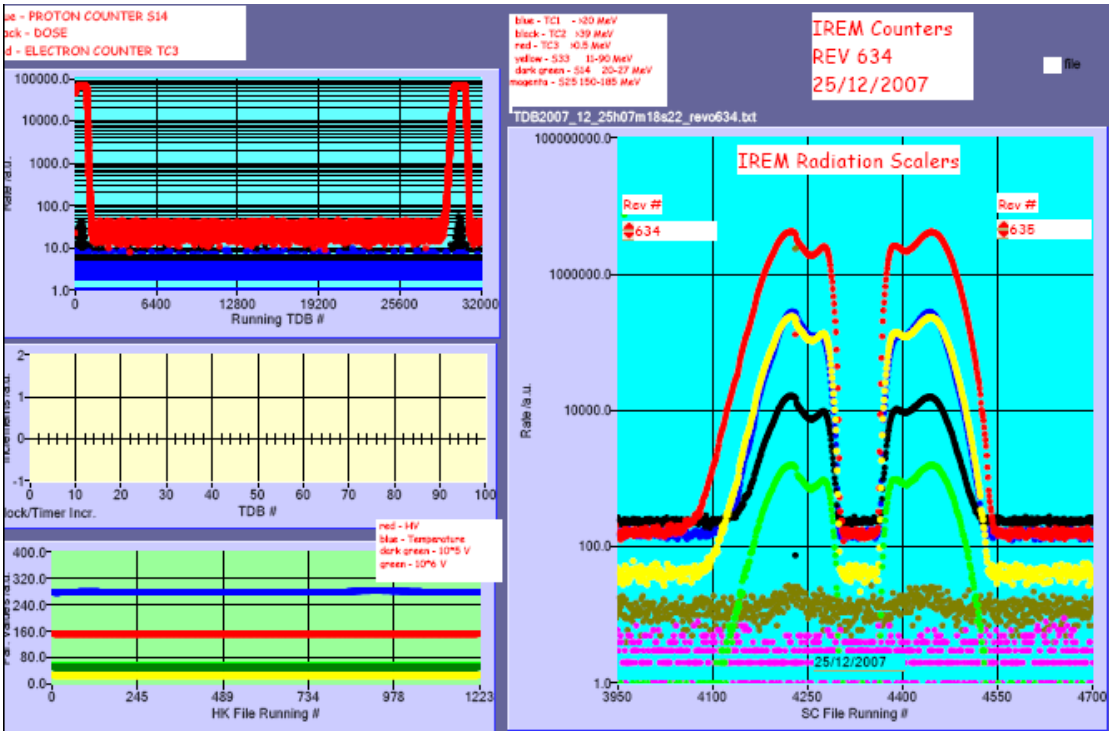
Electron Belts

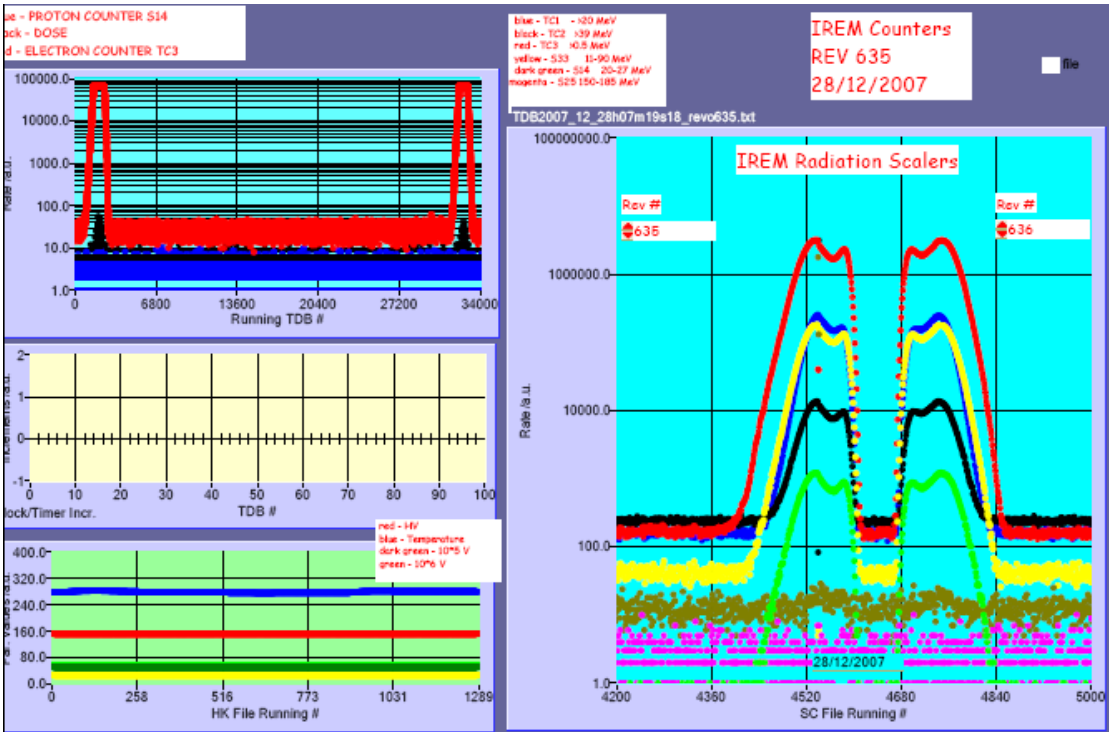
REV	S/C BCPKT (electron)	Electron CUT-OFF Observed Entry/Exit	Observed Entry/Exit Altitude [Km]	Electron CUT-OFF Predicted Entry/Exit	Predicted Entry/Exit Altitude [Km]
633	RAD_ENTR R 2007-12-22T07:30:44Z	22/12/2007 06:53:13	61416.9	22-Dec-2007 09:02:07	42939.59
634	RAD_EXIT R 2007-12-22T17:35:24Z	22/12/2007 16:30:33	>>33202.8	22-Dec-2007 16:32:07	43941.08
634	RAD_ENTR R 2007-12-25T07:18:34Z	25/12/2007 08:06:09	49325.2	25-Dec-2007 08:49:09	42884.25
635	RAD_EXIT R 2007-12-25T17:22:28Z	25/12/2007 16:05:37	>>33225.9	25-Dec-2007 16:19:09	44101.71
635	RAD_ENTR R 2007-12-28T07:05:19Z	28/12/2007 08:22:21	56431.7	28-Dec-2007 08:29:09	43705.41
636	RAD_EXIT R 2007-12-28T17:09:20Z	28/12/2007 15:50:41	>>33221.6	28-Dec-2007 16:09:09	44774.8

Reference
High radiation
Very small error vs reference (less than 10 minutes)
Small error vs reference (between 10 and 30 minutes)
Large error vs reference (more than 30 minutes)

IREM radiation counters:

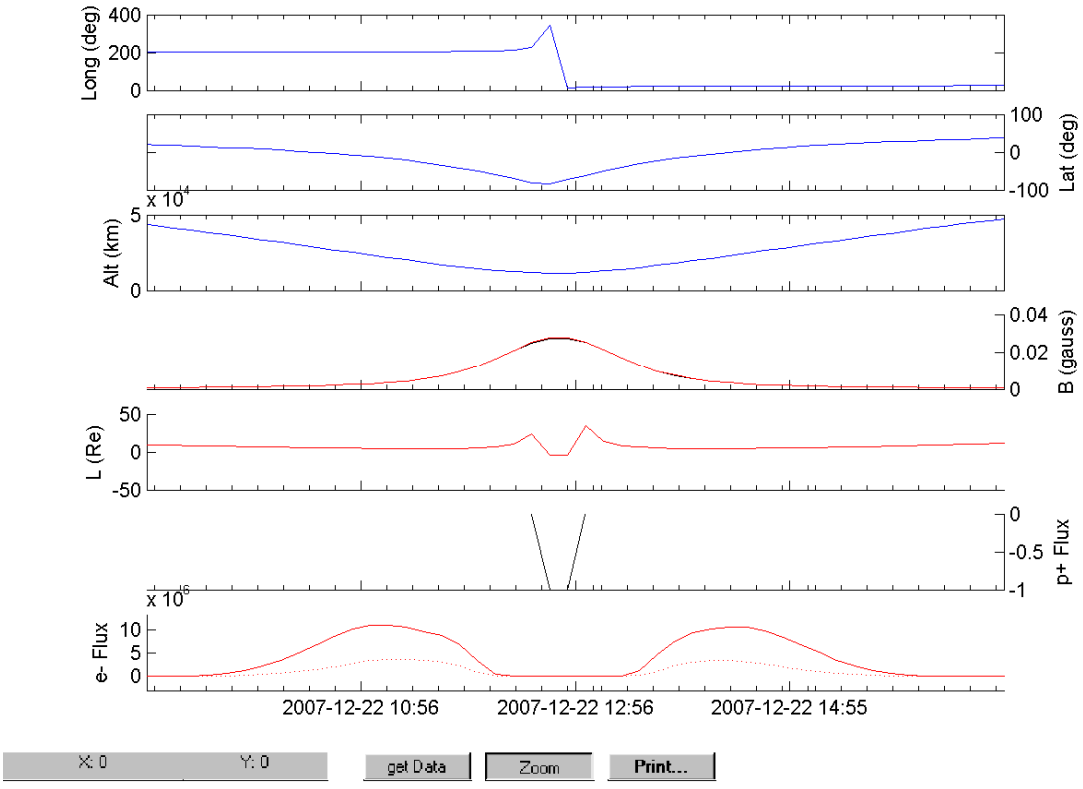




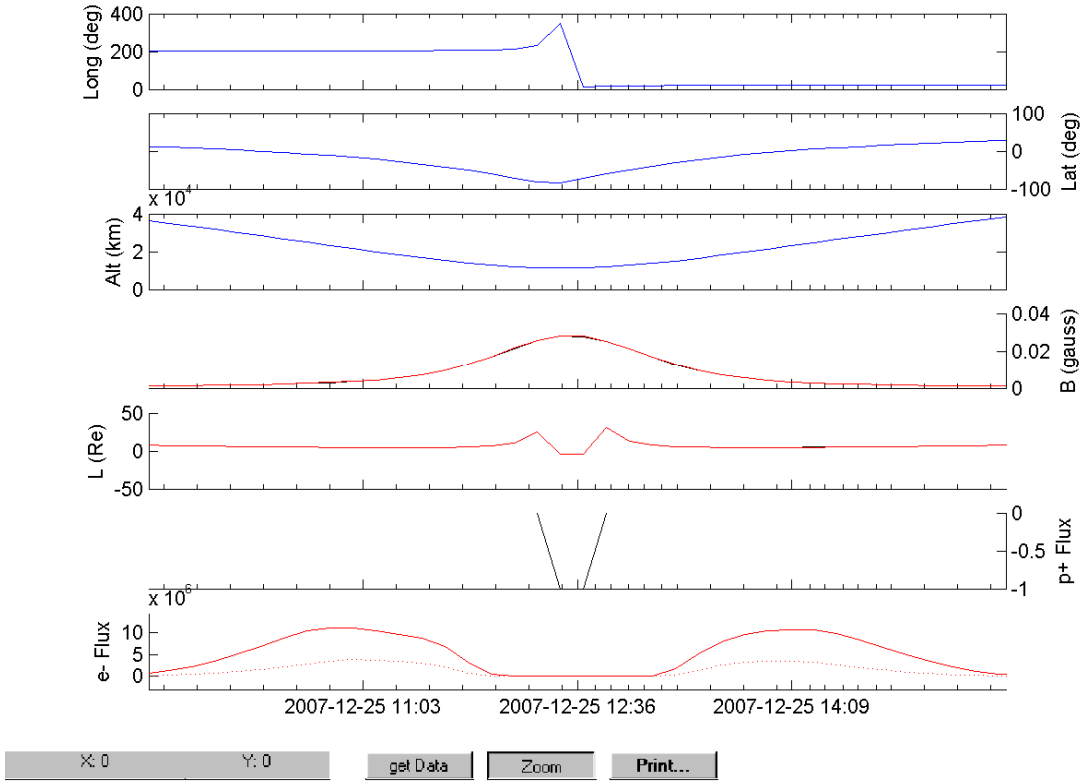


IREM Predicted Radiation Belt Passages

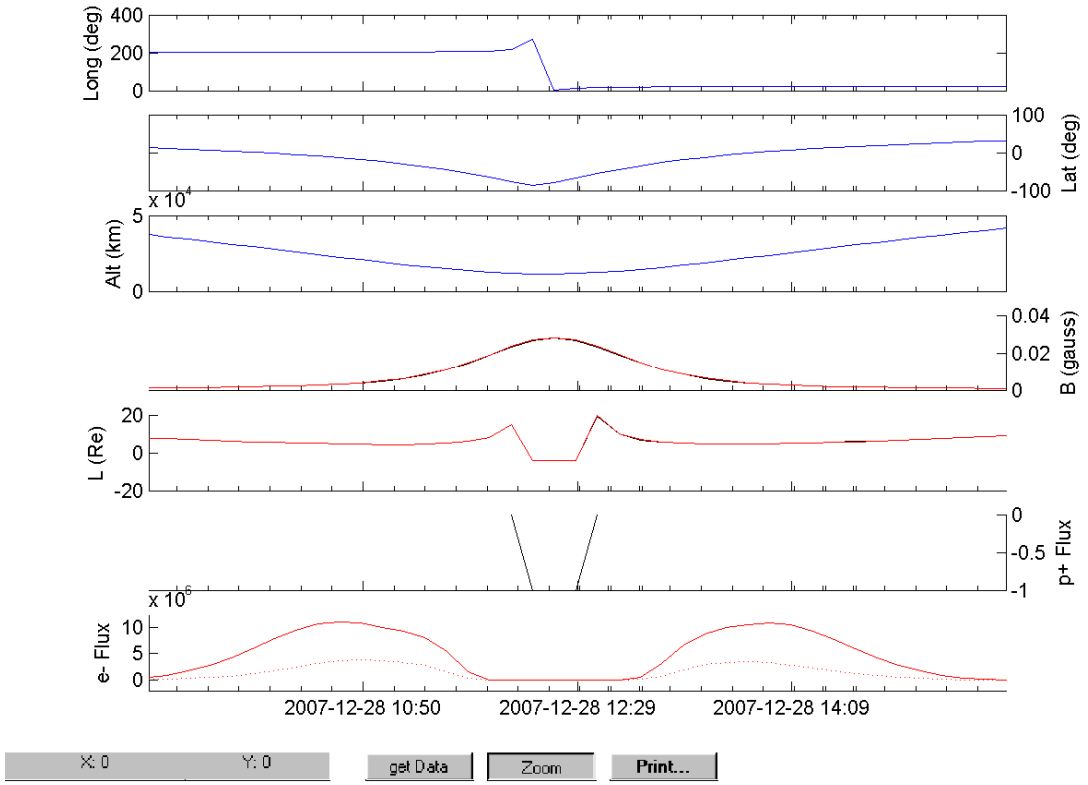
Rev 633



Rev 634



Rev 635



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

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